

The role of behavioural barriers in the natural gas penetration for the Hellenic building sector

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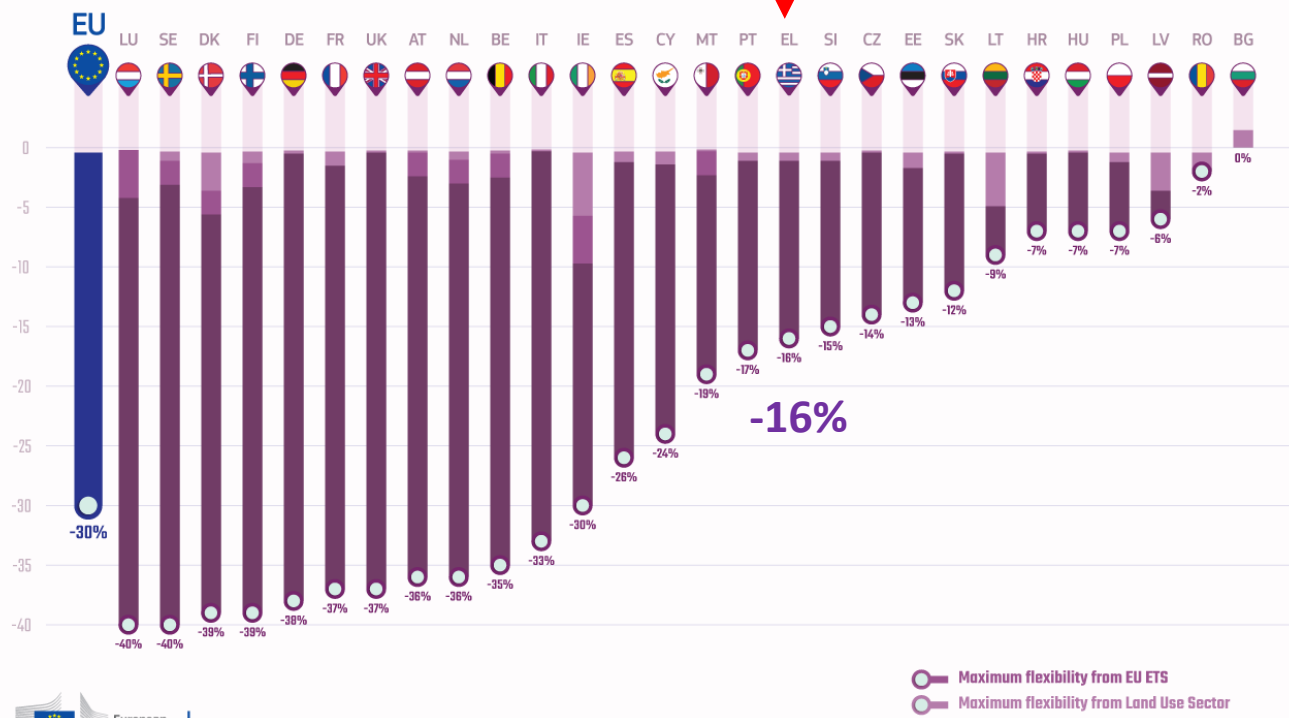
Structure

- National framework
- Methodological approach
- Mapped barriers
- Impact factors
- Discussion
- Conclusions



National target for 2030

Member State specific emission reduction targets for 2030 compared to 2005, for sectors outside the EU Emissions Trading System including new flexibilities for reaching those targets



Main components

- Achievement of **energy savings** in final consumption
- Increased penetration of **natural gas** in energy mix
- Increase the **RES** share in final energy consumption

Source: National Energy and Climate Plan of Greece, 2019. At: https://ec.europa.eu/energy/sites/ener/files/documents/greece_draftnecp.pdf



Main priorities for Natural Gas

- Promotion of Natural Gas (NG) as intermediary fuel for the decarbonization of the energy system
- Improvement of energy efficiency in infrastructures of electric energy and NG
- Reinforcing competitiveness in the markets of electric energy and NG
- Promotion of infrastructures for transfer, distribution and storage of NG

NG in final consumption

- Target
 - Increase in NG use sectors of final consumption by 50% compared to year 2016
- Reasoning
 - Intermediary fuel for moving towards a low GHG emission model for these sectors
- Results
 - Improved energy efficiency
 - Lower energy cost



Penetration rates for NG

	Έτη				
	2013	2014	2015	2016	2017
	% NG in final energy consumption (national, sectoral)				
Country	6,21	5,66	6,18	6,62	7,35
Households	6,17	6,13	8,09	7,68	8,17
Tertiary sector (commercial and public sector)	6,86	7,30	8,86	7,27	6,88

- (1) Source: Eurostat, 2019 - <https://ec.europa.eu/eurostat/documents/3217494/9172750/KS-EN-18-001-EN-N.pdf/474c2308-002a-40cd-87b6-9364209bf936>
- (2) <https://ec.europa.eu/eurostat/web/energy/data/energy-balances>
- (3) 2013 - <https://ec.europa.eu/eurostat/documents/3217494/6898731/KS-EN-15-001-EN-N.pdf/e5851c73-9259-462e-befc-6d037dc8216a>

Barriers

Forces or theoretical mechanisms observed during the function of the market and prevent behaviours or investments that could increase the use of NG in final energy consumption of the building sector

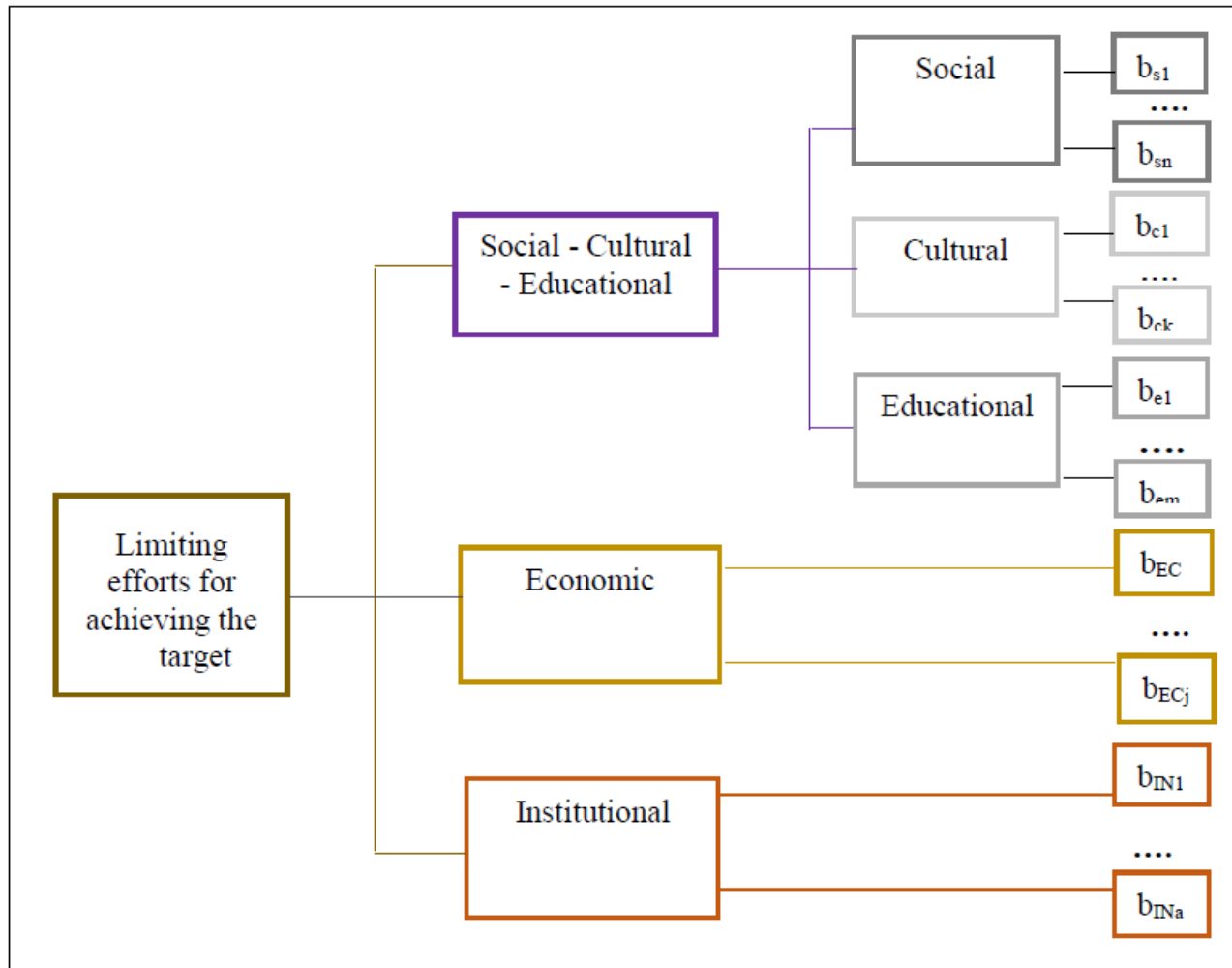


Methodology

- Four steps – based on Analytical Hierarchy Process (AHP)
 - *Step 1:* Mapping, categorization and merging behavioral barriers
 - *Step 2:* Development of the AHP tree and matrices
 - *Step 3:* Calculation of weight coefficients
 - *Step 4:* Definition and calculation of Impact Factors (I) of barriers

Steps 1 & 2

AHP tree and matrices



Steps 3 & 4

Weight coefficients and Impact factors

$$I_{s1} = W_{S-C-E} * W_s * W_{s1}$$

Type	Name of barrier	Function
Social	Social group interactions and status considerations	$I_{s1} = W_{S-C-E} * W_s * W_{s1}$
Social	Socio-economic status of building users	$I_{s2} = W_{S-C-E} * W_s * W_{s2}$
Social	Strong dependency on the neighbors in multi-family housing	$I_{s3} = W_{S-C-E} * W_s * W_{s3}$
Social	Inertia	$I_{s4} = W_{S-C-E} * W_s * W_{s4}$
Social	Commitment and motivation of public social support	$I_{s5} = W_{S-C-E} * W_s * W_{s5}$
Social	Rebound effect	$I_{s6} = W_{S-C-E} * W_s * W_{s6}$
Cultural	Lack of interest/low priority/Undervaluing use of NG	$I_{c1} = W_{S-C-E} * W_c * W_{c1}$
Cultural	Customs, habits and relevant behavioural aspects	$I_{c2} = W_{S-C-E} * W_c * W_{c2}$
Cultural	Bounded rationality/Visibility of using NG	$I_{c3} = W_{S-C-E} * W_c * W_{c3}$
Cultural	Missing credibility/mistrust of technologies and contractors	$I_{c4} = W_{S-C-E} * W_c * W_{c4}$
Educational	Lack of trained and skilled professionals/ trusted information, knowledge and experience	$I_{E1} = W_{S-C-E} * W_E * W_{E1}$
Educational	Lack of awareness/knowledge on savings potential/information gap on NG technologies	$I_{E2} = W_{S-C-E} * W_E * W_{E2}$

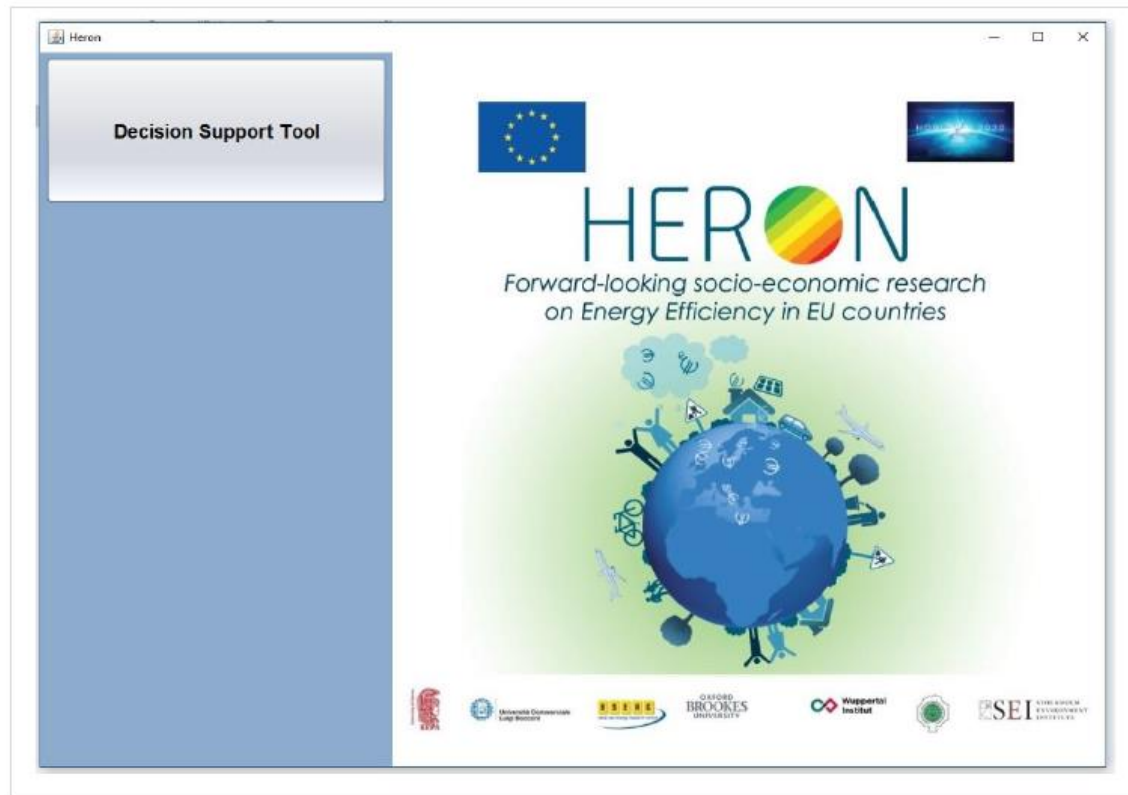
Steps 3 & 4

Weight coefficients and Impact factors

Economic	Lack of any type of financial support (lack of financial incentive (Public and Private sector)/ Lack of funds or access to finance)	$I_{EC1} = W_{EC} * W_{EC1}$
Economic	High capital costs/Financial risk/ Uncertainty on investment/ High cost of innovative technologies for end-users	$I_{EC2} = W_{EC} * W_{EC2}$
Economic	Payback expectations/investment horizons	$I_{EC3} = W_{EC} * W_{EC3}$
Economic	Relatively cheap energy and fuel prices/ misleading Tariff system not reflecting correct prices for energy use of NG/EE	$I_{EC4} = W_{EC} * W_{EC4}$
Economic	Unexpected costs (Hidden costs/ Costs vary regionally (Fragmented ability))	$I_{EC5} = W_{EC} * W_{EC5}$
Economic	Financial crisis/Economic stagnation	$I_{EC6} = W_{EC} * W_{EC6}$
Economic	Embryonic markets	$I_{EC7} = W_{EC} * W_{EC7}$
Institutional	Split Incentive	$I_{I1} = W_I * w_{I1}$
Institutional	Legislation issues (Lack of relevant legislation/Lack of regulatory provision /Change of legislation for local/regional administrative division/ Complex/inadequate regulatory procedures)	$I_{I2} = W_I * w_{I2}$
Institutional	Building stock characteristics/aging stock/ Historical preservation	$I_{I3} = W_I * w_{I3}$
Institutional	Poor compliance with efficiency standards or construction standards/ Technical problems/ Performance gap/mismatch	$I_{I4} = W_I * w_{I4}$
Institutional	Lack of data/information-diversion of management	$I_{I5} = W_I * w_{I5}$
Institutional	Barrier to behavior change due to problematic Implementation Network (IN)/governance framework (Inadequate IN/governance framework /Inadequate implementation of policy measures / poor Policy coordination across different levels/cooperation of municipalities)	$I_{I6} = W_I * w_{I6}$
Institutional	Disruption/Hassie factor	$I_{I7} = W_I * w_{I7}$
Institutional	Security of fuel supply	$I_{I8} = W_I * w_{I8}$

Software HERON Decision Support Tool

Version 1.1.5



Impact Factors - 1

Type	Name of barrier	Impact Factor
Social	Social group interactions and status considerations	0.055
Social	Socio-economic status of building users	0.098
Social	Strong dependency on the neighbors in multi-family housing	0.034
Social	Inertia	0.029
Social	Commitment and motivation of public social support	0.090
Social	Rebound effect	0.018
Cultural	Lack of interest/low priority/Undervaluing use of NG	0.015
Cultural	Customs, habits and relevant behavioural aspects	0.053
Cultural	Bounded rationality/Visibility of use of NG	0.016
Cultural	Missing credibility/mistrust of technologies and contractors	0.049
Educational	Lack of trained and skilled professionals/ trusted information, knowledge and experience	0.014
Educational	Lack of awareness/knowledge on savings potential/information gap on NG technologies	0.041

Impact factors - 2

Economic	Lack of any type of financial support (lack of financial incentive (Public and Private sector)/ Lack of funds or access to finance)	0.133
Economic	High capital costs/Financial risk/ Uncertainty on investment/ High cost of innovative technologies for end-users	0.076
Economic	Payback expectations/investment horizons	0.035
Economic	Relatively cheap energy and fuel prices/ misleading Tariff system not reflecting correct prices for energy use of NG/EE	0.034
Economic	Unexpected costs (Hidden costs/ Costs vary regionally (Fragmented ability))	0.015
Economic	Financial crisis/Economic stagnation	0.052
Economic	Embryonic markets	0.015
Institutional	Split Incentive	0.012
Institutional	Legislation issues (Lack of relevant legislation/Lack of regulatory provision /Change of legislation for local/regional administrative division/ Complex/inadequate regulatory procedures)	0.014
Institutional	Building stock characteristics/aging stock/ Historical preservation	0.008
Institutional	Poor compliance with efficiency standards or construction standards/ Technical problems/ Performance gap/mismatch	0.006
Institutional	Lack of data/information-diversion of management	0.042
Institutional	Barrier to behavior change due to problematic Implementation Network (IN)/governance framework (Inadequate IN/governance framework /Inadequate implementation of policy measures / poor Policy coordination across different levels/cooperation of municipalities)	0.022
Institutional	Disruption/Hassie factor	0.016
Institutional	Security of fuel supply	0.008

Discussion - 1

- **Most important barriers**

- Economic: Lack of any type of financial support - 13.3%
- Social: Socio-economic status of building users – 9.8%
- Social: Lack of public social support – 9.0%

- **Less important barriers**

- Institutional: Poor compliance with efficiency standards or construction standards – 0.6%
- Institutional: Building stock characteristics – 0.8%
- Institutional: Security of fuel supply: - 0.8%

Discussion - 2

- Rationality behind important barriers
 - Socio-economic characteristics of Hellenic end-users
 - Indicator for progress on SDG7 in Greece
 - Indicators for energy poverty



Socio-economic characteristics of end users -1

Demographic indicators for time period 2006-2017

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Age dependence ratio	50.0	50.0	50.0	50.4	51.0	51.8	52.8	53.7	54.5	55.2	55.9	56.5
Ageing ratio	125.0	126.8	127.9	129.0	130.7	132.9	135.4	138.3	141.8	145.5	148.3	150.3

*the ratio of the number of economically non-active persons (aged 0 - 14 and 65 years and over) compared with the number of economically active persons (aged 15 - 64 years).

**the number of persons aged 65 years and over per hundred persons under the age of 15.

Source: Hellenic Statistical Authority, 2019. Living Conditions in Greece.

At: http://www.statistics.gr/documents/20181/14479704/LivingConditionsInGreece_0919.pdf/76f3206f-fcff-4be9-2a58-f64da216ab1f?t=1567769493076

Socio-economic characteristics of end-users -2

Population aged 15 years and over by employment status, 2007 - 2018

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Employment rate	48.5	48.9	48.3	46.7	43.3	39.5	37.7	38.1	39.0	39.9	40.9	41.9
Unemployment rate	8.4	7.8	9.6	12.7	17.9	24.4	27.5	26.5	24.9	23.5	21.5	19.3

*Employment rate represents persons in employment as a percentage of the total population.

Source: Hellenic Statistical Authority, 2019. Living Conditions in Greece.

At: http://www.statistics.gr/documents/20181/14479704/LivingConditionsInGreece_0919.pdf/76f3206f-fcff-4be9-2a58-f64da216ab1f?t=1567769493076

Barriers, energy poverty and SDG7

- Energy Poverty Observatory
 - Inability to keep home adequately warm
 - Arrears on utility bills
- Eurostat for progress on SDG7
 - Inability to keep home adequately warm

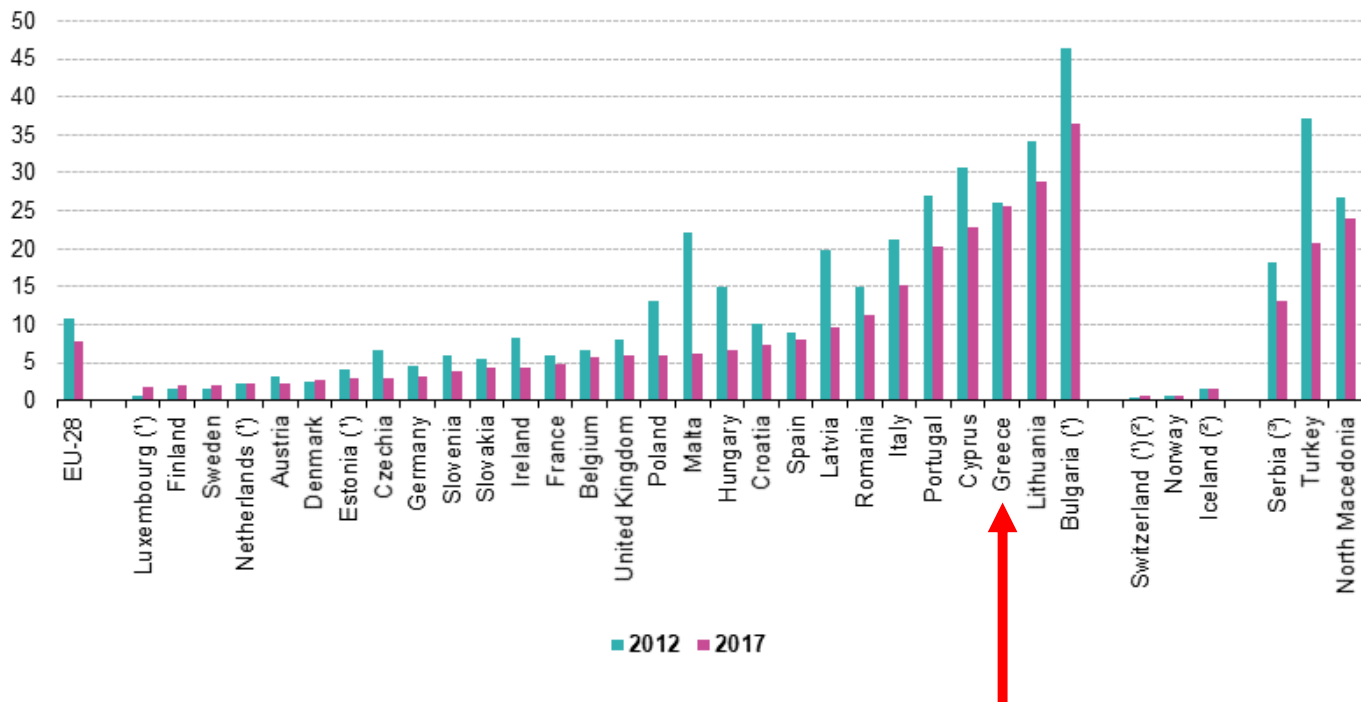
Goal 7:

Ensure access to affordable, reliable, sustainable and modern energy for all.



Inability to keep home adequately warm (2012-2017)

Population unable to keep home adequately warm, by country, 2012 and 2017
(% of population)

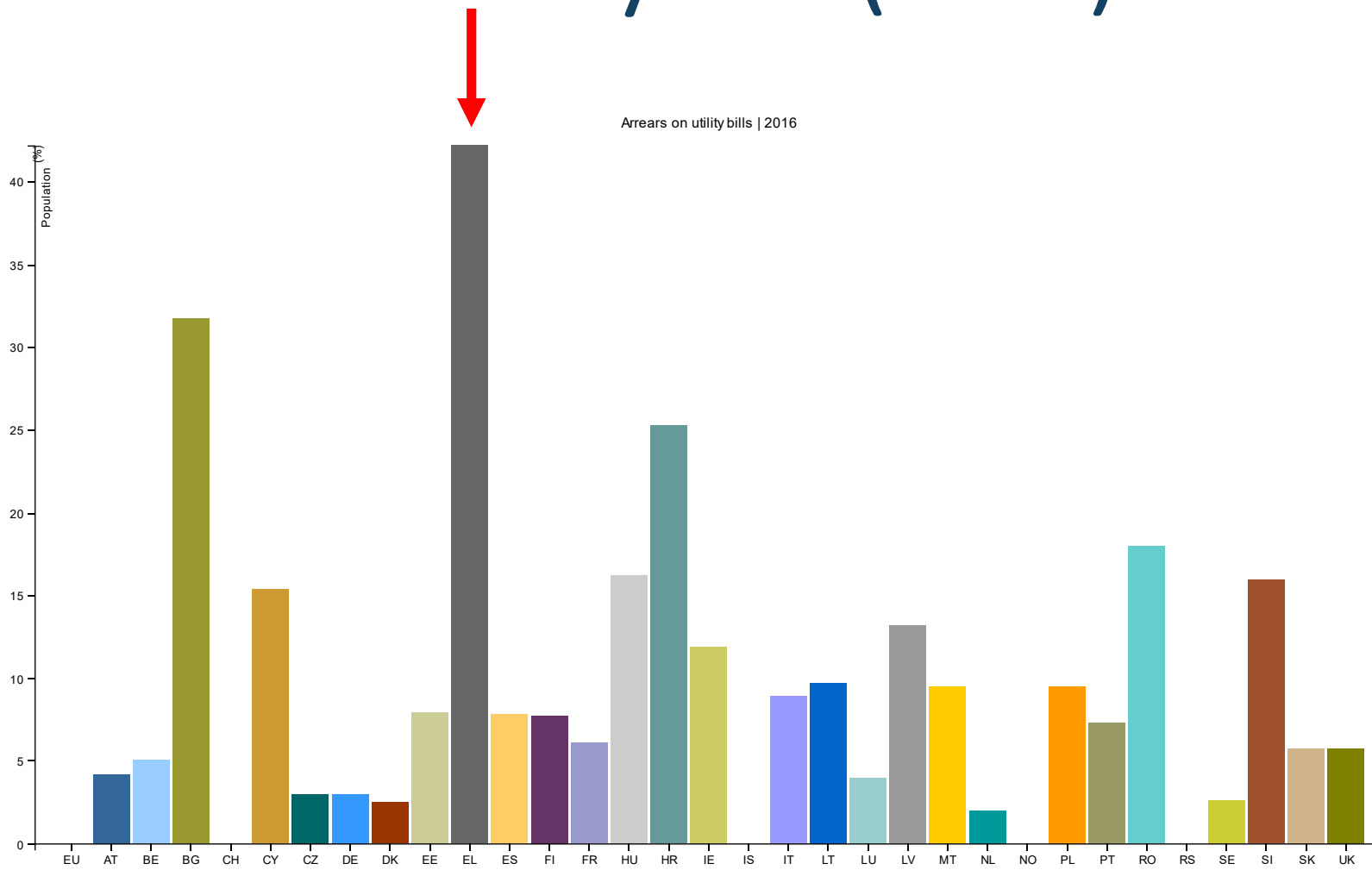


(*) Break(s) in time series between the two years shown.
 (*) 2016 data (instead of 2017).
 (*) 2013 data (instead of 2012).

Source: Eurostat (online data code: sdg_07_60)

At: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Population_unable_to_keep_home_adequately_warm_by_country_2012_and_2017_\(%25_of_population\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Population_unable_to_keep_home_adequately_warm_by_country_2012_and_2017_(%25_of_population).png)

Arrears on utility bills (2016)



Conclusions

- Important barriers in NG penetration
 - Lack of any type of financial support
 - Socio-economic status of building users
 - Lack of public social support
- Financial policy instruments
 - Tax exemptions
 - Subsidies

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