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Energy and Climate Change

PROCEEDINGS

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Hellenic Institute of Passive Building - Hellas

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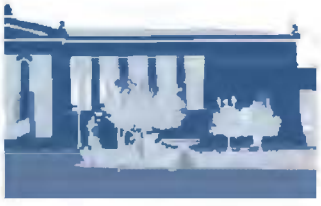

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CHAIR

Prof. Andonaq Londo LAMANI
Polytechnic University of Tirana, Albania

Prof. Milton A. TYPAS
National and Kapodistrian University of Athens, Hellas

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CHAIR

Prof. Andonaq Londo LAMANI
Polytechnic University of Tirana, Albania

Prof. Katherine M. PAPPAS
National and Kapodistrian University of Athens, Hellas

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	Prof. Evangelos DIALYNAS National Technical University of Athens, Hellas
SPEAKERS	**Dr. Patricia KYPRIANIDOU** General Secretariat for Research & Technology, Hellas
	Dr. Hans BRUYNINCKX European Environment Agency
	LIFE 2014-2020: Climate Action sub-programme by Spyridoula NTEMIRI, Ministry of Environment and Energy, Hellas
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Discussion

14:00 **End of Conference**

List of participants

A/A	Title	First Name	Last Name	Organization
1	Mr.	Nikolaos	Agatheris	National Technical University of Athens, Hellas
2	Mrs.	Konstantina	Agra	Ministry of Environment and Energy, Hellas
3	Mrs.	Theodora	Andrikopoulou	National Technical University of Athens, Hellas
4	Mr.	Ilias	Apostolopoulos	Municipality of Papagou-Holargos, Hellas
5	Amb.	Anna	Barbarzak	Embassy of Poland in Hellenic Republic
6	Mrs.	Iris	Behr	Institut Wohnen and Umwelt GmbH, Germany
7	Mr.	Athanasios	Belalidis	Sympraxis Team P.C., Hellas
8	Mrs.	Marianne	Bolger	Embassy of Ireland in Hellenic Republic
9	Mrs.	Angeliki	Boura	Ministry of Foreign Affairs, Hellas
10	Mrs.	Despoina	Boulogiorgou	University of West Attica, Hellas
11	Dr.	Nevila	Broli	University of Tirana, Albania
12	Dr.	Hans	Bruyninckx	European Environment Agency
13	Mr.	Ivan	Chalakov	Embassy of Bulgaria in Hellenic Republic
14	Mrs.	Cristina	Cheban	Embassy of Moldova in Hellenic Republic
15	Amb.	Traian	Chebeleu	Black Sea Economic Cooperation (BSEC) - PERMIS
16	Mrs.	Marianna	Daniil	National Technical University of Athens, Hellas
17	Mr.	Alexander	Deliyannis	Sympraxis Team P.C., Hellas
18	Prof.	Evangelos	Dialynas	National Technical University of Athens, Hellas
19	Prof.	Sonila	Duka	University of Tirana, Albania
20	Mr.	Andreas	Efthimiou	Municipality of Moschato-Tavros, Hellas
21	Mr.	Christos	Elias	GAIAOSE S.A., Hellas
22	Dr.	Andreas	Enseling	Institut Wohnen and Umwelt GmbH, Germany
23	Mrs.	Anna	Flessa	Freelancer, Hellas
24	Ms.	Iva	Ganev	EUROALLIAGES, Belgium
25	Mrs.	Galina	Georgieva Hristova	European Environment Agency

26	Mrs.	Stella	Gerotoliou	National Technical University of Athens, Hellas
27	Mr.	Antonios	Gipakis	General Secretariat for Research and Technology, Hellas
28	Mr.	Nikolaos	Goliopoulos	National Technical University of Athens, Hellas
29	Mrs.	Mavika	Iliou	Piraeus Bank Group, Hellas
30	Prof.	Thor Øivind	Jensen	University of Bergen, Norway
31	Mrs.	Maria	Kaladami	Aegean Energy and Environment Agency, Hellas
32	Dr.	Spyros	Kiartzis	Hellenic Petroleum, Hellas
33	Mr.	Tomasz	Kleczkowski	Embassy of Poland in Hellenic Republic
34	Mrs.	Evangelia	Kokkali	National and Kapodistrian University of Athens, Hellas
35	Dr.	Popi	Konidari	National and Kapodistrian University of Athens - Energy Policy and Development Centre (KEPA), Hellas
36	Mr.	Dimosthenis	Kotsopoulos	Athens University of Economics and Business, Hellas
37	Mr.	Nikitas	Kousiakis	Athens University of Economics and Business, Hellas
38	Mrs.	Agata	Krupa	Embassy of Poland in Hellenic Republic
39	Mr.	Panagiotis	Ktenidis	University of West Attica, Hellas
40	Dr.	Patricia	Kyprianidou	General Secretariat for Research and Technology, Hellas
41	Mrs.	Theodora	Lagogianni	National and Kapodistrian University of Athens, Hellas
42	Mr.	Aristoklis	Lagos	National Technical University of Athens, Hellas
43	Prof.	Andonaq	Lamani	Technical University of Tirana, Albania
44	Mr.	Georgios	Manolis	National Technical University of Athens, Hellas
45	Ms.	Aliki-Nefeli	Mavraki	National and Kapodistrian University of Athens - Energy Policy and Development Centre (KEPA), Hellas
46	Ms.	Eleni-Danai	Mavraki	Aegean Energy and Environment Agency, Hellas
47	Prof.	Dimitrios	Mavrakis	National and Kapodistrian University of Athens Energy Policy and Development Centre (KEPA), Hellas
48	Mrs.	Spyridoula	Ntemiri	Ministry of Environment and Energy, Hellas
49	Mr.	Ioannis	Ntroukas	EPA Attikis, Hellas
50	Mr.	Zhanna	Ostapenko	National Technical University of Ukraine, Ukraine

51	Mr.	Dimitrios	Pallantzas	Hellenic Institute of Passive Building (EIPAK)
52	Mr.	Stefanos	Pallantzas	Hellenic Institute of Passive Building (EIPAK)
53	Mr.	Gerasimos	Panagiotatos -Tzakis	Region of Ionian Islands, Hellas
54	Mrs.	Olga	Papadopoulou	National Technical University of Athens, Hellas
55	Mrs.	Katerina	Papadouli	PRAXIS Network, Hellas
56	Prof.	George	Papageorgiou	European University Cyprus Research Center
57	Ms.	Marianna	Papaglastra	Sympraxis Teama P.C., Hellas
58	Mr.	Dimitrios	Papastergiou	Municipality of Trikala, Hellas
59	Prof.	Katherine	Pappas	National and Kapodistrian University of Athens, Hellas
60	Mrs.	Jenny	Passari	National and Kapodistrian University of Athens, Energy Policy and Development Centre (KEPA), Hellas
61	Mr.	Dan	Pericleanu	Embassy of Romania in Hellenic Republic
62	Mr.	Ioannis	Sakellaris	Aristotle University of Thessaloniki, Hellas
63	Dr.	Anna-Maria	Salama	ENEA, Energy Efficiency Department, Italy
64	Mrs.	Maria	Saliari	National and Kapodistrian University of Athens, Hellas
65	Prof.	Alma	Shehu	University of Tirana, Albania
67	Prof.	Tom	Skauge	Western Norway University of Applied Sciences
68	Mr.	Vasileios	Tikos-Moustakas	European Environment Agency
69	Mrs.	Hanna	Tischenko	Embassy of Ukraine in Hellenic Republic
70	Dr.	Ioannis	Tsipouridis	R.E.D. Pro Consultants - Renewable Energy Development Professionals in Greece
71	Prof.	Milton A.	Typas	National and Kapodistrian University of Athens, Department of Biology, Hellas
72	Dr.	Loreta	Valija	University of Tirana, Albania
73	Amb.	Anatol	Vangheli	Embassy of Moldova in Hellenic Republic
74	Mrs.	Chrisanthie	Vervenioti	National Technical University of Athens, Hellas
75	Mrs.	Artemis	Vidali	Ministry of Environment and Energy, Hellas
76	Mr.	Dolhov	Volodymyr	National Technical University of Ukraine, Ukraine

77	Prof.	Krzysztof	Warmuzinski	Institute of Chemical Engineering, Poland
78	Mrs.	Aimilia	Zikou	E-mc^2-Energy matters to climate change, Hellas

DAY 1: 3rd Green Energy Investments Forum

Session 1: Policy dialogue

Welcome address by Prof. Dimitrios MAVRAKIS

Director of KEPA, National and Kapodistrian University of Athens, Hellas

Your Excellences

Distinguished guests

Dear colleagues

It is a great pleasure and honor for me and my colleagues in KEPA to welcome you to the 11th Annual International Scientific Conference on Energy and Climate Change.

The conference is under the auspices of the Black Sea Economic Cooperation Organization (BSEC), the United Nations Academic Impact (UNAI) initiative and the Hellenic General Secretariat for Research and Technology (GSRT).

It has been recently certified with the "Academic Conference Excellence" distinction and it is structured in three parts. The first is devoted to the "3rd Green Energy Investments Forum", the second contains the "Scientific sessions" that consists the hard-core of the conference while the third, aims to promote and enhance cooperation among the participants, mainly in the frame of "call for proposals" of the "EU Horizon 2020".

This structure reflects our continuous efforts, for more than twenty years, to promote the extrovert regional cooperation among academic institutions, policy makers and market stakeholders on the crucial and demanding issues of Energy and Climate Change.

For more than fourteen years, in close cooperation with partners from the European Union, the Black Sea and Central Asia, we coordinate and implement competitive scientific programmes, mainly financed by the European Commission.

In doing so, we understand our role as knowledge transfer facilitators and green project initiators.

In close cooperation with the Permanent International Secretariat (PERMIS) of the Black Sea Economic Cooperation Organization (BSEC), we cooperate with partners from EU, BSEC, and Central Asia, while we communicate our activities through our websites, printed editions, the scientific journal, and a newsletter reaching 28.000 scientists, engineers, and policymakers in 170 countries.

As an outcome of the political support that we enjoy from PERMIS, KEPA has been appointed as coordinator of the BSEC – Green Energy Network, and we participate in the BSEC Working Groups and the Ministerial meetings on Energy.

We have developed and operate the "PROMITHEASnet" and the "BSEC – Green Energy Network" in an effort to motivate national stakeholders, policymakers and academics to increase the level of regional cooperation on the crucial issues of Green Energy and Climate Change.

There is a long list of activities related to the aforementioned targets that have been realized for the benefit of our societies during those years of fruitful cooperation with PERMIS and we do hope to further extend them in the coming years.

The organization of the current 3rd Annual Green Energy Investments Forum consists of the sequence of the initiative undertaken by the BSEC – Green Energy Network with the aim to increase the awareness among the BSEC – MS on their responsibility to accelerate the green transformation of their economies and benefit from this transformation.

We consider that such an effort has an urgent character due to the negative impacts our societies are experiencing due to the emerging climate change.

Last November KEPA, in the frame of the HERON project, has organized a forum at BSEC headquarters in Istanbul, outlining the importance of the behavioral barriers demonstrated by end users in implementing energy efficiency policies that are strongly related to the efforts to mitigate GHG emissions.

We keep underlining the importance of accelerating the retrofit rate of energy efficiency in the buildings in the BSEC –MS underlining the socio-economic benefits for them and the assistance they can receive from the existing international financing tools.

We have invited the Black Sea Trade and Development Bank (BSTDB) to undertake a more active role in this effort, by requesting its accreditation by the Green Climate Fund, with the aim to become a regional facilitator, transferring green funds and loans, through bankable projects to the national markets.

It is a pity that the Bank has not responded yet to this request, although the issue was raised in the recent Board of Governors of the Bank by PERMIS.

We consider that undertaking action on issues related to the combat against climate change should be further intensified and specified in our everyday life.

Ordinary people should become more proactive in defending their present and future.

General policies should be specified reaching our everyday reality.

Having this in mind, later and during this session, we intend to make an appeal to Secretary General of PERMIS to undertake an initiative to mitigate energy poverty, in a sustainable way, among its Member States with our technical support.

Last but not least, allow me to take the opportunity of the participation of his Excellency the Deputy Secretary General of PERMIS, Ambassador Traian Chebeleu for six consequent years in this Conference, to express my gratitude for his continuous support to our actions and my deep appreciation to his devotion to the principle of regional cooperation.

He honors me, with his trust and cooperation all these years.

This allows me to express in public the gratitude of me and my colleagues from the BSEC - MS cooperating institutions for his creative devotion to the principle of regional cooperation and the political support he has granted to all of us, in the frame of BSEC policies.

I hope that he will continue to be along with PERMIS, as the facilitator of our common efforts to motivate our societies to transform their economies in a greener perspective.

Closing, allow me to express my sincere gratitude to our unique sponsor, the Hellenic Petroleum, to the communication sponsors, to all of you that honor us with your participation, especially those coming from abroad and finally, to the personnel of KEPA for its devotion and the unlimited hours it has spent for the success of the Conference.

Short CV

Prof. Dimitrios Mavrakis is the Director of KEPA; coordinator of the "BSEC – Green Energy Network" focused on Renewable Energy Sources (RES) and Energy Efficiency (EE) for scientists, market stakeholders, and policy makers, from the countries of BSEC under the supervision of BSEC – PERMIS; coordinator of PROMITHEASnet, the Energy and Climate Change Policy Network, consisted of academic institutes from S.E. Europe, Black Sea and Central Asia; Chief editor of the "Energy View of the BSEC countries"; Chief editor of the "Euro-Asian Journal of Sustainable Energy Development Policy"; Editor of the worldwide disseminated "PROMITHEAS newsletter"; Chairman of the annual international scientific conference on "Energy and Climate Change" (11th year); Initiator of the European Energy Community. Current activities: promotion of regional cooperation on Climate Change Policy issues among academic institutions, governmental authorities and market stakeholders from the countries of EU and the BSEC; knowledge transfer about climate change, EE, RES, development of scenarios for mitigation/adaptation, looking-forward energy modelling; organization of the Green Energy Investments Fora within the BSEC region; participation in the BSEC Working Group on energy; coordinator of FP6, FP7 and H2020 projects. He was appointed by EC as member of the Advisory Groups on Energy (AGE) of E.C. for FP6 and FP7.

Opening by Amb. Traian CHEBELEU

Deputy - Secretary General BSEC-PERMIS

Dear Professor Mavrakis,

Distinguished participants,

I am honoured to attend this 3rd Forum on Green Energy Investments, as an important annual event of the BSEC Green Energy Network, gathering together governmental and local government officials and representatives of the banking sector and business communities, and of NGOs, which could give impetuses to the development of the use of Green Energy in the Hellenic Republic and, more generally, in the BSEC Region.

The previous two Fora, organized by Energy Policy and Development Centre (KEPA) of the National and Kapodistrian University of Athens on the occasion of the International Scientific Conferences on Energy and Climate Change, made evident the increased interest for developing the regional cooperation in Green Energy in the BSEC Region, taking advantage of the possibilities of communication and of the professional expertise made available by the BSEC Green Energy Network.

On the initiative and with the support of KEPA, on 24 November 2017, a Green Energy Investment Forum was organized also at the BSEC Headquarters in Istanbul, with the purpose to inform the representatives of the BSEC Member States about the possibilities of investments for combating negative effects of the Climate Change, for developing projects promoting the green transformation of their economies and the achievement of the UN Sustainable Development Goals in the BSEC Region, as well as for exploring ways of cooperation with International Financial Institutions accredited to the Green Climate Fund.

On this occasion, information on the activities in promoting and supporting Energy Efficiency, Renewable Energy and other Green Energy projects in the BSEC Member States were offered by representatives of the Black Sea Trade and Development Bank, the Delegation of the European Union to the Republic of Turkey, the European Bank for Reconstruction and Development and the United Nations Development Program.

The Conclusions and the Recommendations of all these Fora – the two in Athens and the one in BSEC Headquarters –, based on the information provided by the presentations regarding investment funds in the sector of Green Energy and the existing international mechanisms for knowledge sharing and green investments, highlight their usefulness for governmental authorities, at both national and local levels, responsible with the promotion of Green Energy policies.

The common general conclusion of these Fora is that attracting national and international investors is essential for the modernization of the energy sector in the BSEC Member States, and that an adequate administrative and legal framework has to be put in place to this effect.

We have been encouraging the Black Sea Trade and Development Bank, which is an affiliated body to BSEC, to be accredited to the UN Green Climate Fund, as most of the multilateral banks, international organizations and international funds are, for the benefit of the BSTDB itself and for the benefit of the BSEC Member States. This will allow the Bank to enter the promising area of green investments related to Climate Change.

Energy is one of the major sectors of the activities of our Organization. This is quite understandable, considering the significance of our region in what concerns the production and

distribution of energy to the world markets. Today, a vital component of the area of "Energy" is the "Green Energy".

In this regard, I would like to inform the participants that the BSEC Green Energy Strategy was adopted on 27 May 2018 by the decision-making body of BSEC, which is the Council of Ministers of Foreign Affairs of the Organization.

The Strategy contains provisions highly relevant for the purposes of this Investment Forum. In terms of strategy, the BSEC Member States envisage "to ensure a stable investment environment for the rehabilitation of existing facilities and construction of new energy facilities, taking into consideration the efficiency and environmental protection criteria". Related to sustainable fossil fuel energy, the Strategy speaks about promoting "sound policies, regulations, and investment climate for clean fossil energy in the region".

I would conclude my intervention by expressing warm thanks to the organizers of this event, the prestigious KEPA, directed with dedication and enthusiasm by Professor Dimitrios Mavrakis, for the excellent preparations in order to have a fruitful policy dialogue at this Forum and for the kind hospitality extended to all of us.

I wish the participants useful networking and fruitful exchanges.

Short CV

Amb. Traian Chebeleu is the Deputy Secretary General, Permanent International Secretariat of the Organization of the Black Sea Economic Cooperation. He is a career diplomat and has served in the Ministry of Foreign Affairs of Romania, mainly dealing with international organizations. He also held the positions of State Secretary at the Ministry of Foreign Affairs (1992), Diplomatic Adviser and Spokesman for the President of Romania (1993-1996). He was the Ambassador of Romania to Austria (2001-2005) and Special Representative of the Minister of Foreign Affairs for the Black Sea Issues (2008-2009). Subsequently he joined the Permanent International Secretariat Black Sea Economic Cooperation Organization (2009).

Video – message from Mr. Ramu DAMODARAN

Chief of United Nations Academic Impact,

Deputy Director for Partnership and Public Engagement in the United Nations Department of Public Information's Outreach Division

My greetings to the National and Kapodistrian University of Athens on the organization by its Energy Policy and Development Centre of the 3rd Annual Green Energy Investments Forum.

The focus will rightly be on nurturing and enhancing ambition in our collective responsibility towards our planet and its people. Climate change is an issue deeply intertwined with all the sustainable development goals. If we are to succeed in any of our targets it is an issue that must be properly recognized and addressed.

Through the activities of its members, United Nations Academic Impact has noted with admiration the power of scholarship in this quest. Universities in the words of Rector Dimopoulos are about knowledge, innovation as well as the pursuit of excellence.

Members of the United Nations Academic Impact around the world from Mauritius to Argentina have demonstrated that, through their work on sustainability and on the urgency of addressing climate change. They have launched initiatives which have had an immense impact in their communities and across the globe.

Let me share some examples.

A university in Brazil has created a solar power plant which supplies energy throughout the entirety of its campus.

One in the United Kingdom has started a project with students, that create solar part mobile phone chargers for refugees living in Greece, so that they may contact their families and access vital information.

Our partner universities in Chile and Colombia are pushing for alternatives to traditional transportation by promoting the use of bicycles and energy efficient electric cars.

In Germany eight universities have come together for a research project that aims to create more light weight materials for cars so that in consequence they consume less fuel.

In the United Kingdom, Newcastle University has developed the "Clean air for Delhi" project and integrated that into a plan which details a number of strategies and potential interventions for mitigating air pollution in the capital city of India and its surrounding region. It will seek to understand current contributing factors to air pollution across the domestic, transport, industrial and agricultural sectors among others and it will develop modelling tools for collating emission inventories of how air pollution is dispersed and collect policies and best practices for mitigation within the city and the larger region.

Al Farabi Kazak University in Kazakhstan which also serves as the UNAI Global Sustainability hub is actively promoting the concepts of Green Economy through a series of activities envisioned to introduce the basic concepts of Green Economy to students as well as Faculty, not just in Kazakhstan but in all its neighboring countries of Central Asia and beyond. Two of the key concepts that have been implemented on campus are energy saving and alternative transportation, to make the campus greener and more sustainable with practices that could easily be replicated in other institutions of higher education.

Cornell University in the United States works towards sustainable means of campus transportation by its creation the President's Sustainable Campus Committee transportation focus team. It seeks to support collaboration between academic communities, faculty, staff, students and the local community. Major on campus actions to reduce environmental impacts resulting from transportation include policies that actively discourage automobile use and encourage other means of transportation,

providing free bus passes and the promotion of car pooling, biking, the taking of buses and just walking.

A university in Spain holds a Green Week in November highlighting the importance of being responsible consumer and the positive effects of recycling, as well as sustainable agriculture practices. Another initiative is a food loss and waste reduction recovery programme, scheduled from February this year which will continue until March 2019. The aim of this programme is to create national awareness of food loss and to reduce food waste.

New York University Shanghai in China has developed its Gold Green Initiative which has now spread throughout the NYU Global Network to New York and Abu Dhabi and most recently to its first campus in Israel, Ariel university. The Gold Green Initiative encourages students to live green, to think about how they can contribute to improving our planet both as students and the future career pursuants.

Pomona College in the United States led an initiative to make the 2018 Commencement Weekend "zero waste." Abby Lewis, a senior at the college wanted to send off the graduating class in the most sustainable way possible by committing to have a "zero waste" commencement. She focused on the catered of food and products that would be served at the reception on the Commencement Day addressing even the smallest of details. Backed by the college's sustainability grant, she worked with Pomona's catering management on details ranging from the type of wax paper used to wrap food, to suggesting new utensils that were compostable and the use of reusable sugar containers instead of sugar packages. Commencement attendees did not find trash bins at the event; instead they found recycling and composting stations where they could sort their waste. Nearly all the food waste generated, including plates and cups and napkins. were diverted to either compost or recycling. The disposable products used in this Commencement were made from either corn starch or recycled paper.

I share these examples to highlight the extraordinary connections being developed between highly focused research on the one hand and responsible student actions on the other, both in a common cause.

As Professor Dimitrios Mavrakis notes, the most crucial problems we face in the combat of climate change is not the lack of sufficient knowledge and technology, nor the funding instruments but the lack of understanding of the magnitude of the threat by both ordinary people and policy makers. It is this understanding that the work of universities, their faculties and their students fosters.

Today the 10th of October marks the forty third anniversary of Papua New Guinea joining the United Nations. Let me share with you some of the possible consequences of climate change that scholars and business leaders have forecast for this nation.

They include the increasing incidents of malaria in its highlands thanks to mosquitos fed in stagnant water. Roads that require increase maintenance with heavy rain which in one region has been increasing more than ten percent each year.

The expansion of coffee and cocoa production could well be possible, but there are risks of increased plant diseases which will accompany high humidity. Rubber farming will be threatened as latex is washed off the cups of the threes. Food prices are expected to rise as weather disruptions affect the supply chain. The rise in sea levels will make necessary to leave and relocate homes by the coast to higher ground or within the national mainland with their challenges of social mobility and integration.

But there is good news. Two years ago Papua New Guinea became the first country to formally submit the final version of its National Climate Action Plan, called a Nationally Determined Contribution as required under the Paris Agreement on Climate Change. It states its intention to transition to one hundred percent to renewable energy by 2030 as the country's official climate plan. It is a plan that has brought together political leadership, scholarship, science, industry and enterprise together with citizens and civil society.

And that collective endeavor is both instance and proof of what nations and people can do together inspired by global cause that has so specific local dimensions.

Thank you for coming together in that spirit and to this conference in support of United Nations and global good.

Short CV

Mr. Ramu Damodaran is Deputy Director for Partnership and Public Engagement in the United Nations Department of Public Information's Outreach Division and is chief of the United Nations Academic Impact initiative, which aligns institutions of higher learning and research with the objectives of the United Nations and the States and peoples who constitute it. He is also the current secretary of the United Nations Committee on Information. His earlier posts with the Organization have included the Departments of Peacekeeping and Special Political Questions, as well as the Executive Office of the Secretary-General. Ramu Damodaran has been a member of the Indian Foreign Service, where he was promoted to the rank of Ambassador, and where he served as Executive Assistant to the Prime Minister of India as well as in the diplomatic missions in Moscow and to the United Nations, and in a range of national governmental ministries.

Opening by Amb. Anna BARBARZAK

Ambassador of Poland to the Hellenic Republic

Excellences,

Distinguished Audience,

Ladies and Gentlemen,

I would like to thank the Energy Policy and Development Centre (KEPA) at the National and Kapodistrian University of Athens for their kind invitation to take part in the conference today. Special thanks to Prof. Dimitrios Mavrakis, Director of KEPA and Coordinator of BSEC – Green Energy Network, for making this event possible.

In my career as a diplomat I have learnt that there is no other topic than energy and climate that connects better the world of politics, diplomacy, science, technology and innovation. And there is a reason for this. There is no prospect for good quality of life for our societies if we have no smart solutions for energy. There is no prospect for development of our economies if we have no efficient and sustainable sources of energy. And of course, our planet and future generations deserve clean air and no climate change. This is why energy and climate engage such broad attention, and has become globally also a political problem.

So, let me share with you a Polish perspective.

Over three decades, Poland has come a long way from an economy based on central planning with inefficient industry and agriculture and a poorly developed service sector to become a vibrant market economy that has secured its position among developed countries. One of the challenges that Poland still faces is reconciling economic growth with environmental protection, including curbing greenhouse gas emissions. In the period of transformation after 1989, Poland has made significant progress.

A reduction in the consumption of hard coal and lignite as energy sources in favour of petroleum-derivative fuels has been observed for many years, while the share of renewable energy has increased steadily, exceeding 11% in 2016. All these measures have enabled Poland to significantly exceed its Kyoto Protocol reduction target and reduce its domestic greenhouse gas emissions by approximately 30% versus the base year. It is a unique phenomenon in the world.

This progress has been mainly driven through technological advancement by the energy sector and the industry. Most improvements were propelled by restructuring the economy and partially privatising state-owned entities, that led to the upgrading of facilities and finally enhancing their energy efficiency.

In December, Poland once more will have the honour to host a United Nations climate change conference, COP24. This time, the venue for the conference is very symbolic. The organizers have chosen Katowice, a city in Upper Silesia associated with heavy industry. For everyone the region used to be synonymous with huge emissions, which was especially evident in the 1980s. Silesia's landscape was then dotted with smoking chimneys. At present, Silesia and its capital Katowice look quite different. Katowice has even earned the title of "green city". Our efforts are still ongoing but we are already proud to showcase this transition from the stage of huge pollution and emissions towards the goal of a green-city. In Katowice this evolution is visible better than anywhere else.

Polish Presidency of COP24 set forward the following priorities: to adopt comprehensive package of implementing decisions for the Paris Agreement, to efficiently implement political phase of the Talanoa Dialogue, the dialogue focused on actions to be undertaken prior to 2020, and thirdly, to facilitate the high-level ministerial dialogue on financing the climate policy. We are aware of the differences between the Parties when it comes to the choice of priorities and the approach to these events. What remains a major challenge in this context is the management of available time and human resources to ensure that all these issues and events are given prominence at COP24.

The implementation of the Paris Agreement Work Programme is the key priority for the Polish COP24 Presidency. The implementing package to be adopted in Katowice should be comprehensive

enough to allow for the implementation of all provisions of the Paris Agreement to begin. It should also reassure all Parties, that no issue has been omitted. We look forward to the constructive involvement of all regional and negotiation groups as well as the countries chairing these groups. We hope they will play an important role in facilitating discussions and in liaising with other Parties and the COP24 Presidency.

The Leaders Summit to be held on 3rd December 2018 will provide heads of states and governments with an opportunity to send a strong signal in order to work out possibly the most comprehensive package of implementing measures for the Paris Agreement.

We are also drafting another set of priorities and initiatives that may leave a lasting mark on the process and the real world. In terms of the long-term objective of the Paris Agreement, which is to attain climate neutrality and reduce carbon dioxide levels, forestry is an extremely important sector. Here we are tapping into the potential of ecosystems to capture greenhouse gases. Other initiatives we pursue are focused on promoting electromobility and developing the just transition concept, which is best illustrated by the transformations experienced in recent years by Katowice, the host city of COP24.

Electromobility has become an integral part of the transition towards an innovative and green economy in Poland. In the beginning of this year the Polish parliament adopted the Act on Electromobility and Alternative Fuels, which sets a legal framework for the development and utilization of electric vehicles. It gives excise tax exemptions and several other incentives for the users of green cars. In order to spur the expansion of electromobility, the Polish government declared to allocate over one billion euro in the Low-Carbon Transport Fund established last year. Not only do these efforts complement the years of economy transformation in Poland, but they also respond to the latest technology trends and the climate challenges faced today.

Profound technological transitions that trigger changes in the real world, are the natural after-effect of the provisions of the Paris Agreement. Understanding the consequences of these changes and the effective inclusion of just transition in the international climate policy is pivotal for building social confidence in activities aimed at climate protection. We plan to make just transition one of the key issues of COP24, including the Leaders Summit held on 3 December 2018 by heads of states and governments invited by the President of the Republic of Poland, Mr. Andrzej Duda.

We are putting the spotlight on a just transition that takes into account all the needs of citizens - prospects for living a healthy life in a clean environment, having a sense of security including physical, food, energy and economic security by ensuring jobs that guarantee a high quality of life. The objectives of just transition remain unchanged: bridging social inequality and the inclusion of marginalised individuals and groups who are currently outside the labour market. Just transition cannot be achieved by job losses; we need to create new jobs or transform the existing ones.

It is particularly important to support sustainable transformation of jobs in high-emission sectors by facilitating the retraining of employees in these industries, creating new jobs in public sectors and modern technologies. Such activities call for cooperation with representatives of employees and employers to make all participants of the labour market aware of the current situation and long-term goals, and enable them to contribute to decisions on ways of attaining these goals. Equally crucial for just transition is to make the most of available knowledge and technologies, and expand their scope in order to respond to present and future challenges. Digital transformation is one of the keys to a just transition of the economy and society.

COP24 in Katowice presents a perfect occasion to create a realistic roadmap for the implementation of the Paris Agreement. The negotiations of these implementation rules, the so-called Katowice Package, must combine the ambitious targets to reduce greenhouse gas emissions with the principles of just and responsible transition. During the COP24 Presidency, we will want to adopt ministerial declarations relevant to all these problem areas and we encourage all Parties to the Convention to become signatories. We need everyone on board as only the mutual effort of all actors can cause an effective action against the climate change.

Thank you for your attention, and I wish you successful sessions.

Short CV

Amb. Anna Barbarzak is a career diplomat. She joined Polish diplomatic service in 2001. Since this time she worked in the Department for Security Policy, managing NATO enlargement and Partnership for Peace policy. Between 2006-2007 she worked in the Polish Mission to UN and International Organizations in Geneva – where she was responsible for Disarmament and Non-proliferation issues. In 2007 she was assigned at the Polish Embassy in Washington DC, where she worked in the Economic Section, responsible for energy and climate policy. After her return to Warsaw in 2011, she was nominated Head of the Unit of Contacts at the Office of Minister of Foreign Affairs. Since 2013 until November 2015 Ms. Barbarzak Headed the Department for Economic Cooperation, where she was responsible for economic promotion and economic diplomacy. In this capacity she supervised and coordinated many projects related to economic bilateral cooperation, as well as EU trade and investment policies and energy security issues. Mrs. Barbarzak graduated from Warsaw School of Economics. She holds Master's degree in Economics and International Relations. She also completed post-graduate studies in Geneva Center for Security Policy. Mrs. Barbarzak speaks English and Russian. She is married and has 8-year old son. Date of presentation of credentials: January 21, 2016.

Opening by Amb. Anatol VANGHELI

Ambassador of the Republic of Moldova to Hellenic Republic

Dear Secretary General,
Dear Deputy Secretary-General,
Dear organizers of the event,
Dear participants,
Excellences Ambassadors,
Representatives of state and academic institutions,
Ladies and Gentlemen,

I would like to start by thanking you for the invitation to participate and by expressing the privilege to address to you for the second year in row. Last year, on the same event, I had the opportunity to bring to your attention the main actions, both at legislative and executive levels, as well as new initiatives and politics of the Republic of Moldova in fostering the connection between the energy, climate change and a sustainable growing economy of my country. Today, I would like to emphasize the message of continuity of those stated in 2017. For the Republic of Moldova it continues to be a priority promoting the use of green energy by implementing the energy efficiency projects in order to contribute to the combating climate change and strengthening the country's energy security. In this regard, state energy policy from renewable sources maintains to be implemented through local, sectorial and state programs, along with the contribution of foreign donors and investors, which is further encouraged.

The general vision of my country on the energy system development is presented in the Energy Strategy until 2030 approved by Government in 2013. One of the three main objectives of the above-mentioned Strategy is referring to the today subject, namely to provide environmental sustainability and fight against climate changes, along with to secure the energy supply and to create competitive markets and ensure their regional and European integration. Further on, with reference to the above-mentioned objective, the state policy pay attention to adjust the national legislative framework to standards of the European Union.

In this regard, a major step was realized during this year, namely when the Parliament voted on 16 of March 2018 a series of amendments to the Law on the promotion of the use of energy from renewable sources. Amendments aimed to harmonize the national legislation in the field of renewable energy with the European Union acquis by transposing the elements of the energy package III. New support mechanisms for the production and use of energy from renewable sources was also established, as well as other elements related to ensuring the functioning and development of the renewable energy sector. These modifications shall provide more clarity to the investors in the field of renewable energy, respectively shall correlate the provisions of the mentioned law with the legislation on electricity and natural gas. The extension of the period offered to investors from 24 to 36 months, for the construction of power plants, also was approved. In addition, the notions of guarantee of good execution of the contract by offering guarantee for participation were introduced in the legislation. Further, the Government shall establish the rules for the organization and shall conduct the capacity auctions for the production of electricity from renewable sources in order to promote competition among major investors.

Due to its importance and actuality, the energy and climate change subjects found a honorable place on the agenda of BSEC which is well known for promoting the use of green energy and for encouraging the cooperation with the aim to ensure a sustainable, nature-friendly development of energy sector. In this regard, we believe that BSEC will continue to offer a large framework, which could be used for the support of the efforts its member states for ensuring a sustainable energy, and further encourage as well as mobilize funding by facilitating regional cooperation initiatives in this sector.

With those stated above, I wish you success for the today conference with the hope that new incentives to the development and use of Green Energy resources in our countries and whole region will be identified by BSEC member states.

Thank you.

Opening by Amb. Lucian FATU

Ambassador of Romania to the Hellenic Republic[1]

Dear Secretary-General,

Dear Deputy Secretary-General,

Dear Professor Mavrakis,

Distinguished participants,

I am honoured and grateful for the invitation to address the International Scientific Conference organized by KEPA Athens University.

Energy and climate change are ongoing topical issues on the BSEC agenda, with the aim to harness national Government and NGO actions around the Black Sea and add the value of regional cooperation and BSEC expertise.

In 2016, the Paris Agreement marked a turning point in the battle against climate change. World leaders from across the globe united for the first time in history to legally ratify action against pollution through the United Nations Framework Convention.

Since US President Donald Trump decided to withdraw the United States from the Paris Agreement, Europe has been keen to reassert its leadership position on climate change. The EU has been one of the driving forces behind the quest to make the Paris Agreement a reality. That ambition survived its first test in September 2016, when the European Parliament approved the ratification of the agreement, which in turn tipped the climate deal over the necessary benchmark to enter into force. That leadership quest was reiterated at the Global Climate Action Summit in San Francisco this September 15, when a delegation from the European Parliament's Environment Committee called on the EU to "fill the leadership gap". The European Parliament also insisted that the EU should speak with a "single and unified voice" when it comes to global warming and other international issues.

On September 27, a group of 19 countries officially launched the Carbon Neutrality Coalition in New York, just weeks before the European Commission is due to publish a document outlining policy scenarios to reach carbon neutrality by 2050. Europe dominates the coalition, with 12 EU member states pledging to meet the Paris Agreement's goal of achieving carbon neutrality "in the second half of the century".

Romania welcomes the commitment and determination of the EU Member States for the ratification of the Paris Agreement. The formulation and the coordinated implementing of the strategies on sustainable development and climate change, on a national level, reflect Romania's commitment as EU and UN member state, as well as my country' s goal of actively contributing to the implementation of the Paris Agreement mechanisms.

I would like to emphasize that Romania is among the countries with high potential for renewable energy, and this resource is a real opportunity for economic growth. According to our objectives, renewable energy sources will provide 60% of the medium term electricity production. Promoting the production of electricity from renewable energy sources represents an imperative for Romania and the EU justified by environmental protection, increasing energy independence from imports through the diversification of sources of energy supply, and for the economic and social cohesion reasons.

In the first half of 2019, Romania will hold the Presidency of the Council of the European Union, a time of great challenges and opportunities of managing the EU agenda. At the same time, during

[1] The speech was given by Mr. Dan PERICLEANU on behlaf of Amb. L. Fatu.

Romania's presidency, member states will submit plans in the area of energy and climate change, on whose basis the Union will harmonize its energy strategy, crucial for the future of the EU.

Sustainable growth, based on environmental accountability and global responsibility will be one of the key components of our Presidency goals throughout the first half of 2019.

I would like to wish you all fruitful exchanges and productive networking.

Thank you.

Opening by Mrs. Hanna TISHENKO

Consul of the Embassy of Ukraine to the Hellenic Republic

Dear Chairman Prof. Mavrakis!

Dear Deputy Secretary – General!

Dear participants and guests!

First of all, I would like to congratulate Prof. Mavrakis and his Energy Policy and Development Centre team and to welcome all the participants to the 3rd Green Energy Investments Forum and to wish a fruitful and constructive discussion.

Ukraine's current energy generation mix is heavily tilted to fossil fuel and nuclear, with goal- and gas-fired power plants and nuclear power accounting for up to 92 percent of the energy generated. But that mix has been changing slowly.

Since 2014, $550 has been invested in Ukrainian renewables. Ukraine's renewable sector is growing fast: Renewable production tripled from 2012 to 2017, according to Ukrainian Association of Renewable Energy.

One reason for this is that renewables are a good business in Ukraine. According to experts it is an absolutely transparent business, which can bring product payback in one to six years.

Another reason is Ukraine's green tariff system, set up in 2009 – in the second Forum I presented the main points of them – which offers a higher rate to producers of renewable energy on Ukraine's national energy market – a rate that is fixed for a producer when they enter the market. Add to that other favorable factors, such as Ukraine's large land area and climate, good for both wind and solar power plants, and there are very good conditions for the renewable energy market to develop.

The support mechanism and the guaranteed channels for the sale of the electricity provide additional security and protection against the market challenges relating to the search for buyers and sale markets, as well as against currency and/or price fluctuations.

It can be foreseen that incentives for power production from RES will become more diversified in Ukraine in the years to come and will not be solely limited to a Feed-in-tariff.

According to the data provided by the Ukraine's energy regulator, the National Energy and Utilities Regulatory Commission (NEURC), as of January 1, 2018, the cumulative installed capacity of renewables under the FIT (without those plants located in the territory of the Autonomous Republic of Crimea) totaled 1,374.7MW, of which solar power plants accounted for ca. 55% (741.9MW) and wind power plants, ca. 33.8% (465.1MW).

Research by Ukraine's National Academy of Sciences suggests that, with proper investment, 90 percent of Ukraine's energy could come from renewables.

The renewable energy sector in Ukraine is an attractive investment prospect and has considerable potential for further growth in the coming years.

The National Electricity Regulatory Commission (NERC) is responsible for distributing the financial support to the eligible RES plant operators. The law does not foresee a reallocation of these costs to the electricity consumers. Green tariffs are established for all renewable technologies commissioned until 1 January 2030 and are reviewed by the NERC on a quarterly basis with a guaranteed "minimum floor" set in EUR (Section 1 NERC Decree No. 251).

Clear rules of the game, favorable rates and new approaches to selling electricity produced from RES, such as power sale auctions, are increasingly coming into focus.

On 07 June 2018 the Draft Law introducing new support system for renewable energy projects in Ukraine has been registered with the Parliament of Ukraine.

First auctions will be held in 2020, the Government will approve respective technology-specific quotas and auction conditions by 01 December 2019.

Auctions will be held by the Guaranteed Buyer, state-owned entity being part of new electricity market infrastructure. The Guaranteed Buyer will buy electricity from renewable energy producers under Power Purchase Agreement (PPA) and will compensate the difference between the electricity market price and the auction price via Contract For Difference (CFD). PPA and CFD will have 20 years term. Auction price will be fixed in EUR.

It is very important, that the small solar and wind power plants as well as other electricity producers from RES (biomass, biogas, small hydro, etc.) are exempted from auctions and will stay at the current feed-in-tariff system rules unless it is their wish to take part in respective auctions to get 20 years support.

After wind and solar power comes biogas, accounting for 200 megawatts of Ukraine's power generation capacity. Biogas projects are the most attractive long term, as they don't depend on weather conditions and produce fertilizers for the agricultural sector, but for the moment is most effective at a smaller scale: 1 megawatt.

In Ukraine 32.5 million hectares of the total agricultural land is arable. This supply potential consists half of agricultural waste and woody biomass and half from energy crops and biogas. The resource potential of woody biomass in Ukraine accounts to 4 Mt annually. It includes sawmill waste, wood-cutting waste (branches, crowns), firewood and some technical timber, which is currently exported.

This direction is actively developing in the scientific community of Ukraine due to its economic potential and broad availability of raw materials.

As one example of the "factories of innovation" in the field of green energy is the National Technical University of Ukraine "Igor Sikorsky Institute".

In the university among the directions of research conducted with highly effective environmentally friendly energy and resource saving technology as well as equipment in machine-building, chemical, light, oil processing industry. In the Faculty of equipment of pharmacy and biotechnological industry we are developing innovational projects in the field of biogas and its treatment, conducted by research teams of Professors Victoria Melnyk and Lyudmila Ruzhynskaya.

Researchers are directed to obtain without harming the environment and produce a new type of equipment for obtaining methane from biogas for small and medium size farmers who create the vast majority of agricultural industry of our country.

In conclusion, the Embassy of Ukraine in Athens is ready to provide all needed additional information and arrange the necessary contact with the competent Ukrainian authorities and researchers in universities for developing effective business with Ukraine and establishing scientific and technical cooperation.

Session 2: Market perspectives

Smart Trikala

by

Mr. Dimitrios PAPASTERGIOU,

Mayor of Trikala, Hellas

Abstract

Trikala is the leading Smart City in Greece, uses the technology to improve services, increase transparency and become more efficient. To this end a turn to the "smart" use of IT solutions has been made, in order to find ways to make city work better for the people who live in it. Set among green fields in the agricultural heartland of Greece, the historic city of Trikala – population 82,000 – was not an obvious candidate for the nation's first smart city. But through collaborations with partners including the European Commission, which funded a driverless bus pilot, and companies such as Greece's Sieben, SPACE Hellas, Egkritos and Parkguru, Trikala has earned a reputation for innovation that dates back to 2004 when Greece's Ministry of Economics named it the nation's first digital city. It was later shortlisted as one of the top 21 smart cities in the world. By participating in EU-funded projects and offering up a test site for local tech companies, the city has cut its debt by €20m.

Energy Transition is a crucial issue both in local and EU level. A high level of energy efficiency is beneficial for security of supply, sustainability, affordability for households and industry and competitiveness of the local economy. Indeed, it is one of the key objectives of EU energy and climate policy, as set out in the recent Energy Union Communication, the 2014 European Energy Security Strategy and Energy Efficiency Communication.

Energy poverty is a distinct form of poverty associated with a range of adverse consequences for people's health and wellbeing – with respiratory and cardiac illnesses, and mental health, exacerbated due to low temperatures and stress associated with unaffordable energy bills. In fact, energy poverty has an indirect effect on many local policy areas - including health, environment and productivity.

Short CV

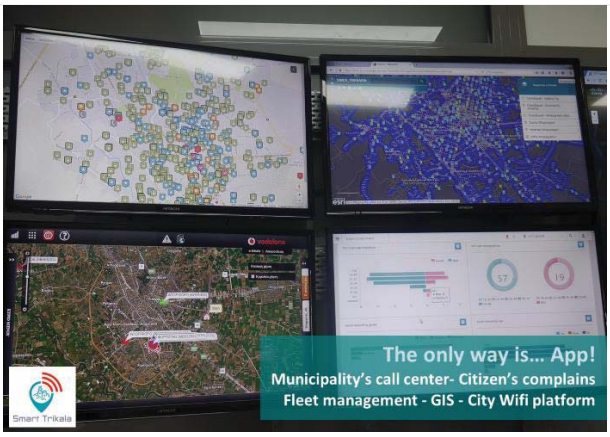
Mr. Dimitris PAPASTERGIOU was born in Trikala in 1973. During his student years he was involved with the student councils. He participated to the assertion committee for the Faculty of Physical Education & Sports in the city of Trikala and other student protests. In 1991 he graduated from the Crosscurricular Lyceum of Trikala. In the same year he passed at the School of Electrical and Computer Engineering / Computer NTUA and in parallel attended journalism courses in Athens.

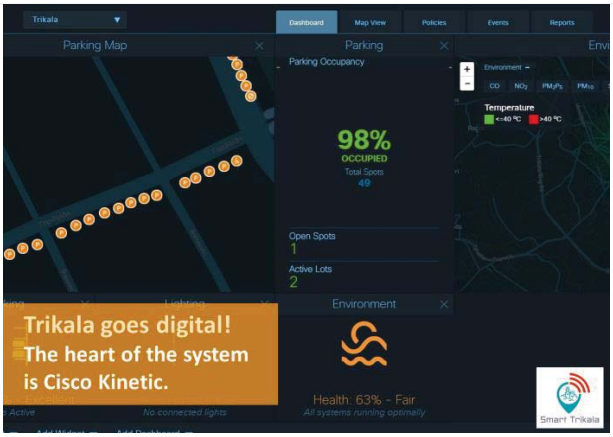
Value of life is the relationship that he has with the radio and music. In 1991 he participated in the launch of the radio station Hot Mix 88 and in 2001, after his military service they set up the Anemos 92. Maintain strong links with technology and the internet, relationship strengthened to the NTUA Multimedia Laboratory. In 2001 through the Hot Mix Radio Station, he designed and launched the first integrated webpage for the prefecture of Trikala, the 3kala.gr.His participation to the local authority began in 2002 when he was elected alderman and continued in 2006 when the citizens of Trikala chose me again to represent them on the municipal council. He can't live without music, basketball, mountain and travel and the PC programming relaxes him. He speaks English and tries to refresh the very good French he knew once. Also talking ... computers in Visual Basic, SQL, Asp, Html and a few .NET, C, Java. He moves as much as he can with his bicycle. He is married with the Traffic Engineer Mrs Sula Braki and states glad father of Fay, Kostas and Nikos.

Smart Trikala

3rd Green Energy Investments Forum

Dimitris Papastergiou – Mayor of Trikala

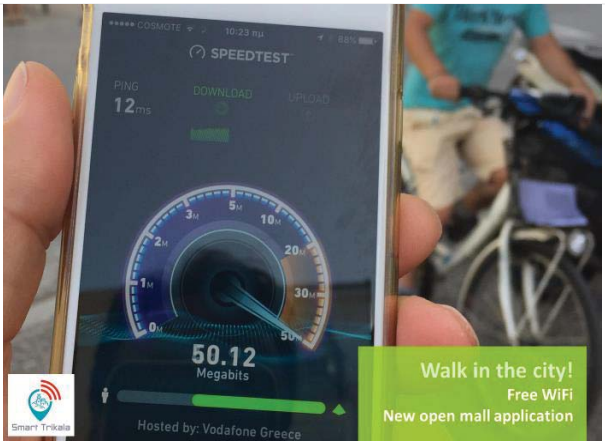





Certifications Self Service
Public certifications (birth, nationality, etc through a NFC resident card)


Parking Map
Parking
Parking Occupancy
98%
OCCUPIED
Temperature
Open Spots
1
Active Lots
2
Environment
Trikala goes digital!
The heart of the system is Cisco Kinetic.
Health: 63% - Fair


Education
We organized the "Code Girls" with the US Embassy for high school girls


SPEEDTEST
PING
12 ms
DOWNLOAD
UPLOAD
50.12
Megabits
Hosted by: Vodafone Greece
Walk in the city!
Free WiFi
New open mall application

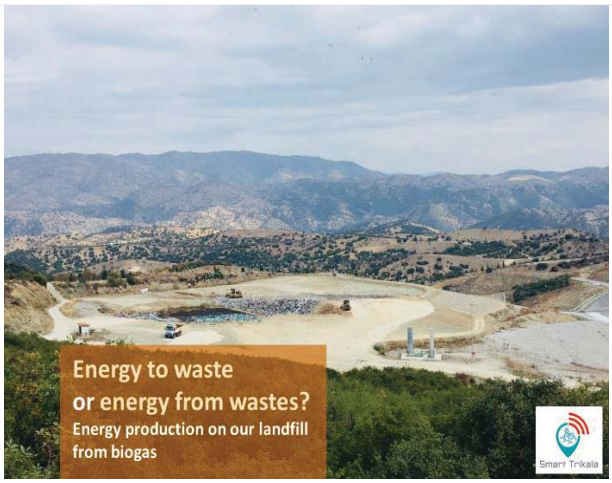

Walk in the city!
New LED street lighting with diming sensors.
Smart parking underground sensors

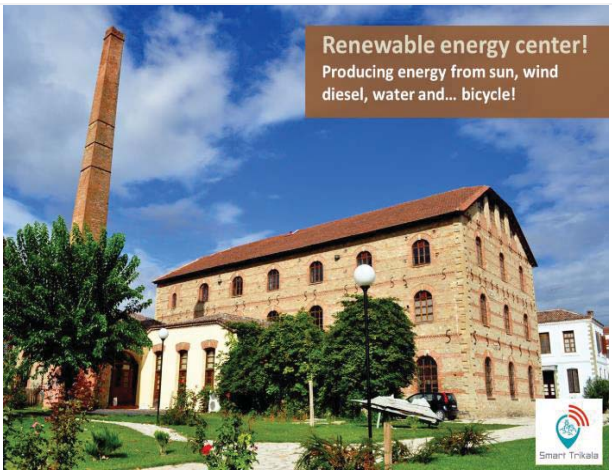

Walk in the city!
CityMobi2 driverless buses pilot project (FP7)
6 months
6 buses
12.138 passengers

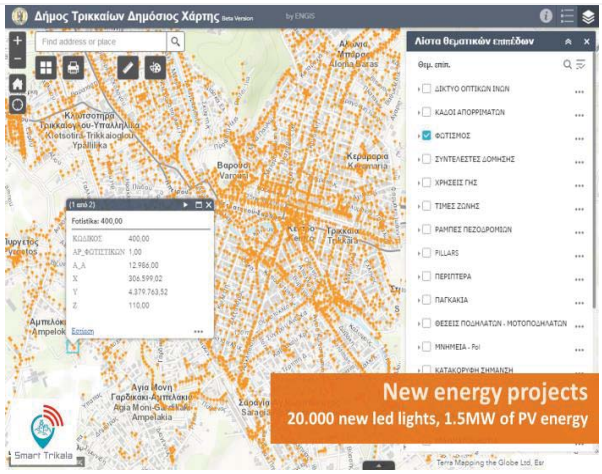

Walk in the city!
Elviten EU Project: 10 light electrified vehicles for urban transportation.
Bicycles, tricycles and quadricycles


Commission announces finalists of the European sustainable urban mobility awards
Walk in EU!
European Commission awarded Trikala as one of the 10 most sustainable cities of Europe for 2015


Here comes the sun!
Our first PV installation of 100kW
Smart Trikala


Energy to waste
or energy from wastes?
Energy production on our landfill
from biogas
Smart Trikala

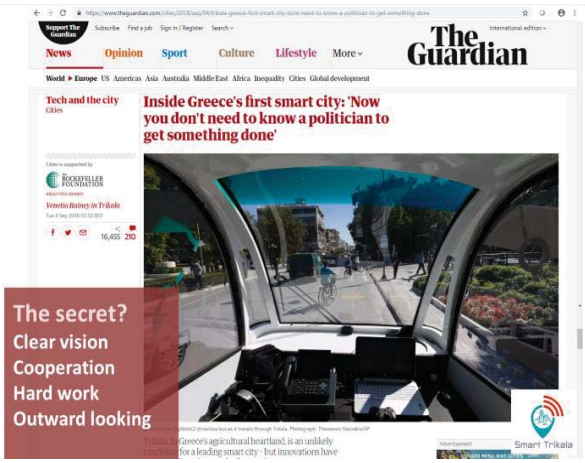

Renewable energy center!
Producing energy from sun, wind
diesel, water and... bicycle!
Smart Trikala


Δήμος Τρικκαίων Δημόσιος Χάρτης
New energy projects
20.000 new led lights, 1.5MW of PV energy
Smart Trikala


New agricultural projects
"New Agriculture for a new
Generation" supported by SNF
Bringing new farmers together
with knowledge, R&D, new markets!
Smart Trikala


New tourist projects
Learning about the herbs and
walk along the paths of the Myth!


New spa projects
Ready to deploy the Rizoma healing springs, close to Meteora
Smart Trikala


The Guardian
News
Opinion
Sport
Culture
Lifestyle
Tech and the city
Cities
Inside Greece's first smart city: 'Now you don't need to know a politician to get something done'
The secret?
Clear vision
Cooperation
Hard work
Outward looking
Smart Trikala


Thank you!

Sustainable banking

by

Mrs. Mavica ILIOU

Director, Green Banking & Development Programmes, Group ESMS Officer,
Piraeus Bank Group

Abstract

Globally, to ensure sustainability, international organizations & institutions like FSB (Financial Stability Board), EBF (European Banking Federation), UNEP FI (United Nations environment programme), Commission etc underline the necessity to embody environmental & social risk management policies into financial assessments.

Piraeus Bank SA following closely the international and European guidelines and regulations, supports Green entrepreneurship, investments in clean technologies and actions for energy efficiency, waste management etc. Providing specific individual and business loans with favorable conditions targeting the holistic approach of a business unit or project, implements environmental and social criteria in the approval process of business lending, along with the economic ones. By this way the Bank is able to identify, evaluate, manage and monitor periodically the environmental and social risks & opportunities that may derive from each business financing.

Short CV

Mrs. Mavica Iliou was born in Athens, studied Business Administration in the American College of Greece and completed postgraduate studies in the field of Energy and Environmental Investments in University of West Attica. She works in Piraeus Bank Group for 25 years. She is now the Director of the "Green Banking & Development Programs" Unit of Piraeus Bank, and is the Group ESMS officer responsible for the Environmental and Social Management System according to the Group's Credit Policy and Risk Strategy.

PIRAEUS BANK

Green Energy Investments Forum

Sustainable Banking

Green Banking & Development Programs

ILIOU MAVICA
Director

October 2018

PIRAEUS BANK

Piraeus Banks' Sustainable Development framework

Sustainable Development
An integrated approach to environmental, social and economic issues that leads to long-term, sustainable profitable growth

Social & Environmental Components
- Health & Insurance
- Legislation & Regulations
- Climate Change
- Risk Management

Environmental & Economic Components
- Natural Resources Efficiency
- Energy Efficiency
- Energy Security

Social & Economic Components
- Jobs
- Education & Development
- Entrepreneurship
- Governance & Society
- Financing

PIRAEUS BANK

EU and international framework for climate change & sustainable banking

September 2015 SDGs | October 2015 Paris Agreement | December 2015 TCFD | December 2016 HLEG | July 2017 TCFD Final Report HLEG Interim Report | September 2017 EBF TF report | January 2018 HLEG Final Report | March 2018 EU Action Plan on Sustainable Finance

- *September 2015 :* 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development — adopted by world leaders in September 2015 at an historic UN Summit
- *October 2015 :* At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets out a global action Plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2° C.
- *December 2015 :* The Financial Stability Board (FSB) appoints a Task Force on Climate-related Financial Disclosures (TCFD) to develop voluntary, consistent climate-related financial risk disclosures for use by companies in providing information to investors, lenders, insurers, and other stakeholders. The final report was issued in July 2017. Specific mention for the banking sector.

PIRAEUS BANK

EU and international framework for climate change & sustainable banking

Σεπτέμβριος 2015 SDGs | Οκτώβριος 2015 Paris Agreement | Δεκέμβριος 2015 TCFD | Δεκέμβριος 2016 HLEG | Ιούλιος 2017 TCFD Final Report HLEG Interim Report | Σεπτέμβριος 2017 EBF TF report | Ιανουάριος 2018 HLEG Final Report | Μάρτιος 2018 EU Action Plan on Sustainable Finance

- *December 2016 :* Commission appoints a High Level Expert Group (HLEG) on Sustainable Finance reforming the EU's rules and financial policies to facilitate green and sustainable investment. The Group of experts submit an interim report in July 2017 and the final one in January 2018.
- *September 2017 :* The European Banking Federation (EBF) has appointed a Task Force on Green Finance (Sustainable Finance Working Group). The report "Towards a green finance framework" was submitted with the objective to provide a general overview of how banks see their role and how they could further increase their support for sustainable economic growth, focusing on transformation to a two-degree economy while correctly assessing the embedded risks in all sectors, not only those at the frontline of the climate change revolution.
- *March 2018 :* EU Action Plan on Sustainable Finance is submitted. This Action Plan unveils EU's strategy for a financial system that supports the EU's climate and sustainable development agenda.

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EC Action Plan : Financing Sustainable Growth

Action 1 Establishing an EU classification system for sustainable activities	**Action 2** Creating standards and labels for green financial products	**Action 3** Fostering investment in sustainable projects
Action 4 Incorporating sustainability when providing financial advice	**Action 5** Developing sustainability benchmarks	**Action 6** Better integrating sustainability in ratings and market research
Action 7 Clarifying institutional investors' and asset managers' duties	**Action 8** Incorporating sustainability in prudential requirements	**Action 9** Strengthening sustainability disclosure and accounting rule-making
	Action 10 Fostering sustainable corporate governance and attenuating short-termism in capital markets	

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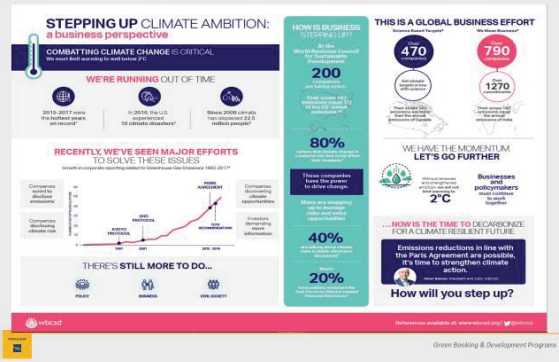
World Business Council For Sustainable Development (WBCSD)



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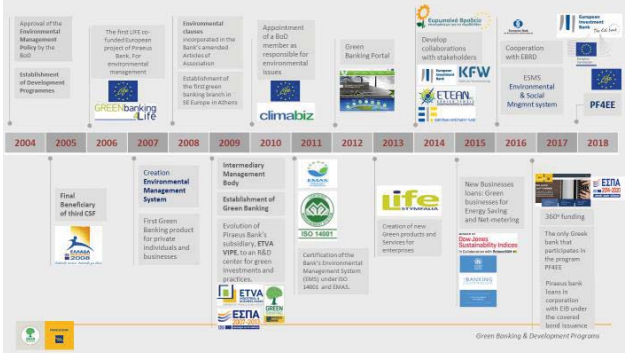
Timeline of Green Banking & Development Programmes



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Green Banking Products and Services

Products for Individuals

Green Mortgage

Green Home Retrofitting

Green Consumer Loan

Small-Medium Enterprises

Piraeus Green Business -Small Businesses Energy Retrofitting

Piraeus Green Business - Loans for SME that wish to invest in Net metering

Green Services "Going Green"

Favorable terms & conditions

PIRAEUS BANK

Subsidy & Grands Program "ENERGY EFFICIENCY I & II FOR HOUSEHOLDS"

Piraeus Bank has successfully participated in "ENERGY EFFICIENCY I & II FOR HOUSEHOLDS"

Piraeus Bank participated actively in Energy Efficiency for Household I and thus successfully managed approximately 30% of the total number of applications, approved from all the banks that participated in the first program. As for Energy Efficiency for Household II, even if it hasn't yet been completed, our participation is expected to be much higher.

In both programs, our strong know-how on green investments resulted to an efficient allocation of resources and thus providing our customers high quality services in short response time.

info

- *Piraeus Bank could provide support further energy efficiency interventions by providing financing through our Green consumer and home improvements loans*

Green Banking & Development Programs

PIRAEUS BANK

Piraeus Business 360° - NSRF

Complete solutions for your business under the new actions of the NSRF 2014-2020!

In Piraeus Bank, with central philosophy promoting Greek entrepreneurship, we support small businesses and professionals who wish to include their investment projects in the NSRF 2014-2020 actions.

Towards this direction, we designed the new package "Piraeus Business 360" a complete proposal which specifically includes selected products and services, designed to meet your needs, from the start of the investment until its completion.

ΕΣΠΑ 2014-2020

Green Banking & Development Programs

PIRAEUS BANK

Private Finance for Energy Efficiency - PF4EE

Private Finance for Energy Efficiency (PF4EE) is a special purpose tool which aims to mobilize Energy Efficiency investments for individuals, businesses and the public sector.

Piraeus Bank, the only bank in Greece that takes advantage of the PF4EE, will be able to provide energy efficiency loans with favorable terms and reduced risk

- Pilot programme
- 10 contracts in Europe
- 1 contract in Greece

- ✓ Financing
- ✓ Collateral - Guarantees
- ✓ Technical assistance

European Investment Bank

Green Banking & Development Programs

PIRAEUS BANK

Subsidy & Grants Program-PBPrivate Finance for Energy Efficiency - PF4EE

Beneficiaries

- Businesses of any legal form and size or organizations for implementing an Energy Efficiency investment

Characteristics

- Liquidity EIB (favorable interest rate & exemption from l.128/1975 levy)
- Loan amount: €40,000 – €5,000,000 (buildings or SMEs)
- Loan amount: €40,000 – €1,125,000 (outdoor lighting or water pumps)
- CAPEX: up to €10 mn
- 75% total project cost

Total Portfolio

- € 100 mn

European Investment Bank

Green Banking & Development Programs

PIRAEUS BANK

Subsidy & Grants Program-ESPA "Small & Very Small Bus (ENERGY EFFICIENCY)"

Expected to be launched in November....

Beneficiaries

- Small & Very small Businesses of any legal form for implementing an Energy Efficiency investment, salary expenses, quality certificates etc

Characteristics

- For project costs from €30.000 to €150.000
- Grants from €15,000 – €112,500
- Up to 75% of the total project cost

Total Portfolio

- € 400 mn

Expected to be launched in November....

ΕΣΠΑ 2014-2020

Green Banking & Development Programs

PIRAEUS BANK

Subsidy & Grants Program JESSICA ("Joint European Support for Sustainable Investment in Urban Areas")

Piraeus Bank has also successfully managed in 2016 EUR 40 million of JESSICA funds ("Joint European Support for Sustainable Investment in Urban Areas") to finance urban development projects in its capacity as an Urban Development Fund for the regions of Central Macedonia and Thessaly.

Piraeus Bank's objectives were to enforce private and public sector to adapt to new, cleaner technologies, which includes all the special features both for the creation of a multiplier effect for the residents and the living conditions in the cities, as well as for the exploitation of European development funds, which contribute to leveraging private capital and maximizing socio-economic benefits.

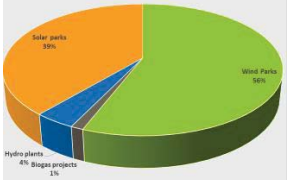
On this concept we aim in 2018 to participate to Infra FoF (Infrastructure Fund of Funds), empowering even more investments in clean techs.

Green Banking & Development Programs

PIRAEUS BANK

Project Financing of Piraeus Bank in Renewable Energy Sources (RES)

Piraeus Bank current Project financing in RES - Based on capacity



Piraeus Bank has significant track record in financing RES projects in all technologies, as it has been active since the initiation of the market :

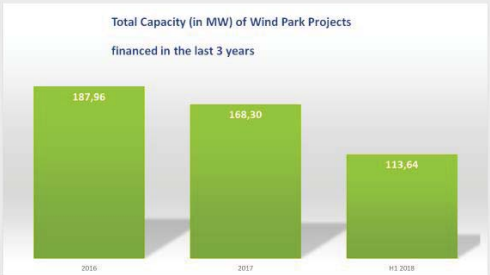
i) It currently has existing credit limits (excluding projects that loans have been fully repaid) for RES projects of total capacity of 1.222 MW
ii) 56% of the financed capacity refers to Wind Parks (764MW), while 39% of financed capacity refers to solar parks (683 MW)
iii) Piraeus Bank is also a pioneer in financing biogas projects in Greece, as it has financed 8 projects of total capacity of 15,3 MW.

Project Finance Division

Green Banking & Development Programs

PIRAEUS BANK

Financing of Wind Parks in the last years



Project Finance Division

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Green Banking & Development Programs

PIRAEUS BANK

High-level conference: Financing sustainable growth

Speech by Vice-President Dombrovskis at the High-Level Conference on Financing Sustainable Growth
Brussels, 22 March 2018

The second objective of our Action Plan is ***to embed sustainability into risk management.*** *This is important, because sustainability risks will have an increasing impact on financial stability. Last year, the amount of catastrophe-related losses covered by insurance reached an all-time high – €110 billion. If we ignore the risks of climate change, we may end up locking capital into projects that are only viable in the short-run, which would be a waste.*

There are two reasons why we should climate-proof our investments, and foster a broader view of risks: first, the impact of climate change can threaten financial stability and lead to major economic losses through floods, land erosion or draughts. And second, because of the risk of stranded assets. If we wake up too late to the reality of global warming, many of today's investments could end up being redundant.

We will also consider incorporating sustainability into prudential rules to boost funding for green projects, for example by adjusting capital requirements for banks. Work is currently ongoing in the European Parliament on a proposal for such a green supporting factor, and the Commission stands ready to give support for this process.

By reducing the costs of certain loans, a green supporting factor could provide incentives to choose investments that are good for the climate, such as building a passive house, or buying an electric car. Still, any measures would need to be justified from a risk and financial stability perspective, and they would need to be carefully calibrated.

Green does not necessarily mean risk-free.

Along this, ***we are looking into amending rules for banks' risk management policies to better account for sustainability risks. Time is running out, so we need solutions to quickly help sustainable finance reach scale, and the green supporting factor could be one of them.***

Green Banking & Development Programs

PIRAEUS BANK

Environmental and Social Management System

By virtue of their role as financiers of the real economy, banks are de facto exposed to credit, reputational, legal, operational and market risk that is driven by environmental and social (E&S) issues that affect their clients and customers (indirect risk).

These risks can stem from :

- the impact clients have on the environment and society (e.g. pollution, natural resource depletion, health and safety concerns for communities and employees)
- the physical impacts based on climate change (e.g. severe weather events, water stress, fluctuating ecosystem services) that affect client's performance and success.

Green Banking & Development Programs

PIRAEUS BANK

Environmental and Social Management Risk System (ESMS)

Targeting the holistic approach of a business unit or project, PB implemented environmental and social criteria in the approval process of business lending, along with the economic ones. By this way the Bank is able to identify, evaluate, manage and monitor periodically the environmental and social risks & opportunities that may derive from each business financing.

With the implementation of an efficient and effective ESMS, the Bank:

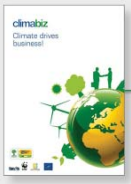
- ✓Ensures enhanced transparency,
- ✓Improves the quality of the portfolio and
- ✓Enhances customer's support in managing E&S risks

Green Banking & Development Programs

PIRAEUS BANK

E.U. Life+ project climabiz

2012 :
E.U. Life+ project climabiz



Climate Risk Management Model

The application calculates the following parameters:

i. The costs of physical and regulatory climate risk at a sector, subsector and company level (which are influenced by climate change)
ii. Costs & benefits of the practices that a company can apply in order to reduce climate risk
iii. Environmental footprint (air pollutants, greenhouse gases, liquid waste, solid waste) at a subsector and company level.

Green Banking & Development Programs

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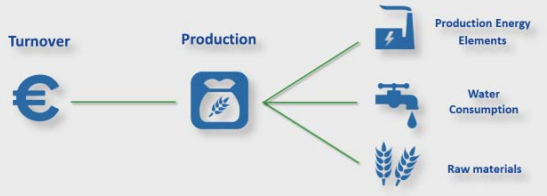
E.U. Life+ project climabiz

The core idea of climabiz



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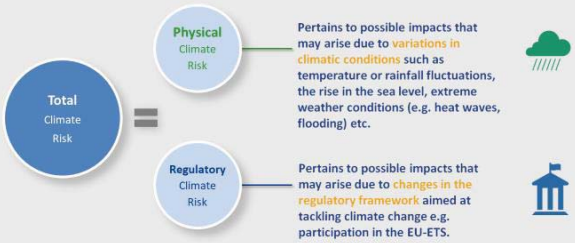
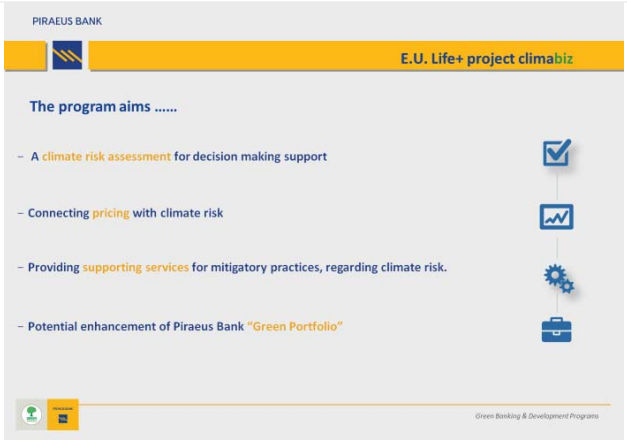
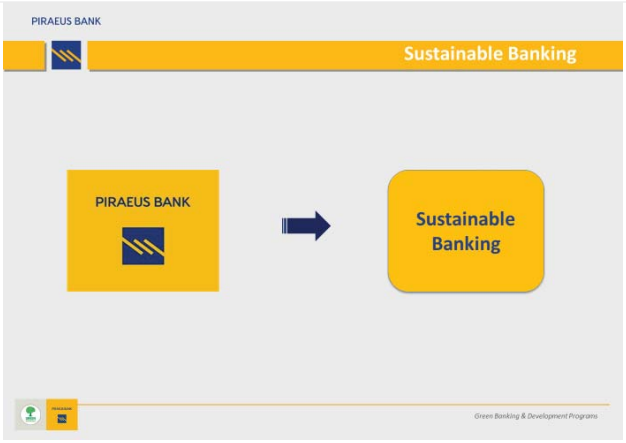
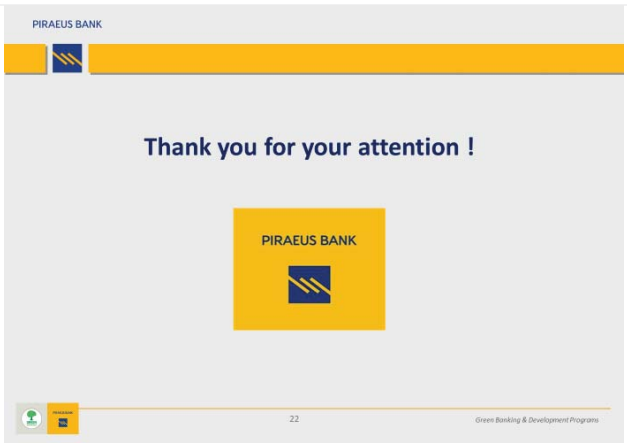
E.U. Life+ project climabiz



Green Banking & Development Programs


PIRAEUS BANK
E.U. Life+ project climabiz
The program aims .....
– A climate risk assessment for decision making support
– Connecting pricing with climate risk
– Providing supporting services for mitigatory practices, regarding climate risk.
– Potential enhancement of Piraeus Bank "Green Portfolio"
Green Banking & Development Programs


PIRAEUS BANK
Sustainable Banking
PIRAEUS BANK
Sustainable Banking
Green Banking & Development Programs


PIRAEUS BANK
Thank you for your attention !
PIRAEUS BANK
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Green Banking & Development Programs

How Green Energy Investments Enhance Energy Security?

by

Dr. Spyros KIARTZIS

Manager New Technologies & Alternative Energy Sources

Hellenic Petroleum, Hellas

Short CV

Dr. Spyros Kiartzis is the New Technologies and Alternative Energy Sources Manager, for the Hellenic Petroleum Group. He is working to implement a comprehensive plan that will increase the use of renewable energy and decrease Group's carbon footprint, promoting new technologies in the energy and transport sector. Vice Chairman and CEO of Energiaki Pylou-Methonis SA a wind park owner and member of the Board of Directors of "ELPEDISON S.A." and "Hellenic Petroleum Renewable Energy Sources S.A."

HELLENIC PETROLEUM

Energy in Transition: How Green Energy Investments Enhance Energy Security

Dr. Spyros Kiartzis
Manager New Technologies & Alternative Energy Sources

11th International Conference on Energy and Climate Change, Athens, 10 October 2018

Contents

Energy security

- **The uninterrupted availability of energy sources at an affordable price (IEA definition)**
  - Long-term energy security deals with timely investments to supply energy in line with economic developments and sustainable environmental needs
  - Short-term energy security focuses on the ability of the energy system to react promptly to sudden changes within the supply-demand balance
- **Is not one topic but a cluster of different problems - the core may be economic but politics and security loom large in the surrounding issues**
  - nuclear safety and the risks of nuclear proliferation
  - the safety of high dams for hydro-power in earthquake zones
  - current fears about 'fracking' (subterranean rock fragmenting) for extracting shale oil and gas
  - speculation over harmful side-effects of extracting wind and solar energy
- **Bioenergy as a valuable option for energy security may have positive synergies with other policy priorities**
  - water and food security
  - support energy access
  - economic development, growth and stability
  - climate security and other environmental goals

From the shale revolution to a shift towards low-carbon fuels

- **The concept of energy security is undergoing a rapid transformation**
  - In the past: geopolitics and the supply of oil and gas were the dominant factors
  - Today: a broader and more complex spectrum of elements are interacting to both stabilize and threaten energy security
- **Strong growth in the production and integration of renewable and distributed energy**
  - diversify energy mix, reduce reliance and price exposure to only a few sources and countries
  - renewable and on-site generation, if connected to advanced microgrid and storage technology, can contribute to energy security
  - new challenges of the digital revolution improve efficiency, lower costs, creates vulnerabilities
- **Supply is as important and as vulnerable as is transmission and distribution of energy**
  - Regardless of climate policy, timely investment into oil and gas supply remains a cornerstone of energy security

Contents

Moving away from fossil fuels?

Not so easy, not that quick!

- ✓ Low-cost renewables are required
- ✓ Volatility in CO_2 markets
- ✓ Infrastructure bottleneck (the chicken – egg dilemma)
- ✓ Not enough money for investments
- ✓ Technology issues to be resolved

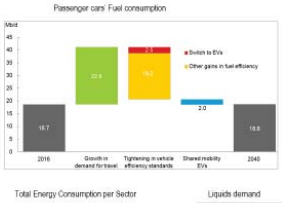
New challenges for energy players

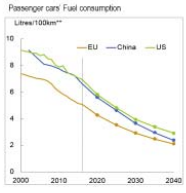
- ✓ Balancing the fuel mix
- ✓ Reliability of fuel quality
- ✓ Knowledge capture
- ✓ Technology integration
- ✓ Identifying new energy sources
- ✓ New business models to capture value

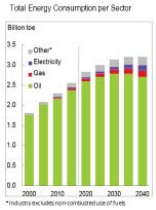
Oil companies diversify into low-carbon energies

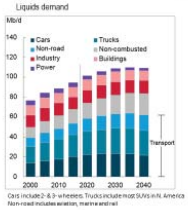
Investor pressure and government support will play a major role

Improved vehicle energy efficiency



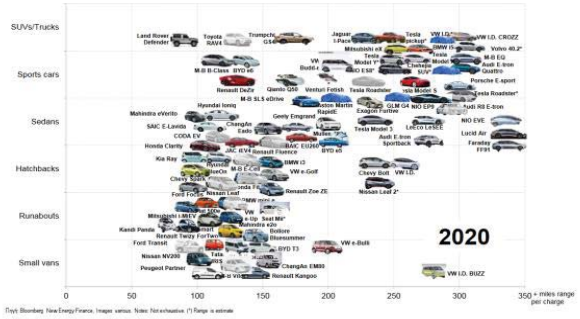






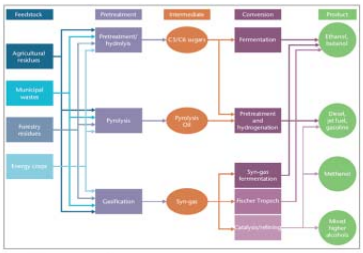
Data: BP, Energy Outlook 2018

E-mobility: plenty of options and models

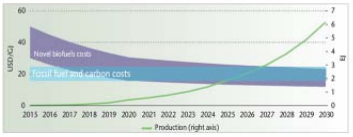


Advanced biofuels can be an alternative

- ✓ **Main technological issues still remain to be resolved**
- ✓ **Advanced biofuels not yet market competitive**
- ✓ **Co-producing fuels and added-value bio-based products will optimize full chain**



Cost reduction trajectory for novel advanced biofuels



Thyni, IEA, Technology Roadmap, 2017

Advanced biofuels: Misconceptions and Reality

- **Cheap oil halts renewables**
  - Capital markets are thirsty for new sections to invest
  - Renewables attract money due to shrinking investments in the oil sector
- **Biofuels is an energy security issue**
  - One single energy carrier can not meet all needs
  - Can serve all modes of transport (road, rail, marine, air)
- **Climate change debate**
  - Policies impact heavily biofuel industry and profitability
  - Stable and predictable policy framework is required to enable long-term investment planning
- **Technology barriers postpone biofuel evolution**
  - Technology revolution and breakthroughs
  - A variety of alternative processing routes are available
- **The biomass quest crossroad**
  - Many alternative feedstocks
  - In the end of the day it is a commodity market

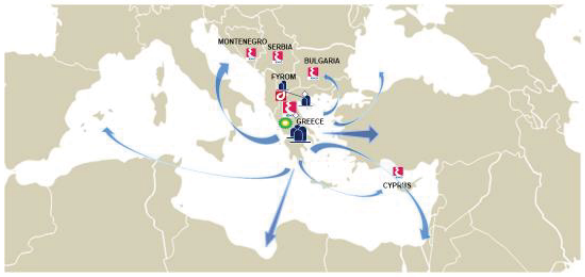
Contents

- Energy in Transition
- A new era in transport
- **Hellenic Petroleum overview**
- Investing in new technologies

Current position

Leading domestic market position; major middle distillates and naphtha/gasoline exporter in the East Med market

Group operational footprint and Sales



Assets overview

Core business around downstream assets with activities across the energy value chain

		DESCRIPTION	METRICS
Exploration & Production		• Exploration assets in Greece	• 50% (operator) in W. Patraikos Gulf • Exploration rights in 2 more areas
Refining, Supply & Trading		• Complex (recently upgraded) refining system: – Aspropyrgos (FCC, 148kbpd) – Elefsina (HDC, 100kbpd) – Thessaloniki (HS, 93kbpd) • Pipeline fed refinery/terminal in FYROM	• Capacity: 16MT • NCI: 9.6 • Market share: 65% • Tankage: 7m M³
Petrochemicals		• Basel technology PP production (integrated with refining) and trading • > 60% exports in the Med basin	• Capacity (PP): 220 kt
Domestic Marketing		• Leading position in all market channels (Retail, Commercial, Aviation, Bunkering) through EKO and HF (BP branded network)	• c.1,700 petrol stations • 30% market share • Sales volumes: 3.5MT
International Marketing		• Strong position in Cyprus, Montenegro, Serbia, Bulgaria, FYROM • Advantage on supply chain/vertical integration	• c.290 petrol stations • Sales volumes:1.2MT
Power & Gas		• ELPEDISON: Second largest IPP in Greece (JV with Edison/EdF) • DEPA/DESFA GROUP: 35% in Greece's incumbent NatGas supply company (DESFA in sale process)	• Capacity: 810 MW (CCGT) • Volumes (2015): 3.0bcm

Contents

- Energy in Transition
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Investing in Renewable Energy Sources

- Developing renewable electricity to diversify Group's energy portfolio. Also offsetting part of CO_2 emissions due to refining and power generation.
  - Wind and PV assets in operation
  - Developing a 200 MW portfolio (in various maturity stages)
- Expanding in biofuels
  - 2nd and 3rd generation biofuels

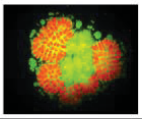

Supporting new technologies in energy and transport

- Supporting R&D projects with various academic institutions :
  - ✓ "Sustain-Diesel": hybrid diesel from used cooking oils
  - ✓ "Sustainable use of marine microalgae for the production of biofuels and high-added value biochemicals": 3rd gen biofuels
- Pilot applications of alternative technologies in transport
  - ✓ Electric vehicle charging points in selected petrol stations
- Corporate Venture Capital - under consideration


Participating in R&D projects …

Sustain-Diesel

Hydrosol Plant project - FCH JU



Sustainable use of marine microalgae for the production of biofuels and high-added value bio-chemicals

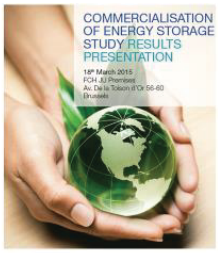
CAPITA GREEN MEOH

Green MEOH project - CAPITA

CHORUS Clean Energy *cluster*

Innovation Clusters

… and European Union initiatives



eurelectric, VATTENFALL, Linde, 50hertz, NEL, VANADIS POWER, REDT, AkzoNobel, Statoil, ITM POWER, AREVA, SIEMENS, NORTHERN POWERGRID, PROTON, Shell, Imperial College London, eurogas, moixa energy, Statkraft, INABENSA, res, GERG, ENSTORAGE, SSE, HELLENIC PETROLEUM, HYDROGENICS, PAE, RAE, UNIVERSITY OF BIRMINGHAM, ABENGOA HIDROGENO

Our vision: Sustainable transport & Clean energy

- Gaining know-how in future energy technologies
- Developing new business
- Converting R&D outputs in production

Evolving to an innovative, reliable and competitive energy supplier in the future

Hellenic Petroleum: Energy for life

Sustainable development against energy poverty

by

Mr. Stefanos PALLANTZAS

Hellenic Passive House Institute, Hellas

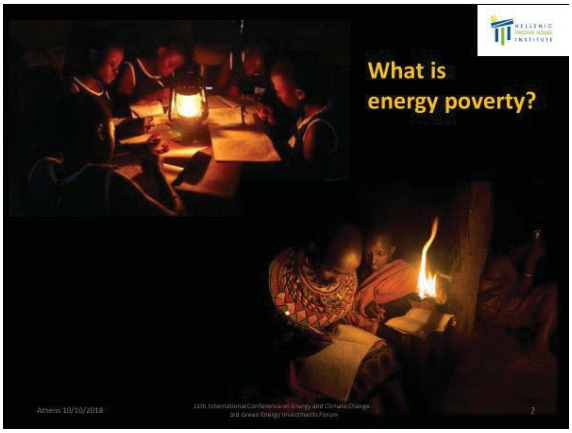
Abstract

Access to modern energy is closely linked to human development and improvements in people's wellbeing. Affordable, reliable and safe energy helps people meet their basic needs for a decent life. Yet according to the United Nations' Sustainable Energy for All (SE4All) initiative, billions of people live without modern energy. More than a third of the global population (2.9 billion) does not have clean and safe energy for household cooking. Nearly one in six people (1.1 billion) do not have basic access to electricity. But do we have energy poverty only in the sub-saharan Africa and Asia? Or is there a different kind of energy poverty also in the developed countries? Unfortunately the answer is yes! High energy expenditure, low household incomes, inefficient buildings and appliances, and specific household energy needs create the energy poverty of the modern world. We need more combined solutions , we need the community services. And key factors must be energy efficiency and RES.

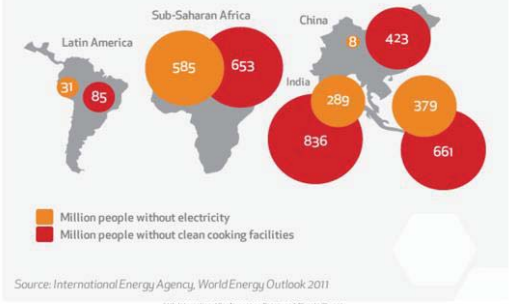
Short CV

Mr. Stefanos Pallantzas graduated from the German School of Athens, Greece and studied Civil Engineering at the National Technical University of Athens, where he specialized in the timescale and financial planning of major projects. He is a Trainer on the passive house design education, accredited by the Passive House Institute in Darmstadt, and has been a rapporteur in 20 CEPH courses in Greece, Cyprus and Turkey. He is the Co-founder (2012) of the Hellenic Passive House Institute and President of the Board. He is also a member of the International Passive House Association (iPHA) from the day of its establishment (2011) and member of the affiliates council (2013) , its Technical Panel(2017) and the International Passive house Conference scientific committee(2016-18). He is Certified Passive House Designer (2014) and Accredited Building Certifier (2016) and speaks german and english.

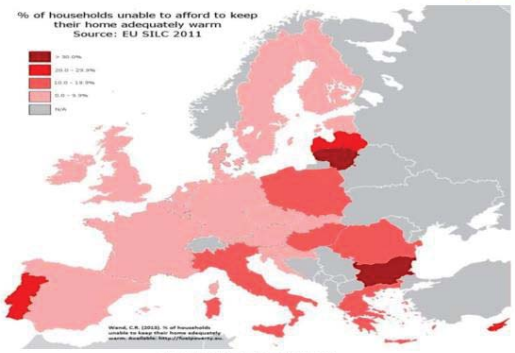
Sustainable Development against Energy Poverty



Global energy poverty



Source: International Energy Agency, World Energy Outlook 2011



THE SHORTCOMINGS OF TEMPORARY SOLUTIONS

Energy price regulation & direct financial support to energy poor homes:

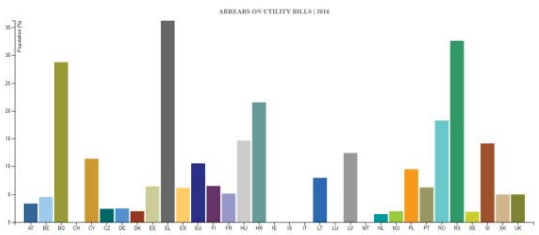
- Are strongly dependent on many economic factors
- Need continuous and even increased funding from public budgets
- Do not generate added value or economic growth

DEEP ENERGY RETROFITS AS A SUSTAINABLE SOLUTION

Multiple benefits:

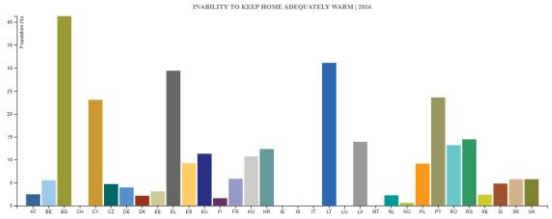
- Avoiding illness and death incidents caused by cold homes
- Higher indoor thermal comfort
- Job creation
- Social inclusion (e.g. by rehabilitating poor districts)
- Reduced energy costs
- Reduced CO_2 emissions

PRIMARY INDICATORS



Arrears on utility bills

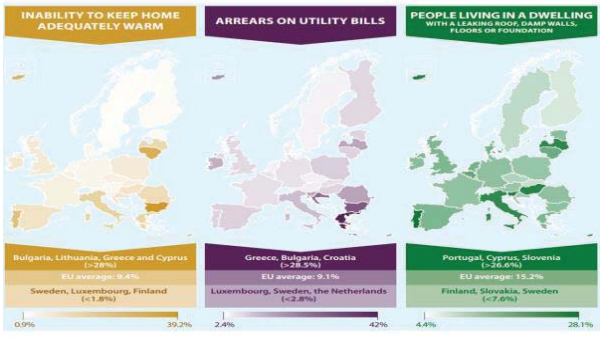
PRIMARY INDICATORS

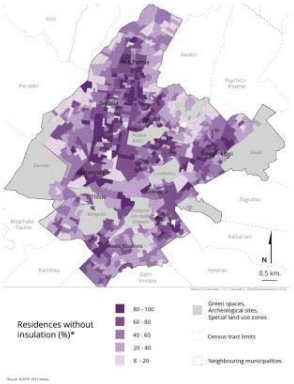


Inability to keep home adequately warm

SECONDARY INDICATORS

- Fuel oil , Biomass , Coal prices
- Household electricity, gas and District heating prices
- Dwellings comfortably cool during summer and winter time
- Dwellings in densely or intermediately populated areas
- Dwellings with energy label A
- Number of rooms per person, owners, retners or total
- Poverty risk
- Consumption expenditure for electricity, gas and other fuels as a share of income
- Share of dwellings equipped with heating and cooling systems
- Excess winter/summer mortality/deaths
- Presence of leak, damp, rot





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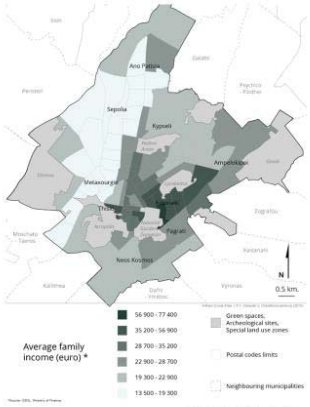

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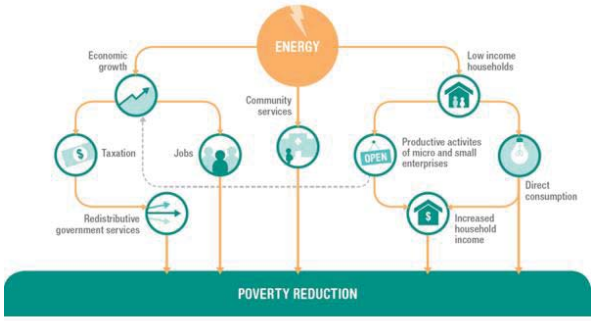
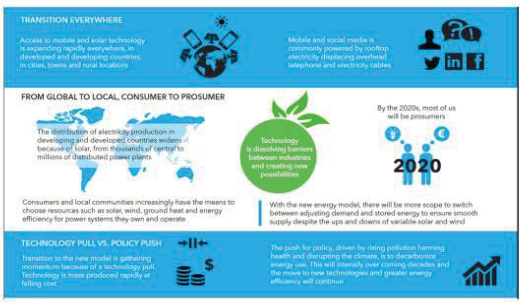
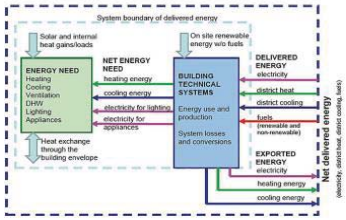
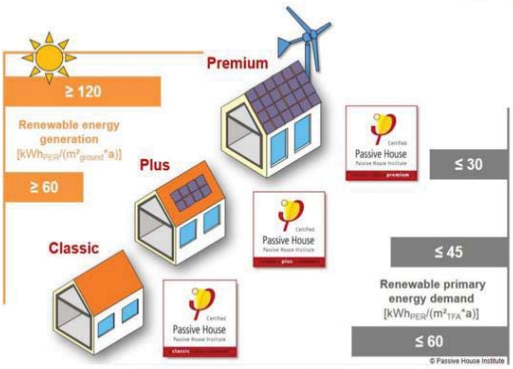






The smart nZEB building:

- efficiency first
- minimum primary energy consumption
- use of renewables
- RES production on site
- optimum cost effectiveness in terms of LCA



Energy Performance of Buildings Directive

Main legislative instrument aiming to promote the improvement of the energy performance of buildings in Europe

2002 – First Directive

- Introduced energy performance certificates of buildings

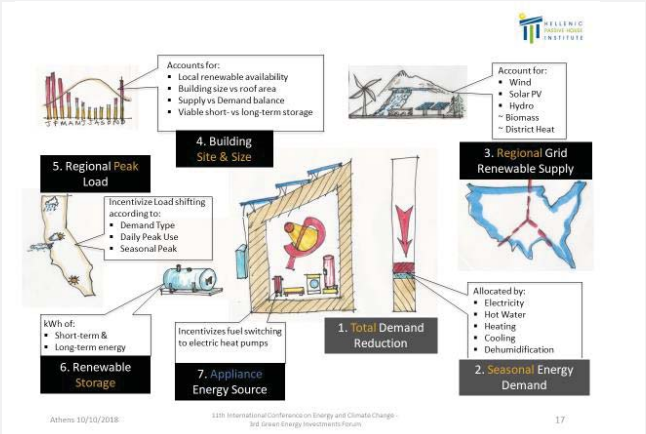
2010 – Recast Directive

- Energy performance certificates shall be stated in the advertisements
- All public building to be nearly zero energy buildings after 31 December 2018
- All new buildings shall be nearly zero energy buildings by 31 December 2020

Now - Revised EPBD contains:

- Long Term National Renovation Strategies
- Smartness Indicator
- Financing Measures
- Electro-mobility

EPBD


Accounts for:
Local renewable availability
Building size vs roof area
Supply vs Demand balance
Viable short-vs long-term storage
4. Building Site & Size
Account for:
Wind
Solar PV
Hydro
Biomass
District Heat
3. Regional Grid Renewable Supply
5. Regional Peak Load
Incentivize Load shifting according to:
Demand Type
Daily Peak Use
Seasonal Peak
Allocated by:
Electricity
Hot Water
Heating
Cooling
Dehumidification
2. Seasonal Energy Demand
kWh of:
Short-term &
Long-term energy
6. Renewable Storage
Incentivizes fuel switching to electric heat pumps
7. Appliance Energy Source
1. Total Demand Reduction
Athens 10/10/2018
11th International Conference on Energy and Climate Change - 3rd Green Energy Investments Forum
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identify energy poor consumers
group these households
aggregate them in energy communities
develop alternative solutions
inform these consumers
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ZCHs
Town
School
Low Carbon Energy
Existing Stock
Local Government Buildings
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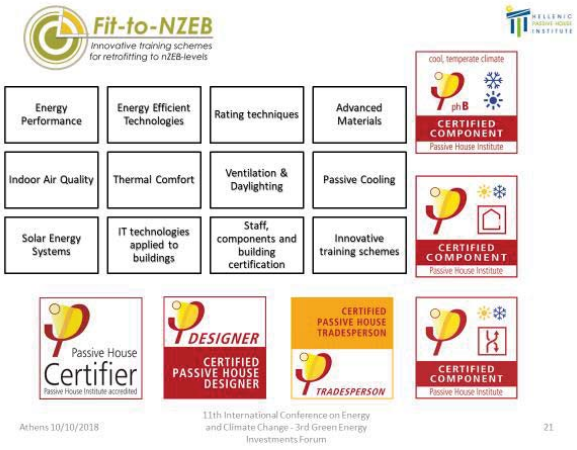
Fit-to-NZEB
Innovative training schemes for retrofitting to nZEB-levels
Energy Performance
Energy Efficient Technologies
Rating techniques
Advanced Materials
Indoor Air Quality
Thermal Comfort
Ventilation & Daylighting
Passive Cooling
Solar Energy Systems
IT technologies applied to buildings
Staff, components and building certification
Innovative training schemes
cool, temperate climate
CERTIFIED COMPONENT
Passive House Institute
Passive House Certifier
DESIGNER
CERTIFIED PASSIVE HOUSE DESIGNER
CERTIFIED PASSIVE HOUSE TRADESPERSON
TRADESPERSON
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21


NO ONE SHOULD EVER HAVE TO CHOOSE BETWEEN EATING OR HEATING
Thank you
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The European Union Emissions Trading Scheme: Overview of the scheme and impact on the ferro-alloys industry

by

Mrs. Iva GANEV

Director in charge of European Energy, Climate and Raw Materials Policy at EUROALLIAGES

Abstract

The paper provides a brief overview of the complex European Union Emissions Trading Scheme (EU ETS), which is the core of the European Union's climate policy. The scheme directly impacts the ferro-alloys industry in Europe.

The EU ETS established a scheme for trading of greenhouse gas emissions allowances within 31 European countries. The paper features the structure of the scheme that has been fine-tuned over the years, including the evolution towards a fully market-based system. In this respect, it includes takeaways from the European experience with free allocation, as well as a description of the regime for the period going from 2021 until 2030.

Today, the EU ETS covers almost half of EU's emissions, and is part of the daily life of a large number of companies. The ferro-alloys sector is impacted in terms of direct and indirect costs, for which the paper includes observed examples and comparison to other industrial sectors in Europe. The EU ETS Directive represents the backbone of EU's action against climate change, but it also works in combination with several other pieces of legislation in a delicate balance.

Last, but not least, since the adoption of the Paris Agreement, the EU ETS is set to evolve and live up to the high ambition of the European climate policy. The potential consequences of the European policy in this regard are also described in the paper.

Short CV

Mrs. Iva Ganev is a Director with EUROALLIAGES, the European Ferro-Alloys and Silicon Producers Association. Her daily tasks consist of tracking and analysing development, as well as recommending and implementing advocacy on the European Energy, Climate and Raw Materials policy aspects relevant to the sector. Building on her understanding of the interaction between corporate needs and the necessary alignment with public policy, her strong points are the design and execution of institutional strategies. Prior to joining EUROALLIAGES in 2012, she was Manager at a Brussels-based consultancy, chairing the Energy department and seconding the Executive Director in the daily management of the Brussels office and team.

EURO ALLIAGES

THE EUROPEAN UNION EMISSIONS TRADING SCHEME: OVERVIEW OF THE SCHEME AND IMPACT ON THE FERRO-ALLOYS INDUSTRY

11th International Scientific Conference on Energy and Climate Change
Athens, 10th October 2018

EUROALLIAGES

OUR ASSOCIATION

- Association of European ferro-alloys and silicon producers
  - Ferro-alloys: essential raw materials for steel-making
  - Silicon: end users are aluminium, chemicals, electronics and solar
- Membership: 23 companies, operating nearly 50 plants in 14 countries, with 8,000 employees and a cumulative annual turnover around €2 bn
- EUROALLIAGES represents about 95% of ferro-alloys and silicon production in Europe (EU + EEA)

OUR VISION

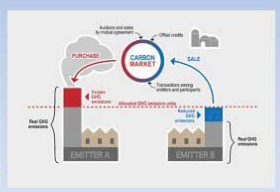
- A small sector in absolute terms, but **strategic for European economy**
- Importance of the **energy-intensive** nature of production processes

EUROPEAN UNION EMISSIONS TRADING SCHEME (EU ETS): THE PRINCIPLES

What is the EU ETS?

Cap-and-trade system

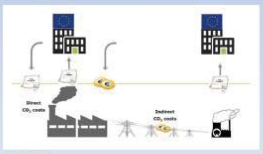
How does it work?



Auctioning vs. free allocation

EUROPEAN UNION EMISSIONS TRADING SCHEME (EU ETS): A DUAL IMPACT

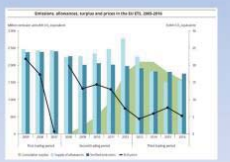
- **Direct impact**
  - Carbon leakage
  - Investment leakage
- **Indirect impact:** CO_2 cost passed in electricity prices



Source: Ecofys

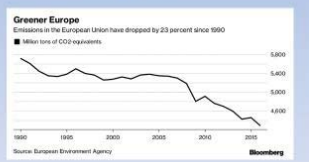
EUROPEAN UNION EMISSIONS TRADING SCHEME (EU ETS): THE CHALLENGES

How has it evolved?



3 phases so far, from learning-by-doing to auctioning as the principle

Does it work?

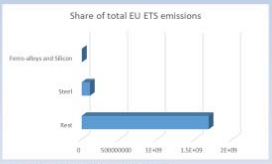


Decoupling of emissions and growth

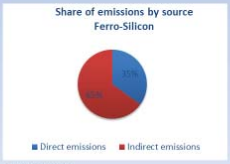
IMPACT ON THE FERRO-ALLOYS INDUSTRY: EXPERIENCE FROM THE CURRENT (2013-2020) TRADING PERIOD

Impact in terms of:

- Cost (direct + indirect)
- Predictability



Source: European Environment Agency, EU ETS data viewer



Source: EUROALLIAGES

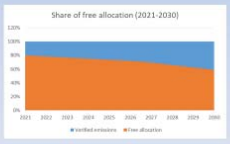
Impact on the Ferro-Alloys Industry: Direct cost

Ferro-alloys (observed 2013-2016)

- Extra cost (approximation):
  - ✓ 2015: €1.5 mln
  - ✓ 2016: €2.5 mln

Scenario for ferro-alloys (tentative 2021-2030)

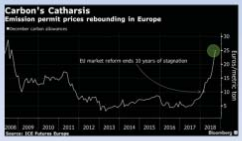
- More stringent framework = lower level of free allocation to protect competitiveness
- Carbon price is a central factor

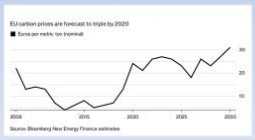


Impact on the Ferro-Alloys Industry: Indirect cost

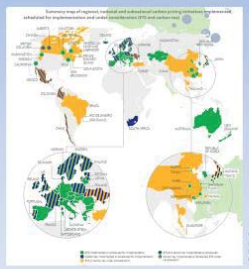
Indirect cost = CO_2 cost passed into electricity price

- No harmonization of indirect emissions compensation expected after State Aid Guidelines review in 2019
- Carbon price is a major factor





The EU ETS in the International Context



World map of Emission Trading Schemes and carbon tax measures
Source: World Bank and Ecofys, Carbon pricing watch 2017

Conclusions

- ❖ The EU ETS puts an important cost pressure on European industry
- ❖ It is all the more true for the post-2020 period: "life or death" issue
- ❖ Objective "net zero carbon emissions" in the EU by 2050
- ❖ Political will to address climate change at international level…
- ❖ … But we are far from a global carbon market

EURO ALLIAGES

Thank you for your attention!

Iva GANEV
Director – Energy, Climate and Raw Materials Policy
EUROALLIAGES
ganev@euroalliages.be

Initiative to mitigate energy poverty among the BSEC –MS and contribute to the mitigation of the associated CO_2 emissions

by

Prof. Dimitrios MAVRAKIS

Director of KEPA, National and Kapodistrian University of Athens, Hellas

Introduction: Climate Change

Your Excellences,

Distinguished guests,

Dear Colleagues,

As I keep saying in the opening sessions of this event, all these years, the most crucial challenge we face as humanity is this of the occurring climate change.

We travel in space in a spacecraft where we pollute the air we breathe, we gradually destroy the air conditioning circuit, we over consume and destroy the limited stock of resources we have available for our survival, and we pretend that everything remains under our control. In other words, we are trapped in the ostrich's syndrome. If we ignore the danger then it does not exist.

On the 10th of September 2018 the United Nations Secretary-General in a speech on Climate Change addressed to the leaders of our planet, he warned that "we face a direct existential threat".

This threat is directly related with the carbon dioxide (CO_2) which is released mainly through human activities such as deforestation and burning fossil fuels.

For three million years and until the beginning of the industrial era, during the 19th century, the CO_2 concentration in air fluctuated under the 280ppm.

For those who are not familiar with these magnitudes, 1ppm CO_2 is equal to 2.13Gt Carbon, 1Gt corresponds to 1000 million tones and 1GtCO_2e corresponds to one-year transport emissions in the EU, including aviation.

In an effort to mitigate the negative repercussions of occurring climate change, signatories of the Paris Agreement, three years ago, were pledged to stop the temperature rise below the 2°C up to 2100, a target that corresponds to 450ppm while in an ambitious perspective they were pledged to keep, if possible, the increase as close as possible to 1.5°C.

Today and before the end of the first quarter of the 21st century we have surpassed the 411ppm and the CO_2 concentrations continue to rise vertically.

According to the "Emission Gap Report - 2017" of the UN – Environment, sometime well before the 2030, the cumulative CO_2 emissions will have surpassed the all-time budget for the 1.5°C limit while they will remain around 200 GtCO_2 to surpass the 2.0°C limit.

It is now evident, that even if the undertaken National Determined Contributions by all signatories of the "Paris Agreement" are to be implemented only one-third of the necessary reductions will be achieved.

It is thus quite understood the emphasis of the Secretary-General of the United Nations at the closing his speech, to request from civil society and young people to campaign for climate action underlining that "there is no more time to waste".

Energy efficiency

In the frame of the aforementioned statement, here in KEPA we try all these years to mobilize academics, policy-makers and market stakeholders on the need to increase their engagement in the combat against climate change for the benefit of their societies.

For three years we coordinated an EU-FP7 programme, of 1million Euros total budget, covering 14 countries, from Albania to Russia and from Austria and Serbia to Azerbaijan and Kazakhstan, transferring knowledge and developing mitigation/adaptation policy portfolios confronting Climate Change for countries with developing economies.

One of the important findings was that putting emphasis on energy efficiency was the most efficient instrument to mobilize the local societies in the combat against climate change.

In parallel, it was surprising the weak support that such policies were receiving in these countries despite the obvious benefits for their economies.

In our understanding, this situation was occurring due to behavioral obstacles demonstrated by our interlocutors.

How to implement a policy, if the potential beneficiaries are not convinced?

We devoted three additional years of scientific research through the H2020 HERON, a project financed with 1 million Euros, in order to understand how those behavioral barriers influence negatively energy efficiency policies implemented by EU and EU-MS.

In parallel, we have tried, through the "Green Energy Investments Forum", to attract the attention of the BSEC – MS on the importance of developing and implementing large Energy Efficiency programmes taking advantages of the beneficial financing terms provided by the Green Climate Fund and the other multilateral banks.

Energy poverty

In this process, we came across the problem of energy poverty and its implications on the combat to mitigate poverty and CO_2 emissions through improving the energy efficiency of the building stock of the end users.

Energy poverty is a situation in which persons have difficulty obtaining the necessary energy in their home to meet their basic needs because of inadequate resources or living conditions.

Adequate warmth, cooling, lighting and the energy to power appliances are essential services needed to guarantee a decent standard of living and citizens' health. Energy poverty occurs when a household suffers from a lack of adequate energy services in the home.

Energy poor households experience inadequate levels of these essential energy services, due to a combination of high energy expenditure, low household incomes, inefficient buildings and appliances, and specific household energy needs.

Energy poverty is a distinct form of poverty associated with a range of adverse consequences for people's health and wellbeing – with respiratory and cardiac illnesses, and mental health, exacerbated due to low temperatures and stress associated with unaffordable energy bills. In fact, energy poverty has an indirect effect on many policy areas including health, environment and productivity.

As side effects can also be mentioned, illegal access to energy networks, intensive burning of chemically polluting wooden material, increase of CO_2 emissions, social exclusion, etc.

Switching from traditional to green policy instruments

Addressing energy poverty in a sustainable dimension has the potential to bring multiple benefits, including less money spent by governments on health, reduced air pollution, better comfort and wellbeing, improved household budgets, and local economic development.

The aim of this initiative that targets the BSEC –MS is to facilitate vulnerable consumers suffering from energy poverty to resolve their problem in a green and sustainable way.

This will be achieved with their transformation from energy consumers to energy prosumers with the active support of their local authorities (municipalities).

In this process a number of problems should be faced in advance.

Addressing energy poverty in local societies is a sensitive issue that has to be explained among potential beneficiaries for the expected benefits without raising issues of social discrimination.

Optimum sustainable solutions are a combination of available technical proposals, RES energy production and net metering techniques that should be explained and accepted in advance by the potential end-users.

Developing funding portfolios for each proposal by each user is subject to barriers related to negative funding and financing potential of end-users. ESCOs and Banks are reluctant if negative to get involved in programmes with numerous and distinct clients with low income and high risks of meeting their borrowing obligations.

Summing the problems for implementing solutions about mitigating energy poverty in households in a sustainable dimension, it is necessary: i) to convince potential beneficiaries to get involved in the proposed program, ii) to develop optimum and affordable solutions, iii) to develop efficient funding portfolios, iv) to agree with bankable financing schemes, v) to develop and activate managerial schemes for the implementation of the agreed programs.

The initiative is based on a sequence of actions that aim to aggregate end-users in energy communities capable to conclude and implement optimum sustainable technical solutions.

This time-related process is supported by:

i) a structured “policy dialogue” that facilitates the data interchange, knowledge transfer, and the decision-making procedures,
ii) a technical support facility, capable to provide the state of progress for technical solutions related to the "smart buildings" reflecting, a) low, b) moderate, c) high Energy Efficiency solutions corresponding to 1) tailor-made low-cost improvements, 2) NZEB, 3) Smart ZEB solutions; including RES energy production, with the combination of net and virtual net metering techniques,
iii) the development of "smart financing" schemes, based on the aggregated consumers, carefully developed funding portfolios for the concluded proposals, based on the necessary Pre-feasibility and Feasibility studies, and leading through negotiations to acceptable financing agreements with Banks and ESCOs.

We have spent more than a year studying the various parameters of this initiative, in close cooperation with distinguished partners from Greece and abroad.

We have developed detailed implementation work packages corresponding to the initiative I have just presented to you.

We have spent time ensuring that countries from our region with developing economies, such as Albania, Azerbaijan, Serbia, Moldova, Ukraine can benefit from the Green Climate Fund of the United Nations for such programmes, not to mention the respective financing programmes of the multilateral banks.

We have tried in vain, so far, to convince the Black Sea Trade and Development Bank to be accredited to Green Climate Fund (GCF). We shall not refrain from efforts to convince the Bank's board of governors on the necessity to expand the banking activities to this quite promising and profitable sector for both the bank and the economies of the region.

We are in contact with the United Nations headquarters in an effort to secure their support to this initiative that is closely related to the 6th and 13th Sustainable Development Goals while at the same time we try to involve municipalities from EU and BSEC countries in this initiative.

Ladies and gentlemen

There is no time to waste in the combat against Climate Change.

As the UN Secretary stated, “every day we fail to act is a day we step a little closer towards a fate that none of us wants”.

In this frame I believe that the fight to improve the energy efficiency and mitigate energy poverty can be a contribution to reverse these steps.

We do believe that we have the appropriate policy tools that can be implemented for the benefit of our societies.

It is for these reasons that I make an appeal to the Secretary-General of BSEC – PERMIS his Excellency Amb. Michael Christides, and to the Deputy Secretary General, his Excellency Amb. Traian Chebeleu, to adopt this initiative and promote it among the BSEC – MS.

Thank you

DAY 2: Scientific Sessions

Session 1: Environment – Climate Change

Weather clustering approaches and air quality climatic trends in urban environments

by

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John G. BARTZIS
Professor at UOWM, DME, Environmental Technology Laboratory, Kozani, Hellas

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Abstract

Climatic changes are expected to have a direct influence on local and urban air quality. The present study falls within the frame of European ICARUS Project and its climatic trends on air quality in selected European urban environments. The present methodology is basically a clustering technique (Serra C. et al., 1999), applied in daily weather data of 50-year period (from 2001 to 2050) in order to estimate the appropriate number of clusters. For the years 2006-2050 the weather predictions are based on the future emission scenarios developed by the last IPCC assessment report. In fact, the moderate Representative Concentration Pathway - RCP4.5 was selected which follows a rising radiative forcing pathway leading to 4.5W/m^2 in 2100 (Meinshausen M., et al., 2011). The detailed weather data were derived from the Coordinated Regional Climate Downscaling Experiment (CORDEX) provided from the Earth System Grid Federation (ESGF) index nodes (Gobiet A., Jacob D., 2012; EURO-CORDEX, 2018). The Regional Climate Model (RCM) INERIS-WRF331F was selected, using the EUR 11 (about 10 km resolution) horizontal domain projection (Gobiet A, Jacob D., 2012). In this work results are presented for the wider area of Stuttgart, while the analysis for other European cities is in progress. A ~50km^2 area domain was extracted. The daily weather parameters that were selected, cover and characterize different physical properties. To reduce the number of weather variables Principal Component Analysis (PCA) was performed (Serra C. et al., 1999). In order to classify the days in meteorological homogeneous clusters k-means clustering technique was applied (Austin E. et al., 2014). The selected cluster characteristics are discussed including their trends over the 50-year period. The individual cluster behavior with respect to the major air pollutant concentrations measurements obtained for the past 2001-2015 years, is also discussed. Some indicative results showed 10 discrete clusters/weather patterns. Focusing on cluster 9 which shows a linear increase in frequency of occurrence, is described by high atmospheric boundary layer and lower surface pressure with higher levels of NO_2 and PM_{10} concentrations.

Keywords: Weather Classification; Climatic Trends; Cluster Analysis; European Air Quality

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Weather clustering approaches and air quality climatic trends in urban environments

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- The present study is in the frame of European founded H2020, ICARUS Project.

The ICARUS project's main objective is to develop integrated tools and strategies for urban impact assessment in support of air quality and climate change governance in EU Member States leading to the design and implementation of appropriate abatement strategies to improve the air quality and reduce the carbon footprint in European cities.

More information could be found in https://icarus2020.eu/

ICARUS

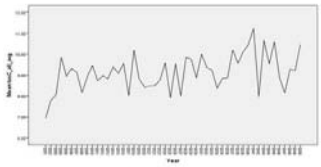
Motivation - I

- Climatic changes are expected to have a direct influence on local and urban air quality.
- Air Quality changes depend mainly on:
  - Weather patterns changes
  - Emissions patterns changes

Note: Weather pattern change studies have to take into consideration its **highly irregular temporal variation.**

Motivation -II

Example: A numerical prediction of yearly average temperature in the city of Stuttgart for the period 2001-2050



A logical approach ➡ **Weather Clustering**

Aim of the study

- Use existing regional weather numerical data for 50 years (i.e. 2001-2050) to perform weather cluster analysis.
  - **EURO-CORDEX** Database
  - IPCC Fifth Assessment Report (AR5) climatic scenarios (**RCP4.5**)
- Identify weather trends with respect to time in terms, of the generated clusters 'frequency of occurrence'.
- Identify the clusters behavior with respect to air quality in terms of major hazardous pollutants concentrations (O_3, NO_2, PM) based on the existing data in the past period (2001-2015).

CASE STUDY: Stuttgart wider urban area.

Methodology

Following the climatic scenario RCP4.5 and using the set of the **CORDEX daily data (spatial resolution ~10km)** produced by **INERIS-WRF331F model** for the period **2001-2050**, specific weather patterns have been identified called **weather clusters** for the city of Stuttgart focusing on a 50km x 50km area around the city centre.

Step 1 - Data Selection and Collection

Step 2 – Principal Component Analysis(PCA)

Step 3 – K means Cluster Analysis

⬇

Cluster Identification

Step 1- Data Selection and Collection

The selected Weather parameters:

1. 2-meter temperature
2. daily temperature range
3. 2-meter relative humidity (%)
4. surface pressure
5. precipitation
6. 10- meter U-component wind velocity
7. 10-meter V-component wind velocity
8. downward short-wave surface radiation
9. atmospheric boundary layer thickness

Each of the above parameters has been averaged over the selected 50km x 50km city domain.

Step 2- PCA

Principal component analysis (PCA) enables us to transform a number of (possibly) correlated parameters (such as the abovementioned weather parameters into a (smaller) number of uncorrelated variables called principal components

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Step 3- k-means Cluster Analysis

- Cluster analysis is a statistical method able to identify, from a large dataset, subgroups with some degree of homogeneity.
- **k-means method** seems to perform well through various methods in the field of weather pattern identification.
- In the k-means cluster analysis, a number of **n** vectors is partitioned to preselected **k** groups called clusters.

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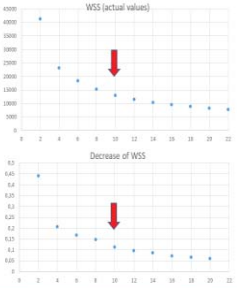
k-means Cluster Analysis Results

$$WSS(k) = \sum_{i=1}^{k} \sum_{x \in Ci} \| x - zi \|^2$$

where x denotes all data objects belonging to the cluster Ci; zi is the ith corresponding cluster centroids (CC).

$$fractional\ decrease\ in\ WWS(k) = \frac{WWS(k) - WSS(k+1)}{WWS(k)}$$



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Clusters interpretation methodology

- ***Clusters characterization :*** It is mainly based on the weather parameters statistics (Average, SD, Min, Max) as well as wind patterns.
- **Cluster frequency of occurrence** along the 50yr period as **a climatic change indicator** (use a 5-year time step).
- **The clusters associated with elevated concentrations** for the priority air pollutants (e.g. NO_2, O_3, PM).

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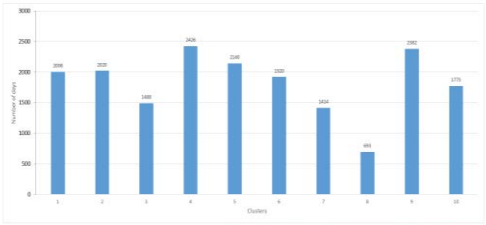
Results - Days distribution



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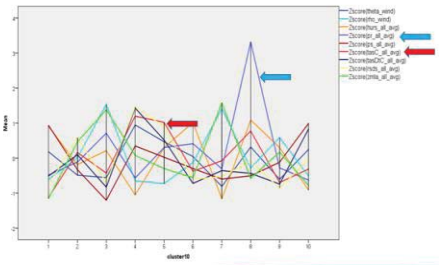
Results – Weather variables averaged per cluster



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Results - Cluster trends

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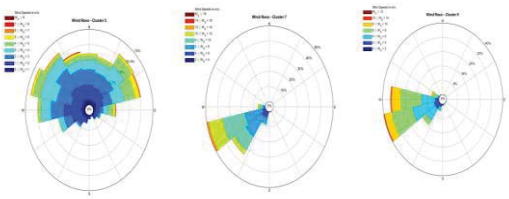
Results - Prevailing Wind directions

Examples of wind direction for 3 selected clusters



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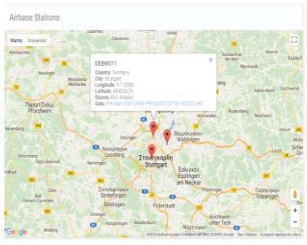
Results - Characterize the clusters with respect to air pollution levels – The Air Pollution Data

EEA data derived from HEALS EDMS (http://heals.uowm.gr/)- Meteorological stations DEBW011&13



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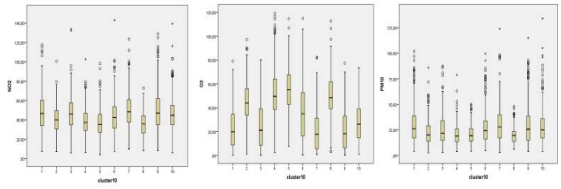
Results – Clusters vs Air pollutants



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Stuttgart - Clusters vs Air Pollutants

- Elevated NO2 : Cluster 7
- Elevated O3 : Cluster 5
- Elevated PM10 : Cluster 7

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Concluding Remarks and Future work

➢A novel approach based on weather clustering is inaugurated to study climate change effect on air quality levels

➢With respect to **cluster frequency trend over the 50year period** slight changes are observed. More specifically:

- The clusters associated with elevated PM show an increase in Stuttgart area.
- The clusters with elevated NO_2 concentrations show also an increase.
- The cluster associated with elevated O3 show a slight increase.

➢Detailed Modeling studies are on the way to reveal pollutants concentrations time trends

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Ευχαριστώ
Thank you

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10-12 October, Athens, Greece

Evaluation of groundwater quality and its suitability for domestic and irrigation use in Patos – Marinza Region

by

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Abstract

The present study was focused on the hydrochemistry of groundwater in Patos-Marinza oilfield, one of the largest onshore heavy oil fields in the Western Lowlands of Albania of the Fier district. The oilfield was affected from the lack of investments in technology, infrastructure as well as up-to-date methods of management. A total of fifteen ground water samples were collected randomly from different sites and analyzed for major quality parameters following standard test procedures (American Public Health Association et al., 1995; Babu K.N. et al., 2007). The assessment of water quality for domestic purpose was done using Water Quality Index (WQI) (Brown R. M. et al., 1970; Fulazzaky M. A. et al., 2010), while the suitability of ground water for irrigation was estimated in respect of salinity and indices such as, Sodium Adsorption Ratio (SAR), sodium percentage (Na %), Residual Sodium Carbonate (RSC), and Permeability Index (PI) (Saha D. et al., 2008). Based on the results obtained, generally the quality of the groundwater samples was therefore not suitable for human consumption without adequate treatment, while it can be used for irrigation on almost all soils.

Keywords: groundwater, water quality index, irrigation

1. Introduction

Groundwater has long been regarded as the pure form of water compared to surface water, because of purification of the former in the soil column through anaerobic decomposition, filtration and ion exchange. This is one of the reasons for the excessive consumption of groundwater in rural and semi-urban areas all over the world (Saha et al., 2008). It is estimated that approximately one third of the world's population uses groundwater for drinking purposes (UNEP, 1999). This is a well-recognized fact that the groundwater, through the ages, continues to be an essential commodity for a large number of users. The chemical composition of groundwater is determined by a number of processes, which can chiefly be grouped into three - atmospheric inputs, interaction of water with soil and rock and anthropogenic activities. Precipitation, climate change and natural hazards add to the atmospheric inputs, while weathering and erosion of crustal materials result from the interaction of water with soil and rock (Babu et al., 2007). The anthropogenic disturbances through industrial and agricultural pollution, increasing consumption and urbanization degrade the groundwater and impair their use for drinking, agricultural, industrial and domestic uses (Simeonov et al., 2003; Sreedevi, 2004). Groundwater, being a fragile and important source of drinking water, must therefore be carefully managed to maintain its purity within standard limits. Groundwater degradation occurs when its quality parameters are changed beyond their natural variations by the introduction or removal of certain substances. In regions of intense agricultural activities, the degradation results from the addition of salts by dissolution during the irrigation process, from salts added as

fertilizers or soil amendments and from the concentration of salts by evapo-transpiration. Since irrigation is the primary use of water in arid and semi- arid regions, irrigation return flow can be the major cause of groundwater pollution in such regions. Water pollution not only affects water quality but also threats human health, economic development and social prosperity. The quality of groundwater is equally important to its quantity owing to the suitability of water for various purposes (Schiavo et al., 2006; Subramani et al., 2005). The Water Quality Index (WQI) integrates complex data to generate a score that describes the status of water quality to the public as well as to decision and policy makers (Simoes et al., 2008; Fulazzaky et al., 2010). Moreover, it may be used for comparing the quality of different water sources and in monitoring the temporal changes in the quality of water (Sarkar and Abbasi, 2007). It reflects the aggregate influence of various physical, chemical, and biological parameters of water quality conditions (Liou et al., 2004). The results of the WQI allow the preliminary classification of groundwater for the purpose of various uses and provide a benchmark for evaluating management strategies (Debels et al., 2005). The WQI is a unitless number between 0 and 100 with the higher value indicating poor quality of water. Water quality indices have various approaches to statistical integrating and interpreting variables and have been frequently utilized for the assessment of water quality (Kannel et al., 2007). The results are compared with drinking water quality standards laid down by the World Health Organization (WHO) (WHO, 2005)

2. Materials and methods

2.1 Study area

The Patos - Marinza oilfield is one of the largest onshore heavy oil fields in Europe located mainly in the Western Lowlands of Albania of the Fier district. The oilfield suffered from the lack of investments in technology, infrastructure as well as up-to-date methods of management. Pollution and environmental degradation are significantly associated with social welfare in communities or regions. Groundwater samples were collected from fifteen (15) shallow and deep wells on the study area as shown in Table 1.

2.2 Water analysis methods

Physical and chemical analysis of the water samples were done according to standard methods as per American Public Health Association (APHA) (1995). Field parameters such as pH and electrical conductivity were recorded at the sampling site and other parameters like total dissolved solids, total alkalinity, total hardness, total suspended solids, calcium, magnesium, chloride, nitrate, sulphate, dissolved oxygen and biological oxygen demand were analyzed in the laboratory. In the present study, for the calculation of water quality index, thirteen (13) important parameters were chosen.

Table 1: Location of sampling stations of the study area.

Station	***Latitude***	***Longitude***	***Depth (m)***
S_1	40°43'22.56"N	19°37'32.65"E	35
S_2	40°43'28.84"N	19°37'28.94"E	100
S_3	40°43'46.89"N	19°37'19.28"E	25
S_4	40°43'10.93"N	19°38'31.16"E	70
S_5	40°44'0.49"N	19°39'58.18"E	1900
S_6	40°43'47.74"N	19°40'5.60"E	1700
S_7	40°43'25.19"N	19°39'28.84"E	45
S_8	40°42'59.14"N	19°39'35.97"E	100
S_9	40°45'45.90"N	19°39'2.93"E	100
S_{10}	40°45'46.65"N	19°37'57.62"E	2000
S_{11}	40°45'22.90"N	19°37'51.45"E	25
S_{12}	40°44'54.07"N	19°38'57.37"E	35
S_{13}	40°44'43.22"N	19°38'44.03"E	1700
S_{14}	40°44'39.14"N	19°38'50.60"E	20
S_{15}	40°44'37.28"N	19°38'48.62"E	1300

Table 2: Status of water quality based on Water Quality Index (W.Q.I) (Source: Yogendra & Puttaiah, 2008).

Water quality Index Level	*Water quality status*
0-25	Excellent water quality
26-50	Good water quality
51-75	Poor water quality
76-100	Very poor water quality
100 and above	Unfit for drinking

The WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organization. The weighted arithmetic index method (Brown et al.,1970) has been used for the calculation of WQI. Further, quality rating or sub index (q_n) was calculated using the following expression.

$$q_n = 100[V_n - V_{i0}]/[S_n - S_{i0}] \quad (1)$$

q_n =Quality rating for the n^{th} water quality parameter
V_n=Estimated value of the nth parameter at a given sampling station.
S_n =Standard permissible value of the nth parameter.
V_{i0} = Ideal value of n^{th} parameter in pure water. (i.e., 0 for all other parameters except the parameter pH and Dissolved oxygen (7.0 and 14.6 mg/L respectively)

Unit weight was calculated by a value inversely proportional to the recommended standard value S_n of the corresponding parameter.

$$W_n = K/S_n \quad (2)$$

W_n= unit weight for the n^{th} parameters.
S_n= Standard value for n-th parameters
K= Constant for proportionality

$$K = 1/\Sigma 1/S_n \quad (3)$$

The overall Water Quality Index was calculated by aggregating the quality rating with the unit weight linearly.

$$WQI = \sum q_n W_n / \sum W_n \quad (4)$$

Water quality is classified as excellent, good, poor, very poor and unfit for drinking and its status is presented in Table 2.

3. Results and discussion

3.1 Drinking water quality

The results of the physico-chemical analysis of water samples from fifteen groundwater (wells) are summarized in Table 3.

Temperature: Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. The temperature values of water samples ranged from 16.8°C to 20.3°C during the study period. The values reported in this work are within the range recommended by European Commission (EC). High temperature conditions may not be desirable for water samples as they encourage the growth of micro-organisms, which have the potentials of altering the odour, taste and colour of the water.

pH: pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. The pH values of water samples varied between 6.67 to 7.91 and were found within the limit prescribed by WHO (6.5 to 8.5). A low pH can cause corrosion of water carrying metal pipes, thereby releasing toxic metals such as zinc, lead, cadmium, copper etc (Trivedy and Goyal, 1986).

Electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts. Conductivity value range from 505 μS/cm (S10) to 3970 μS/cm (S8). This fluctuation in EC is related to the geological nature of their water basins. However, with the exception of S8, all analyzed waters have conductivity within the limits recommended by the EC Directives for drinking water (2500 μS/cm).

Dissolved Oxygen (DO): Dissolved oxygen is an important parameter in water quality assessment and reflects the physical and biological processes prevailing in the water. The DO values indicate the degree of pollution in water bodies. DO values varied from 1.4 mg/l (S4, Sheqisht) to 13.9 mg/l (S8, Zharrëz).

Biochemical oxygen demand (BOD) is a measure of the dissolved oxygen consumed by microorganisms during the oxidation of reduced substances in waters and wastes.

Table 3: Statistical summary of physico-chemical parameters of sampled wells.

Parameters	Min	Max	Mean
pH	6.67	7.91	7.22
Temperature (°C)	16.80	20.30	18.65
Conductivity(µS/cm)	505.00	3970.0	1252.47
DO (mg/L)	1.40	13.90	5.06
BOD (mg/L)	0.03	2.81	0.81
TDS (mg/L)	354.28	2987.68	922.35
TSS (mg/L)	0.15	14.46	3.02
Turbidity (NTU)	<0.01	20.10	2.92
Alkalinity (mg/L)	6.00	486.27	140.08
Hardness (mg/L)	178.88	1453.40	595.89
Calcium *(mg/L)*	11.2	507.2	142.6
Magnesium *(mg/L)*	19	109.7	56.2
Chloride (mg/L)	43.93	955.94	139.72
Sulfate (mg/L)	11.28	146.51	48.89
N-NO_3 *(mg/L)*	0.18	0.18	3.1

NTU – Nephelometric Turbidity Unit

Typical sources of BOD are readily biodegradable organic carbon and ammonia. These compounds are common constituents or metabolic byproducts of plant and animal wastes and human activities (domestic and industrial wastewaters). Water samples analyzed have shown the BOD values ranging from 0.03 mg/L to 2.81 mg/L O_2.

Total Dissolved Solids (TDS): Total dissolved solids indicate the salinity behavior of groundwater. TDS values of water samples varied from 354.28 mg/L to 2987.68 mg/L. Water containing more than 500 mg/L of TDS is not considered desirable for drinking water supplies, but in unavoidable cases 1500 mg/L is also allowed. Approximately 93.3 % of the analysed samples had shown TDS values lower than this value.

Total Suspended Solids (TSS): The total suspended solids of well waters varied from a minimum of 0.15 mg/L to a maximum of 14.46 mg/L**.** Total suspended solids (TSS) does not have a health based guideline, but it is recommended that it should be below 500 mg/L for effective disinfection. All the groundwater samples were below this guideline. The total suspended solids are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium, manganese, organic matter, salt and other particles.

Turbidity in NTU: In most waters, turbidity is due to colloidal and extremely fine dispersions. The turbidity values for all the investigated samples were found to be from <0.01 NTU to 20.1 NTU (S3). Almost 80% of water samples were found to be within the turbidity value prescribed by WHO (5NTU).

Total Alkalinity (TA): Alkalinity of water is its capacity to neutralize a strong acid and it is normally due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium. Total alkalinity values for all the investigated samples were found to be from 268 mg/L to 857 mg/L $CaCO_3$ and were found within the limit prescribed by WHO.

Total Hardness (TH): Water hardness is the soap consuming property of water caused by the presence of alkali earth metals (calcium and magnesium), and to a lesser extent, the salts of other metals such as iron and manganese. When these metals are combined with bicarbonates, they form temporal hardness which can easily be removed by heat, but when in combination with nitrates, they form permanent hardness which is not easily removable by heat (Freeze & Cherry, 1979). According to McGoowan (2000), groundwater with hardness between 0-60 mg/l is considered as soft; between 61-120 mg/l as moderately hard; 121-180 mg/l as hard and greater than 181 mg/l as very hard. In this study, values of hardness of all samples ranged from 179 mg $CaCO_3$/L (S11) to 1453 mg $CaCO_3$/L (S8). Generally, hardness in the study area could be described as hard to very hard, as

approximately 87% of the samples had shown values >300 mg $CaCO_3$/L.

Sulfate (SO_4^{3-}): Sulfate occurs naturally in water as a result of leaching from gypsum and other common minerals. Discharge of industrial wastes and domestic sewage tends to increase its concentration. The sulphate concentration varied between 11.3 mg/L (S10, Kallm) to 146.5 mg/L (S1, Sheqisht); and was found within the prescribed limit by WHO (400 mg/L).

Chloride (Cl^-): The chloride concentration serves as an indicator of pollution by sewage. In the present study, chloride concentrations were found in the range of 44 mg/L (S5) to 956 mg/L (S 8). The chloride concentration was within the limit prescribe by WHO (250 mg/L) except water sample collected from sites S1.

3.2 Water Quality Index

Water Quality Index is established through the measurement of various important physicochemical parameters of the groundwater. For calculation of WQI values, each of the 13 parameters has been assigned a weight (Wn) and water quality rating (*qn*) according to the guidelines laid down by the WHO. (Table 4). The results of WQI calculations are presented in Table 5. WQI values of the study area range from 44.3 to 86.0. The minimum WQI has been recorded at site S6 (Marinëz), while maximum WQI has been recorded at site S3 (Sheqisht).

Table 4: Drinking Water standards unit weights (Source: Etim E.E. et al., 2013).

Parameters	Unit	WHO Standards	Unit Weight
pH	-	6.5-8.5	0.1926
Electrical Conductivity	µS/cm	300	0.0055
Total Dissolved Solids	mg/L	500	0.0033
Total alkalinity	mg/L	120	0.0136
Total hardness	mg/L	300	0.0055
Total suspended solids	mg/L	500	0.0033
Calcium	mg/L	75	0.0218
Magnesium	mg/L	30	0.0546
Chlorides	mg/L	250	0.0065
Nitrate	mg/L	45	0.0364
Sulphate	mg/L	150	0.0109
Dissolved oxygen	mg/L	5.00	0.3274
Biological oxygen demand	mg/L	5.00	0.3274

Table 5: Calculated WQI of groundwater in the study area.

Station	*Depth (m)*	*Water Quality Index*	*Water quality status*
S1	*35*	*84.5*	*Very poor water quality*
S2	*100*	*77.8*	*Very poor water quality*
S3	*25*	*86.0*	*Very poor water quality*
S4	*70*	*66.7*	*Poor water quality*
S5	*1900*	*59.1*	*Poor water quality*
S6	*1700*	*44.3*	*Good water quality*
S7	*45*	*49.0*	*Good water quality*
S8	*100*	*70.7*	*Poor water quality*
S9	*100*	*77.0*	*Very poor water quality*
S10	*2000*	*62.5*	*Poor water quality*
S11	*25*	*60.2*	*Poor water quality*
S12	*35*	*49.1*	*Good water quality*
S13	*1700*	*47.6*	*Good water quality*
S14	*20*	*84.4*	*Very poor water quality*
S15	*1300*	*53.6*	*Poor water quality*

The WQI values of groundwater at selected wells has been classified into three types, good water (WQI 26-50), poor water (WQI 51-75), very poor water (WQI 76-100). It is also observed that the majority of groundwater samples fall in poor (40%) to very poor (34%) category indicating that groundwater was therefore not suitable for human consumption without adequate treatment.

Higher content of EC, TDS, alkalinity, hardness, calcium, may be responsible for poor water quality at these sites and water from these sites is unfit for drinking purpose. Proper treatments and disposal of the effluent, proper drainage for the domestic and agricultural wastes is essential for improvement in ground water quality.

3.3 Suitability for irrigation

The excess amount of dissolved ions such as sodium, bicarbonate and carbonate in irrigation water effects plants and agricultural soil physically and chemically is thus reducing the productivity. The physical effects of their ions are to lower the osmotic pressure in the plant structural cells, thus preventing water from reaching the branches and leaves (Imran et al., 2011). Excess salinity reduces the osmotic activity of plants and thus interferes with the absorption of water and nutrients from the soil. Salinity and indices such as, Sodium Adsorption Ratio (SAR), sodium percentage (Na %), Residual Sodium Carbonate (RSC), and Permeability Index (PI) are important parameters for determining the suitability of ground water for irrigation uses (Saleh et al., 1999)

Sodium Adsorption Ratio (SAR)

Sodium Adsorption Ratio can indicate the degree to which irrigation water tends to enter into cation exchange reactions in soil. Sodium replacing adsorbed calcium and magnesium is a hazard as it causes damage to the soil structure and becomes compact and impervious. SAR is defined by Karanth (1987) as:

$$SAR = \frac{[Na^+]}{\sqrt{\frac{1}{2}([Ca^{2+}]+[Mg^{2+}])}} \quad (5)$$

Where, all the jonic concentrations are expressed in meq/L. Results of sodium adsorption ratio are presented in Figure 1.

In the study area, SAR values ranged from 0.153 meq/L to 0.685 meq/L, indicating that all samples are suitable for irrigation purposes.

Percent sodium (Na%)

Sodium concentration plays an important role in evaluating the groundwater quality for irrigation because sodium causes an increase in the hardness of the soil as well as a reduction in its permeability. The sodium percentage (Na %) is calculated using equation (6) (González-Acevedo et al., 2016). Where, all the jonic concentrations are expressed in meq/L.

$$Na\% = \frac{(Na^+ + K^+)\cdot 100}{(Ca^{2+} + Mg^{2+} + Na^+ + K^+)} \quad (6)$$

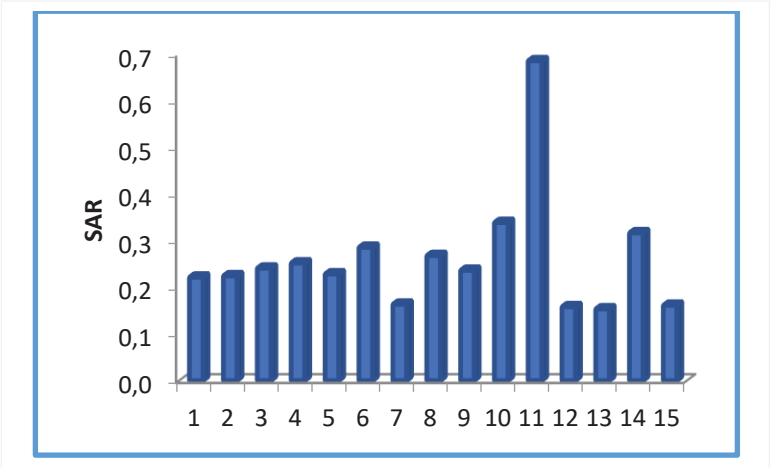

Figure 1: Graphical presentation of SAR values in Patos-Marinza area for the 15 samples (calculation by the authors).

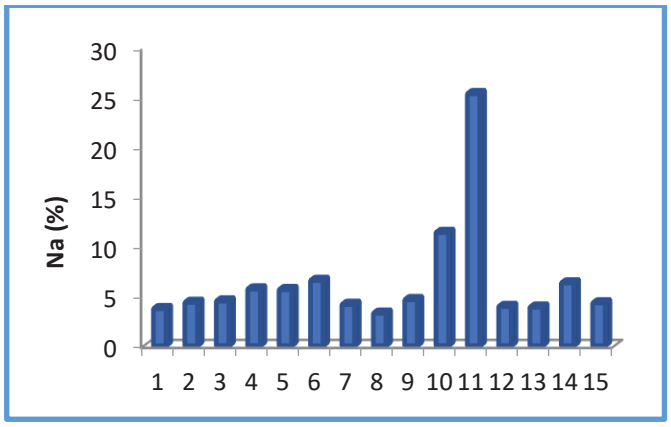

Figure 2: Graphical presentation of % Na values in Patos-Marinza area area for the 15 samples (calculation by the authors).

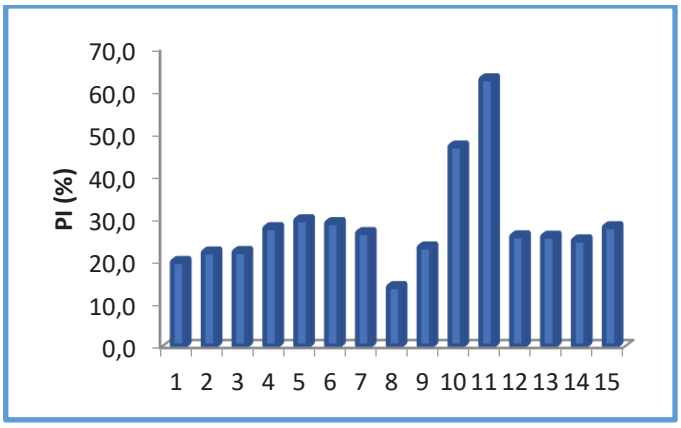

Figure 3: Graphical presentation of PI (%) values in Patos-Marinza area area for the 15 samples (calculation by the authors).

Permeability Index (PI)

The soil permeability is affected by long term use of irrigation water as it is influenced by sodium, calcium, magnesium, and bicarbonate content of the soil. The Permeability Index is calculated using equation (7) and the results are presented in Figure 3. Where, all the jonic concentrations are expressed in meq/L.

$$PI(\%) = \frac{(Na^{+} + \sqrt{HCO_3^{-}})}{(Ca^{2+} + Mg^{2+} + Na^{+})} 100 \qquad (7)$$

The PI values range from 13.9 to 62.8 % and indicate that 60% of the water samples of the study area fall within class II which makes the water suitable for irrigation purposes.

4. Conclusions

The evaluation of the groundwater quality in Patos-Marinza region presents a special importance because of unauthorized use as drinking water. Quality assessment is based on the requirement of the Council Directive relating to the quality of water intended for human consumption [98/83/EC] as well as on Water Quality Index. Water from these resources meets the A1 category requirements (according to 75/440/EEC) for the measured parameters and may be used as drinking water after the necessary treatments, with the exception of well S8, which is mainly categorized as A2. The calculated WQI provides an easy way of understanding the overall water quality and water management. The water quality based on WQI revealed that 27 % of sampling wells are fit for drinking purpose, while 40% and 33 % of wells fall in poor and very poor status respectively. The physico-chemical analysis revealed that the groundwater in the study area is better for irrigation rather than for drinking purpose. The classification of irrigation water according to the SAR, % Na, PI values indicate that all water samples could be used for irrigation on almost all soils.

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Classification and Evaluation of Commercial Bottled Drinking Water in Tirana, Albania

by

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Abstract

Demand for bottled water registered a significant increase due to the growing population and concern about contaminants in natural water supplies (Ahipathy M.V. and Puttaiah E.T., 2006). Due to an increasing demand, several new brands have been introduced in the market (Academic National Press, 1997; Ahiropoulos V., 2006). Bottle water samples were collected over a 4-month period in 2017 in different markets in Tirana. The items analyzed for each water sample were: pH, conductivity, Total Dissolved Solids (TDS), Total Hardness (TH), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Sulfate (SO_4^{2-}), Nitrate (NO_3^-) and Chloride (Cl^-).

Calcium, TDS and magnesium ions represented about 43, 47.6 and 57.2% of studied sample contents lower values than label amount, respectively. Sulfate, pH, nitrate and chloride were about 33.3, 38.1, 42.8 and 57.1% respectively higher than label values. Dietary Reference Intakes of Ca^{2+} and Mg^{2+} (DRIs) were evaluated based on the levels of these two elements (Anderson T.W., LeRiche W.H., 1971; Aschengrau A. et al., 1989). The DRI of Ca^{2+} varied from 0.6 - 23.08 % (average 10,73 %); the DRI of Mg^{2+} varied from 0.31- 11.98 % (average 3,31%) in all bottles analyzed.

The purpose of this study is to investigate almost all the physico-chemical characteristic of the most consumable and very high sales brands between other bottled mineral waters in the capital of Albania, compared them with parameters printed on their labels and estimation of DRI of Ca^{2+} and Mg^{2+} as the most recommended parameter established by nutritional experts recently (Ahiropoulos V., 2006).

Keywords: Bottled water; water quality; dietary reference intakes of Ca^{2+} and Mg^{2+} (DRIs)

1. Introduction

Water is of vital importance for the life-sustaining activity of all living beings in the world. The access to safe drinking water is essential to human health; it is one of the basic human rights and the constituent of an effective health protection policy (Food and Drug Administration, 2002).

Over the past five decades, nutritional experts have established Recommended Dietary Allowances (RDAs) for various minerals and nutrients. A cooperative effort between the United States and Canada revised previous recommendations and created dietary reference intakes (DRIs) (Frengstad B.S. et al., 2010; Garzon P. and Eisenberg, 1998). Compared to the old RDAs, the new DRIs incorporate the concept of preventing nutrient deficiencies as well as risk reduction for chronic conditions such as heart disease, diabetes, hypertension, and osteoporosis. For the DRI of Ca^{2+} and Mg^{2+} calculation was made assuming that adults drink 2 liters of water per day, equivalent to eight 250 ml glasses (Bityukova L. and Petershell V., 2010; Brereton R.G., 2003).

A diet that is fortified in Ca^{2+} may reduce the rate of age-related bone loss and hip fractures, especially among adult women. Drinking water may be a significant source of

Ca^{2+}, and Ca^{2+}-rich mineral water may provide over one-third of the recommended dietary intake of this mineral in adults (Alabdula'aly A.I. and Khan M.A., 1999; Aldrees A.M. and Al-Manea S.A., 2010).

Epidemiological studies suggest that an inverse relation exists between Mg^{2+} levels in drinking water and the occurrence of cardiac disease. Mg^{2+} in water is highly bioavailable, and waterborne Mg^{2+} is absorbed approximately 30% faster and better than Mg^{2+} from food. Consequently, Mg^{2+} supplementation may be best achieved using a high Mg^{2+} nutrient with the best bioavailability such as drinking water (Al-Redhaimen K. and Abdel-Magid H., 1985; Azoulay A.P., Garzon and Eisenberg M. J., 2001).

The reader may therefore compare recommended intakes with actual intakes according to varying quantities of bottled drinking water.

Because of growing concern that constituents of drinking water may have adverse health effects, consumption of tap water in Albania has decreased and consumption of bottled water has increased. The main purpose of this study was to investigate the physico-chemical characteristics of some of the most widely distributed domestic brands of bottled drinking waters sold in Albania. The obtained chemical parameters were compared with standards adopted for drinking water.

2. Materials and methods

i. Water samples collection: A total of 21 brands of domestically produced bottled waters (all non-carbonated), consisting both the groundwater and the processed water, were purchased randomly from local supermarkets and independent food stores throughout Albania. The water samples were collected between March and June 2017. All the water samples were stored in separate Polyethylene Terephthalate (PET) bags with plastic screw caps. The holding capacities of bottled water containers varied between 0.25 and 1.5 L. Most of the water brands contain the following parameters: pH, Total Dissolved Solids (TDS), Total Hardness (TH), Calcium (Ca), Magnesium (Mg), Sulfate (SO_4^{2-}), Nitrate (NO_3^-), and Chloride (Cl).

ii. *Physico-chemical determinations:* Physico-chemical determinations on the water samples were carried out through standard methodologies of the American Public Health Association (American Public Health Association, 2005). pH and conductivity were measured using Multi/Parameter Meter (5465015-ION 156). Each parameter was determined in triplicate and the average of three values was recorded. Spectrophotometric determinations for the study were carried out with a UV-VIS Spectrophotometer, SHIMADZU 2401.

3. Results and discussion

The results obtained from this study are presented in Table 1 - statistical summary of physico-chemical parameters of different brand of drinking water. Comparison of these values with those set by the World Health Organization *(WHO)* and International Bottled Water Association standards *(IBWA)* guidelines (International Bottled water Association, 2004; Khan N. B. and Chohan A.N., 2010) are also shown in Table 2. The following are observed:

i. pH is classified as a secondary drinking water contaminant whose impact is considered aesthetic. The pH value for the majority of the water samples range from 7.04 (Sant´ Anna brand) to 8.07 (Fab brand), with an overall value of 7.56, indicating slightly alkaline nature of the studied water. The pH variations in the studied brands are related to HCO_3 concentration, which is the most abundant ion. Recommended pH values for drinking water according to local and international standards are 6.5 to 8.5 (Table 2). Slightly alkaline water is preferable as heavy metals are removed by carbonate or bicarbonate precipitates (Ahipathy M. V. and Puttaiah E. T. , 2006).

ii. Conductivity is the important water quality measurement; it gives an idea of the amount of dissolved material in the water. Conductivity value ranges from 29 µS/cm (Sant´ Anna brand) to 636 µS/cm (Vera brand), with an overall value of 276.4 µS/cm (Table 3). This fluctuation in European Community (EC) is attributed to soil source, lithology and geological origin of source that produced of each

bottled water. All the water brands have conductivity values within the International standard limit (International Bottled Water Association, 2004; World Health Organization, 2008).

iii. "Total dissolved solids" is the term used to describe the inorganic salt and small amount of organic matter present in water like calcium, magnesium, sodium, potassium cation, and addition carbonate, chloride, bicarbonate, sulfate and nitrate. Total Dissolved Solid (TDS) values of the sample varied from 24.1 (Sant´ Anna brand) to 419 mg/l (Vera brand), with an overall value of 166.4 mg/l (Table 3). These values were within the WHO and IBWA standards (International Bottled Water Association, 2004; World Health Organization, 2008).

iv. *Cl* is the second most abundant anion and its concentration in the studied brands ranged between 1.44 and 31.9, with an overall value of 10.63 mg/L (Table 3). No sample among the studied brands has Cl levels that exceed the standard guideline recommendations. According to Zoeteman (1980), Cl levels in the excess of 250 mg/L can give rise to detectable taste in water, but the threshold depends on the associated cations. Taste thresholds for NaCl and $CaCl_2$ in water are in the range of 200-300 mg/L. Consumption of drinking water containing some Cl is not harmful for health but high amounts of it can produce a salty taste.

v. The SO_4^{2-} concentrations in all the water samples are within the international standards for drinking water. This sulfate ion is generally harmless, except its effect on taste. The major physiological effects resulting from the ingestion of large quantities of sulfate are catharsis, dehydration and gastrointestinal irritation.

Table 1: Statistical summary of physico-chemical parameters of different brand of drinking water (authors' calculations).

Parameter	Unit	Min	Max	Mean
pH	-	7.04	8.07	7. 56
Conductivity	µS/cm	29	636	276.4
TDS	mg/L	24.1	419	166.4
Hardness	mg $CaCO_3$/L	9.02	385.2	136.1
Ca^{2+}	mg/L	2.88	115.4	44.51
Mg^{2+}	mg/L	0.44	23.5	6.1
NO_3^- - N	mg/L	0.196	1.32	0.54
SO_4^{2-}	mg/L	<1.5	99.38	17.78
Cl^-	mg/L	1.44	38.26	10.63

Table 2: Internationals standards WHO - World Health Organization and IBWA - International Bottled Water Association for quality of bottled drinking water.

Parameter	*Unit*	*WHO(2008) drinking water*	*IBWA(2004) Bottled Water*
pH	-	6.5-9.5	6.5-8.5
Conductivity	µS/cm	1000	1000
TDS	mg/L	500	500
Hardness	mg $CaCO_3$/L	200	200
Ca^{2+}	mg/L	100	100
Mg^{2+}	mg/L	30	30
NO_3^--N	mg/L	11.3	10
SO_4^{2-}	mg/L	250	250
Cl^-	mg/L	250	250

Table 3: Levels of some physico-chemical parameters for all water brands analyzed.

Water brands	*pH value*	*Conductivity µS/cm*	*TDS (mg /L)*	*Chlorine (mg /L)*	*Sulfate (mg /L)*
Lajthiza	*7.51*	*103*	*74.8*	*2.44*	*10.08*
Tepelena	*7.44*	*207*	*125.6*	*4.38*	*2.38*
Trebeshina	*7.51*	*480*	*298.8*	*21.07*	*59.5*
Qafshtama	*7.8*	*157*	*86*	*8.76*	*<1.5*
Sophie	*7.6*	*98*	*71.2*	*2.94*	*11.13*
Fab	*8.07*	*117*	*100.4*	*7.52*	*<1.5*
Oro	*7.4*	*209*	*119.6*	*7.52*	*2.63*
Dukati	*7.64*	*388*	*229.6*	*8.28*	*25.63*
Naturel	*7.9*	*499*	*301.2*	*28.91*	*57.88*
Qafë Mali	*7.23*	*133*	*65.6*	*7.52*	*8.13*
Spring	*7.2*	*249*	*140*	*11.28*	*1.75*
Acqua Julia	*7.99*	*118*	*56.4*	*1.44*	*4.81*
Mon Cheri	*7.6*	*501*	*333.2*	*38.26*	*99.38*
Alba	*7.21*	*192*	*97.2*	*23.7*	*21.75*
Sant' Anna	*7.04*	*29*	*24.09*	*5.02*	*2.75*
Vera	*7.4*	*636*	*419.2*	*7.28*	*16.13*
Levvisima	*7.65*	*118*	*70.4*	*5.07*	*12.63*
Evian	*7.1*	*513*	*286.8*	*8.91*	*10.63*
Acqua Panna	*8.03*	*217*	*149.6*	*8.41*	*19.88*
Korpi	*7.58*	*422*	*260.8*	*11.18*	*3.38*
San Benedetto	*7.82*	*419*	*184.8*	*3.52*	*3.13*

Table 4: Classification of the water brands based on TH (mg $CaCO_3$/L).

Water samples	*Concentration mg $CaCO_3$/L*	*German Degrees*	*English degrees*	*French Degrees*	*Hardness as Classification*
Lajthiza	47.9	2.88	3.35	4.78	Soft water
Tepelena	119.9	7.2	8.40	11.99	Moderately hard water
Trebeshina	203.4	12.18	14.24	20.34	Very hard water
Qafshtama	92.9	5.58	6.50	9.29	Moderately hard water
Sophie	48.6	2.9	3.402	4.86	Soft water
Fab	106.2	6.36	7.434	10.62	Moderately hard water
Oro	117	7.02	8.19	11.7	Moderately hard water
Dukati	192.6	11.58	13.48	19.26	Hard water
Naturel	203.9	12.24	14.27	20.40	Very hard water
Qafë Mali	48.6	2.9	3.40	4.86	Soft water
Spring	120.6	7.26	8.44	12.06	Moderately hard water
Acqua Julia	60.5	3.6	4.23	6.04	Soft water
Mon Cheri	207	12.42	14.49	20.7	Very hard water
Alba	72.5	4.38	5.08	7.25	Moderately hard water
Sant' Anna	9.02	0.54	0.63	0.9	Soft water
Vera	385.2	23.1	26.96	38.52	Very hard water
Levvisima	61.2	3.66	4.28	6.12	Moderately hard water
Evian	284.4	17.04	19.40	27.72	Very hard water
Acqua Panna	97.2	0.6	6.80	9.72	Moderately hard water
Korpi	223.2	13.38	15.62	22.32	Very hard water
San Benedetto	169.2	10.2	11.84	16.92	Hard water

Table 5: Evaluation of DRI_{Ca} & DRI_{Mg} (%) in drinking water analyzed.

Water brand	*DRI_{Ca} (in %)*	*DRI_{Mg} (in %)*
Lajthiza	3.25	0.96
Tepelena	9.31	0.47
Trebeshina	15.3	1.67
Qafshtama	0.62	11.34
Sophie	3.36	0.89
Fab	8.21	0.48
Oro	8.21	1.92
Dukati	11.46	6.56
Naturel	14.83	2.47
Qafë Mali	3.02	1.44
Spring	9.4	0.41
Acqua Julia	4.65	0.31
Mon Cheri	15.16	2.32
Alba	1.73	6.78
Sant' Anna	0.57	0.24
Vera	23.09	12.70
Levvisima	4.65	0.41
Evian	14.98	11.98
Acqua Panna	6.77	1.68
Korpi	17.57	0.48
San Benedetto	10.81	4.56

vi. Concentrations of $N\text{-}NO_3^-$ in the studies of the water bottles vary from 0.196 to 1.29 mg/L with an average value of 0.55 mg/L. Concentrations of this nitrate ion in the bottled water samples are below the international recommended values for drinking water. The primary health concern regarding NO_3 is the formation of methemoglobinemia, a so-called 'bluebaby syndrome'. NO_3 can change to NO_2 in the stomach of infants, which can then oxidize hemoglobin to methemoglobin, making it difficult to transport oxygen around the body (Cidu R. F. et al., 2011; Greer F. R. and Shannon M., 2005).

In Italy, a limit of 1 mg/L NO_3^--N has been recommended for the water destined to infants (Versari A. et al., 2002).

vii. Hardness is a key water parameter and its control is important to assure proper water quality. The maximum allowable limit of TH for drinking purpose is 500 mg/L (WHO, 2008), while the most desirable limit is 80-100 mg/L. Based on the levels of $CaCO_3$ (mg/L) hardness of water is categorized as below:

- 0 to 60 mg/L - Soft water
- 60 to 120 mg/L - Moderately hard water
- 120 to 180 mg/L - Hard water
- >180 mg/L - Very hard water

viii. From this study resulted that five brands were classified as soft waters (24 %), eight brands were classified as moderate hard waters (38 %), two brands were classified as hard waters (9 %) and six brands were classified as very hard waters (29 %). Classification of the water brands based on Total Hardness (TH) is presented in table 4. Based on these criteria, the studied samples range from 50 (Sant´ Anna brand) to 385.2 mg/L (Vera brand) with an average value of 136.1 mg/L (Table 1 & 4). The epidemiological studies demonstrated that water hardness may protect against certain diseases.

ix. Calcium & magnesium. Calcium is used to build bones and teeth. A deficiency over a long period may lead to

osteoporosis. It is also used for coagulation of the blood and regulates heart activity. Calcium deficiency increases the risk of high blood pressure and heart attack. Concentrations of Ca ranged between 2.2 (Sant´ Anna brand) to 115.4 mg/L (Vera brand) with an average value of 44.51 mg/L. All the studied water brands have Ca levels falling within the international standard limits. Natural water sources typically contain concentrations of up to 10 mg/L Ca. The taste threshold for the Ca is in the range from 100 to 300 mg/L, depending on the associated anion, but higher concentrations are acceptable is consumed (Garzon P. and Eisenberg M. J., 1998; Guler C. and Alpaslan M., 2005).

Magnesium is essential for bones and cells, especially for muscular cells. It helps to maintain the muscular and nervous equilibrium. It is also used for building bones and tendons and in the construction of many enzymes. Epidemiological studies suggest that consumption of Mg may reduce the frequency of sudden death (Garzon P. and Eisenberg M. J., 1998). Concentrations of Mg range from 0.44 to 23.5 mg/L with an average value of 6.1 mg/L. All the water brands have Mg levels well within WHO and IBWA standard limits (Saleh M. A. et al., 2008).

The recommended Ca daily intake for adults' ranges between 700 and 1000 mg while the recommended Mg daily intake for adults ranges between 300 and 400 mg (Academic National Press, 1997). Dietary Reference Intakes of Ca^{2+} and Mg^{2+} (DRIs was evaluated) for all brands of drinking water analyzed, based on the levels of these two elements according to formula 1 & 2 and represented in *table 5.*

$$DRI_{Ca} = (C_{Ca} * 2 \text{ liters})/1000 \text{ mg/day} \quad (1)$$

$$DRI_{Mg} = (C_{Mg} * 2 \text{ liters})/365 \text{ mg/day} \quad (2)$$

For the bottled waters examined by this study, Ca Dietary Reference Intake (DRI), varied between 0.6 and 23.08 % while Mg Dietary Reference Intake (DRI), varied between 0.31- 11.98%. The results from the current study can be used to estimate the amount of ingestion of certain elements by consumers.

4. Conclusions

- The physical and chemical contents of the studied water brands are found within the acceptable limits set for drinking water by International Bottled Water Association (IBWA, 2004) and World Health Organization (WHO, 2008).
- Calcium, TDS and magnesium ions represented about 43, 47.6 and 57.2 percent of studied sample contents lower values than label amount, respectively. Sulphate, pH and nitrate were about 33.3, 38.1, and 42.8 % respectively higher than label values.
- Classification of the water brands based on Total Hardness (TH) shows that a majority of the studied samples fall in *moderate hard water category*.
- Bottled water that contain more than 1 mg/L NO_3 –N are not recommended for the water destined to infants and pregnant women.
- Results of this study may be useful for guiding the consumers in their choices for suitable brands.

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The separation of carbon dioxide from $CO_2/N_2/O_2$ mixtures using commercial membrane modules

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Abstract

The capture of CO_2 may be realized using well-established gas separation techniques, including absorption, adsorption, membrane separation and cryogenic processes. The practical potential of a given technology is, to a large extent, determined by its cost. Any system realizing the separation of CO_2 from flue gases generated during the combustion of fossil fuels has, first, to produce an enriched stream with CO_2 concentrations exceeding 95 vol.% and, second, to ensure CO_2 recovery above 90%. However, in most cases a high purity is associated with a low recovery of a desirable product. Moreover, the favourable combination of these two parameters is difficult and costly to obtain in a single-stage process. Therefore, to realize this task multistage systems are usually proposed or, alternatively, hybrid techniques which combine various separation methods. In the present study a hybrid approach is proposed which couples pressure swing adsorption (PSA) with membrane separation, with the membrane unit acting as stage 2 of the whole system. The separation of ternary gas mixtures was investigated in three hollow-fibre commercial membrane modules. The feed gas mimicked the composition of a mixture leaving stage 1 of the hybrid PSA – membrane system. In the gas stream containing 70 vol.% of CO_2 the O_2 concentration was varied between 0 and 5 vol.%. The combination of the two separation techniques produced gas streams with CO_2 content exceeding 95 vol.%; the recovery was virtually complete, as the retentate was recycled to the inlet of the hybrid installation.

Keywords: membrane separation, CO_2 capture, commercial membrane modules

1. Introduction

The problem of curbing anthropogenic greenhouse gas emissions is of profound social, political and scientific importance. The main culprit in provoking climate change is carbon dioxide, emitted into the atmosphere in various industrial processes and, most notably, by the energy sector. The capture of CO_2 may be realized using well-established gas separation techniques, including absorption, adsorption, membrane separation and cryogenic processes (Majchrzak and Nowak, 2017; Song et al., 2018; Wang et al., 2017; White et al., 2017; Woo et al., 2016).

The practical potential of a given technology is, to a large extent, determined by its cost. The overall cost of CO_2 abatement includes capture, transport and storage. However, it is the capture of CO_2 from flue gas which is the most expensive stage of the whole CCS chain (Figueroa et al., 2008). Currently, the most mature and commercially attractive techniques are based on absorption. This is due to the fact that monoethanolamine has been used for over six decades for selective scrubbing of acid gases (CO_2 and H_2S) from natural gas streams. Consequently, the body of theoretical and practical knowledge amassed in the chemical and petrochemical industries could be transferred onto power engineering, and most of the pilot plants for the capture of CO_2 from flue gas are based on absorption (cf. Global CCS Institute). However, the use of absorption in the removal of CO_2 from flue gas may lead to an increase in the cost of energy

generation by 50–90% (Merkel et al., 2010), while it is generally assumed that this increase should not exceed 35% (Figueroa et al., 2008).

An interesting alternative to amine scrubbing is membrane separation. Membranes, characterized by low energy consumption due to the lack of interphase transfer and supplementary sorbents can indeed provide an energy-efficient solution to the removal of CO_2 from the flue gas (Li et al., 2014; Merkel et al., 2010; White et al., 2017).

Any system realizing the separation of CO_2 from flue gases generated during the combustion of fossil fuels has, first, to produce an enriched stream with CO_2 concentrations exceeding 95 vol.% and, second, to ensure CO_2 recovery above 90% (Report of DOE NETL, 2012). However, in most cases a high purity is associated with a low recovery of a desirable product. Moreover, due to the low CO_2 content in the flue gas (below 20 vol.%) the favourable combination of these two parameters is difficult and costly to obtain in a single-stage process. Therefore, to realize this task multistage systems are usually proposed (Ishibashi et al., 1996; Merkel et al., 2010; Wang et al., 2017; Zhang et al., 2014) or, alternatively, hybrid techniques which combine various separation methods (Wang et al., 2017; Warmuzinski et al., 2015; Zhang et al., 2014).

Warmuzinski et al. (2015) propose a hybrid approach which couples pressure swing adsorption (PSA) with membrane separation, with the membrane unit acting as stage 2 of the whole system. The high recovery is achieved by minimizing CO_2 content in the purified stream after stage 1 and recycling the carbon dioxide remaining after stage 2 to the inlet of the installation. Based on numerical simulations of the PSA process in stage 1 of a large-scale laboratory installation of capacity 0.33 kmol/h (Tanczyk et al., 2012) it was found that the flow rate of the dry gas directed to a membrane module (stage 2) would be 0.05 kmol/h, and the gas would contain 70 vol.% of CO_2 and between 0 and 5 vol.% of oxygen. The membrane module itself was selected based on the experimental evaluation of the separative properties of the available commercial units operating at the foregoing flowrates and concentrations. Extensive theoretical and experimental investigations were performed for mixtures containing 70 vol.% of CO_2 and between 0 and 5 vol.% of O_2 in three different membrane modules that were to form the final stage of the hybrid system.

2. Experiments

Experimental studies concerning the separation of $CO_2/N_2/O_2$ mixtures were carried out in three hollow-fibre membrane modules (Air Products and UBE). The active layer was either modified polysulphone (Air Products) or polyimide (UBE). The experimental setup is shown in Fig. 1.

The main compnents of the installation include a membrane module and a system for preparing gas mixture, consisting of a mixer and a thermostat. The mixer was a metal cylinder 20 mm in diameter and 500 mm in height, into which pure gases were introduced. The temperature of the gas stream entering the module was controlled via a heat exchanger (thermostat), with water as a heating medium. The gas was fed to the inside of the hollow fibres. Once there, it dissolved in the membrane material and diffused to the shell side of the module, from where it was collected as permeate.

The mixture remaining inside the fibres was recovered at the outlet as retentate. Since the permeation coefficient may vary with temperature, the inlet and outlet tubes and the module itself were carefully insulated.

The permeate flow rate is a function of the solubility and diffusivity of a gas in the membrane material (i.e., of the permeation coefficient) and the partial pressure difference between the feed side and the permeate side of the module. Therefore, during the experiments the flow rate, pressure, temperature and composition were measured and controlled in the feed, retentate and permeate. The composition was determined using a three-channel microchromatograph (Varian), which allowed the simultaneous measurement of concentrations in each stream with an accuracy of 0.01%. A detailed description of the experimental procedure has been given elsewhere by Warmuzinski et al. (2012). The experiments were performed for mixtures containing 70 vol.% of CO_2, 0–5 vol.% of O_2, and nitrogen. The feed flow rate was 0.05 kmol/h, and the feed pressure was varied between 1.2 and 7.5 bar (abs) using a pressure controller.

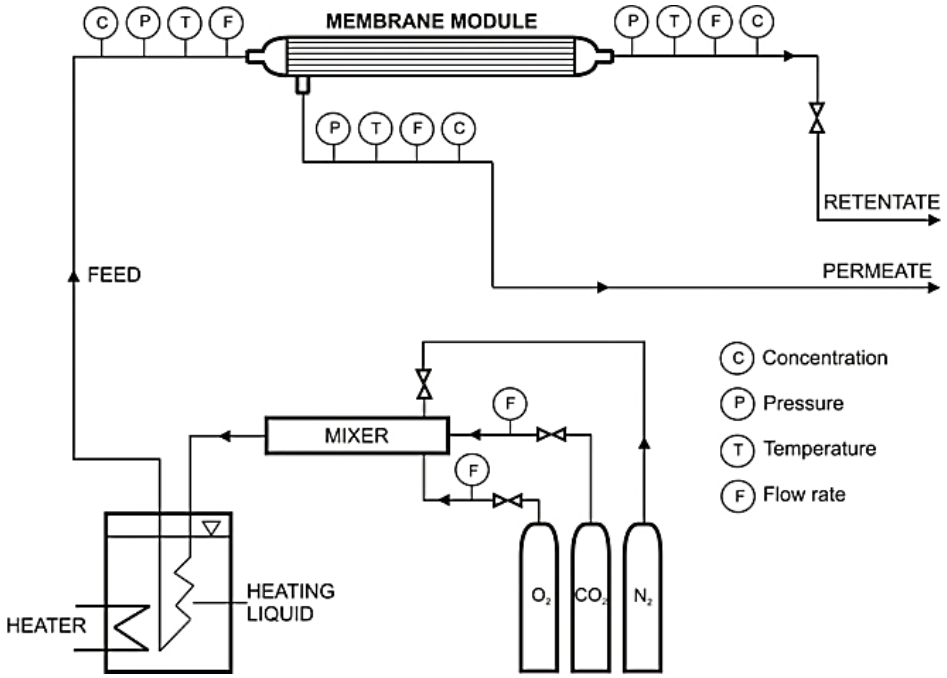

Figure 1: Experimental setup with a hollow-fibre membrane module.

The upper level was determined by the limitations of the measurement and control equipment employed. The pressure on the permeate side was equal to (or marginally higher than) the atmospheric pressure.

3. Discussion

The experimental results concerning $CO_2/N_2/O_2$ mixtures in all the three modules are shown in Fig. 2 as CO_2 permeate concentration vs. feed-to-permeate pressure ratios.

Due to different separation properties and membrane areas, each of the modules operated over a different pressure ratio. The UBE CO-C05 and UMS-A5 modules worked, respectively, under the low (1.2–1.6 bar) and high (2.6–7.2 bar) pressure range. The Air Products PRISM module operated under intermediate pressures (1.6–3.2 bar). It has to be remembered that the energy expenditure associated with compressing the feed has a tremendous effect on the overall cost of the separation. Consequently, the process should be carried out for the lowest pressure ratio possible. It may be seen that the content of CO_2 in the permeate initially rises with an increase in the pressure ratio and then, upon reaching a maximum value, begins to drop. Only for the UBE UMS-A5 module does the CO_2 concentration remain virtually constant. It is interesting to note that for this module, for each of the mixtures studied, the CO_2 content in the permeate exceeds 95 vol.%. Such purity levels were also attained in the Air Products module for the separation of a binary mixture (Janusz-Cygan et al., 2016), and it is in these cases only that the purity did not drop below the advisable threshold (95 vol.%).

It is seen from Fig. 2 that the presence of oxygen in the feed markedly influences the CO_2 concentration in the permeate. An increase in the O_2 content from 0 to 5 vol.% produces a drop in the maximum CO_2 level in the product in each of the modules. In UBE UMS-A5 an increase in O_2 content from 0 to 5 vol.% led to a drop in CO_2 concentration in the permeate by 1.3 percentage points. For the Air Products module such a rise produced a drop in the maximum CO_2 concentration from 95.1 vol.% to 92.3 vol.%. Finally, for UBE CO-C05 the maximum CO_2 content diminished from 87.5 vol.% to 84.4 vol.%. In Fig. 3 the recovery of CO_2 is shown as a function of the pressure ratio. The recovery is defined as the mass of CO_2 removed to the total mass of CO_2 introduced into the separation system.

It is found that with an increase in the pressure ratio (in our case, with an increase in the feed pressure), the recovery also increases. In both UBE CO-C05 and Air Products PRISM the maximum recovery was rather high (around 90%).

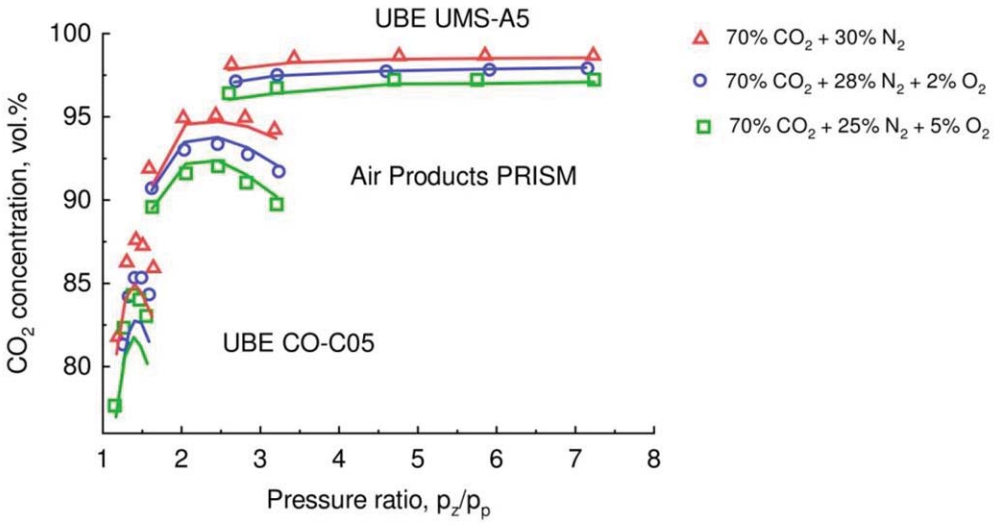

Figure 2: CO_2 permeate concentration vs. pressure ratio; (symbols – experiment, lines – calculations).

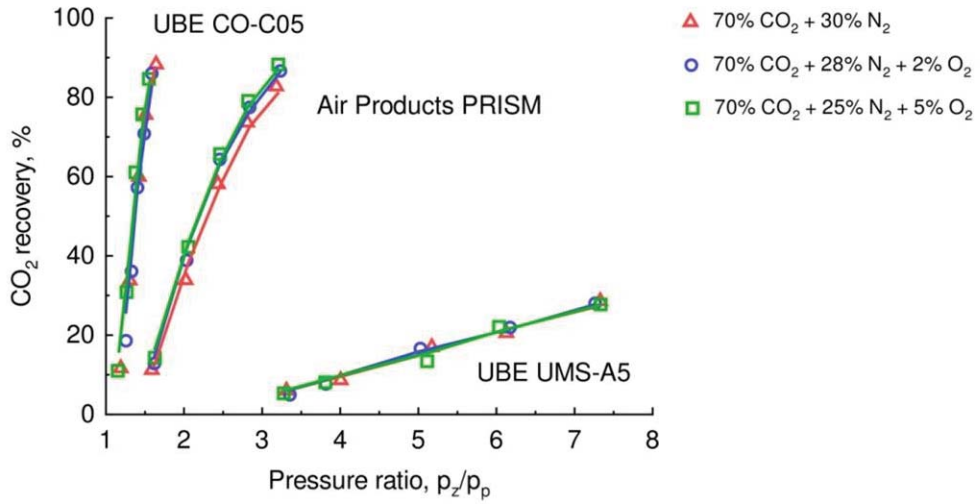

Figure 3: CO_2 recovery vs. pressure ratio; (symbols – experiment, lines – calculations).

On the other hand, the recovery obtained with UBE UMS-A5 was below 30%.

It may be noted that for the PRISM module even minor drop in the permeate CO_2 concentration (from the maximum value of 95.1 vol.% to 94.2 vol.%) leads to an increase in the recovery from 58% to 83%, for a rise in pressure ratio from 2.5 to 3.5 (binary mixture). Similar trends were observed in all the modules, although the individual modules differed in their sensitivity to the pressure ratio. The most susceptible of the three was the module UBE CO-C05, in which even minor increase in the pressure ratio produced a considerable rise of the recovery, while the least sensitive was UBE UMS-A5.

The lines in Figs. 2-3 show the numerical results based on the model assuming plug flow on the feed side and unhindered permeate flow (Tanczyk et al., 2011). The permeation coefficients and the ideal separation factors are those measured for pure species and described elsewhere (Janusz-Cygan et al., 2016; Warmuzinski et al., 2012). As may be seen from Figs. 2-3, the simulations agree very well with the experimental results. Some discrepancies were only observed for UBE CO-C05. This was probably due to the fact

that, in this module, an increase in the feed pressure led to an increase in the permeate pressure (slightly above atmospheric); therefore, the unhindered flow of the permeate was in fact disrupted. The maximum relative error concerning the CO_2 concentration was 3.2% for this module (with an average relative discrepancy of only 0.2% for the other modules).

4. Conclusions

The separation of ternary gas mixtures was investigated in three hollow-fibre membrane modules. The feed gas mimicked the composition of a mixture leaving stage 1 of a hybrid PSA – membrane system. In the gas stream containing 70 vol.% of CO_2 the O_2 concentration was varied between 0 and 5 vol.%. It is found that the presence of oxygen leads to a drop in the concentration of CO_2 in the permeate for each of the commercial modules studied. On the other hand, the effect on CO_2 recovery depends on the type of the module: for the Air Products PRISM a rise in O_2 content produces an increase in the recovery, whereas for the two UBE modules the recovery remains unchanged.

In gas permeation processes both the purity and the recovery are of importance. As may be seen from Figs 2 and 3, the highest purity is obtained in UBE UMS-A5 (close to 99 vol.%) but, simultaneously, this module is characterized by the lowest recovery (only 28%). Overall, the best results were obtained with the Air Products PRISM, for which both the purity and the recovery of CO_2 were satisfactorily high (92–95 vol.% and 70–80%, respectively).

The experimental studies clearly show that, from the standpoint of the hybrid adsorptive-membrane process, the Air Products PRISM compares favourably with the other two commercial modules tested. Thus, it is this module that was selected as the final section (stage 2) of the hybrid installation, and the full-scale hybrid experiments further corroborated its usefulness. The combination of the two separation techniques produced gas streams with CO_2 content exceeding 95 vol.%; the recovery was virtually complete, as the retentate was recycled to the inlet of the hybrid installation.

Symbols

p – absolute pressure, bar (abs)

Subscripts and superscripts

P – permeate

Z – feed

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Validation of a simple spectrophotometric method for the determination of TOC in sediment samples of Vaini Lagoon, Albania

by

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Abstract

In this study, the content of total organic carbon was determined in sediments of one of the most important ecosystems in Albania, the Vaini Lagoon. Even though sources of organic matter in soils and sediments derive mainly from natural processes, anthropogenic activities can cause severe contamination of aquatic environments (Dean, 1999). Determination of the total content of organic carbon (TOC) was conducted after digesting sediment samples with dichromate solution (0.27 M) in the presence of sulfuric acid, according to the method proposed by Walkley-Black (Wakley, 1947; EPA, 2002). The produced Cr^{3+} was determined spectrophotometrically at 585 nm against the glucose standards, which were similarly treated. Method was validated in terms of some common parameters including the working range, repeatability and reproducibility, whilst accuracy was evaluated by using the method of standard additions (Wang et al., 2012; Sleutel et al., 2007). Obtained results confirmed that this method can be successfully used for the determination of TOC content in sediment samples. The working range resulted to be dependent on the quantity of the sample being analyzed. Accordingly, when 5 ml of dichromate solution 0.27 M is used to react with 0.1 g sample in a total volume of 100 ml, the working range varies between 0.8-20 mg C/100 ml, corresponding to 8 – 200 mg C/g sediment. Reproducibility of the method varied from 0.8 - 3%, expressed as standard deviation, while the recovery coefficient resulted RC > 96 %. Concentration of TOC in sediment samples of Vaini Lagoon ranged from 3.0 – 20 mg/g, confirming that these sediments can be classified as mineral to mineral organic soils.

Keywords: total organic carbon; method validation; sediments

1. Introduction

Organic carbon can be present in various forms in soils, sludges, sediments and wastes. Quantitative determination of all individual organic carbon compounds is difficult due a wide diversity of all organic compounds that constitute organic matter in such environments. The total carbon content, deriving from organic matter constitutes the Total Organic Carbon (TOC) in soils and sediments (Dean W.E., 1999). The TOC content is an important indicator for numerous applications. In agricultural science, carbon is a crucial parameter to gain an insight about the element cycling of sediments and soils. Decomposition of animal and plant residues introduce organic carbon to the environment which then acts as source of nutrients for plants and microorganisms (Sleutel et al., 2007).

Sediments contain natural organic matter ("humus"- like material) which is likely to bind strongest different contaminants. Binding

strength depends not only on the type of compound but also on the organic matter content of the sediment. However, some contaminants in sediment may return into water system if there is an environmental alteration (New York State Department of Environmental Conservation, 2014). Soil and sediment TOC determinations are requested with contaminant analyses as part of the ecological risk assessment data package. TOC contents may be used also qualitatively to assess the nature of the sampling location (e.g., if it was a depositional area) or may be used to normalize portions of the analytical chemistry data set (e.g., equilibrium partitioning). The amount of organic matter that can be stored in sediments is influenced by several factors, for instance, the types and sources of organic compounds introduced, sediment texture, grain particle size and sedimentation (New York State Department of Environmental Conservation, 2014).

Besides organic carbon, inorganic carbon also exists in soils and sediments, commonly in the form of carbonates. The two most typical sources of carbonate in soils and sediments are the minerals dolomite and calcite. The corresponding bulk parameter, Total Inorganic Carbon (TIC), includes not only these minerals but also other carbonate derivatives, such as bicarbonate and carbonic acid. Inorganic carbon can be differentiated from organic carbon as it is not an accessible form of carbon for biological systems, i.e. it is not bio-available (Heiri O. et al., 2001). Soil organic carbon is commonly measured by dry combustion with automated analyzers, or a wet chemical oxidation method, i.e., the Walkley and Black method (Wang X. et al., 2012; Walkley A. and Black C.A., 1947). The basic principle for the quantitation of total organic carbon relies on the destruction of organic matter present in the soil or sediment although there are a few non-destructive techniques identified in the literature that are currently under development. The destruction of the organic matter can be performed chemically or via heat at elevated temperatures (Schumacher B.A., 2002; Wielopolski L., Doron O., 2012).

The aim of this work was to evaluate a simple spectrophotometric method for the determination of the TOC content in some sediment samples of the Kune-Vaini Lagoon, Albania. Performance parameters of the method such as sensitivity, repeatability, limit of detection and limit of quantification were evaluated with regard to standard glucose solutions. Method of linear regression was used for the calculation of TOC content in sediment samples whilst accuracy of the obtained results was controlled by the method of standard additions. Study was conducted in the framework of the Project: "Climate changes adaption interventions of the Kune-Vaini lagoon system - ecological approach". The Program will cover the monitoring of three important biotic components: Phytoplankton, Zooplankton, and the development of Aquatic plants (Macrophytes), all in response to Kune-Vaini Project intervention (tidal channel). It will be in parallel with monitoring of Physical and chemical parameters and nutrient profile in Kune-Vaini system.

2. Materials and methods

2.1 Studied area

Kune-Vaini was the first protected area in the history of nature protection in Albania; it was categorized in 1960 as Hunting Reserve by the Albanian Government. During the former regime the access to the Kune and Vaini area was very limited and strongly controlled. Therefore, most parts remained fully preserved concerning their biodiversity, in particular the bird colonies. Recently (2010), the Albanian Government designated the enlargement of the Kune-Vaini-Tale zone (44 km) as Managed Natural Reserve (IVth category after IUCN). On the international scale, Kune is registered as a Specially Protected Area and Biological Diversity in the Mediterranean (Barcelona Convention) (Miho A., et al., 2013).

Four sediment samples were collected in three different stations of the lagoon aiming to represent the whole area. Three superficial as well as one at about 20 cm depth (at station S2) were analysed after the method validation to the laboratory. The map of sampling stations is presented in the Figure 1.

2.2 Pre-treatment of sediment samples

Sediment samples were collected manually, in accordance with the EPA, 2014 standard method for sampling of soil samples and ISO 11464:2006 standard for pretreatment of soil samples (Simmons K., 2014; International Organization for Standardization, 2006).

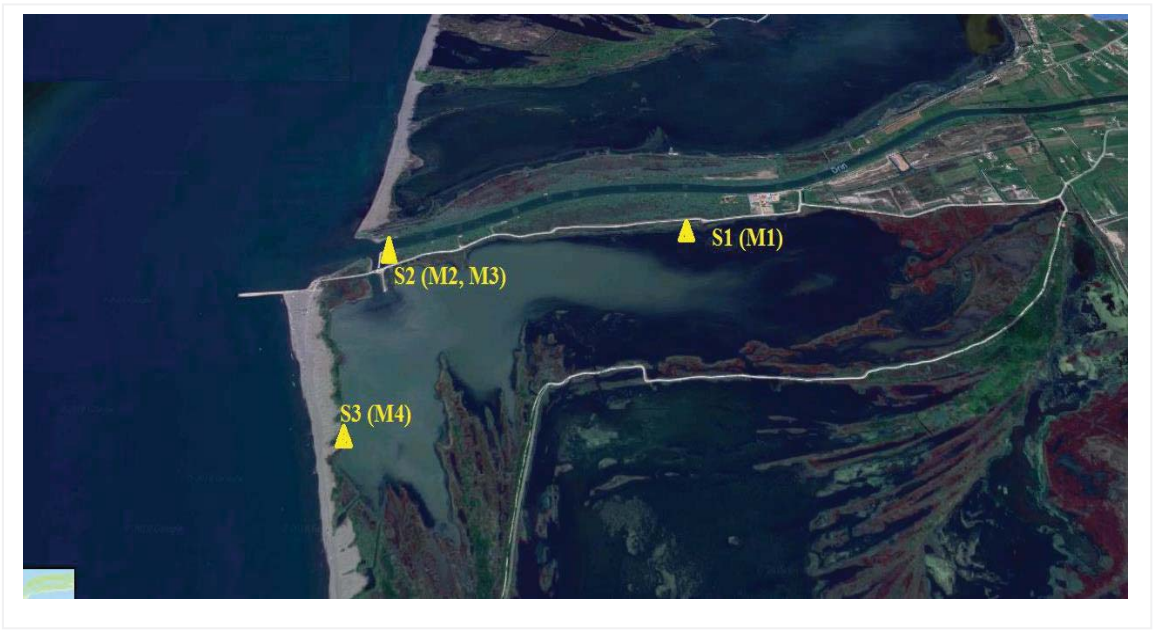


Figure 1: Map of sampling stations.

Accordingly, samples were cleaned from unwanted materials such as big stones, plant and animal materials and then were dried at 40ºC for 24 hours using a drying thermostat. After drying, samples were grinded using an electric blender, until all the material passes the 0.63 μm pore size sieve.

2.3 Determination of Physico-Chemical parameters

Physico-chemical parameters of sediment samples such as pH and conductivity were determined based on the ISO standard methods (International Organization for Standardization, 1994a; 1994b). For this purpose, samples were treated with deionized water, in a ratio of 1:5, were shaken for 24 hours at room temperature and then were let to settle down for about two hours. pH and conductivity were measured in the solution in contact with sediment by using the WTW pH/Cond meter.

3. Optimization of the spectrophotometric method for the determination of TOC in sediment samples of Vaini Lagoon

3.1 Procedure of TOC determination

TOC concentration in selected sediment samples was determined based on the standard method ISO 14235:1998 (International Organization for Standardization, 1998). The principle of this method is the sulphochromic oxidation of organic matter, producing Cr^{3+} ions which can be measured spectrophotometrically at 585 nm. The reaction that takes place in this case is:

$$3C + 2K_2Cr_2O_7 + 16H_2SO_4 \rightarrow 3CO_2 + 4Cr^{3+} + 8H_2O$$

For this purpose, sediment samples (or glucose standards) were treated with 5 ml $K_2Cr_2O_7$ 0.27 M, 7.5 ml H_2SO_{4cc} and were heated for 30' at 150ºC. After the oxidation step, samples were cooled at room temperature and were diluted to a known volume using deionized water. After the dilution, an aliquot of each sample was filtered using syringe filters and the absorbance of transparent solution was measured at 585 nm.

3.2 Evaluation of spectral interferences

Spectral interferences were evaluated by recording the spectral curves of Cr^{3+} and $Cr_2O_7^{2-}$ ions, prepared in water solution. For this purpose, two standard solutions of each ion were prepared and spectral curves were recorded in the VIS region of electromagnetic radiation, from 340-800 nm. Measurements were conducted using the Shimadzu UV 2401 PC double beam spectrophotometer. Band shift of the optimal wavelength of Cr^{3+} ions was evaluated by studying the absorption spectra of two chromium (III) solutions, prepared in water and after the oxidation reaction, respectively. Obtained results are presented in the Figures 2 and 3.

3.3 Evaluation of method performance parameters

TOC content in sediment samples was determined by the method of linear regression, MLR. Aiming to decide the procedure of standard solutions treatment, two linear regression calibration curves were obtained. First, by using Cr^{3+} ion standard solutions prepared in water media and second, a series of standards obtained by the reaction of glucose standards with 5 ml $Cr_2O_7^{2-}$ 0.27 M and sulphuric acid. Absorbance of all solutions was measured at 585.6 nm, using a 10 mm glass cuvette. Sensitivity of both linear curves was evaluated by the slope "b" while limit of detection, LOD and limit of quantification, LOQ were calculated after converting the equation as a function of absorbance versus the concentration of carbon contained in each solution. For this purpose, 5 blank solutions were treated according to the TOC determination procedure. Results are presented in Figures 4 and 5 whilst the values for LOD and LOQ are presented in Table 1.

3.4 Determination of TOC in sediment samples

TOC concentration in sediment samples of Vaini lagoon was determined using the MLR, as a function of absorbance versus the carbon content in standard solutions. Samples were treated according to the ISO standard method (International Organization for Standardization, 1998). Accordingly, 0.5 g sample was first treated with 5 ml of 0.27 M $K_2Cr_2O_7$ solution and 7.5 ml H_2SO_4, in conical flasks. Samples were heated at 150^{o}C for 30' and then were cooled to room temperature. After cooling, samples were diluted at 100 ml with deionized water and were let to settle down for 24 hours. Obtained results are presented in the Figures 8 and 9.

3.5 Quality control of the results

Two experiments were carried out aiming to evaluate repeatability of the method as well as the accuracy of the results. First, different portions from each sample were weighted and treated according to the standard method for TOC determination. Second, the method of standard additions was used to evaluate the recovery of the analyte. For this purpose, a known quantity from each sample was spiked with different quantities of glucose and then treated according to the procedure. Obtained results were also compared using the Student's test (α=0.05).

4. Results and Discussion

4.1 Spectral interferences

Obtained results regarding the spectral curves of Cr^{3+} and $Cr_2O_7^{2-}$ ions show that no overlapping of the curves occurs, meaning that $Cr_2O_7^{2-}$ ions do not interfere during Cr^{3+} measurements. Given the results, it can be concluded that Cr^{3+} ions absorb at 585.6 nm, which is the wavelength where further measurements were conducted. Results show also that there was no band shift of the optimal absorption wavelength of the Cr^{3+} ions produced from the reduction of dichromate ions by glucose solution (Figure 3).

4.2 Parameters of calibration curve

Considering the slope of linear regression curves of Cr^{3+} ions obtained in water solution and after the oxidation reaction, it can be concluded that there is a difference of about 11.1 % between the two slopes. In this case, we recommend that standard solutions should be prepared by following the oxidation reaction of glucose (Figure 4).

4.3 Determination of LOD and LOQ of the method

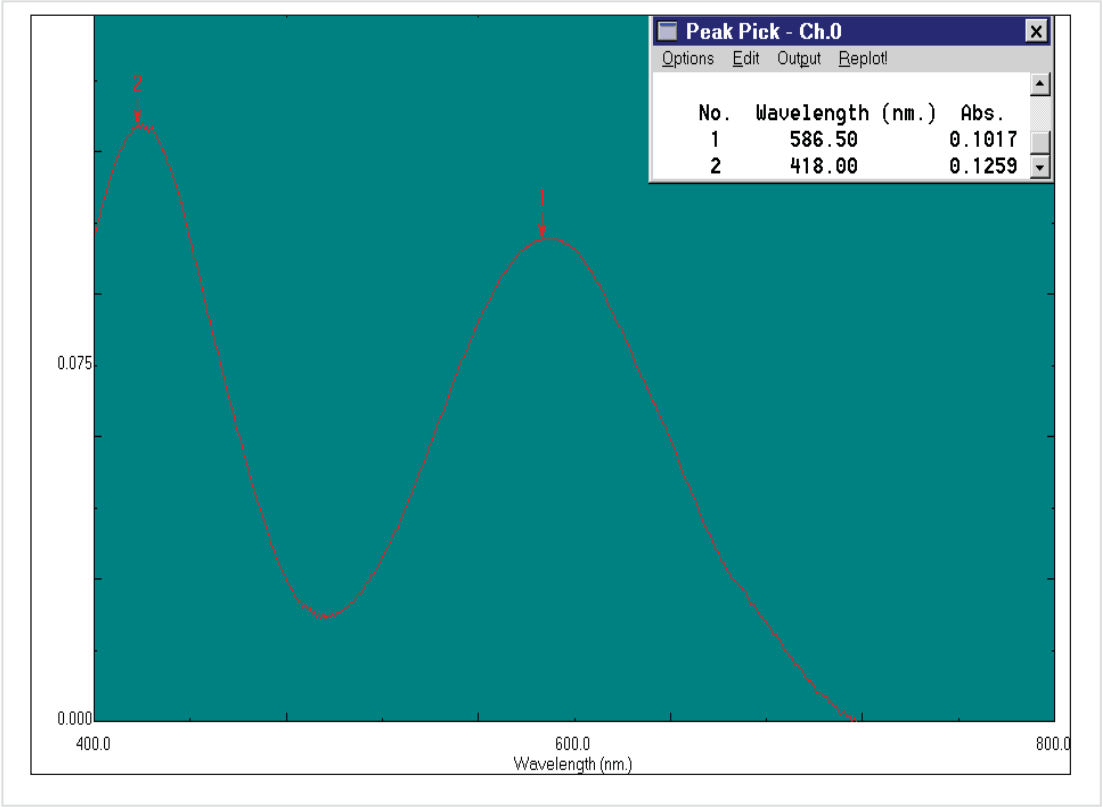
In Table 1, results of LOD and LOQ of the method are presented. It was concluded that the limit of detection has resulted to be 0.10 mg C whilst the limit of quantification 0.55 mg C.

5. Results of samples analysis

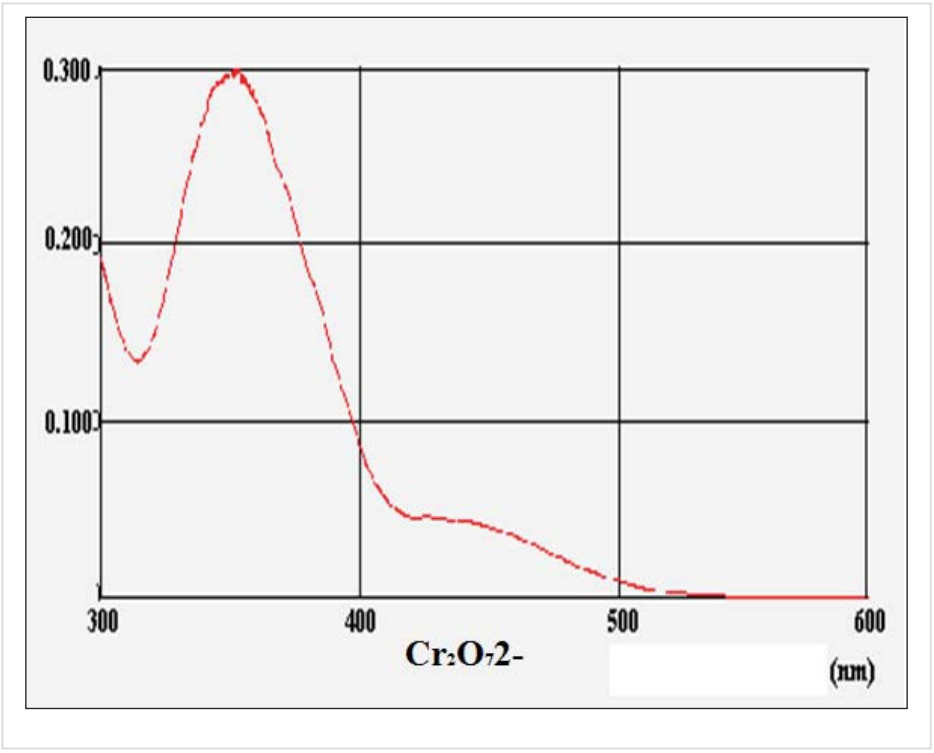
5.1. Physico-chemical parameters

Prior to TOC determination, physico-chemical parameters of sediment samples were determined. Obtained results are presented in Figure 6. Based on the obtained results, it was concluded that variation of conductivity was more evident compared to pH. Accordingly, conductivity values varied from 0.7553 mS/cm, recorded in sample 2, station S2 to 4.185 mS/cm in sample 3, station S2.

Both samples belong to the same station, but collected at different depths of the sediment. Conductivity is well dependent on the composition of the sediment. Conductivity has resulted to be higher in samples containing more clay and loamy material compared to samples consisted more of sandy material.



(a)



(b)

Figure 2: Spectral curves of Cr^{3+} and $Cr_2O_7^{2-}$ ions ((a) and (b)).

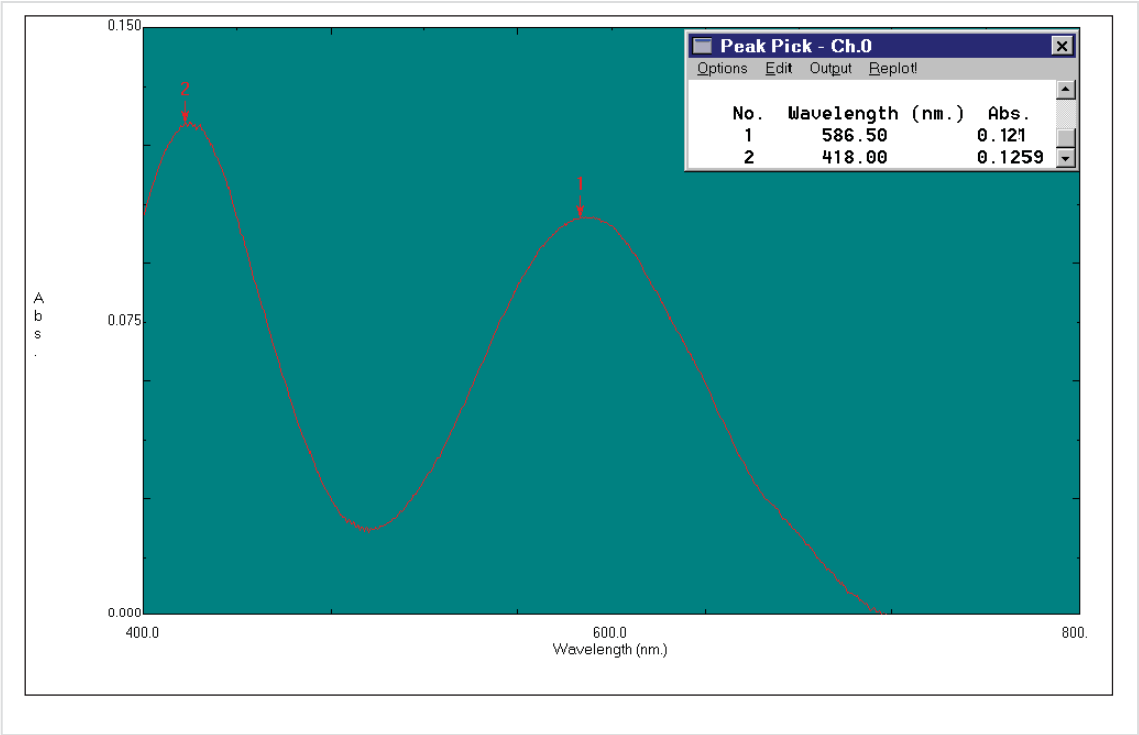


Figure 3: Spectral curve of Cr^{3+} ions, formed in solution after the sulphochromic oxidation of glucose.

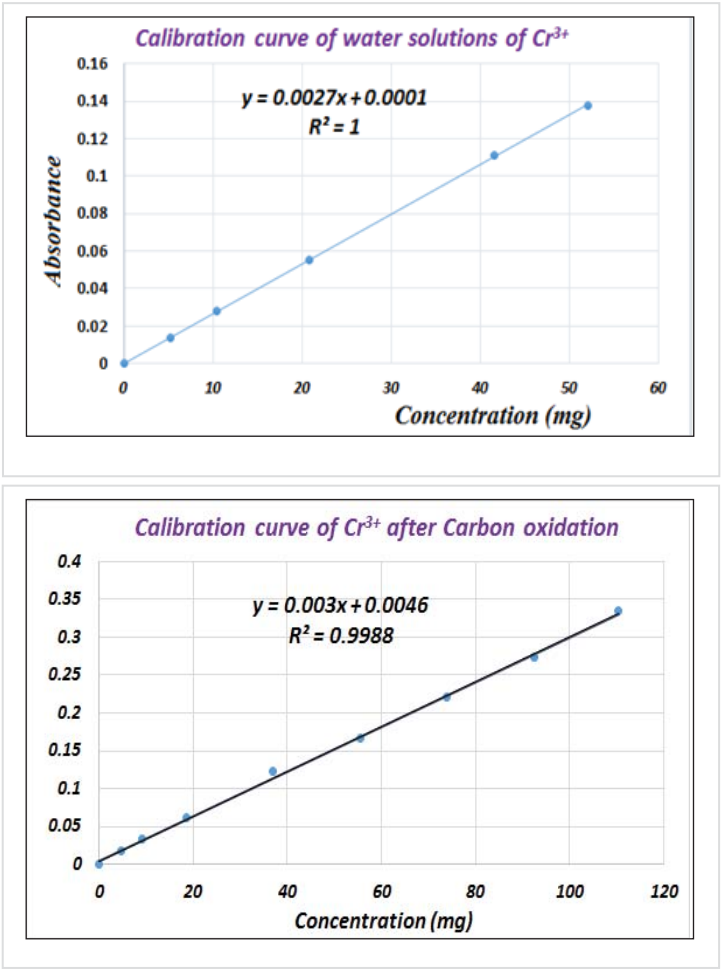


Figure 4: Calibration curves of C^{3+} ions. On the left-water standard solutions; on the right-after the reaction standard solutions.

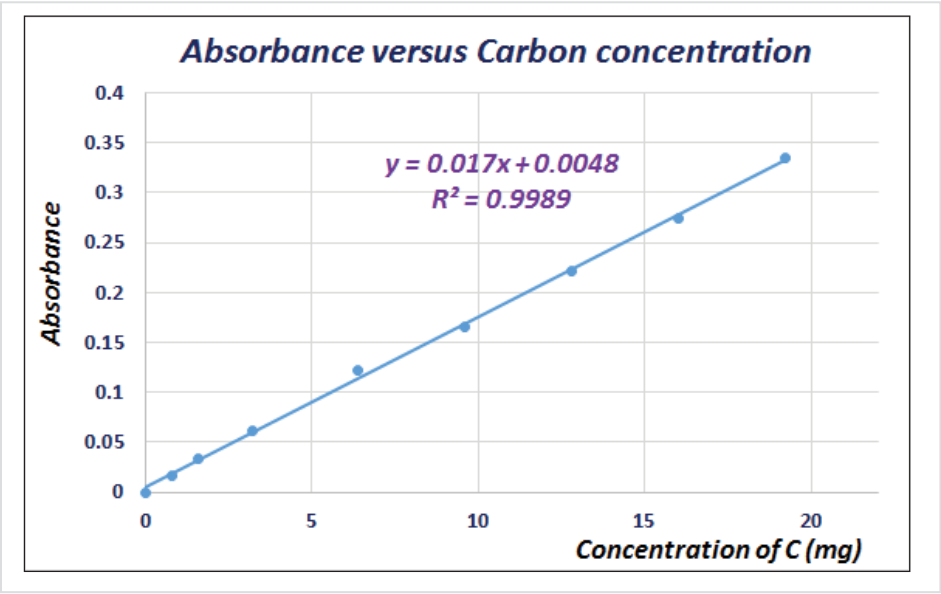


Figure 5: Calibration curve of carbon standard solutions.

Table 1: Results of LOD and LOQ values.

A_{av}	Standard Deviation (mg)	S_{LOD}	S_{LOQ}	LOD mg C	LOQ mg
0.0032	0.0011	0.0065	0.014	0.10	0.55

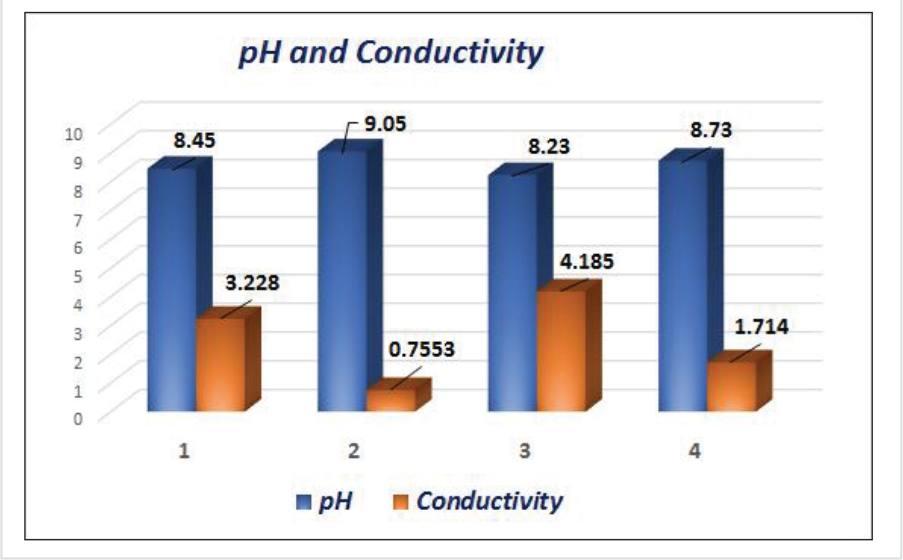


Figure 6: pH and Conductivity of sediment samples.

Values of pH varied between 8.23 to 9.05. No correlation was found between the pH and conductivity and the values of these parameters in water (Figure 7).

5.2 Results on TOC content in sediment samples

In Figures 8 and 9, results on TOC content in sediment samples of Vaini lagoon are presented. Aiming to evaluate method repeatability as well as the presence of matrix interferences, different portions of each sediment sample were treated according to the standard method and TOC content was calculated by means of the MLR. Based on the obtained results, it can be concluded that there was a good correlation between the concentration of the carbon and the quantity of

the sample being analyzed, $R^2 = 0.999$. The concentration of TOC resulted to be higher in sample 3, station S2 (18.68 mg/g) as well as in sample 1, station S1 (17.7 mg/g). The lowest content of TOC was recorded in sample 4, station S3 (3.78 mg/kg).

5.3 Quality assurance – Method of standard addition

Accuracy of the obtained results with regard to TOC content in each sediment sample was evaluated by the method of standard additions. For this purpose, each sample was spiked with pure glucose standard solution and oxidized in the presence of dichromate and sulfuric acid. Results are presented in Figure 10. According to the obtained results, it can be concluded that the recovery coefficient resulted to be RC > 96 %, calculated as percentage difference between the MLR and MSA curves slopes.

Results obtained by the method of standard additions were also compared with those obtained by the method of linear regression. Student's test "t" was used for this purpose ($\alpha = 0.05$, $f = 2$), (Figure 11).

It can be concluded that there were no significant differences between the results obtained by both the method of linear regression and the method of standard additions. This was also confirmed by the Student test "t".

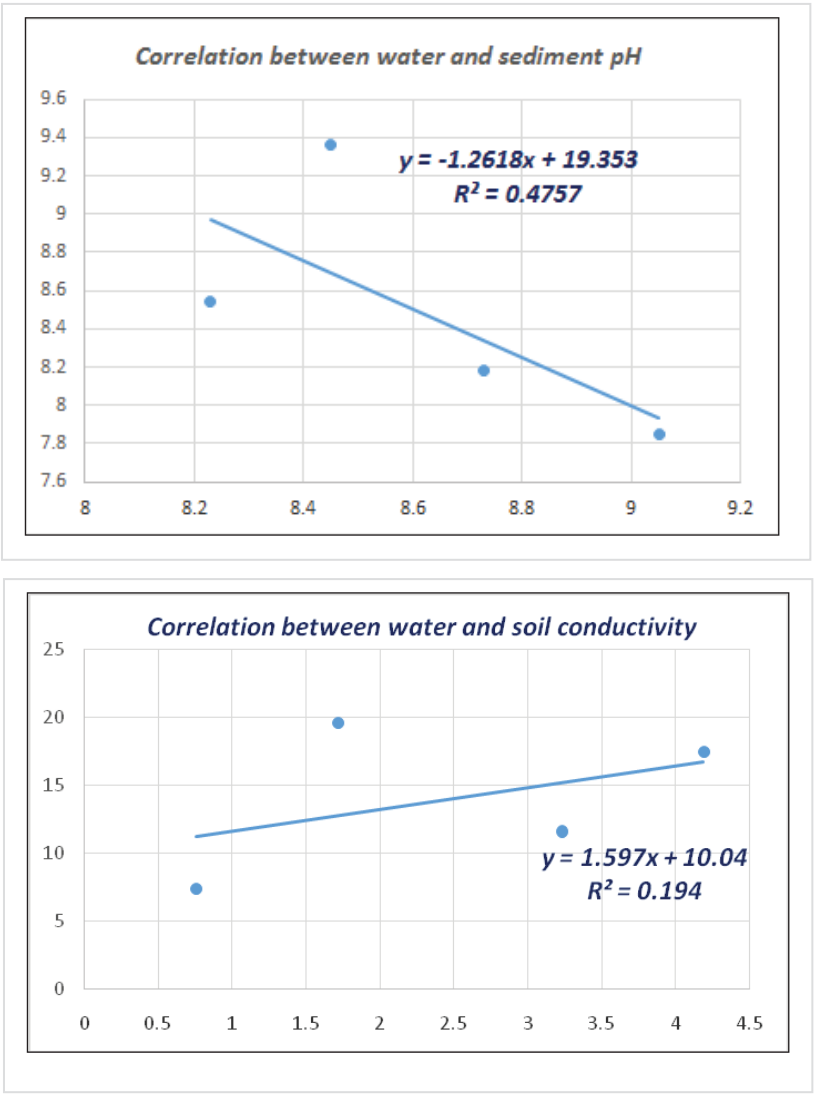


Figure 7: Correlation of physico-chemical parameters between water and sediment.

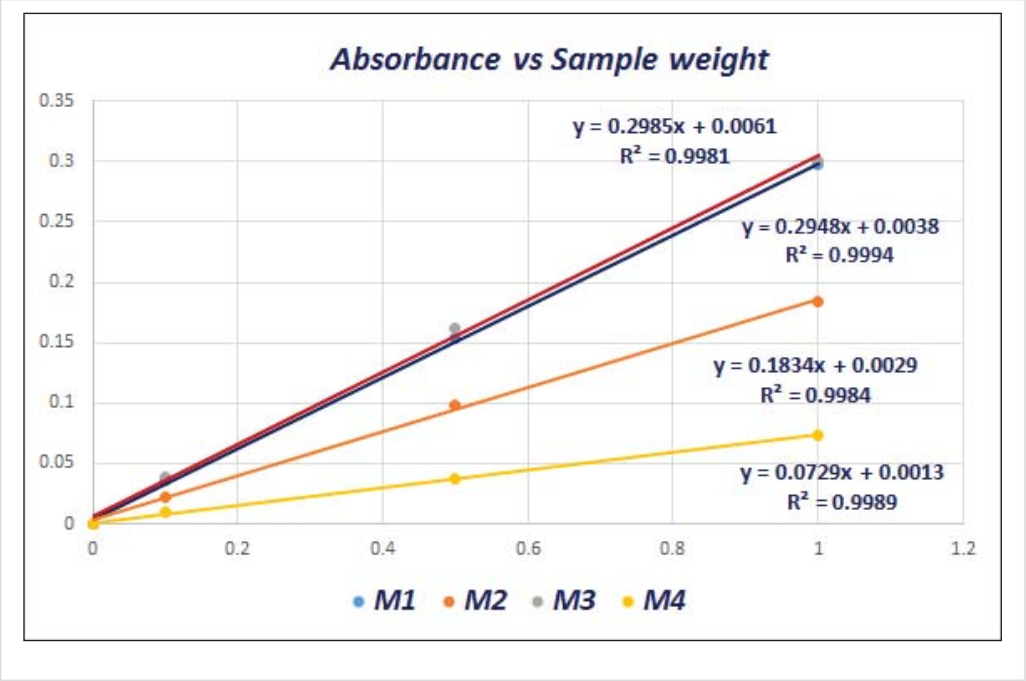


Figure 8: Correlation between carbon content and sample weight.

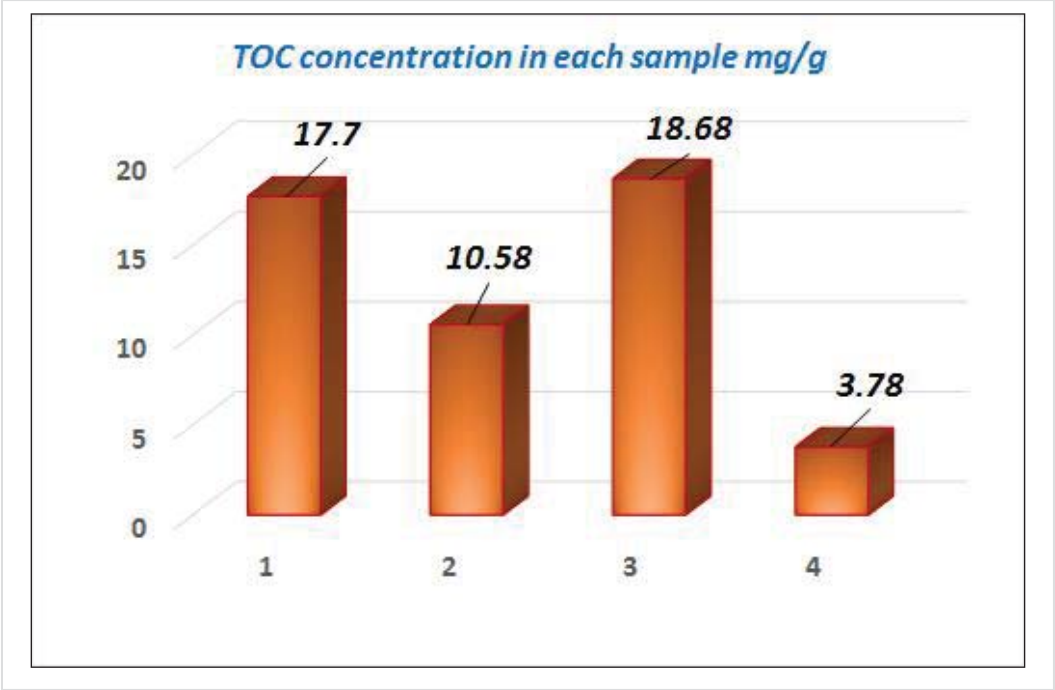


Figure 9: Concentration of TOC in sediment samples.

Table 2: Student's Test results.

Sample	Result MLR mg/g	SD (MLR)	Result MSA mg/g	t_{exp}	$t_{krit\ (95\%,2)}$
M1	17.70	0.59	16.66	3.05	4.3
M2	10.58	0.48	10.20	1.37	4.3
M3	18.68	1.36	17.75	1.18	4.3
M4	3.78	0.32	3.63	0.81	4.3

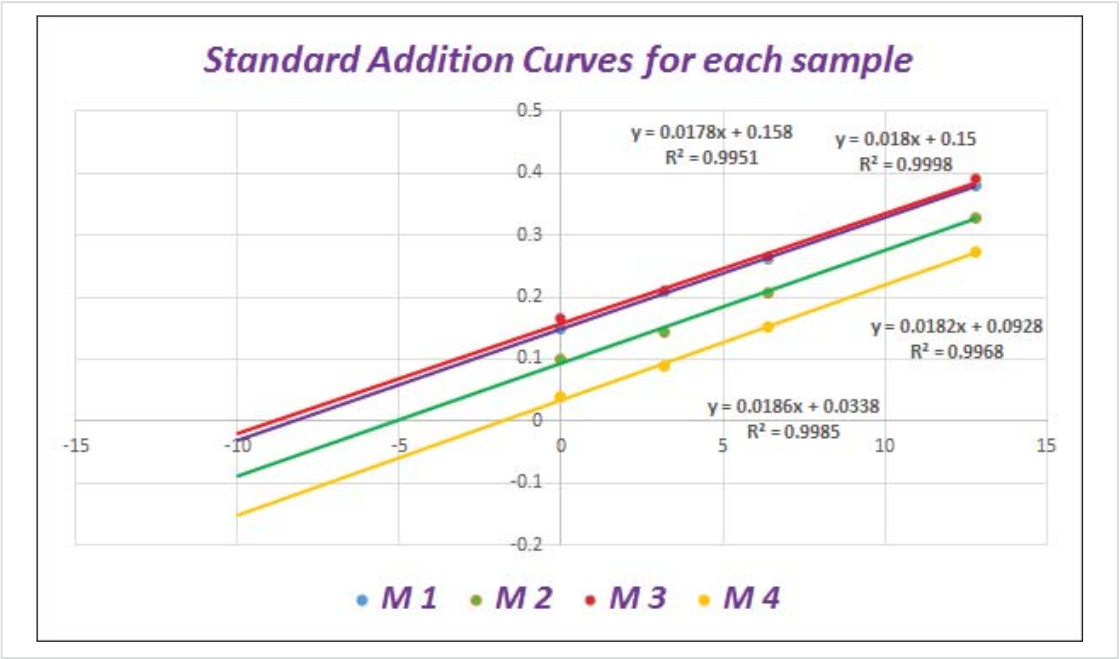


Figure 10: Results of the method of standard additions.

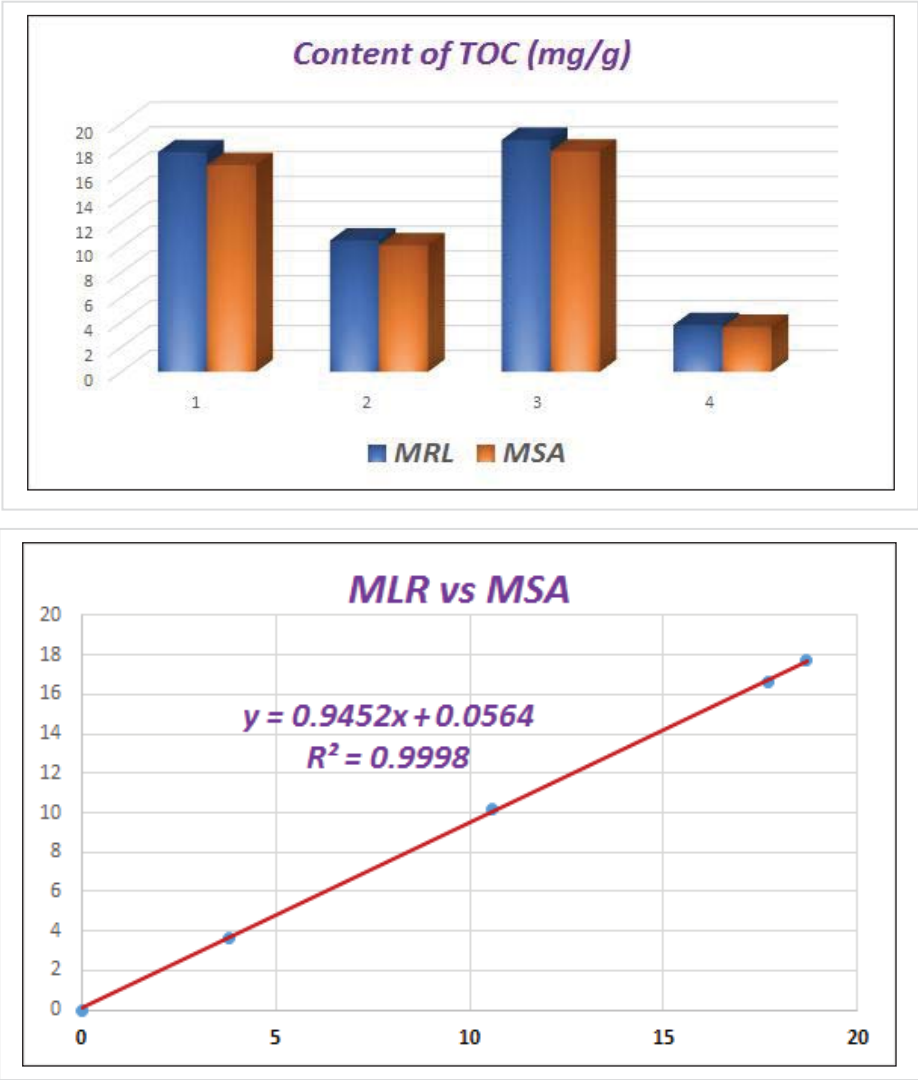


Figure 11: Comparison of results obtained by MLR and MSA.

6. Conclusions and recommendations

In this study, a simple spectrophotometric method was evaluated aiming to determine the TOC content in sediment samples of Vaini lagoon Albania. Obtained results confirmed that this method can be successfully used for the determination of TOC content in sediment samples. The working range resulted to be dependent on the quantity of the sample being analyzed. Accordingly, when 5 ml of dichromate solution 0.27 M is used to react with 0.1 g sample in a total volume of 100 ml, the working range varies between 0.8-20 mg C/100 ml, corresponding to 8 – 200 mg C/g sediment. Reproducibility of the method varied from 0.8 - 3%, expressed as standard deviation, while the recovery coefficient resulted RC > 96 %. Concentration of TOC in sediment samples of Vaini Lagoon ranged from 3.0 – 20 mg/g, confirming that these sediments can be classified as mineral to mineral organic soils.

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Determination of phenols in underground waters using carbon paste biosensor modified with banana crude tissue

by

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Abstract

A carbon paste biosensor modified with Crude Tissue of Banana (CPEB) was prepared for a simple rapid determination of phenolic compounds in aqueous solution using voltammetry techniques. The modified carbon paste electrode was prepared by mixing the monodisperse graphite powder with paraffin and with banana crude tissue which contains Polyphenol Oxidase (PPO) enzyme in its living environment (Lupu S. et al., 2009; Negash N. et al., 2014). Banana PPO is dicopper oxidase that catalyzes the hydroxylation of monophenols to form o-diphenols and the oxidation of o-diphenols to o-quinines, using molecular oxygen (Salgado R. and Simoes M., 2013; Yang X. et al., 2013; Chauke V. et al., 2010). The optimization of the experimental parameters was performed regarding the ratio between components of electrode (1.000 g graphite powder - 250 µl paraffin and 100 mg banana tissue), pH 7 and scan rate 50 mV/s. Under the optimal conditions, the reduction peak current varies linearly with the concentration of phenols within 1.48×10^{-5} – 16.7×10^{-5} mol/L, sensitivity 1.75×10^{-5} µA/ mol/L, correlation coefficient 0.9981 and detection limit (S/N = 3) of 1.9×10^{-6} mol/L. The concentrations of phenolic compounds in the analyzed underground water samples was $3.6 \times 10^{-5} \pm 0.1$ mol/L phenol, $1.8 \times 10^{-5} \pm 0.02$ mol/L m-Cresol, $2.2 \times 10^{-5} \pm 0.1$ mol/L p-Cresol, $1.9 \times 10^{-5} \pm 0.02$ mol/L 4-clorophenol.

Keywords: Carbon paste biosensor, crude tissue, PPO enzyme, phenols, voltammetry

1. Introduction

Groundwater in solution may have a high quantity of inorganic and organic compounds. When water is in contact with pore gases contaminants there may be transference between the liquid and the gas states. This is an important way of volatile compounds to migrate from the subsurface. After dissolved in water, these compounds can persist for a long time as a separate liquid phase which has prejudicial effects for the human life and the ecosystems. One of the aims of the water analysis is to obtain better knowledge concerning the water quality, residence times in the aquifer, age, recharge areas, flow paths, and also a potential or prohibitive use due to human pollution problems (Salgado R. and Simoes M., 2013). Phenolic compounds, such as phenol and cresol, have great importance in industry and are chemical pollutants widely present in the atmosphere, water systems and many food products (Yang X. et al., 2013; Chauke V. et al., 2010). These compounds appear and can be introduced into the environment through wastewaters or other missions, include coal conversion, petroleum refining, pharmaceuticals, production of dyes, pesticides, surfactants, resins, and plastics (Lupu S. et al., 2009). Particularly in the case of coal conversion, phenolic residues are considered an acute environmental problem. Most phenolic compounds, especially chlorophenols and nitro phenols, are toxic, highly resistant to biological degradation and

persistent in the environment. Chlorinated phenols such as 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol and pentachlorophenol are toxic and possess carcinogenic and immunosuppressive properties (Negash N. et al., 2014). As a result, the United State Environmental Protection Agency (EPA) and the European Union have included these phenolic compounds in their list of primary pollutants (Puig D. and Barcelo D., 1996; Muna G.W. et al., 2005). Therefore, the reliable and effective determination and disposal of phenolic compounds are very important and has long been of interest (Muna G.W. et al., 2005). Various methods have been developed to determine the concentration of phenols in solution, such as chromatography, capillary electrophoresis, spectrophotometry and electrochemical methods (Asan A., Isildak I., 2003; Chen K. et al., 2013). These methods all have their own disadvantages. Chromatography, capillary electrophoresis and spectrophotometry usually require a complicated, time-consuming sample pretreatment process, and also demand expensive instruments and a long analysis time, which makes them unsuitable for routine analysis. However, electrochemical methods can overcome these limitations because of their high accuracy, good reliability and inexpensive instrumentation, making them ideal for environmental and industrial analysis. Electrochemical sensing provides an alternative technique for analysis or disposal since most phenolic compounds can be easily oxidized in an electrochemical cell (Negash N. et al., 2014). Numerous biosensors have been proposed for the detection of phenolic compounds based on primarily the phenol oxidase, tyrosinase (Liu S. et al., 2003). Biosensors developed using plant tissue materials in combination with transducers offer an alternative to other biosensors based on enzymes. In recent years, the usage of plant tissue based biosensors have also played very important role in biosensor applications and they have some advantages such as low cost, simplicity of construction, and not to be needed cofactor for enzyme regeneration (Akyilmaz E. and Imer O., 2011). In the construction of plant tissue biosensors especially, root tips, young leaves, fruits and seeds of plants have been used in the biosensor construction (Schubert F. et al., 1993). Banana PPO is the best-known dicopper oxidase and has industrial applications such as its use in biosensors for oxygen and phenols (Cummings E.A. et al., 2001). It catalyzes the hydroxylation of monophenols to form o-diphenols and the oxidation of o-diphenols to o-quinines, using molecular oxygen (Cummings E.A. et al., 2001; Duran N., Esposito E., 2000): o-Quinones can be electrochemically reduced to o-diphenols with a low over potential without any electron transfer mediator.

In this work, we fabricated an electrochemical biosensor modified with crude tissue of banana source of PPO enzyme for rapid, sensitive and selective determination of phenols. Then the analytical performance of the modified electrode in quantification of hydroquinone in an aqueous buffer solution was described. Finally, this constructed electrochemical biosensor was used for determination phenols in underground water samples.

2. Experimental

2.1. Reagents and Solutions

Carbon graphite powder synthetic, (99.9% Alfa Aesar with particles size 0.09-0.071 mm) and paraffin oil (Olio di Vaselina, Zeta farmaceutici) were used for the preparation of the carbon paste. The crude tissue taken from banana peel was used as source of PPO and purchased from a local market as fresh culture fruit. All of the other chemicals were analytical grade and were used without further purification. Phenol, 4-Chlorophenol, m-Cresol, p-Cresol and Hydroquinone were purchased from Merck 99%. Phosphate buffer solutions (0.1 M) with pH 7 were prepared by mixing appropriate amounts of K_2HPO_4 x $3H_2O$, KH_2PO_4, K_2HPO_4 and KCl. All solutions were prepared with doubly distilled water. H_3PO_4 (1:9) was prepared: 10 ml H_3PO_4 with 90 ml doubly distilled water, for water sample pretreatment.

2.2. Apparatus

The electrochemical measurements were performed with an Electrochemical Analyzer (MEC-12B). Voltammetric measurements were carried out using a conventional three-electrode cell with a modified carbon paste electrode as a working electrode, an Ag/AgCl electrode as a reference electrode and a Pt wire as a counter electrode. All experiments were performed at room temperature (20±2°C) in

0.1 M phosphate buffer solution as the background electrolyte. Cyclic voltammograms with SWV were obtained at potentials scanning from E_i = -0.4 V to E_f = 1.0 V, in 0.1 M buffer solution (pH= 7), scan rate 50 mV/s. In each case the background voltammogram was firstly recorded and then the addition of phenolic standard solution was introduced into the cell, kept under stirring with a magnetic stirrer.

2.3 Electrode preparation

The Carbon Paste Electrodes modified with Banana (CPEB) is prepared using banana crude tissue taken inside of banana body, the graphite powder with the same grannulometry and paraffin mixed together and homogenized. The graphite powder and banana tissue were mixed firstly and then the paraffin was added and mix together until to obtain a homogenous paste. The modified carbon paste material was stored in refrigerator at 4°C for one day before measurement in order to immobilize the PPO enzyme into carbon paste. A portion of the resulting paste was put into a plastic syringe little by little to form a CPEB electrode. Electrical contact to the paste was established by inserting a copper wire down the plastic syringe tube and into the back of the mixture. The surface of the working electrode was gently smoothed using a clean glass surface before the measurements. Unmodified carbon paste electrode was prepared in the similar way without the banana tissue in the carbon paste matrix.

2.4 Preparation of real samples

Underground water samples were stored in a refrigerator immediately after collection. Firstly the water samples were cleaning by undergoing a distillation process to minimize interference during electrochemical determination of phenol. It was built distillation apparatus according to the instructions in the manuals of use of the equipment (Salgado R. and Simoes M., 2013). In 500 ml water sample taken in cylinder and passed on to the balloon distillation was added 10 % H_3PO_4 drops to adjust pH = 4 (for the elimination of sulfur compounds that are released in the form of H_2S and SO_2) After collecting 500 ml of distillate, the samples are ready to be analyzed using CPEB biosensor optimized in laboratory conditions. For analysis 5 ml sample was added into electrochemical cell containing 15 ml of 0.1M phosphate buffer (pH = 7). Studied phenols are very volatile and the samples were analyzed within a short time and for how long are used they are stored in the refrigerator.

3. Results and Discussion

3.1 Catalytic Effect of PPO

Square Wave Voltammograms (SWV) was used to characterize the modification process of the CPE electrode. Figure 1 shows SWV curves of biosensors modified with banana crude tissue and carbon paste electrode both in blank phosphate buffer solution and 2.99 x 10^{-5} mol/L hydroquinone at pH 7. No reduction peaks were generated in the blank solution, which means that carbon paste was inactive in the selected potential range. In the phosphate buffer solution containing 2.99 x 10^{-5} mol/L hydroquinone, both electrode generated a reduction peaks produced by a reversible reaction. The CPE electrode produced a relatively weak cathodic reduction peak, whereas CPEB produced a high reduction peak in the same concentration of hydroquinone. This suggests that the reduction peak current of CPEB was significantly higher than that of CPE. With the catalysis of PPO, oxygen can oxidize hydroquinone into *p*-benzoquinone and *p*-benzoquinone can produce reduction current on the electrode. A cathodic potential scan detected the reduction current of *p*-benzoquinone. The significant increase of the reduction peak current suggested that CPEB readily promoted the oxidation of hydroquinone by PPO enzyme and had effective catalytic ability to reduce hydroquinone. CPEB was used as the working electrode in subsequent experiments because of its good electrocatalytic activity.

3.2 Optimal Experimental Parameters for Determination of Hydroquinone

3.2.1 Effect of supporting electrolyte and pH

The effect of pH and supporting electrolytes was also investigated to study the electrochemical reduction of hydroquinone. Different supporting electrolytes were examined such as sodium phosphate, sodium acetate and borate using cyclic voltammetric techniques in the pH range of 4.0 to 9.0. Carbon paste electrode modified with banana crude tissue showed a reduction peak in,

sodium acetate and borate buffers. The highest peak current and the best peak shape for the reduction of hydroquinone was observed using phosphate buffer. In general, conditions that are too acid or alkaline lower the activity of enzymes. The enzyme showed the strongest reactivity towards hydroquinone at pH 7, so we chose 7 (phosphate buffer) as the optimal pH for further studies. Information about the mechanism of electrochemical reactions can be determined from the relationship between scan rate and peak current.

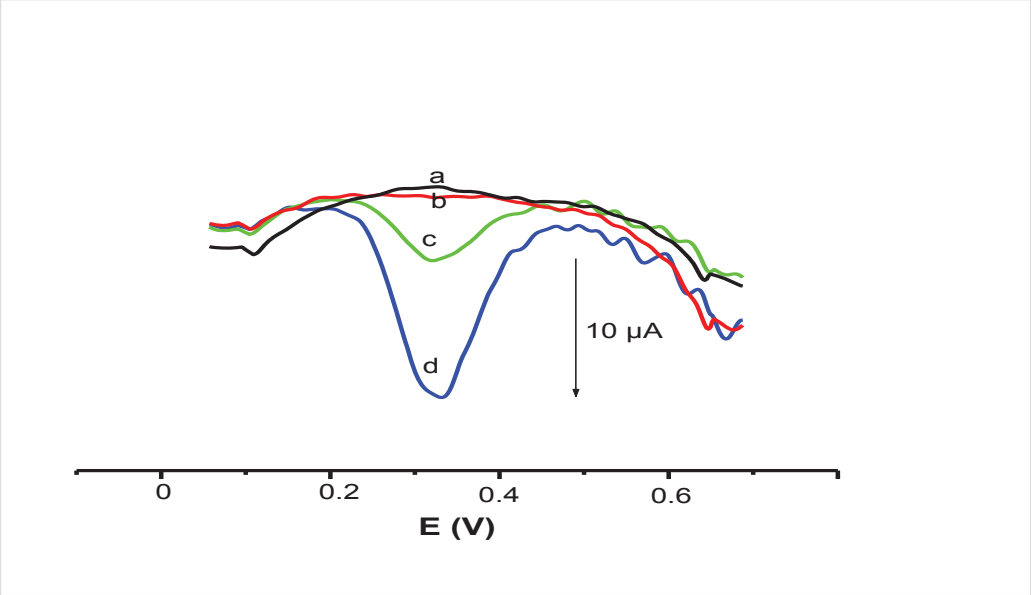
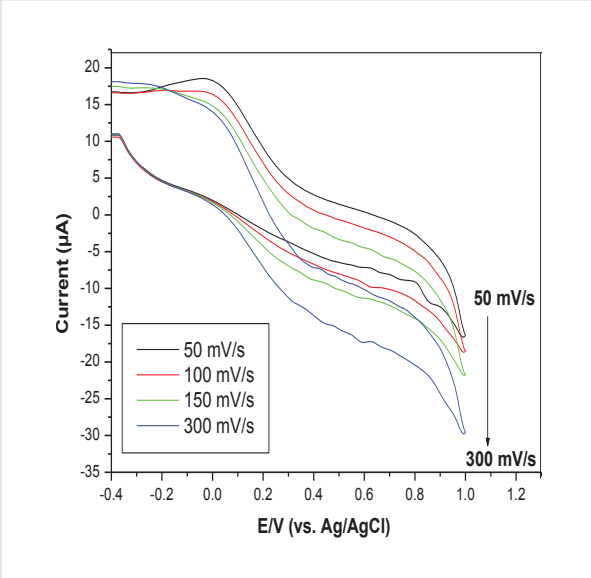
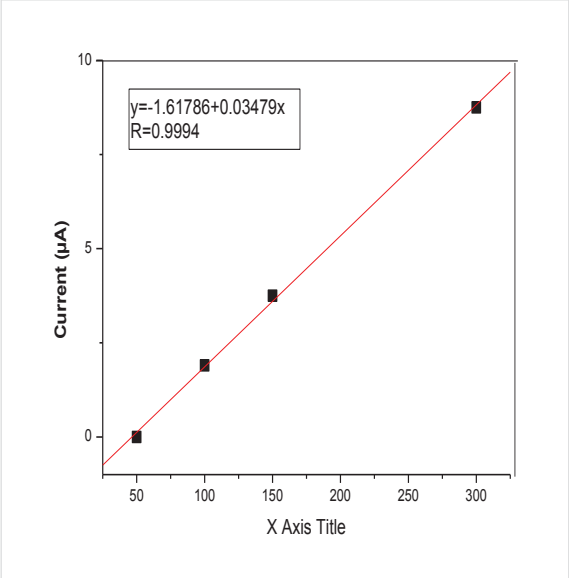


Figure 1: Voltammograms of CPE (b), CPEB (a) in the buffer solution; and in 2.99 x 10^{-5} mol/L hydroquinone CPE (c), CPEB (d); Conditions: 0.1 mol/L phosphate buffer solution (pH 7.0), scan rate 50 mV/s.





(A) **(B)**

Figure 2. (A) The cyclic voltammograms obtained at CPEB in phosphate buffer solution (pH 7), at different scan rates from 50 to 300 mV/s, in the presence of 1.48 x 10^{-5} mol/L hydroquinone. Scan range: −0.4–1.0 V. B) Plot of $v^{1/2}$ versus. *I*c.

3.2.2. Effect of Scan Rate

Therefore, we studied the effect of different scan rates on the electrochemical oxi-red of hydroquinone. Figure 2A shows the CV curves of 1.48 x 10^{-5} mol/L hydroquinone in phosphate buffer solution at scan rates from 50 to 300 mV/s using the CPEB. The reduction peak currents increased with scan rate, indicating that the conductivity of the surface of the electrode gradually increased with scan rate. The linear relationship between scan rate and peak current suggests that the reduction of hydroquinone occurring at the CPEB is a diffusion controlled electron transfer process (Fig. 2B) (Chen K. et al., 2013), which can be used to quantitatively analyze the hydroquinone present at the electrode surface. To reduce the effects of background current and still maintains good sensitivity, 50 mV/s was selected as the scan rate for subsequent experiments.

3.2.3 Effect of Modifier (PPO enzyme) Dosage

Polyphenol oxidase (in banana crude tissue) is an important component in the catalytic reaction of hydroquinone. We prepared CPEB biosensors containing 1.00 g graphite powder, 250 µl paraffin and different amounts (50, 100, 150 and 300 mg) of banana tissue to optimize the amount of bio modifier. Cyclic Voltammograms of 2.99 x 10^{-5} mol/L hydroquinone in phosphate buffer solution obtained using the different biosensors are presented in Figure 3. When the amount of banana tissue (PPO) was increased from 50 to 100 mg, the reduction peak current increased because the catalytic reaction of hydroquinone was facilitated. In contrast, when the amount of banana tissue was increased from 100 to 300 mg, the current gradually decreased. This may be because the increased amount of biological modifier (PPO enzyme) increased the resistance for interfacial electron transfer (Schubert F. et al., 1993). As a consequence, 100 mg was the optimum dosage of banana tissue in the carbon paste electrodes.

3.3. Linear Regression and Detection Limit

The electrochemical behavior of the CPEB biosensor was quantitatively analyzed by square wave voltammetry (SWV) under optimal conditions using different concentrations of hydroquinone. The results of these experiments are shown in Figure 4. When the concentration of hydroquinone was increased from 1.48 x 10^{-5} – 16.7 x 10^{-5} mol/L, the reduction peak current increased linearly. The sensitivity was found 1.75 x 10^{-5} µA/mol/L, with a correlation coefficient of 0.9981 and a limit of detection (S/N = 3) of 1.9 x 10^{-6} mol/L. Thus CPEB has good electrocatalytic activity and adsorption capacity towards high concentrations of hydroquinone, so it could be used to detect high concentrations of hydroquinone

3.4. Reproducibility, Repeatability and Stability

The reproducibility, repeatability and stability of CPEB were investigated by SWV measurements of 1.48 x 10^{-5} mol/L hydroquinone. In order to evaluated the reproducibility we prepared three uniform electrodes under the same conditions and determined their reduction peak currents in phosphate buffer solution containing 1.48 x 10^{-5} mol/L hydroquinone (pH 7.0). The relative standard deviation (RSD) of the electrodes resulted 3.6%. The repeatability was checked for 5 continuous measurements in 1.48 x 10^{-5} mol/L hydroquinone using the same electrode, the RSD was 3.2 %, indicating that the CPEB biosensors show good reproducibility and repeatability.

After electrochemical testing, we cleaned the electrode with double distilled water and stored it at 4 °C. The stability of CPEB biosensor it was studied by measuring its response to hydroquinone in phosphate buffer solution (pH=7), in different days within 3 weeks. It was observed that after 12 days the current obtained in the same experimental conditions and concentration resulted 12 % lower and 25 % lower after 22 days. These results indicate that PPO enzyme in banana fruit tissue was denatured in presence of molecular oxygen, as a result of successive reactions that occur during the process of decomposition of phenolic compound in this plant tissue (Yoruk R., Marshall M. R., 2003; Navaratne A. And Rechnitz G. A., 1992). Therefore, the CPEB biosensor should be prepared freshly for analytic determination and can be stored up to one week.

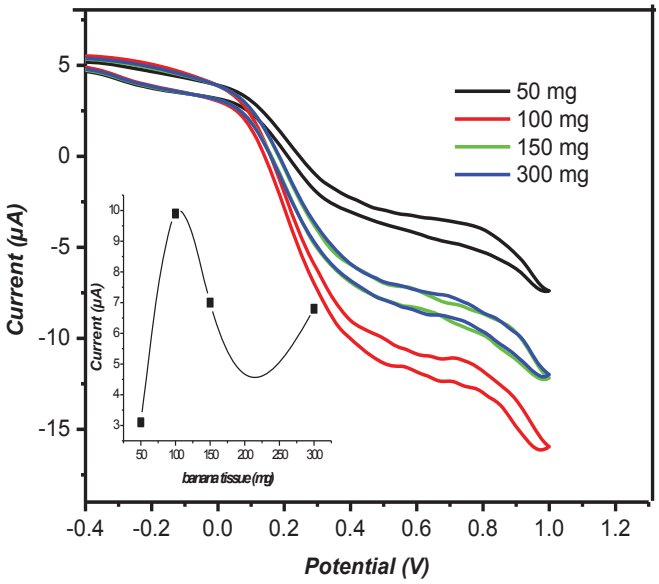


Figure 3: Cyclic Voltammograms of biosensors containing different dosages of banana tissue (Graphite: 1.00 g, paraffin: 250 µL) in PBS buffer solution pH=7, containing 2.99 x 10^{-5} mol/L hydroquinone, scan range: −0.4–1.0 V, scan rate: 50 mV/s.

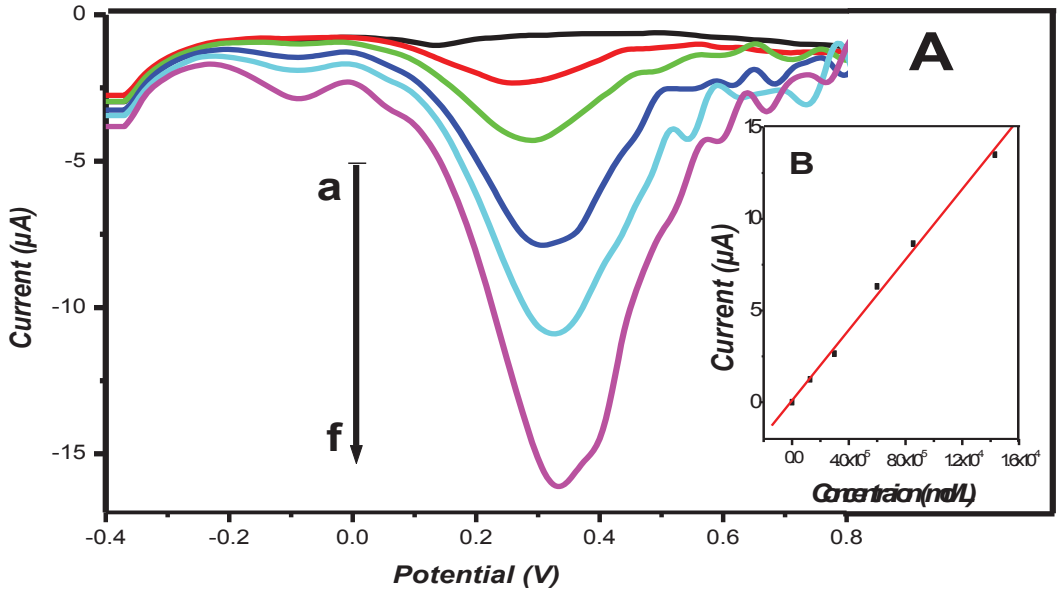


Figure 4: *Inset A.* Square Wave Voltammograms using CPEB in 0.1M phosphate buffer solution pH 7, with increasing hydroquinone concentration of 1.48 x 10^{-5}, 2.99 x 10^{-5}, 5.99 x 10^{-5}, 8.54 x 10^{-5}, 16.7 x 10^{-5} mol/L from **a** to **f**, amplitude 30 mV and step potential 10 mV. *Inset B.* Linear regression curve.

Table 1: Experimental results obtained by electrochemical detection of phenols in underground water sample (n=3).

Underground water samples - Amount (mol/L)			
4-Clorophenol	p-Cresol	m-Cresol	Phenol
$1.9 \times 10^{-5} \pm 0.02$ mol/L	$2.2 \times 10^{-5} \pm 0.1$ mol/L	$1.8 \times 10^{-5} \pm 0.02$ mol/L	$3.6 \times 10^{-5} \pm 0.1$ mol/L

Table 2: Determination of phenols in underground water samples using the CPEB Biosensor.

Analyte	Amount added (mol/L)	Found[a] (mol/L)	RSD[b] (%)	Recovery (%)
Hydroquinone	4.99×10^{-6}	4.90×10^{-6}	2.77	98.2
	9.99×10^{-6}	9.18×10^{-6}	2.02	91.8
4-Chlorophenol	4.98×10^{-6}	4.85×10^{-6}	8.73	97.4
	9.96×10^{-6}	10.03×10^{-6}	8.40	100.7
m-Cresol	4.99×10^{-6}	4.80×10^{-6}	1.96	96.2
	9.98×10^{-6}	9.70×10^{-6}	4.70	97.2
p-Cresol	4.99×10^{-6}	4.90×10^{-6}	4.00	98.2
	9.98×10^{-6}	10.07×10^{-6}	8.25	100.9

[a]Average value of three measurements. [b] Relative standard deviation for the proposed method (n = 3).

3.5 Real sample analysis

The applicability of the propose voltammetric biosensor was tested in determination of phenolic compound (hydroquinone, 4-clorphenol, p-cresol, m-cresol, phenol) in real samples of underground water. The samples of underground water in phosphate buffer solution were determined in triplicate using standard addition method and SWV technique in optimal conditions recommended in this work (Table 1).

No hydroquinone signal was detected in sample. It means that there was no hydroquinone in the sample or it was below the detection limit of the method. The results clearly demonstrate and confirm the capability of the modified electrode (CPEB) for the voltammetric determination of phenol, 4-clorphenol, p-cresol, m-cresol with good selectivity and good reproducibility. In order to evaluate accuracy of the method and the presence of systematic errors the recovery method was used. Analytical recovery measurements were calculated based on the results obtained by adding different amounts of phenols (4-clorphenol, p-cresol, m-cresol and hydroquinone) into the sample. In table 2 are shown the recoveries results.

The recoveries of the electrochemical biosensor were from 91.8% to 98.2% for hydroquinone, between 96.2% and 97.2% for m-Cresol, from 97.4% to 100.7% for 4-chlorophenol and between 98.2 % and 100.9% for p-Cresol. These results clearly show that our electrochemical biosensor is a reliable and effective for determinations of phenols in real samples.

4. Conclusions

By modifying a carbon paste electrode with banana crude tissue, we successfully prepared an electrochemical biosensor that could be used to detect the concentration of phenols in underground water samples. Because of the catalytic effect of PPO enzyme on the surface of the electrode could realize good electrocatalytic activity and generate an electrochemical response to phenols. The reduction peak current was increased using the electrode containing biological material compared with the bare one. The biosensor accurately detected the concentration of phenols in actual underground water samples, and gave satisfactory recoveries of p-cresol, hydroquinone, m-cresol and 4-chlorophenol. Our results indicate that CPEB electrode can be used to rapid and sensitive detection of the concentration of phenols in water samples with good reproducibility and stability.

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Lock-ins and tipping points: Factors to block or enable energy system transformation

by

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Abstract

The paper is based on several assumptions. First, we assume that there is awareness of the climate threat and that energy production is one of the main man-made sources. Second, we assume that there is motivation for change, including for a transformation of energy-supply systems. Third, we assume that technology is not a major problem: Sustainable technologies (hydro, wind, solar) are both in mass-production and prices are falling rapidly. Fourth, these relevant sustainable technologies are relatively downscaleable, pointing to structural flexibility. Fifth, these technologies are in economical terms marked by high upfront cost (investments) and low running costs, pointing to regulative or other protection from price wars. With these simplifications we have a situation where the main factors for energy system transition, bringing sustainable energy from niches to main energy regimes, are found in the system dynamics of politics and markets

The paper is based on several recent projects with our participation, the most important being the SANCOOP project for energy transformation in Southern BRICS countries (Brazil, India, China, South Africa) 2014-17 and the study of the transition in the Norwegian ferry sector, 2017-18.

The main purpose of the paper is to present a handful of mechanism with some empirical data and present them as "models" that represent a collection of hypothesis on trigging or blocking factors for energy system change.

The different groups of factors to be discussed are: 1. Fundamental belief systems (cases form N, SA) 2. Institutional setup and power relations, incl path dependence (SA, N, B) 3. Regulative strategies (SA) 4. Production resources and market forces (Ch, N). Final discussion are on how the factors may be negative or positive and how state and marked blend in the dynamics of change forces.

Keywords: energy system transformation, factors

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11th International Conference on Energy and Climate Change, Athens 2018

LOCK-INS OR RAPID CHANGE: FACTORS TO BLOCK OR ENABLE ENERGY SYSTEM TRANSFORMATION

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With

Tom Skauge, Western Norway Univ of applied Science

- The urge for transition is dramatic (IPCC oct 2018)
- New technologies are present, in standardized production and costs are low
  - Relevant technologies are often linked to a more decentralized structure
- System changes are then dependent on political and market factors
- From a niche to a regime, how ? (Geels)
  - Sometimes a «good niche» is OK until it threatens a regime
- Sosiotechnical system changes are historically known to :
  - Be unpredictable
  - May happen very fast under certain conditions
    - And leave old technology as stranded assets (Scumpeter) unlike most literature on energy sytem delvelopment (Schumpeter)
  - May be blocked by lock-in mechanisms
- Our suggestions of decisive factors : 1. Fundamental beliefs 2. Institutional setup 3. Regulation 4. Market and production

THE SITUATION IN ENERGY SYSTEM TRANSFORMATION TO SUSTAINABLE SYSTEMS

- Background data for this paper:
  - Sancoop project on sustainable energy (Brazil, China, India, South-Africa)
    - Interviews with key actors in all countries, documents
  - Evaluation study of the Norwegian change to electrical ferries
  - General observations/literature at the system level

DATA

- BLOCK The problem of political and scientific beliefs in economy making Norwegian oil sector continuing and growing («the ghost of cost-effiency»)
  - Textbook theoretical resource economy in universities and government
    - The theoretical elegance of CO2-quota (ETS) trading
- BLOCK The engineering perspective of the grid in regulating authorities in South Africa: Generations of experiences with «big grid-few suppliers» makes the solar panels look «ugly» and «not possible to use on a large scale».
  - CHANGE But remember the computer revolution 1980-2000 !
  - CHANGE And remember the strong belief that elecrircity= progress 1900-70 !!
  - CHANGE And the «Tesla» revolution: still not «profitable», but carried on a wave of beleif and enthusiasm

1. FUNDAMENTAL BELIEFS AS A CRUCIAL CHANGE OR BLOCK FACTOR

- Institutions and their surroundings reflect certain solutions and powerful actors. (Companies, trade uinions, bargaining rules, formal procedures of influence)
  - Norway and the non-implemention of solar and wind energy
    - (these sectors are not institutionalized and present)
    - (these sectors threaten the continuing oil investments(was shut down), but when investements was not profitable, e windoiw opened
  - Norway and the regional electrification of ferries
    - Companies with solutions and capacity, unemployment, politicians with a problem of lacking means for CO2-reduction and **formal public structural power**
- The «coal» solution in South Africa
- The institutional lock-in of local electricity in SA
  - National Coal Energy monopoly, municapial reselling for profit (tax)
    - Solar roof panels = «tax avoidance «

2. INSTITUTIONAL SETUP

- (tender/procurerment competition + protection)
  - REIPPP 1-5 in SA, well-regulated success
    - But only when the main power player allows (=grid and supply breakdown)
  - Wind power in Brazil
  - Electrical ferries in Norway
  - Key factors
    - CO2-reduction becames a competitive factor
    - Price competition AND protection
- Electrical installation regulation makes solar almost impossible (SA)
- Economic regulation blocks the inclusion of solar panles and SWH in housing financing in SA (and the opposite in US Solar City project)
- The problems of Nuclear phase IV

3. REGULATIVE STRATEGIES AND PRACTICES

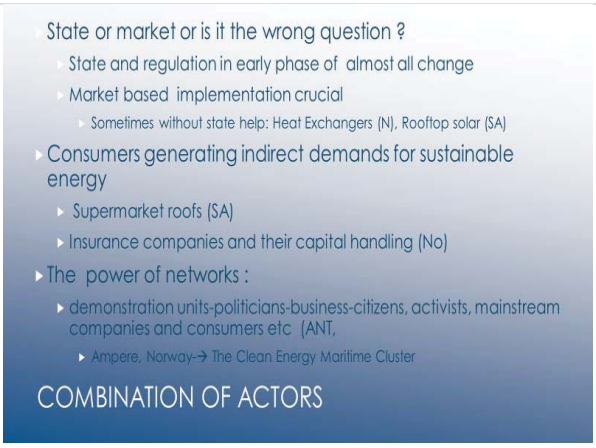
China wind and solar: The power of manufacturing, markets and profit (J. Mathews)

- But : always need startup (regulative)help
- Investment policies favours the small/medium, the predictable with clear buyer structure
  - = renewble solar, wind, SWH units
- Direct and indirect consumer demands
  - SA: medium size solar on institution rooftops, political climate consumers
- Norway and electrical cars: huge demands, thousand of consumers are waiting (and Tesla has huge stockholder value)

4. MARKET AND PRODUCTION FORCES

- Norway 1+2 The special «resource economy belief» is supported by institutional interests of the oil sector (owners , workers, bureaucrats)
- SA 1+2 The trust in «Big state» invites «Big Solutions» that again points to coal and nuclear in SA, supprted by institutionalized interests of government, workers and national companies
- SA 3+4 REIPPP success combines buying power through tender, protective regulation and market conditions
- Brazil 2+3 The success of introducing wind power in Brazil creates institutions and interests that makes a new «path»
- Norway 2+3+4 Electrical ferries combines buying power through tender, strong regulation and market players
- China 2+4 The Chinese success of wind and solar linked to startup support and regulation
  - But now (Oct 18)the effects is threatened by corruption and reginal interests (?)

COMBINATION OF FACTORS


State or market or is it the wrong question ?
State and regulation in early phase of almost all change
Market based implementation crucial
Sometimes without state help: Heat Exchangers (N), Rooftop solar (SA)
Consumers generating indirect demands for sustainable energy
Supermarket roofs (SA)
Insurance companies and their capital handling (No)
The power of networks :
demonstration units-politicians-business-citizens, activists, mainstream companies and consumers etc (ANT,
Ampere, Norway→ The Clean Energy Maritime Cluster
COMBINATION OF ACTORS


WE STARTED WITH THE AIM OF GETTING A RECIPE FOR CHANGE TO SUSTAINABLE ENERGY AND ENDED WITH THE DISCUSSION OF A SMALL GROUP OF FACTORS IN SEVERAL MIXES AND ROLES:
1. Fundamental beliefs
2. Institutional setup
3. Regulative arrangements
4. Market and production forces
A CONCLUSION ?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SOURCES

Strategy Formulation for Promoting Active Transportation via System Dynamics

by

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Abstract

Active transportation could be paramount to decreasing energy needs and consumption. We define active transportation as a means of transport whereby individuals actively move; such as walking or cycling. A shift from vehicle use to mobile means of transport, could forward the reduction of pollution and mitigate the current climate change crisis. Governments should shift their focus to promoting more sustainable means of transport; namely active transportation. This paper discusses how a system dynamics methodology can be used to analyse the effects of walkability on energy savings and greenhouse gas emissions.

Keywords: Strategy, Sustainability, Walkability, System Dynamics, Energy and Climate Change

1. Introduction

There is an urgent need to address the critical issue of climate change. Air pollution which is majorly attributed to vehicle use, has detrimental environmental and health effects as well as adverse impacts on wildlife. The World Health Organisation estimated that 1 in 9 deaths are caused by air pollution worldwide. This exemplifies how urban planning strategies at present, are not succeeding in reducing pollution and hence, climate change.

Current literature on urban planning methods fail to capture the systemic effects that result from their strategy implementation. Formulating appropriate strategies for sustainable development and more specifically, for enhancing active transportation, is a complex and challenging task. Active transportation could be paramount to decreasing energy needs and consumption. The issue of walkability in relation to sustainable transport systems, is a widely recognised concern. People in the U.S who reside in areas where walkability levels are low, drive 39 miles more than those where walking activity is high – a 30% gap (Goldberg et al., 2007). Such findings suggest it is imperative that governments and municipal institutions, focus on encouraging more walking amongst citizens to promote sustainable urban development.

In this paper, we discuss how system dynamic analysis can aid policy makers, governments and municipal institutions in formulating effective strategies to address the climate change issue.

2. Literature Review

Most studies formulating sustainable development strategies, rely on qualitative and quantitative methods that often fail to capture the systemic dynamic effects of their implementation. In this section, we review such studies along with system dynamics methods.

2.1 Qualitative studies

Cao & Li (2011) deliberate how low-carbon eco-city planning designs and

development strategies will not only encourage, but also lead to sustainable urban development and living. Consequently, businesses and industries will be given plentiful opportunities in which they can progress and grow, leading to further advancements within industries. Lizarralde et al (2015), who carried out a document analysis and conducted interviews that revealed the tensions involved in sustainable development. Constructive propositions can materialise from such qualitative studies on certain aspects of planning. But what emerges from these studies, are ultimately subjective views that could be a target of heavy criticism. This necessitates the need of such studies to be supported with quantitative methods.

2.2 Quantitative studies

The US energy department discovered that areas with greater population densities and more walkable streets, resulted in less vehicle use. Improving built-up areas could also lead to a fall in U.S. transportation energy and greenhouse gases from anywhere up to 10% by 2050.

Quantitative studies provide more reliable conjectures backed by empirical findings. However, these studies examine relationships in isolation, and thus fail to assess interdependencies that exist with other entities of the system. They also rely on static and past data, which may not necessarily hold for the future. In contrast, our research centres on utilising dynamic data suggesting an integrated holistic system dynamics method.

2.3 System Dynamics-Simulation studies

Cao et al. (2009), adopted Shanghai as a case study to showcase how an integrated model could examine the dynamics of urban growth. Their model indicated that road network planning could potentially play a significant role in the establishment of newly urbanised land. Feng et al. (2012), also opted to construct a system dynamics model to analyse the course of CO_2 emissions in Beijing from 2005-2030. It was found that policies controlling for population growth and promoting a change in energy structure from carbon rich fuel like coal, to low-carbon fuel such as natural gas in Beijing, affect the demand for energy consumption. Even though system dynamics methods have been applied in a variety of city planning studies, in the case of walkability and active transportation, research is rather limited.

We propose a system dynamics method dedicated to promoting walkability and sustainable active transport. In our proposed method, we account for energy consumption and socio-economic benefits.

3. Developing a System Dynamics Method for Promoting Active Transportation

This system dynamics method, has been constructed with the intent of inferring plausible strategies for active transportation. We suggest orchestrating a "computer-aided approach to policy analysis and design" (*System Dynamics Society*). Relating to the dynamic issues at hand – including the social, economic, environmental and behavioural systems – we construct a network of interdependent, mutually interactive, information feedback and circular causality systems. In this way, we establish their links and aid us in unveiling appropriate active transportation policies accordingly. The method is coupled with causality and feedback loops. Causality loops demonstrate information feedback from one dynamic system to another with the aim of contriving the interrelatedness of these systems (economic, behavioural and so forth). Feedback loops dictate the structure of the multiplex system by adopting the notion that system outputs, are routed back into the system as inputs. In other words, the system can be said to feed back into itself.

System dynamic models that present network linkages between systems, have been adopted by researchers to address a myriad of global issues including population growth, healthcare delivery, energy transition scenarios and epidemics to name a few (*System Dynamics Society)*.

In mathematical terms, computer simulation is used with non-linear, first order differential (or integral) equations. Simulated time is subdivided into discrete intervals of length *dt*, stepping the system through time one *dt* at a time. We keep in mind that information feedback and circular causality loops alone, are not sufficient. The intuition for establishing links is also heavily reliant on the nonlinearity and the influential power of a loop relative to others.

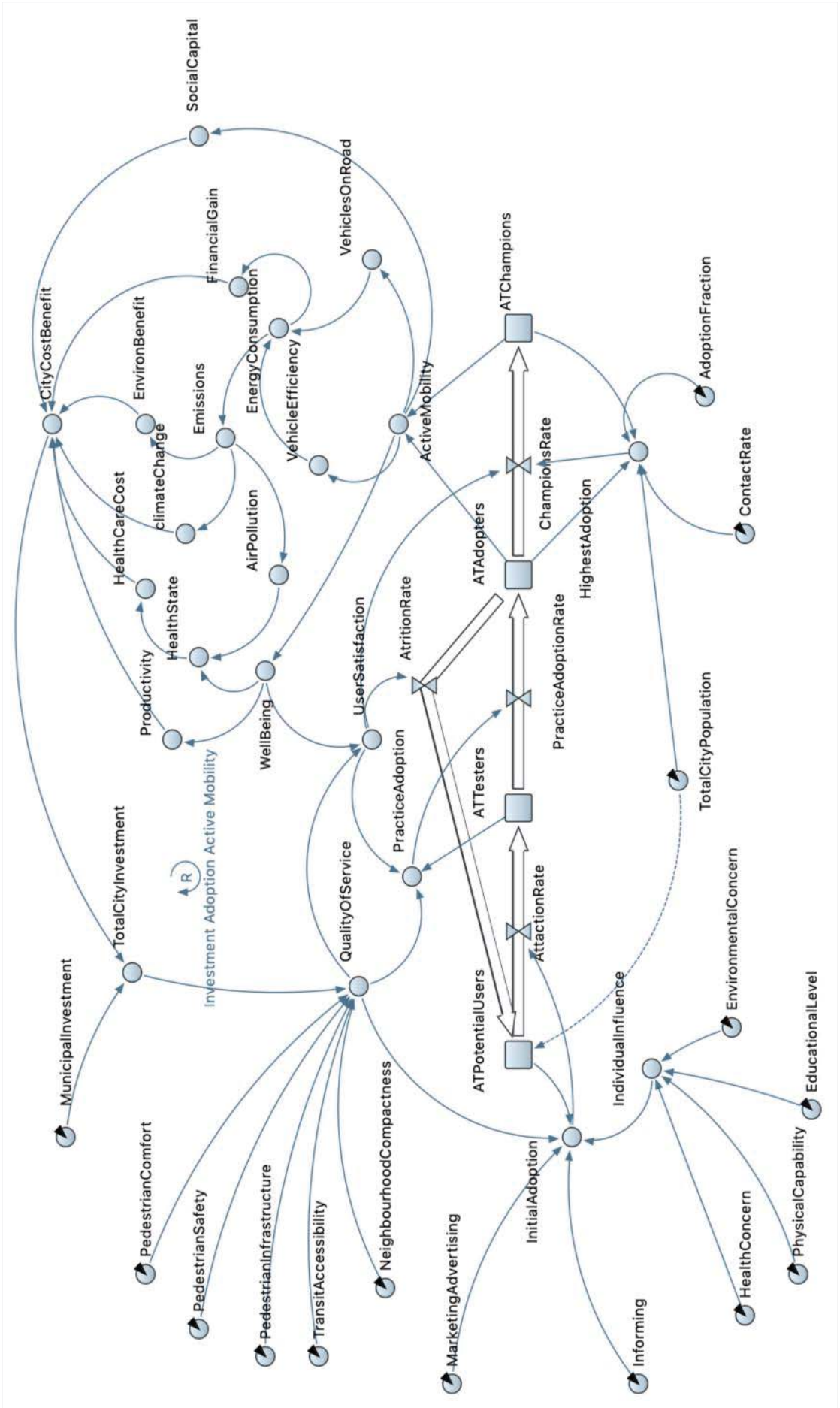

Figure 1: Active Mobility System Dynamics.

A fundamental concept of system dynamics modelling is endogeneity. This plays a pivotal role in construction modelling. It is viewed that exogenous factors only stimulate changes in the behavioural aspect of the system. But causes are confined to within the structure of the system. Feedback loops ensure that all causes are endogenous.

System dynamics models require the employment of stocks (levels) and flows (rates). A stock can be thought of as any container (for instance consider a bathtub) that has a capacity to be filled. Flows (inflows or outflows) can be described as a faucet that fills or drains the stock. If there are more inflows than outflows, the number of entities in the stock will increase. The reverse holds if the opposite occurs. Outflows equal to inflows, signals a dynamic equilibrium within the dynamic system setting. In theory, there is no limit to how many flows a stock can be subjected to, though usually, there are four to six inflows and/or outflows per stock.

To exemplify the concept of stocks and flows in the case of active transport, consider the behavioural system. An individual's attitude towards active transport *(the stock)*, is governed by different aspects of an individual's life, such as upbringing, concern for the environment and area of residence *(the flows)*. Figure 1 shows some of the most important relationships in our suggested system dynamics approach for active transport, energy consumption and climate change.

4. Discussion and Conclusions

Current policies to improve infrastructure for congestion are ineffective. Active transport can encourage individuals to substitute vehicle use with active transport, thus aiding to reduce CO_2 and GHGs. Our system dynamics method instigates a network that enables us to include key parameters and factors that influence our stocks and flows. This provides insight into how optimal strategies can influence active transport. This needs to be evaluated with dynamic data which allows for structural and institutional differences across different urban areas. We need to employ dynamic means so that policies can be tailored to different organisational, and governmental systems. By constructing a system dynamics model, we will build on these foundations, pairing them with mathematical means and simulations to produce viable results that will guide us to optimal strategic policies. We can apply such policies to various urban cities and test the significance of such policies.

Acknowledgements

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RentalCal Project: Speeding energy efficiency investment in the rented housing sector of eight member states

by

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Abstract

The current level of energy efficiency investments in the rental housing sector is in danger of missing EU policy targets. RentalCal[2] has developed a tool – the RentalCal tool – for assessing the profitability of energy efficiency retrofitting in the rental housing stock. This perspective is innovative as so far the financial perspective had been limited to the owner occupier, thus neglecting other relevant stakeholder groups such as the rental housing sector. Although this sector represents the majority of Europe's multifamily houses stock, current viability calculation methods for energy efficiency retrofits are geared towards owner occupiers and ignore some inherent characteristics of the specific national rental market. RentalCal increased the transparency of national investment conditions as there are technical, legal, financial and stakeholder i.e. investors individual conditions mainly functioning as barriers to energy efficiency investments. Special emphasis is given to the great diversity of national investors and their specific investment conditions. In the course of the project the green value connotation of energy efficiency investments had increased. From the very beginning the RentalCal focus was on dissemination of key insides into the green value proposition to specific target groups. Green value meanwhile has an impact on the profitability of energetic retrofitting investments by increased rents respectively increased sales prices. However, this is not common knowledge and consequently the project's focus is on awareness raising to the impact of green and sustainable investments within the housing sector.

Keywords: Profitability of energy efficiency investments, landlords' perspective, impact of green investment within the housing sector

1. Introduction: Landlords' perspective in preparing the energy efficiency investment

The rental housing stock of the eight countries under review[3] offers a high potential for energy efficiency investments. Looking at the eight countries, the size, age and energy performance of rental housing stocks vary widely across the RentalCal countries. With the help of the Intelligent Energy Europe (IEE) project TABULA a typology of the rental

[2] Acknowledgement: The project was funded by the European Commission Executive Agency for Small and Medium sized Enterprises (EASME), grant agreement no. 649656 – RentalCal – H2020 – EE – 2014-2015/H2020-EE-2014-3-market uptake. The project was coordinated by INSTITUT WOHNEN UND UMWELT GMBH (IWU) Germany and performed together with EUROPEAN GREEN CITIES APS (EGC) Denmark; STU-K, a.s. (STU-K), Czech Republic; DELPHIS DEVELOPMENT ETUDES POUR LE LOGEMENT LA PROMOTION DE L'HABITAT INNOVATATION ET LE SOCIAL ASSOCIATION (DELPHIS), France; Narodowa Agencje Poszanowania Energii SA (NAPE), Poland; UNIVERSITAET REGENSBURG (UREG), Germany; UNIVERSIDAD DE ALICANTE (UA), Spain; THE CHANCELLOR MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE (UCAM), United Kingdom; Karlsruher Institut fuer Technologie (KIT), Germany; Tias Nimbas Business School B.V. (TIAS), Netherlands; AALBORG UNIVERSITET (AAU), Denmark

[3] Germany, Spain, United Kingdom, France, The Netherlands, Poland, Czech Republic and Denmark

housing stock per country (according to building type and building age) was possible[4]. It showed that among the RentalCal Countries there are certain common energy efficiency measures but also specific differences among these countries. The most relevant current energy efficiency measures relate to the building envelope (insulation, windows, doors) and the heating systems (heating/Domestic Hot Water (DHW) and ventilation). Also a great variance has been identified in respect to investment costs for energy efficiency measures across the RentalCal countries. As a matter of fact energy savings vary depending on climate conditions – the climate in Spain is quite different compared to the climate in Denmark – building types and the composition of their refurbishment packages.

TABULA is used to estimate energy saving potentials for pre-defined measure packages. RentalCal presents own cost estimations for the standard and advanced refurbishment packages from TABULA separated for single-family/ terraced houses and multifamily houses/apartment blocks.

In general, the standard refurbishment package is defined according to the current national practice or regulation and the advanced refurbishment packages consider more ambitious levels of insulation, windows and energy supply systems (e.g. to achieve refurbishment requirements of national funding schemes). As expected, the investment costs for both packages vary widely across the RentalCal countries and partly within both building categories in each country (see Figure 1).

Energy saving potentials can be reached up to about 50 % through standard refurbishment and up to 80 % through advanced refurbishment, depending on the country, the building type and the definition of the refurbishment packages. Figure 2 (the vertical axis on the left) shows the annual amount of energy saved per m² of living area by introducing the standard refurbishment packages. The vertical axes on the right displays the estimation of standard refurbishment costs (Value Added Tax (VAT) excluded) that must be invested to achieve annual energy savings of one kWh. All values are shown separately for the RentalCal partner countries and the building types Single Family House/Terraced House (SFH/TH) and Multi Family House/Apartment Block (MFH/AB). The high renovation costs per unit of saved energy for heating and DHW in Spain can be explained by the fact that only Mediterranean climate zone data were available for the purpose of this evaluation. This zone is a specific case with low energy demand for heating and a very high energy demand for cooling and air conditioning which could not be reflected in the chart.

2. Parameters impacting the profitability of energy efficiency retrofits

The investors'/landlords' ambition to invest into energy efficiency depends on a plethora of parameters which mostly are taken as barriers and hardly ever as incentives. There are soft barriers, i.e. related to personal criteria and procedural elements as well as financial and legal framework conditions or barriers, all of them impact the individual disposition of an investor to take or to leave an energy efficiency investment (Stevens D., 2017). The energy efficiency investments also strongly depend on governance aspects i.e. the configuration of each landlord.

Following the investment conditions that impact energy efficiency investments are described. These investment conditions are all integrated in the RentalCal tool described under chapter 4.

2.1 Split incentives

A set of market failure mechanisms summarized under "split incentives' barriers" are obstacles for investment in the rental housing sector. Split incentives may not only arise from the factor separation of investor and beneficiary, i.e. landlord and tenant disincentive as there is often the inability to share costs and benefits properly between the landlords and tenants. As long as tenants pay the maintenance costs, heat and hot water there is no proper incentive for the investor to invest to increase energy efficiency in these fields. To the detriment of the tenant there is often no full compensation of charged rent increases by an

[4] For further details see summary of technical framework conditions: http://www.rentalcal.eu/summaries-of-rentalcal-reports

adequate decrease of heating costs. This is a serious social aspect to be considered when it comes to rent increases after any deficiency investments normally combined with other modernization activities.

There is also asymmetrical risk exposition during the refinancing period (temporal disincentives) while landlords' investments need a very long payback period for the recovery of the investment (Zeitler J.- A., 2018).

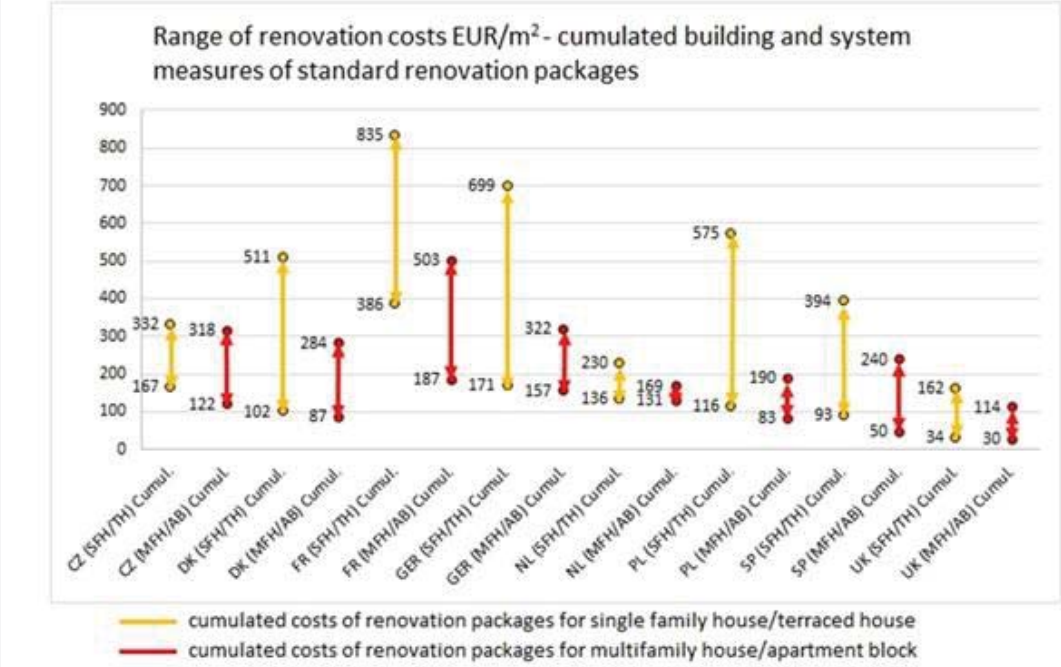


Figure 1: Standard refurbishment costs €/m² per country (ranges).

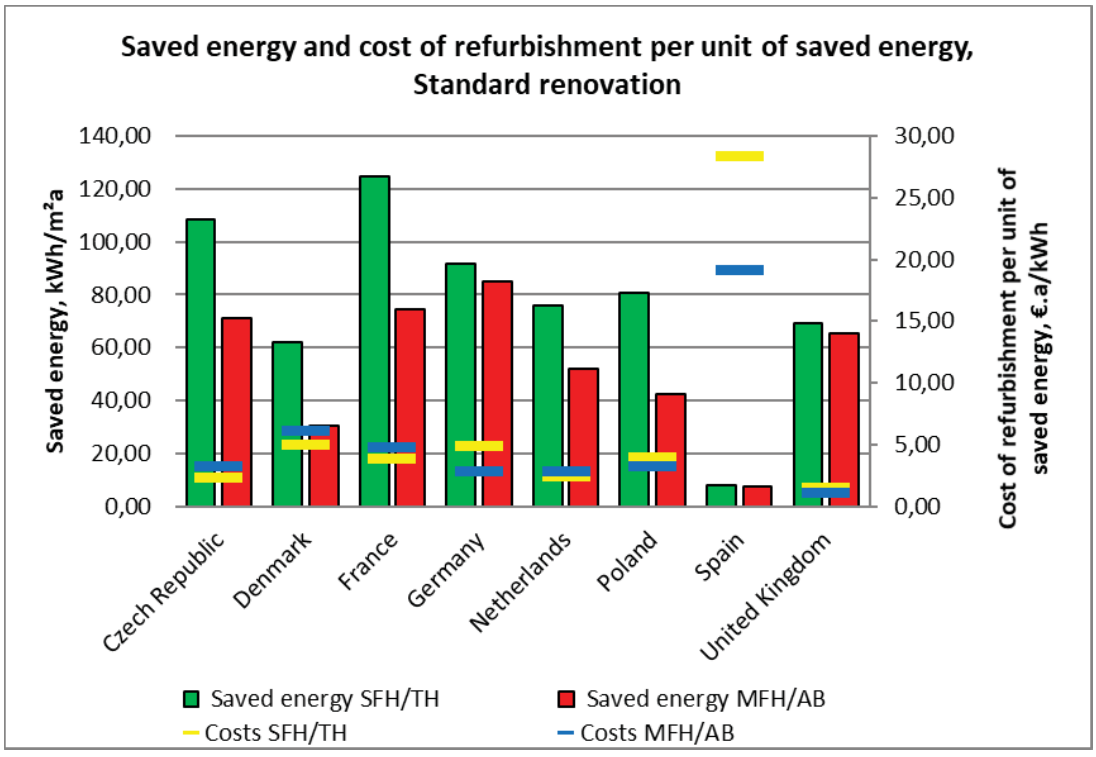


Figure 2: Annual amount of saved energy per one square meter of living area and costs of refurbishment per unit of saved energy – standard refurbishment packages.

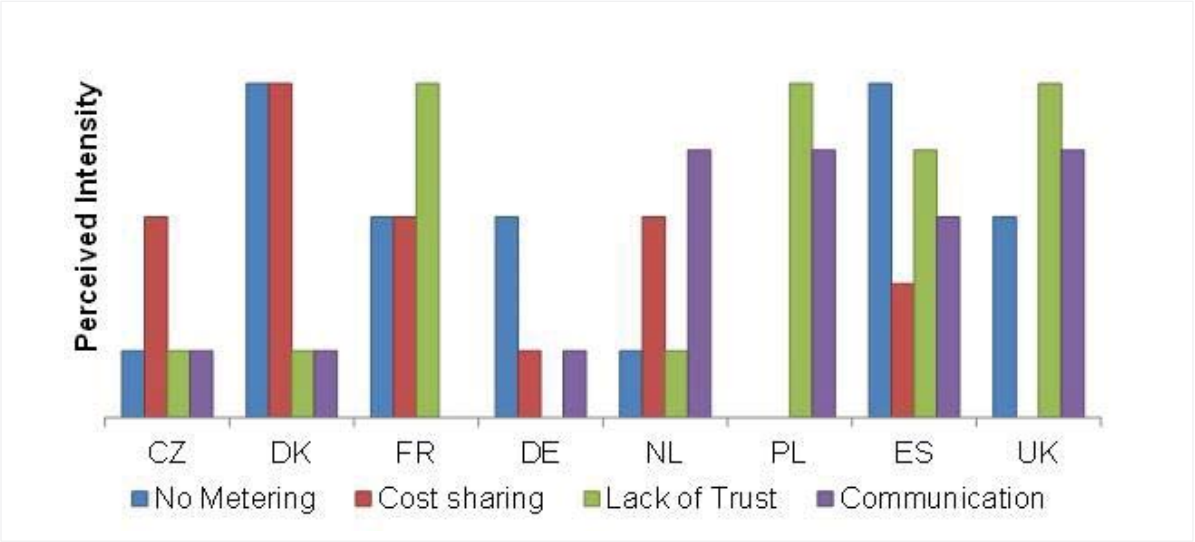


Figure 3: Soft barriers for investments.

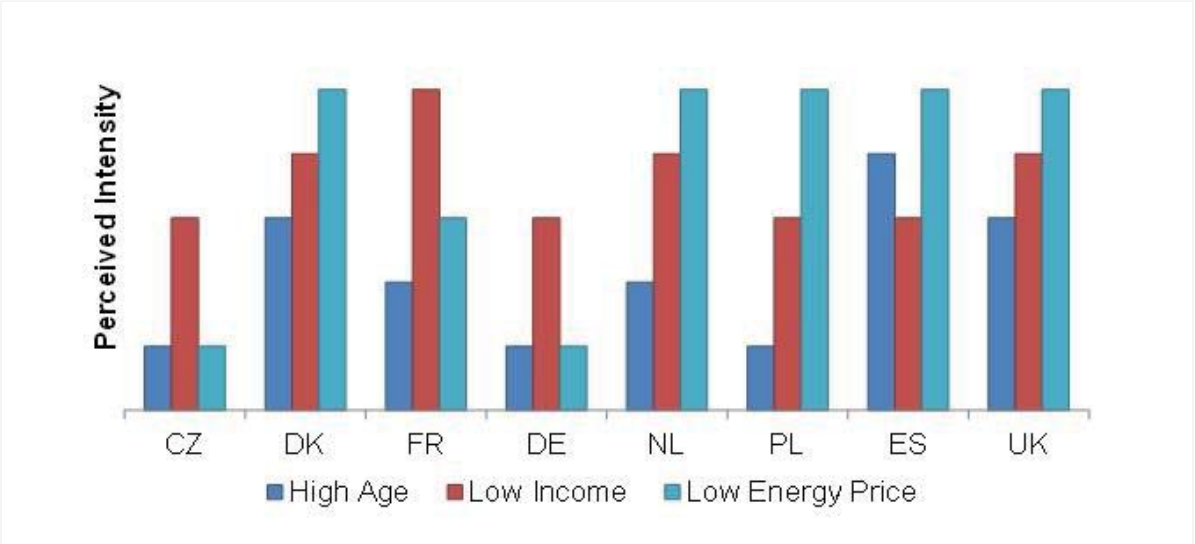


Figure 4: Tenants related investment barriers.

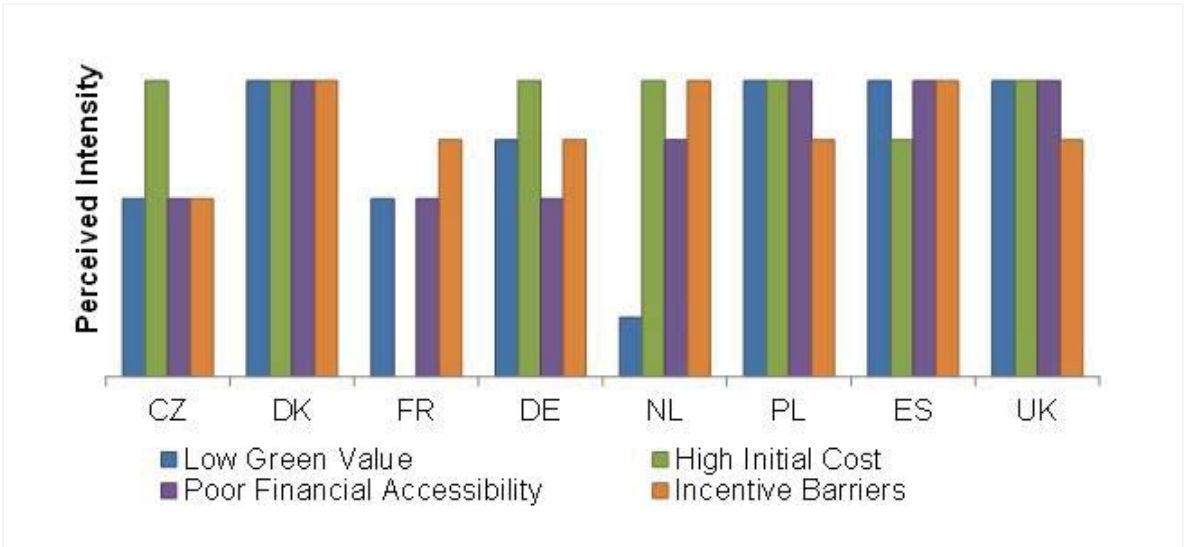


Figure 5: Financial impact on energy efficiency investment.

Meanwhile however green value i.e. investment shows effects in rent increase possibilities and increased sales prices. Despite the split incentives various all investigated countries allow energy efficiency modernization investment to be refinanced by means of rent increases.

2.2 Soft barriers

As long as energy efficiency and the respective investment is not perceived as a positive common good and both landlords and tenants don't trust into the different benefits of energy efficiency measures there is a negative impact. Therefore, the communication process is an integral part of establishing trust and consumer satisfaction in any industry. Yet this is cited as a significant barrier in the Netherlands, Poland, Spain and the UK. A mainstream barrier visible in all countries is the non- metering of energy consumption in each individual flat. As long as the tenants' bill doesn't show the see energy consumption resp. the energy cost there is no incentive for tenants to change the behavior and save energy resp. costs. The same is true as long as energy prices are low. This barrier was cited to be most prominent in Denmark and Spain. Denmark has reacted by introducing the respective legislation in 2016. The issue of cost sharing of energy efficiency retrofits was mostly indicated as a significant barrier. As long as cost sharing of energy efficiency retrofits happens, i.e. the tenant contributes to the costs there is no need for the respective energy efficiency investment. This is a significant barrier in Denmark, France and The Netherlands. Figure 3 shows the perceived intensity of soft barriers in the eight RentalCal countries.

High age is a demographic barrier that applies to both tenants and landlords. Elderly people (pensioners) often have limited spending ability which is most prominent in Spain, the United Kingdom (UK) and Denmark.

Low income is a barrier to invest in green initiatives seems to be consistent across all of the countries. Low stable energy prices – with the exception of Germany and Czech Republic are not favorable for energy efficiency investments. A very obvious soft barrier is the tenants' perception of energy efficiency retrofits as a secondary priority by tenants which is visible in the majority of the countries, with the exception of Denmark. Thus tenants tend to substitute a way from energy efficiency.

2.3 Financial and legal barriers

Besides the above-mentioned informational deficits the population age of landlords' too, is detrimental to energy efficiency investments. Not only that the enthusiasm for energy efficiency investments diminishes for elderly people but also the difficulties to get middle term and long term credit from banks are increasing with the aging of the investor (most of the time no term of the loan after 70 years old). Therefore, other incentives such as tax incentives are necessary and will be set out under chapter 3.

There are more financial related impacts on energy efficiency investment seen through the eyes of the investor. A common issue, which is well documented in the literature, revolves around the inability of green value to be fully capitalized in property value. In figure 5 this is reflected under "low green value". However meanwhile there are studies that point to a "green premium". Yet this premium appears to be more significant in the owner-occupied market segment than in the private rental market. Still it was found out that sales premiums exist in the majority of the countries and the consortium except Czech Republic, Poland and Spain in which no studies exist to date. Likewise in some countries, France, Germany, Netherlands and the UK, favorable rental price and reduced void periods premiums are reported. High initial costs and poor financial accessibility are mentioned as another barrier to energy efficiency take up.

Moving from the financial to the legal parameters impacting the profitability of energy efficiency investment first of all the chance of reflecting energy efficiency investments within the rent, i.e. being able to increase the rent after energy efficiency investment is at stake [5].

[5] For further details see summary of legal framework conditions and summary of market and financial framework conditions: http://www.rentalcal.eu/summaries-of-rentalcal-reports

In all RentalCal countries the initial contractual rent setting is entirely free for negotiations. Rent increases strongly depend on individual clauses written in the tenancy contract (freedom of contract). Although **modernization** costs are generally attributed to the landlords they can seek compensation in rent increase which has to follow given national legal requirements and procedures.

Recuperating modernization investments vary within the RentalCal countries: In the Czech Republic the rent increase after energy efficiency refurbishment is limited to 10 % and the consent of 2/3 of tenants is necessary. Without such consent, the rent increase cannot exceed 3.5 %. In Denmark "the total economy neutrality" principle applies according to which the landlord is entitled to increase the rent by the amount which is saved by the tenant due to the saving on energy costs. In France the rent increase after energy refurbishment is limited to 50 % of the energy costs savings and to a period of 15 years. In Poland the rent increase has to be defended in front of the court if it exceeds the inflation rate. The criteria to justify the increase are not specified and will be judged case by case based on the statuary concept of "fair" profit, which is also individually decided by court based on the current situation and all circumstances involved. In the case of Spain it is envisaged and practiced, if agreed by both landlord and tenant that the tenant directly participates in cost sharing. Based on such expenditures the tenant is then entitled to temporary rent decrease. In Czech Republic and the United Kingdom the participation of the tenant in refurbishment financing can occur if it is agreed upon with landlord. A particular instrument reflecting green premium is the "rental table" that allows a rental surcharge for measurable energy efficiency in Germany. In all countries rent control happens with the help of court supervision initiated by the tenants.

The described rent mechanisms are mainly regarded as barriers to investments – this is the case for France, Germany, The Netherlands and the United Kingdom, they are rarely seen as "neutral" this is the case in Czech Republic and Poland and sometimes they are seen as "facilitators" which is the case in Spain. All countries foresee rent control with the help of courts initiated by the tenants.

Due to the general contractual freedom the **maintenance** costs are regulated in the tenancy contract. The prevailing market practice in all RentalCal countries is that the maintenance costs are born by the tenants either as part of the rent or as separate charges.

2.4 Taxation and depreciation rules

Rental income taxation is another relevant parameter impacting the profitability of energy efficiency investments. In most countries the personal rental income is taxed together with other "earned income sources" including capital gains using a general Personal Income Tax (PIT) scale. The scales are usually progressive, with 2 to 5 levels. Statistics "characterizing the market tax rate in a best possible way" are not available. The effective tax rate applicable for each individual landlord is different and depends on many individual factors. Typically, many of those factors are not related to the landlord's rental activity. For this reason any investor has to calculate his/her own applicable tax rate[6]. Regarding non-professional landlords' taxation and consequently tax incentives are playing the key role in almost all participating countries. It underlies the importance of the national tax policies to enhance the energy efficiency in the private rented housing stock. This becomes even more important if one considers that the non-professional private landlord is by far the main investor in the private rented housing sector all over Europe. Regarding the energy efficient measures, they all have personally little knowledge, competences and capacities. They need a global and multi-dimensional support at the local level to favor and guide their acting out. Besides national income taxation there is additional local property and rent action taxation in all countries with different taxation bases as it is the property

[6] A detailed overview of the each RentalCal members' income taxation is given in the legal framework conditions for energy efficiency retrofit investments in the private rental housing market sector. On these findings one can learn that there is a great variety of taxation systems which all had to be integrated in the RentalCal tool as described in Chapter 4.

value or the modernization. Depreciation rules are of particular relevance in case of energy efficiency measures. There are unified depreciation rules and their relation to the balance sheet value of the real estate in all countries but there is poor harmonization of tax related rules. There are similar practices on the assessment of maintenance expenses seen as tax deductible costs. Energy efficiency "green" investments which lead to improvements increase the balance sheet value of the property. Still missing is a clear distinction between maintenance expenses and investments. Uncommon however advisable are individual depreciation rules for building components. This would reflect the reality of building components' life cycle differ and need replacements in different intervals.

As the ambition of the profitability calculation tool Rental Cal was to be as detailed as necessary but at the same time as easy as possible it was a big challenge to design the right input and output parameter of the tool. The RentalCal tool has been adapted according to the different investor types and their capacities as described in Chapter 4.

2.5 Set up of investors

While identifying the institutional framework conditions it quickly turned out that there is a plethora of investors operating in the private rented housing sector. Four typical cases have been identified, the former Central and Eastern Countries (CEEC) case (Czech Republic and Poland), the Mediterranean case (Spain, Italy) the northern countries' case (Scandinavia, Germany, The Netherlands), the "mixed" case (France, UK). The percentage of the rental housing stock varies from 13 % (Spain) to 56.7 % (Germany) of the total housing stock and in the rental housing stock, the percentage of the rental market subject to market rents varies from 8.3 % (Netherlands) to 96 % (Germany). With an average of 2/3 the private rented housing stock in the RentalCal countries, the private landlords are the most relevant institutional target group. This group in itself is not homogeneous; between 50 % to 70 % of those private landlords own just a small number of dwelling units. Their lack of information and competences makes the needs for external and local support a key factor to enhance the energy efficiency of the private rental housing sector.

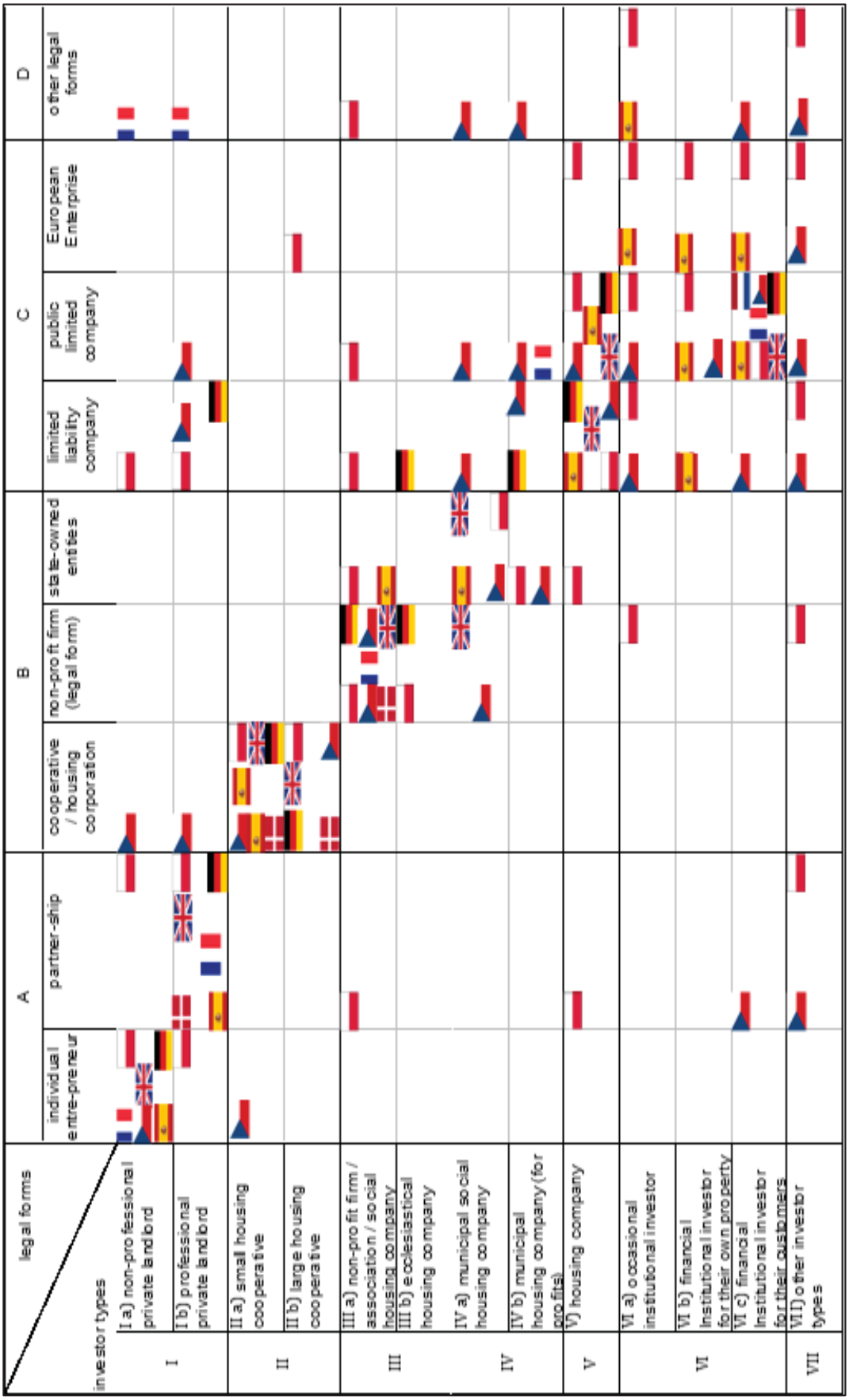
The three main invested types in the private rental housing sector are by order of importance the private landlords, the institutional investors with a public background and the private institutional investors. The third Invested type remains marginal in the housing sector as privileging investments in commercial premises and their higher rental yields. The skills and competences to decide and to lead the implementation of energy efficiency investments is strongly related to the size of the housing stock managed individually by each investor. From view dwellings as mentioned above with regards to private landlords (Spain, France, United Kingdom) to tens of thousands of housing units in case of municipal companies or cooperatives (Germany, Czech Republic, Denmark). In all participating countries regarding the energy concept and the tentative energy efficient measures, private landlords need external services. Regarding the technical and financial matters, they have hardly any information, knowledge and capacities as described above. This underlines once more the particular need of an easy accessible profitability calculation tool helping the private landlords to find the way to energy efficiency investment.

The investor type policy also sets out that there is a great variety of legal forms used by the investors ranging from partnership to limited liability company be it private or public, cooperatives and non-for profit companies. However, the legal form is less important than the tax system attached with the activities performed by the landlord. For example, the legal form of the public limited company may be used either by non-profit or by a profit organization. It is not so much the legal form that impacts the energy efficiency investments but the financial and legal situation offering or not offering tax incentives and subsidized credits as it will be set out in the following chapter.

3. How to speed up energy efficiency investments - policy recommendations

For too long, the energetic retrofitting of the private rental housing sector had been the poor relation of public energy efficiency policies.

Table 1: Investor typology shows heterogeneous investors.



There are certain progresses but they remain rather slow to compensate for delays of the past. It is visible that there is a gap between the implementation of the energy efficiency policies concerning institutional investors and private landlords in all European countries. Policy makers that face a failure in the energy efficiency refurbishment of the rental housing stock owned by private landlords should take into account the characteristics of these private landlords. An efficient policy should be a mix of tax incentives, i.e. such as tax exemption, accelerated and shortened depreciation with financial incentives such as zero or low interest rates (France zero % eco loans) which may be subscribed individually or collectively, advance or low to zero interest loans given for refurbishment measures and/or installation of renewable energy systems. Such financial incentives should be linked to high binding and efficiency standards to be respected when receiving the funding. As the research of RentalCal has shown that there is no country in which the investor in private rental housing integrates consciously the green value in its calculation to justify energy efficiency investments. It is important to get a proper green value representation both in rents and in property values. Place for this is rental regulation and rent tables effectively rewarding energy efficiency investments by allowing rent increases.

As explained above knowledge and trust is a prerequisite for energy efficiency investments. Therefor funding policies and funding schemes must be transparent easily accessible as well as predictable. Investors must have the option to plan and rely on financial and taxing incentive.

Last but not least green value research and monitoring is needed in order to "proof" the benefit of taking up the effort of energy efficiency investments. Research and monitoring includes the evaluation of existing programs to establish a framework for future policy considerations.

Having set out the framework for triggering and assisting investors' decisions for (any or more) energy efficiency investment following the developed device the RentalCal tool will be explained.

4. The RentalCal tool – Profitability calculation software for the assessment of energy refurbishments of rental housing

4.1 Scope of the tool

Although the calculation methodology ('cost optimal methodology') established within the Energy Performance of Buildings Directive (EPBD) framework (EPBD recast of 19th May 2010) suggests the overall financial viability of retrofitting investments within given cost conditions, there is still no sufficient energy investment in European housing stock.

Therefore, the essential challenge for improving the attractiveness of investments within the rental housing industry will be the removal or mitigation of investment barriers. One investment barrier is also the limitation of the EPBD methodology framework to the financial perspective of the owner-occupier, thus neglecting other relevant stakeholder groups such as the rental housing sector. Until now, there is no standardized methodology for profitability calculation of refurbishment investments, not even within single countries' property valuation standards.

The **RentalCal tool** is a web-based profitability calculation software for the assessment of energy refurbishments of rental housing. The tool and the additional documents and features have been developed within the Horizon 2020 RentalCal project by the consortium, consisting of 11 institutions from eight European countries set out at above.

One of RentalCal main objectives is to develop a standardized methodology for the profitability assessment of energy efficient retrofitting investments in the rental housing sector. This methodology needs to incorporate given national levels in costs (investments and operational costs) and efficiency improvements on the one side, returns (rental and appreciation returns of "green value") as well as technical, legal, institutional and financial framework conditions (capital costs, taxation e.g. depreciation allowances, user specific investment horizon, future dynamics of prices and rents, subsidies etc.) on the other side.

The RentalCal tool is multifaceted and supports users from different target groups to assess and compare the profitability of energy efficiency refurbishments in rental properties for a concrete building or a wide variety of

model buildings among several European countries. The tool is also suitable for policy consultancy to quantify the impact of variation in energy efficiency policies among these countries (Enseling A., Lützkendorf T., 2017).

Overall, it can be seen that the development of the RentalCal tool is caught between the complexity of the country-specific boundary conditions, user-friendliness and robustness of the results. Particular attention must be paid to the heterogeneity of the different target groups. (National) tool testing in the course of the project has shown that the demand for a certain depth and detailing of the tool features (simplicity versus completeness) depends on the very stakeholder: e.g. energy consultants assisting private home owners (landlords), resp. private landlords themselves need other information than a professional housing company. Corresponding to the demand of user-friendliness the tool is now offered in seven European languages.

4.2 Methodology of the tool

The RentalCal tool is based on the simple principle of **input, processing** and **output**. Data is either entered directly by the user or selected from default values. The user is guided through the work steps in a structured manner and at the end, the calculation results are presented to the user in a thematically structured and graphically prepared form.

The calculation core of the RentalCal tool uses a dynamic calculation model (thus dynamic investment calculation as part of financial mathematics as a basis) in the form of a complete financial plan (hereafter: VoFI)[7]. This VoFI is used to test the profitability of energy efficient modernisation procedures in rental housing. Especially in this scenario (energy modernisation), it makes it possible to model the economic efficiency in great detail. The calculation is based on the delta approach, which simply includes the change in cash flows in the economic efficiency assessment. In this way, the difference between cash flows before and after the energetic modernisation is taken into account in the calculation.

In addition to the direct cash flows of the property and the energetic motivations, essential differences to other financial mathematical approaches are that indirect payments can also be modelled. These include in particular the consideration of taxes, depreciation, amortisation and financing. Based on the investment costs of the energy-related modernisation, the return on equity of the investor for the capital employed is thus calculated and presented, taking into account possible rent increases, subsidy measures, changes in other management costs and much more (Vimmr T. et al., 2016).

4.3 Workflow of the tool

The RentalCal Profitability Calculation tool consists of three parts (see Figure 6):

In the first part, the basic **information** to understand and apply the tool is provided to the user. This includes a comprehensive presentation and a video tutorial.

In the second step (**input**), the necessary input data for the profitability calculation is requested from the user. As the tool at hand is addressed to several target groups, the input data is obtained and organised differently depending on the data and information available to the user.

For users who are interested in a general evaluation of a typical building, there is a wide variety of model building types and bundles of measures for which profitability calculations can easily be performed using the default values provided by the tool. Similarly, users who would like to evaluate a specific building and want to perform an energy retrofit and profitability calculation but do not have complete information to do so, might also use the default setting.

On the other hand, users who have a complete set of energy audit information can choose a free-hand mode, by-passing the guided input process, and to instead input their own values directly.

For the third step (**output**), the tool calculates the profitability of the investment in question and displays the results to the user.

[7] For further details see summary on the Financial viability of energetic retrofitting: a complete financial plan (Visualization of Financial Implications (VoFI)): http://www.rentalcal.eu/summaries-of-rentalcal-reports

Relevant results are presented according to the perspectives of investors, tenants and environment respectively. Key Performance Indicators (KPIs) are customised regarding the relevant actor group's (investors, housing companies, private landlords) knowledge, customs and requirements and can be associated with them. Moreover, the RentalCal tool also points out the additional non-monetary impacts of the refurbishment like e.g. positive impact on inhabitants' health (Mörmann K., Lützkendorf T., 2016). It is possible to download the Visualisation of Financial Implications as well as further calculation results in PDF format.

4.4 Conclusions: What does the tool offer and who will work with the tool?

The RentalCal web-based tool offers standardized profitability calculations for different types of energy efficiency investments into the rental housing stock. The RentalCal tool applies a dynamic calculation model in the form of a complete financial plan (the so called VoFI) which is used to test the profitability of energy efficient modernization procedures in rental housing.

As a result the tool shows the Return on Equity and other important key performance indicators from an investor's perspective as well as the consequences on net rent and gross rent from a tenant's point of view. Moreover the 'green' benefit of an investment, i.e. the reductions of CO_2 and primary energy consumption are shown. Finally, the RentalCal tool also points out the additional non-monetary impacts of the refurbishment like e.g. positive impact on inhabitants' health.

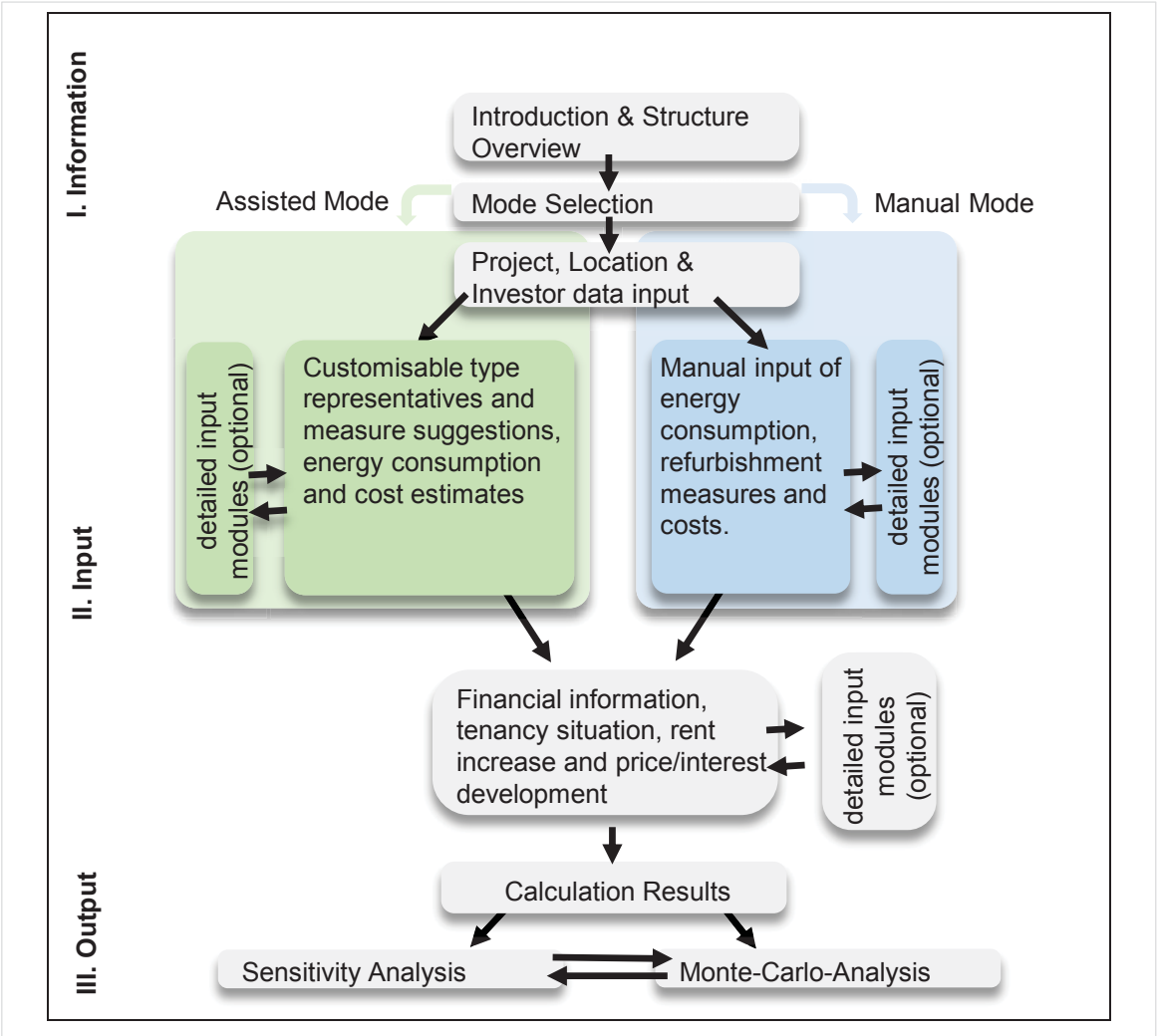


Figure 6: RentalCal tool workflow.

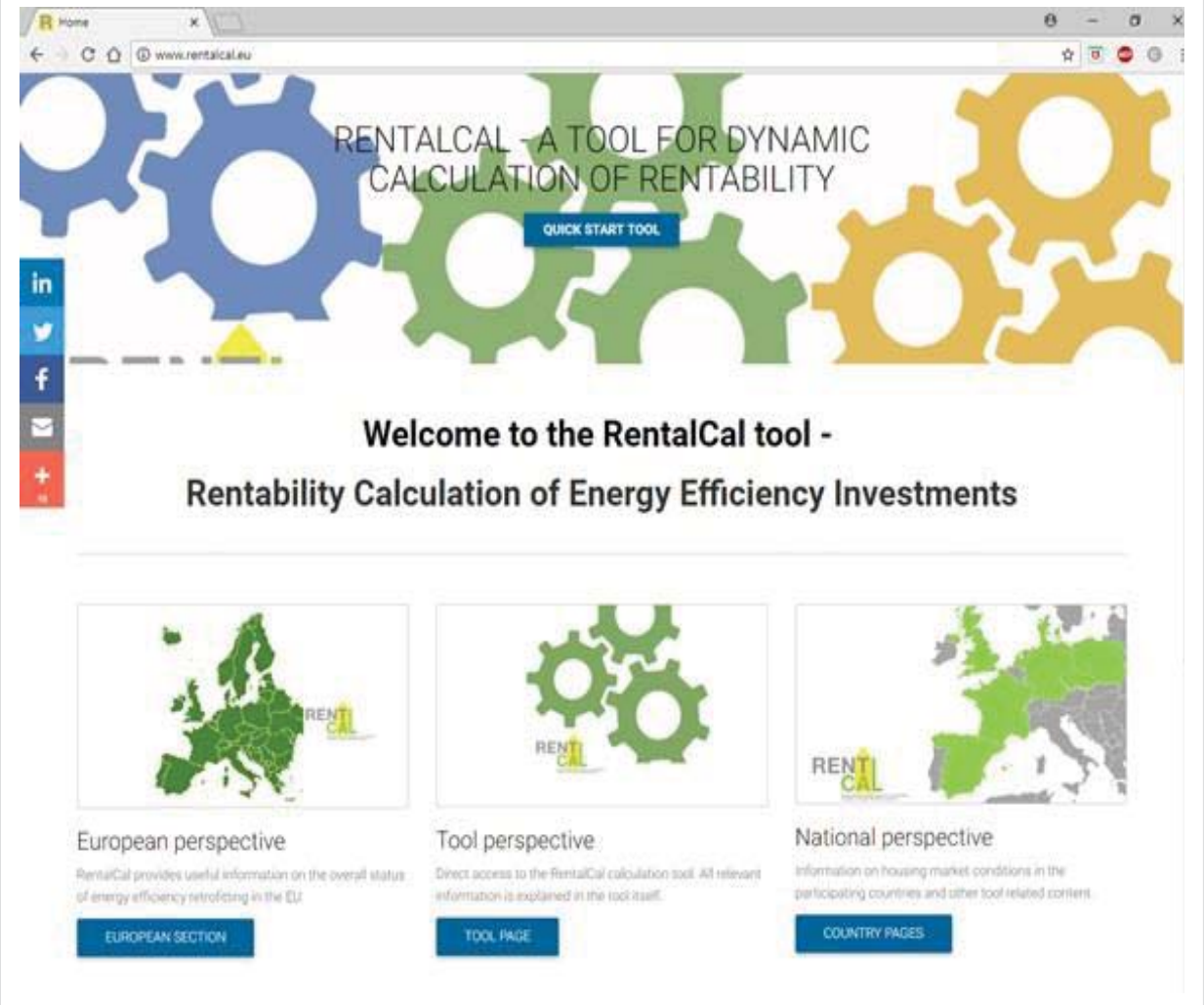


Figure 7: RentalCal tool and online information platform.

The RentalCal tool is intended for policy consultants, housing professionals, energy consultants and private landlords to compare the state of rental housing stock in different European countries and to assess the profitability of energy efficiency refurbishments (www.rentalcal.eu). In this regard, the tool seeks to reduce the investment backlog in the rental housing stock and to help achieve the European Union's climate targets.

Behind the tool a great deal of substantive information on framework conditions (technical, legal, financial and institutional) of eight member states are available. The cross country comparison has been condensed to five pagers dealing with the different framework conditions, a policy paper with policy recommendations and national fact sheets. The place to find all this information is the online information platform (see figure 7 and www.rentalcal.eu.)

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Implementing Carbon Free Ferry Technology - Electrical routes in the land of fjords

by

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Abstract

A game changer for maritime transport is about to be implemented in Norway. Electrical- or hydro-electrical engines will replace 61 ferries in 37 ferry services fueled by diesel the years to come. New ferries are under construction or in the decision making pipeline for ordering. This paper investigates the snowball effect for renewable energy and power supply to other parts of costal Norway on technological-, organizational-/regulative, economic- and political actor aspects of this radical shift of maritime transport technology in the fjords of Norway.

The Norwegian West Coast county council Hordaland took the first initiative. The county council Hordaland decided to organize a process of tender requiring low emission from new ferries with 700 daily departures crossing the fjords (Skauge T. et al., 2017). Our research indicated that this revolution on maritime engines and green energy supply could be explained the combination of new disruptive battery technology, local innovative industry combined with political visons and regulations.

This paper present reflection on following up data for the major decisions for green ferries along the Norwegian Coast. The paper addresses these research questions: What is the disruptive element of the green ferry revolution (Bower J.L and Christensen C.M., 1995)? What seems to be the role of marked vs. public policy on risk taking? What driving forces can explain the new wave of electrical fueled vessels? Proactive business actors (Midttun, A., 2013) or proactive regulation and risk-taking strategies (Bjerkan K. Y., et al., 2016, Braithwaite J. & Drahos P., 2000)?

Keywords: Energy, zero carbon, maritime, electrical ferries, responsible innovations

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Western Norway University of Applied Sciences

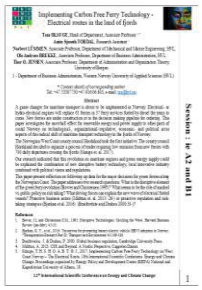
Implementing Carbon Free Ferry Technology

- Electrical routes in the land of fjords

Tom Skauge
Head of Department of Business Administrasjon

Overview

- Research Question
- The Challenge – Contextual landscape
- Electricals Routes for Norwegian Ferries
- From niche to dominant technology – What factors can explain?

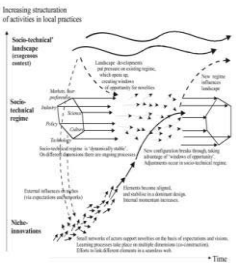


Theory: (Geels)

Landscape
(Context)

Regime

Niche innovations



Our challenge: Global surface temperature
IPCC report Monday

The report highlights a number of climate change impacts that could be avoided by limiting global warming to 1.5°C compared to 2°C, or more. For instance, by 2100, global sea level rise would be 10 cm lower with global warming of 1.5°C compared with 2°C. The likelihood of an Arctic Ocean free of sea ice in summer would be once per century with global warming of 1.5°C, compared with at least once per decade with 2°C. Coral reefs would decline by 70-90 percent with global warming of 1.5°C, whereas virtually all (> 99 percent) would be lost with 2°C.

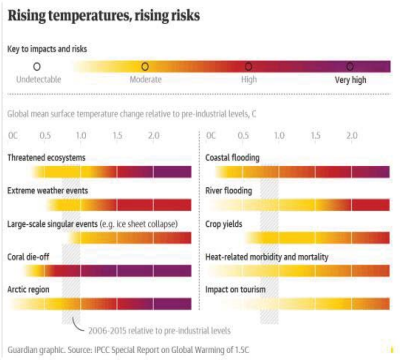
"Every extra bit of warming matters, especially since warming of 1.5°C or higher increases the risk associated with long-lasting or irreversible changes, such as the loss of some ecosystems," said Hans-Otto Pörtner, Co-Chair of IPCC Working Group II. Limiting global warming would also give people and ecosystems more room to adapt and remain below relevant risk thresholds, added Pörtner. "

Our challenge: Global surface temperature
IPCC report Monday

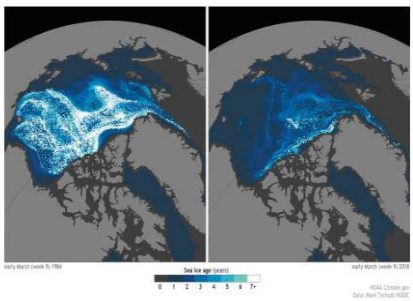
The report noted that emissions need to be cut by 45% by 2030 in order to keep warming within 1.5C.

That means decisions have to be taken in the next two years to decommission coal power plants and replace them with renewables, because major investments usually have a lifecycle of at least a decade.

Our Challenge
Rising temperatures
Rising Risks



Our Challenge:
Old sea ice continues disappearing from the Arctic Ocean



Our Challenge: Risk of drought and fires

True scale of CO2 emissions from shipping revealed

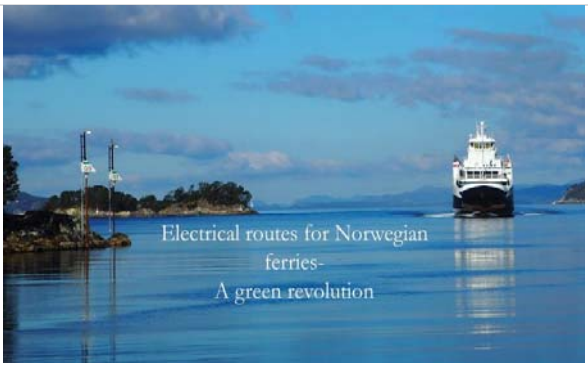
The true scale of climate change emissions from shipping is almost three times higher than previously believed, according to a leaked UN study seen by the Guardian.

It calculates that annual emissions from the world's merchant fleet have already reached 1.12bn tonnes of CO_2, or nearly 4.5% of all global emissions of the main greenhouse gas.

The report suggests that shipping emissions - which are not taken into account by European targets for cutting global warming - will become one of the largest single sources of manmade CO_2 after cars, housing, agriculture and industry. By comparison, the aviation industry, which has been under heavy pressure to clean up, is responsible for about 650m tonnes of CO_2 emissions a year, just over half that from shipping.

Until now, the UN's Intergovernmental Panel on Climate Change has estimated shipping emissions to be a maximum 400m tonnes, but the new draft report by a group of international scientists is a more sophisticated measure, using data collected from the oil and shipping industries for the International Maritime Organisation, the UN agency tasked with monitoring pollution from ships. It not only shows emissions are much worse than feared, but warns CO_2 emissions are set to rise by a further 30% by 2020.

The health implications of shipping emissions are most acute for Britain and other countries bordering the English Channel, one of the world's busiest shipping lanes. A recent peer-reviewed study of shipping emissions found world shipping led directly to 60,000 deaths a year.



Ferry Connections

- Approx. 200 vessels traffic
- 130 ferry routes in fjords and coastlines of Norway.
- 17 connections are linked to the national road network.
- 113 connections to the county road network
- 21 million vessels annually are transported to
- 365 ferry kays

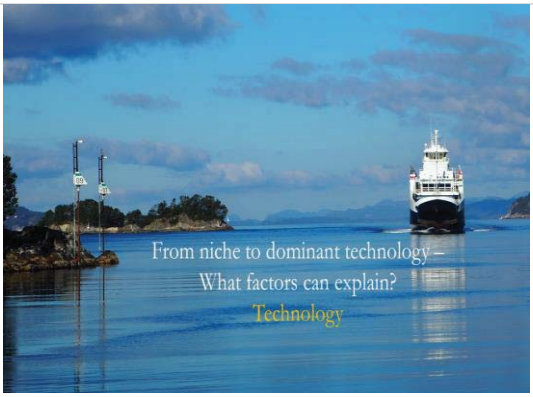
Electrical- or hybrid-electrical engines will replace aprox 70 ferries in 2022

Ferry Connections
The first mover: Hordaland West Coast

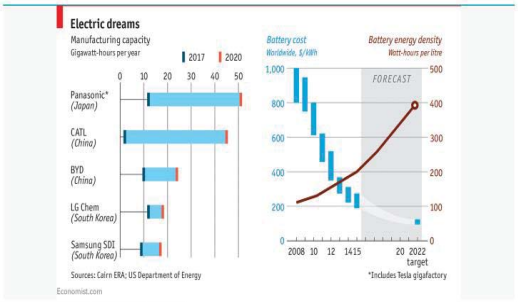
"Rutepakke" Packages for tender	Current / former technology	New technology	Expected CO_2 reduction	Expected energy reduction	In traffic from
Package 1: • Krokeide - Hufthamar • Krokeide - Hufthamar • Husavik - Sandvikvåg • Halhjem - Våge • Sløvåg - Leirvåg • Fedje - Sævrøy • Hatvik - Venjaneset • Langevåg - Buavåg	7 diesel ferries, 1 LNG ferry refitted with plug-in hybrid propulsion	8 ferries where an electrical battery is the main energy source, with a biodiesel-generator as back-up for electrical propulsion	87 %	60 %	3 ferries from 01.01.2018, the rest from 01.01.2020
Package 2: • Skjersholmane - Ranavik • Skjersholmane - Ranavik • Jektevik – Nordhuglo -Hodnanes • Gjermundshamn - Varaldsøy - Årsnes • Jondal - Tørvikbygd	4 diesel ferries, 1 rebuilt diesel-electric hybrid	4 ferries where an electrical battery is the main energy source, with a biodiesel-generator as back up for electrical propulsion. will be built. 1 ferry has been rebuilt for induction charging	90 %	65 %	01.01.2020
Package 3: • Klokkarvik - Lerøy - Bjelkarøy - Hjellestad • «Fjellbergsambandet»	2 diesel ferries	High degree for electrification	86 %	58 %	01.01.2020
Package 4: • Masfjordnes - Duesund	Cable ferry with diesel generator	Fully-electrical ferry	88 %	65 %	01.01.2020
Package 5: • Kvanndal - Utne • Kinsarvik - Utne • Skånevik - Matre – Utåker	3 diesel ferries	High degree for electrification	92 %	74 %	01.01.2020

Electrical innovations in the main ferry counties of Norway

County	Current/former technology	New technology	Expected CO2 reduction	Expected energy reduction	In traffic from
Hordaland	10 diesel ferries; 1 LNG ferry refitted with plug-in hybrid propulsion; 1 rebuilt diesel electric ferry; 1 cable ferry with diesel generator	1 fully-electrical ferry; 12 ferries where an electrical battery is the main energy source, with biodiesel-generator as back-up for electrical propulsion; 1 ferry has been rebuilt for induction charging; 5 ferries with high degree for electrification	80-92%	58-74%	2018: 3 ferries 2020: 16 ferries
Sogn og Fjordane	8 diesel ferries; 2 diesel electric ferries	1 ferry with full electric operation; 5 ferries with at least 80% electric operation; 2 ferries with full electric; 1 ferry will be rebuilt to use biodiesel	2 ferries: 90% 5 ferries: reduction of 9000 ton CO2 each year 1 ferry: 15-26% NOx 1 ferry: no information	2 ferries: 70% 7 ferries: no information	2018: 2 ferries 2019: 2 ferries 2020: 5 ferries
Møre og Romsdal	21 diesel ferries; 7 diesel electric ferries	5 ferries with full electric operation; 6 ferries with full electric operation and diesel engine as backup; 6 ferries with electrical motor and plugin hybrid technology; 1 hybrid ferry; 2 ferries with high degree of electrification or full electric operation; 5 ferries with low or zero emission of CO2; 1 ferry with minimum 30% and 5 ferries with min. 75% operation with electric power, hydrogen or electrical power used to produce hydrogen on land	11 ferries: 75-89% 4 ferries: min. 15-20% NOx reduction 2 ferries: min. 80% NOx reduction 13 ferries: no information	1 ferry: 15% fuel save 29 ferries: no information	2019: 3 ferries 2020: 17 ferries 2021: 4 ferries 2024: 6 ferries
Trøndelag	6 diesel ferries; 1 diesel-electric ferry; 3 liquefied natural gas engine	2 ferries with full electric operation; 2 ferries with full electric operation and diesel engine as backup; 2 ferries with high degree or full electric operation; 2 hybrid ferries with 43% electric operation; 1 ferry with 50-100% and 1 ferry with 75% plugin hybrid technology; 1 electric cable-ferry	6 ferries: 75% 1 ferry: reduction of 2700 ton CO2 each year 4 ferries: no information	11 ferries: no information	2019: 6 ferries 2020: 4 ferries 2021: 1 ferry
Troms	4 diesel ferries; 2 diesel electric ferries	6 ferries: high degree of electrification or full electric operation	4 ferries: 87% 2 ferries: no information	6 ferries: no information	2020/2021: 6 ferries
Nordland	14 diesel ferries; 1 diesel-electric ferry with biodiesel	7 ferries with high degree of electrification or full electric operation; 2 ferries with hybrid technology; 3 ferries rebuilt as plugin hybrid; 1 ferry with electrical engine with biodiesel – prepared for plugin hybrid and for full electrical operation; 2 ferries with low or zero emission of CO2	3 ferries: 60% 3 ferries: 90% NOX reduction 8 ferries: no information	3 ferries: 20%; 3 ferries: 26% fuel save 8 ferries: no information	2018: 4 ferries 2019: 1 ferry 2020: 4 ferries 2021: 6 ferries



Electrical Dreams
Rapid Innovations for Battery Technology

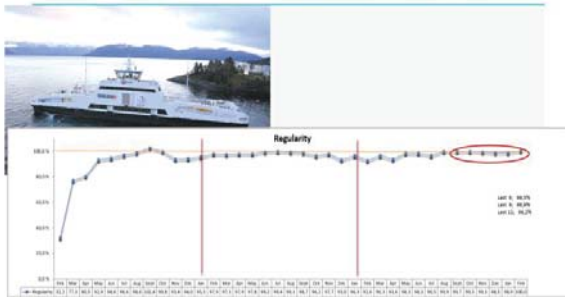


Battery cost and battery capacity 2008-2022 estimated by Economist

17

Effects of new battery technology
Distance from 4-5000 meter few years ago. Today 10-12000 meter

The zero emission technology – electrical engines
Stability in operation of the demonstration project: Ampere



New technology of charging without contact
Induction

Batteries in the Maritime sector Globally

- Today, more than 200 ships with electrical engines and hybrid ships are in operation or in order - most of them Norwegian.
- According to a recent report from DNV GL, one third of all world ships will have batteries on board by 2050.
- By 2050, greenhouse gas emissions from the world's fleet should be reduced to half of what it was in 2008.
- Batteries are part of the solution.

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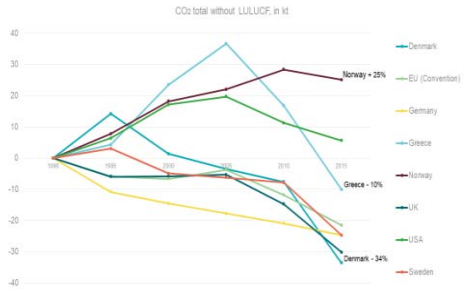
Landscape –
Emission Context Norway



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Alternatives presented for political decision,
Hordaland County Parliament 2015

Alternatives	Minimum reduction CO_2	Minimum increased energy efficiency	Weighting of Environment as an award criteria
Alternative 1	20 %	15 %	20 %
Alternative 2	55 %	25 %	30 %
Alternative 3	35 %	25 %	30 %

24

"Rutepakke" Packages for tender	Current / former technology	New technology	Expected CO_2 reduction	Expected energy reduction	In traffic from
Package 1: • Krokeide - Hufthamar • Krokeide - Hufthamar • Husavik - Sandvikvåg • Halhjem - Våge • Sløvåg - Lairvåg • Fedje - Sævrøy • Hatvik - Venjaneset • Langevåg - Buavåg	7 diesel ferries, 1 LNG ferry refitted with plug-in hybrid propulsion	8 ferries where an electrical battery is the main energy source, with a biodiesel-generator as back-up for electrical propulsion	87 %	60 %	3 ferries from 01.01.2018, the rest from 01.01.2020
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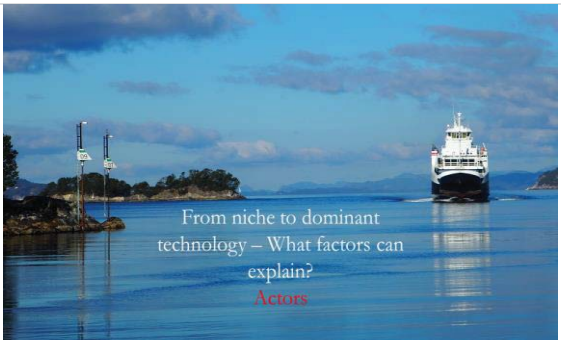
To be competitive
The Tender Process Gave Value to Green Energy

A public construction of a market:

- 70%: Price
- 30%: Environmental premises: Higher score on CO2 reduction gave success



Theory:
Three dimensions of social acceptance (Wustenhagen et al.)

Technological expertise and industrial stakeholders

HAVYARD
Oma Baatbyggeri
FJELLSTRAND 1928 90 2018
WÄRTSILÄ
FISKERSTRAND

We find technological expertice:
NCE Maritime CleanTech Strategy

Urban Shuttle
Supported from Horizon 2020

Ferry and express boat operators

Fjord1
NORLED
TORGHATTEN
FosenNamsos Sjø

Political actors

- **Market Pull:** *Norled –Fjellstrand*
  - *CleanTech Cluster*
- **Market Creators** – Market Push:

Political institutions and NGO's

- **Norwegian Parliament:**
- Asked for zero emission tender for ferry connections
- **County Parliament Hordaland – First mover:**
- Implemented low/zero emission for new tenders
- **NGO's**

Political Mobilization

Parliament Dec. 2014

«Stortinget claim from Government:

All new tender should claim zero or low-emission in new ferry technology

-

Regional Transport Committee

Unanimous decision

Krev statleg hjelp til ferjerevolusjon

Summing up
factors for successful route from niche to dominant regime

TECHNOLOGY

1. New efficient, cheaper battery technology
2. Demonstration project success
3. Grid systems to the kays

INDUSTRIAL-INSTITUTIONAL CAPACITY

4. Entrepreneurial industry og shipyards
5. Innovative oriented Ferry operators

POLITICS

6. Political will to implement Paris goal
7. Tender construction.
8. Risktaking

Actors summing up

Explaining the success

Moving from niche to an new Standardised regime

-electrical routes

Western Norway University of Applied Sciences

Thank You for your attention

Tos@hvl.no

Implementing Carbon Free Ferry Technology
- Electrical routes in the land of fjords

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Tron Ø Jensen, University of Bergen (UiB)

Paper to PROMITHEASnet 11th Int. Scientific Conference on Energy and Climate Change 10-12 Oct. 2018

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Quantification of energy end-users' behavioral patterns

by

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Abstract

Quantification of end-users' behavioral patterns contributes to optimum combination of inputs in energy efficiency modelling, resulting to more effective policies. A methodology, based on the Analytical Hierarchy Process (AHP), allows the quantification of the behavioral patterns of end-users. The development of an innovative Decision Support Tool (HERON-DST) provides the numerical values for the impact of these patterns, demonstrates the deviation of the set energy efficiency targets due to them, minimizes the negative impact of end-users' behavior on these targets and leads to the optimum combination of the respective technologies and practices. This paper presents this methodology and the software. Perspectives and future use of the tool are discussed.

Keywords: Energy Efficiency, behavioral barriers, Decision Support Tool

1. Introduction

For achieving Energy Efficiency (EE) targets, more and more emphasis is placed on the consumer involvement (Poznaka L. et al., 2015). There are three reasons for this approach: First, a number of scholars refer to a significant difference between the observed levels of EE and those that are expected due to optimal energy use. The difference is mentioned as "energy efficiency gap" and is attributed to a number of barriers among which are those linked with consumers' behavior (Gillingham K. et al., 2018; Hackle B. et al., 2017). Second, behavioral barriers demonstrated by end users create negative deviations in EE set targets between 5-20% in EU and 20-30% globally (UNEP, 2016). Third, there is increased demand of improving the design of models so as to become more 'realistic' by incorporating features observed in the real world (McCollum L. David et al., 2017). One group of such features of the 'real world' relates to human behavior. Barriers, related to end-users' behavior, need to be incorporated in forward looking EE modelling after being identified and analyzed (McCollum L. David et al., 2017; EC, 2015a, 2015b; EEA, 2013).

However, there is a lack of studies that measure actual behaviors and intentions or contribute to the full understanding of such factors in the consumption of EE products (Nguyen T. N., 2017; NEED4B, 2017). The HERON[8] - a Horizon 2020 funded research and innovation project - addresses this shortage with its main outcome, the innovative Decision Support Tool (HERON-DST). This, developed by KEPA, tool is a user-friendly software, whose methodology is based on the Analytical Hierarchy Process (AHP) (Mavrakis D., Konidari P., 2017). The purpose of the tool was to confront the problem of how to overcome deviations in EE targets, created by behavioral barriers demonstrated by end users. This is achieved by: i) calculating the negative impact of barriers (Impact Factor), ii) incorporates

[8] Full title: Forward-looking socio-economic research on Energy Efficiency in EU countries; Implementation period: 2015-2017

these Impact Factors (IF) in forward looking EE scenarios, iii) calculating the occurring deviation against EE targets due to these barriers; iv) providing combinations of technologies and practices, allowing the optimization of scenario's inputs; v) minimizing the negative impact of end-users' behavior in EE policy-making and leading to the optimum combination of EE technologies and practices.

The paper focuses on the HERON-DST. The first session concerns its concept. The second session refers briefly to its methodology. The third session describes the main modules. The last session discusses its potential (functions and results) and is followed by conclusions.

2. Concept

The key drivers (or assumptions) used for the development of scenarios for EE include the penetration of EE technologies (Building shell improvement, efficient heating and cooling, heat pumps, more efficient vehicles, etc.) and their supportive policy package (energy labelling, building standards, fuel taxes etc.) (IEA, 2013; European Communities, 2006). Depending on the rationality of the developed scenarios, may include assumptions that refer to overcoming identified existing barriers. usually these assumptions concern a numerical change in the energy consumption that is set arbitrarily according to the user's judgement. Each identified barrier, due to end-users' behavior towards EE issues, has a different impact in limiting the efforts of achieving any type of EE target (Mavrakis D., Konidari P., 2017).

Therefore, the concept was to quantify qualitative data about non-economic and non-market elements, such as social, educational and cultural ones linked with the end-user's behavior, in such forms capable to be incorporated into EE modeling, as input drivers or as part of them. Quantification of the qualitative information of identified barriers allows the numerical expression of the respective Impact Factors on the inputs for the forward-looking EE modelling.

3. Methodology

With the use of the Analytical Hierarchy Process (AHP), comparative analysis is conducted among barriers linked with the end users' behavior towards technologies, measures and policy instruments for achieving EE targets. This process reveals and quantifies the negative impact of each barrier on the set of the assumed targets, in EE modeling (Mavrakis D., Konidari P., 2017). As a next step, mathematical expressions using the calculated impact factors of barriers provide numerical inputs to energy modelling reflecting the deviation from the set EE target due to the end-users' behavior.

The methodology for calculating the Impact Factors of the identified has six steps (Mavrakis D., Konidari P., 2017):

Step 1: Mapping, categorization and merging of behavioral barriers; Barriers are mapped, merged and grouped into three main categories: i) Social-Cultural-Educational, ii) Economic and iii) Institutional. The outcome of this step is based on: i) Bibliographic research (National Action Plans, Strategies, National Communications, reports from target groups (associations of household owners, chambers, projects etc), published papers); ii) interviews or questionnaire survey (Hochman G. and Timilsina R. G., 2017; Chiaroni D. et al., 2016; HERON, 2015a; 2015b).

Step 2: Development of the AHP tree and matrices; The selection of the AHP is justified by the advantages that this multi-criteria method has for the purposes of this study (Mavrakis D., Konidari P., 2017). It allows pair-wise comparisons among the objects that need to be assessed (either criteria/sub-criteria, alternatives, options or barriers). The mapped and classified barriers into groups and sub-groups of Step 1, form the AHP tree. Apart from the structure of groups and sub-groups, the goal (zero level of AHP tree) needs to be determined also. The goal reflects the aim of the tree which is – in this case - to "limit the efforts for achieving the EE target" due to the impact of each barrier that is part of this tree (Figure 1).

Step 3: Calculation of weight coefficients; Barriers are compared pair-wised and the importance of one barrier over the other is assessed using a 1-9 scale. The assigned inputs for these pair-wise comparisons are checked for their consistency (Mavrakis D., Konidari P., 2017). If the result of the consistency test is accepted then the calculations of this step are used for the next step. Details about the used equations are described in a previous work (Mavrakis D., Konidari P., 2017; HERON, 2017).

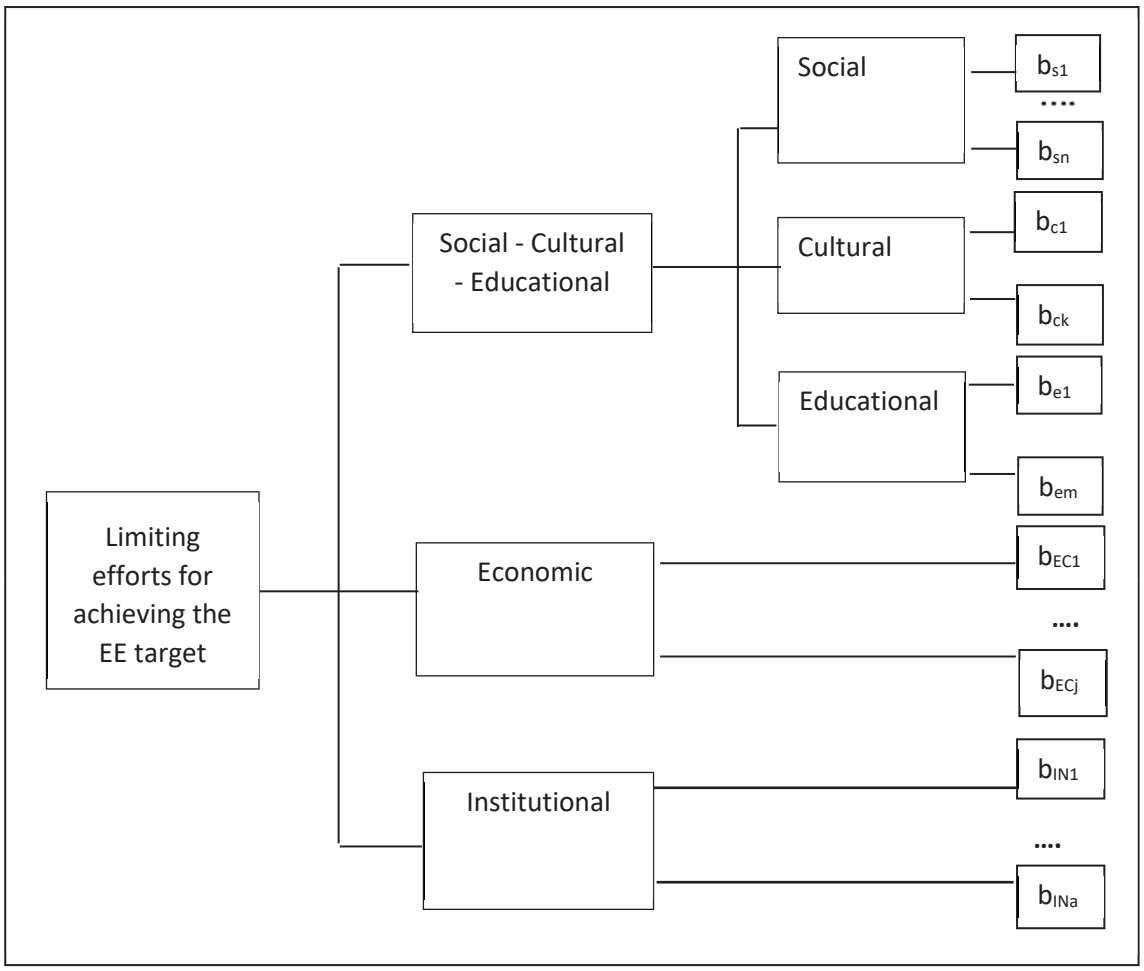

Figure 1: The AHP tree of the barriers.

Step 4: Definition and calculation of Impact Factors of barriers: After the completion of all comparisons (in all levels of the AHP tree), the Impact Factor (IF) for each one of the identified barriers is calculated. The IF is a numerical outcome, expressing the contribution of the concerned barrier in preventing the achievement of EE targets (Mavrakis D., Konidari P., 2017).

Step 5: Linkage of Impact factors with input drivers: The total impact of the assumed existing barriers on a certain input is expressed by the Total Impact Factor which is also calculated. Consequently, EE technologies and practices are linked with the relevant barriers through their Total Impact factors that are provided by HERON – DST (Mavrakis D., Konidari P., 2017).

Step 6: Incorporation of the Total Impact factors in the forward-looking EE modelling: The occurring deviations are calculated. Options for reducing deviations through the best combination of EE technologies and practices and the minimization of the IFs leads to optimized outcomes. Outcomes are available to be used as inputs to EE modelling (Mavrakis D., Konidari P., 2017).

4. Software

The aforementioned briefly described methodology was turned into the HERON-DST software. The rationality underpinning the software is reflected with a flow diagram so that the user is facilitated in understanding the simplified for him/her procedure without getting into the details (Figure 2). The user can see what are the requested by him/her main actions depending at which step of the methodology he/she has reached.

4.1 Impact Factors

The first main window that opens reflects steps 1-4. The user has on the left, in a column, all the groups and sub-groups of the barriers corresponding to the levels of the AHP tree. The respective to the group or sub-group matrix appears on the right. Each cell of the matrix is filled by the user after selecting a

number from the AHP scale to express the importance that one barrier has over the other when two of them are compared. This scale contains the numbers 1, 3, 5, 7 and 9. Information about the scale is available to user. If the outcome of the consistency test is acceptable (after filling in the whole matrix and pressing the calculation button), the user allows to the software to save these values and use them in the subsequent steps (Figure 3). The values of the weight coefficients will be used for the calculation of the "Impact Factor" (IF) of each barrier. The user places his/her judgements as the inputs by going through all levels (groups and barriers). When all matrices are filled and the impact factors of all levels in the AHP tree are calculated, then the user can proceed and the second main window opens (Figure 4).

The software has the already calculated IFs for seven countries (Bulgaria, Germany, Greece, Estonia, Italy, UK and Serbia[9])(HERON, 2017). This option was included to facilitate users if they do not wish to fill in all matrices and confirm the consistency of their inputs until the there is an acceptable value.

4.2 Deviation of the EE target

4.2.1 Overall target

The second main window concerns the calculations for steps 5 and 6. The user sets the inputs for this window by selecting country, sector/sub-sector and the EE target. This target may be either the one that will be used in the developed scenarios for the EE modelling (ie in a LEAP, MARCAL or any other model) or an already set EE target. The user is able to explore the impact of barriers on the EE target or options in reducing the impact of selected barriers on this target. The options for exploring the deviation on the EE target are determined by the user as described below.

After setting the EE target the user has two options: i) to select the EE technologies out of a list that the HERON-DST has and proceed with this selected combination; ii) to be facilitated in his/her selection through the "Best combination of technologies". The technologies that appear in the list correspond to those of the relevant sector and are those to be used usually in the scenarios for energy efficiency. Depending on the number of the technologies that the user would like to concern in the development of the scenarios, the software displays a set of seven combinations of an n number of technologies (n is 2, 3, 4, 5 or 6) (see Figures 4 and 5). The hierarchy by which these combinations are displayed depends on the number of common barriers that the technologies of each combination exhibit.

Once the preferences regarding the technologies are set, the user presses the "Calculate" button. The calculated target due to the impact of the barriers linked with the technologies is displayed. The user can realize the size of the deviation and has now two options to explore. The first is to press the "Reset" button and see the EE target that needs to be set for achieving the initial one (before selecting the technologies). The second option is to decide which barriers need to be confronted so that their impact is minimized and the deviation from the EE target is reduced.

4.2.2 Targets per technology

Another option for the user is to set EE targets per technology. Depending on the detailed availability of official data and how the scenarios are developed, the user may need to set penetration rates for a technology or amounts of energy savings attributed to the concerned technology (Figures 6 and 7).

4.3 Minimization of IF

The third main window of the HERON-DST concerns the selection of the barriers for which the user may assume that can be confronted with the introduction of the appropriate policy instruments. There are three options: i) to select specific barriers out of a list; ii) to select from a list of those that are common among the selected technologies and iii) to select all the common barriers among the examined technologies (Figures 8 and 9).

[9] Case studies: https://heron2017.wordpress.com/implementation/

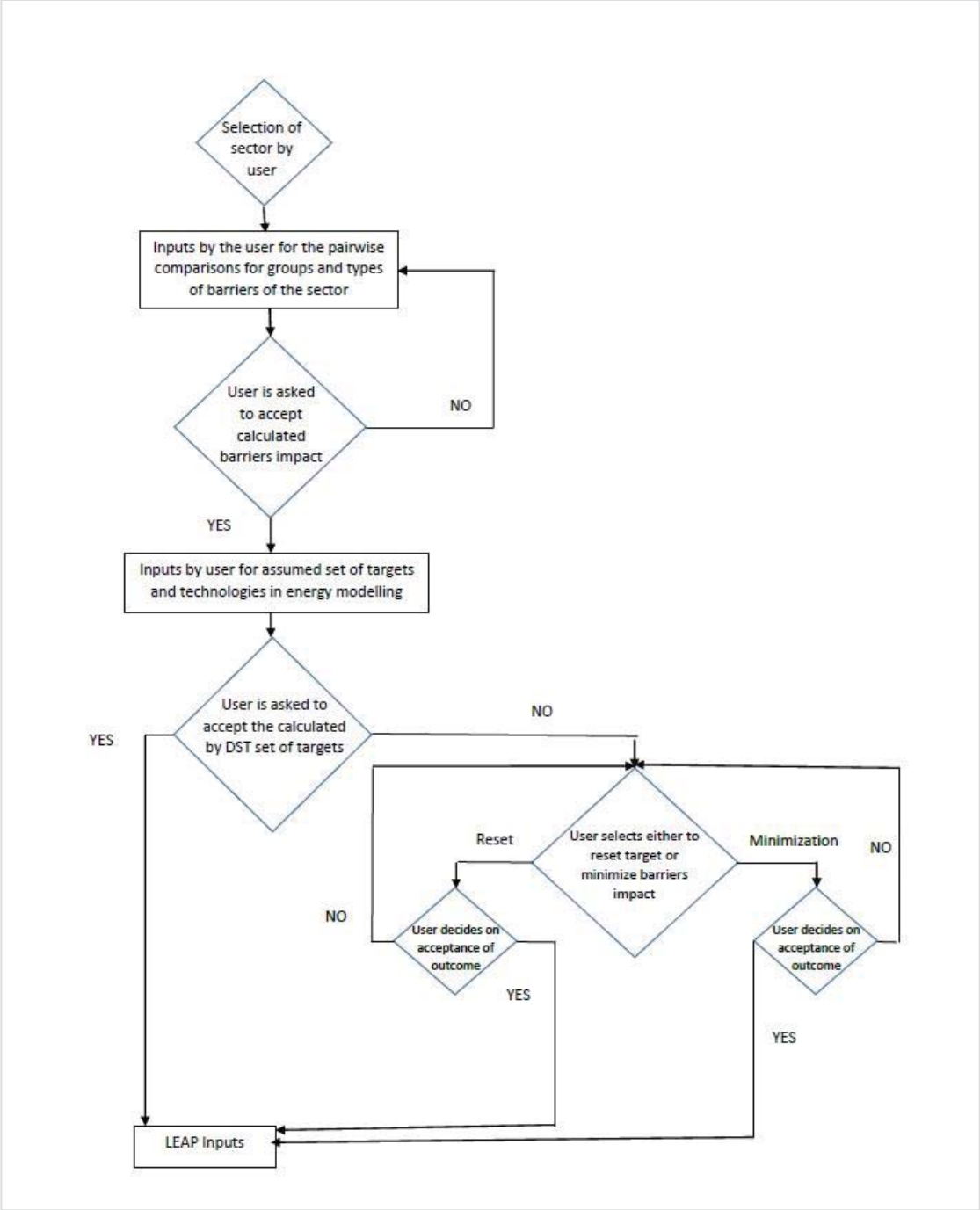

Figure 2: Flow diagram for the HERON DST software.

The user sets its preferences about barriers, base year and the future year for which the outcomes are needed. The new EE target or targets are displayed on the right top of the window (Figure 10). The user can see the differences among the initially set EE targets and the ones after the minimization of the IF of the barriers. The user has the option to press the "Help" button that is next to each barrier and see what are the already used and the proposed policy instruments for confronting that specific barrier.

4.4 Outcomes

The software offers the option to save the outcomes in an Excel file that can be used as inputs to the model (LEAP, MARKAL etc). A pop-up window appears to inform the user about this option.

5. Potential

The software is designed so as to be flexible and incorporate without problems additional inputs (HERON, 2017). These inputs may concern: i) Areas: It can be used for the areas

of natural gas, oil or renewable energy sources with a different set of sectors and barriers; ii) Sectors: Apart from the two sectors (Buildings and transport) other sectors can be added (industry, agriculture, waste management etc); iii) barriers: If another work or study concludes to additional barriers or if new ones emerge these can be included to the software; iv) countries: apart from the seven aforementioned countries if the work is repeated for another country the outcomes can be also incorporated to the software. v) technologies: new technologies can be included as well as long as they are linked with the set of barriers.

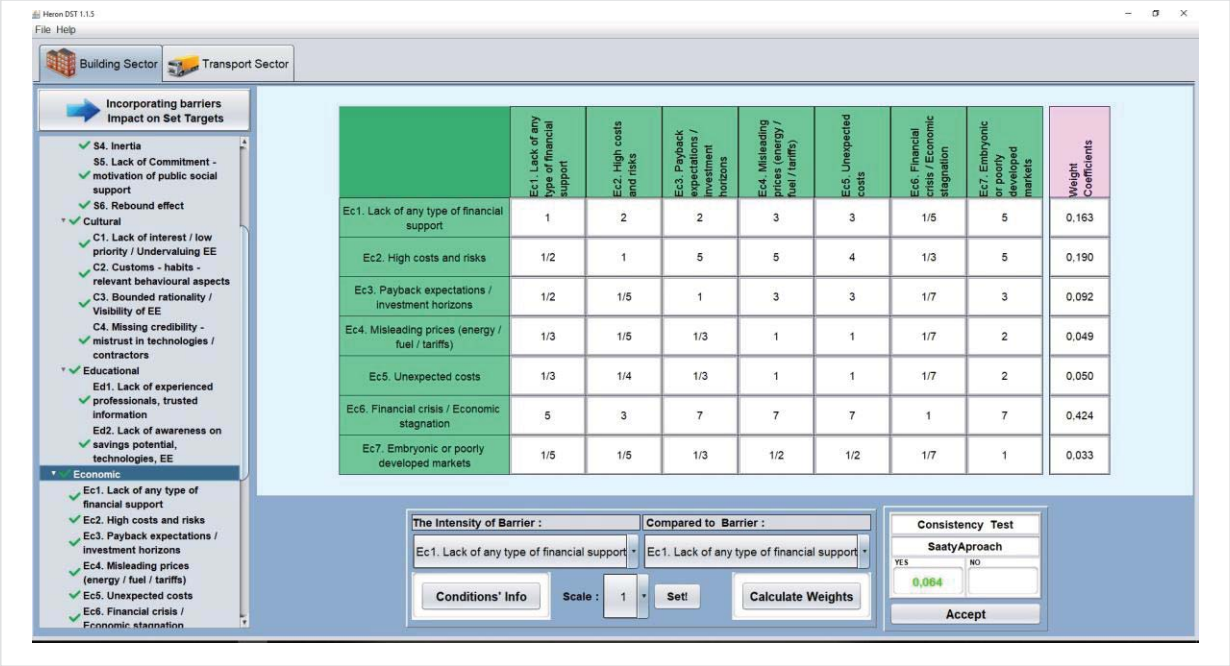

Figure 3: First main screen/window for determination of the Impact Factors of the barriers.

Figure 4: Inputs for EE targets (country, sector, numerical value of general target, EE technologies).

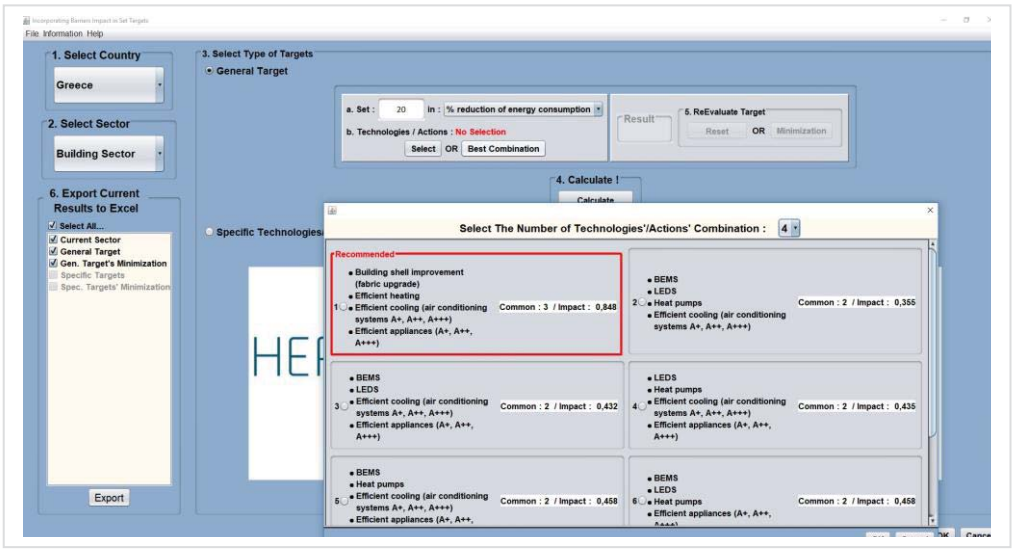

Figure 5: Options for "Best combination" of EE technologies.

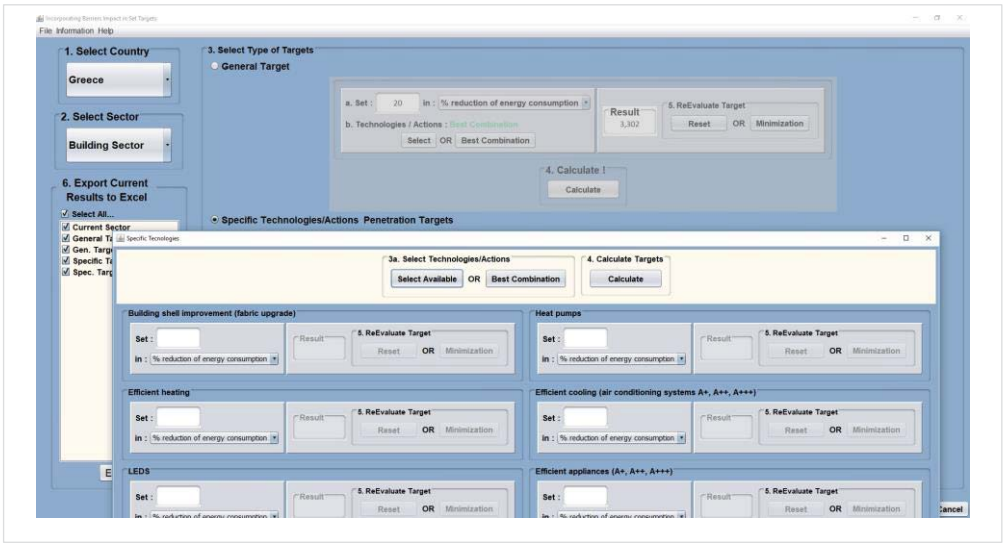

Figure 6: Inputs for EE targets (country, sector, numerical values for targets per EE technology).

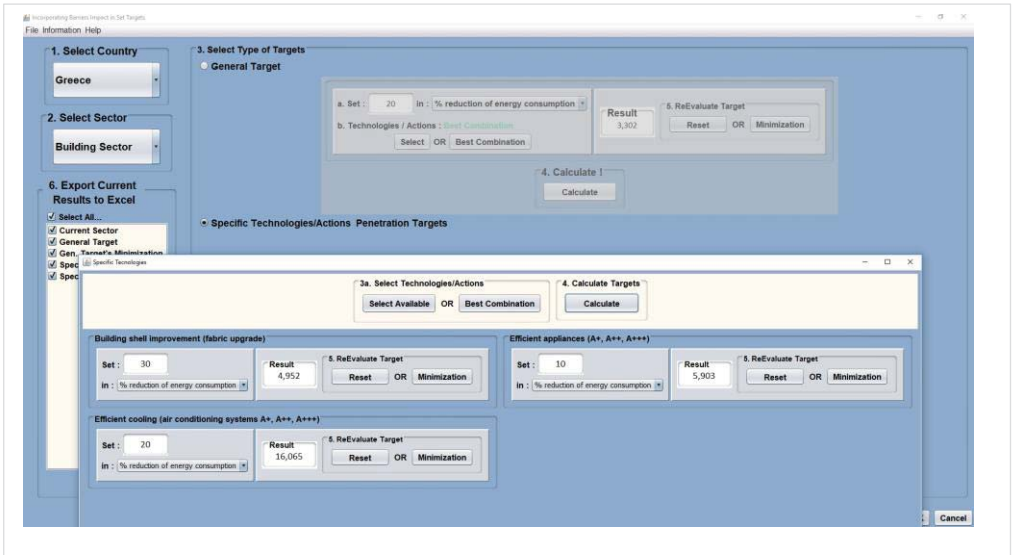

Figure 7: Best combination of three EE technologies and deviations of targets.

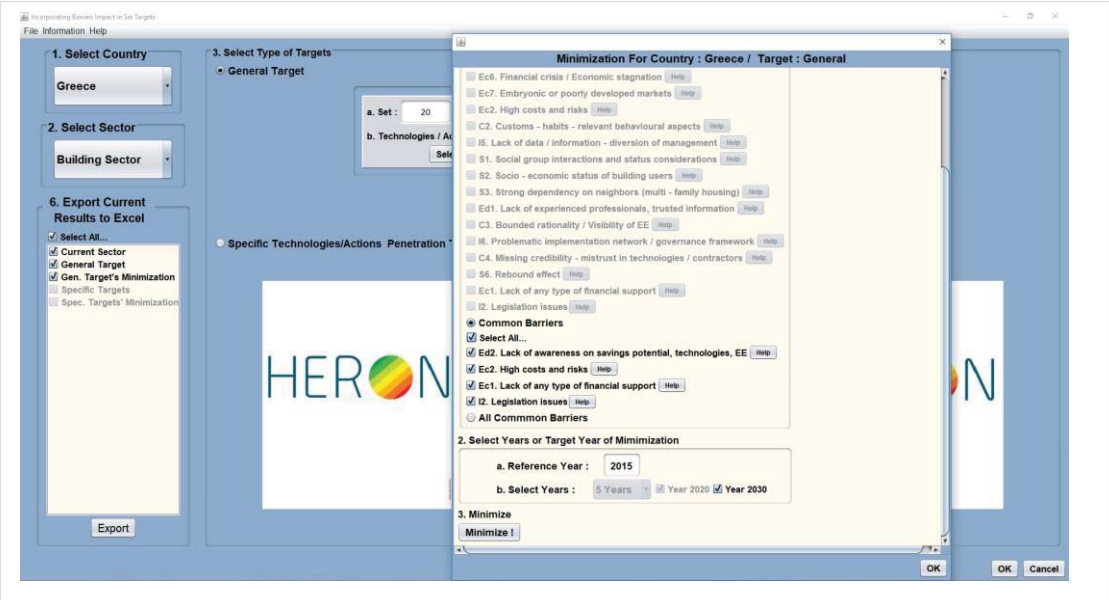

Figure 8: Inputs for minimization of IF of barriers.

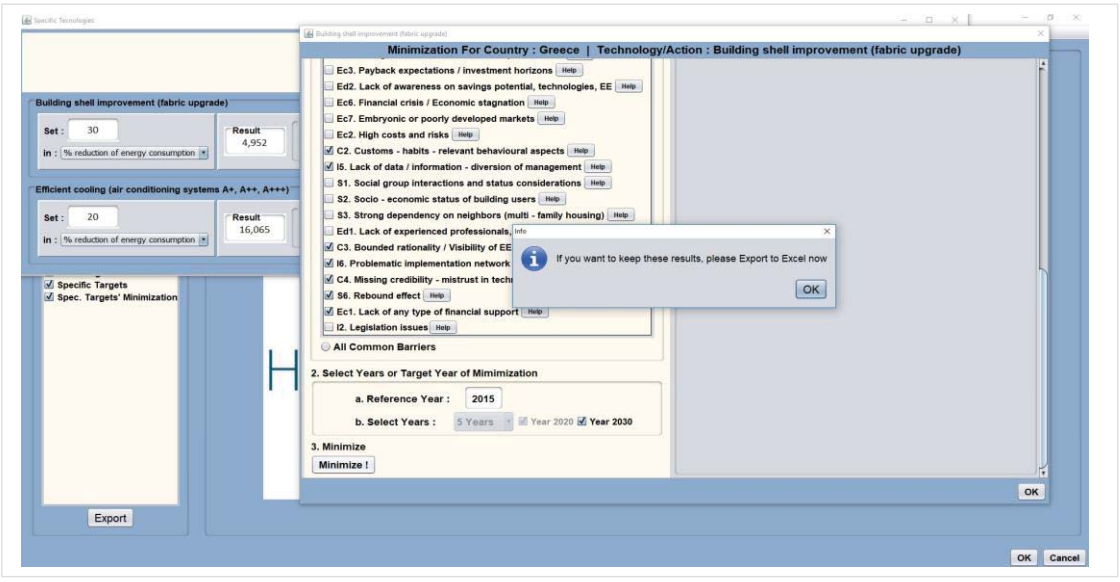

Figure 9: Option to save outcomes in Excel file.

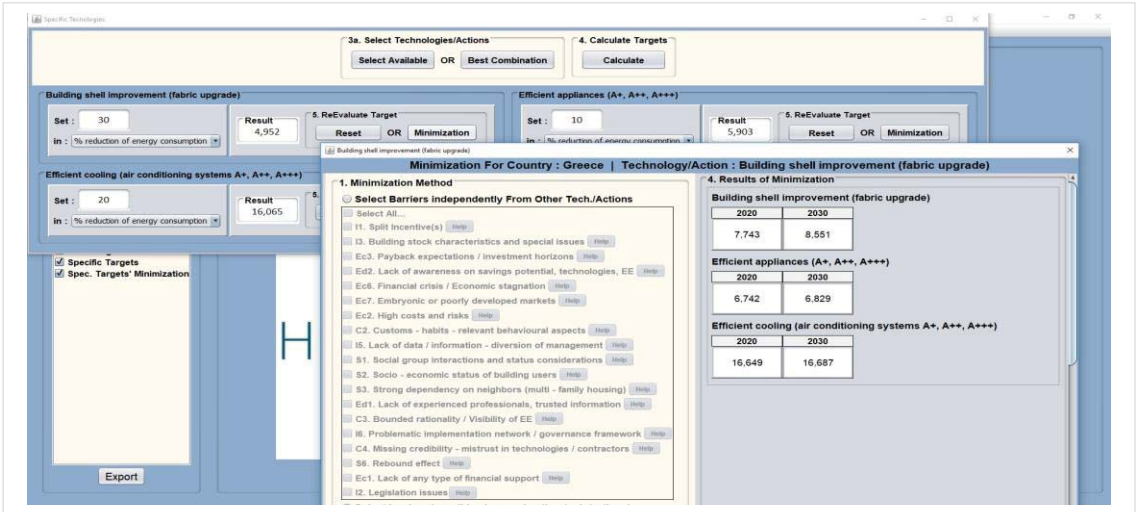

Figure 10: Minimization outcomes.

The HERON-DST is part of the overall HERON process (pathway), that follows these steps (HERON, 2017):

1. Develop EE scenarios;
2. Define the set of behavioral barriers *(in relation to input drivers)*;
3. Collect and develop a reliable qualitative data base;
4. Calculate (through the HERON – DST) the impact and total impact factors of barriers;
5. Calculate the emerging deviations, due to behavioral barriers, on both the input drivers and EE targets, in scenarios' analysis;
6. Optimize the mixture of input drivers and final targets with HERON -DST;
7. Identify the optimum EE scenario against *Environmental performance*, *Political acceptability* and *Feasibility of implementation* using the multi-criteria AMS;
8. Conclude with a policy mixture leading to a more effective and preferable EE scenario.

Provided that the EU countries will develop reliable qualitative data for barriers, then the HERON-DST and the developed methodology will assist policy makers in modifying their implemented EE policies and developing more reliable ones.

6. Conclusions

The main characteristics of the presented HERON-DST[10] software are:

- Working fields: Buildings and transport sectors (Two sets of common barriers for seven countries);
- Options to add: i) or modify barriers and/or technologies; ii) countries; iii) sectors; iv) areas.
- Incorporation of end-user's behavioral barriers as inputs for EE modelling;
- Calculation and optimization of occurring deviations;
- Outcomes provided in Excel file.

Based on advanced research, surveys and questionnaire, the HERON-DST: i) provides policy makers with the ability, for the first time, to quantify the qualitative characteristics associated with end-users' behavioral barriers. ii) allows the calculation of the impact of behavioral barriers on the input drivers (technologies and policies) and the assumed targets of EE scenarios. The developed scenarios are now more reliable, allowing the selection of effective policies for the mitigation of climate change and promoting, through these optimum pathways, sustainability.

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Energy Efficiency in the framework of 2030 Agenda for Sustainable Development Goals: The case of Italy

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Abstract

The 17 Goals included in the United Nations 2030 Agenda for Sustainable Development refer to different interlinked aspects of social, economic and environmental development. The energy issue represented in the Goal 7 (Affordable and clean energy) assumes a crucial role. "Ensuring universal access to economic, reliable, sustainable and modern energy services" is particularly relevant both to guarantee inclusion and equity in the use of energy resources and for the positive effect of a more efficient and rational use of energy on economic and social development and in terms of environmental and energy sustainability. Energy efficiency is a priority for national and international policies. The 2030 Agenda established the target 7.3 of doubling the global rate of improvement in energy efficiency. The EU policies set targets for 2020 (20% increase in energy efficiency) and 2030 (27%), while the "Clean Energy for the Europeans package" proposed an energy governance model focused on energy efficiency ("putting energy efficiency first"), as a means of economic and employment promotion and sustainability.

The aim of the proposed presentation is to analyze energy efficiency indicators over time, in a international, national and regional (according with data availability) perspective, with a focus on Italian situation in terms of energy savings achieved by sector (ISTAT, 2018; ENEA, 2018). The expected outcome is a comparative description of the state of advancement in energy efficiency comparing with international policies targets, and, for Italy, with national targets (Action Plan for Energy Efficiency and National Energy Strategy). The approach of analysis is descriptive. From a preliminary analysis, it can be concluded that, despite the improvements achieved over time, the policy targets are still far from achieving and the disparities between countries are still substantial (UNSD, 2018; Eurostat 2018; Eurostat 2017).

Keywords: energy efficiency, sustainable development goals

1. The 2030 Agenda for Sustainable Development Goals: initiatives for the implementation at national and international level in a global integrated perspective

"Furthering economic and social development while ensuring that it meets the needs of the present generations without compromising those of the future ones" is the generally accepted definition of sustainable development, which refers to the concept of compatibility between economic growth and environmental protection.

In 2015, the United Nations General Assembly adopted the 2030 Agenda for sustainable development (UN General Assembly, 2015), a global action plan for people, planet and prosperity which takes into account the need to support universal peace and freedom, to eradicate poverty in all its

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forms and dimensions, achieving a sustainable transformation of the society, the economy and the environment by 2030, also in terms of safety, well-being and justice.

The 17 Sustainable Development Goals (SDGs) included in the Agenda refer to different areas of social, economic and environmental development, which need to be considered in an integrated approach, including international cooperation and the political and institutional context.

The 17 goals, which are declined in 169 targets (UN Statistical Commission, 2016, 2017, 2018) are the following:

1. *No poverty*. End poverty in all its forms everywhere;
2. *Zero hunger*. End hunger, achieve food security and improved nutrition and promote sustainable agriculture;
3. *Good health and well-being*. Ensure healthy lives and promote well-being for all at all ages;
4. *Quality education*. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all;
5. *Gender equality*. Achieve gender equality and empower all women and girls;
6. *Clear water and sanitation.* Ensure availability and sustainable management of water and sanitation for all;
7. *Affordable and clean energy*. Ensure access to affordable, reliable, sustainable and modern energy for all;
8. *Decent work and economic growth*. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all;
9. *Industry innovation and infrastructure*. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation;
10. *Reduced inequalities*. Reduce inequality within and among countries;
11. *Sustainable cities and communities*. Make cities and human settlements inclusive, safe, resilient and sustainable;
12. *Responsible consumption and production*. Ensure sustainable consumption and production patterns ;
13. *Climate action*. Take urgent action to combat climate change and its impacts;
14. *Life below water*. Conserve and sustainably use the oceans, seas and marine resources for sustainable development;
15. *Life on land*. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss;
16. *Peace, justice and strong institutions*. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels;
17. *Partnership for the goals*. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

In order to identify a common statistical framework as a tool for monitoring and assessing progress towards the objectives of the Agenda, an Inter Agency Expert Group on SDGs (IAEG-SDGs) was set up by UN Statistical Commission. The IAEG-SDGs has been working to a first list of more than 200 indicators associated with different targets – presented in March 2016, on the occasion the 47th session of the UN Statistical Commission, and to further implementation of reviews of the list (UN Statistical Commission 2016; 2017; 2018). The current, revised set includes 244 indicators, some of them considered relevant to more than one goal.

The indicators are classified by three "Tiers" (I, II and III), according with the level of development of methodology and with data availability. 83 indicators belong to Tier I, based on a standard methodology and regularly produced at the national level (34% of the total); 67 indicators equally based on standard methodology, but not being regularly produced, belong to Tier II (27%), and 88 indicators not based on standard methodology belong to Tier III (36%). Lastly, 3% of indicators has not been yet classified by tier, or belong to more tiers due to the heterogeneity of their components.

The implementation process is still in progress and involves more updating steps to ensure a thorough review of the indicators, their correct classification by the different Tiers, and the preparation of the necessary metadata. The IAEG-SDGs is considering some additional indicators and the

methodologies for the TIER III indicators are being defined together with the custodianship agencies. An overall review is expected in 2020 and another in 2025.

The High-level Group for Partnership, Coordination and Capacity-Building for statistics for the 2030 Agenda for Sustainable Development (HLG-PCCB) ensures strategic leadership in monitoring and statistical reporting of the whole process. The HLG developed the "Cape Town Global Action Plan"[12] for sustainable development data, adopted by the resolution of the General Assembly in July 2017 (UN General Assembly, 2017). Within a global vision for the planning and implementation of actions to implement the Agenda, the document provides a concrete list of actions aimed at strengthening the statistical capabilities of the countries. It recognizes the importance of the national statistical systems to identify new strategies, develop the statistical production of quality and strengthen partnership and cooperation, and the coordinating role of the National Statistical Offices (NSOs). In fact, the NSOs play a crucial role: because of their methodological and technical know-how, but also as reference points for data production at national level and coordinators of national initiatives in the study and experimentation of alternative data sources as well. Several NSOs, including Italy's ISTAT, take part in the HLG-PCCB and IEAG-SDGs activities.

Reconciling the level of ambition of the SDGs targets and indicators defined at global level with the specific experiences of the countries is certainly a challenge for statistics, but also an opportunity for the national statistical system and for a country. To satisfy the global and national information demand together, since 2016 ISTAT has been developing statistical measures that allow the monitoring of progress towards the SDGs, considering their interrelation, the factors that may condition their achievement, the potential synergies among statistical indicators SDGs and statistical indicators for specific policies. ISTAT is conducting the collection and analysis of IAEG-SDGs indicators with an inter-institutional approach, inside and outside the boundaries of Sistan, in order to make possible the definition of a methodologically consistent mapping, integrated and shared, and an assessment of the overall SDG indicators.

Since 2016, Istat has made available, with half-yearly updates, the SDGs indicators produced whithin Sistan. In July 2018, 235 statistical measures for 117 SDGs indicators were available[13]. With reference to the indicators defined at international level, 83 measures are in perfect coincidence (identical; covering 55 SDGs indicators), 96 measures partially reflect the information needs (Similar, partial; 61 SDGs); 56 measures were included to provide further useful elements for understanding and monitoring the target in the "national context" (Table 1).

In this fourth release, ISTAT published the First Report on the SDGs for Italy (Istat, 2018), presenting statistics and analyses from the global to the national and regional level and an integrated lecture of information that will be further developed in the next reports.

2. Sustainable Development Goal 7 – Affordable and clean energy

Comparing with previous Millennium Development Goals (UN, 2000), the Agenda 2030 points out the centrality of the energy issue with respect to the three pillars of sustainable development (social, economic and environmental) by the definition of a dedicated goal. Indeed, "Ensuring universal access to economic, reliable, sustainable and modern energy services" is crucial, not only to guarantee social equity in the use of energy resources, but also for the effects of a more efficient and rational explotation of energy on economic development and in terms of environmental sustainability. Relaying on clean fuels and safe technology is extremely important to contain health risks associated with the emission of harmful gases at both domestic and atmospheric levels, while the extension in the utilization of renewable energy sources is functional to contain progressive depletion of natural resources. Despite the improvements over time, the disparities between countries in achieving the 2030 Agenda are still relevant.

12 https://unstats.un.org/sdgs/hlg/Cape-Town-Global-Action-Plan/

13 https://www.istat.it/en/well-being-and-sustainability/sustainable-development-goals/istat-indicators-for-sustainable-development

The Goal 7 includes 3 targets and 2 means of implementation targets, to be reached by 2030, and, for each of them, one or more reference indicators:

7.1 By 2030, ensure universal access to affordable, reliable and modern energy services;

7.1.1 Proportion of population with access to electricity;

7.1.2 Proportion of population with primary reliance on clean fuels and technology;

7.2 By 2030, increase substantially the share of renewable energy in the global energy mix;

7.2.1 Renewable energy share in the total final energy consumption;

7.3 By 2030, double the global rate of improvement in energy efficiency;

7.3.1 Energy intensity measured in terms of primary energy and GDP;

7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology;

7.a.1 International financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems;

7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in accordance with their respective programms of support;

7.b.1 Investments in energy efficiency as a proportion of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services.

For Goal 7, ISTAT disseminated six indicators, referring to three of the five targets: two indicators for 7.1; three indicators for 7.2; one indicator for 7.3 (Table 2).

A representation of the main trends measured by ISTAT indicators for Goal 7 in Italy can be summarized on the basis of the main evidence measured in the short, medium and long term (Table 3).

Table 1: Indicators published by ISTAT for Italy.

GOAL	TARGET	SDG INDICATORS	INDICATORS PUBLISHED BY ISTAT	COVERAGE ISTAT OF SDG SET		
			TOTAL	IDENTICAL	SIMILAR, PARTIAL OR OF NATIONAL CONTEXT	TOTAL
1	7	14	17	2	4	6
2	8	13	11	1	5	6
3	13	27	28	13	5	18
4	10	11	25	5	3	8
5	9	14	18	3	4	7
6	8	11	13	1	5	6
7	5	6	6	1	3	4
8	12	17	22	7	5	12
9	8	12	11	5	3	8
10	10	11	12	4	1	5
11	10	15	17	2	7	9
12	11	13	13	3	4	7
13	5	8	9	0	1	1
14	10	10	6	0	2	2
15	12	14	11	2	4	6
16	12	23	11	4	4	8
17	19	25	5	2	2	4
Total	**169**	**244**	**235**	**55**	**61**	**117**

Table 2: List of SDG indicators and indicators disseminated by ISTAT.

INDICATORS	COMPARING WITH SDGS INDICATOR	LAST AVAILABLE DATA
SDG 7.1.1 - Proportion of population with access to electricity		
Households very or fairly satisfied for the continuity of the service of electricity supply (%) (ISTAT, 2017)	Proxy	92,5
SDG 7.1.2 - Proportion of population with primary reliance on clean fuels and technology		
Inability to keep home adequately warm (%)(ISTAT, 2016)	National context	16,1
SDG 7.2.1 - Renewable energy share in the total final energy consumption		
Renewable energy share in the gross final energy consumption (%) (Gestore dei Servizi Energetici, 2016)	Proxy	17,4
Renewable energy share (transport sector excluded) in the gross final energy consumption (%) (data from Gestore dei Servizi Energetici[14], 2016)	National context	16,6
Electricity generated from renewable sources (% of gross electricity consumption) (data from Terna Spa[15], 2016)	Partial	33,1
SDG 7.3.1 - Energy intensity measured in terms of primary energy and GDP		
Energy intensity of the economy (%) (Eurostat, 2016)	Identical	98,4

Table 3: SDG indicators disseminated by ISTA: variations in short, medium and long term.

Ref. SDG	INDICATOR	VARIATIONS			
		long term	middle term		short term
		2006-2016	2006-2011	2011-2016	2015-2016
7.1.1	Households very or fairly satisfied for the continuity of the service of electricity supply			a	b
7.1.2	Inability to keep home adequately warm				
7.2.1	Renewable energy share in the gross final energy consumption				
	Electricity generated from renewable sources (% of gross electricity consumption)				
7.3.1	Energy intensity of the economy				

LEGEND

Net improvement
Slight improvement
Stability
Slight worsening
Net worsening

NOTES

(a) 2012-2017
(b) 2016-2017

3. SDG 7.3.1 - Energy intensity measured in terms of primary energy and GDP

Energy efficiency is a priority for national and international policies. The 2030 Agenda established the target 7.3 of doubling the global rate of improvement in energy efficiency. The EU policies set targets for 2020 (20% increase in energy efficiency) and 2030 (27%), while the "Clean Energy for the Europeans package" proposed an energy governance model focused on energy efficiency ("putting energy efficiency first"), as a means of economic and employment promotion and sustainability.

The 2030 Agenda adopted the energy intensity - measured in terms of ratio of total energy supply and GDP - as reference indicator for monitoring the degree of progression

[14] https://www.gse.it/
15 http://www.terna.it/

towords the target. The increase in energy efficiency, aimed at reducing energy consumption and related emissions, is an extremely important target for energy and environmental sustainability and an important means of combating energy poverty at the social level, while offering high benefits for production activities. SDGs indicator metadata[16] provide the following:

- Definition: Energy intensity is defined as the energy supplied to the economy per unit value of economic output;
- Rationale: Energy intensity is an indication of how much energy is used to produce one unit of economic output. It is a proxy of the efficiency with which an economy is able to use energy to produce economic output;
- Concepts: Total energy supply, as defined by the International Recommendations for Energy Statistics (IRES), as made up of production plus net imports minus international marine and aviation bunkers plus-stock changes. Gross Domestic Product (GDP) is the measure of economic output. For international comparison purposes, GDP is measured in constant terms at purchasing power parity Comments and limitations: Energy intensity is only an imperfect proxy for energy efficiency. It can be affected by a number of factors, such as climate, structure of the economy, nature of economic activities etc. that are not necessarily linked to pure efficiency;
- Comments and limitations: Energy intensity is only an imperfect proxy for energy efficiency. It can be affected by a number of factors, such as climate, structure of the economy, nature of economic activities etc. that are not necessarily linked to pure efficiency.

The analysis over time of 7.3.1 indicator shows a decreasing trend: compared to 2000, global energy intensity has reduced by 18%, while the improvement compared to 2010 is almost 7% (Figure 1). The geographical areas that, in relative terms, have benefited of the greatest progress are those with higher energy intensity than the average global level: Central Asia, which registred a near halving of the energy intensity compared to 2000 (-47%) and a decrease of 10% compared to 2010, and sub-Saharan Africa (respectively, -28.2% and -6%). More limited improvements characterize the areas with lower energy intensity, as an effect of higher performaces and, consequently, lower possibilities of improvement. Between 2000 and 2014, in North-Africa and Latin America energy intensity decreased significantly below the average level (-0.5% and -6.0% respectively), while West Asia registered an increase of 1.3%.

The most energy-intensive geographical areas are Central Asia and sub-Saharan Africa with an energy intensity equal to 167 for the first (the world energy intensity=100) and 133 for the latter, followed by Eastern Asia (Figure 2).

Levels of energy intensity below the global average characterize North Africa, Latin America and the Caribbean (71 for both) and South East Asia (76).

4. The Italian performance within the EU context

Looking at Italy in more detail, the primary energy demand in 2016 was 154.7 Mtoe (-0.9% compared to 2015), continuing the negative trend of the last decade after the 2015 break. Gross inland consumption in 2016 was 154.7 Mtoe, the energy demand remaining fairly stable for the last few years. The fall in primary consumption since 2005 has brought Italy back to the consumption levels of the first half of the 1990s (Figure 3).

Italy has values of primary energy intensity (98.4 toe/M€2010) lower than both the average of the 28 European Union countries (EU-28) (118.6 toe/M€2010) and the countries belonging to the Euro Zone (114.7 toe/M€2010, Figure 4). More specifically, assuming EU-28 average equal to 100, Italian energy intensity is equal to 83, sixth in the EU ranking after Ireland (50), Denmark (56), Malta (70), Luxembourg (74) and the UK (77). On the contrary, primary energy intensity is much higher in Eastern Europe countries: Bulgaria shows a value greater than 3.5 times the EU-28 average, followed by Estonia (292), Czech Republic (202), Hungary and Poland (195 for both). The average EU-28 energy intensity decreased by 23% from 2000 to 2016, and by 12% from 2010.

[16] Last update: 16 March 2018; https://unstats.un.org/sdgs/metadata/

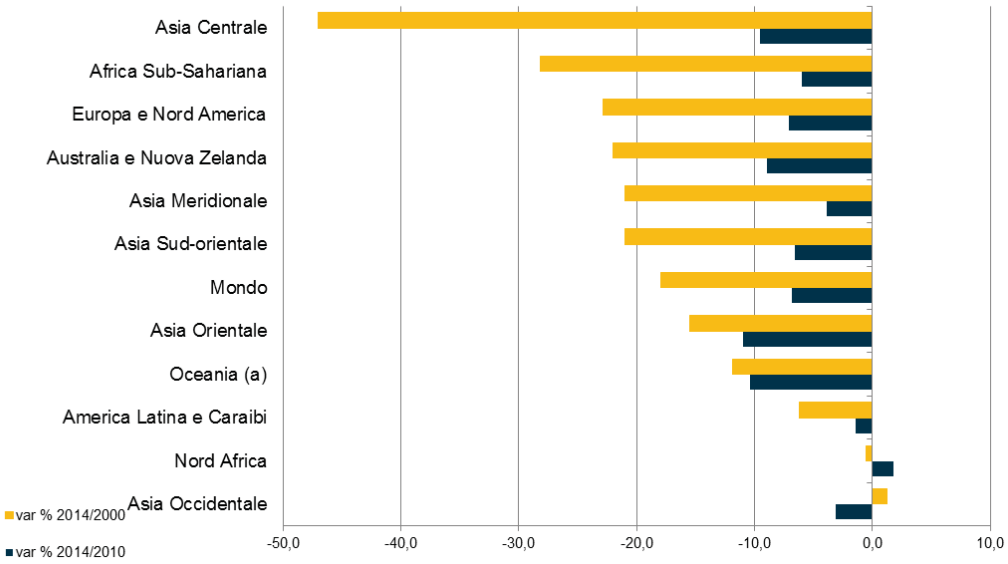


Figure 1: Energy intensity by geographical area (% var. 2014/2000; 2014/2010). (a) Australia and New Zealand excluded. Source: ISTAT elaboration on United Nations data (https://unstats.un.org/sdgs/indicators/database/).

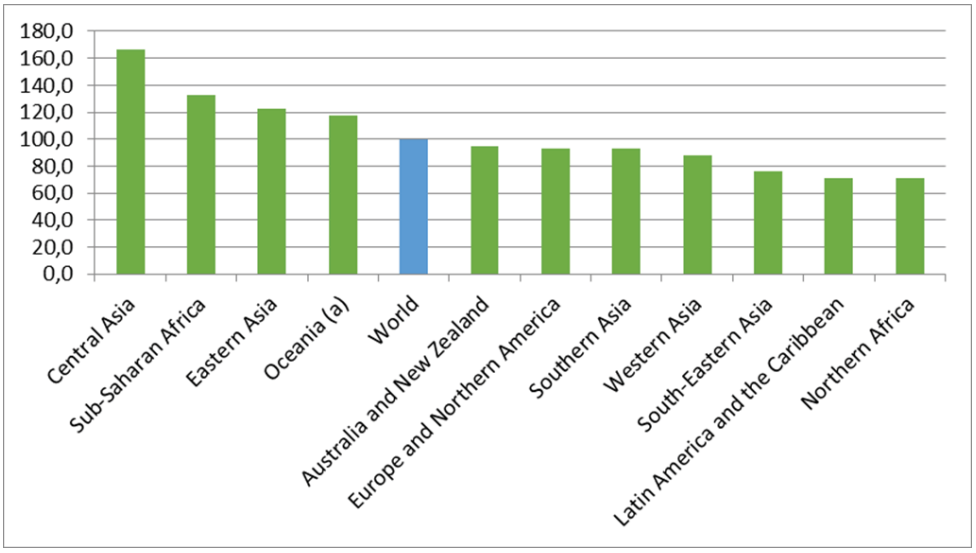


Figure 2: Energy intensity by geographical area (World=100). (a) Australia and New Zealand excluded. Source: ISTAT elaboration on United Nations data (https://unstats.un.org/sdgs/indicators/database/)

In the 2000-2016 period countries with the most significant progress are Slovakia, Romania and Ireland (about -50%), Lithuania (-47%), Malta and Bulgaria (-44%). Italy has shown over time a development trajectory characterized by lower performances compared to the EU-28 average, which instead showed higher initial levels and greater savings. Indeed, it should be emphasised that Italy's good positioning makes it more complex to continue to reduce the energy intensity: in the period 1995-2016 energy intensity decreased by 14.3% in Italy, by 31.3% for the EU-28 and 25.4% for the Euro Zone. Despite these differences in the reduction rate, in 2016 the Italian primary energy intensity was 17% lower than the EU-28 average and 14.1% below the average of the Euro Zone countries.

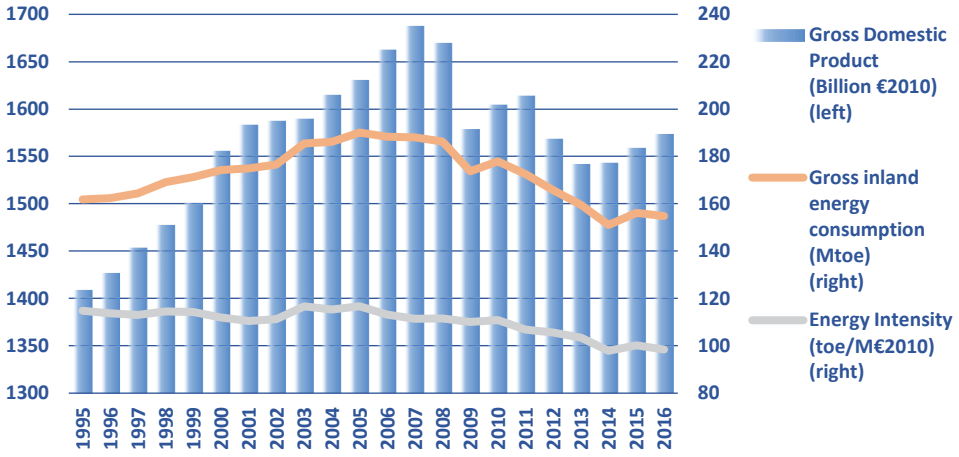


Figure 3: GDP, gross inland energy consumption of energy and primary energy intensity, years 1995-2016. Source: ENEA and ISTAT elaboration on Eurostat data (http://ec.europa.eu/eurostat)

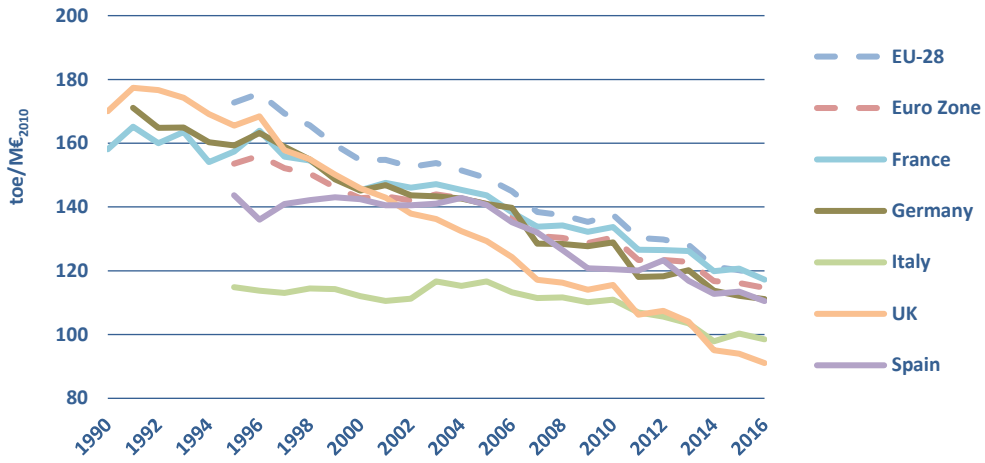


Figure 4: Primary energy intensity in some European Union countries (toe/M€2010), years 1990-2016 (Source: Eurostat (http://ec.europa.eu/eurostat))

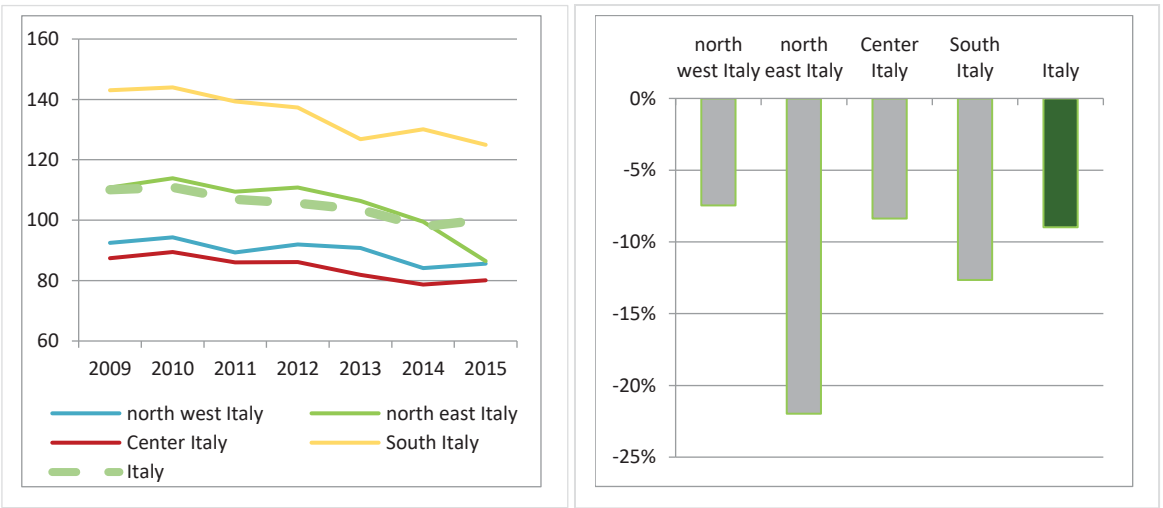


Figure 5: Energy Intensity in Italian macro regions (kg of oil equivalent per 1,000 Euro of GDP) Source: ENEA elaboration on Eurostat data (http://ec.europa.eu/eurostat)

In terms of primary energy intensity of the Italian macro-regions, all of them have shown a decrease since 2009: the greater reduction has been observed in the North-East area of Italy (-22%, from 110.9 kg of oil equivalent per 1,000 Euro of GDP in 2009 to 86.5 in 2015), followed by South (-12.7%), Centre (-8.4%) and North-West (-7.5%), compared to a reduction of 9% at National level over the considered period. The decrease is mainly due to a reduction in gross inland consumption compared to GDP.

5. The Italy's National Energy Strategy

Following the guidelines of the measures contained in the *Clean Energy for All Europeans* package, presented at the end of 2016 by the European Commission, the 2017 *National Energy Strategy* (NES) confirms the key role of energy efficiency in our country's energy transition path. The NES aims to strengthen energy efficiency policies by facilitating the measures that have the best cost-effectiveness ratio in order to achieve 30% energy savings by 2030 compared to the expected consumption at that date.

Extensive additional energy efficiency investments are expected over the entire period: 110 billion euros out of the 175 overall which are expected to be spent over the period thanks to the NES. This amount of resources will result in a reduction in final energy consumption from active policies of around 10 Mtoe/year in 2030, equal to about 1 Mtoe of annual savings from new interventions in the period 2021-2030, to be mainly focused in residential sector, services and transport.

For the residential sector, an expansion of interventions is expected under the National Fund for Energy Efficiency. The Fund was launched in March 2018 to support projects that require a high initial investment, stimulating their financing by banks. The NES also tries to optimise the Ecobonus mechanism, and for this purpose the 2018 Budget Law has further developed the incentive system by adding new deduction rates as appropriate, new interventions and new technical and performance conditions, as well as significant changes to credit transfer which was extended to all taxpayers and for any project, and which may benefit suppliers who have carried out the work or other private parties with the option of subsequent credit transfer. With regard to this last point, the recent bulletin of May 2018 from the Revenue Agency clarified that the credit transfer must be considered limited to a single transfer subsequent to the original one. Also, the term "other private parties" must be understood as parties other than suppliers, provided they are connected to the relationship that gave rise to the deduction.

Particular attention was also paid to public buildings through the continuation of the Programme for the Energy-related Renovation of Buildings of the Central Public Administration (PREPAC) in the period 2021-2030 and the definition of mandatory savings clauses in the contracts of energy services supplying the public administration.

For the industrial sector, besides strengthening and simplifying the obligation scheme of White Certificates, efforts will be focused on Impresa 4.0 National Plan, and the promotion of energy efficiency in SMEs will continue through calls for co-financing of energy audits and management systems.

For the transport sector, the NES underlines the need to reduce the use of private mobility through measures aimed at encouraging a shift towards smart mobility and local public transport. As far as road freight transport is concerned, an important contribution in terms of efficiency is expected from the optimisation of the logistics system, promoted through the diffusion of new Intelligence Transport Systems (ITS) technologies. Some measures consistent with these guidelines have already been included in the Budget Law for 2018.

6. Energy efficiency measures in Italy

The decrease in Italian energy intensity is mainly due to the contribution of energy efficiency incentive policies carried out since 2005: White Certificates, Ecobonus and Renewable Energy for Heating and Cooling Support Scheme.

Since the start of the White Certificate mechanism in 2005, overall additional primary energy savings of approximately 25.7 Mtoe have been certified and more than 47.5 million Energy Efficiency Certificates (EEC) have been issued. The annual amount of the EEC issued in 2017 is approximately 5.8 million, a level similar to that of the two-year period 2012-2013, but far from the peak of over 7.5 million observed in 2014. The volume of

certified savings in 2017, equal to about 2 Mtoe, was practically unchanged compared to 2016, but far from the over 3 Mtoe recorded in the period 2010-2012.

With regard to tax deduction for upgrading the energy efficiency of buildings (so-called Ecobonus), in the four years 2014-2017 approximately one and a half million projects were carried out, including more than 420,000 in 2017, with more than half of them involving the replacement of windows and shutters and 20% the replacement of heating systems. Since 2011, over 2.3 million projects have been carried out; over 3.3 million since the start of the mechanism in 2007. Table 4 shows a detail of the energy savings obtained, according to the different types of projects carried out. The trend is positive, with 0.112 Mtoe/year obtained in 2017. During the considered period, energy savings amounted to just over 0.4 Mtoe/year, and starting from 2011 the achieved energy savings amounted to 0.77 Mtoe/year. Since the start of the mechanism in 2007, total savings amount to 1.31 Mtoe/year. The scheme has been a key driver of energy efficiency improvements in the residential sector: differences in the figures provided about macro-regional primary energy intensity mirror regional differences observed for implemented actions within the Ecobonus (Figure 6).

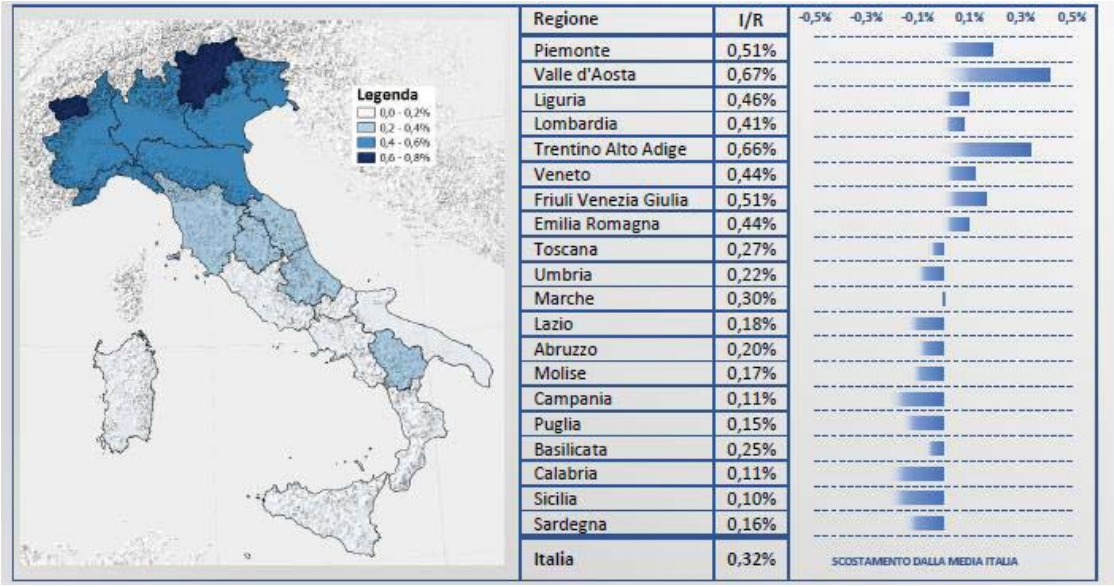
In 2017 the Renewable Energy for Heating and Cooling Support Scheme showed a clear acceleration, for that year along generating requests equal to 130% of all those received in the period 2013-2016: over 43,000 (+189% compared to 2016), which correspond to incentives equal to 183 million euros (+168% compared to 2016). There was also a significant increase in the requests from public administration (from 141 requests in 2016 to 333 in 2017), for almost 62 million euros. Table 4 shows the details of the requests received in 2017 by type of energy efficiency project within public administration buildings.

Compared to the 2011-2020 target, envisaged in the National Energy Efficiency Action Plan (NEEAP) of 2014, the achieved energy savings in 2017 amounted to just over 8 Mtoe/year, equivalent to almost 52% of the final target. Approximately 37% of these savings derive from the obligation scheme of the White Certificates and over a quarter from tax relief. At a sectoral level, the residential sector has already reached its target for 2020, while industry is half way to its goal (Table 3).

With regard to the obligation to carry out energy-related renovations of 3% of the total floor area of heated and/or cooled buildings owned and occupied by the Italian central public administration, in the four-year period 2014-2017, projects for over 190 properties were completed or planned for a total area of over 1,870,000 m^2. The figure is largerly due (both in terms of projects and in terms of renovated surface area) to the Programme for the Energy-Related Renovation of the Buildings of the Central Public Administration, while the remainder is attributed to other specific incentive measures (such as those from Structural Funds) and the projects carried out by the Italian Government Agency for State Property as part of the centralised maintenance system, as per Italian Law Decree 98/2011.

With regard to the minimum energy saving target of 25.5 Mtoe of overall final energy to be achieved in the period 2014-2020 pursuant to article 7 of the Energy Efficiency Directive, Table 5 shows the savings achieved in the years 2014-2016 and 2017 (estimated) through the notified measures[17]. The results are in line with the expected trend of savings for achieving the 2020 target. For the period 2011-2017, the cumulative achieved energy savings amounted to approximately 8.3 Mtoe of primary energy, of which about 6 Mtoe are linked to lower consumption of natural gas (Figure 7).

[17] The table does not include the reduction of energy consumption deriving from other energy efficiency measures, in particular at a regional level, for which reference should be made to the full report. The six regional measures that do not allow the cumulation with the described national incentive schemes and for which energy savings data are available, even if only estimated, have produced a cumulative energy savings of just over 9 ktoe over the period 2014-2017.



Regione	I/R
Piemonte	0,51%
Valle d'Aosta	0,67%
Liguria	0,46%
Lombardia	0,41%
Trentino Alto Adige	0,66%
Veneto	0,44%
Friuli Venezia Giulia	0,51%
Emilia Romagna	0,44%
Toscana	0,27%
Umbria	0,22%
Marche	0,30%
Lazio	0,18%
Abruzzo	0,20%
Molise	0,17%
Campania	0,11%
Puglia	0,15%
Basilicata	0,25%
Calabria	0,11%
Sicilia	0,10%
Sardegna	0,16%
Italia	0,32%

Figure 6: Ratio between activated investments and net available income (I/R) by region and difference relative to the average, for year 2016. Source: ENEA elaboration of ENEA and ISTAT data.

Table 3: Achieved energy savings by sector, period 2011-2017 and expected for 2020 (final energy, Mtoe/year) according to the 2014 NEEAP (Source: Italy's Ministry of Economic Development, 2018)

Measure / Sector	White Certificates	Tax Relief *	Conto Termico	Impresa 4.0 National Plan *	European Regulations and High-Speed Rail *	Italian Legislative Decrees 192/05 and 26/6/15 **	Energy savings		Achieved target (%)
							Achieved in 2017 **	Expected by 2020	
Residential	0.71	2.08	-	-	-	0.85	**3.64**	**3.67**	**99.2%**
Services	0.15	0.02	0.005	-	-	0.04	**0.22**	**1.23**	**17.5%**
Industry	2.1	0.03	-	0.3	-	0.07	**2.5**	**5.1**	**49.0%**
Transport	0.01	-	-	-	1.68	-	**1.69**	**5.5**	**30.7%**
Total	**2.97**	**2.13**	**0.005**	**0.3**	**1.68**	**0.96**	**8.05**	**15.5**	**51.9%**

* Estimate for the year 2017.
** Estimate for the period January-September 2017. The residential sector includes the savings from the replacement of large household appliances also.

Table 4: Mandatory savings (Mtoe) pursuant to article 7 of the Energy Efficiency Directive, years 2014-2017 (Source: Italy's Ministry of Economic Development, 2018)

Notified measures	New Savings achieved				Cumulative savings	
	2014	2015	2016	2017 *	2014-2017	Expected in 2020
Mandatory scheme White Certificates	0.872	0.859	1.101	1.341	4.174	12.51
Alternative measure 1 Conto Termico	0.003	0.008	0.019	0.045	0.075	0.43
Alternative measure 2 Tax relief	0.306	0.597	0.873	1.164	2.940	8.39
Alternative measure 3 National Energy Efficiency Fund	0.000	0.000	0.000	0.000	0.000	0.18
Alternative measure 4 Impresa 4.0 National Plan	0.000	0.000	0.000	0.300	0.300	4.00
Total savings	**1.181**	**1.465**	**1.993**	**2.850**	**7.489**	**25.50**

* Preliminary estimate on data not yet consolidated

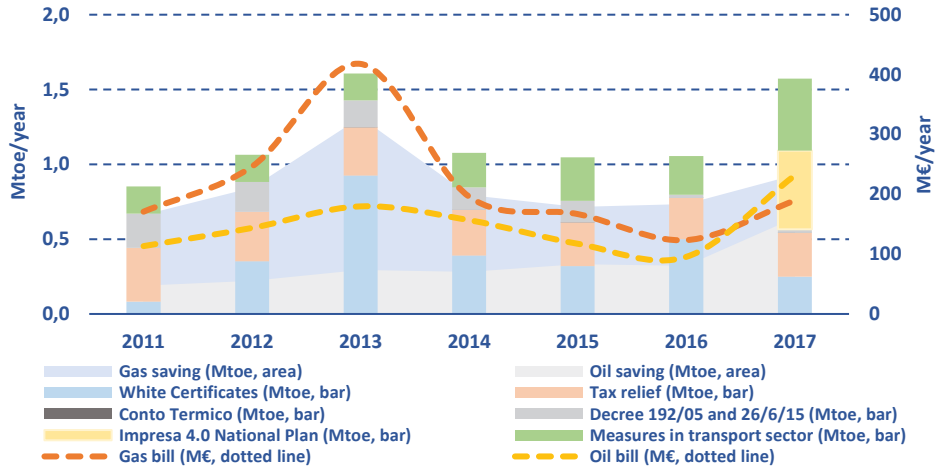


Figure 7: Savings on National energy bills (M€/year, on the right) and energy savings (Mtoe/year, on the left), years 2011-2017. (Source: ENEA elaboration)

The assessment of the bill savings was based on the price trend of crude oil and natural gas over the years in question. Overall, the cumulated savings on bill exceeds 2.5 billion euros per year in 2017, of which 1.5 for lower imports of natural gas. The savings achieved in 2011-2017 prevented the emission of about 19 $MtCO_2$ in 2017, equal to more than 5% of the CO_2 emissions reported for Italy in 2016.

7. Actions to achieve the energy efficiency objectives

Incentive mechanisms underlying the requirements set out in article 7 of the Energy Efficiency Directive are effective and consolidated tools, which can certainly be the main lever used to orient demand, still not inclined to the use of innovative financing or management schemes, towards the most cost-effective energy efficiency measures able to better and faster improve the energy intensity performance also (Figure 8).

As shown in the depicted SWOT analysis, the strengthening of coordinated and planned actions focused on information and training of users, like the aforementioned three-year Information and Training Programme prepared by the Ministry of Economic Development and implemented by ENEA, constitute an optimal instrument, shared and acknowledged by all sector operators and consumer associations, able to accelerate the behavioural change necessary to fully exploit the available opportunities, also in consideration of Italy's low participation in life-long learning.

Regarding the actions to be taken for buildings, there is an evident need to radically operate on them by addressing the envelope and the heating/cooling system together, a type of project with a better cost-effectiveness. To this end, a coordinated system of measures is required that - depending on the main building types, the climatic zones, the specific types of materials available in a given region - identifies and incentivises standard "packages" of solutions, also aimed at better integrating renewable sources in the envelope and the heating/cooling system and using prefabricated components in a systematic way. "Extreme" solutions, difficult to be implemented on a large scale, require the demolition and reconstruction of the building.

Measures that can be taken into consideration in an integrated form, and in part already present in the provisions of the Stability Law of 2017 and 2018 concern:

- Incentive mechanisms.
  - Variation of the incentive rate, increasing according to the complexity of the project and/or the linking with other incentivised issues (e.g. anti-seismic works).
  - Possibility of transferring credit to corporate bodies that banks and financial institutions have invested in without having a majority shareholding.
  - Funds to facilitate access to credit and reduce its cost.
- Incentives to construction companies.

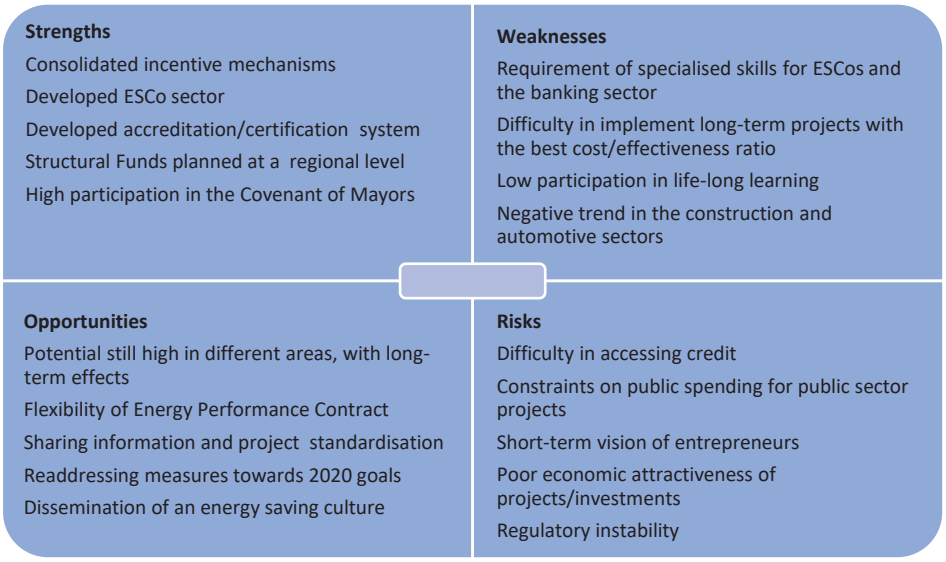


Figure 8: Barriers and opportunities for achieving energy efficiency objectives in Italy: SWOT analysis
Source: ENEA

- Incentives for households and owners, also in order to resolve the problem of split incentives.

In order to orient demand towards the more complex activities of the industry process, the measures to be taken could provide incentives for such activities, already mentioned in the energy audits sent to ENEA, which have longer payback times. Considering that at the end of 2019, pursuant to art. 8 of Italian Legislative Decree 102/2014, a new audit will have to be presented by a large number of companies, even if the projects carried out at that date were not included in the first audit of 2015, incentives might be envisaged related to the reduction of specific energy consumption in the production process monitored by the two audits.

It is also necessary to take into account the new energy-saving decree (Italian Ministerial Decree of 12/21/2017) which seeks to finally combine incentives for energy-intensive industries with energy efficiency. Once the new mechanism is fully operational, incentives could be linked to the energy efficiency of the company and not only to the energy it consumes.

For the transport sector there are five strategic lines of action:

- Policies to support the renewal of the public and private vehicle fleet, aimed at improving energy efficiency and using sources other than fossil fuels.
- Construction of refuelling stations for vehicles powered by alternative energy (electricity for light vehicles, Liquified Natural Gas (LNG) for heavy vehicles, hydrogen for cars and buses).
- Rail development, both in urban areas, through the completion of the underground and tramway networks under construction, and nationally, through the development of the high-speed and regional rail network, the integration of logistics hubs with the national railway network for freight and the renewal of rolling stock.
- Reinforcement of collective transport in urban areas and development of soft and shared mobility.
- Support for the intermodality of goods on long journeys.

From a governance point of view, as mentioned above, actions should aim to:

- Strongly orient existing and available resources from European funds, making sure that private and public activities include and increase the value of the investment of European funds, reducing the share of regional and national co-financing both through a model of public private partnership, and through voluntary agreements that involve the entire chain of stakeholders, from manufacturers to distributors, sellers, installers, construction companies.

- Guarantees for loans granted by banks: for large investments, the constitution of a Special Purpose Vehicle with a project financing approach might be envisaged. For smaller transactions, on the other hand, an evolution of the current contractual frameworks and their effective implementation is appropriate, with the aim of guaranteeing the lender all revenues deriving from energy efficiency projects to pay back the debt, even through the establishment of public guarantee funds able to cover the risks that banks are not able to assess on the basis of the available information.

In addition to the aforementioned three-year Training and Information Programme, for all the aforementioned actions and for a more general behavioural change, the dissemination and strengthening of the instrument of the energy performance contract and the greater stability of the regulatory framework accompanied by streamlining and simplification of the authorisation procedures will be crucial in enabling factors.

8. Conclusions

Energy efficiency is a priority for national and international policies. During the past 15 years much progress has been made in reducing energy intensity and containing energy consumption. To this aim the *Clean Energy for All Europeans* package strengthened in the EU the "*Energy Efficiency First!*" principle.

Despite the improvements achieved over time, the policy targets are still far from being achieved and the disparities between countries are still relevant, not only at global level, but also in the European Union context. In Italy,in 2017 half of the expected path towards the 2020 targets has been covered.

From a statistical point of view, work is still in progress. Further developments will be in the direction of improving methodology, enlarge the number of available indicators and the geographical coverage. The possibility of producing Energy Intensity by regions (NUTS 3[18]) is under study: preliminary results show differences in the energy intensity of the Italian macro-regions, mainly between South of Italy and the rest of the country, mirroring the economic situation and investment propensity for (not only) energy efficiency.

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Perspectives of cooperation

by

Dr. Popi KONIDARI[1]
Head of Climate Change Policy Unit of KEPA

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Abstract

The presentation aimed to facilitate the discussions for cooperation under the Brokerage event that is scheduled on the 3rd day of the Conference. Based on the information that was provided by the interested participants, the institutions and their expressions of interest in Horizon 2020 open calls are the content of this presentation.

Keywords: Horizon2020, cooperation

11TH INTERNATIONAL SCIENTIFIC CONFERENCE ON ENERGY AND CLIMATE CHANGE
Pre-meetings for Brokerage event
11 October 2018, Athens-Greece

PERSPECTIVES OF COOPERATION

Dr. Popi KONIDARI
Scientific Secretariat, NKUA – KEPA

Outline

- Institutes
- Open calls
- Discussion

Institutes (1)

- EUC Research Center - Cyprus
- Institut Wohnen und Umwelt GmbH – Germany
- Aegean Energy and Environment Agency – Greece
- DAFNI – Network of Sustainable Greek Islands - Greece
- Environmental Technology Laboratory, Department of Mechanical Engineering, University of Western Macedonia - Greece
- Energy Policy and Development Centre – National and Kapodistrian University of Athens - Greece

Institutes (2)

- Group Building Environmental Studies, Section of Environmental Physics and Meteorology, Physics Department – National and Kapodistrian University of Athens - Greece
- Soft Energy Applications Laboratory, University of West Attica - Greece
- SYMPRAXIS TEAM P.C. – Greece
- ELTRUN e-Business Research Center - Greece

EUC Research Center - Cyprus

- *Type:* Research Institute
- *Working fields:* Energy management, RES, Sustainable Development, Urban Development, Modelling and simulation, system Dynamics, Active Mobility
- *Upcoming calls:* Horizon – 3 calls
- *Contribution:* Expertise in ICT, evaluation of sustainability impact of energy strategies and systems via modelling and simulation

Institut Wohnen und Umwelt GmbH – Germany

- *Type:* Extra University Research Institution
- *Working fields:* Financing of EE investment of housing stock, local energy production and consumption, Housing policy, land and housing (financing) policy instruments
- *Upcoming calls:* -
- *Contribution:* Team (economist, sociologist, lawyer, all relevant disciplines in house), research matters, consultancy and project management

Aegean Energy and Environment Agency - Greece

- *Type:* Non-profit organization providing services
- *Working fields:* EE, RES, Sustainable Development, waste management, water management, cultural heritage, sustainable tourism, circular economy
- *Upcoming calls:* Horizon – 7 calls
- *Contribution:* Knowledge and understanding in several subjects (from energy and climate to culture and environment)

DAFNI – Network of Sustainable Greek Islands - Greece

- *Type:* Non-profit organization
- *Working fields:* Sustainability, EE, circular economy, innovative technologies
- *Upcoming calls:* *Horizon 8 calls*
- *Contribution:* Bring in 44 members

ETL – UOWM - Greece

- *Type:* Research Group of the University
- *Working fields:* Air pollution, Indoor air quality, Emissions of air pollutants, air quality/atmospheric modelling, emission modelling, environmental databases
- *Upcoming calls:* Horizon 1 call, LIFE Environment
- *Contribution:* establishment of innovative monitoring systems

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KEPA - Greece

- *Type:* Research Group of the University
- *Working fields:* Policy issues for EE, energy poverty, climate change, multi-criteria evaluation methods, AMS – evaluation of policy instruments, DST
- *Upcoming calls:* Horizon 4 calls
- *Contribution:* Research, development of scenarios for EE, RES, mitigation, adaptation, dissemination and communication activities

10

Group Building Environmental Studies, NKUA - Greece

- *Type:* Research Group of the University
- *Working fields:* EE, energy poverty, climate change, urban environment, zero energy buildings, zero carbon buildings, indoor air and outdoor environmental quality, intelligent materials, quality control and accreditation, energy and environmental rating, LCC
- *Upcoming calls:* *Horizon 4 calls*
- *Contribution:* research partners, simulation tools

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SEALAB, University of West Attica - Greece

- *Type:* Research Group of the University
- *Working fields:* Intelligent agents, energy community, socio-technical transition, Energy Union targets, technology transfers, innovation management, capacity building, smart islands, smart sustainable cities & communities
- *Upcoming calls:* *Horizon 1 call*
- *Contribution: Communication*

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SYMPRAXISTEAM P.C. - Greece

- *Type:* B2B Services Agency
- *Working fields:* climate change mitigation and adaptation, EE in buildings, deep building renovation, Building renovation passports, RES, urban environment, quality of life, water
- *Upcoming calls:* Horizon – 17 calls, LIFE – 2018 Capacity building projects
- *Contribution:* Communication, dissemination, consultation and engagement activities

13

ELTRUN e-Business Research Center - Greece

- *Type:* Research Center within the Athens University of Economics and Business
- *Working fields:* EE, innovation, behavioral research, organizational behavior, ICT, gamification, Business, commercialization of research, socio-economic impact, research planning
- *Upcoming calls:* almost all
- *Contribution:* Design of ICT-enabled solutions for EE, organization of pilots' execution, dissemination

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Horizon calls

- ***Secure, clean and efficient energy***
- ***Climate action, environment, resource efficiency and raw materials***

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Common expression of interest

	EUC Cyprus	GBES Greece	SEALAB Greece	IWUG Germany	ETL-UOWM Greece	DAFNI Greece	NKUA-KEPA Greece	AEEA Greece	SYMPRAXIS Greece	ELTRUN Greece
LC-SC3-EE-1-2018-2019-2020		x							x	x
LC-SC3-EE-5-2018-2019-2020		x							x	x
LC-SC3-EE-10-2018-2019-2020							x		x	x
LC-SC3-EE-14-2018	x						x			x
LC-SC3-EE-16-2018-2019-2020			x					x		x
LC-SC3-EE-17-2019							x		x	x
LC-SC3-EE-18-2019		x								x
LC-SC3-RES-7-2019	x									x
LC-SC3-EC-1-2018-2019-2020	x							x		x
LC-SC3-EC-2-2018-2019-2020		x					x		x	x

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Common expression of interest

	EUC Cyprus	GBES Greece	SEALAB Greece	IWUG Germany	ETL-UOWM Greece	DAFNI Greece	NKUA-KEPA Greece	AEEA Greece	SYMPRAXIS Greece	ELTRUN Greece
SC5-14-2019					X				X	X
LC-SC3-ES-8-2019						X		X	X	X
CE-SC5-4-2019								X		X
CE-SC5-07-2018-2019-2020								X		X
SC5-13-2018-2019						X		X		X
SC5-20-2019						X		X		X
LC-SC3-EE-2-1018-2019				X?					X?	X
LIFE									X	
INTERREG						X				

17

Calls

- LC-SC3-EC-2-2018-2019-2020: Mitigating Household energy poverty – SYMPRAXIS, KEPA, GBES, ELTRUN
- LC-SC3-ES-8-2019: European Islands Facility – Unlock financing for energy transitions and supporting islands to develop investment concepts – SYPRAXIS, DAFNI, AEEA, ELTRUN

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Calls

- LC-SC3-EE-14-2019: Socio-economic research conceptualizing and modelling energy efficiency and energy demand- EUC, KEPA, ELTRUN
- LC-SC3-EC-1-2019: The role of consumers in changing the market through informed decision and collective actions - EUC, AEEA, ELTRUN

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Calls

- LC-SC3-EE-1-2018-2019-2020: Decarbonisation of the EU building stock: innovative approaches and affordable solutions changing the market for buildings renovation – GBES, SYMPRAXIS, ELTRUN
- LC-SC3-EE-5-2018-2019-2020: Next-generation of Energy performance Assessment and Certification – GBES-SYMPRAXIS, ELTRUN

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Calls

- SC5-14-2019: Visionary and integrated solutions to improve well-being and health in cities – ETL-UOWM, SYMPARXIS, ELTRUN
- LC-SC3-EE-16-2018-2019-2020: Supporting public authorities to implement the Energy Union – SEALAB, AEEA, ELTRUN

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Thank you

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DAY 3: Brokerage event

Session 1: Funding opportunities

Opening

by

Dr. Patricia KYPRIANIDOU

General Secretary for Research and Technology, Hellas

Thank you, Mr. President,

To address your request, I am a Chemist and my permanent position as a researcher is in the National Center for Scientific Research, Democritus in Athens. I am addressing to you with my responsibility as the General Secretary for Research and Technology.

I am really happy that I am here and I thank the organizers for the invitation. We are happy to follow your efforts in this important field.

Dear organizers, esteem participants, ladies and gentlemen,

A few words about the research system. Greece is getting out after eight very difficult years of crisis and strict fiscal measures. So our country needs now to follow and implement a social responsible strategy for development and growth. Main component of this strategy is nappling knowledge into research and innovation and enabling access of micro enterprises and small medium enterprises to knowledge, research and innovation. So, as to facilitate job creation and social benefits from the high added value, goods and services. This involves the development of a new production model for our country based on the knowledge economy that will ensure the international position of our country in the years to come in a fast-changing international environment.

It is well believed as you probably all know, that “budget premises” is that investment in R&D that has a significant multiplier effect on GDP of a country.

To this sense there has been a substantial increase of R&D expenditure as a percentage of GDP until now for 2016, exceeding the psychological, let’s say, limit of 1% for Greece, of our GDP, indicating most of all, a serious commitment of our government under very difficult financial circumstances. This trend is expected to be continued also in 2017, as preliminary data show. So, we do our best about public investment which has been raised, approximately 30% in 2016, in comparison to 2015.

And the good news is that also companies are getting more innovators, they are getting stronger to the innovation, let’s say, field and they are taking the risks day by day in new coming fields in order to be a part of the new markets, to foster economy and society.

In plus, we have some important encouragements of new posts in universities and research institutions and, if I may say, we are not so bad, in fact, are really good in our performance. In Horizon 2020, Greek researchers are really competitive and up to now Greece is reported in the 12th position among the 28 of the European Union, in money funding budget and 10th, I believe, in participations. So, the research and innovation framework, already in place, incorporates three major poles. First pole, capacity, maintenance and capacity building is already mentioned, support for innovative entrepreneurship and flagship initiatives. Also, legislative actions and financial tools have been implemented with the aim of developing the appropriate environment for reaching these objectives.

In particular, I would like to mention the new institution, the Hellenic Foundation for Research and Innovation, the Age of Farray, as we name it, that has been established, designed to support most research and capacity building for grants for young scientists and senior scientists as well, high quality research for universities and research institutions in Greece.

The pool of money is about 240 million euros. It is endeavored for 3 years. And this institution is co-funded by the European Investment Bank and together with a loan that the Greek state – with very good terms – has from the European Investment Bank for the period 2017-2019.

For promoting the Innovative Entrepreneurship, three major actions are in place to support the comparative research projects between universities and research organizations, with companies mainly through structural funds, but not only. In the first place of this action and until now, a public budget of around 700 million Euros is committed, is allocated to support R&D projects. Most important for us, as you can understand, is the creation through this process, these projects, of new quality jobs especially for young scientists. We believe that until 2020-2021, the programming period will be implemented with around 9000 jobs. This is already on going, of course.

Creating opportunities also for new innovative companies through the establishment of fund of funds, the Equi-Fund as we named it, is a fund for equities, capital supply. A flagship initiative established at the end of 2016 and already active now with some important investments, involving the European Innovation Fund with an initial investment of 260 million euros increased with leverage. Equi-Fund includes three funds, for your information, the innovation window, for transforming research ideas into start-ups. The early stage of windows-fund for supporting new companies in their first steps and the growth window for supporting the mature enterprises to grow.

A series of new incentives also has been designed for private investment in R&D which are expected to create high quality career opportunities for young scientists and in the private sector as well which is a very important key issue. And third major policy pool is for us the flagship initiatives, horizontal research actions, as we might say, like the missions of the EU, the new idea for Horizon Europe. Flagship actions, top down, in emerging research fields, with a strong social dimension, as for this moment, are agri-food, precision medicine, oncology and cardiovascular diseases. By these means, knowledge economy, ladies and gentlemen, will become an additional pillar for growth which will enable us to face the challenges of the future and in particular the landscape arising in the context of the forthcoming fourth industrial revolution, which I might say, is already here.

Given all the above, science and research have a very high position to our agenda especially when we count on research institutions and staff, the human capacity of our groundzip contribution to dealing with the big challenges of our era, which of course, as you know better than me, are the energy issues, the modelling of our economy, climate change and environmental issues.

So, big challenges for our country, for the Mediterranean region, for Europe which has already suffered the impact of all these climate changes and reality which raises the resilience of our societies in a very urgent manner. We spent actually significant money for research based on the EU percentage in energy research and a little more than the EU medium average for environment issues, for environment research projects.

So also, the participation of our country in Horizon 2020 “Secure, Clean and efficient energy” is very important, I think. And from Structural Funds, I could name for energy around 120 million Euros and for environment 150, 155 up to 160 million Euros. Projects are funded in all over the area, in all the thematic areas covered decarbonization, renewable energy, digilization, smart grids, energy grids, transport issues which is very important for our country, energy storage, fuel shells, hydrogen, biofuels, waste management and more others.

Also, we have three open access. National infrastructures in the thematic areas of your interest, that take part in the Hellenic, National roadmap which some of them are also I think is this 3rd Roadmap. For integrated energy change for future vehicle environmental performance and for waste valorization and sustainable management of resources.

Last but not least, I would like to mention the Euro-Mediterranean common project for climate change, the primine initiative, I don’t know if you are aware of it, which we value so much because it is an opportunity to make synergies and research and projects for water and agrifood together with Mediterranean countries, so not only Member States, but together with neighboring countries we can cooperate on these important issues for our times. Greece has already marked 10 million Euros for this purpose.

So, ladies and gentlemen, I do not want to take more of your time. I believe you have an important discussion here these days. The conclusions of which we will be very happy to follow. The impact of which also, of course, in the society is evident.

We would like to thank the organizers once more for inviting us to be here and wish you all best success in your endeavors.

Thank you

Short CV

Dr. Matrona (Patricia) Kyprianidou holds a degree in Chemistry, a MSc in the organization and administration of Industrial Systems – and more specifically in Energy and Environmental Management systems – from the University of Piraeus and the National Technical University of Athens and, a Ph.D. from the Department of Chemistry - School of Sciences of the National and Kapodistrian University of Athens. Her research interests focus on the field of Radiopharmaceutical Technology and Radiopharmaceutical Chemistry. She has been active for 20 years in the research and development of new radiopharmaceutical compounds and their evaluation for the diagnosis or the treatment of various diseases in the Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety at the National Centre for Scientific Research (NCSR) "Demokritos". She has published papers in international scientific journals and conference proceedings and has participated in a series of subsidized competitive research programs, while she has significant development work in the field of radiopharmaceuticals, coordinating joint public and private development projects in Greece and abroad. She has extensive experience in executive positions in the private sector and in particular, as a scientific director in the production and quality control of pharmaceutical products and in the development of new pharmaceutical products. During the period 2010-2014, she was elected member of the Board of Directors of NCSR. "Demokritos", while during the years 2015-2016, she was a scientific adviser to the Deputy Minister of Research and Innovation in the newly created portfolio of the Ministry of Education, Research and Religious Affairs.

From environmental policy to systemic sustainability transitions: credible approaches for the 21th century

by

Prof. Hans BRUYNINCKX

Executive Director of the European Environment Agency

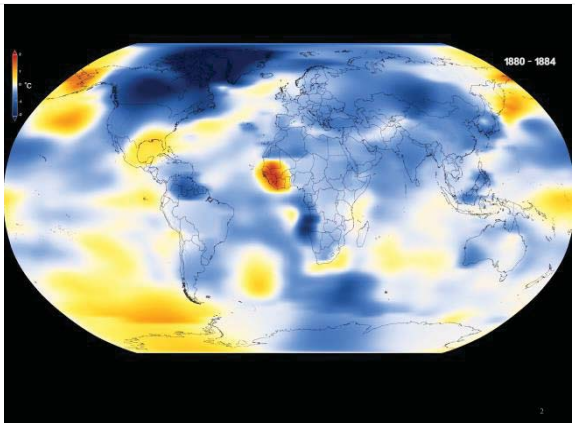
Short CV

Prof. Hans Bruyninckx is the Executive Director of the European Environment Agency since 1 June, 2013. In 1996 Dr. Bruyninckx completed a PhD in international environmental politics at Colorado State University. From 2010 until his appointment at the EEA, he was head of the HIVA Research Institute in Leuven, Belgium, a policy-oriented research institute associated with the Katholieke Universiteit Leuven, where he was also head of the Political Science department from 2007 to 2010. Over the last 20 years, he has conducted research in more than a dozen countries, in areas including environmental politics, climate change, and sustainable development. He has taught on global environmental politics and global environmental governance in relation to the European Union (EU), publishing extensively on EU environmental policies and its role as an actor in global environmental governance. Throughout his career Dr. Bruyninckx has worked with governmental agencies, civil society and businesses, often in an advisory role.

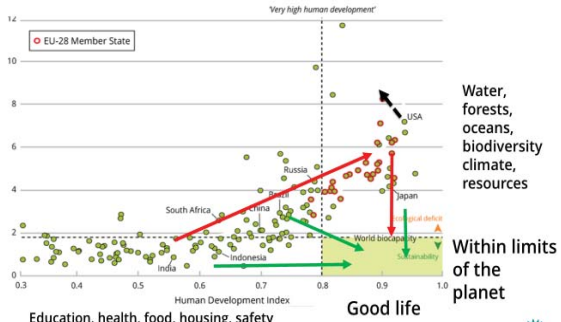
From environmental policy to systemic sustainability transitions: credible approaches for the 21st century

11th International Scientific Conference on Energy and Climate Change, Athens
Dr Hans Bruyninckx, 12 October, 2018

European Environment Agency



Challenge of 21st century: 10 billion people, 1



(Global Footprint Network, 2012; UNDP, 2014)

European Environment Agency

Global response: Sustainable Development Goals

European Environment Agency

EU Policy framework – 7th Environment Action Programme

Living well, within the limits of our planet

7th Environment Action Programme

European Environment Agency

Vision of the 7th Environment Action Programme

'In 2050, we live well, within the planet's ecological limits.

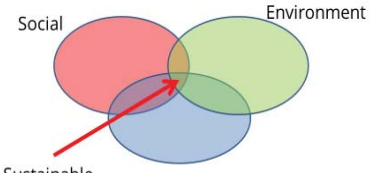
Our prosperity and healthy environment stem from an innovative, **circular economy** where nothing is wasted and where natural resources are managed sustainably, and **biodiversity is protected**, valued and restored in ways that enhance our society's resilience.

Our **low-carbon growth** has long been decoupled from resource use, setting the pace for a global safe and sustainable society.'

Source: 7th Environment Action Programme, European Commission, 2013

European Environment Agency

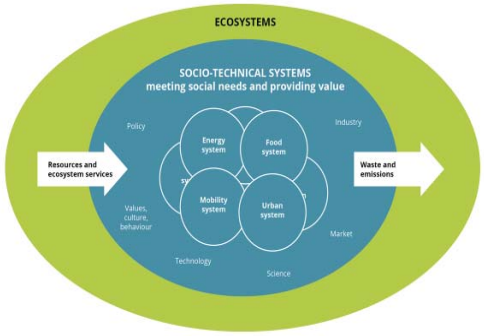
Rethinking « sustainable development »?



Sustainable development ?
Of course not!

European Environment Agency

Natural capital as explicit boundary condition



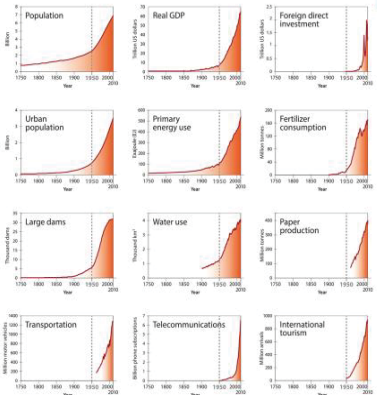
European Environment Agency

Implicit order in the SDGs

European Environment Agency

Global trends1

Socio-economic trends

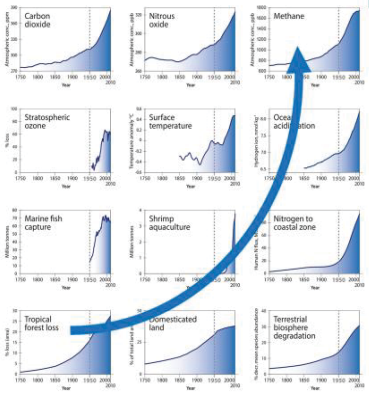


Globalisation of unsustainable systems of production and consumption

European Environment Agency

Global trends2

Earth system trends



Expectations/ policy promises

OR

How credible?
How feasible?
What sort of policies and knowledge?

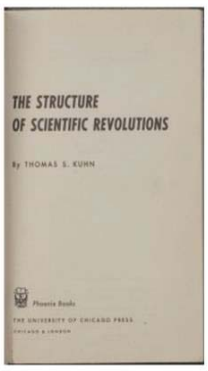
European Environment Agency

This could be our best century ever, or our worst

Dr James Martin, founder Oxford Martin School

European Environment Agency

Paradigm shift in knowledge and



Normal Science
Puzzle solving stage
Scientists share common paradigm
-make measurements
-articulate theory
-make predictions

Anomaly
Blame apparatus
Set aside problem
Modify paradigm

Crisis
Anomaly too problematic
Faith in paradigm shaken

Change in World View
Gestalt shift
Problem seen from different perspective
New paradigms explored

New Paradigm
Scientists return to routine
Revolution becomes invisible

Pre-paradigm phase
Alternative concepts compete
Anarchic period
Fact gathering appears unguided

European Environment Agency

Normal

Normal Science
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Alternative concepts compete
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Fact gathering appears unguided

Crisis
Anomaly too problematic
Faith in paradigm shaken

Change in World View
Gestalt shift
Problem seen from different perspective
New paradigms explored

"Over the past 40 years, a broad range of environment legislation has been put in place, amounting to the most comprehensive modern standards in the world. This has helped to address some of the most serious environmental concerns." (7EAP)

Policy theory: initially 'fighting pollution'

Knowledge paradigm: "Union environment policy is based on environmental monitoring, data, indicators and assessments linked to the implementation of Union legislation, as well as formal scientific research...." (7EAP)

European Environment Agency

Anomalies occur

Normal Science
Puzzle solving stage
Scientists share common paradigm
-make measurements
-articulate theory
-make predictions

New Paradigm
Scientists return to routine
Revolution becomes invisible

Anomaly
Blame apparatus
Set aside problem
Modify paradigm

Pre-paradigm phase
Alternative concepts compete
Anarchic period
Fact gathering appears unguided

Crisis
Anomaly too problematic
Faith in paradigm shaken

Change in World View
Gestalt shift
Problem seen from different perspective
New paradigms explored

"However, many environmental trends in the Union continue to be a cause for concern, not least due to insufficient implementation of existing Union environment legislation." (7EAP)

"Addressing some of those complex issues requires tapping into the full potential of existing environmental technology [...], as well as increased use of market-based instruments." (7EAP)

Modify policy theory: Efficiency thinking

Modify knowledge: Efficiency; market-based instruments; BAT studies; voluntary instruments

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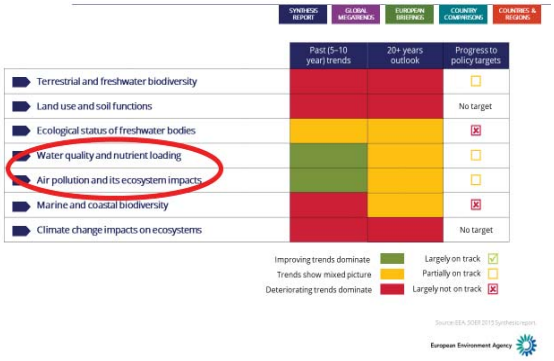
Thematic priority objective 1: Protecting, conserving and enhancing natural capital



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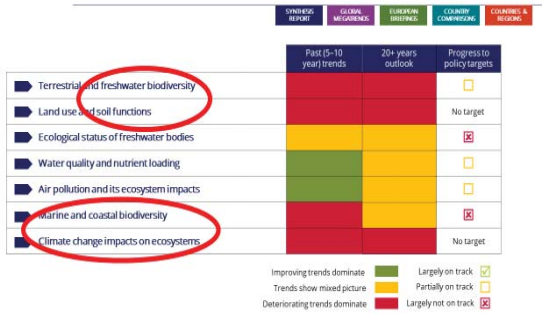
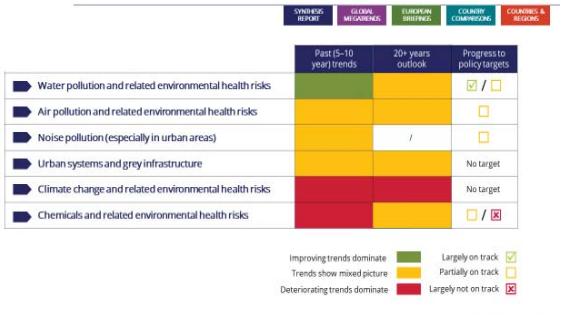
Thematic priority objective 1: Protecting, conserving and enhancing natural capital



Thematic priority objective 3: Safeguarding from environmental risks to health



Challenges for established governance approaches

Are they addressing the underlying drivers of environmental degradation?

In 2001, the EU set itself the target to halt biodiversity loss in the EU by 2010.

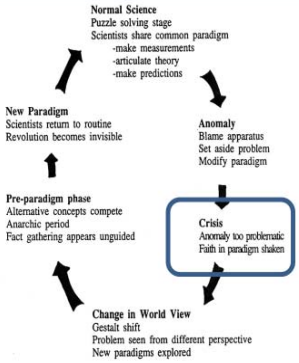
In 2011, the EU set the target to 'halt loss of biodiversity and degradation of ecosystem services in the EU by 2020'.

EU Biodiversity Targets (2020)	Progress at mid-term (2015)
2020 Headline Target	No significant progress
Halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restore them in so far as feasible, while stepping up EU contribution to avoid global biodiversity loss	Overall [illegible] ecosystem services in the EU [illegible]deline, as confirmed by the mid-term review. This is consistent with projections for the capacity of ecosystems in the future. While many local successes and improvements in the ground delivers positive outcomes, these are not yet adding up to have a measurable impact on the overall

Next? '2030'? Or, addressing the fundamental drivers?

Source: Mid-term review of the EU biodiversity

Science/knowledge/policy in



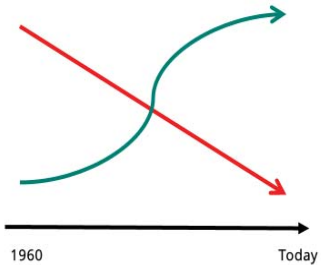
"Together with current wasteful production and consumption systems in the world economy, [...] depletion of resources [...], generating more pollution and waste, increasing global GHG emissions and exacerbating land degradation, deforestation and biodiversity loss." (7EAP)

"This report has come to the conclusion that traditional incremental approaches based on the efficiency approach will not suffice. Rather, unsustainable systems of production and consumption require fundamental rethinking in the light of European and global realities." (SOER2015)

The overall picture: Efficiency improvements have not secured long-term resilience

Core anomaly

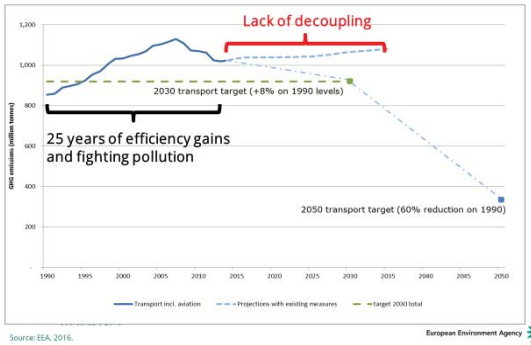
Institutional vs ecosystem developments



Different explanations:

- Counterfactual
- Implementation GAP
- Better regulation
- Time-lag effect
- Institutional solutions don't address the core issues!

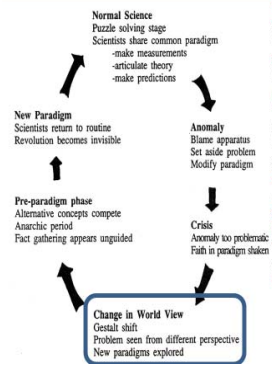
EU GHG emissions from transport



Source: EEA, 2016.

Limits of the current techno-efficiency paradigm

Change in world



"Biodiversity, including the ecosystem services it provides (natural capital), for its intrinsic value and for its essential contribution to human well-being and economic prosperity."

"The current knowledge base [...] has gaps [...] required to meet emerging policy demands. These gaps call for actions to widen the knowledge base [...] in the coming decade. "... systems science; complex environmental change and systemic risks; global megatrends; interplay between socio-economic and environmental factors; transitions in production-consumption systems; environmental risks to health; and the inter-relationships between economic development, environmental change and human well-being." (7EAP)

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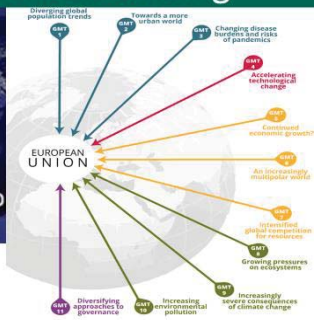
Changes in understanding



Changing global context: impact and role for Europe?

European Environment Agency

Gestalt Schift in problem analysis and responses?

Transitions

= **fundamental shifts** in the **systems** that fulfill societal needs, through profound changes in *dominant* **structures, practices, technologies, policies, lifestyles, thinking** ...

... in line with the sustainable development ambitions and objectives embedded in the Sustainable Development Goals

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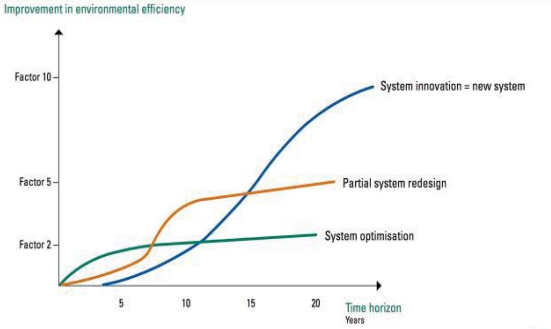
Achieving needed change requires system innovation



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Evolving policy responses: macro-integrated approach

- **Long-term**: 2030-2050-2100
- **Integrated**: e.g. Common Agricultural Policy
- **Systemic**: e.g. Decarbonisation of transport
- **Developing/iterative**: e.g. Circular Economy; Climate and Energy
- Require a **different governance** approach
- Thus, complex, uncertain, **lacking knowledge** (of a certain type)

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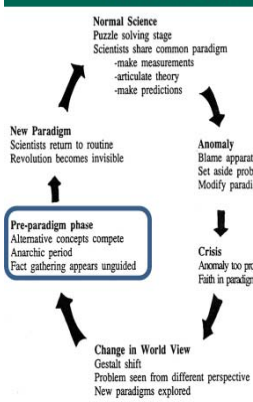
In the direction of a new



"The transition to a green economy is a long-term, multi-dimensional and fundamental process that will require a move away from the current linear economic model..." (SOER2015)

Alternative concepts:

Europe's emerging transition agenda

Making sense of the Green, Blue, Circular, Resource Efficient, Low Carbon, Bio, Smart, Digital Economy?

Unguided fact gathering: e.g. green economy; green investments; green finance; circular economy; green jobs; smart cities; ...

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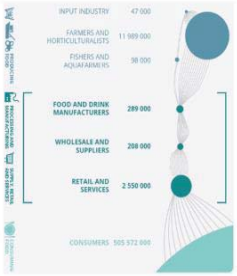
Taking a fundamental systems perspective



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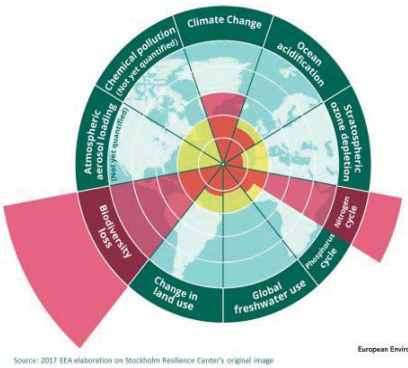
Serious reflection on policy implications?



Source: 2017 EEA elaboration on Stockholm Resilience Center's original image

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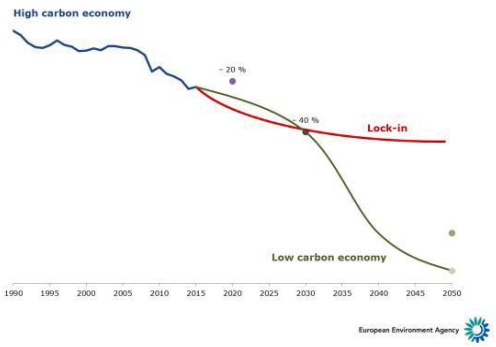
Creating pathways to sustainability



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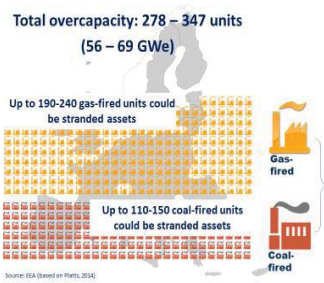
Transforming the EU power sector – avoiding a carbon lock-in



If existing and planned units were operated according to extended lifetimes...

1/3 of the capacity of all coal-fired and gas-fired units, respectively, would be in excess in 2030, and thus at risk of becoming stranded

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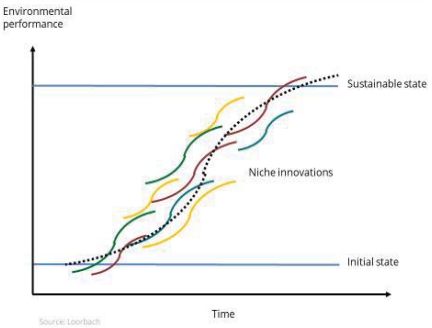
Systemic change combines multiple innovations



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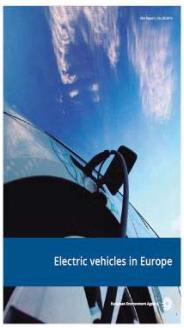
Catalysing the shift to electric vehicles



Supporting incentives and coordinated policies are key in accelerating electric vehicle market development.

INSTRUMENT	EXAMPLES
Regulatory incentives	CO2 standards, sales targets
Financial measures	Subsidies, loans, capital grants
Non-financial incentives	Access to bus lanes, free parking
Information provision	Product labels, PR campaigns, public debates
Infrastructure provision	Charging infrastructure, finance home chargers
Technology push institutions	EU Business Innovation Centres

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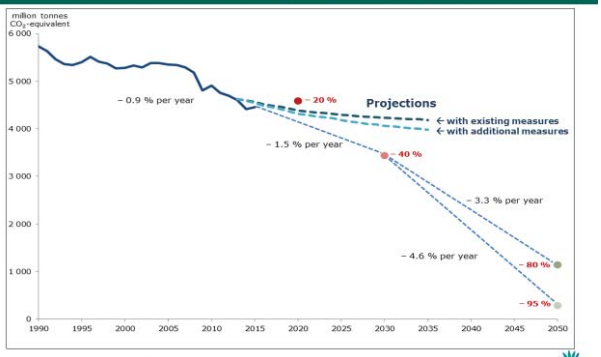
Long-term challenge: speeding-up emission reductions



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Source: EEA, Trends and projections in Europe 2016 — Tracking progress towards Europe's climate and energy targets.

Lock-ins and barriers for change

Systemic approach
- Spatial planning
- (Urban) infrastructure
- Fiscal system
- Pricing of externalities
- R&D
- Lack of long-term vision (Pact idea)
- Behaviour
- Attractive alternatives
- SMART

Source: Marc Hoffmann

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Credible alternatives?

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Reflecting on the core of the system?

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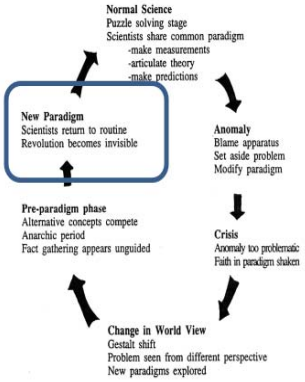
Magic potions?

European Environment Agency

New paradigm-new normal



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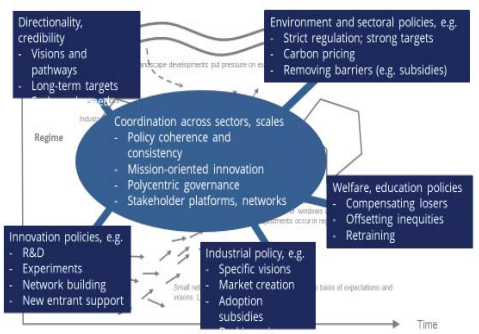
Policy mixes for systemic change



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Necessary and mutually reinforcing policy characteristics

- Consistency
- Coherency
- Strong implementation
- Sense of urgency
- Visionairy
- Engaging

And thus credible to put us on a trajectory for the 'best century'.

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Supporting transitions demands new types of knowledge

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Thank you

Hans.Bruyninckx@eea.europa.eu

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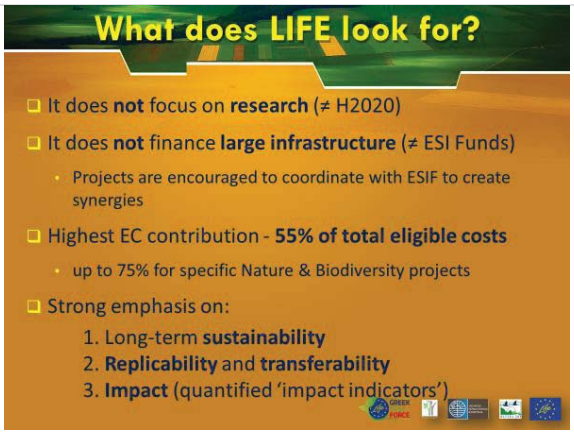
European Environment Agency

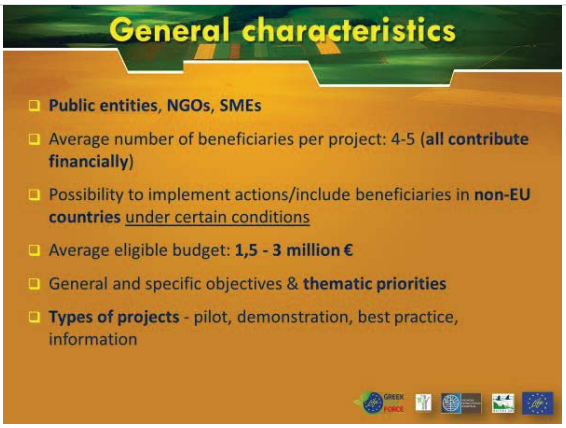
Life 2014-2020: Climate Action sub-programme

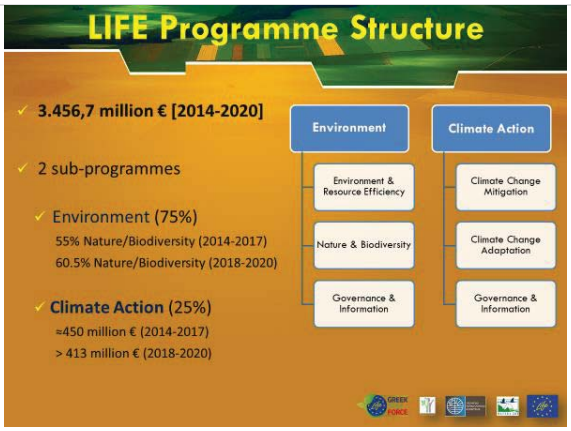
by

Mrs. Spyridoula NTEMIRI,

Ministry of Environment and Energy, Hellas



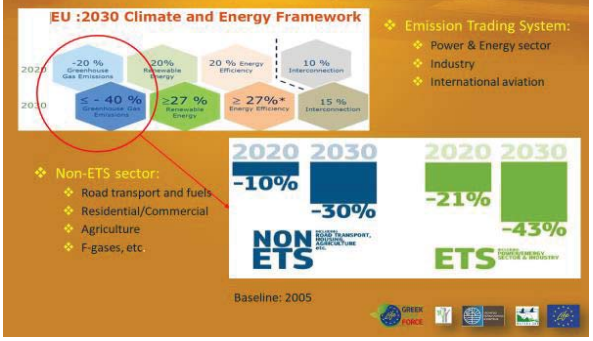




Climate Action sub-programme

- 3 Priority Areas (PAs) – CCM, CCA, GIC (specific objectives set out in Article 14, 15 and 16 or LIFE Regulation)
- Each PA includes a number of **policy areas** of particular interest for the period 2018-2020
- Annual calls contain more detailed **work areas**
- 1-stage approach (2018) →2-stage approach (2019, 2020)

Main EU CCM related priorities



EU CCM related priorities

LULUCF Regulation 2021-2030

'MSs to ensure that the amount of greenhouse gas absorbed by the LULUCF sector is at least equivalent to that emitted'

EC's Communication of the Future of Food and Farming, 2017

'A main objective of the future Common Agricultural Policy is to contribute to the EU's environmental and climate goals'

Other EU priorities

- **Investments in EU's industrial innovation:**
  - ✓ Energy Intensive Industries
  - ✓ Industries at risk of carbon leakage
- **F gases – substitutes for ozone depleting substances:**
  - ✓ F-gases regulation: HFCs reduction by almost 80% by 2030
  - ✓ Kigali amendment (2016): Phase down at global level

LIFE Policy areas for CCM [1]

1. MSs and regional/local efforts for non-ETS sectors
   - Transport and fuels
   - Agriculture
   - Construction (e.g. energy efficiency in buildings)
   - Land use, land use change and forestry (LULUCF)
2. GHG accounting and CCM in LULUCF sector
3. Land management practices having an impact on emissions/removals (i.e. supplementary measures to ESIF)

LIFE Policy areas for CCM [2]

4. Enhancement of the ETS operation with a high impact on energy and GHG intensive industrial production
5. Support to the implementation of F-gases related legislation
6. GHG monitoring and reporting by authorities

Main EU/GR CCA related priorities

- EU Strategy on Adaptation to Climate Change
- Paris Agreement →Urban Adaptation
- Covenant of Mayors (2015) → Combination of mitigation and adaptation
- National Strategy on Adaptation to Climate Change
- Law 4414/2016, ΦΕΚ Α' 149, Art. 42-45
- Regional Adaptation Plans, law specification 11258/2017
- *Useful Link:*

European Climate Adaptation Platform (Climate-Adapt) - http://climate-adapt.eea.europa.eu/

LIFE Policy areas for CCA (1)

1. Urban adaptation and land planning limiting CC impacts
2. Resilience of infrastructure, including
   a. Green-blue infrastructure
   b. Ecosystem based approaches
3. Sustainable management of water in drought-prone areas, flood and coastal management

LIFE Policy areas for CCA [2]

4. Resilience of agricultural, forestry and tourism sectors, including in island and mountain areas
5. Support to the EU's Outermost Regions: preparedness for extreme weather events, notably in coastal areas

LIFE Policy areas for GIC

1. Development and implementation of national 2030 climate and energy strategies and/or mid-century strategies
2. incentivising behavioural change, mainstreaming emission reduction and resource efficiency actions in sectors
3. Assessment by authorities of the functioning of the EU ETS
4. Building capacities, raising awareness among end-users and the equipment distribution chain of F-gases
5. Climate policy monitoring, assessment and *ex post* evaluation
6. Best practices and awareness-raising activities addressing adaptation needs

LIFE Programme in Greece

Since the launch of the LIFE Programme by the European Commission in 1992 and until 2018, a total of **254** projects have been co-financed with a Greek beneficiary as a Coordinator.

The total investment of these projects amounts to **€ 388.1 million**, of which the EU's contribution is **€ 212.1 million**.

Currently there are 9 on-going Climate Action projects in Greece.

LIFE Programme in Greece (1992-2018)

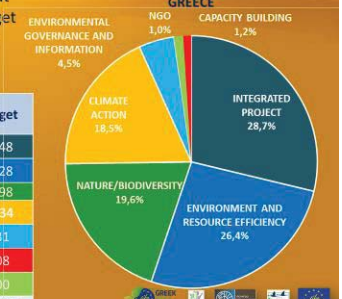
Sub-Programme	Number of projects	Percent of total	Total budget	EC contribution
ENVIRONMENT AND RESOURCE EFFICIENCY	143	56.3%	190,786,258	89,472,968
NATURE/BIODIVERSITY	73	28.7%	107,329,228	72,706,252
CLIMATE ACTION	**24**	**9.4%**	46,118,442	24,198,386
ENVIRONMENTAL GOVERNANCE AND INFORMATION	10	3.9%	10,305,351	5,608,388
INTEGRATED PROJECT	2	0.8%	31,189,548	18,533,169
CAPACITY BUILDING	1	0.4%	1,304,708	953,600
NGO	1	0.4%	1,120,000	672,000
TOTAL	**254**	**100%**	**388,153,536**	**212,144,763**

Source: Database of LIFE projects - European Commission, interpreted by the Greek LIFE Task Force

Projects in progress

There are **39 projects** with Greek beneficiaries as coordinators that are in progress with a total budget of **€ 108.5 million,** of which the EU's contribution is **€ 64.9 million**.

Sub-Programme	No. of projects	Total budget
IP	2	31,189,548
ENV & RE	13	28,675,028
NAT/BIO	10	21,277,898
CA	9	20,034,834
GIE	4	4,914,331
CAP	1	1,304,708
NGO	1	1,120,000
TOTAL	**39**	**108,516,347**



Greek participation in the CA 2018 Call

10 proposals with Greek beneficiaries as coordinators and **5** proposals with coordinators from another country and Greek beneficiaries as partners have been submitted in the 2018 LIFE Call for Climate Action (September 2018).

Priority Area	Number of proposals with Greek beneficiary as a coordinator	Number of proposals with Greek beneficiary as a partner
CCM	5	1
CCA	4	3
GIC	1	1
TOTAL	**10**	**5**

Interested? Where can you get more info? «LIFE14 CAP/GR/000003 – GR LTF»

Capacity Building project:
provide financial support to activities required to build the capacity of Member States, with a view to enabling Member States to participate more effectively in the LIFE Programme

Duration:
01/01/2016 – 30/04/2019*

Budget:
Total amount: € 1,304,708
Requested EC funding: € 953,600

Beneficiaries:
Green Fund, Coordinating Beneficiary
Ministry of Environment and Energy, Associated Beneficiary

GR LTF Role

- Inform potential beneficiaries
- Support in the preparation of proposals
- Provide technical assistance & consulting to potential beneficiaries
- Promote the exchange of experiences and best practices
- Enhance the uptake of LIFE projects results
- Operate the platform on LIFE in Greece
- Enhance the operation of the LIFE National Contact Points

More efficient participation of Greece in LIFE projects


Thank you for your attention!
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support.lifetaskforce.gr
www.prasinotameio.gr

Green Fund: Funding opportunities for environmental protection

by

Mrs. Konstantina AGRA, Mrs. Artemis VITALI

Ministry of Environment and Energy, Hellas


2018 Budget
98 million €
Due to crisis - Utilization per year:
only the 2.5% of the available balance is permitted


Protection of the Marine Environment & Prevention of the Marine Pollution (Blue Fund)
Forest Protection & Restoration
Natural Protected Areas
Natural Environment & Innovative Actions
European Programme LIFE
Environmental Balance
2018 Funding Programmes


European Programme LIFE - 2 m €
GF as Coordinator – Capacity Building
GF as Beneficiary of LIFE Programs
Part of National Contribution in E.U. approved projects


Environmental Balance 38 m €
Actions for improving Urban Environment
Beneficiaries : Municipalities
Actions targeting Urban & Rural abnormalities / deviations (e.g. removing polluting materials, demolishing illegally constructed structures / buildings)
Beneficiaries : Regional Administrations


Thank you for your attention
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Horizon 2020: Climate action and environment

by

Mrs. Katerina PAPADOULI

PRAXI Network, Hellas

praxi
help-forward network

Horizon 2020
Climate Action, Environment, Resource efficiency and Raw materials

Work Programme 2018-2020

PRAXI Network

- Unit of Foundation for Research and Technology Hellas
- Founded in 1991 as an initiative to bridge the gap between research and industry (FORTH, SEV, SBBE)
- Employs more than 30 people with research, business and consulting background
- Offers technology transfer services to SMEs and Research organisations

1 October 2018

PRAXI Network as National Contact Point

- ✓ Legal & Financial Aspects
- ✓ SMEs
- ✓ Access to Finance
- ✓ Nanotechnologies, advanced materials and advanced manufacturing and processing (NMP)
- ✓ Space
- ✓ Climate action, environment, resource efficiency and raw materials
- ✓ Smart, green and integrated transport
- ✓ Secure societies - protecting freedom and security of Europe and its citizens
- ✓ Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy
- ✓ Spreading excellence and widening participation

12 October 2018

Horizon 2020

Funding tool of the Commission

- 77 billion euros for Research and Innovation

12 October 2018

The 3 pillars of Horizon 2020

12 October 2018

Societal Challenges in Horizon 2020

The EC has identified and prioritized 7 Societal Challenges

- Targeted investment on research and innovation for the interest of the society and European citizens

1. Health, demographic change and wellbeing;
2. Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy;
3. Secure, clean and efficient energy;
4. Smart, green and integrated transport;
5. Climate action, environment, resource efficiency and raw materials;
6. Europe in a changing world - inclusive, innovative and reflective societies;
7. Secure societies - protecting freedom and security of Europe and its citizens.

12 October 2018

Rules for Participation

- ✓ *"The proposal content corresponds, wholly or in part, to the topic description against which it is submitted, in the relevant work programme part."*
- ✓ The proposal must be in line with the eligibility conditions depending on the action:

Type of Action	Eligibility Conditions
Research & Innovation Action	✓At least 3 legal entities ✓Each from different MS or H2020 associated country ✓Entities independent from each other
Innovation Action	
Coordination & Support Action	✓At least 1 legal entity from MS H2020 associated country
SME Instrument	✓At least one SME

12 October 2018

Societal Challenges in Horizon 2020

Societal Challenge 5-Climate Action

› **Climate action, environment, resourse efficiency and raw materials**

*The 20th century's era of seemingly **plentiful and cheap** resources is coming to an end. The ability of the economy to **adapt** and become more **climate change resilient**, **resource efficient** and at the same time remain **competitive** depends on high levels of eco-innovation, of a societal, economic, organizational and technological nature.*

12 October 2018

Formulation of the Work Programme 2018-2020

Challenge-based approach, with **big high-impact calls** and **broader topics**, each supporting a balanced portfolio of projects

Focus areas:

- Building a low-carbon, climate resilient future
- Connecting economic and environmental gains – the Circular Economy
- Digitising and transforming European industry and services
- Boosting the effectiveness of the Security Union

- **Making research and innovation more visible** through communication, open access to research results, new emphasis on data management

Source: EC, SC5 Infoday 2017 & SC5 Infoday 2018

12 October 2018

Formulation of the Work Programme 2018-2020

The Societal Challenge 5 policy context

Source: EC, SC5 Infoday 2018

12 October 2018

Societal Challenge 5: Climate action, environment, resource efficiency and raw materials

Work Programme 2018-2020

Focus:

- ✓ moving to a greener, more resource efficient and climate-resilient economy in sync with the natural environment
- ✓ demonstrating a strong commitment to supporting the UN's Sustainable Development Goals (SDGs) and the targets of the COP21 Paris Agreement

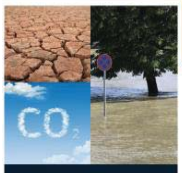
2 multiannual calls:

"Building a low-carbon, climate resilient future: climate action in support of the Paris Agreement"

"Greening the economy in line with the Sustainable Development Goals (SDGs)"

- Total indicative budget 2018-2020: €1.1bn
- budget for 2019: €387.5m

European Commission



Call "Building a low-carbon, climate resilient future: climate action in support of the Paris Agreement"

- ✓ **Decarbonisation**
- ✓ **Climate adaptation, impacts and services**
- ✓ ***Inter-relations between climate change, biodiversity and ecosystem services***
- ✓ ***The Cryosphere***
- ✓ **Knowledge gaps *[in 2020]***
- ✓ ***Earth observation [in 2020]***

Budget in 2019: €116 million

European Commission

Call "Greening the economy in line with the Sustainable Development Goals (SDGs)"

- ✓ **Connecting economic and environmental gains - the circular economy**
- ✓ **Raw materials**
- ✓ **Water for our environment, economy and society**
- ✓ **Innovating cities for sustainability and resilience**
- ✓ **Protecting and leveraging the value of our natural and cultural assets: Earth observation; nature-based solutions, disaster risk reduction and natural capital accounting; heritage alive**

Budget in 2019: €256.1 million

European Commission

Climate Action: Work Programme 2018-2020

2019 topics open: 14 Nov 2018

Call deadlines: 19 Feb 2019 (single/first stage) 4 Sep 2019 (second stage)

12 October 2018

Climate Action: Work Programme 2018-2020

Call (2019) - Building a low-carbon, climate resilient future: climate action in support of the Paris Agreement

Indicative topics for 2019

- **LC-CLA-02-2019:** Negative emissions and land-use based mitigation assessment (RIA)
- **LC-CLA-05-2019:** Human dynamics of climate change (RIA)
- **LC-CLA-06-2019:** Inter-relations between climate change, biodiversity and ecosystem services (RIA)

12 October 2018

Climate Action: Work Programme 2018-2020

Call (2019) - Greening the economy in line with the Sustainable Development Goals (SDGs)

Indicative topics for 2019

- **CE-SC5-04-2019:** Building a water-smart economy and society (IA)
- **SC5-14-2019:** Visionary and integrated solutions to improve well-being and health in cities (IA)
- **SC5-20-2019:** Transforming historic urban areas and/or cultural landscapes into hubs of entrepreneurship and social and cultural integration (IA)

12 October 2018

Horizon 2020 SC5 Climate Action 2018 Information Day - calls 2019

Information Day and Brokerage Event

11-12 September, Brussels

More information:
https://ec.europa.eu/easme/en/2018-information-day-calls-2019

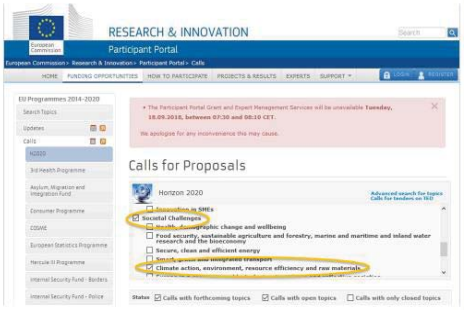
(All presentations and webstreams are available)

12 October 2018

Participant Portal:
http://ec.europa.eu/research/participants/portal/desktop/en/home.html

12 October 2018

12 October 2018



12 October 2018

NCPs CaRE project
http://www.ncps-care.eu

Network of National Contact Points

- Information and networking events
- Support in partner search

12 October 2018

NCPs CaRE – Partner search tool

Register on the online platform to:

- ✓ Create partnership profiles
- ✓ Search collaboration opportunities

12 October 2018

What can PRAXI Network do for you as an NCP?

Information

- We disseminate general information on the funding opportunities in H2020
- We organize info-days and seminars
- We disseminate partner searches to our clients from consortia around the world
- We disseminate the information on planned info-days, seminars and workshops organised in Greece and abroad

12 October 2018

What can PRAXI Network do for you as an NCP?

Provision of support, consulting and training

- Look for the right call
- Rules and procedures for participation
- Evaluation Criteria
- Horizontal issues (e.g. innovation management, commercialization, IPR, legal and financial issues)

12 October 2018

What can PRAXI Network do for you as an NCP?

Mediation

- With the appropriate members of the Commission responsible for the respective thematic area
- For partner searches to create the best consortia
- With NCPs and partners around the world to promote client profiles
- To signpost you to the right experts for specialized issues outside our scope/expertise

12 October 2018

Next Framework Programme on Research and Innovation-FP9

Horizon Europe

- In preparation phase
- Will cover the period 2021-2027
- Indicative budget: 100 billion euros
- EU proposition is now public

➢ For more information, visit the site of EU

Horizon Europe - the next research and innovation framework programme

12 October 2018

Thank you for your attention

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NCP for H2020 – Food safety, Sustainable agriculture and the Bioeconomy
Papadouli@praxintetwork.gr

Vaya Piteli
NCP for H2020 – Climate Action, Environment and Raw materials
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e-mail: praxi@praxinetwork.gr
praxinetwork

Session 2: Projects

HORIZON 2020	iBRoad
Title: Individual Building (Renovation) Roadmaps **Project Web Site:** https://ibroad-project.eu/ **Duration:** 36 months **Start Date:** 01/06/2017 **Key Words:** energy efficiency, buildings, Building Renovation Passports, deep renovation	**Funding mechanism:** Horizon 2020, Secure, clean and efficient energy, Coordination and support action **Total Cost:** 1.957.095,60 € **EC Contribution:** 1.957.095,60 € (100%) **Consortium:** 11 partners from 8 EU countries **Project Coordinator:** Sympraxis Team P.C.

The Challenge

Renovating a building can be complex and time consuming. For building owners, the lack of knowledge about what to do, and in which order to implement renovation measures, is one of the main obstacles to improving the energy performance of their building.

The iBRoad project works on lifting these barriers by developing an Individual Building Renovation Roadmap for single-family houses. This tool looks at the building as a whole, and provides a customised renovation plan (iBRoad-Plan) over a long-term horizon (15-20 years). The plan is supported by a logbook (iBRoad-Log), a repository of all information available about the building.

The renovation roadmap is, at its core, a home-improvement plan which considers the occupant's needs and specific situation (e.g., age, financial situation, composition and expected evolution of the household, etc.) and avoids the risk of a 'lock-in' of future renovation solutions due to a lack of foresight.

Project Objectives

1. Explore the principles of Individual Building Renovation Roadmap: Overview of the current situation regarding deep renovation strategies in the participating countries and analysis of four main initiatives, developed in Germany, France, Belgium - Flanders and Denmark, to support home owners with customised instructions.
2. Develop modules and key approaches of iBRoad: Creation of the main modules of individual building renovation roadmaps and logbooks.
3. Design and test national implementation of iBRoad: The identified principles and modules will be adapted to the home context in the pilot countries (Bulgaria, Poland, Portugal, plus Germany for the logbook) and implemented experimentally with the help of specially trained certified auditors.
4. Analysis of the replicability and feasibility of iBRoad in the EU. Investigation of policy recommendations for a Europe-wide implementation of the iBRoad roadmap and logbook, including the integration of these with other instruments, in support of deep renovation.
5. Stakeholders engagement: Identification, connection and engagement with stakeholders in all participating countries.

6. Communication and Dissemination: Ensure a recognisable and strong presence of the project and its outcomes. The project website, brochures and videos have been delivered in 10 languages.

Methodology

The methodology implemented includes analysis of relevant examples (from Germany, France, Belgium - Flanders and Denmark), development of an overall concept based on specific tools, pilot implementation (in Bulgaria, Poland, Portugal and Germany), and consolidation of lessons learnt into guidelines for further potential developments and applications.

iBRoad as an evolution of EPCs

While EPCs (Energy Performance Certificates) are delivered mostly for the sale or rent of a property, iBRoad targets all home owners interested in home improvement, and includes suggestions and measures to achieve deep renovation based on technical information, as well as personal needs and preferences. The iBRoad-Plan provides custom made recommendations based on individual building data, outlining each renovation step and the links upon each measure over time.

DIRECTIVE 2018/844 CONTEXT

With the entry into force of the revised Energy Performance of Buildings Directive (2018/844), which includes reference to Building Renovation Passports, the iBRoad integrated concept of Individual Building Renovation Roadmaps seems more timely than ever.

Expected Results and Impacts

Main results expected from the project:

- 8 country factsheets
- Report on existing building renovation roadmaps and logbooks
- Guide to integrating techno-economic assessment modules and logbook components in iBRoad programmes
- Study for the pilot-country-specific adoption of iBRoad
- iBRoad modules for the three pilot countries
- iBRoad training toolkit for energy auditors in the pilot countries
- Report on implementation and evaluation of the iBRoad for the pilot countries
- Assessment of the feasibility and replicability of iBRoad across Europe, policy brief
- Guidance on data protection issues relevant to iBRoad
- Extensive communication and stakeholder engagement, including project website, discussion forum and national meetings.

Expected impacts

- Enabling the adoption of future policies in support of energy performance and decarbonisation of the building stock.
- Increasing the number of individual deep renovations.
- Providing tailor-made advice, suggesting an optimal strategy for an individual building, taking into account the owners' financial and occupancy situation, specific needs and preferences.
- Supporting a reliable energy performance rating.
- Monitoring the performance of buildings over time, creating a positive impact on the compliance rate of the implemented measures.

Project partners	
Sympraxis Team	Greece
BUILDING PERFORMANCE INSTITUTE EUROPE (BPIE)	Belgium
ifeu – Institute for Energy and Environmental Research	Germany
TU Wien – Technical University of Vienna	Austria
INZEB – Institute of Zero Energy Buildings	Greece
BPAC – Blue Planet Academy & Consulting	Belgium
Eneffect Center for Energy Efficiency	Bulgaria
ADENE Energy Agency	Portugal
VEA – Flemish Energy Agency	Belgium
KAPE – Polish National Energy Conservation Agency	Poland
INCD URBAN-INCERC – National Institute for Research and Development in Construction, Urban Planning and Sustainable Spatial Development	Romania

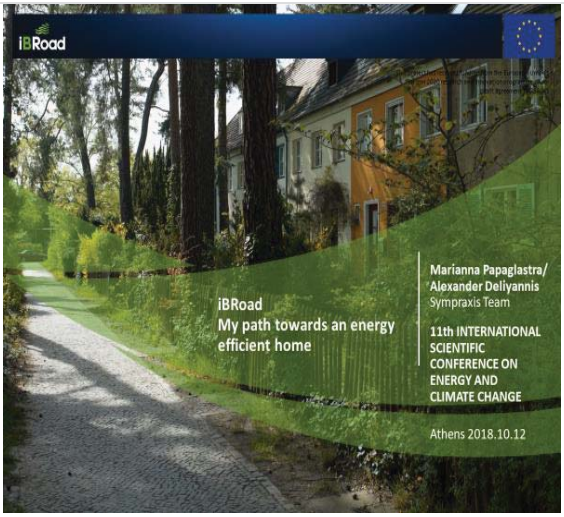
Presentation

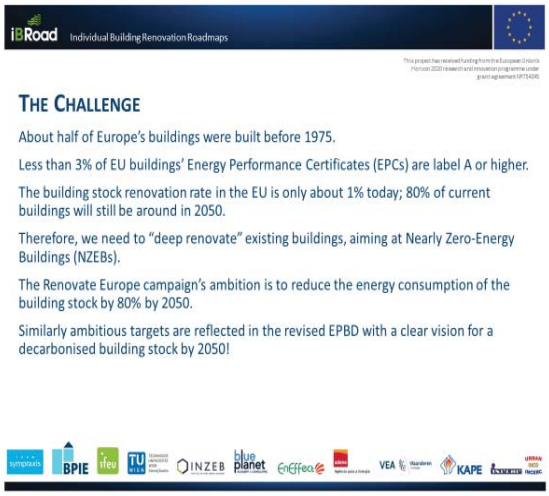
by

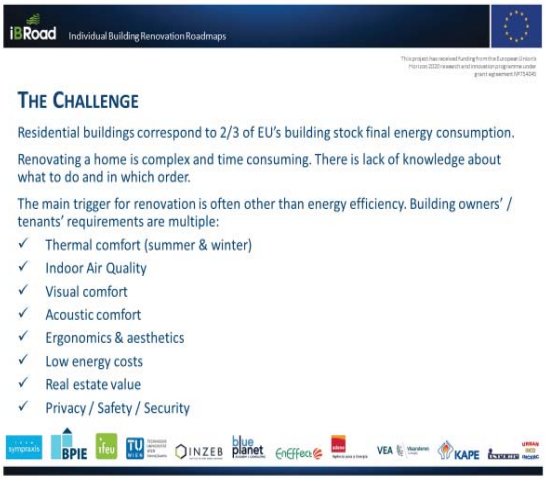
Mrs. Marianna PAPAGLASTRA

International Account Manager

Symparxis team, Hellas







iBRoad Individual Building Renovation Roadmaps

PROPOSED SOLUTION – iBRoad

iBRoad works on lifting barriers to renovation by developing an Individual Building Renovation Roadmap for single-family houses. This tool looks at the building as a whole, and provides a customised step-by-step renovation plan (iBRoad-Plan) over a long-term horizon (15-20 years).

The plan is supported by a logbook (iBRoad-Log), a repository of all information available about the building.

iBRoad Individual Building Renovation Roadmaps

PROJECT TASKS

Explore the principles of the Individual Building Renovation Roadmap – Analyse existing examples from Germany, France and Belgium (Flanders).

Develop modules and key approaches of iBRoad

Design and test national implementation of iBRoad supported by auditor training – in Bulgaria, Poland, Portugal and Germany.

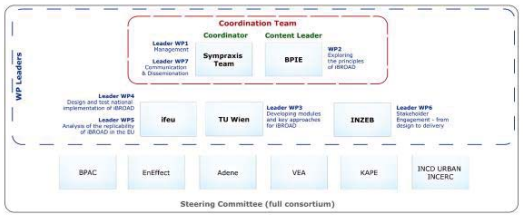
Analyse the replicability and feasibility of iBRoad in the EU

Engage Stakeholders

Communicate and Disseminate project results

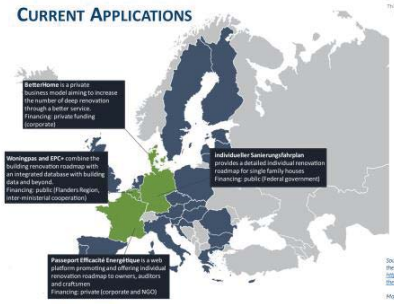
iBRoad Individual Building Renovation Roadmaps

THE TEAM



iBRoad Individual Building Renovation Roadmaps

CURRENT APPLICATIONS



iBRoad Individual Building Renovation Roadmaps

THE BUILDING RENOVATION PASSPORT CONCEPT

INFORMATION AT INDIVIDUAL BUILDING LEVEL

EXISTING ENERGY PERFORMANCE CERTIFICATE (EPC)

ON-SITE GATHERED INFORMATION
- Energy audit
- Building professionals, e.g. construction plan, info installations, BIM, etc.
- Building owner or tenant
- Public authorities

AUTOMATED DATA
- Smart meters
- Monitoring systems, e.g. RES, heating, CO_2 meters, etc.

BUILDING RENOVATION PASSPORT

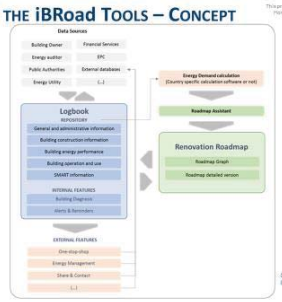
RENOVATION ROADMAP
- Comprehensive audit
- Systematic renovation in a sensible order and packages
- Considers individual context
- Long-term perspective

LOGBOOK
- Inventory of building-related information
- Functionalities for users
- Beyond energy
- Linking building owners and users to third parties

Source: iBRoad project

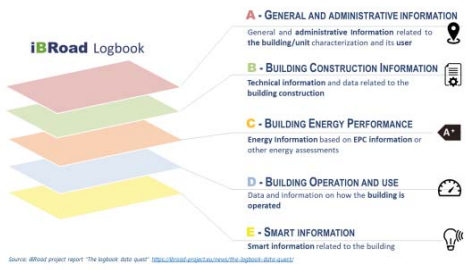
iBRoad Individual Building Renovation Roadmaps

OVERVIEW OF THE iBRoad TOOLS – CONCEPT



iBRoad Individual Building Renovation Roadmaps

iBRoad-LOG OVERVIEW (1)

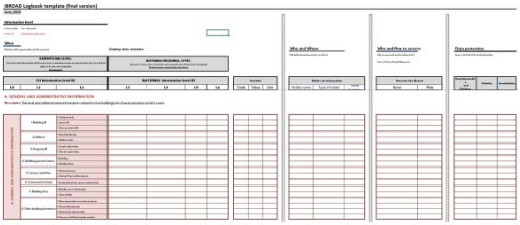


iBRoad Individual Building Renovation Roadmaps

iBRoad-LOG OVERVIEW (2)

iBRoad Individual Building Renovation Roadmaps

iBRoad-LOG OVERVIEW (3)



iBRoad Individual Building Renovation Roadmaps

Stakeholders considered (source: ADENE)

iBRoad Individual Building Renovation Roadmaps

potential iBRoad-Log functionalities (source: ADENE)

iBRoad Individual Building Renovation Roadmaps

iBRoad-PLAN OVERVIEW

Source: iBRoad project (Work in progress)

iBRoad Individual Building Renovation Roadmaps

EXPECTED BENEFITS

The iBRoad renovation roadmap is a customised, long-term, home-improvement plan which considers the occupant's needs and specific situation and avoids the risk of 'lock-in' effects. In this respect, it enables

- ✓maintaining the overview of the building's history
- ✓planning of renovation steps
- ✓achieving deep renovation levels over a long-term horizon (stepwise)
- ✓access to financing (either through own resources, or by giving insurance to financing institutions)

iBRoad Individual Building Renovation Roadmaps

EXPECTED IMPACTS

- ✓Enabling the adoption of future policies in support of energy performance and decarbonisation of the building stock.
- ✓Increasing the number of individual deep renovations.
- ✓Providing tailor-made advice, suggesting an optimal strategy for an individual building, taking into account the owners' financial and occupancy situation, specific needs and preferences.
- ✓Supporting a reliable energy performance rating.
- ✓Monitoring the performance of buildings over time, creating a positive impact on the compliance rate of the implemented measures.

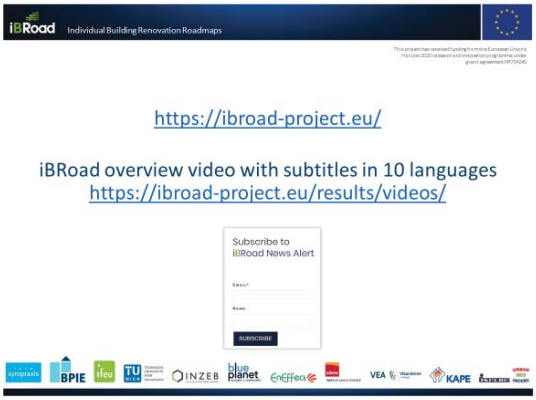
iBRoad Individual Building Renovation Roadmaps

iBRoad FIRST OUTCOMES

iBRoad Individual Building Renovation Roadmaps

iBRoad – NEXT STEPS

- ✓Finalising software tools
- ✓Pilot application in BG, PL, PT, DE
- ✓Stakeholder feedback
- ✓Replicability across Europe, including data management aspects


iBRoad
Individual Building Renovation Roadmaps
https://ibroad-project.eu/
iBRoad overview video with subtitles in 10 languages
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Thank you
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HORIZON 2020	IMPLEMENT
Title: Improving local energy and climate policy through quality management and certification **Project Web Site:** https://www.european-energy-award.org/eu-project-implement/ **Duration:** 48 months **Start Date:** 01/02/2018 **Key Words:** local climate policy, local energy policy, quality management tool, certification, European municipalities	**Funding mechanism:** HORIZON2020, European Commission **Total Cost:** 1.389.615 € **EC Contribution:** 1.389.615 € **Consortium:** 7 partners from 6 countries **Project Coordinator:** Bond Beter Leefmilieu (Belgium)

The Challenge

By introducing the quality management and certification system **European Energy Award** (*EEA*) in Belgium, Croatia, Greece and Poland, the project aims at setting up the necessary structures to carry out the programme in municipalities in the new target regions.

Project Objectives

4 main objectives are addressed through this project:

1. Roll out the European Energy Award quality management system and certification scheme in four EU member states
2. Capacity Building: empower municipalities to implement climate strategies based on integrated energy and climate plans
3. Measurable energy, CO_2 and costs savings as well as increasing production and consumption of renewable energy in 30 pilot municipalities
4. Certification of municipalities ensuring quality standards and positive recognition

Methodology

The partners will introduce and roll out a successful international quality management programme for local climate policy implementation, in 12 regions in four countries. Also national EEA offices and steering committees involving stakeholders from different governance levels, will be set up. An interdepartmental energy team from each municipality will prepare an energy policy programme (30 in total), which will outline a set of binding activities, responsibilities, budgets and deadlines for the subsequent years.

During the project period, 30 pilot municipalities will receive external guidance in putting their energy policies into practice. Municipalities will assess and plan activities in 6 areas of activity: Development & spatial planning, municipal buildings & facilities, supply & disposal, mobility, internal organisation and communication & cooperation. As part of the *EEA*process, the work done by the energy teams will be moderated and reviewed by accredited *EEA* advisors. At the end of the project all achievements will be assessed by an external EEA-auditor. These audits will lead to certifications and depending on the success rate, the European Energy Award will be granted.

Expected Results

During the project, 30 pilot municipalities will further develop and implement their climate and energy strategy by using the EEA standards and the associated criteria catalogue with a detailed set of recommendable measures. Accredited EEA advisors will guide and monitor the continuous progress while certification will ensure that municipalities implement their climate and energy plans to high quality standards. The municipality's experiences and successes will pave the way for more municipalities in the target regions to join the EEA.

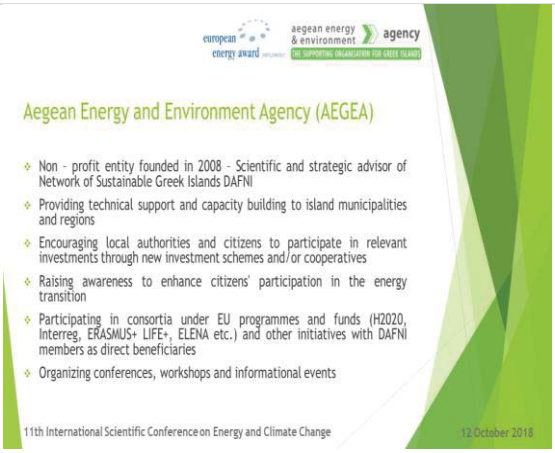
Project partners	
Bond Beter Leefmilieu	Belgium
Krajowa Agencja Poszanowania	Poland
Association Pour La Promotion Des Energies Renouvelables - Apere ASBL	Belgium
Regionalna Energetska Agencija Sjeveverozapadne Hrvatske Regea	Croatia
Aegean Energy and Environment Agency	Hellas
B. & S.U. Beratungs- Und Servicegesellschaft Umwelt MBH	Germany
Brandes Energie AG	Switzerland

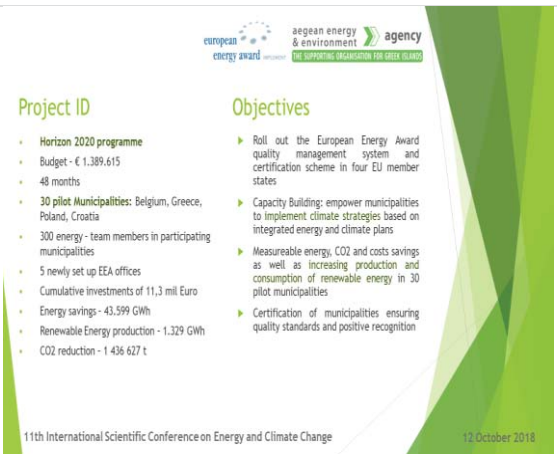
Presentation

by

Mrs. Maria KALADAMI

Aegean Energy and Environment Agency (AEGEA), Hellas





IMPLEMENT in Greece

AEGEA becomes a national EEA office:

- Setting up the EEA Advisors team
  - Advisors background: knowledge in energy related topics and experience in working with municipalities
  - Trainings on the EEA process and tools → Qualified EEA advisors
- Setting up the Steering Committee
  - Role: to provide specific expertise in order to adapt EEA to the national context
  - Members profile: knowledge of the target group - local authorities, technical expertise on implementing measures, knowledge of local climate policy

AEGEA in IMPLEMENT

AEGEA supports 6 Pilot Municipalities and their Energy Teams with:

- Initial Energy Review: Identification of measures already implemented and areas providing potential for improvement
- Initial Energy Policy Programme: Defining activities for subsequent years and setting out responsibilities and deadlines
- Yearly internal audits: Assessing progress achieved within the EEA areas
- Consultancy support throughout the Project Implementation
- External auditor and certification & awarding

The 6 Greek Pilot Municipalities

Municipality	Profile
Chios	51,390 inhabitants in the process of developing a SEAP
Amorgos	1,859 inhabitants in the process of developing a SEAP
Mykonos	10,134 inhabitants in the process of developing a SEAP
Milos	4,977 inhabitants with valid SEAP
Thira	15,550 inhabitants without a SEAP
Kos	33,388 inhabitants without a SEAP

AEGEA and Pilot Municipalities (1)

- October 2018 → Signing cooperation agreement; Defining Energy Teams; Energy Team kick-off meeting
- October 2018 - January 2019 → Developing the Initial Energy Review: Meetings & close cooperation with Energy Team
- February 2019 → Developing the Initial Energy Policy Programme
- February 2019 - December 2021 → Implementing activities defined under the Initial Energy Policy Programme and progress review
- 2022 → Certification and awarding ceremony

AEGEA and Pilot Municipalities (2)

- they can reduce (energy) costs ...
- they minimise CO2 emissions ...
- Increased use of renewable energies

... by selecting the most efficient climate protection measures

- Creation of new jobs (through the implementation of measures)
- Local value creation!

- Creating a network in the municipality - involving dedicated stakeholders
- **Improvement of image and consciousness raising through the award**
- They become attractive and sustainable locations for families and businesses

Additional EEA Municipalities

EEA roll - out

- Yearly events for networking, raising awareness, exchange of experiences, promoting good practices
- 3 additional Municipalities per participating region enrolling in the EEA by the end of the project

Thank you

Maria KALADAMI, MSc. Eng
Junior Energy Expert
Email: [redacted]
AEGEA: www.aegean-energy.gr/en
IMPLEMENT: www.european-energy-award.org/eu-project-implement

HORIZON 2020	ZERO-PLUS
Title: Achieving near Zero and Positive Settlements in Europe using Advanced Energy Technology **Project Web Site:** http://www.zeroplus.org **Duration:** 48 months **Start Date:** 01/11/2015 **Key Words:** NZE settlements, Innovation technologies, Energy efficiency in buildings, sustainable energy technologies, Thermal-energy simulation, environmental and cost performance	**Funding mechanism:** Innovation Action Horizon2020, Funding Scheme Horizon 2020, Secure Clean and Efficient Energy, Research and Innovation Action. **Total Cost:** 4.171.947, 50 € **EC Contribution:** 3.468.982,50 € **Consortium:** 16 partners from 8 countries **Project Coordinator:** National and Kapodistrian University of Athens (Greece)

The Challenge

ZERO-PLUS is a collaborative approach to the design and construction of settlements, involving technology providers, energy efficiency and renewable energy experts and developers who work together from the earliest stages of project conception.

The goal of this project is to provide the market with an innovative, yet readily implementable system for Net Zero Energy (NZE) settlements that will significantly reduce their costs. The benefits of the analysis at the settlement level arise from looking at the larger scale compared to single buildings, and at a system of houses with their interactions. This means, for instance, cost reduction through the deployment of renewable energy technologies at the settlement level instead of individually in each building. The concept can expand to aspects such as efficient water systems, electric mobility, etc.

ZERO-PLUS settlements exceed the state of the art by setting performance objectives requiring improvement relative to other energy efficient buildings:

- Operational energy usage in residential buildings in a ZERO-PLUS settlement is reduced to an average of 0-20 kWh/m2 per year.
- The NZE settlement generates a minimum of 50 kWh/m2 of renewable energy per year.
- The cost of the ZERO-PLUS building is reduced by at least 16%, compared to a regular NZE building.

Until the end of the project four ZERO-PLUS settlements will be realized. They will be located in different locations (Cyprus, France, Italy and the UK) and consist of different types of building (ranging from villas to apartment buildings for social housing) thus demonstrating the adaptability and wide applicability of the ZERO-PLUS concept.

Project Objectives

1. The first objective of the project is a reduction of the operational energy usage in residential buildings to an average **of 0-20 kWh/m^2 per year, compared with the current average of 70-230 kWh/m^2 energy per year**. The reduced energy consumption will be attained through the application of a number of technologies, including highly efficient insulation, heating and lighting, as well as automated Building Energy Management Systems (BEMS) in four selected case studies of 2600 m2 of gross floor area of buildings.

2. In order to achieve the NZE goal, **at least 50kWh/m^2 renewable energy per year** will be generated, on average, in the NZE settlement. This objective will be attained through the integration in the settlement of innovative energy production technologies such as advanced insulation components, solar energy concentration technology and advanced HVAC technologies.
3. Greater energy efficiency can only be achieved through **a transition from single NZE buildings to NZE settlements**, in which the energy loads and resources are optimally managed. This objective will be attained through the application of solutions for the distribution network, energy storage and micro grid control on a district level, as well as through an optimum climatic management of the open spaces in the settlement.
4. The cost of NZE settlements will be **reduced by at least 16%**, compared with current costs. This cost reduction will be achieved through strategies like the deployment of renewable energy and energy management technologies at the settlement level and the improvement of the microclimate.
5. To ensure that the results of this project will have an impact on the building industry, the final objective is a market uptake of the solutions developed in this project by the year 2018. This will be attained through the demonstration of the solutions **in four different real-life case studies across the EU under different climatic conditions**, and through the dissemination and exploitation of the results of these case studies, based on a comprehensive market analysis and business plan.
6. To support the shift towards resource-efficient, low-carbon and climate-resilient buildings and districts, by enhancing the role of Europe‘s construction industry in the reduction of the EU‘s carbon footprint by almost **77kgrCO2/m2 with a total 408 tonnes CO_2 offset for all ZERO-PLUS case studies**.

Methodology

In order to achieve the project's objectives, it will be carried out in a number of phases. Following the collection of all the required input data, different solutions will be developed and integrated into the system for NZE settlements. This system will then be optimized according to the specific requirements of each case study. Following the implementation, extensive monitoring will be carried out to verify the performance of the system. Finally, activities dedicated to the exploitation and dissemination of the results will be carried out to maximize the impact of these results. Accordingly, the project will be carried out in the following phases:

1. State of the Art on NZE and Positive Energy Settlements: Initial Preparation and Collection of Data in the Four Demonstration Sites
2. Design of technologies and solutions
3. Integrated Design and Optimisation of the Zero Energy Settlements
4. Construction management, Cost Management and Implementation of the Innovative Technologies
5. Monitoring and Evaluation of the Settlements Performance
6. Market Analysis and Model for Business Growth
7. Dissemination

Expected Results

- Increased energy and environmental performance.
- Improving innovation capacity and the integration of new knowledge:

- Increased innovation capacity
- Delivery of innovations to the markets
- Integration of new knowledge
- Compliance of NZE Settlements with the EU Directive 2010/31/EU for buildings
- Contribution to standards

Project Partners	
National Kapodistrian University of Athens	Greece
Technische Universität München	Germany
Ben-Gurion University of the Negev	Israel
University of Perugia	Italy
Oxford Brookes University	United Kingdom
The Cyprus Institute	Cyprus
Technical University of Crete	Greece
ABB Italy	Italy
Anerdgy AG	Switzerland
FIBRAN S.A.	Greece
ConsorzioArca (ARCA)	Italy
Eco Ltd	United Kingdom
Office Public d'Aménagementet de Construction de l'Isère	France
CONTEDIL di Ricco M. & C. S.A.S	Italy
George Vassiliou Ltd.	Cyprus
Joseph Rowntree Housing Trust	United Kingdom

Presentation

by

Mrs. Maria SALIARI

NKUA, Hellas

Achieving near Zero and Positive Energy Settlements in Europe using Advanced Energy Technology
H2020 - 678407

GA no. 678407

M. Saliari ,M.N. Assimakopoulos, M. Laskari
Group Building Environmental Studies, Physics Department, National and Kapodistrian University of Athens, Greece

PROMITHEASNET
11TH INTERNATIONAL SCIENTIFIC CONFERENCE ON ENERGY AND CLIMATE CHANGE
Projects and Funding Opportunities on Energy and Climate Change
12 OCTOBER 2018, Athens, Greece

The ZERO-PLUS project

- ZERO-PLUS: "Achieving near Zero and Positive Energy Settlements in Europe using Advanced Energy Technology" is an EU funded project in which a comprehensive, cost-effective modular system for Net Zero Energy (NZE) settlements is being developed, implemented and demonstrated in a series of case studies across the EU.

- **Coordinator:** National and Kapodistrian University of Athens
- **Consortium:** 16 partners from the academia and the industry
- **Funding:** H2020
- **Total budget:** 4 171 947,50 euros
- **Duration**: 48M i.e Oct. 2015- Sep. 2019
- **Website:** http://www.zeroplus.org/

M37

Who we are

Case study owners
(AETHERIA, OPAC38, Contedil, JRHT)

CYPRUS, Peyia
FRANCE, Voreppe
ITALY, Granarolo dell' Emilia
UK, Derwenthorpe

Technology providers
(ARCA, ANERDGY, ABB, FIBRAN)

FAE HCPV
WindRail
SolarBlock biPV
REACT+
FIBRAN XPS
freescoo HVAC

Research partners
(NKUA, BGU, TUC,ECO,TUM, Cyl, UNIPG, OBU)

- Monitoring and Evaluation of the Settlements' Performance
- Design and Optimization of Modular Envelope Components
- Energy Production and Management of Individual Buildings
- Integrated Design and Optimization of the NZE Technologies to be implemented at the Settlements Level – Creation of Simulation and Monitoring Protocols
- Market Analysis and Model for Business Growth
- Construction Management, Cost Management and Implementation of the Innovative Technologies
- Integrated Design and Optimization of the Zero Energy Settlements

Energy, environmental & socioeconomic objectives

KPIs

- Operational energy usage of **0-20 kWh/m²** per year.
- At least **50kWh/m²** renewable energy generation per year
- Reduction of the **cost** of NZE settlements by at least **16%,** compared with current nZEB costs.

- **Transition** from single NZE buildings to NZE settlements
- Form an comprehensive market analysis and business plan
- **Reduction** of the EU's **carbon footprint** by **77 kgrCO_2/m²** for all ZERO-PLUS case studies

The ZERO-PLUS concept

TARGET

Provide the market with an innovative, yet readily implementable system for NZE residential neighborhoods that will significantly reduce their costs.

16% reduction of initial investment

3 PARALLEL STRATEGIES

Increasing the efficiency of the components directly providing the energy conservation and energy generation in the NZE settlement.

Reducing the costs through efficient production and installation processes.

Reducing operational costs through better management of the loads and resources on a district scale rather than on the scale of a single building.

The ZERO-PLUS Case Studies

- **Derwenthorpe, York, UK.** Derwenthorpe is a mixed tenure community in the outskirts of York which when complete in 2019, will consist of around 489 new family homes. Through ZERO-PLUS **three typical UK homes** will be transformed into near zero energy homes. In addition to the three dwellings that are part of the project, other parts of the settlement will be used to support the renewable energy targets of the project.(*warm Temperate climate, fully humid, warm summer, Cfb- Koeppen-Geiger climate classification*)
- **Granarolo dell' Emilia, Italy.** It is part of a housing development area (~ 9600m²) already under construction. **Two single family villas** will be built following the guidelines given by ZERO PLUS. The total area dedicated to the demonstration case study i.e the two NZE buildings and their near proximity is close to 2760m². (*Temperate and Mediterranean climate- Cfa*)
- **Voreppe, France.** Two buildings comprising 18 and 14 **social housing** units will be constructed as well as a building of 20 dwellings. The ZERO PLUS building is a building with **18 apartments** on 4 floors. (half-oceanic and half-continental climate- H1C/Cfb)
- **Peyia, Cyprus.** The settlement is located in the western part of Cyprus. **One villa** (175m2) will be built according to the ZERO PLUS guidelines. (*mild Mediterranean climate, generally warm and temperate- Csa*)

UK, Derwenthorpe
ITALY, Granarolo dell' Emilia
FRANCE, Voreppe
CYPRUS, Peyia

The ZERO-PLUS technologies

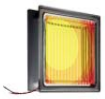
Advanced Envelope Components (FIBRAN). Innovative, composite cool- thermal insulating material based on the new generation of extruded polystyrene (XPS) will be installed on the building envelope. The final layer is either a) a ceramic tile (for flat surfaces) with cool material properties or b) a coating with cool and photocatalytic properties (vertical surfaces)

Advanced HVAC (Solarinvent). Freescoo VAC module is a compact system for ventilation, cooling, dehumidification and heating of buildings, based on a new solar Desiccant Evaporative Cooling concept & hosting in one casing every component used for the operation.

Energy management Systems (ABB):
Integrated solar inverter and storage system. Its is a fully optimized energy management system, embedded on the device that allows the highest self-consumption capability all the way up to self-sufficiency.

The ZERO-PLUS technologies - continued

FAE –HCPV (IDEA). The High Concentrating Photovoltaic (HCPV) systems exploit the property of optics (lenses or curved mirrors) to focus a wide area impacted by the sun radiation on a small area occupied by one or more high efficiency photovoltaic cells (up to 44% of conversion rate) to generate electricity. The FAE HCPV module system has been designed integrated with active cooling for combined heat and electricity generation.



BIPV (SBSkin). precast, dry-assembled and prestressed translucent BIPV components, made of DSC-integrated glassblocks, for building façade and roof installations, with high energy saving and production performance.

WindRail (ANERDGY) a modular wind turbine system that harnesses the energy of the wind, by exploiting the pressure differences around the building, and the solar radiation to generate electricity. PV cells can be integrated to contribute to electricity or thermal energy

The ZERO-PLUS technologies - continued

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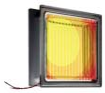

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Technical and financial optimization of the ZERO-PLUS settlements

Horizon 2020 European Union Funding for Research & Innovation

Aims:

Evaluation of the energy interaction between the selected technologies and the total integrated energy performance of the settlement by using advanced simulation techniques.
Minimization of the life cycle cost of the energy and environmental systems and techniques.
Optimization of the global energy and environmental performance of each of the settlements.

Methodology steps:

1. **Optimization and sensitivity analysis**, so as to identify the optimized, innovative systems and techniques, minimize their life cycle costs and optimize the global energy and environmental performance of each one of the four settlements.
2. Selection of the **optimum technical sizing / units** of each technology.
3. Integration of the optimized, innovative systems and techniques **in the final design** of the buildings and the settlements.

Road so far

✓ **Optimization** of the energy and environmental performance at **building scale.** Using advanced simulation techniques, all residential typologies across the four case studies were assessed.

✓ **Design and Optimization** of the **NZE** Technologies to be implemented at the **Settlement** scale

✓ **Initial cost assessment of the ZERO PLUS case studies**

Target: Reduction of the cost of nZE settlements by at least 16% compared with current costs

Development of a methodology for the assessment of the cost reduction of the Zero Plus building

Initial selection of the energy technologies and techniques at building and at settlement level

✓ **Technical and financial optimization** of the integrated architectural and engineering design developed for each one of the four involved settlements:

--Full and detailed simulation of the energy and environmental performance of each settlement

--LCC analysis regarding the specific contribution of each of the selected innovative components in order to estimate the optimum economic sizing.

→ **Construction of the case studies**

Peyia, Cyprus- Construction site.

Voreppe, France- Construction site

Granarolo dell' Emilia, Italy- Construction site

Villa 1

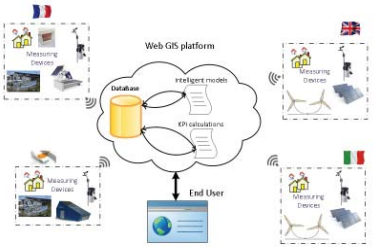
Villa 2

Derwenthorpe, York, UK- Construction site

Monitoring and Evaluation of the Settlements' Performance

Fundamental component is the Web-GIS Platform

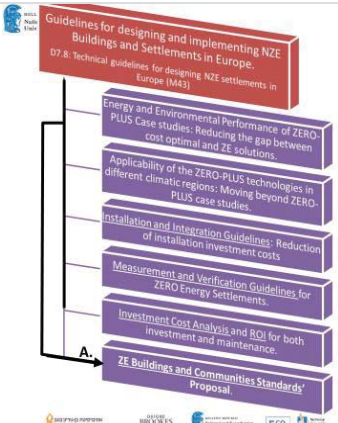
- Intelligent models for evaluation of IEQ
- Intelligent models for analysis of energy demand, production and predictive maintenance
- Fault detection of sensors
- Generation of 15-day report for Problem Identification



WP7: Monitoring and Evaluation

T7.5 Analysis of the energy and environmental performance of the settlements, verification of simulation tools and generalisation of experimental results

- Assessment of Zero-PLUS Settlements energy & environmental performance
  - **D7.6** High quality data sets collected during monitoring of the 4 settlements (M46)
  - **D7.7:** Report on the Energy Performance Analysis of the 4 settlements (M46)
- Guidelines for designing and implementing NZE Buildings and Settlements in Europe.
  - **D7.8:** Technical guidelines for designing NZE settlements in Europe (M43)
  - **CEN/CENELEC-** ZERO-PLUS liaison



B.

A specific section on **necessary NZE Buildings and Communities Standards** will be **developed and submitted to CEN**.

HELLENIC REPUBLIC
National and Kapodistrian University of Athens

Horizon 2020 European Union Funding for Research & Innovation

THANK YOU

http://www.zeroplus.org/

Coordination Team

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University of Athens, Physics Department
Section of Environmental Physics and Meteorology
Group Building Environmental Studies

HORIZON 2020	MOTIVATE
Title: Promoting citizens' active involvement in the development of Sustainable Travel Plans in Med Cities with Seasonal Demand **Project Web Site:** interregmed.eu/en/thematics/urban-transports http://heron-project.eu/ **Duration:** 40 months **Start Date:** 1/11/2016 **Key Words:** sustainable urban mobility, SUMP, mobility data, participatory approach, crowd sourcing, social media, Mediterranean Region	**Funding mechanism:** European Regional Development Fund (ERDF) **Total Cost:** 1.927.608,75€ **EC Contribution:** 1,638,467.45€ **Consortium:** 9 partners and 2 associate partners from 4 countries **Project Coordinator:** Câmara Municipal de Almada

The Challenge

Large fluctuations in population weighs heavily on environment and transport infrastructure In the Mediterranean. Therefore, increasing the use and access to low carbon systems becomes a priority, allowing travelers, i.e. residents and visitors, to move around in ways that help preserve the natural and cultural heritage of Mediterranean cities, all while strengthening social cohesion and improving local quality of life. To this direction, MOTIVATE contributes to the uptake of low-carbon transport in five MED cities - Ioannina, Rhodes, Larnaca, Almada and Siena - by actively engaging travelers in the development and implementation of Sustainable Urban Mobility Plans (SUMPs) through the use of social media and crowdsourcing techniques.

Project Objectives

1. To accelerate SUMP development through participatory approach focusing on the needs of urban MED areas and aligning both residents and visitors needs with sustainable mobility policy goals.
2. To prove the dynamic and effectiveness of using social media and crowdsourcing techniques for facilitating SUMP development.
3. To develop an innovative and cost-efficient data collection framework by demonstrating a mobility observatory, which integrates the use of mobile applications in the collection of transportation related data in form of trip diaries.

Methodology

MOTIVATE aims to help decision makers to gain a strong understanding of the main mobility problems that residents and tourists face, and the most accepted and sustainable interventions, using cost effective ways of data collection and analysis, which will make the development, update and monitoring of SUMP much more targeted and efficient. To achieve more participatory planning and implementation of SUMP, MOTIVATE offers tools allowing:

1. authorities and policy makers to capture real time mobility data and adjust their services and strategies accordingly
2. travelers (residents & tourists) to be better informed about transport services, have a say in their evaluation and contribute to their improvement

3. open dialogue among stakeholders on planned and envisioned transport interventions in MED cities
4. the uptake of alternative, sustainable mobility MOTIVATE e-platform and mobile app are the main tools / outputs of the project. Both will be tested in a period of 18 months, covering both touristic and non-touristic seasons. These activities will take place in 5 pilot cities: Ioannina, Rhodes, Larnaca, Almada, and Siena.

Expected Results

1. Increase the participatory approach of SUMP development at the Pilot Municipalities
2. Provide cost effective and sustainable services in the Pilot Municipalities
3. Strengthen territorial cohesion

Project partners	
MemEx	Italy
AEGEA	Greece
HIT/CERTH	Greece
Tiemme spa	Italy
Municipality of Rhodes	Greece
Municipality of Ioannina	Greece
Municipality of Larnaka	Cyprus
Municipality of Almada	Portugal
Municipality of Sienna	Italy
Associate partners	
Network of Sustainable Greek Islands DAFNI	Greece
RODA	Greece

Presentation

by

Mrs. Eleni-Danai MAVRAKI

Aegean Energy and Environment Agency (AEGEA), Hellas

Until now: 1. Agreement upon Pilot Cities sustainable mobility measures, actions and plans

PILOT CITY
ALMADA
IOANNINA
RHODES
LARNACA
SIENNA

Evaluation of sustainable mobility measures *under development*

Evaluation of existing/ future transport infrastructure and policies

Origin-Destination data collection

Promotion of sustainable mobility

Until now: 2. Development of the MOTIVATE Application and Platform

Download **Motivate** Apps at:

Google Play | App Store

MOTIVATE project

http://motivate.interreg-med.eu

Up to now: 3. Promotion of MOTIVATE App and Platform to Tourists, Citizens, Students

Project co-financed by the European Regional Development Fund

Observations until now

The unexpected ones…

Use of Social Media, Use of Apps and Care about active participation

https://motivate.interreg-med.eu

y projects

act

Project co-financed by the European Regional Development Fund

What is next ???

1. Collection of data based on the users evaluation, ranking and feedback
2. Feedback use into Pilot cities' Sustainable Urban Mobility Plans
3. **Promotion of MOTIVATE approach to other cities**

Coming up activities: Transferring the MOTIVATE experience

- **Living Labs** in Pilot cities
- **Workshops** in Pilot cities and/or their neighboring cities
- **Conferences** in Med cities
- **Exhibition halls** in Med cities
- **Thematic events** on Sustainable Mobility in Pilot cities
- **Peer to peer** among municipalities board members

Project co-financed by the European Regional Development Fund

Thank you

Eleni-Danai MAVRAKI
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aegean energy & environment agency

HORIZON 2020	ENTROPY
Title: Design of an innovative Energy-Aware IT Ecosystem for Motivating Behavioural Changes Towards the Adoption of Energy Efficient Lifestyles **Project Web Site:** http://entropy-project.eu/ **Duration:** 36 months **Start Date:** September 2015 **Key Words:** energy efficiency, IoT, ICT, occupant behaviour, gamification, serious game	**Funding mechanism:** Horizon 2020, Secure Clean and Efficient Energy, Research and Innovation Action. EU Horizon 2020 Research and Innovation programme grant agreement No 649849. RIA **Total Cost: 2.439.467,50 €** **EC Contribution: 1.997.592,50 €** **Consortium: 9 partners from 8 countries** **Project Coordinator:** Universidad de Murcia (Spain)

The Challenge

Energy efficiency is a significant contributor to cutting carbon emissions by 2020 and the ICT sector is pivotal in reaching those goals. Hence, the design and development of novel energy efficient solutions and the examination of their potential for energy saving is considered crucial. As stated in the Energy Efficiency Plan 2011, the greatest energy saving potential lies in buildings. In order to exploit this potential, innovative solutions have to be implemented taking into account the occupants' behavior towards energy efficiency.

Taking into account the need for reducing energy consumption and the potential offered through ICT, ENTROPY aims to design and deploy an innovative IT ecosystem aimed at improving energy efficiency through consumer engagement and behavioral change. Focus is given on the collection and proper analysis of energy-related information from heterogeneous data sources, and the provision of interactive services, applications and serious games to end users for stimulating their interest in energy efficient activities, recommending actions for adopting more energy efficient lifestyles and increasing overall energy consumption awareness.

Project Objectives

1. ***Behavior Change:*** Motivate end-users towards adopting energy efficient lifestyles.
2. ***Innovative ICT solutions:*** Aggregation of energy consumption data from various sources through IoT technologies, mobile crowd-sensing and advanced networking.
3. ***Optimization and recommendation framework:*** Towards energy consumption and optimal use of energy resources.
4. ***Energy data analytics framework:*** Analyzing energy consumption, efficiency and associated costs, enabling the extraction of meaningful analytics, detection of anomalies and corrective actions.
5. ***Innovative serious games and personalized applications:*** Stimulating collaboration and interaction among end users towards greater energy efficiency and awareness.
6. ***End-user engagement:*** Enabling them to monitor their buildings' energy consumption and making them primary actors.
7. ***Personalized behavioural analysis and consumption disaggregation:*** Reporting tools for monitoring the energy consuming sources in real time and enabling comparisons.

8. ***Address key socio-economic issues:*** Towards large scale up-take and deployment of the proposed ICT solutions.
9. ***Validate and Evaluate the research results:*** Developing a set of proof-of-concept showcases, proving the applicability and effectiveness of the proposed, innovative technologies, models and tools.

Methodology

ENTROPY project aims to design, deploy and assess an innovative energy-aware IT ecosystem to motivate user engagement and behavioral change towards the adoption of more energy efficient lifestyles. The ENTROPY ecosystem builds upon:

(a) Internet of Things technologies for interconnecting numerous devices and collecting energy-related information from heterogeneous data sources,

(b) advanced Data Modelling and Analysis techniques that support the realization of semantic models and knowledge extraction mechanisms and

(c) recommendation and gamification mechanisms that can stimulate user interest for energy efficient activities, increase awareness with regards to their daily energy consumption and, ultimately, educate them in adopting more energy efficient lifestyles.

More specifically, the ENTROPY ecosystem will engage the end users by developing a set of serious games and personalised mobile applications that provide them with energy-related information and recommendations for achieving energy savings in their daily activities and adopting more energy efficient behavior. The designed IoT-enabled ecosystem will be evaluated in practice through its application in three public buildings (pilot sites): the Navacchio Technology Park in Pisa, Italy, the Technological park and University campus in University of Murcia, Spain, and the Technopole in Sierre, Switzerland.

The expected outcomes and results of the ENTROPY project are:

1. The open, generic ENTROPY Reference Architecture.
2. The innovative Energy-Aware Infrastructure Monitoring Parameters Semantic Model.
3. The innovative Citizens Environmental Friendly Behavioral Semantic Model.
4. The scalable, modular and extendable IoT-enabled ENTROPY Ecosystem, comprised of:
    a. the Data Modeling, Fusion and Analytics Framework.
    b. the Recommendation Framework.
    c. the Gamification Framework.
    d. The Behavioral Assessment Framework.
    e. the ENTROPY Personalised Mobile Applications and Serious Games.
5. The ENTROPY Pilots' results that will justify the utilization of persuasive technologies as sustainable energy behavior change drivers.
6. The educational content for energy behavior change that is to be delivered through the ENTROPY services and tools.
7. The wide-scale dissemination and exploitation of the project results to European academic, scientific and industrial stakeholders.

Project Partners	
Universidad de Murcia	Spain
ARVRtech	Serbia
ELTRUN E-Business Research Center, Athens University of Economics & Business	Greece
HES-SO Valais-Wallis (Haute Ecole Specialisee de Suisse Occidentale)	Switzerland
Hyperborea SRL	Italy
Intelen Services Ltd.	Cyprus
Polo Navacchio S.p.A.	Italy
STI Universitaet Innsbruck	Austria
Ubitech – Ubiquitous Solutions Ltd.	Greece

Presentation

by

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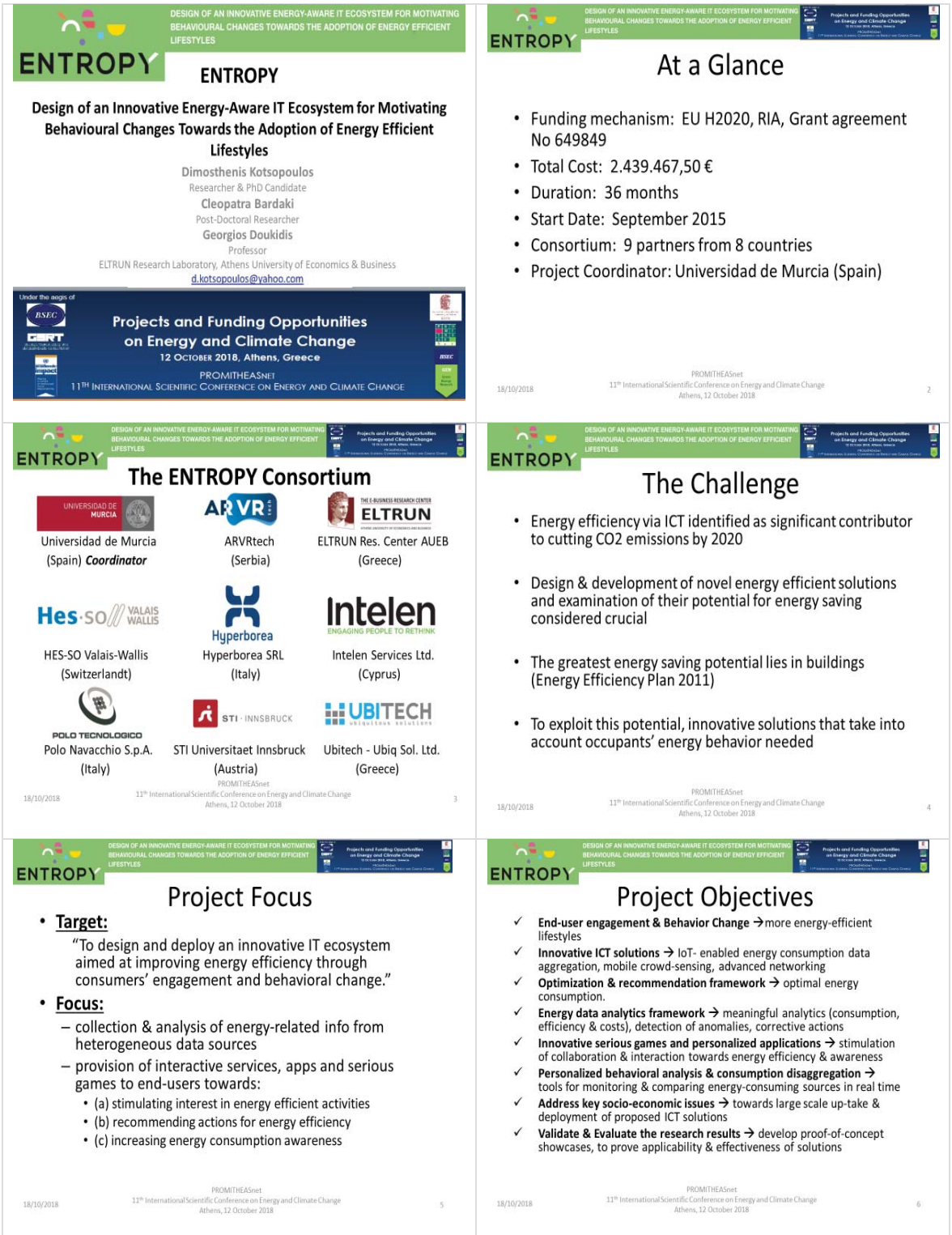

ENTROPY

DESIGN OF AN INNOVATIVE ENERGY-AWARE IT ECOSYSTEM FOR MOTIVATING BEHAVIOURAL CHANGES TOWARDS THE ADOPTION OF ENERGY EFFICIENT LIFESTYLES

Methodology

- Design & deploy an innovative energy-aware IT ecosystem to motivate user engagement and behavioral change towards the adoption of more energy efficient lifestyles, that builds upon:
  - IoT technologies for interconnecting devices & collecting energy-related information
  - advanced data modelling & analysis techniques that support the realization of semantic models and knowledge extraction
  - recommendation & gamification mechanisms to:
    - stimulate users' interest for energy efficient activities
    - increase awareness of daily energy consumption patterns
    - educate in adopting more energy efficient lifestyles
  - serious games and personalized mobile apps that:
    - provide energy-related information and recommendations
    - engage end users towards energy saving
- Evaluate the designed solution through application in 3x pilot sites

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ENTROPY

DESIGN OF AN INNOVATIVE ENERGY-AWARE IT ECOSYSTEM FOR MOTIVATING BEHAVIOURAL CHANGES TOWARDS THE ADOPTION OF ENERGY EFFICIENT LIFESTYLES

3 Pilot Sites / Workplaces

- Site 1: The Navacchio Technology Park (Business Incubator)
  in Pisa, Italy
- Site 2: The Technology park & University campus
  in Murcia, Spain
- Site 3: The Technopole (Technology Park)
  in Sierre, Switzerland

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ENTROPY

DESIGN OF AN INNOVATIVE ENERGY-AWARE IT ECOSYSTEM FOR MOTIVATING BEHAVIOURAL CHANGES TOWARDS THE ADOPTION OF ENERGY EFFICIENT LIFESTYLES

Outcomes

- ✓ Open, generic ENTROPY Reference Architecture
- ✓ Innovative Energy-Aware Infrastructure Monitoring Parameters Semantic Model
- ✓ Innovative Citizens Environmental Friendly Behavioral Semantic Model
- ✓ Scalable, modular and extendable IoT-enabled ENTROPY Ecosystem, comprised of:
  - Data Modeling, Fusion & Analytics / Recommendation / Gamification / Behavioral Assessment Frameworks
  - ENTROPY Personalised Mobile Applications and Serious Games
- ✓ ENTROPY Pilots' results that will justify the utilization of persuasive technologies as sustainable energy behavior change drivers
- ✓ Educational content for energy behavior change, delivered through the ENTROPY services and tools
- ✓ Wide-scale dissemination & exploitation of project results to academic, scientific & industrial stakeholders

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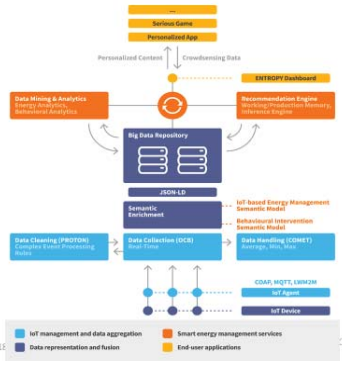
DESIGN OF AN INNOVATIVE ENERGY-AWARE IT ECOSYSTEM FOR MOTIVATING BEHAVIOURAL CHANGES TOWARDS THE ADOPTION OF ENERGY EFFICIENT LIFESTYLES

The ENTROPY Reference Architecture



Composed of 4 layers:

- ENTROPY apps
- Smart energy management services: (a) data mining & analytics (b) Recommendation Engine
- Data processing and storage in big data repository
- Sensor management and data aggregation

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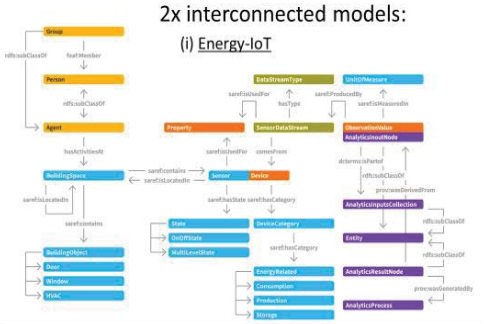
ENTROPY

DESIGN OF AN INNOVATIVE ENERGY-AWARE IT ECOSYSTEM FOR MOTIVATING BEHAVIOURAL CHANGES TOWARDS THE ADOPTION OF ENERGY EFFICIENT LIFESTYLES

The ENTROPY Semantic Models

2x interconnected models:

(i) Energy-IoT



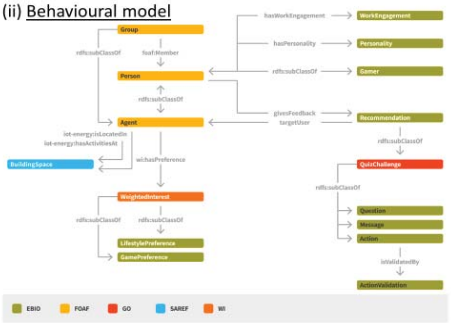
18/10/2018

ENTROPY

DESIGN OF AN INNOVATIVE ENERGY-AWARE IT ECOSYSTEM FOR MOTIVATING BEHAVIOURAL CHANGES TOWARDS THE ADOPTION OF ENERGY EFFICIENT LIFESTYLES

The ENTROPY Semantic Models

(ii) Behavioural model



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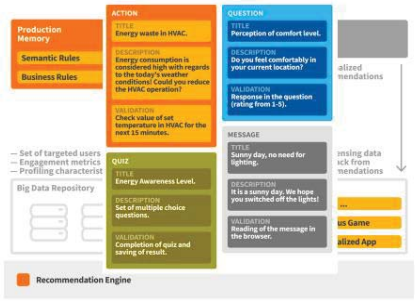
DESIGN OF AN INNOVATIVE ENERGY-AWARE IT ECOSYSTEM FOR MOTIVATING BEHAVIOURAL CHANGES TOWARDS THE ADOPTION OF ENERGY EFFICIENT LIFESTYLES

Recommendation Mechanisms



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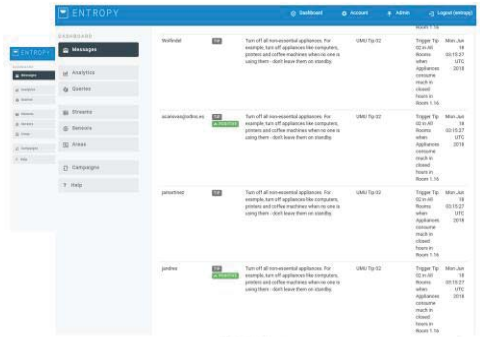
ENTROPY

DESIGN OF AN INNOVATIVE ENERGY-AWARE IT ECOSYSTEM FOR MOTIVATING BEHAVIOURAL CHANGES TOWARDS THE ADOPTION OF ENERGY EFFICIENT LIFESTYLES

Recommendation Mechanisms



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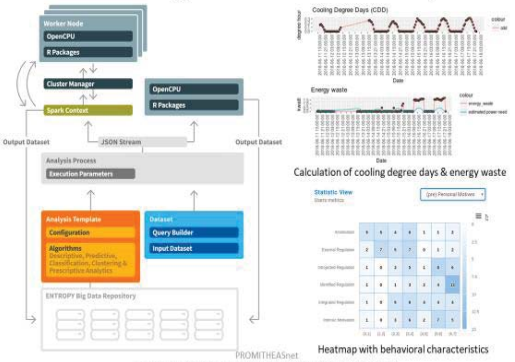
Energy & Behavioral Data Analytics



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The ENTROPY AR "Treasure Hunt" Serious Game

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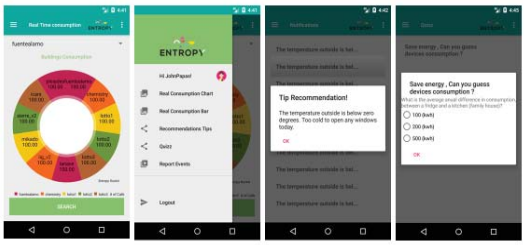
The ENTROPY Personalized GamifiedApp



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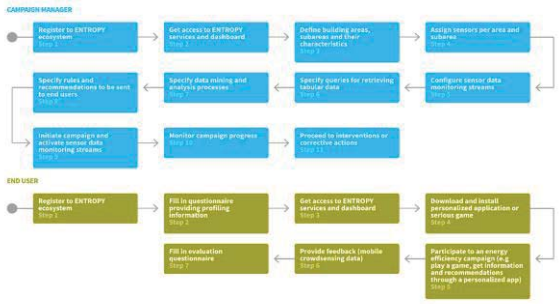
Campaign Workflow



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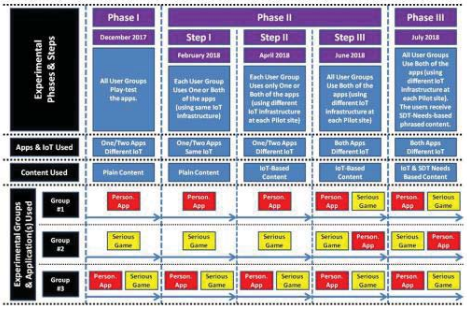
Pilots' Execution



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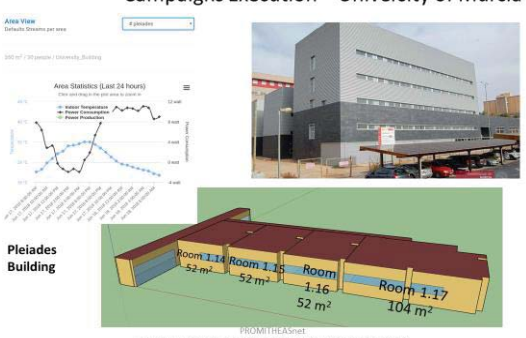
Campaigns Execution – University of Murcia



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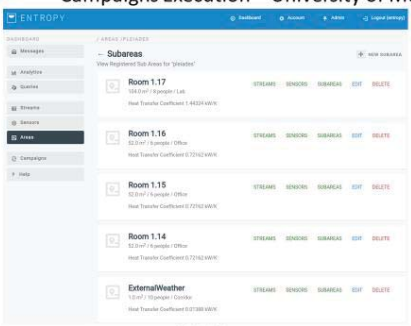

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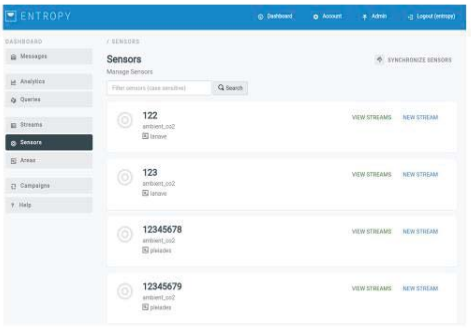

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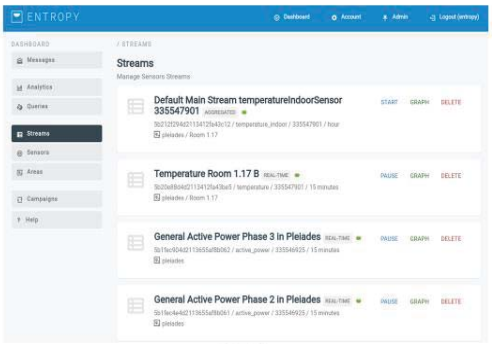

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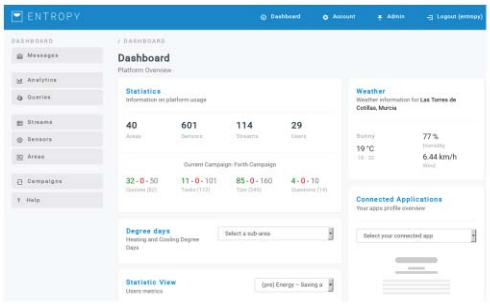

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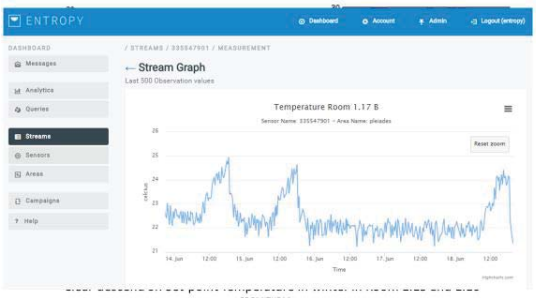

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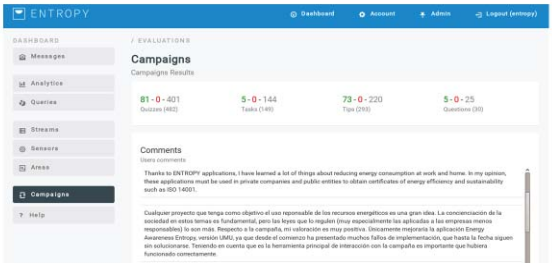

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Introduction to ENTROPY (Video)

ENTROPY

https://youtu.be/PC5fQuXsQI4

ENTROPY

Thank you for your attention!

Questions

http://entropy-project.eu/
https://twitter.com/EntropyEu
https://www.facebook.com/entropyproject

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Middle-out intelligent agents, strengthening energy community ecosystem capacity

by

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Abstract

PROACTIVE MENTOR project proposal shapes middle-out intelligent agents and strengthening energy community ecosystem capacity. Aims to accelerate socio-technical transition at local level and support local and regional authorities to achieve energy transition goals adopting and practising innovative ways to enable public engagement in the energy transition while developing interface capacities within public authorities to engage with civil society into a transition through innovative sustainable energy solutions.

Main objective of the project proposal is to communicate the knowledge and develop ground-breaking technological and non-technological solutions, especially for the energy systems, and technology transfers as key tools to deliver Energy Union targets. Modelling the energy transition can complement the knowledge about the energy transition because it allows us to model the complex non-linear properties of the energy system. Taking it as guideline we will structure and label the quality of demand side service providers such as energy cooperatives and improve their accessibility for end energy users and ensure scale-up implementation and secure data handle as middle-out intelligent agents critical function.

We expect to improve public officer's capacity skills and help creating of policies influenced through the action with more efficient and effective interfaces measured by number of public officers with improved capacity/skills and by number of policies influenced through the action. A strong impact expected will be the systemic gap bridging between the knowledge and innovation management of public R&D bodies.

The project proposal will be submitted to H2020 programme under "Supporting public authorities to implement Energy Union" LC-SC3-EE-16 call. A potential consortium will be formed by universities' teams, local and regional authorities as well as non-governmental organisations and citizen's communities.

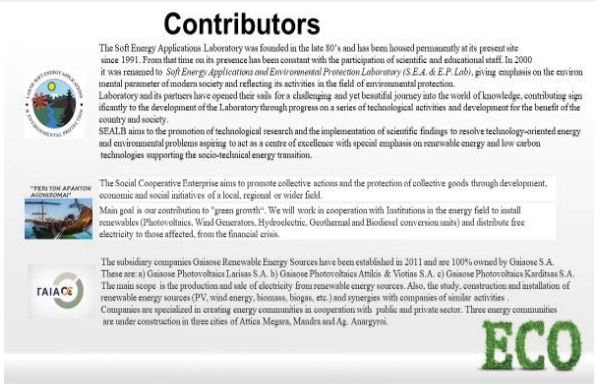
Keywords: middle-out intelligent agents, energy transition, socio-technical transition, ecosystem capacity, quadruple helix.

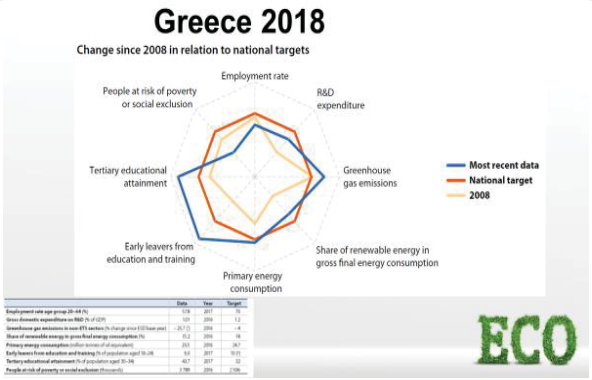
Presentation

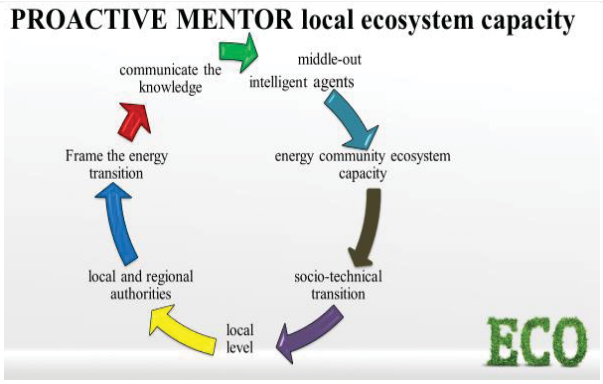
by

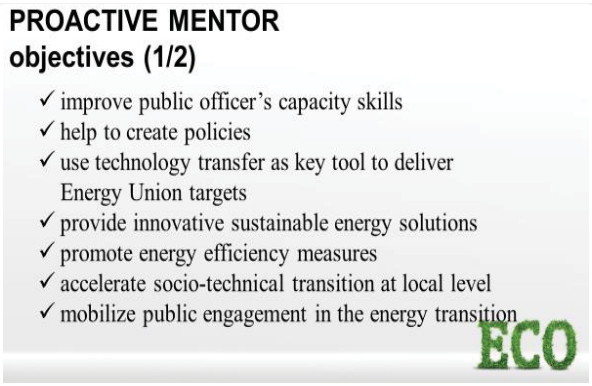
Mrs. Despoina BOULOGIORGOU,

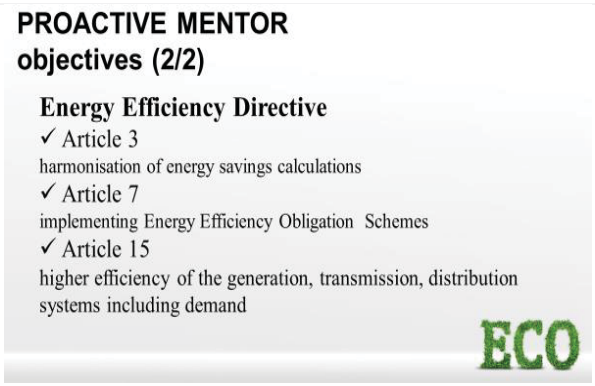
Laboratory of Soft Energy Applications and Environmental Protection (SEALAB), University of West Attica, Hellas





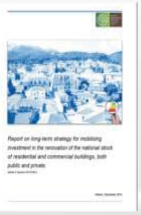






The need of innovative socio - technical excellence

Technology Innovation for the Local Scale
Optimum Integration of Battery Energy Storage



ECO

Europe 2018

The EU imports 54% of all the energy it consumes, at a cost of more than €1 billion per day. Energy also makes up more than 20% of total EU imports. Specifically, the EU imports:

- 90% of its crude oil
- 69% of its natural gas
- 42% of its coal and other solid fuels
- 40% of its uranium and other nuclear fuels.

According to the European Commission, by 2030 more than 50 GW wind and more than 50 GW solar could be owned by energy communities

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Greece Energy Communities law 4513/2018
Local and Regional Authorities

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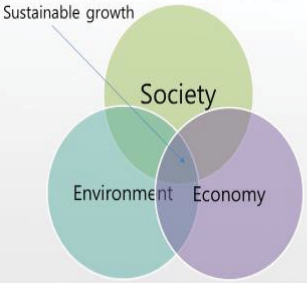
Energy Transition
Socio-technical Transition



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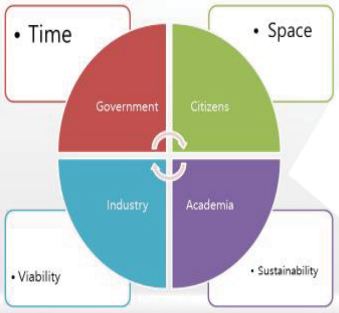
Quadruple Helix Synergies Model
Communicate the Knowledge



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Living Lab
Energy Ecosystem Capacity

- ✓ On going process
- ✓ Multidisciplinary field (STEM & SSH)
- ✓ Scientific approach, recording & processing data
- ✓ Creating a paradigm

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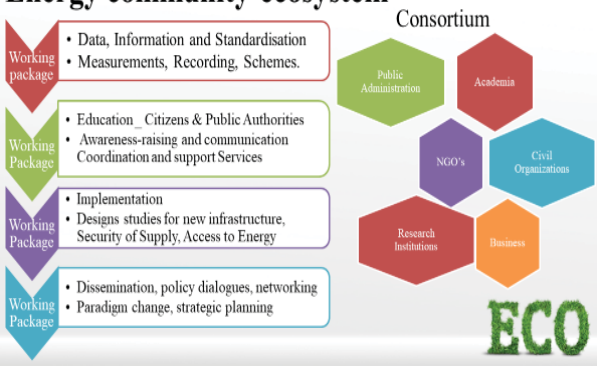
Energy community ecosystem



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WHY:
- ✓ paradigm
- ✓ replicate
- ✓ scale-up

WHERE:
- ✓ Local - National – European - International

HOW:
- ✓ socio-technical transition
- ✓ experiential knowledge...

WHO:
- ✓ QH Actors
- ✓ local community engagement

WHAT:
- ✓ Energy Transition
- ✓ Living lab

WHEN:
- ✓ On going

Energy Communities
Local Level

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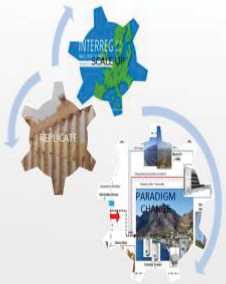
Paradigm change, replicate, scale up Mechanism



- ✓ Which are the best practices public authorities and local citizens engagement in Energy Transition?
- ✓ How can we establish an ecosystem at local community level to support flourish the Energy Transition benefits?

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PROACTIVE MENTOR
Frame the energy transition

- ✓ Energy Transition
- ✓ Excellence
- ✓ Motivation for Innovation
- ✓ Improvement with New Solutions
- ✓ Empowerment Innovators

Providing standards from which particular coherent traditions of scientific research springs.

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PROACTIVE MENTOR
Middle-out Intelligent Agent

Energy efficiency targets, energy efficiency schemes, energy transformation, sustainable, secure and affordable energy for all can be achieved by building energy communities, bringing together society under a common goal and joining forces of top down and bottom up policies.

ECO

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