



Energy in Transition: How Green Energy Investments Enhance Energy Security

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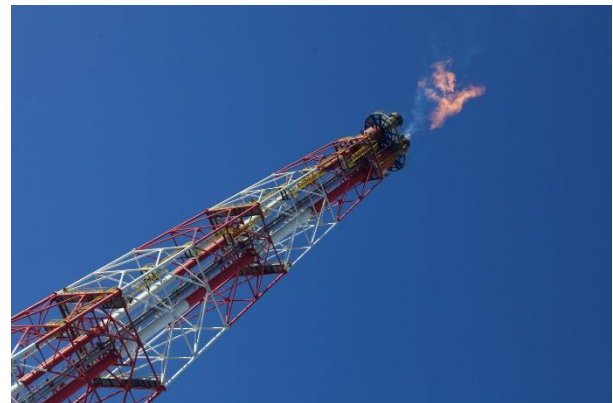


• Energy in Transition

- A new era in transport
- Hellenic Petroleum overview
- Investing in new technologies

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



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Moving away from fossil fuels?

Not so easy, not that quick!








- ✓ Low-cost renewables are required
- ✓ Volatility in CO₂ 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

	CCS 	Geothermal 	Wind 	Solar 	Storage 	Biofuels 	Funding 
	✓		✓	✓	✓	✓	✓
	✓	✓	✓		✓	✓	✓
	✓	✓	✓	✓		✓	✓
	✓		✓	✗		✓	✓
	✓			✓		✓	✓
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	✓	✗	✓	✓		✓	✓

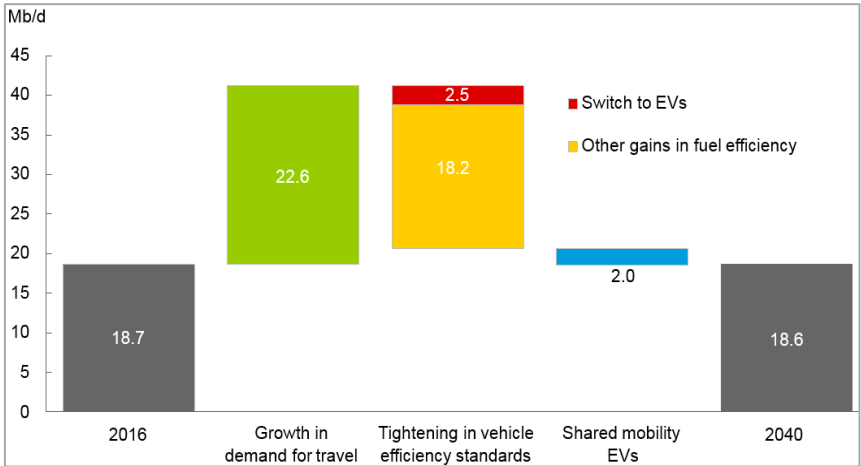
✓Existing ✓Announced development or research ✗Divested

Πηγή: Wood Mackenzie

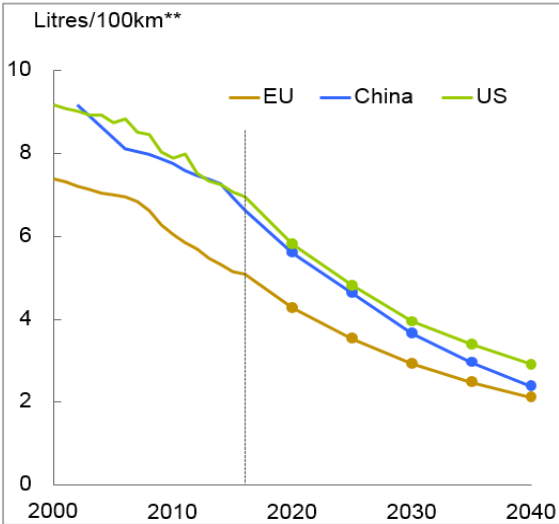
Investor pressure and government support will play a major role

Improved vehicle energy efficiency

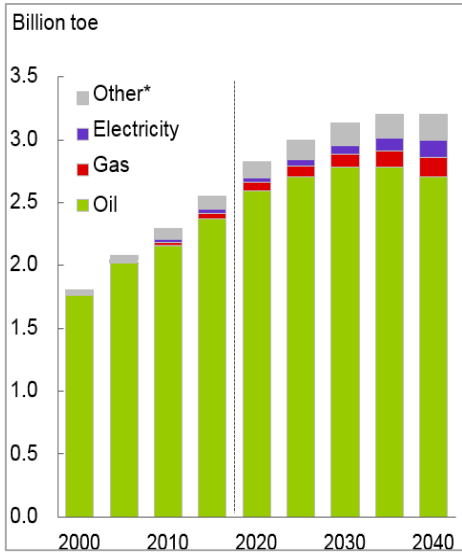
Passenger cars' Fuel consumption



Passenger cars' Fuel consumption

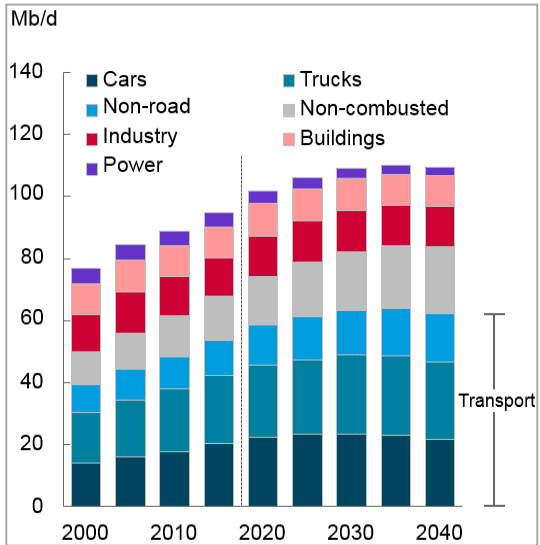


Total Energy Consumption per Sector



*Industry excludes non-combusted use of fuels

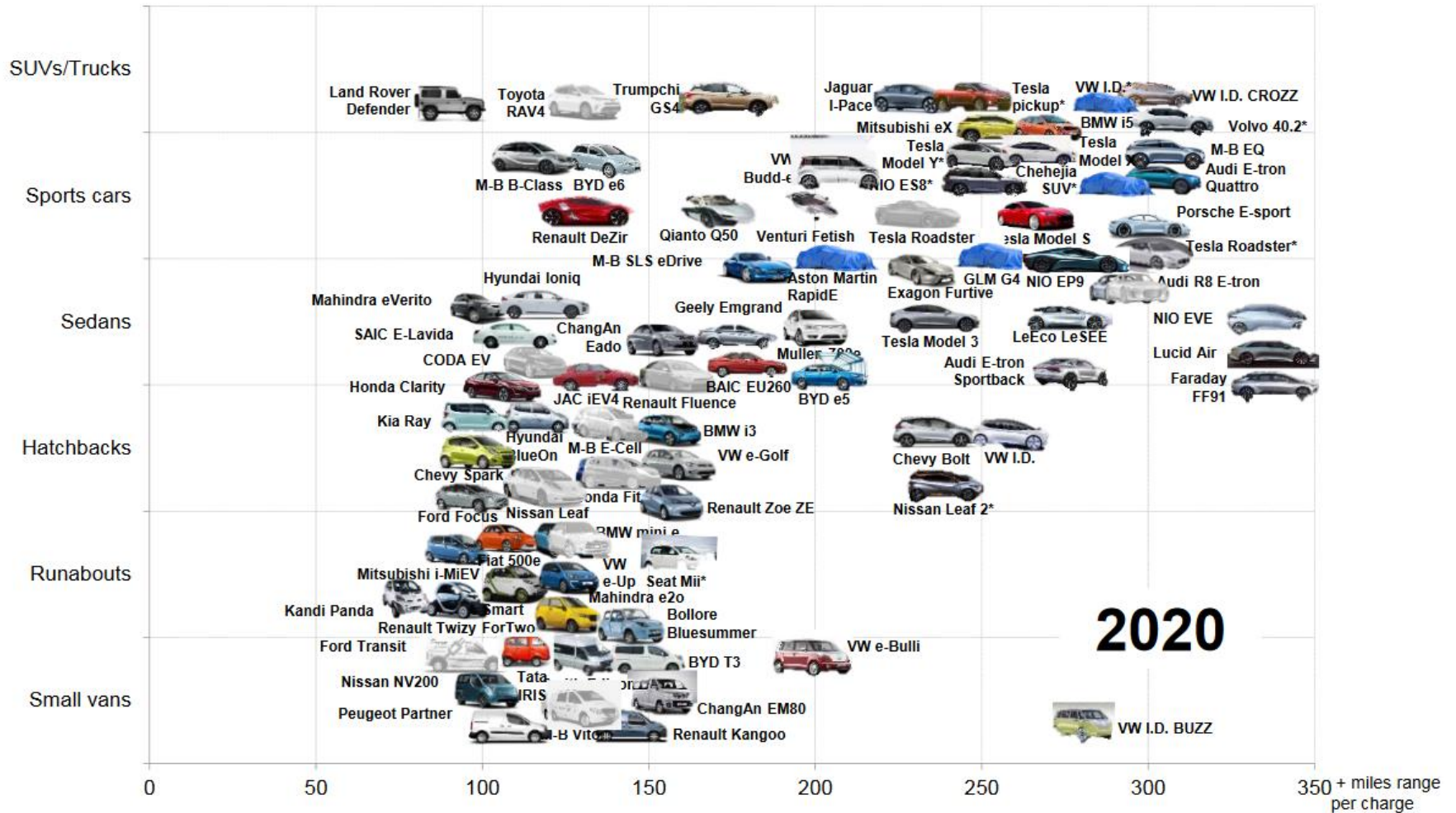
Liquids demand



Cars include 2- & 3- wheelers. Trucks include most SUVs in N. America
Non-road includes aviation, marine and rail

Πηγή: BP, Energy Outlook 2018

E-mobility: plenty of options and models

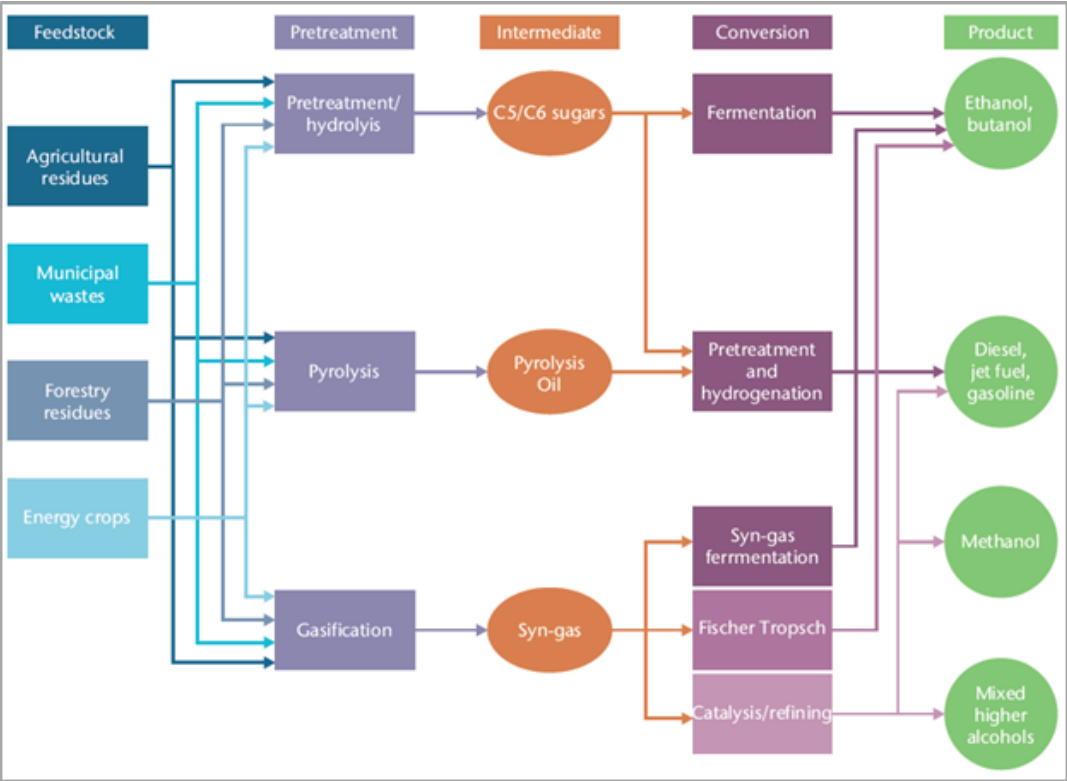


2020

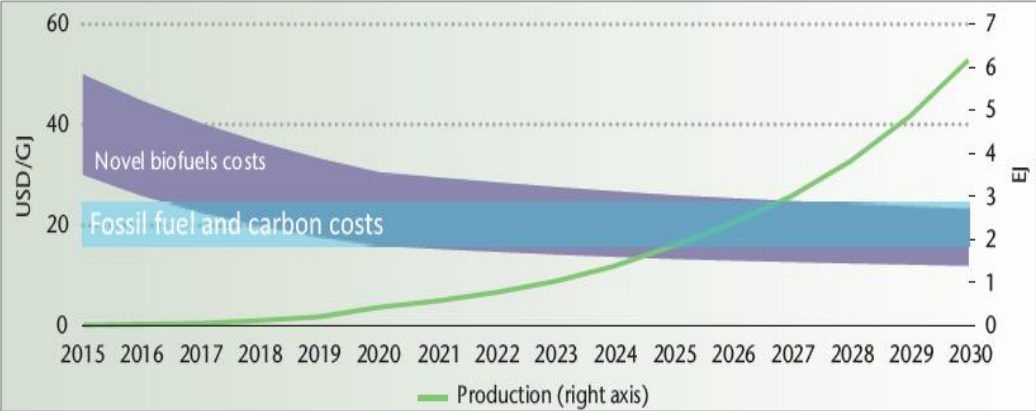
Πηγή: Bloomberg New Energy Finance, Images various. Notes: Not exhaustive. (*) Range is estimate

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




Πηγή: 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



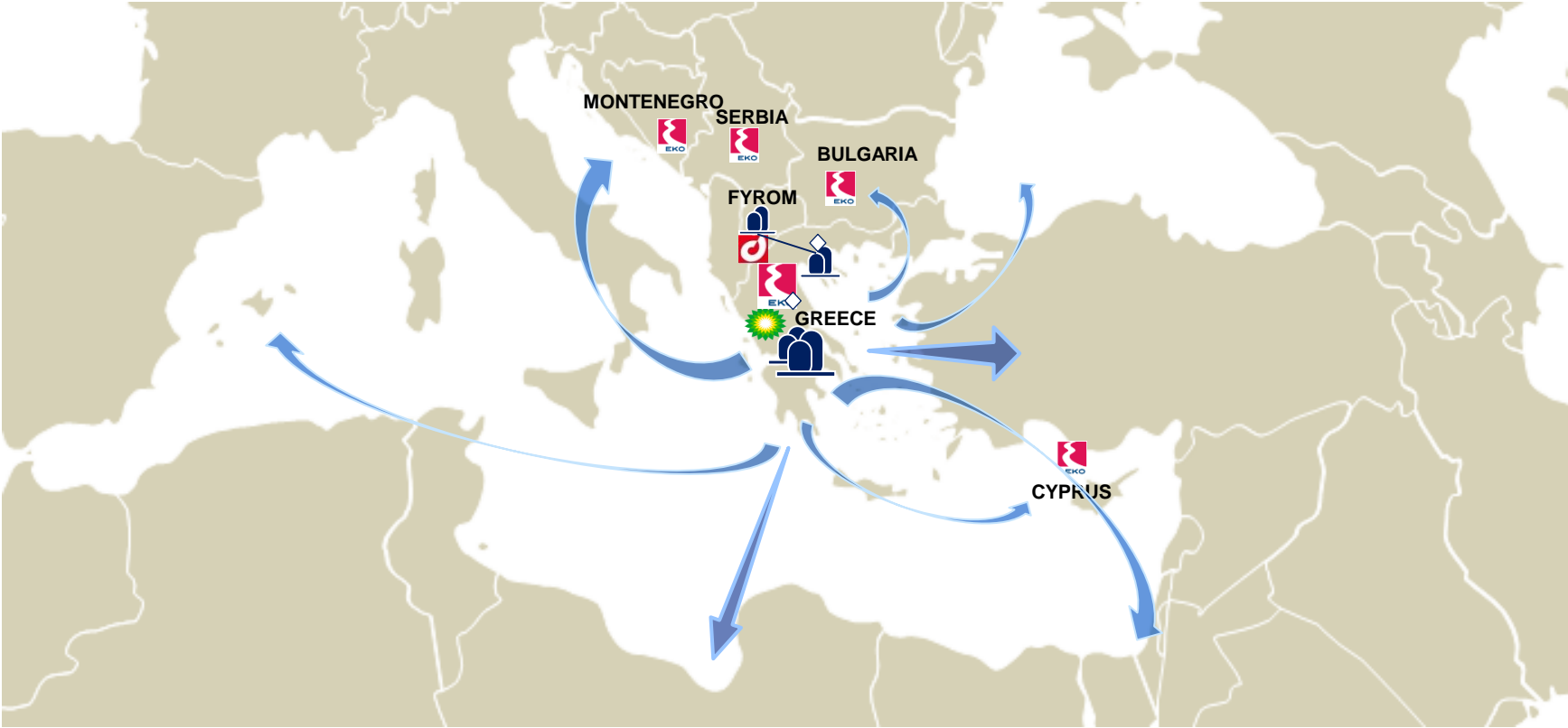
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Current position

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

Group operational footprint and Sales



◇ Power & Gas

Assets overview

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

		DESCRIPTION	METRICS
Exploration & Production		<ul style="list-style-type: none"> Exploration assets in Greece 	<ul style="list-style-type: none"> 50% (operator) in W. Patraikos Gulf Exploration rights in 2 more areas
Refining, Supply & Trading		<ul style="list-style-type: none"> Complex (recently upgraded) refining system: <ul style="list-style-type: none"> Aspropyrgos (FCC, 148kbpd) Elefsina (HDC, 100kbpd) Thessaloniki (HS, 93kbpd) Pipeline fed refinery/terminal in FYROM 	<ul style="list-style-type: none"> Capacity: 16MT NCI: 9.6 Market share: 65% Tankage: 7m M³
Petrochemicals		<ul style="list-style-type: none"> Basel technology PP production (integrated with refining) and trading > 60% exports in the Med basin 	<ul style="list-style-type: none"> Capacity (PP): 220 kt
Domestic Marketing		<ul style="list-style-type: none"> Leading position in all market channels (Retail, Commercial, Aviation, Bunkering) through EKO and HF (BP branded network) 	<ul style="list-style-type: none"> c.1,700 petrol stations 30% market share Sales volumes: 3.5MT
International Marketing		<ul style="list-style-type: none"> Strong position in Cyprus, Montenegro, Serbia, Bulgaria, FYROM Advantage on supply chain/vertical integration 	<ul style="list-style-type: none"> c.290 petrol stations Sales volumes: 1.2MT
Power & Gas		<ul style="list-style-type: none"> ELPEDISON: Second largest IPP in Greece (JV with Edison/EdF) 	<ul style="list-style-type: none"> Capacity: 810 MW (CCGT)
		<ul style="list-style-type: none"> DEPA/DESFA GROUP: 35% in Greece's incumbent NatGas supply company (DESFA in sale process) 	<ul style="list-style-type: none"> Volumes (2015): 3.0bcm

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Investing in Renewable Energy Sources

- Developing renewable electricity to diversify Group's energy portfolio. Also offsetting part of CO₂ 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



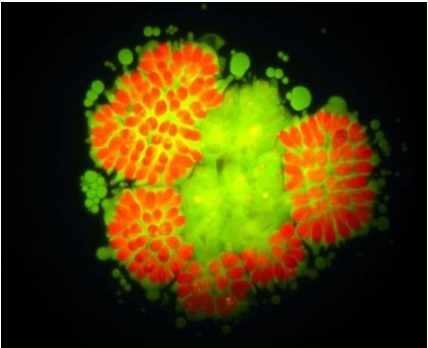
Participating in R&D projects ...



Sustain-Diesel



Hydrosol Plant project - FCH JU



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

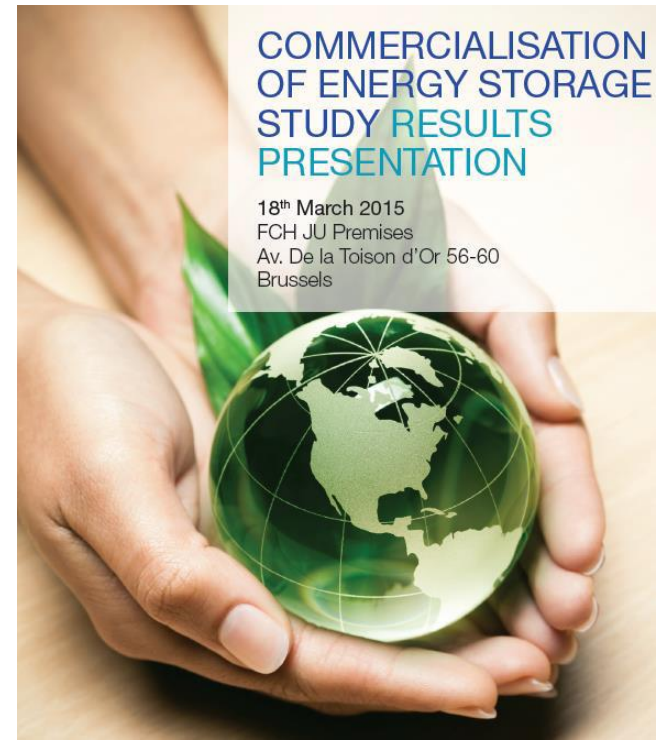


GREEN MEOH
Green MEOH project - CAPITA



Innovation Clusters

... and European Union initiatives



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

