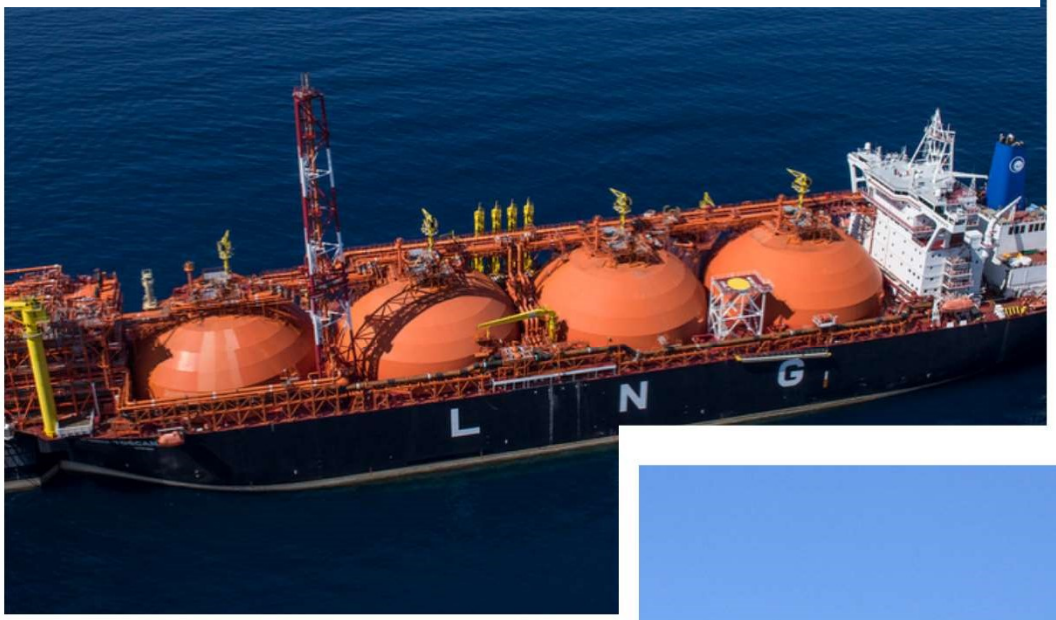
Energy Markets

June, 2020



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ

εκδδα

ΕΘΝΙΚΟ ΚΕΝΤΡΟ ΔΗΜΟΣΙΑΣ ΔΙΟΙΚΗΣΗΣ & ΑΥΤΟΔΙΟΙΚΗΣΗΣ

Kostas Andriosopoulos
Professor in Finance and Energy Economics, ESCP Business School

ABOUT MYSELF

Academia:

- ESCP Europe Business School:
  - Professor, Finance and Energy Economics
  - Director, Research Centre for Energy Management (www.rcem.eu)
  - Academic Director, Full-time and Executive Masters in Energy Management
- Visiting lecturer: Cass Business School (UK), AUEB (GR), EDI (NL), ESA (LB).

Industry:

- Vice-Chairman of BoD, Greek Public Gas Corporation (DEPA Group)
- CEO, Akuo Energy Greece (subsidiary of Akuo Energy)
- Board member (International Expert), Global Gas Centre – World Energy Council
- Former Vice President (Publications), International Assocation for Energy Economics (IAEE)
- Former founding Chairman, Hellenic Association for Energy Economics (official affiliate of the IAEE)
- Former co-founder and Partner, Symmetria Web Solutions (Web Services)

Background:

- B.Eng. Production Engineering and Management, Technical University of Crete, Greece
- M.B.A. and MSc in Finance, Northeastern University, USA
- Ph.D. in Finance, Cass Business School, City University London, UK

Seminar Outline

1. A single EU Energy Market
2. Country Profile
3. Investments
4. Natural Gas & LNG Markets
5. Electricity
6. Renewable Energy Sources
7. Hellenic Energy Exchange

Part 1

1. A single EU Energy Market

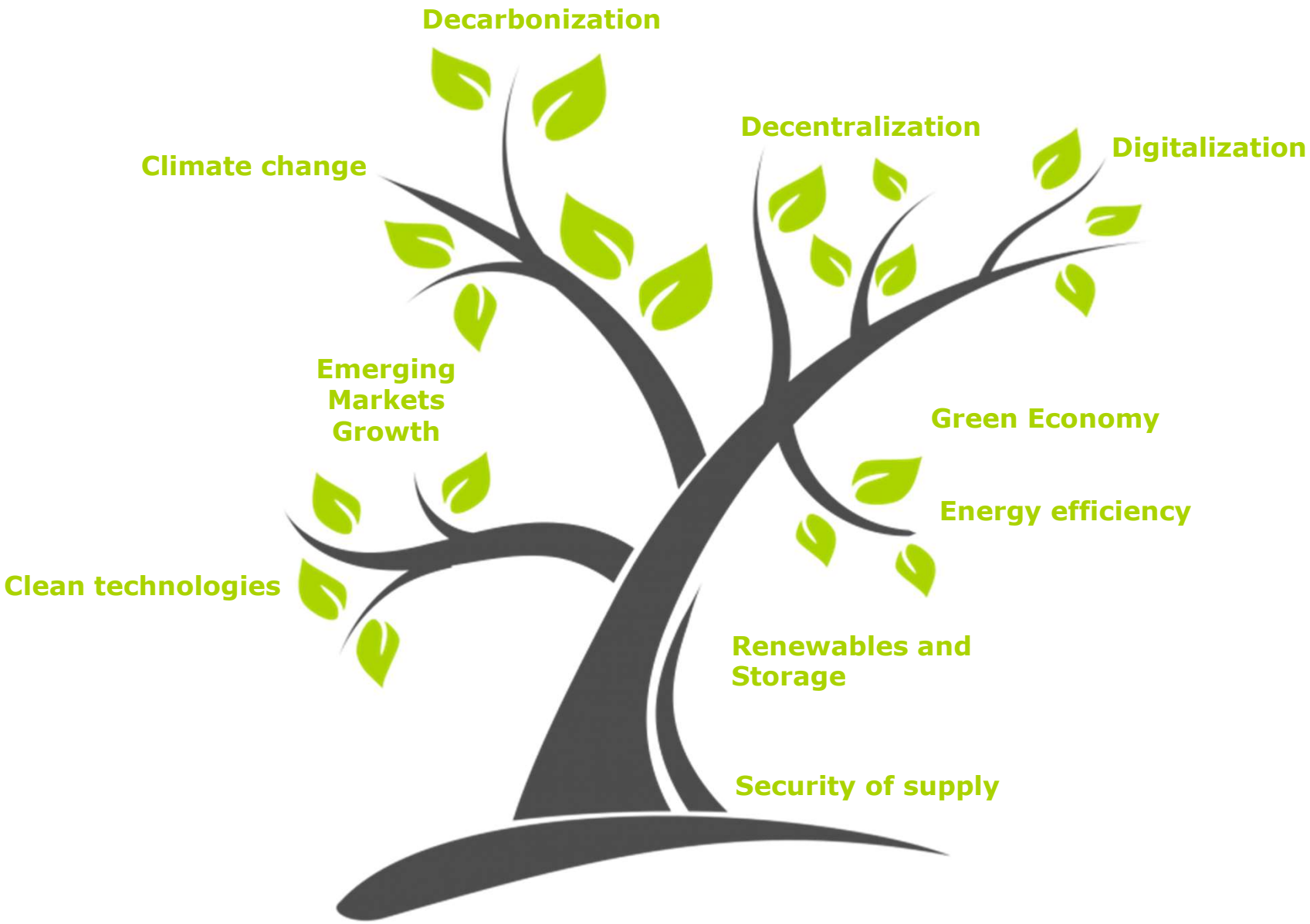
2. Country Profile 

 3. Investments

Duration (09:30 – 11:30)

1. The Creation of a Single EU Energy Market

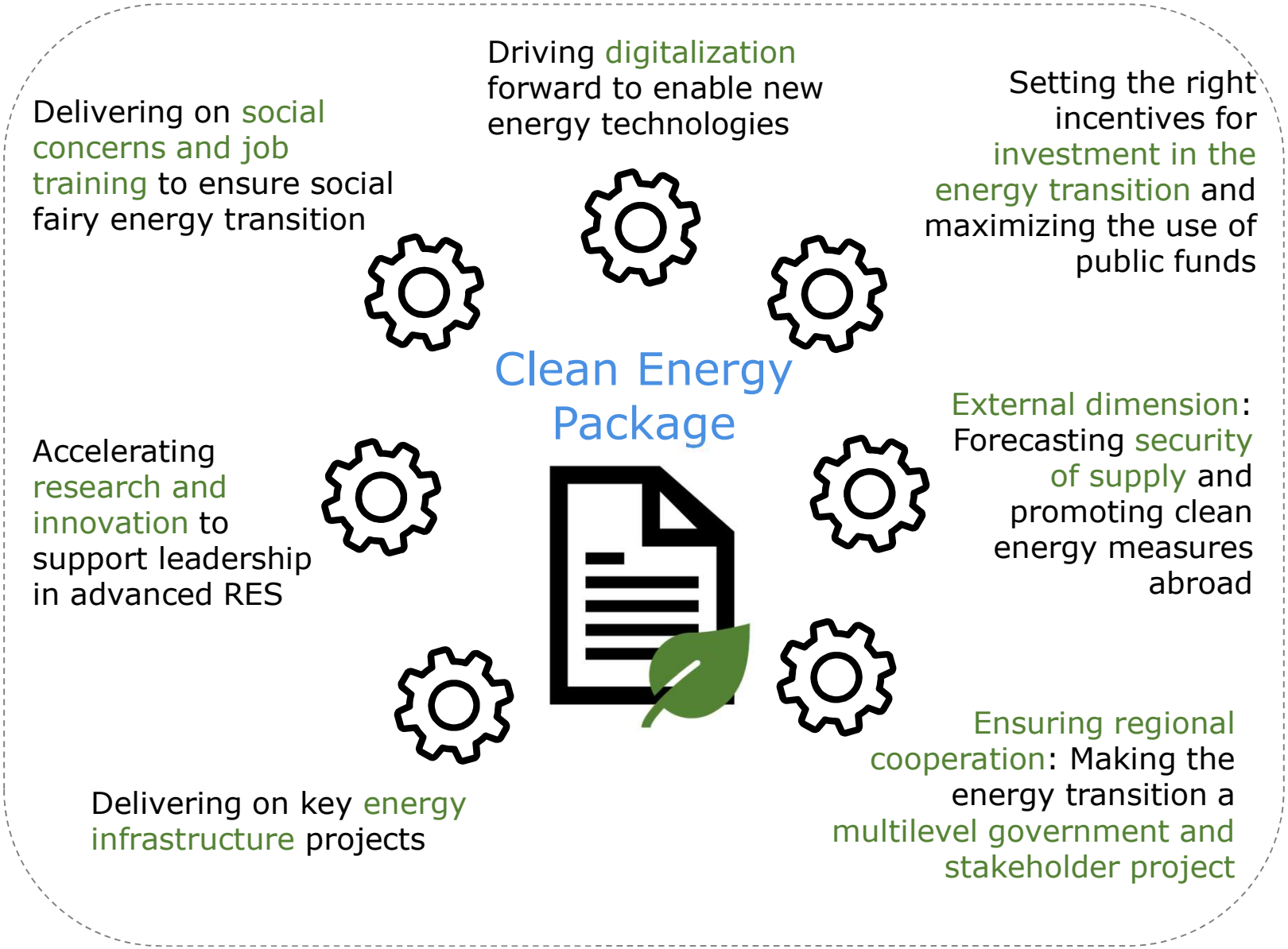
10 Trends shaping the current and future policies around the Energy sector



The creation of a single EU market is of top priority

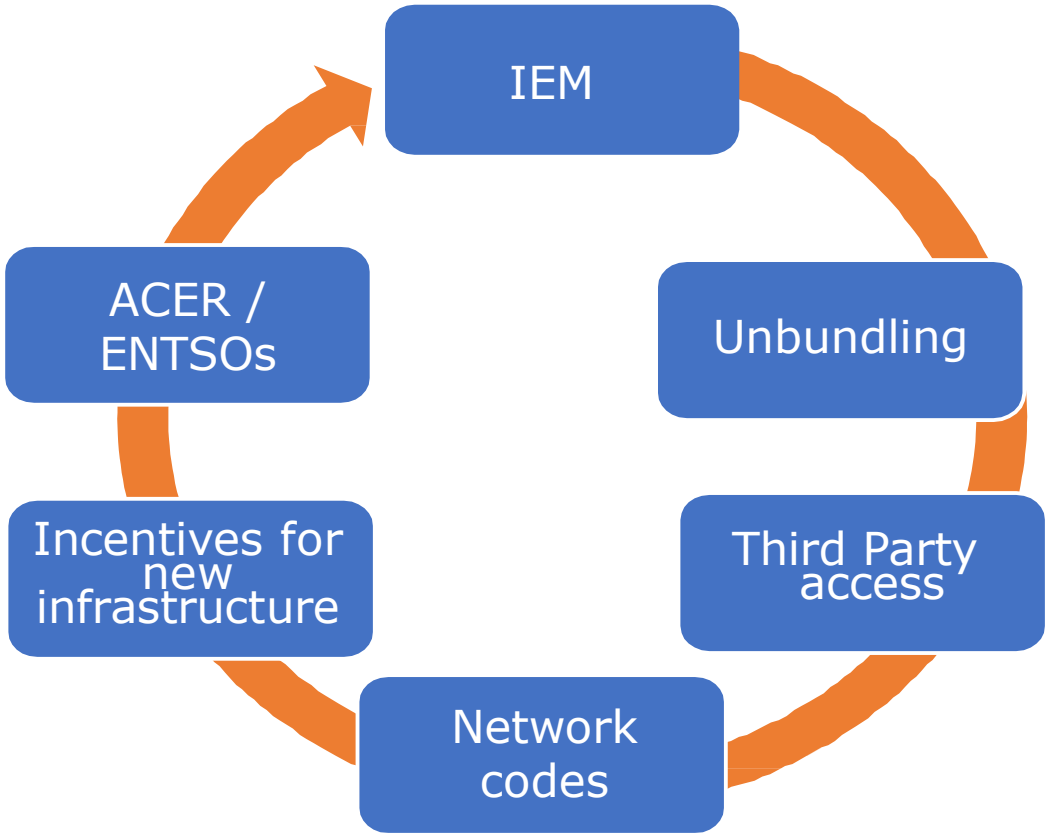
- EU Member States are committed to complete the **Internal Market for Electricity (IME)**
- The internal market requires **removing barriers** to trade and aligning markets
- The 3rd Package creates a new regulatory framework to assist IME and it is **legally binding** for markets to couple (EU Regulation 714/2009)

The Clean Energy Package is a set of measures that provides an energy policy framework to accelerate the clean energy transition in the EU



Source: European Commission

Third Energy Package: the tools towards the IEM



Objectives of EU energy policy

Competitiveness

Smart Infrastructure

Competitive Markets

Diversified Supply

Energy Efficiency

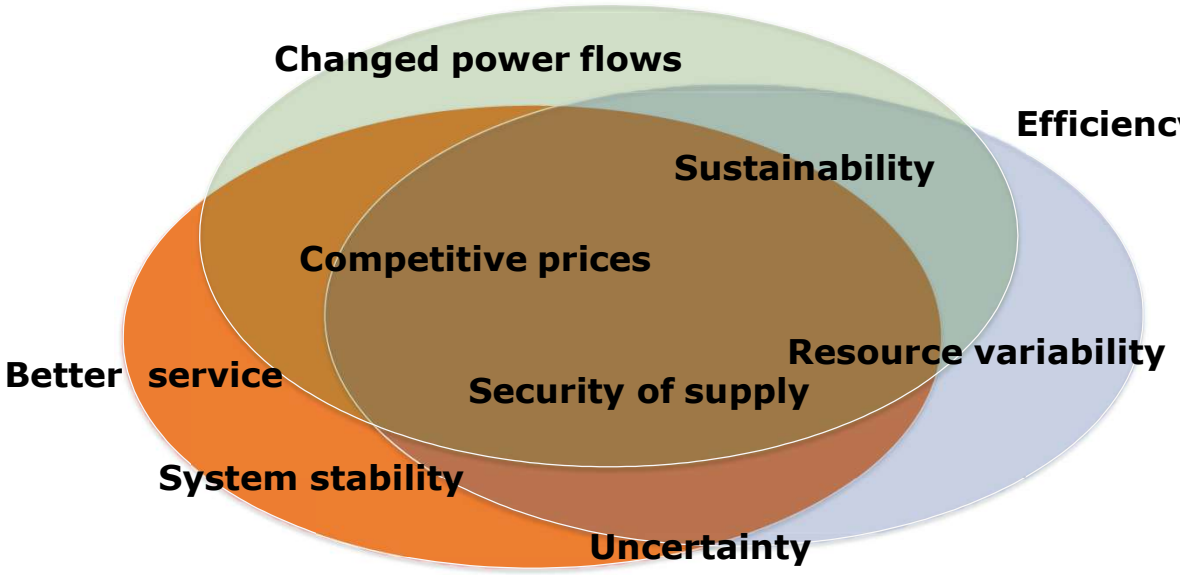
Security of Supply

Renewable Sources

Sustainability

Three pillars for delivering the Internal Energy Market

Infrastructure:
Delivering a fit for purpose network



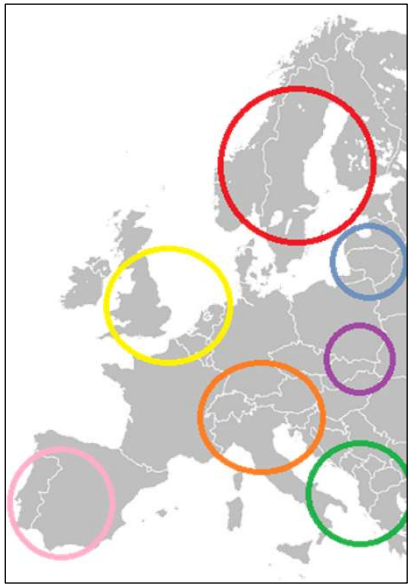
System operation:
Delivering coordinated schemes

Market:
Delivering well designed pan-European markets

New Business Environment

1990

2015



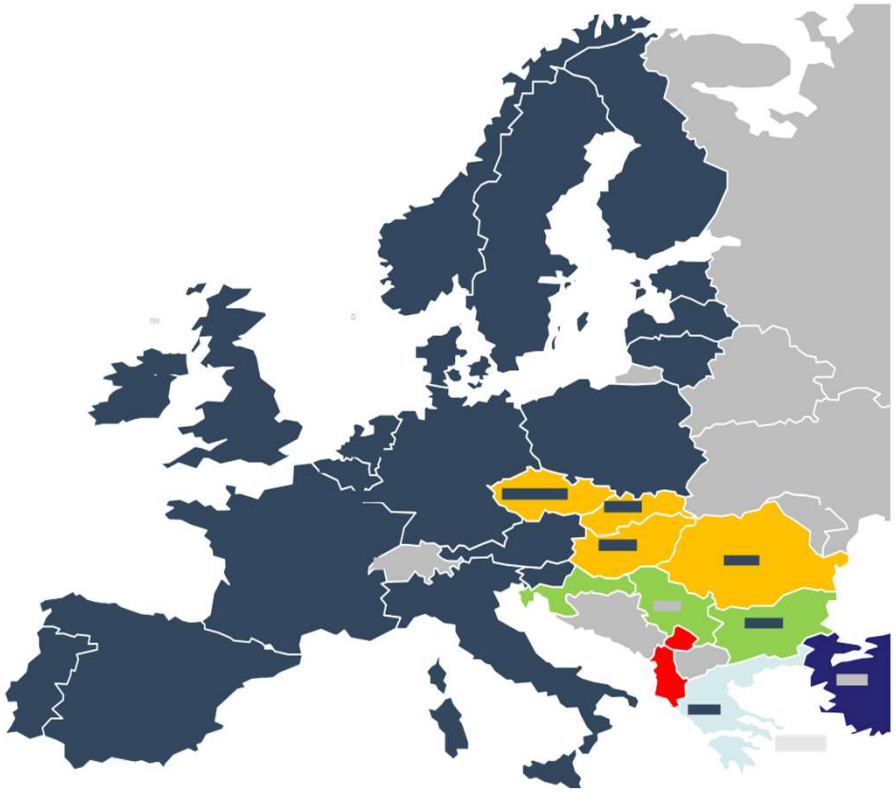
2030

All participants in the market will face a **new business environment**

Energy Markets will gradually become **coupled** and operate under **pan-European rules**

The largest Electricity Market in the world

- 42 TSOs in 35 Countries
- 312 693 km of Transmission Lines
- 3278 TWh Electricity Consumption(15% of Global)
- Over 500 million customers served
- Approx. 1000 GW net generation
- Pooling of resources saves the European customer €13 bill./year
- 13% of sales traded cross borders



Internal Energy Market for Electricity- Status of play

EU Internal Energy Market for electricity

Guidance and standards for each timeframe:

Forward Market / Derivatives Market

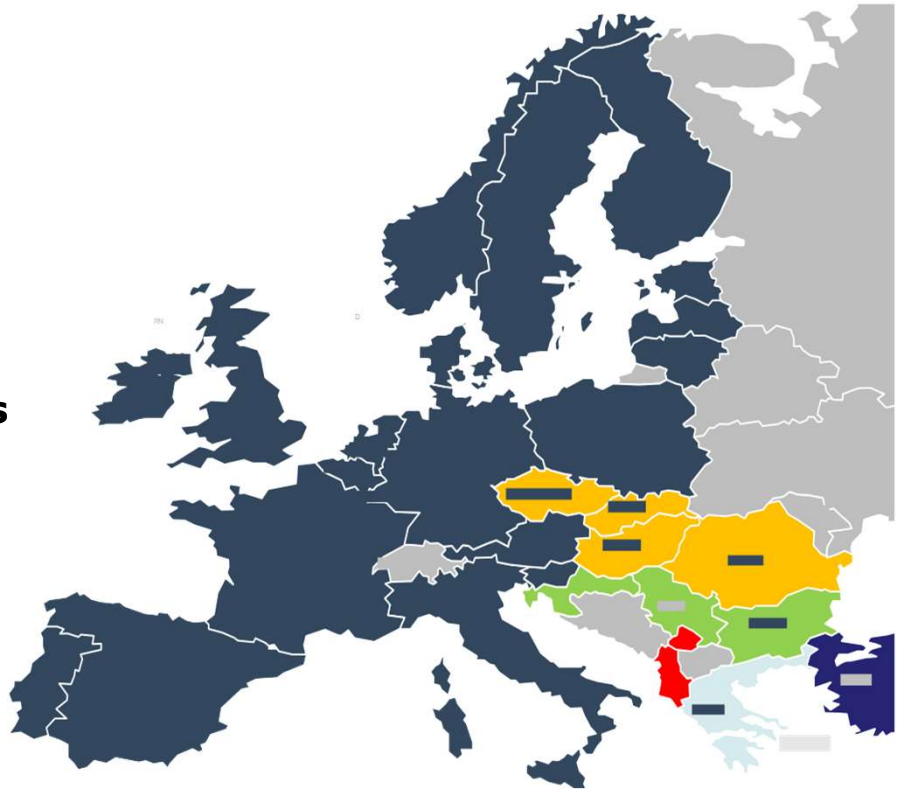
Day Ahead (DAM)

Intra-Day (IDM)

Balancing

Multi-Regional Coupling (MRC) / TSOs + PXs

- Coupling of regions and efficient management of available transmission capacities between areas and countries
- Implicit capacity allocation - Cross Border Intraday Trading
- Price Coupling of Regions (PCR)
- The initiative of Power Exchanges to develop a single price coupling solution
- EUPHEMIA algorithm

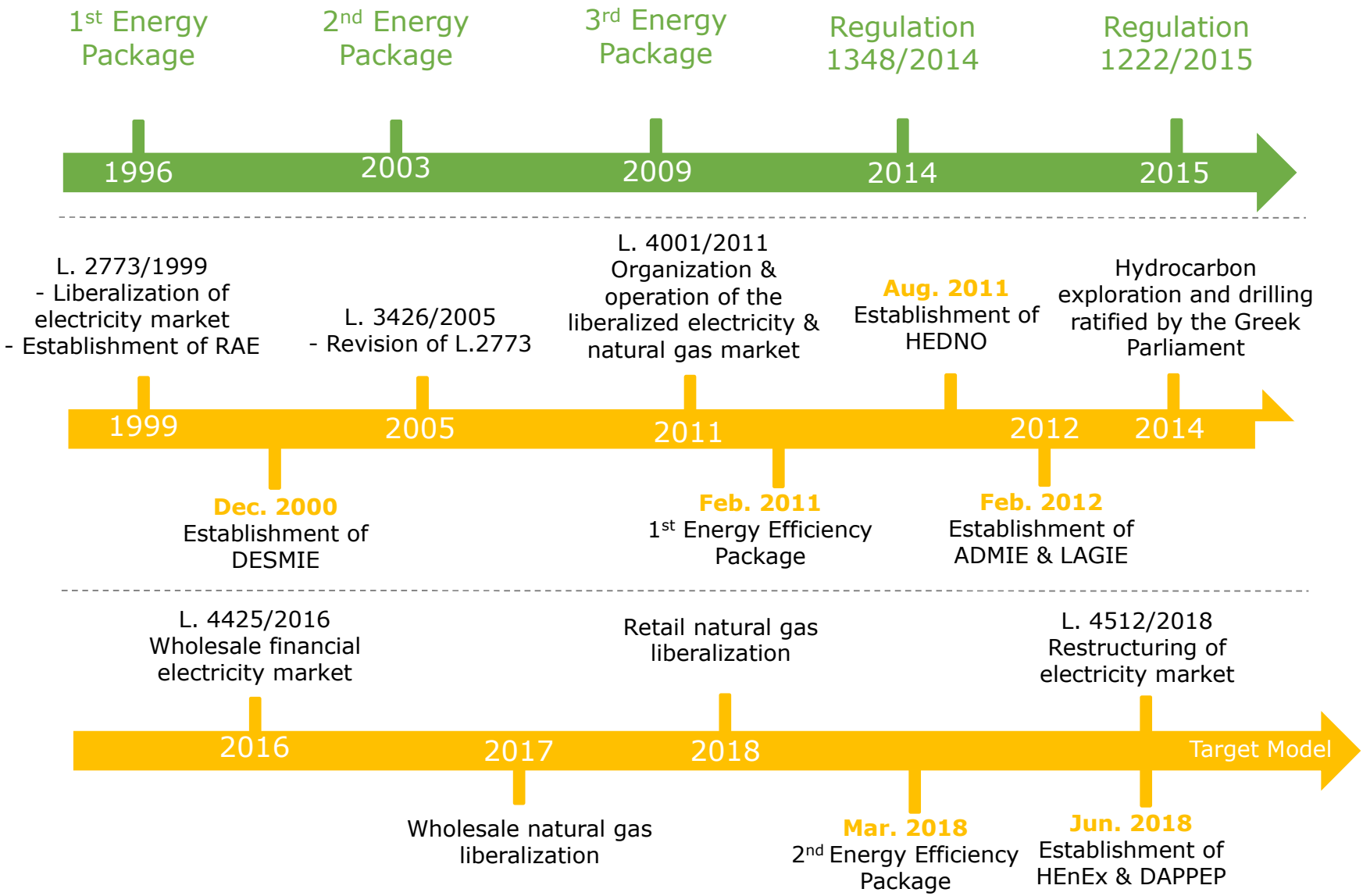


IEM is expected to increase liquidity, efficiency, social welfare and transparency of prices and flows

2. Country Profile

The liberalization process of energy market has been relatively delayed, however significant developments are observed recently

Timeline of the liberalization process in the Greek energy market



The revised targets of the National Energy and Climate Plan 2019

Reduction of Greenhouse Gas Emissions and other Environmental Targets

Total greenhouse gas emissions to be reduce by at least 40% compared to 1990 (percentage achieved reduction> 42%)

- achieve equivalent objectives in terms of emissions reduction in the individual areas inside and outside of the trading system of allowances
- quantitative achievement of national targets for the reduction of specific air pollutants
- withdrawal of lignite units power generation by 2028

Increase of RES penetration

The share of RES in final gross energy consumption to rise at least at 35%

- the share of RES in final gross electricity consumption energy to rise at least 60%
- the share of RES for the heating needs and cooling to overcome 40%
- the share of RES in transport sector to exceed 14% (achieves 19%) according to the relative methodology calculation of the EU

Achieve improvement in energy efficiency

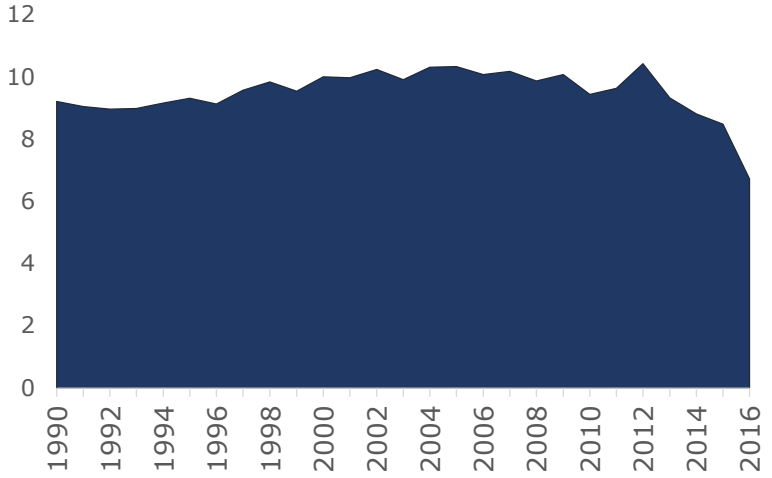
Achieve improvement in energy efficiency by 38% according to European methodology

- the final consumption of energy should not to exceed 16,5 Mtoe the year 2030
- the primary energy consumption should not exceed 2 2,5 Mtoe in the year 2030
- to be achieved at least 7 M toe cumulative energy saving in the period 2021 2030
- 3% annually energy renovation of the total buildings area of the central public administration by year 2030

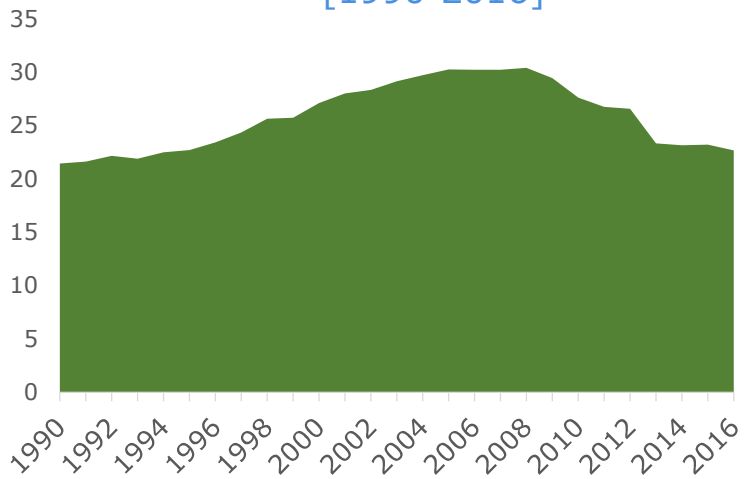
Source: Draft National Energy and Climate Plan, Ministry of Environment and Energy (2019)

Greece is far away from energy independency, since there is a significant gap between total production and total consumption

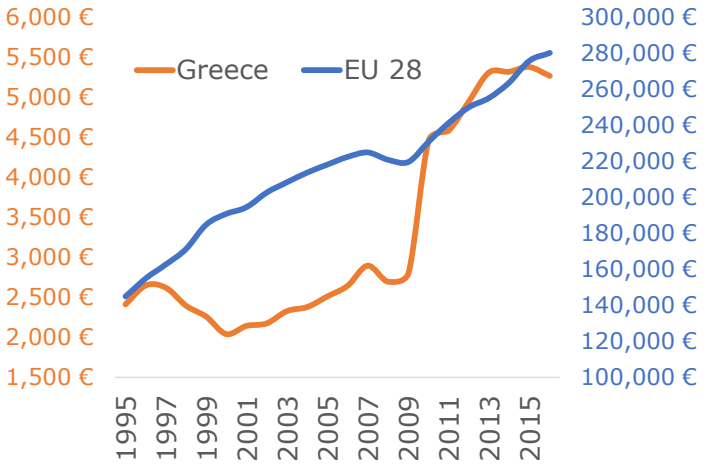
Energy production in Greece (Mtoe), [1990-2016]



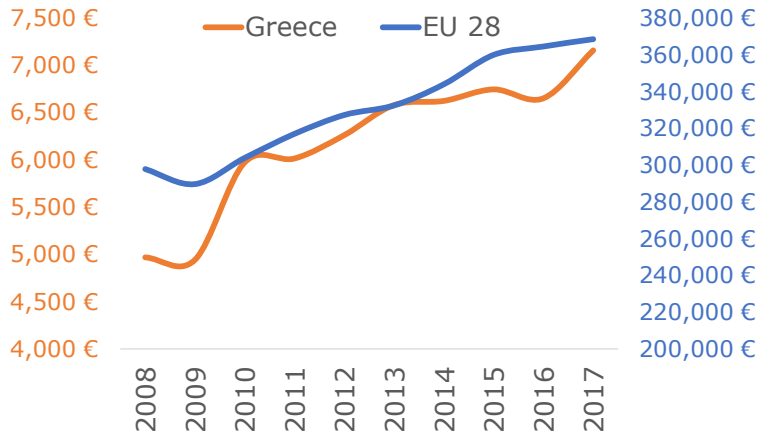
Total primary energy supply (Mtoe), [1990-2016]



Total amount of energy tax revenue in Greece and EU 28 (millions €), [1996-2016]



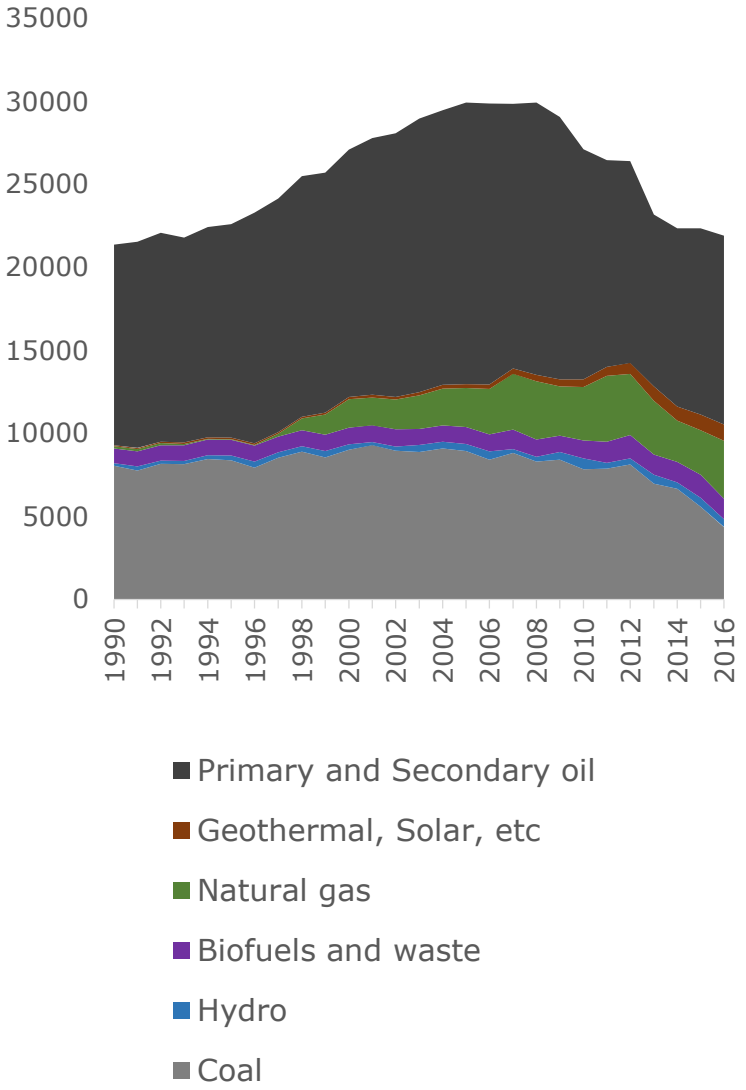
Total environmental taxes in Greece and EU 28 (millions €), [2008-2017]



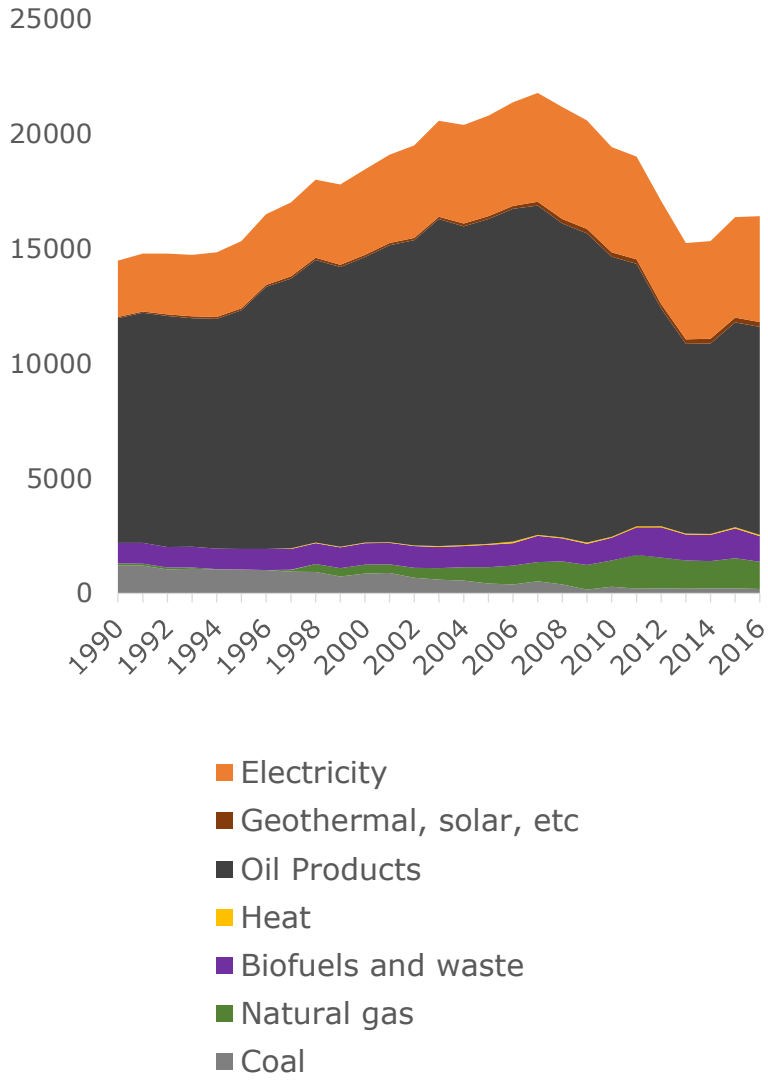
Source: IEA & Eurostat

The intertemporal interplay between energy supply and energy consumption by source in Greece

Total primary energy supply in Greece (ktoe), [1990-2016]



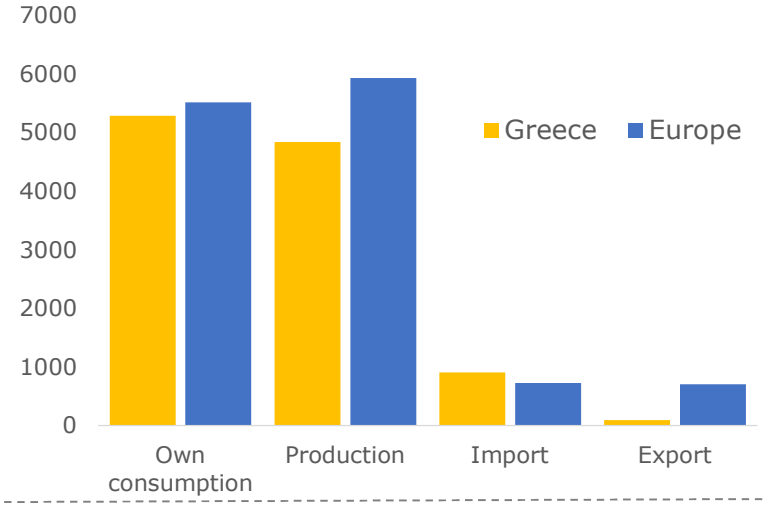
Total final energy consumption by source (ktoe), [1990-2016]



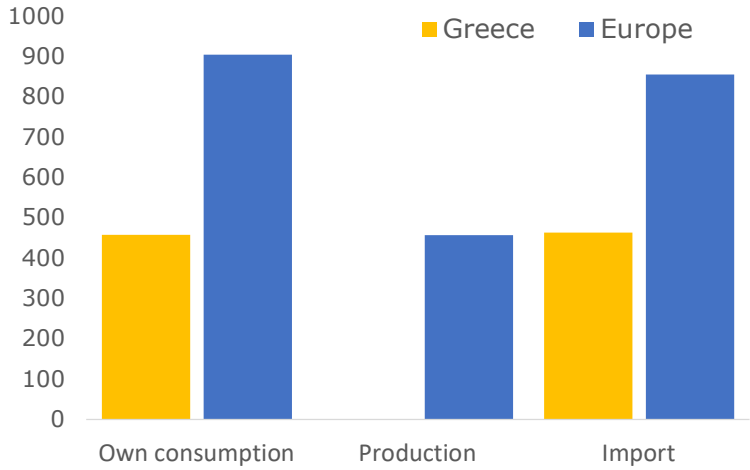
Source: IEA

Greece imports the majority of its oil and gas needs, which is translated as a huge cost and low rating in terms of security of supply

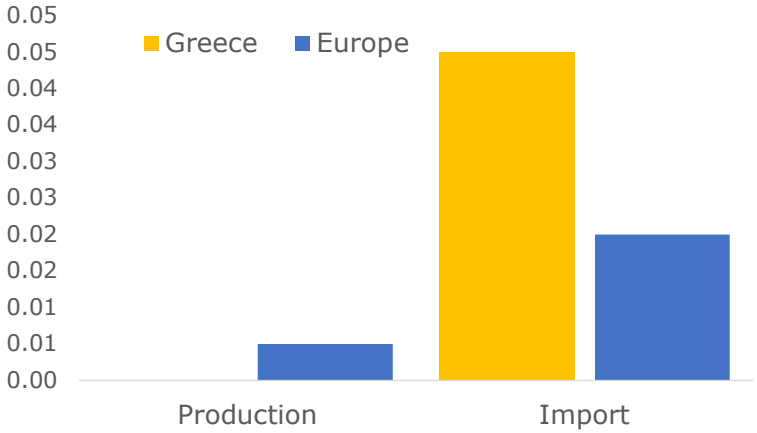
Electricity key figures per capita in Greece and Europe (KWh), [2017]



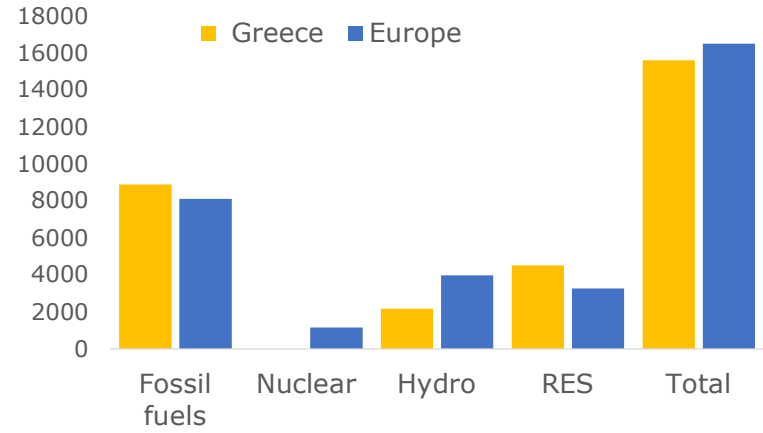
Natural gas key figures per capita in Greece and Europe (cubic meters), [2017]



Crude oil key figures per capita in Greece and Europe (bbl.), [2017]



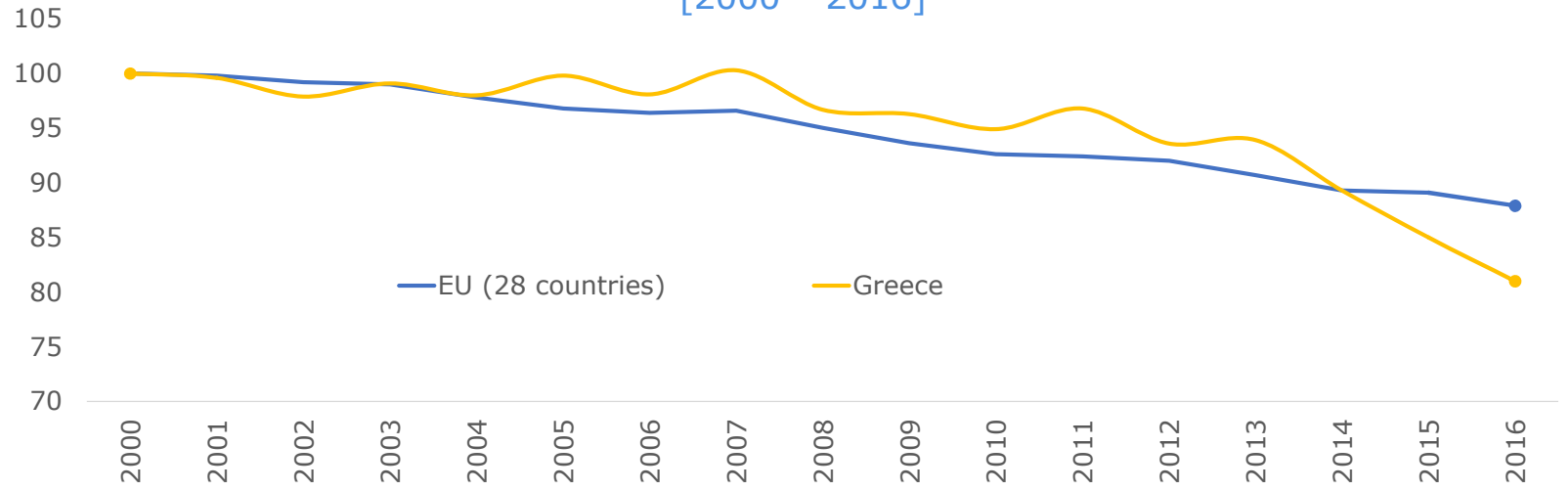
Production capacities by source per capita in Greece and Europe (KWh), [2017]



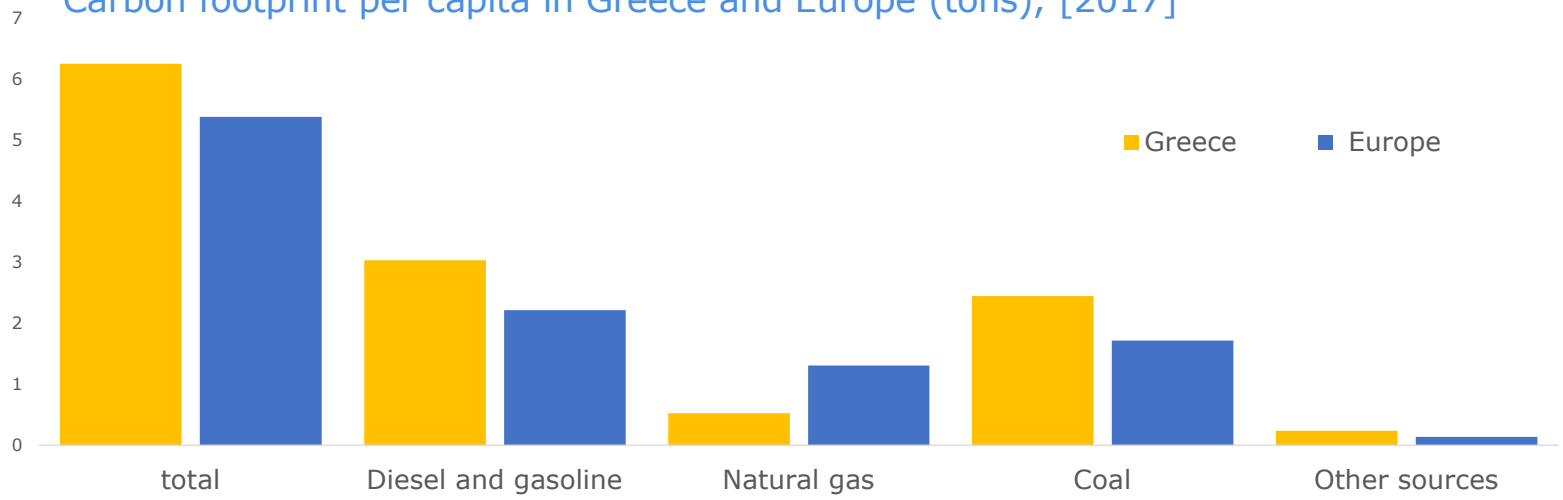
Source: Eurostat

Greece has completed the national target of 20% reduction in greenhouse emissions in respect to 1990 levels, mainly because of the financial crisis

Greenhouse gas emissions intensity of energy consumption (2000 = 100), [2000 – 2016]



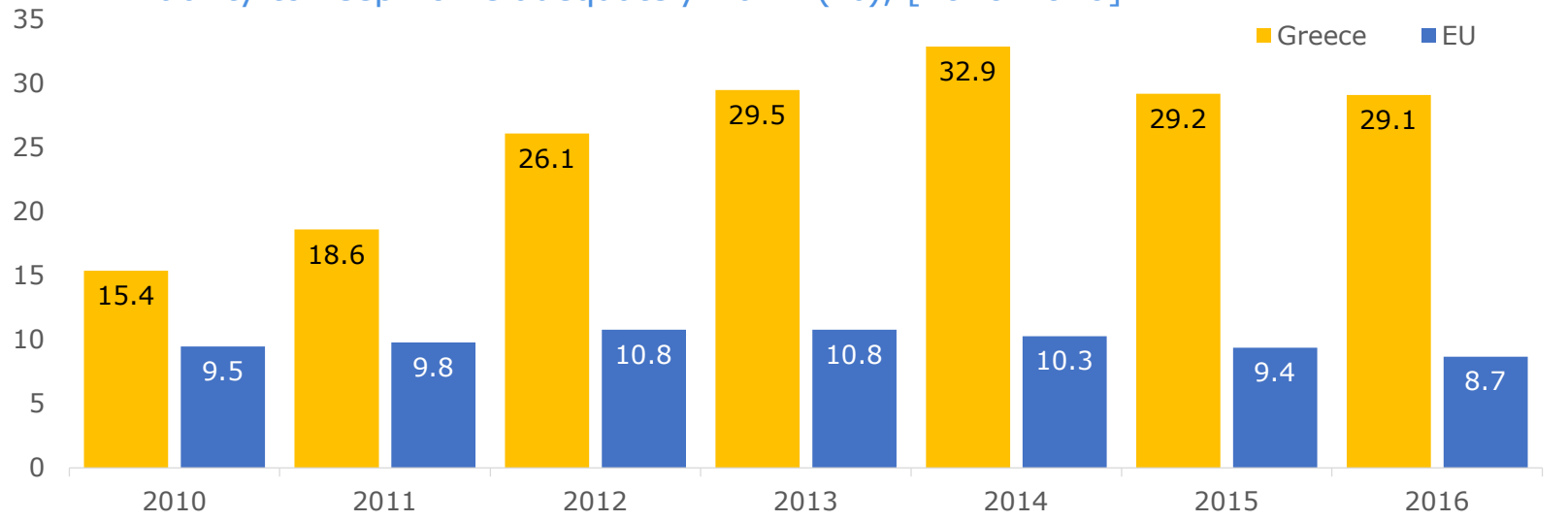
Carbon footprint per capita in Greece and Europe (tons), [2017]



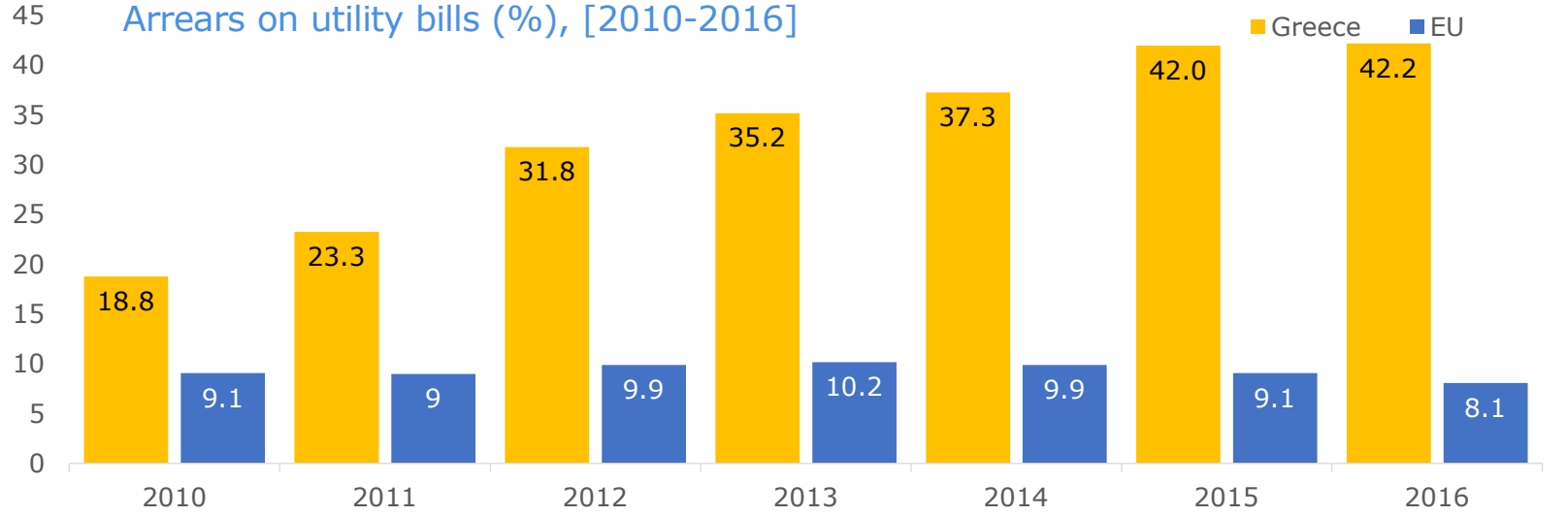
Source: Eurostat

Compared to the rest EU countries, Greece has experienced the biggest increase as far as the inability to keep homes adequately warm

Inability to keep home adequately warm (%), [2010-2016]



Arrears on utility bills (%), [2010-2016]

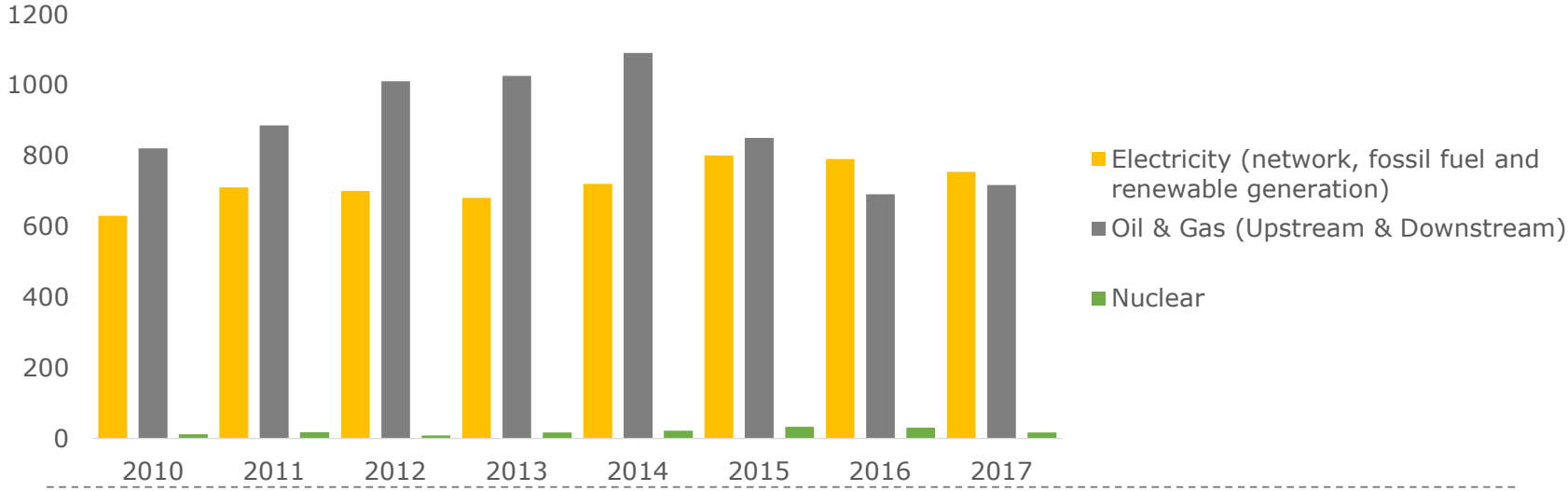


Source: European Commission

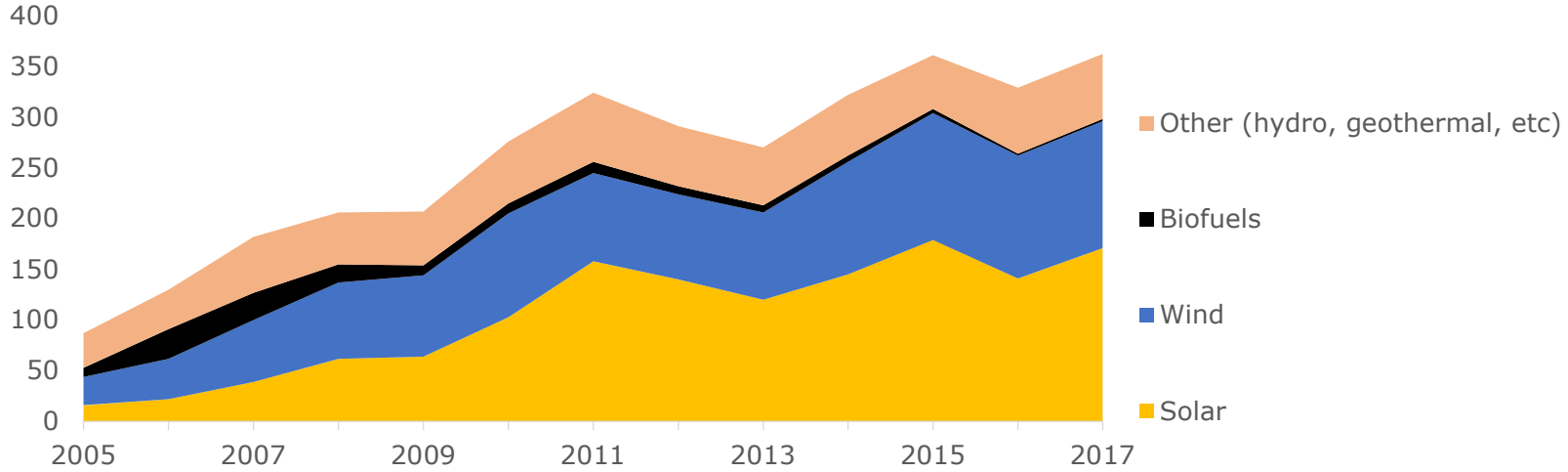
3. Investments

Investments are crucial in order to enable the transition to a low carbon energy supply by the year 2050; A Global Overview

Global new energy investments by sector (billion $), [2010-2017]



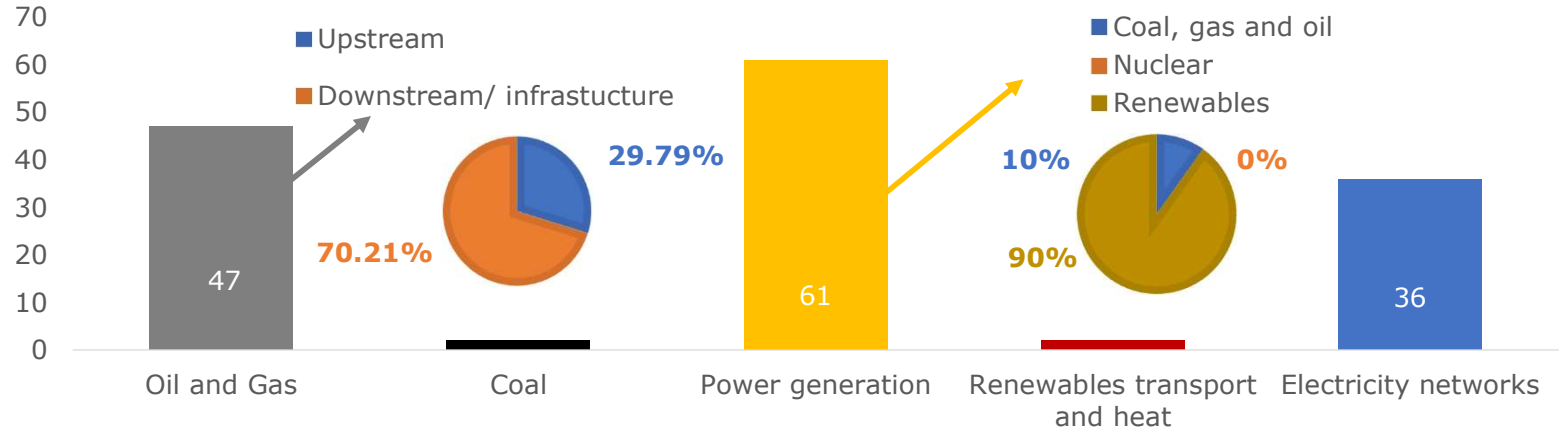
Global new investments in renewables by sector, (billion $), [2005-2017]



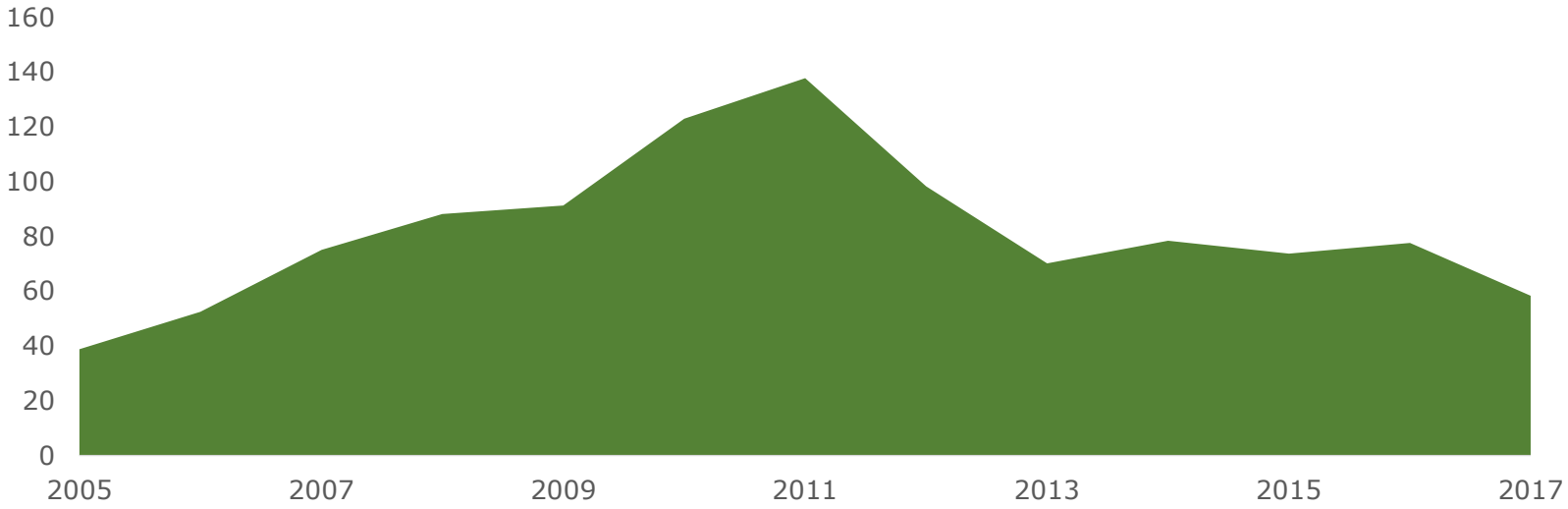
Source: IEA & Bloomberg

European energy investments is on a growing pattern, mainly boosted by better debt financing terms

Energy investment by fuel in Europe, (billion $), [2017]



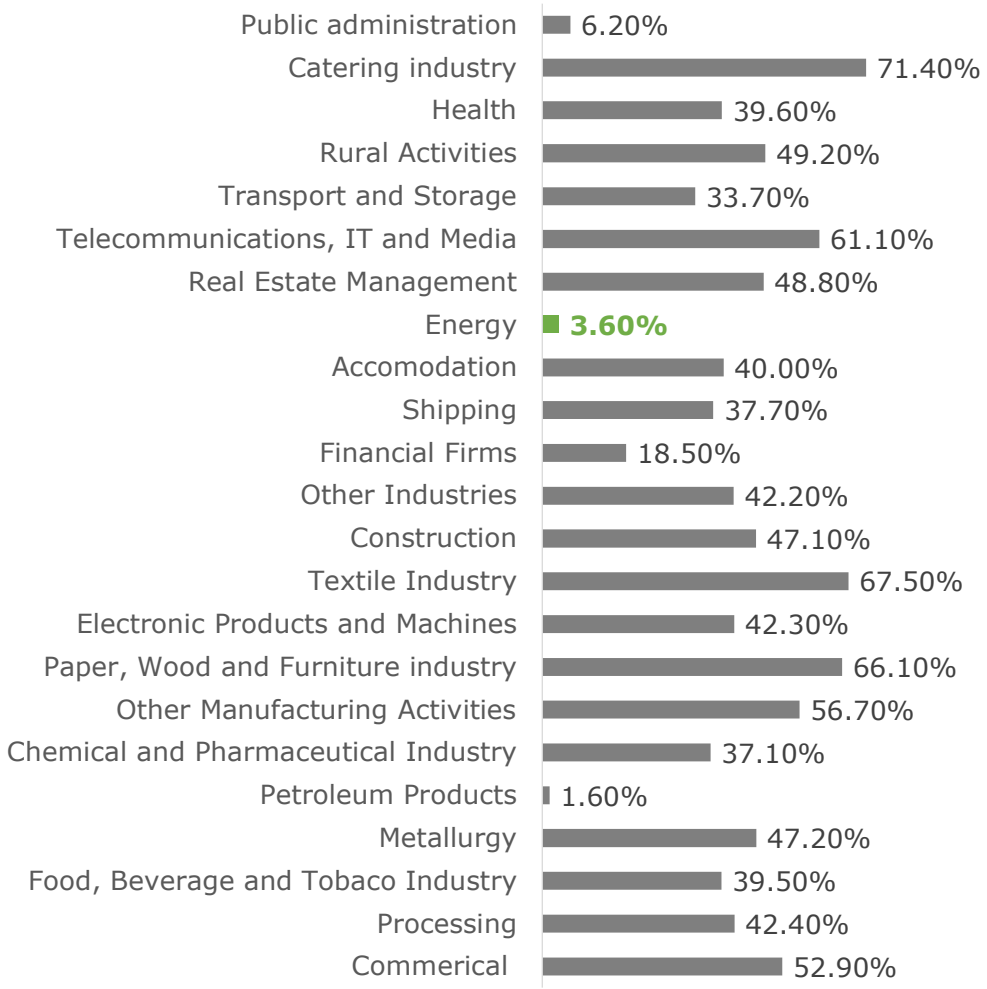
Total new investments in renewables EU (billion $), [2005-2017]



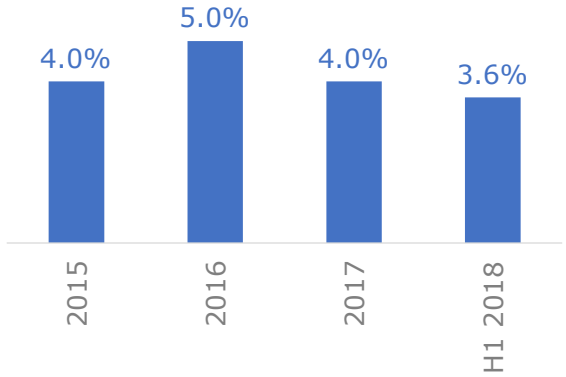
Source: IEA & Bloomberg

The Greek banking system prefers to provide loans on the robust Greek energy sector, since its NPE percentage is considerably low

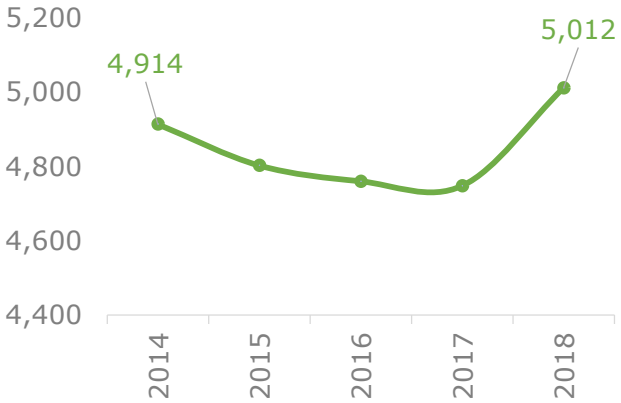
Non performing exposure by sector in Greece (%), [H1.2018]



Non performing exposure of the energy sector (%), [2015-2018]



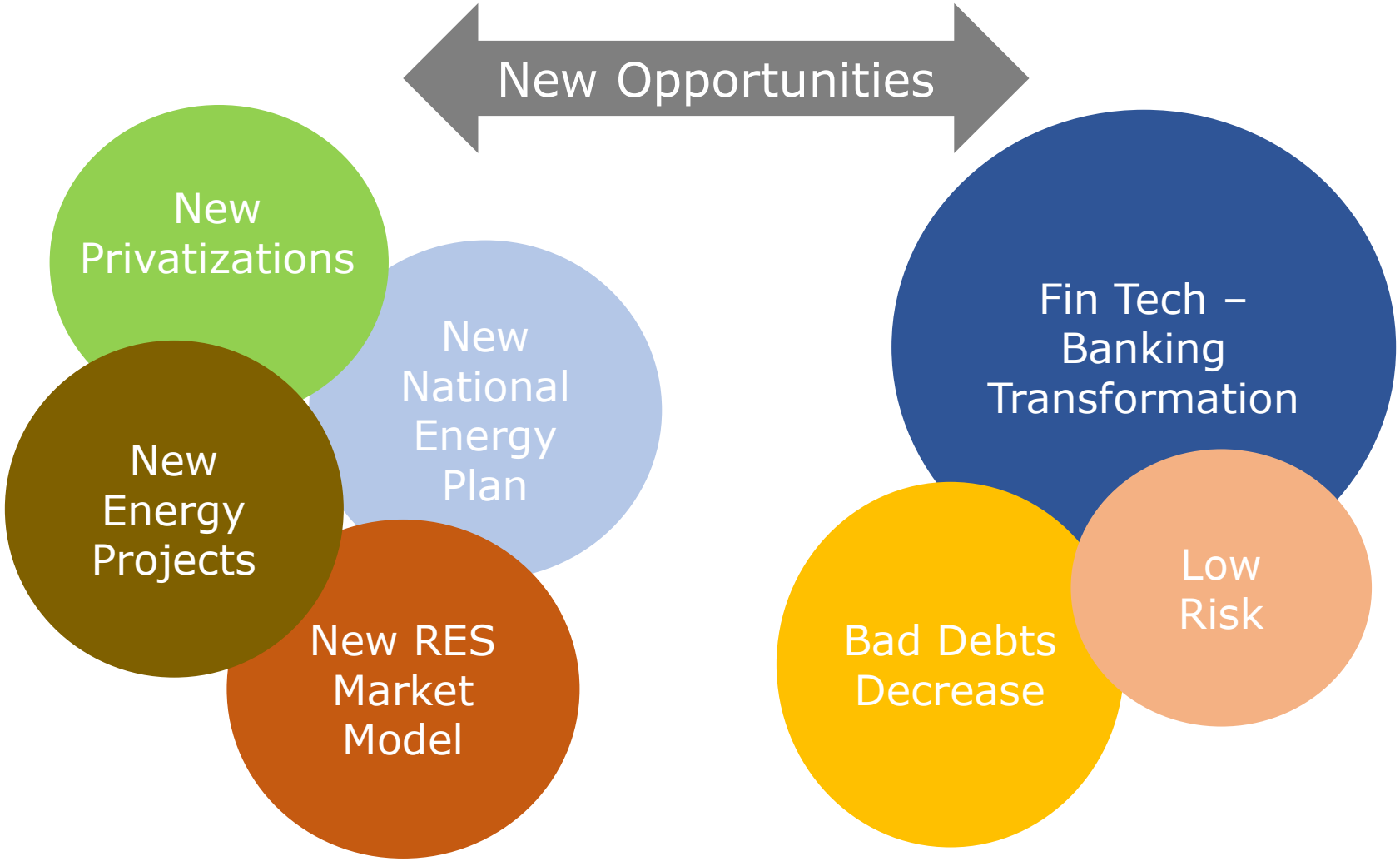
Outstanding loans in the energy sector (mil. €), [2014-2018]



Source: Bank of Greece

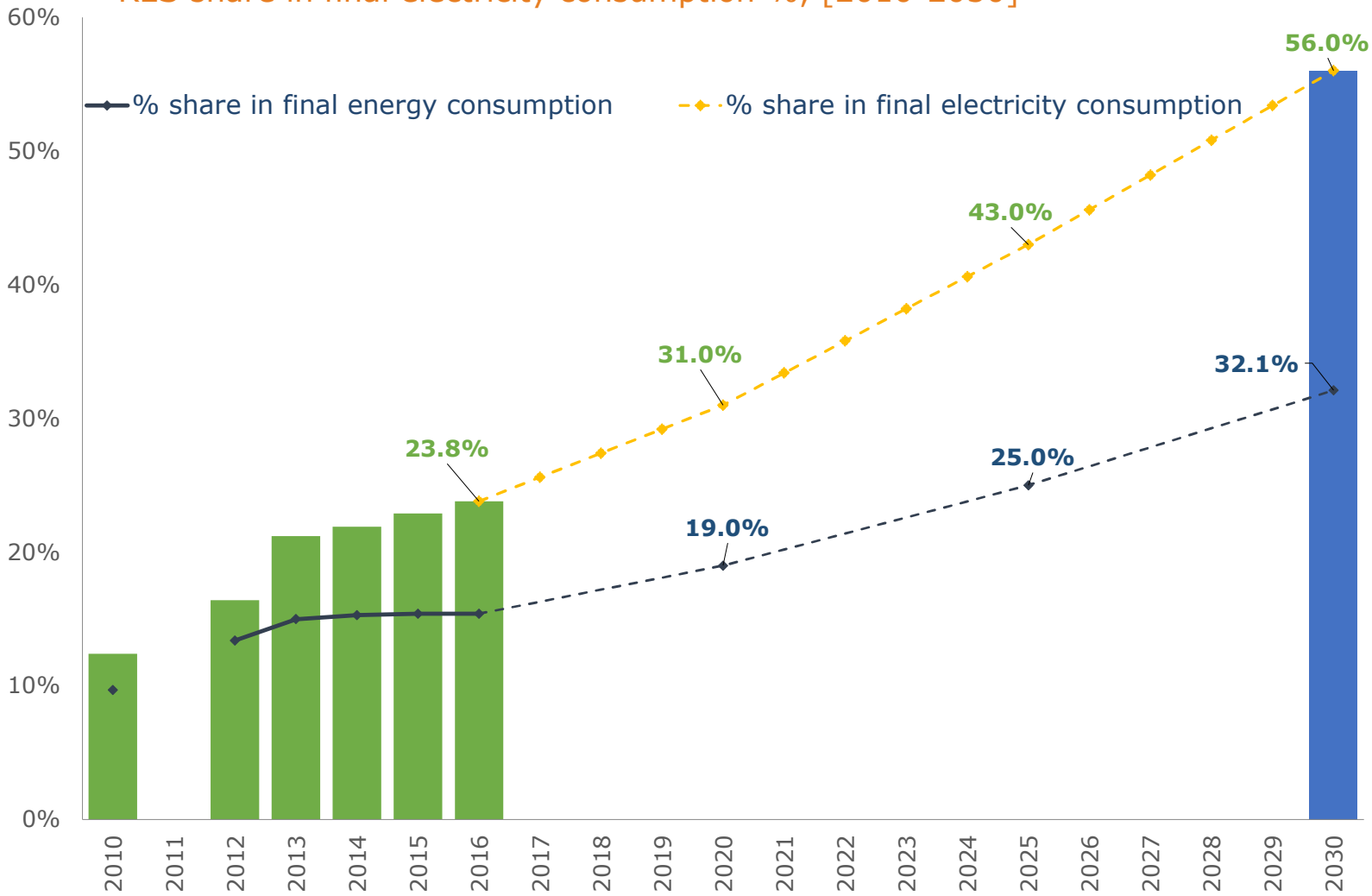
The next day for Greek banking system is to provide a set of new investment opportunities that could assist win-win potentials in the market

The new energy framework in line with the challenges of the banking sector



Greece is expected to create energy investment opportunities due to the availability of RES potential and the ongoing sizeable infrastructure projects

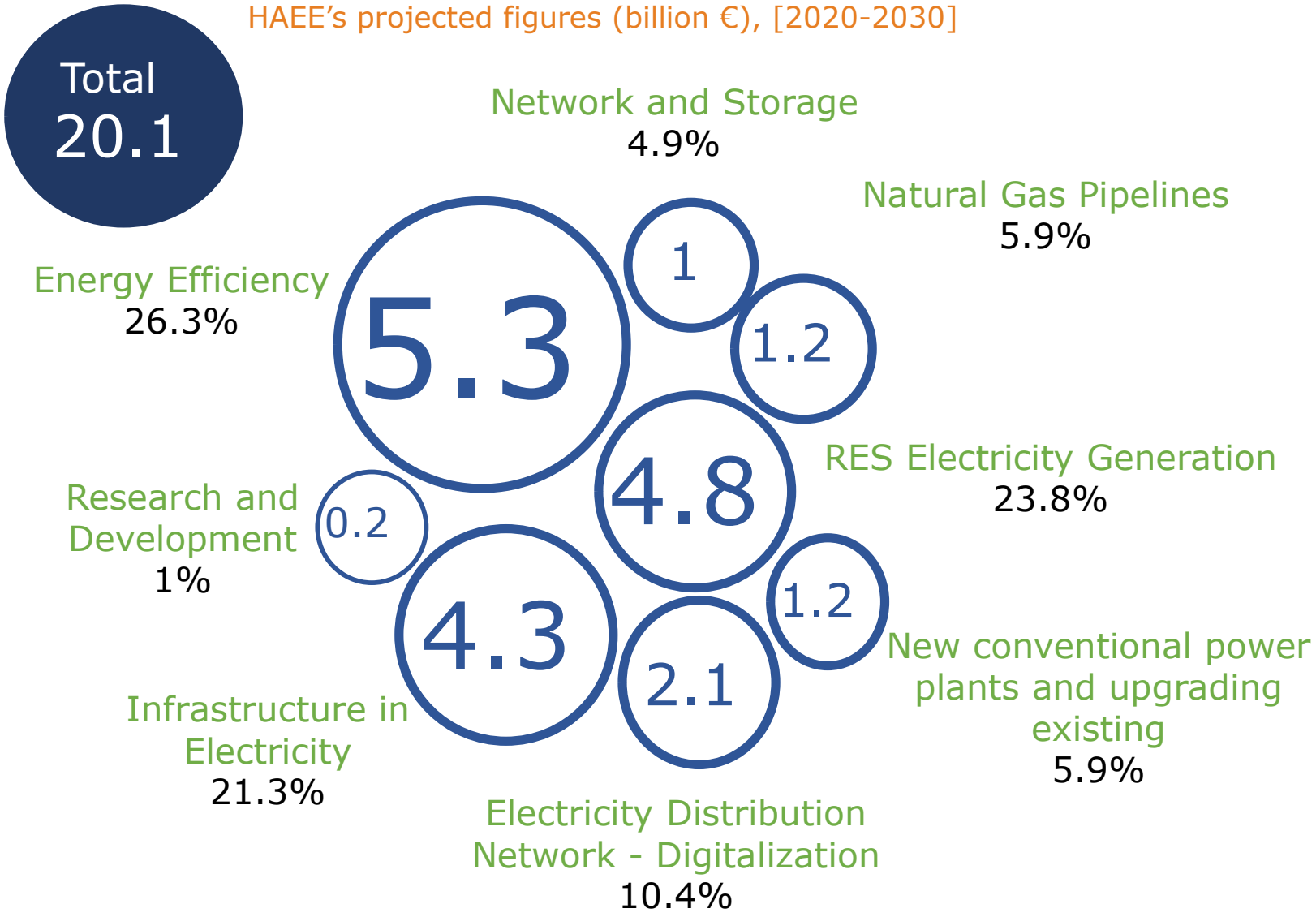
RES share in final electricity consumption %, [2010-2030]



Source: Draft National and Climate Plan 2030, Ministry of Environment and Energy (2018)

According to a realistic revision by HAEE, the projected investments regarding the period 2020-2030 will reach 20.1 billion euros

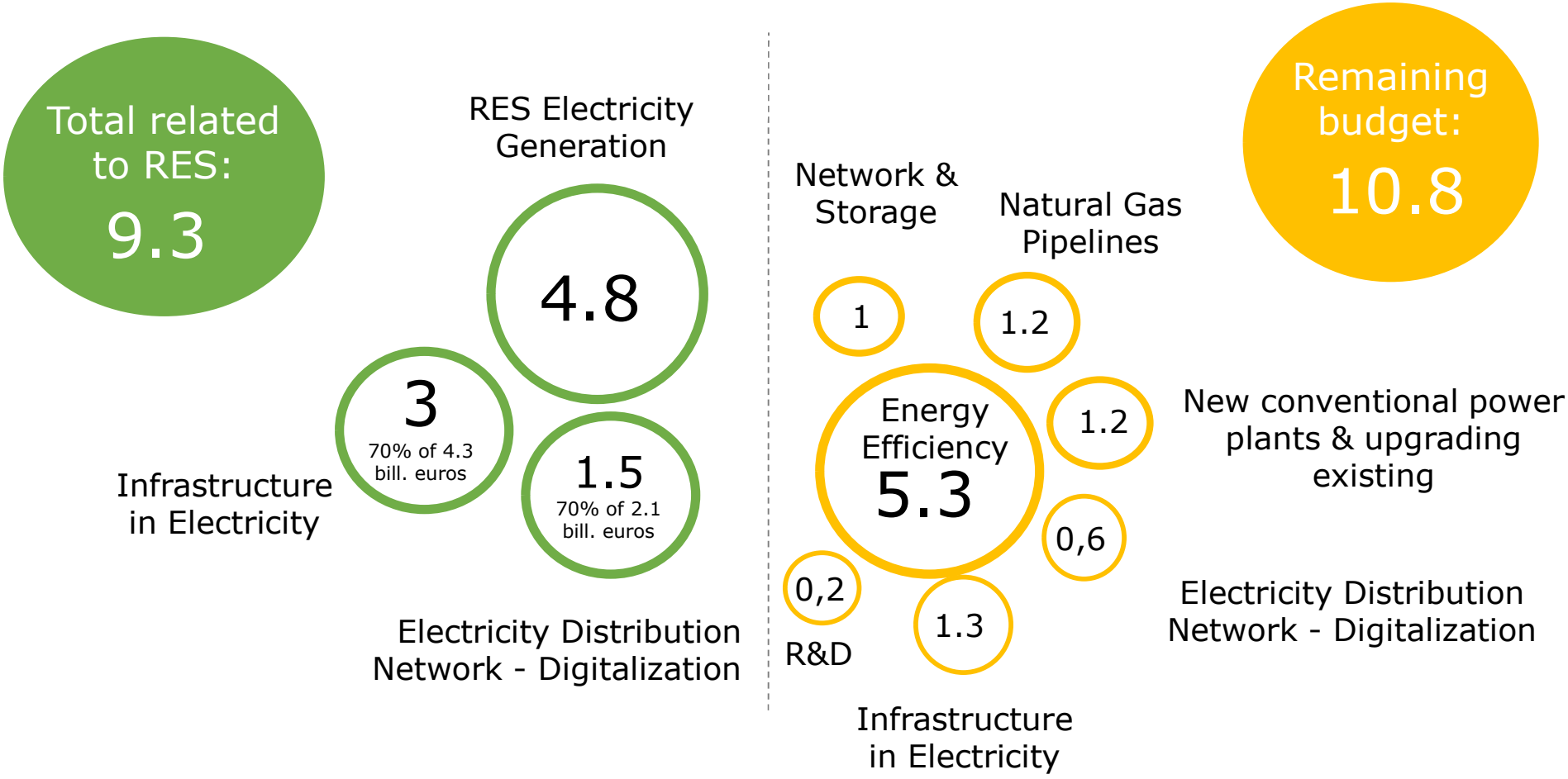
HAEE's projected figures (billion €), [2020-2030]



Source: HAEE

Total investments related to RES stand at 46.2% out of the total amount projected to be invested in the Greek energy market by 2030, based on HAEE's realistic revision

Fragmentation of projected figures (billion €), [2020-2030]



Source: HAEE

Coffee Break

Duration (11:30 – 11:45)

Part 2

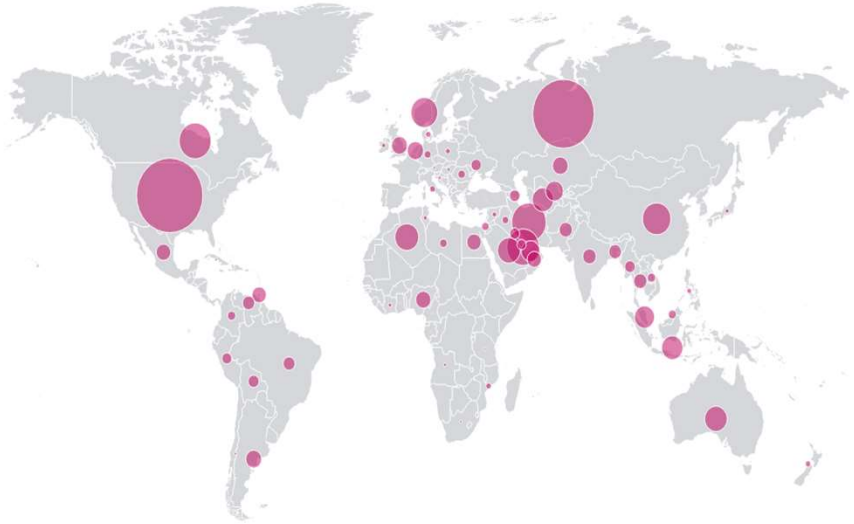
4. Natural Gas & LNG Markets

Duration (11:45 – 13:30)

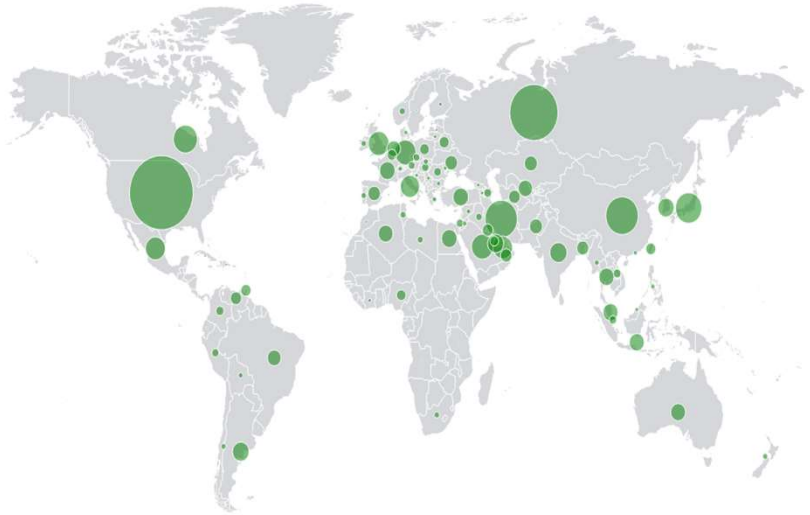
4. Natural Gas

Natural Gas reserves are abundant worldwide and can support the energy transition to a low carbon economy

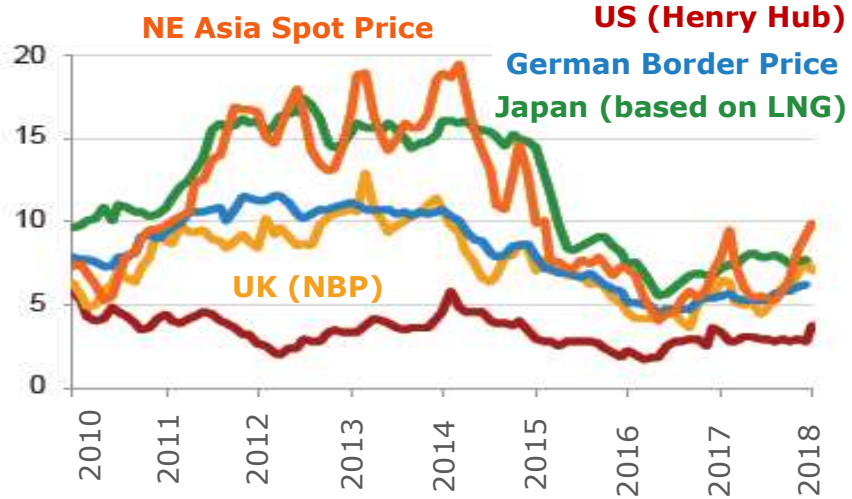
Global natural gas production [2018]



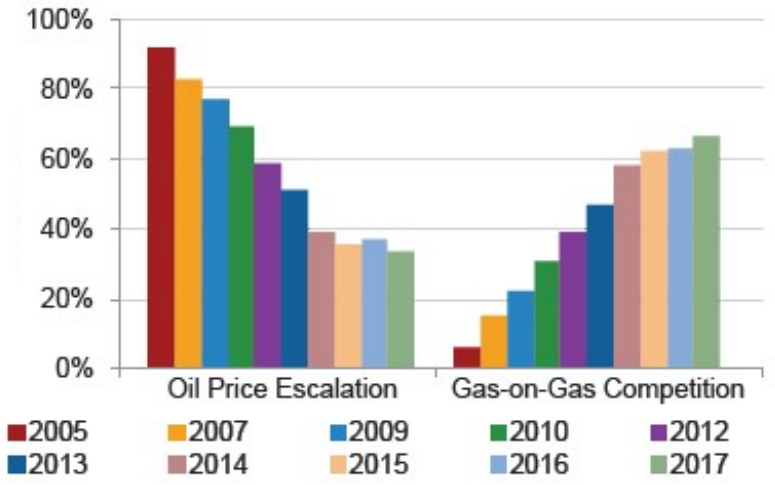
Global natural gas consumption [2018]



Monthly average regional gas prices ($/mmBtu), [2010–2018]



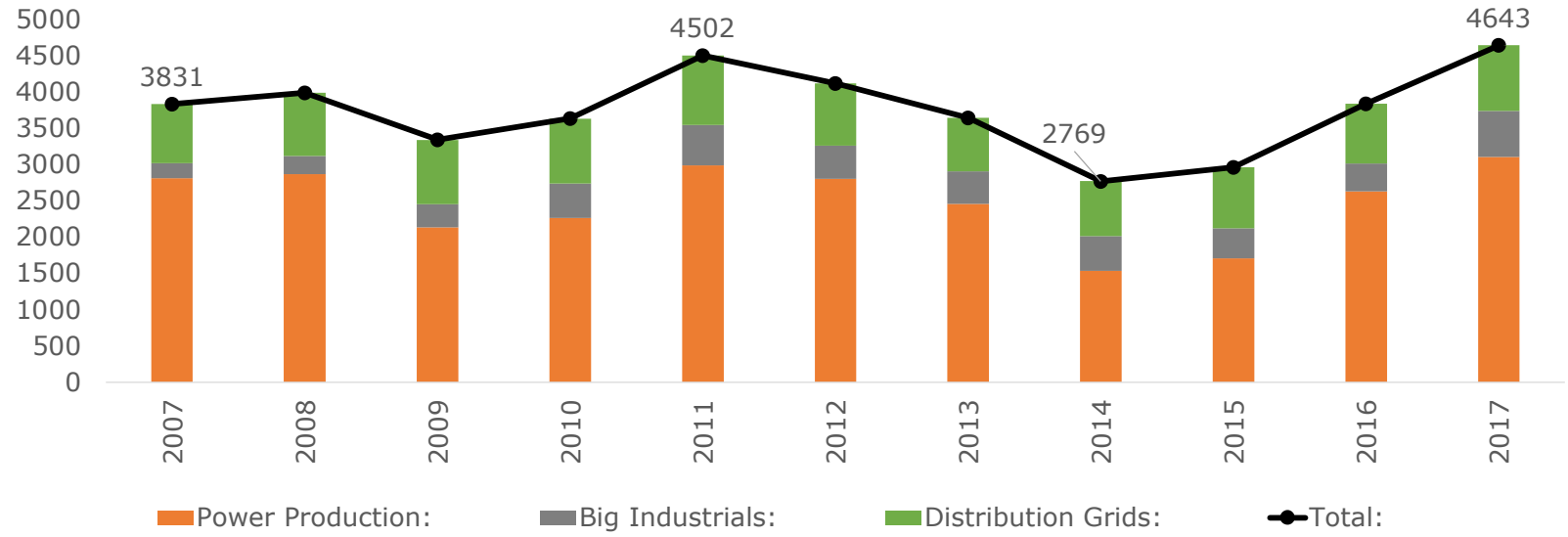
European import price formation (% of price formation mechanism) [2005-2017]



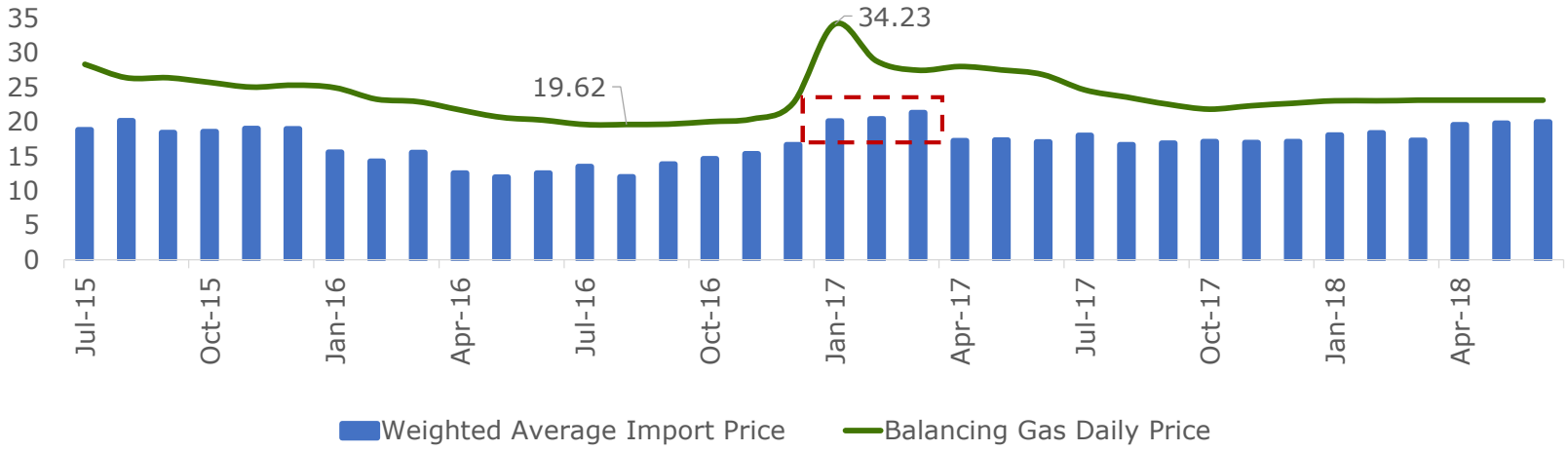
Source: IEA, IGU

Greek natural gas market is rising again after a steep drop during the economic crisis, being transformed to a fully liberalized market

Natural gas consumption in Greece (mil. Nm3), [2007-2017]



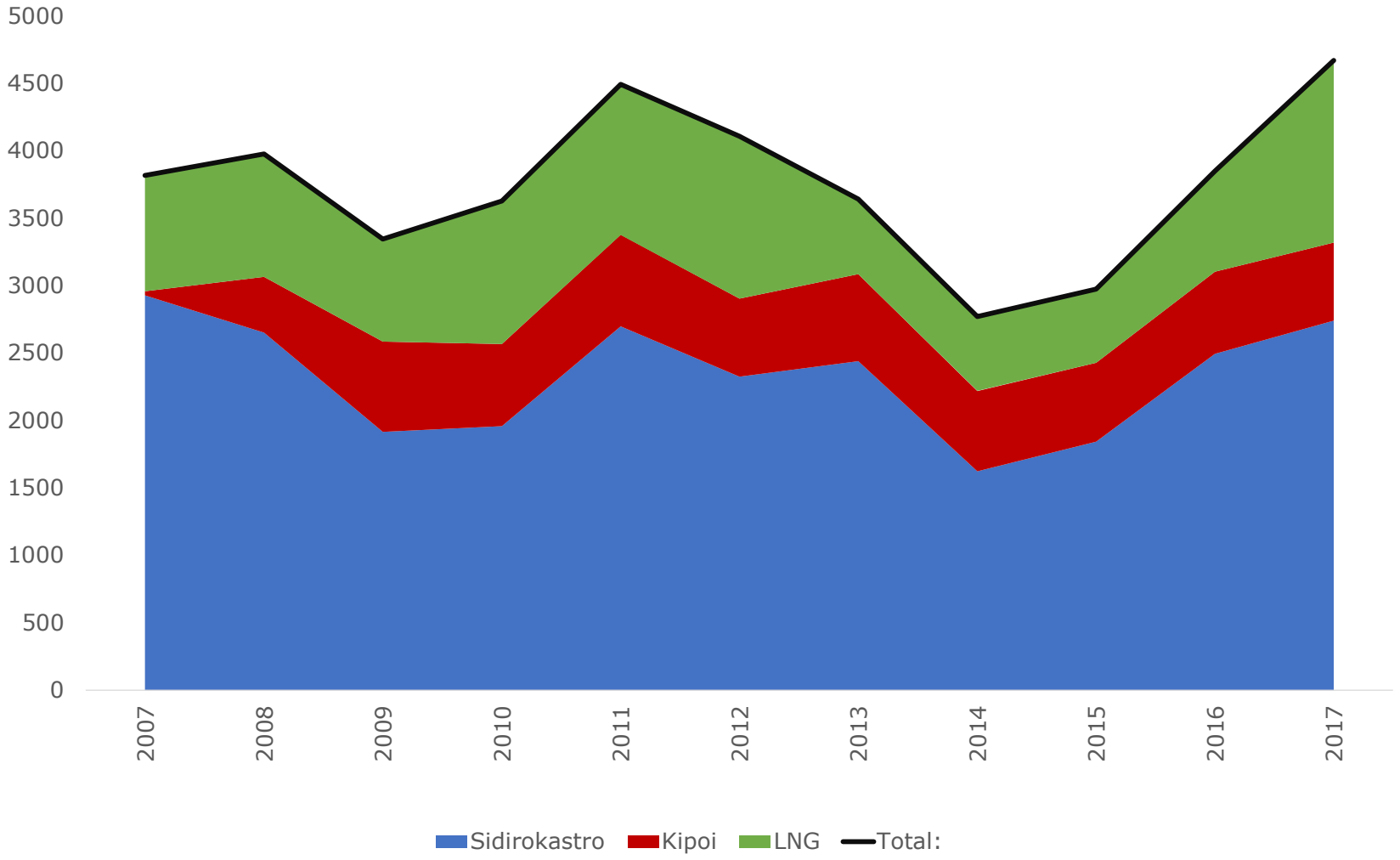
Natural gas Prices in Greece (€/MWh), [2015-2018]



Source: DESFA & RAE

Natural gas entry points are expected to increase and get upgraded facilitating bi-directional flow of natural gas with neighboring countries

Entry points and quantities (mil. Nm3), [2007-2017]

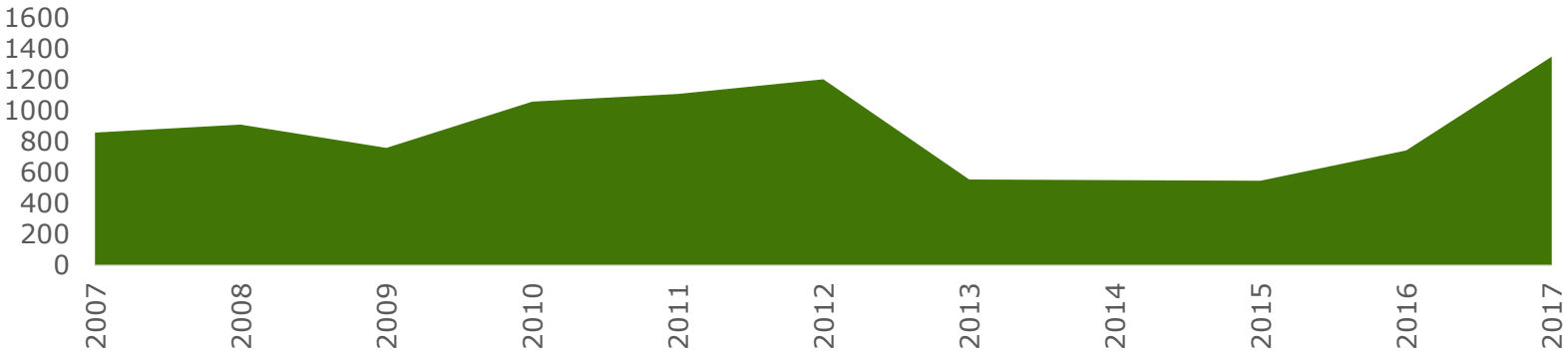


Source: DESFA

Existing LNG terminal and future infrastructure will transform Greece to a natural gas hub, increasing the importance of the country in terms of security of supply

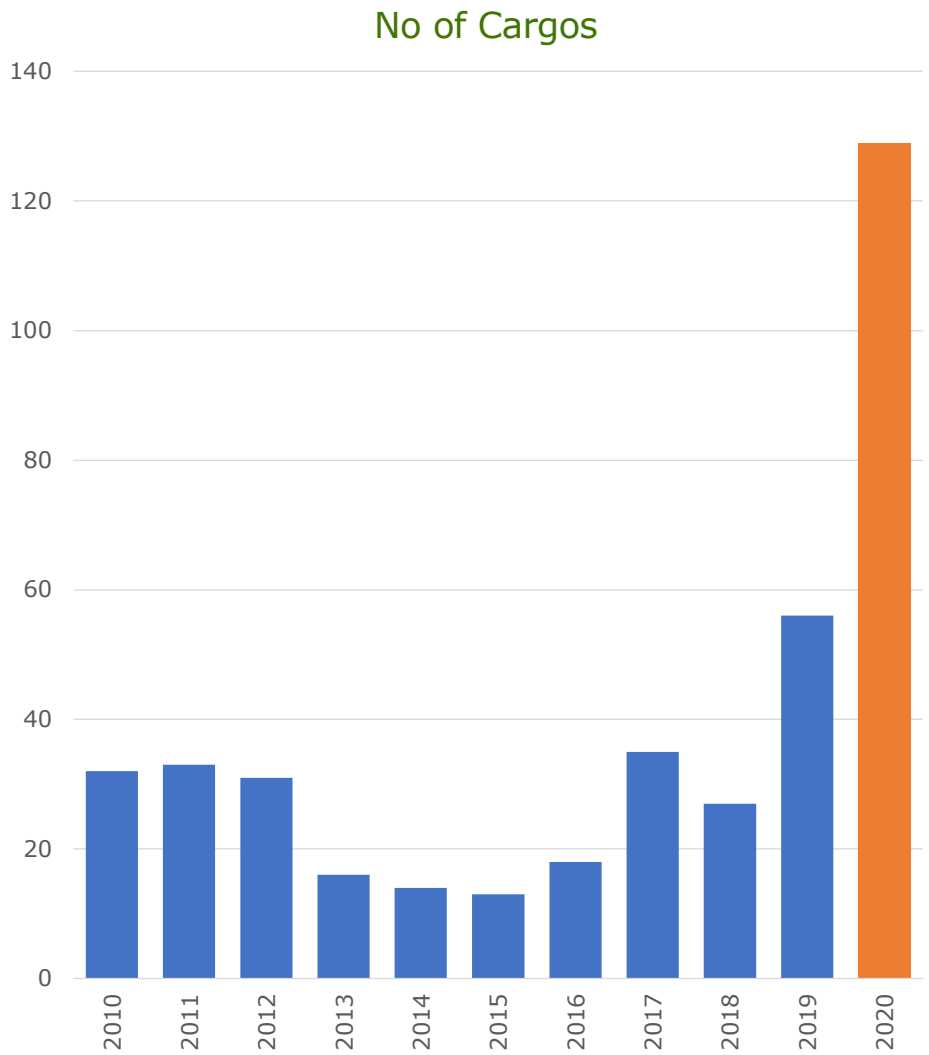
Route of Trans Adriatic Pipeline (TAP)

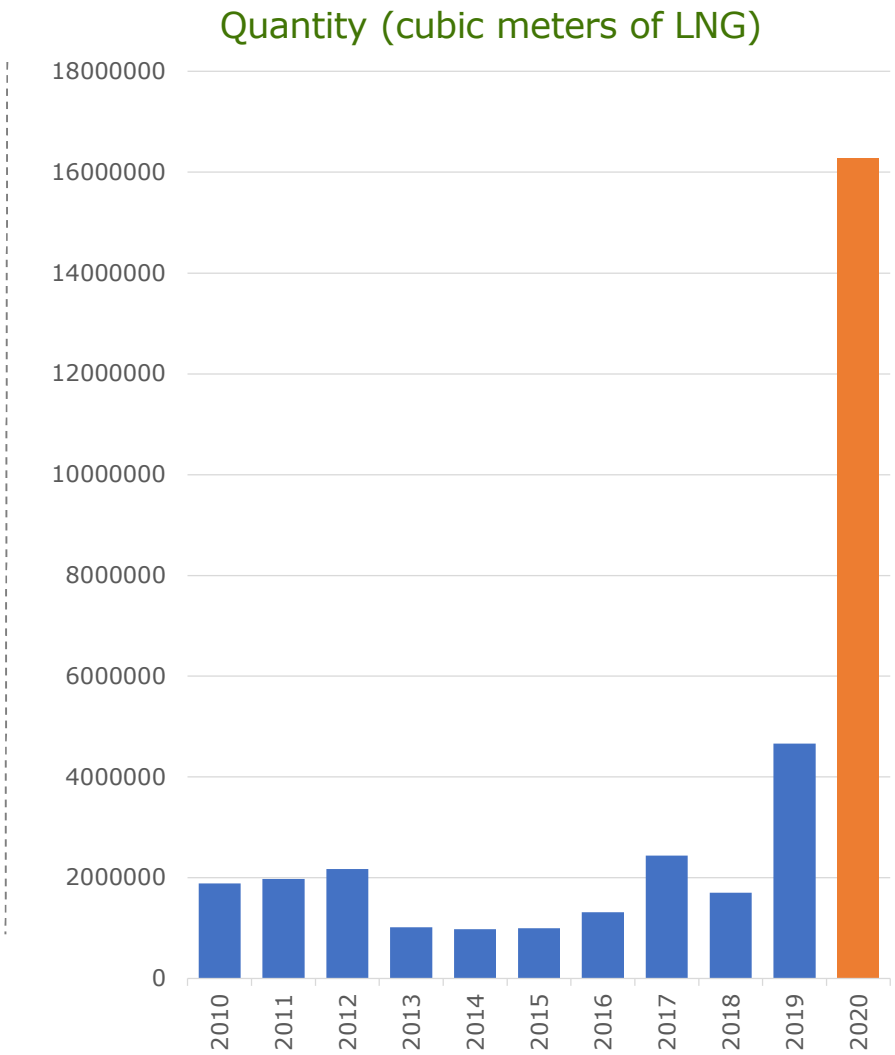
LNG market in Greece (mil. Nm3), [2007-2018]



Source: TAP & DESFA

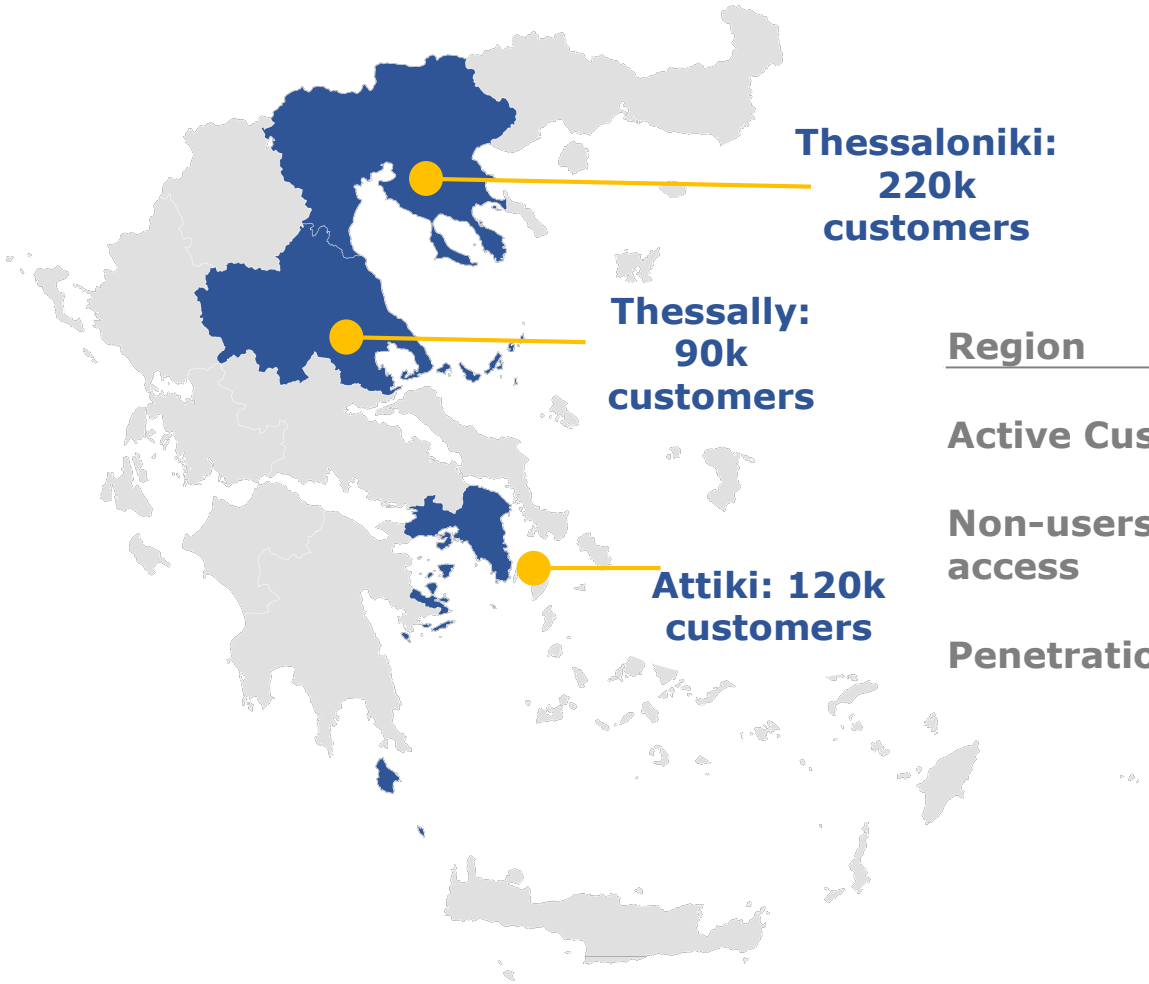
The current projection for LNG growth in the Greek market is significant greater compared to the previous decade





Retail market exists mainly in the regions of Thessaloniki, Thessaly and Attiki, yet there is an ambitious plan for expansion of the market through new grid construction and use of CNG/LNG technologies for remote areas

Active customers in the three regions of EDAs, [2018]

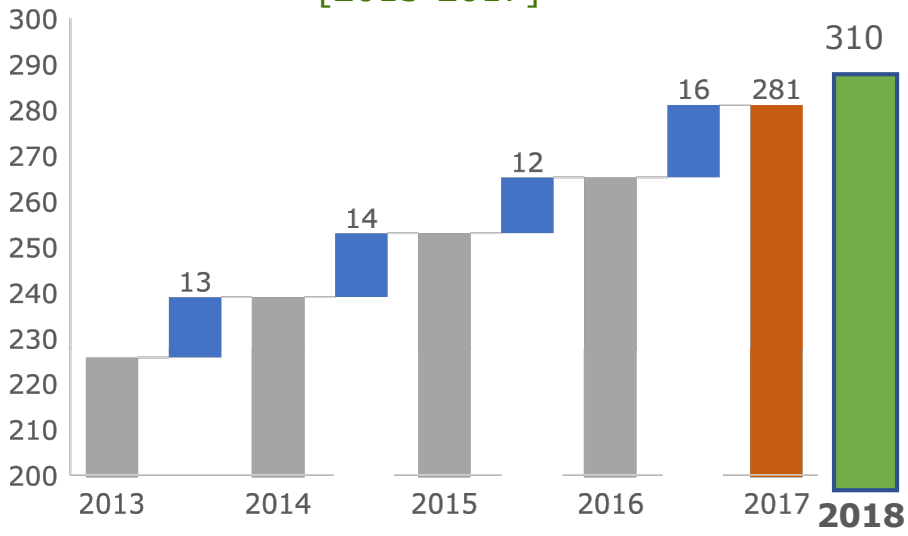


Region	Attiki	Thess	Total
Active Customer	120k	310k	430k
Non-users with access	585k	232k	817k
Penetration	36%	54%	43%

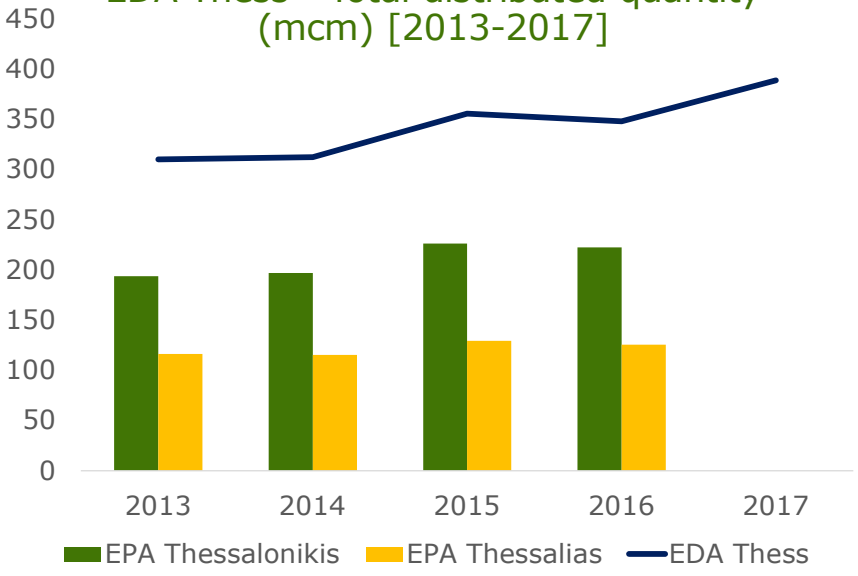
Source: EDA Attiki, EDA Thessaly & EDA Thessaloniki

The area of Thessaloniki and Thessaly are under "EDA THESS" DSO, being the first areas to have been provided with natural gas

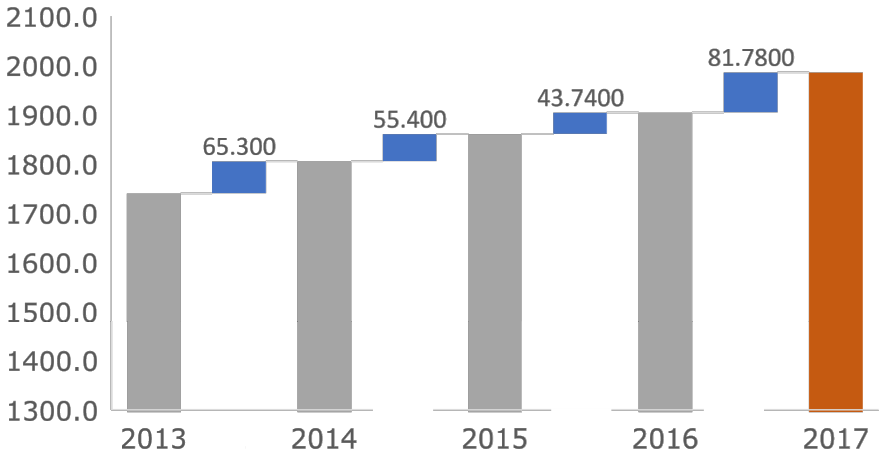
EDA Thess – Number of customers [2013-2017]



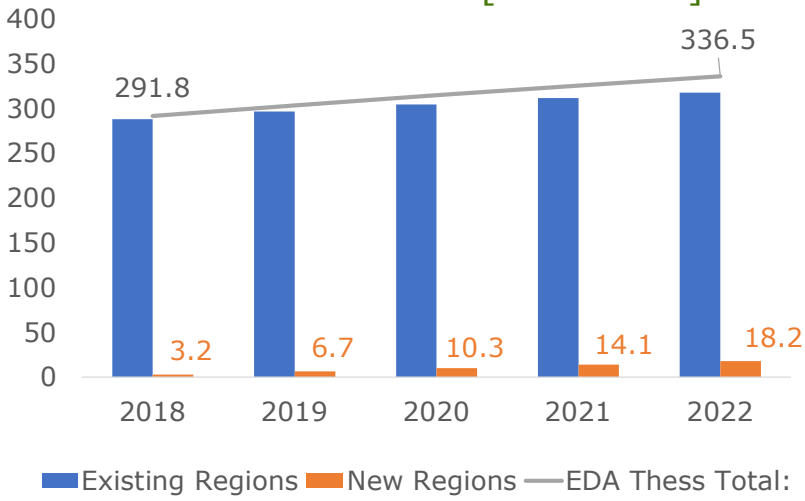
EDA Thess - Total distributed quantity (mcm) [2013-2017]



EDA Thess - 4 Bar grid construction (km), [2013-2017]

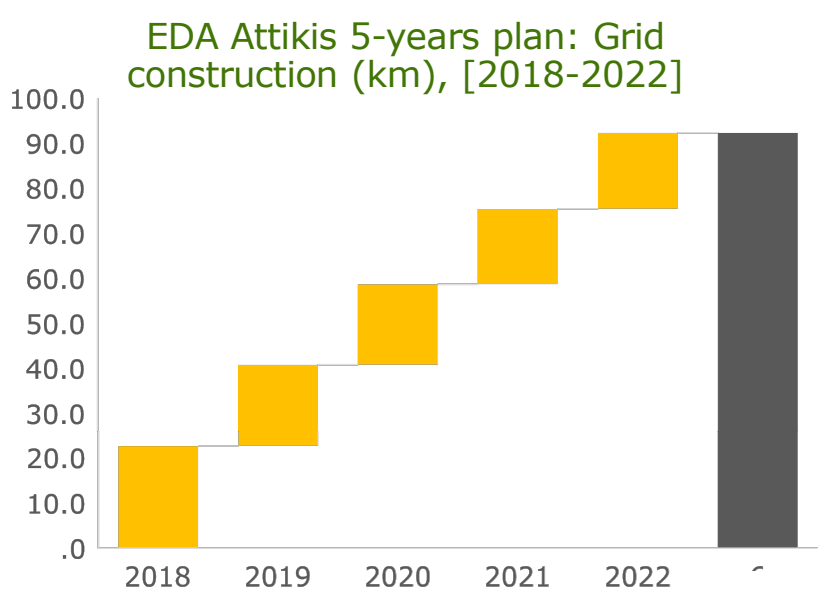


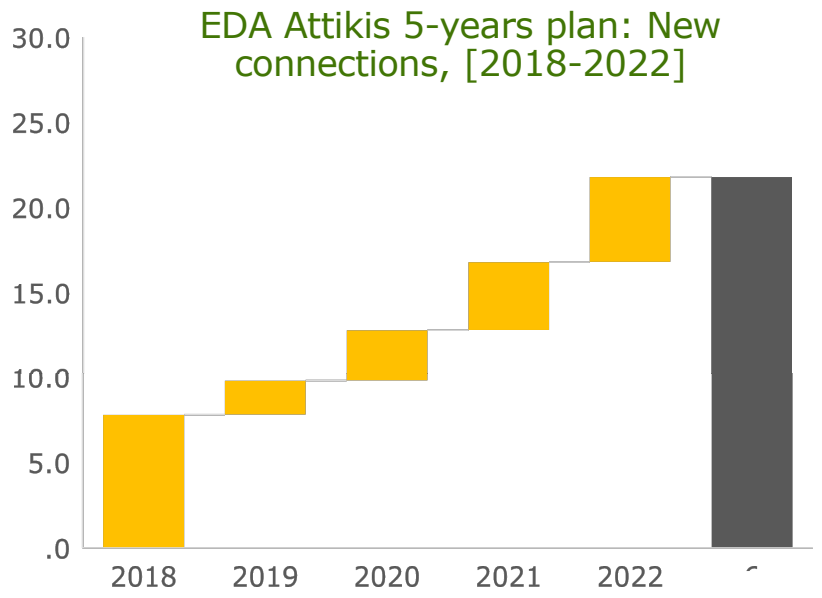
Active customers. [2018-2022]

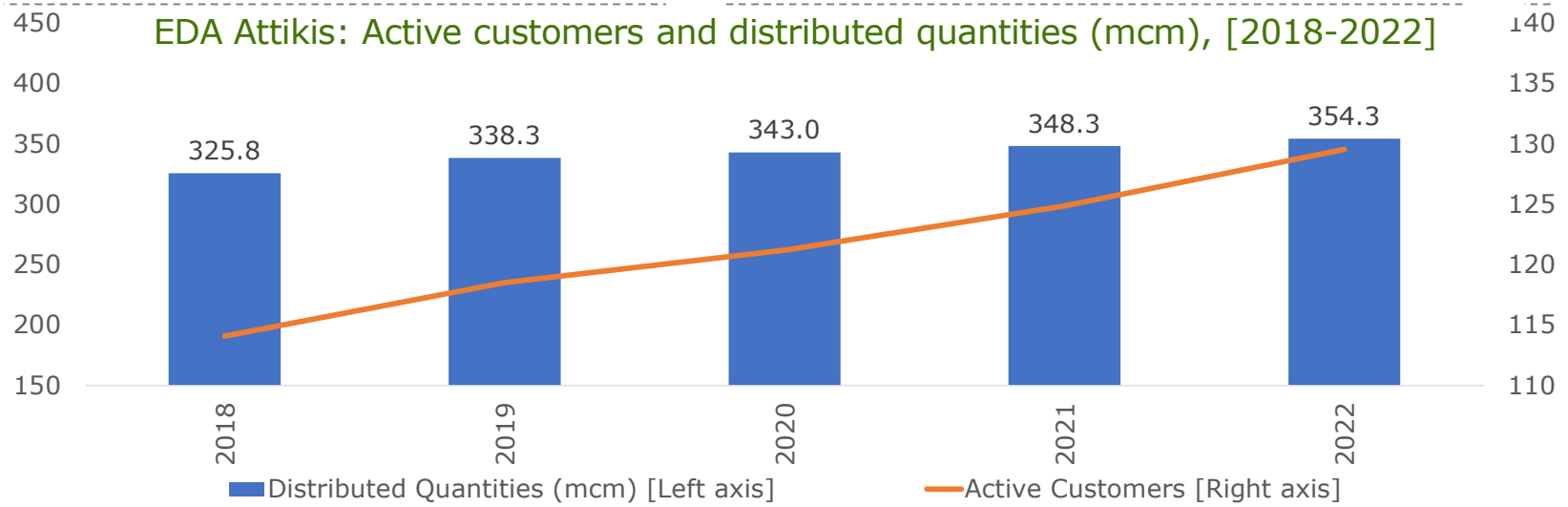


Source: EDA Thess

The area of Attiki is under "EDA Attiki" DSO, being the area with the lowest penetration rate and therefore with the greatest dynamic for market expansion

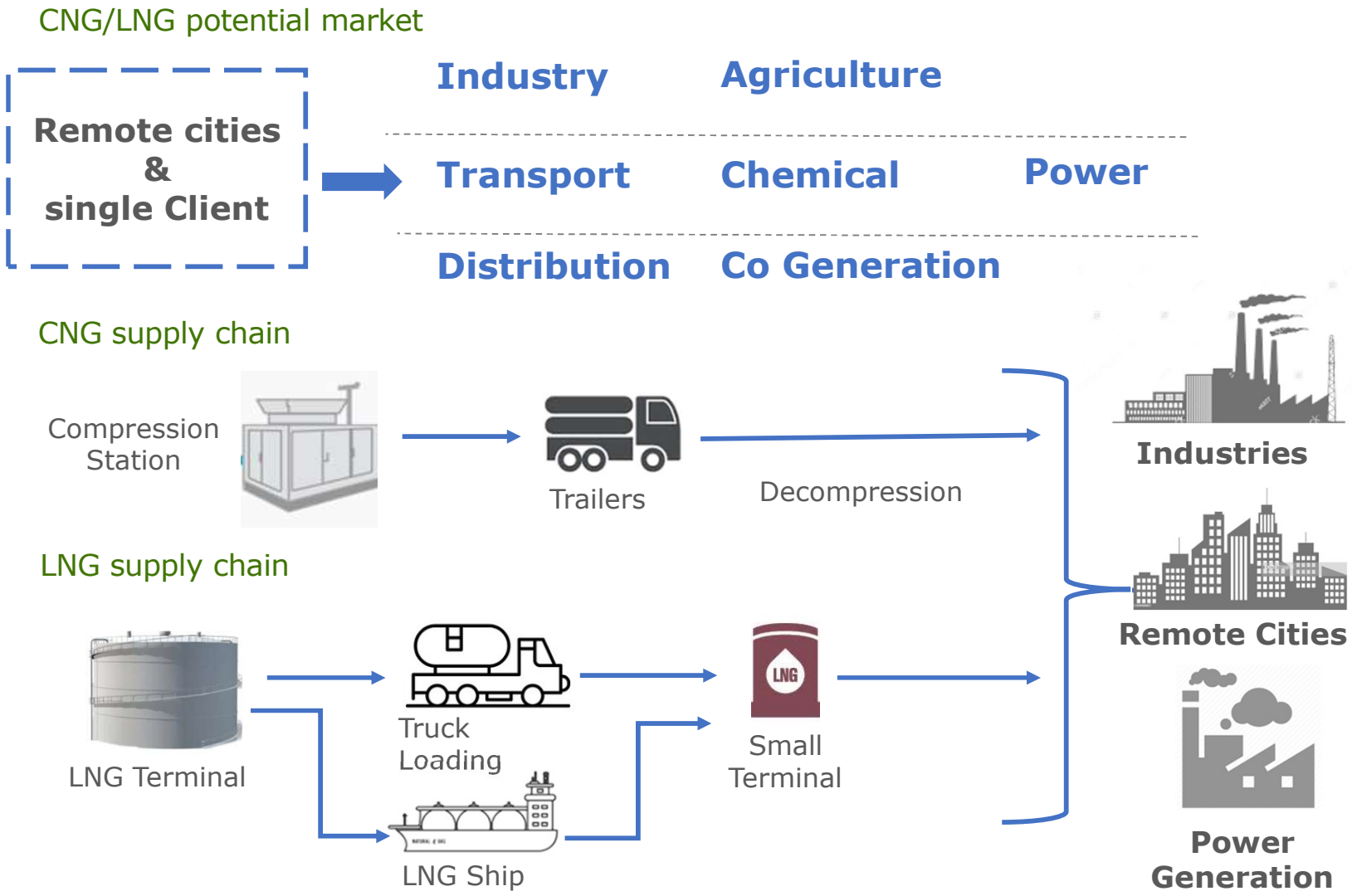






Source: EDA Attikis

CNG & LNG technologies can offer reliable solutions to remote areas in which pipeline construction is costly, and at the same time are considered as ideal technologies for the expansion of the market to the islands



Source: HAEE

The retail market consists of more than 8 active suppliers some of which have started selling quantities in the B2B market before 2018

Pricing formulas used by Greek natural gas suppliers

1st Formula: Professional → Fixed Amount per month + DEPA Auctions + Premium

2nd Formula: Residential Central Heating → Fixed Amount per month + Supply Price + Premium

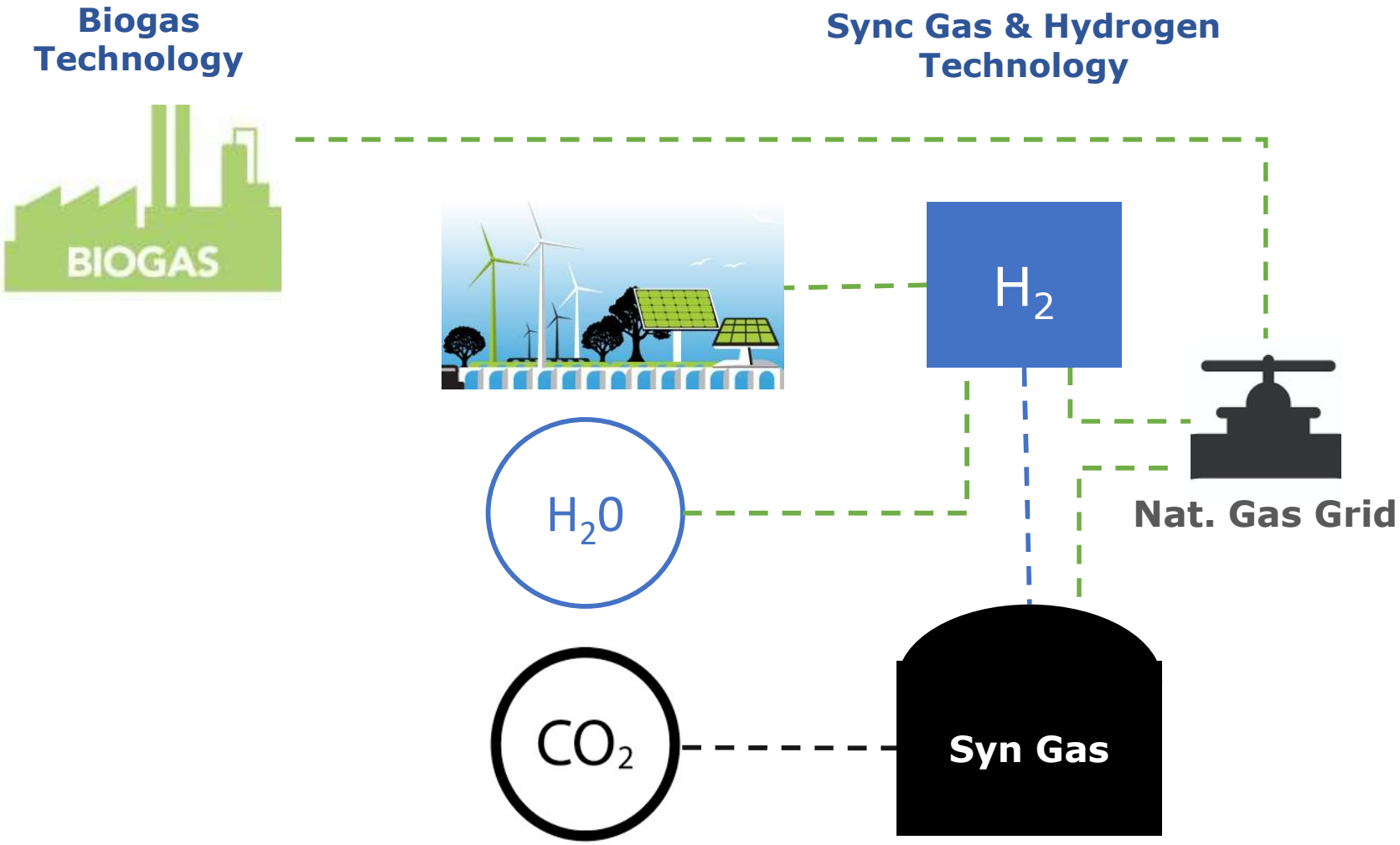
3rd Formula: Residential Autonomous → Fixed Amount per month + Fixed Amount per month on quantity

Single Product **OR** **Double Offer (Power)** + **Services**

Source: HAEE

Future technologies around natural gas are coming to bridge the gap to a zero-carbon transition

Penetration of biogas and sync gas into the natural gas grid

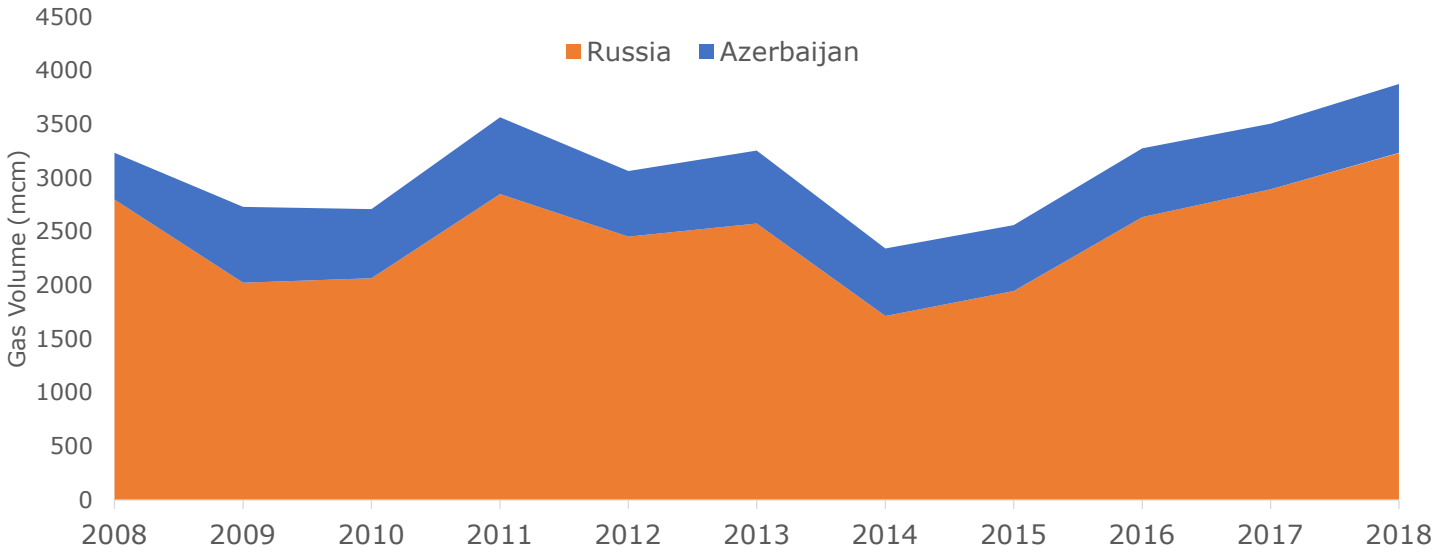


Source: HAEE

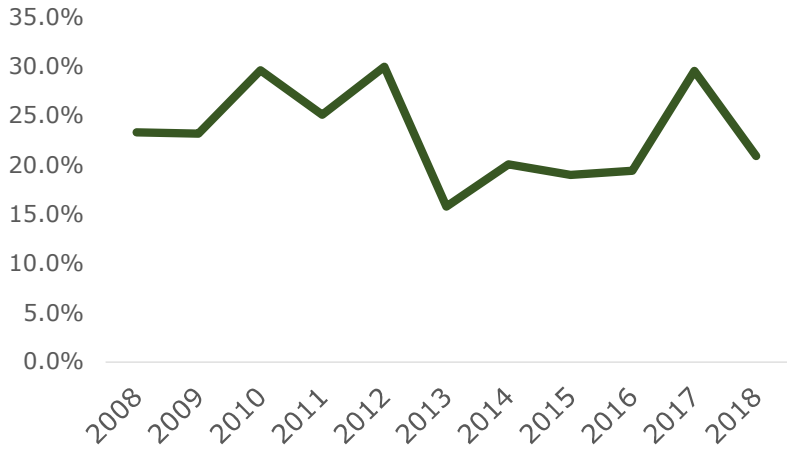
South East Gas Market and Prices: A Country-level Analysis

Greece

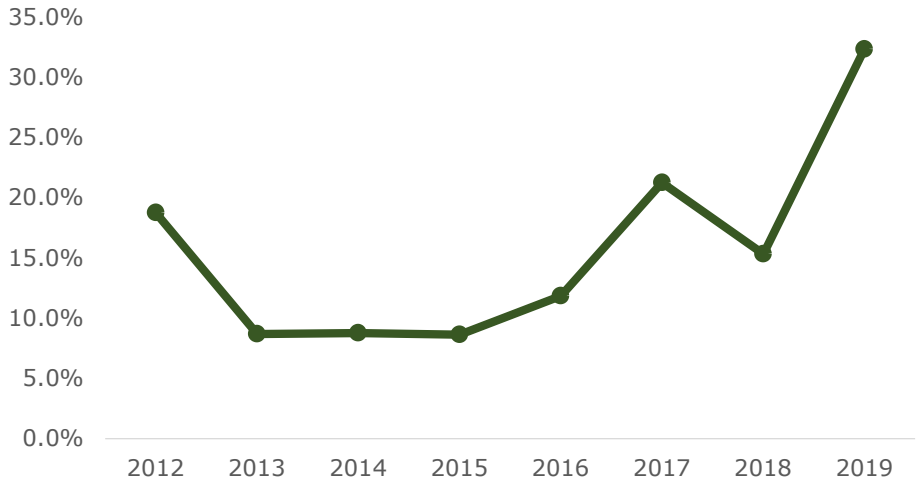
Imported Volumes of Gas by Pipeline in Greece, [2008-2018]



Percentage of Total Imported Natural Gas in the form of LNG in Greece, [2008-2018]



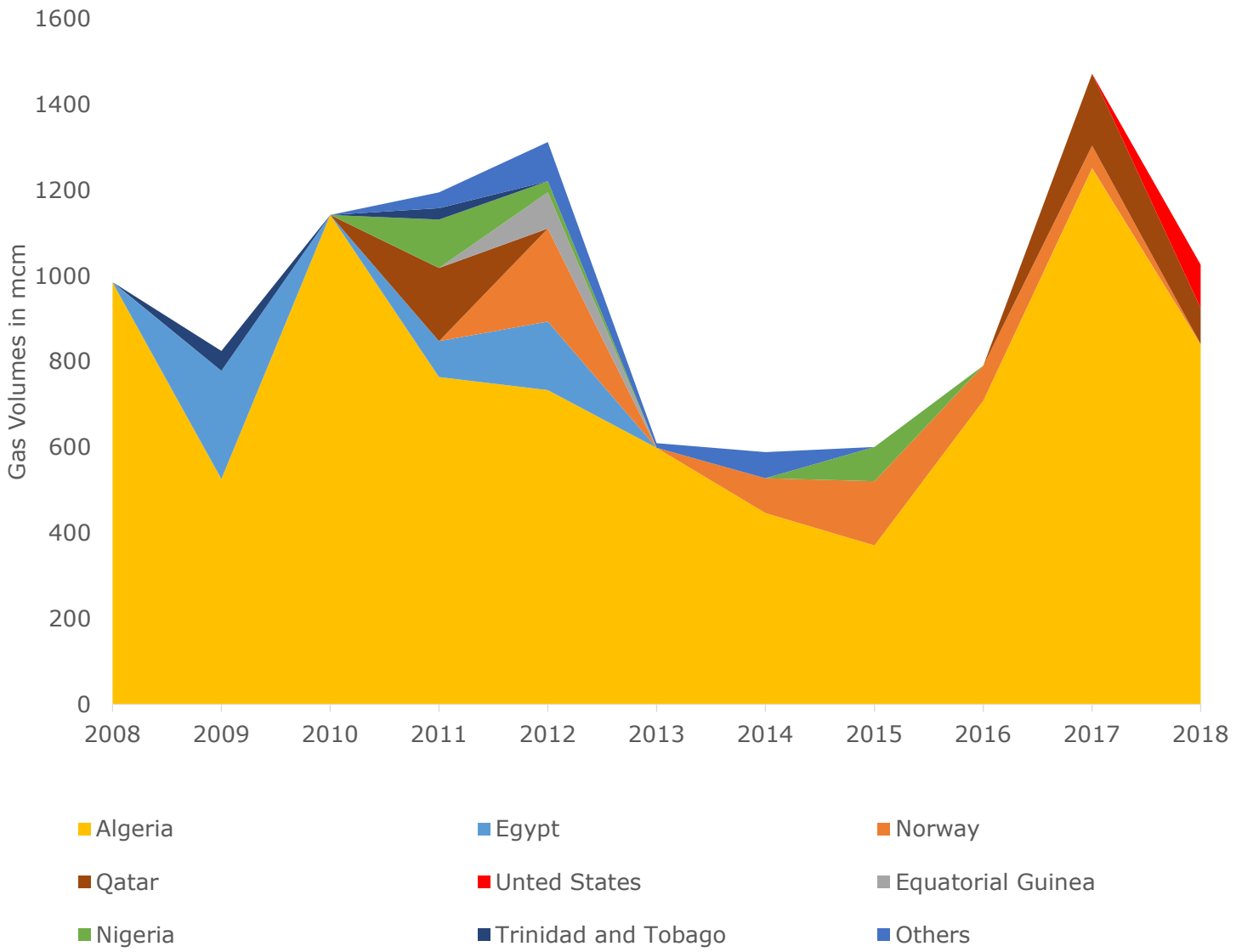
Regasification capacity utilization rate of the LNG import facility in Revithousa, [2012-2019]



Source: : Eurostat & ALSI

Greece

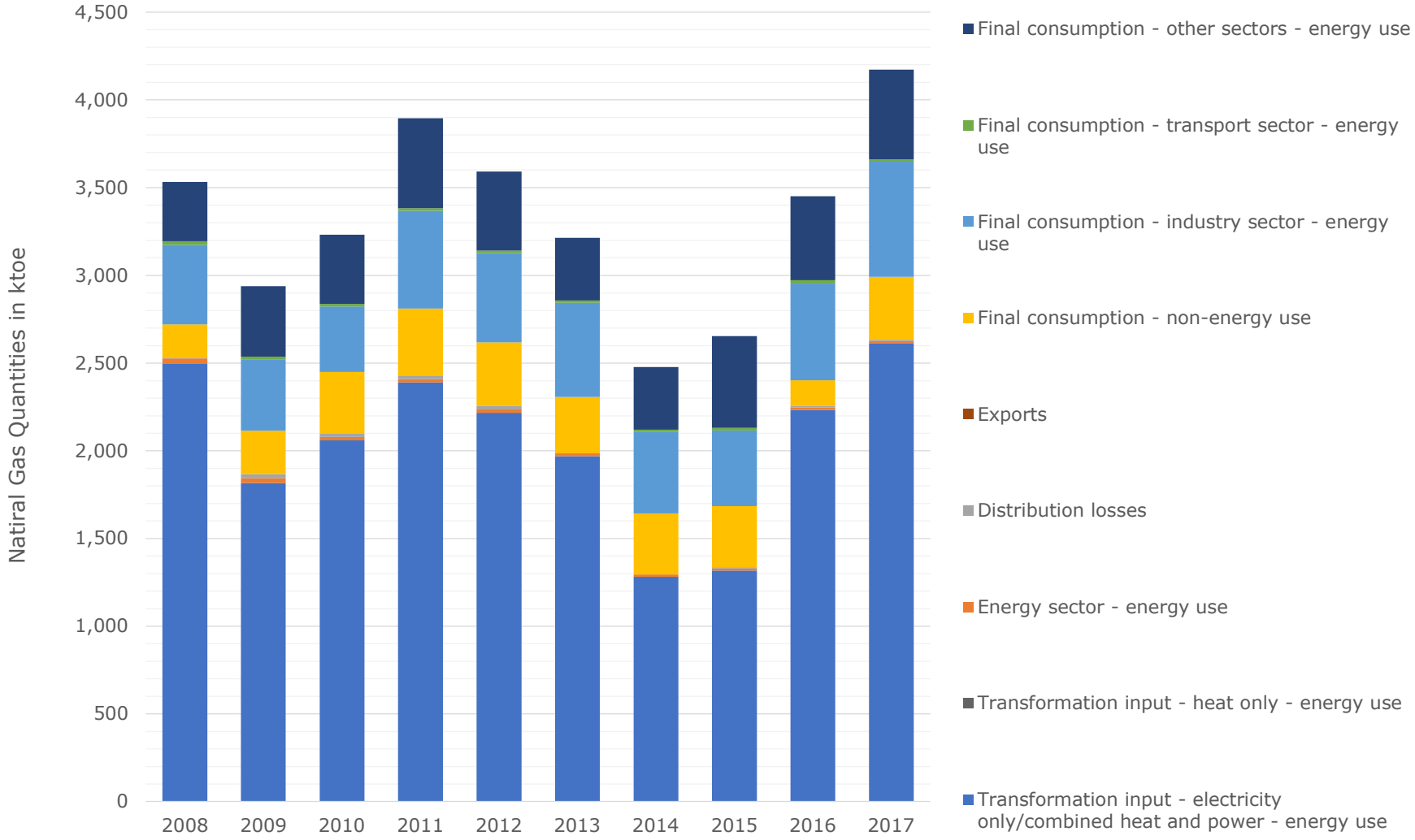
Imported Volume of Gas in LNG form in Greece



Source: : Eurostat

Greece

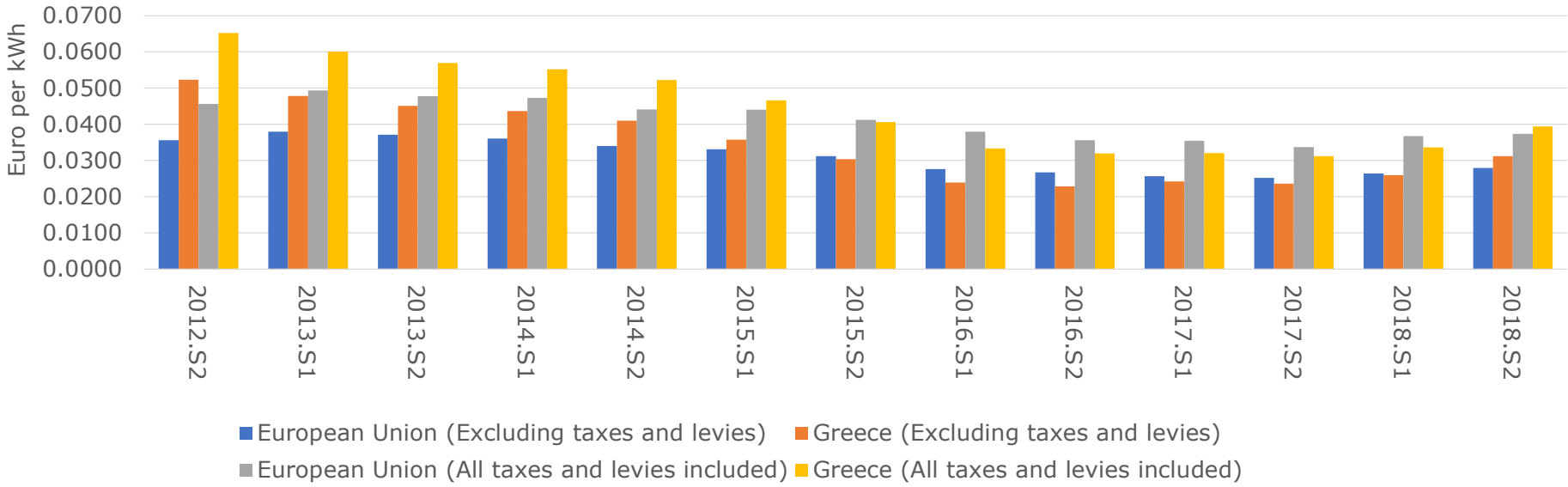
Natural Gas Quantities used in Greece by sectorial end-use, [2008-2017]



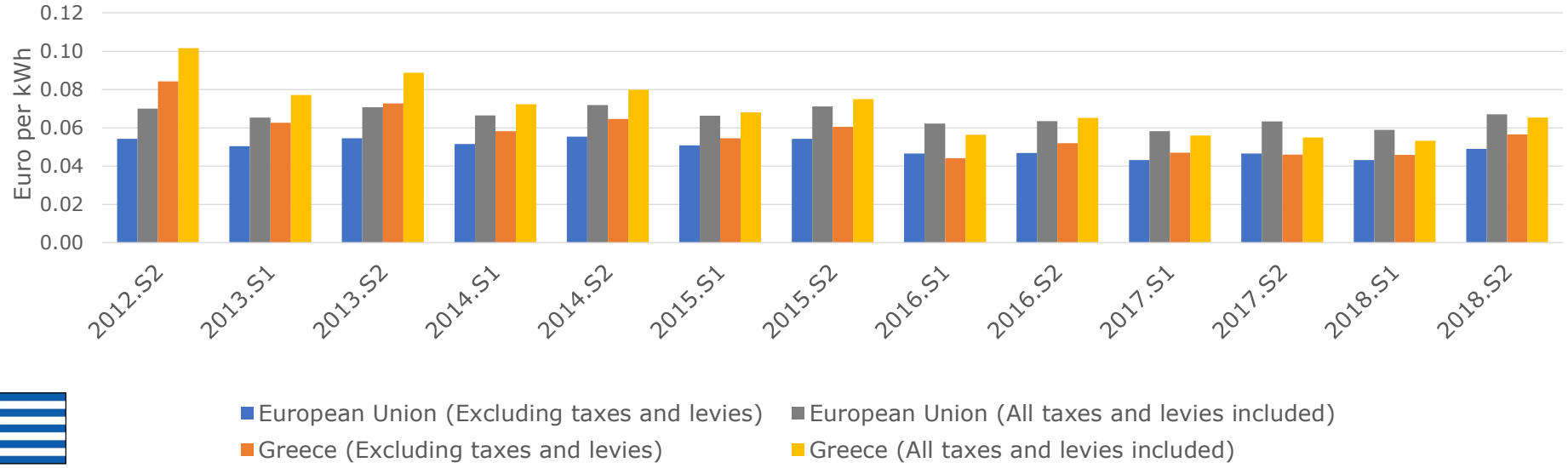
Source: : Eurostat

Greece

Evolution of Gas Prices in EU-Greece for non-household consumers, [2012-2018]



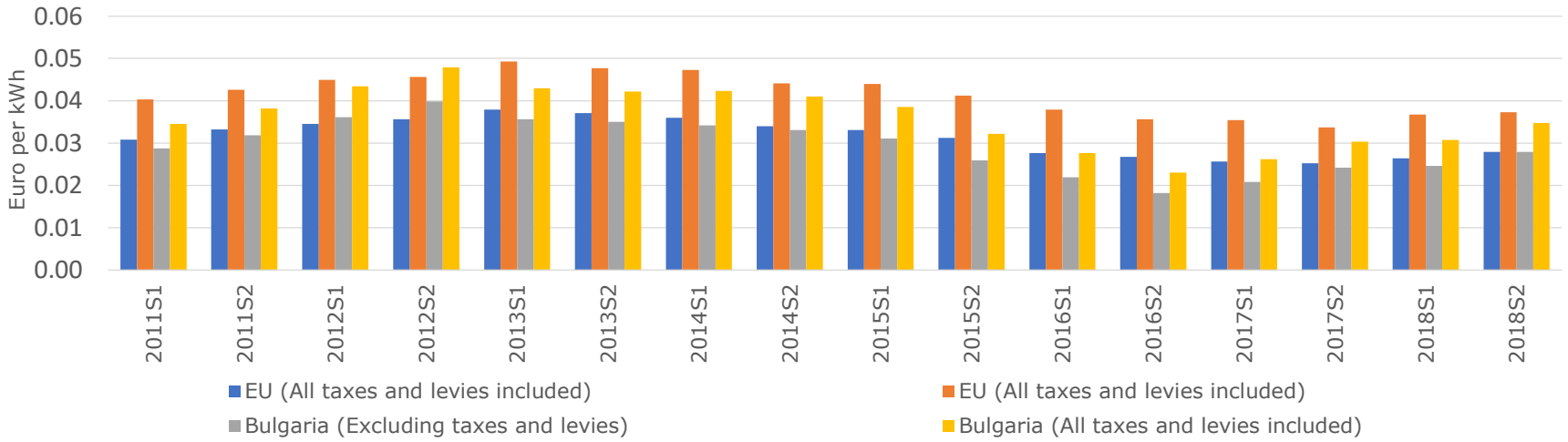
Evolution of Gas Prices in EU-Greece for household consumers, [2012-2018]



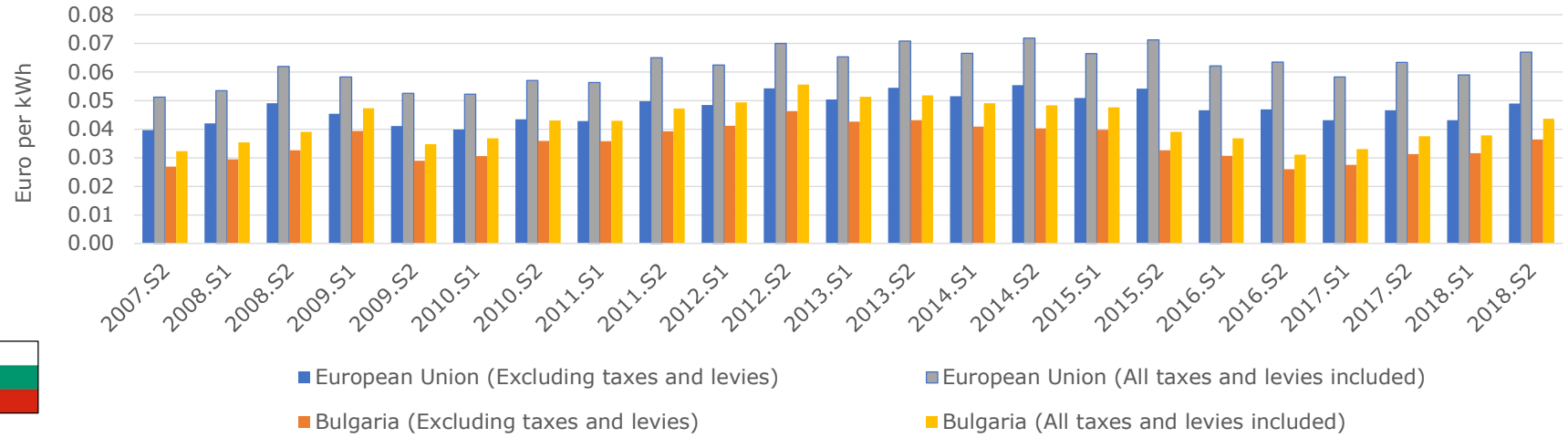
Source: : Eurostat

Bulgaria

Evolution of Gas Prices in EU-Bulgaria for non-household consumers, [2011-2018]



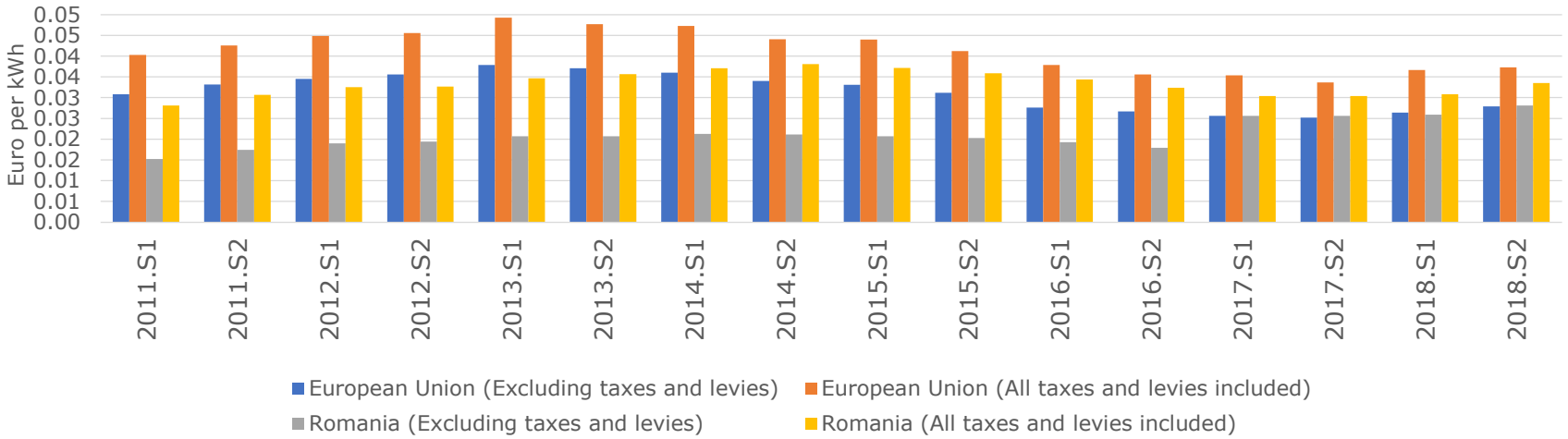
Evolution of Gas Prices in EU-Bulgaria for household consumers, [2007-2018]



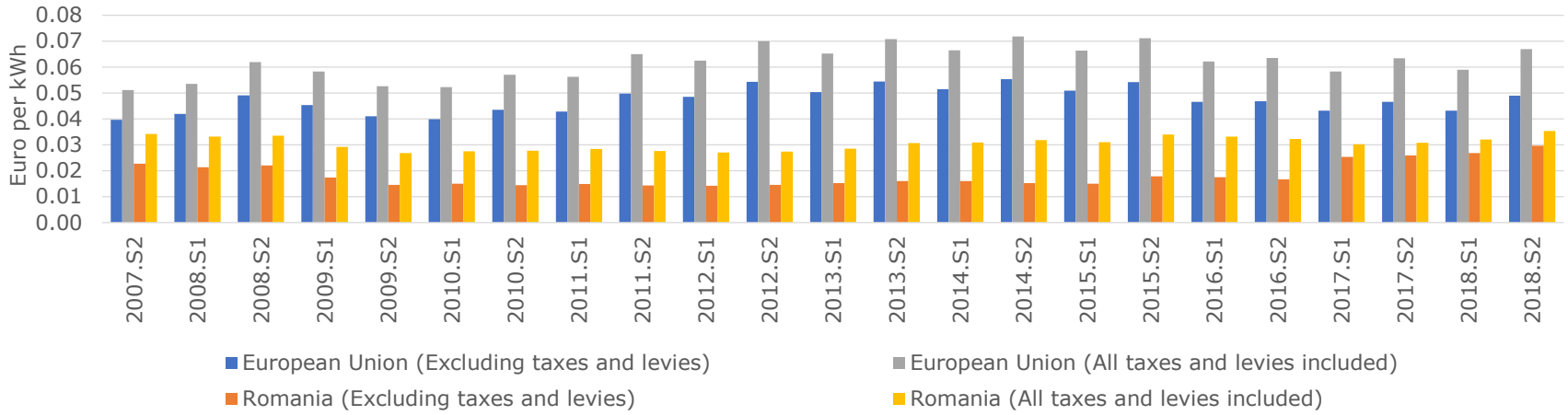
Source: : Eurostat

Romania

Evolution of Gas Prices in EU-Romania for non-household consumer, [2011-2018]



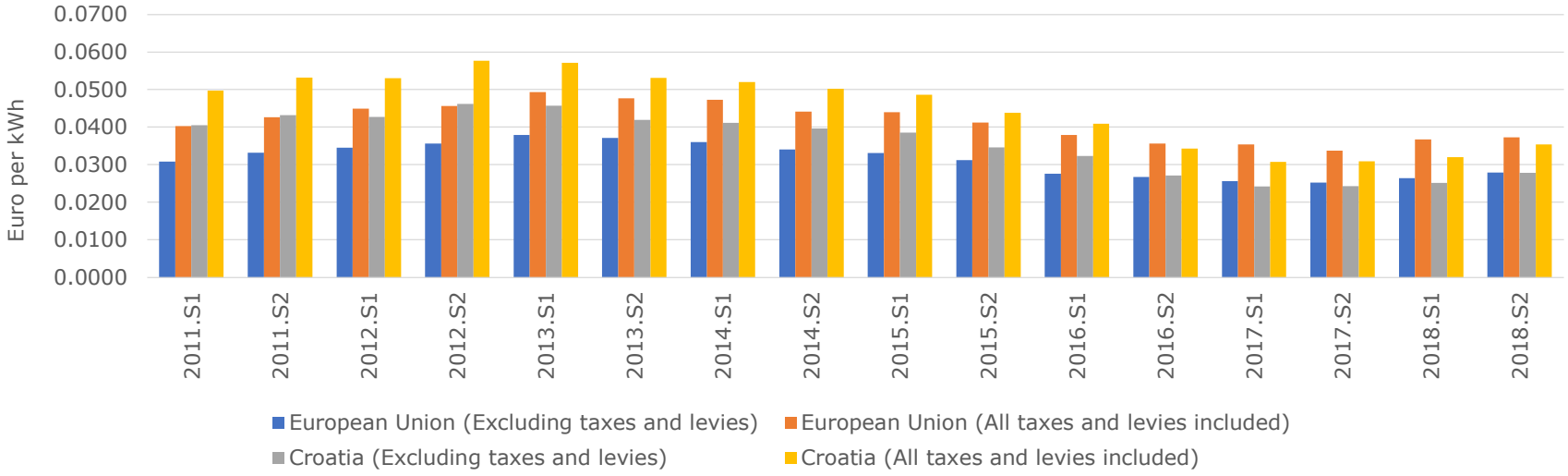
Evolution of Gas Prices in EU-Romania for household consumers, [2007-2018]



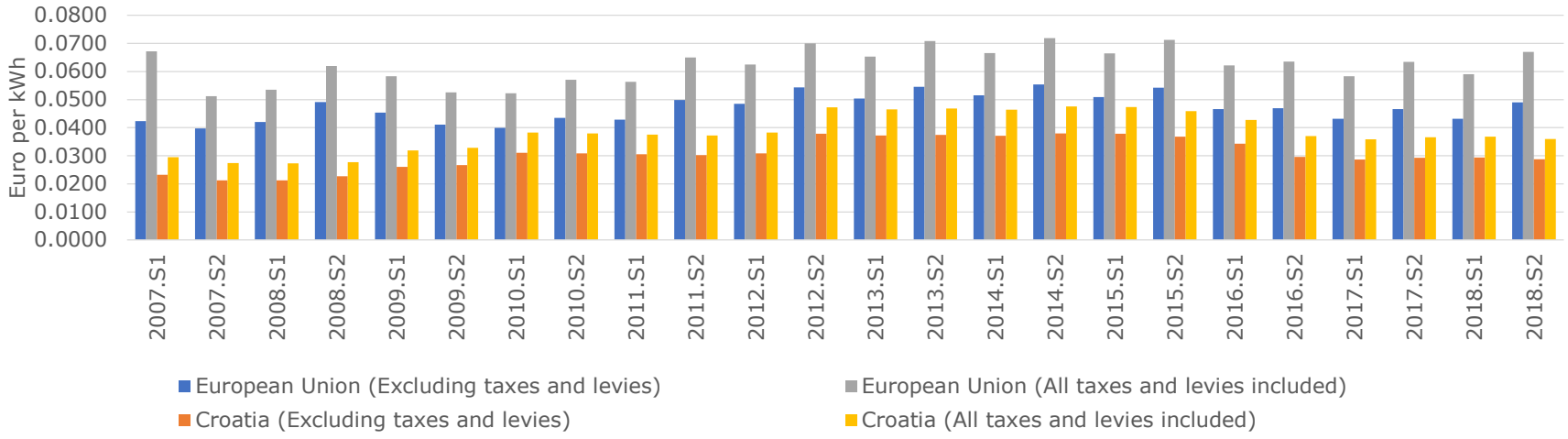
Source: : Eurostat

Croatia

Evolution of Gas Prices in EU-Croatia for non-household consumers, [2011-2018]



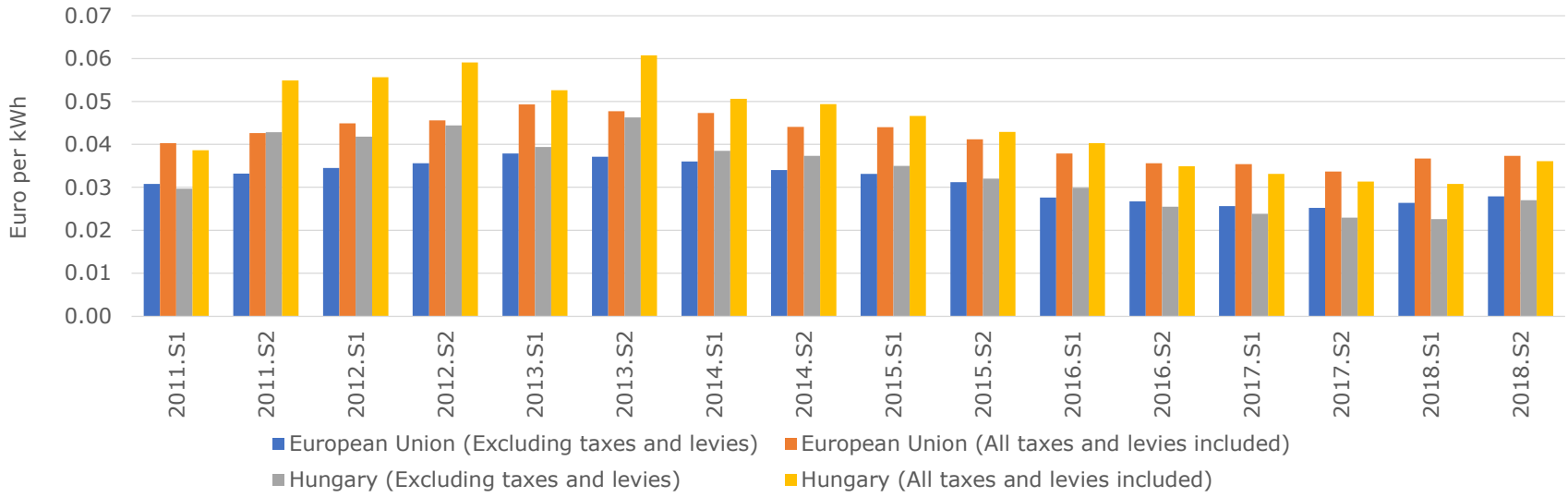
Evolution of Gas Prices in EU-Croatia for household consumers, [2007-2018]



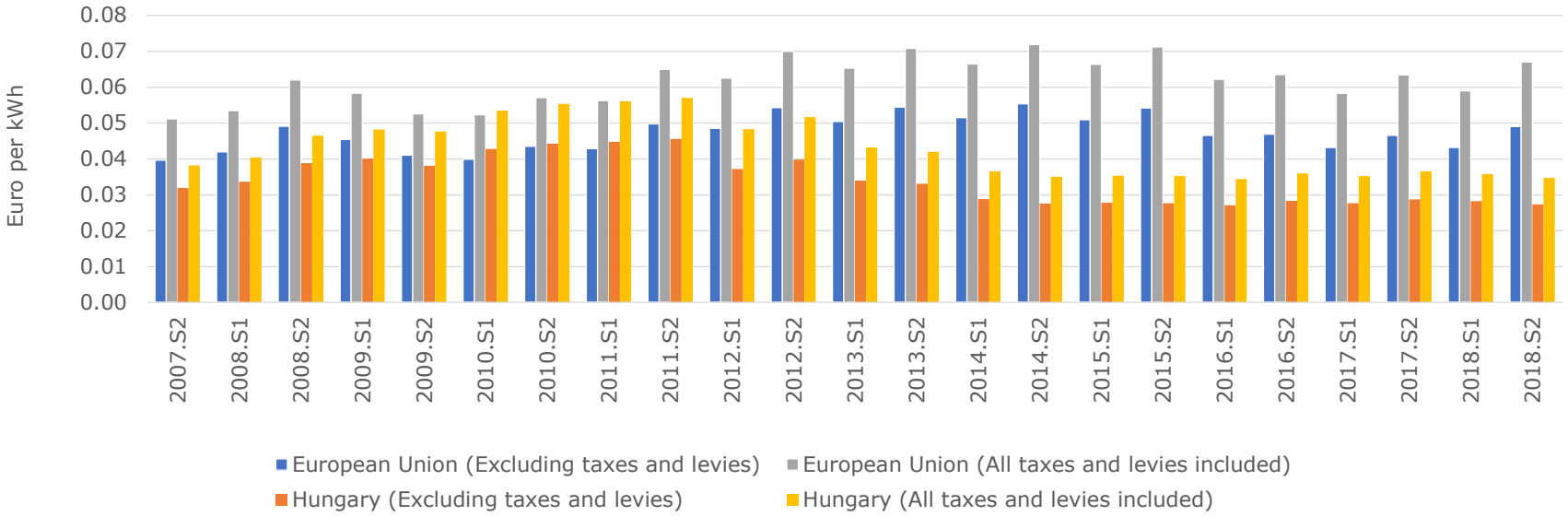
Source: : Eurostat

Hungary

Evolution of Gas Prices in EU-Hungary for non-household consumers, [2011-2018]



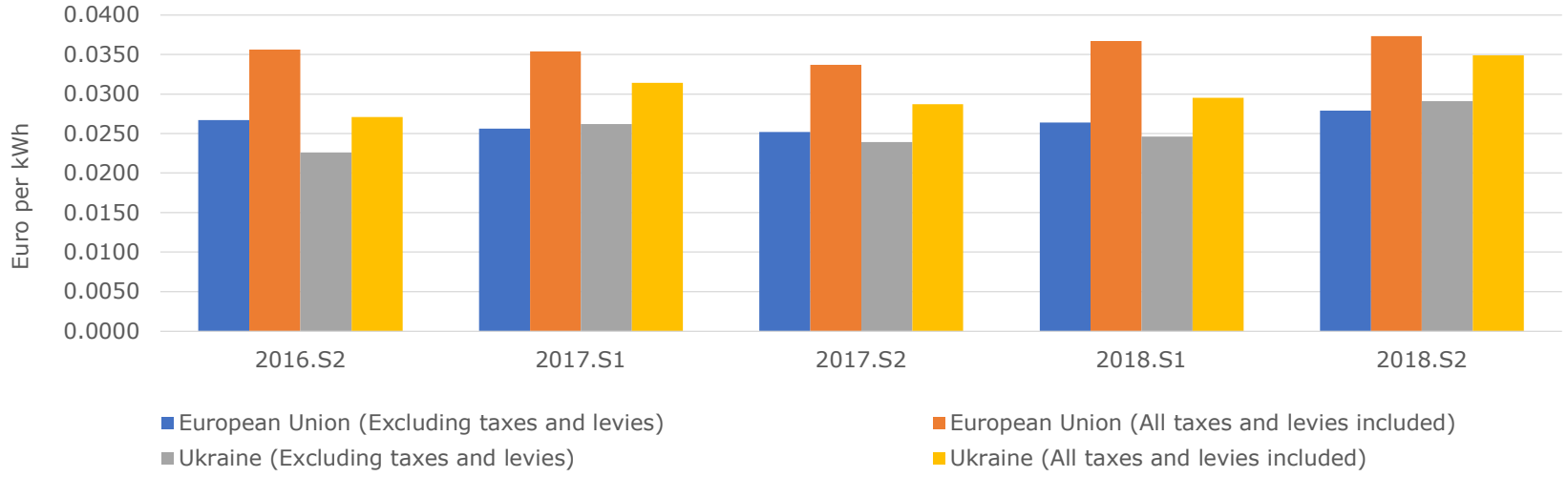
Evolution of Gas Prices in EU-Hungary for household consumers, [2007-2018]



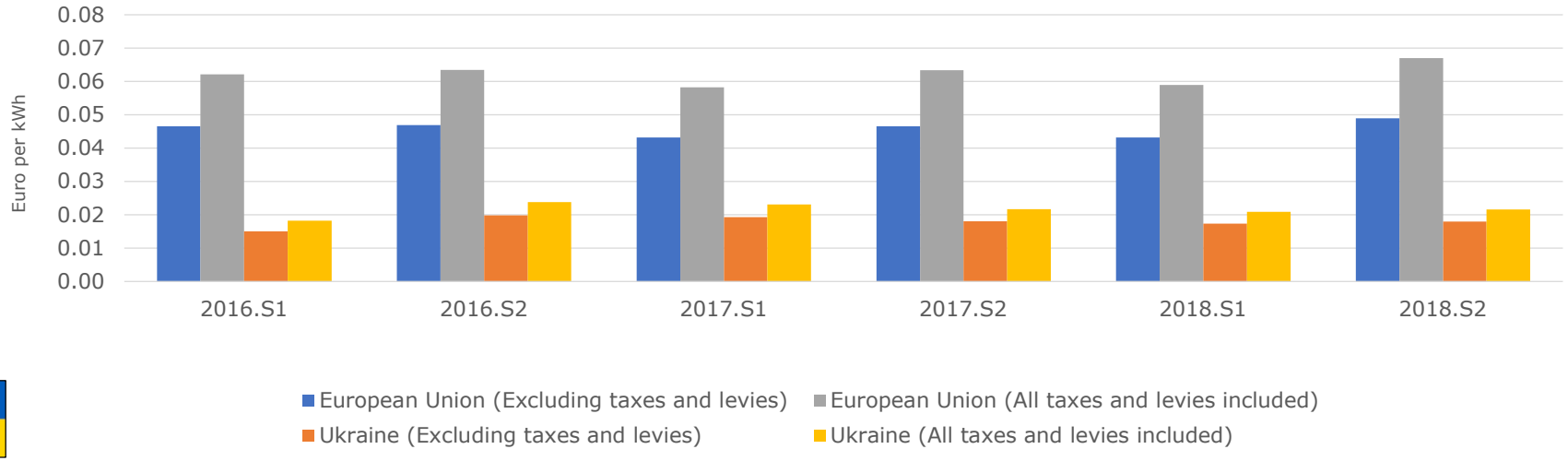
Source: : Eurostat

Ukraine

Evolution of Gas Prices in EU-Ukraine for non-household consumers, [2016-2018]



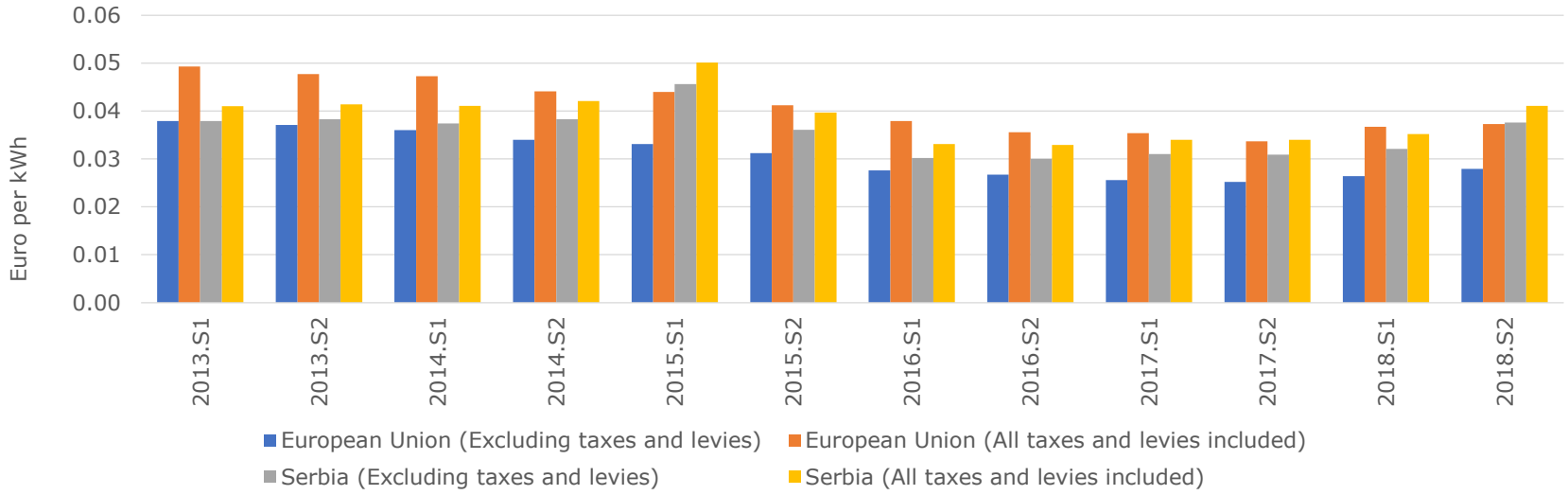
Evolution of Gas Prices in EU-Ukraine for household consumers, [2016-2018]



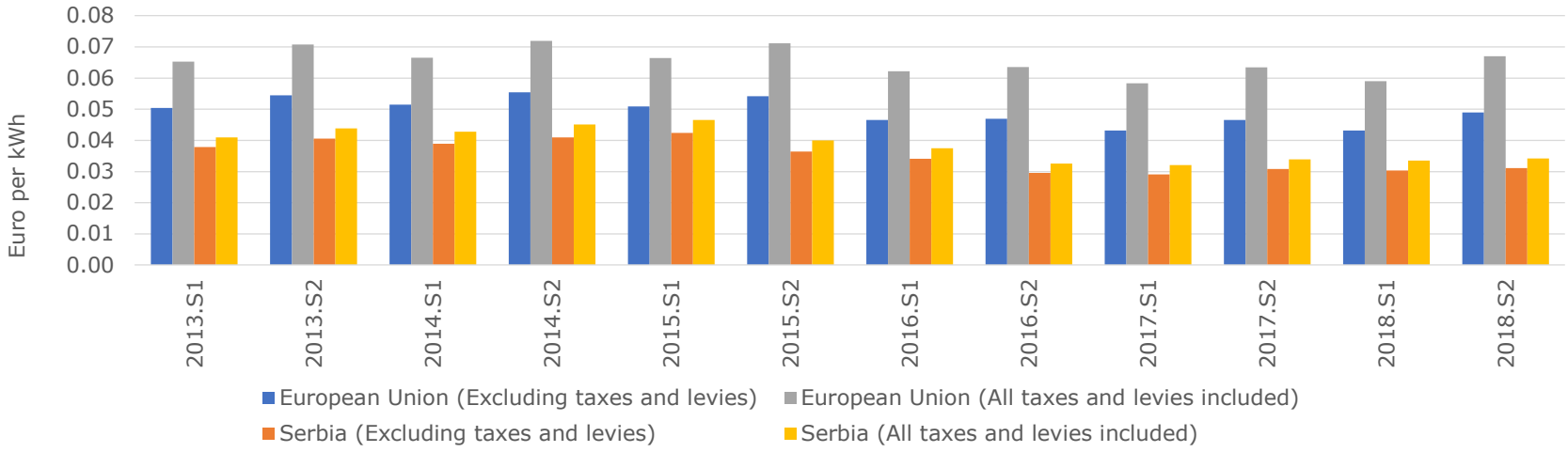
Source: : Eurostat

Serbia

Evolution of Gas Prices in EU-Serbia for non-household consumers, [2013-2018]



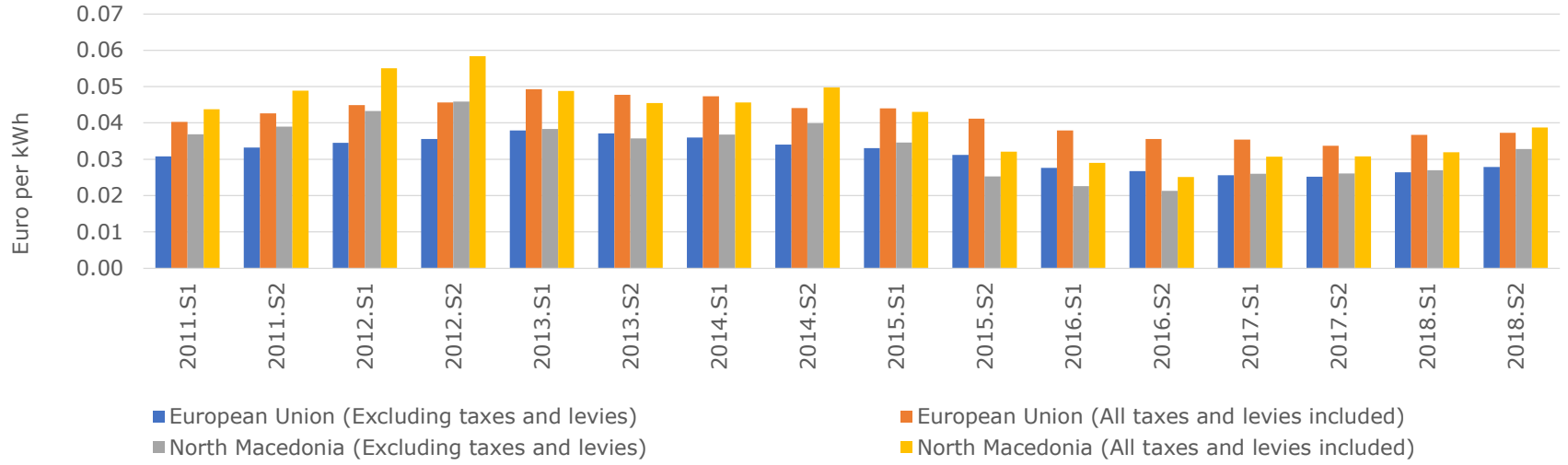
Evolution of Gas Prices in EU-Serbia for household consumers, [2013-2018]



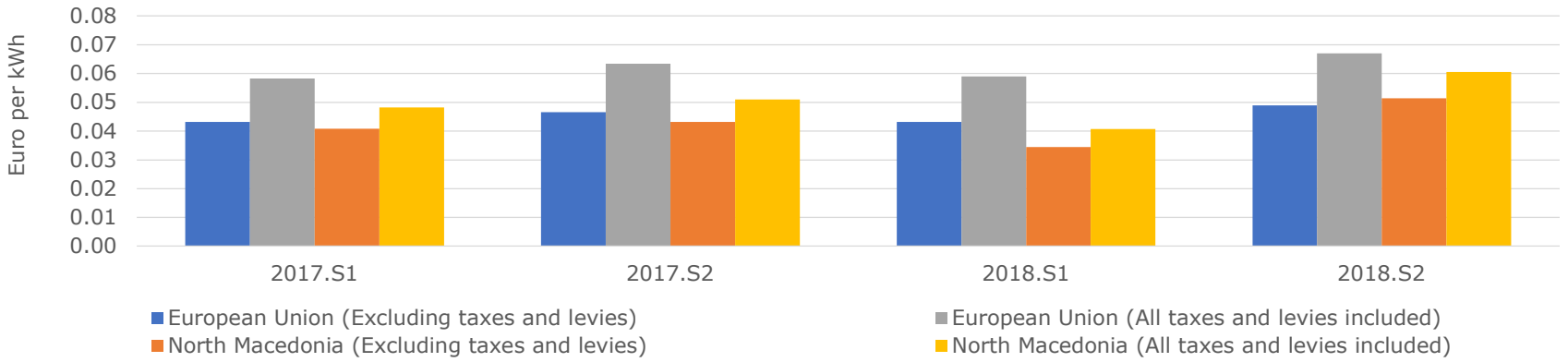
Source: : Eurostat

North Macedonia

Evolution of Gas Prices in EU-North Macedonia for non-household consumers, [2011-2018]



Evolution of Gas Prices in EU-North Macedonia for household consumers, [2017-2018]



Source: : Eurostat

Lunch Break

Duration (13:30 – 14:30)

Part 3

5. Electricity

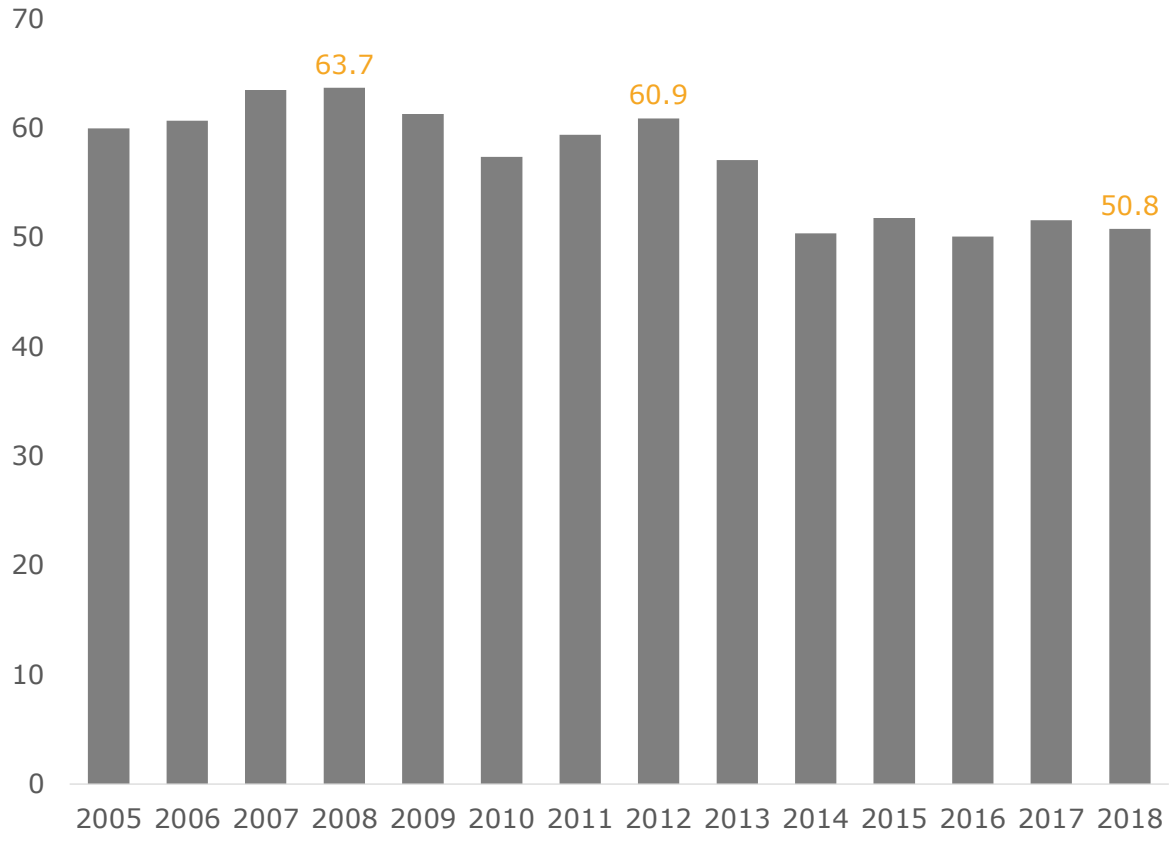
6. Renewable Energy Sources

Duration (14:30 – 16:00)

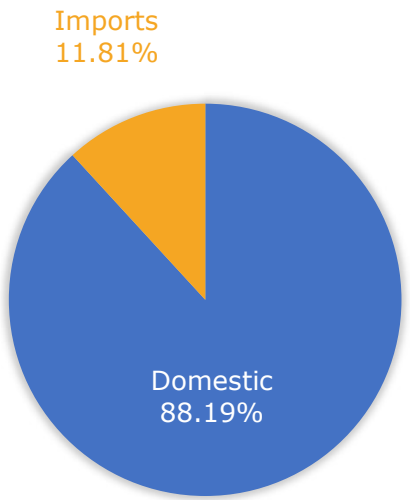
5. Electricity

Fossil fuels are still essential for the security of supply and the containment of electricity prices for industrial and household consumers

Gross electricity generation (TWh), [2005-2018]



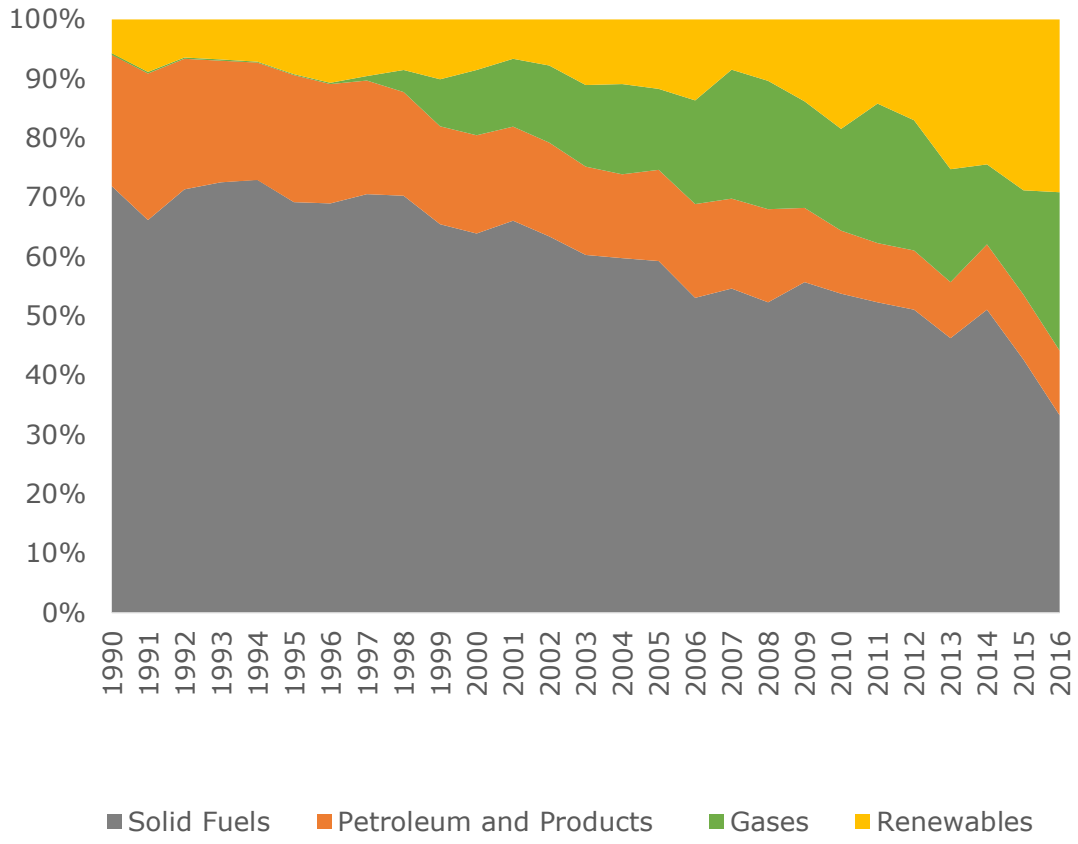
Security of supply (%) [2018]



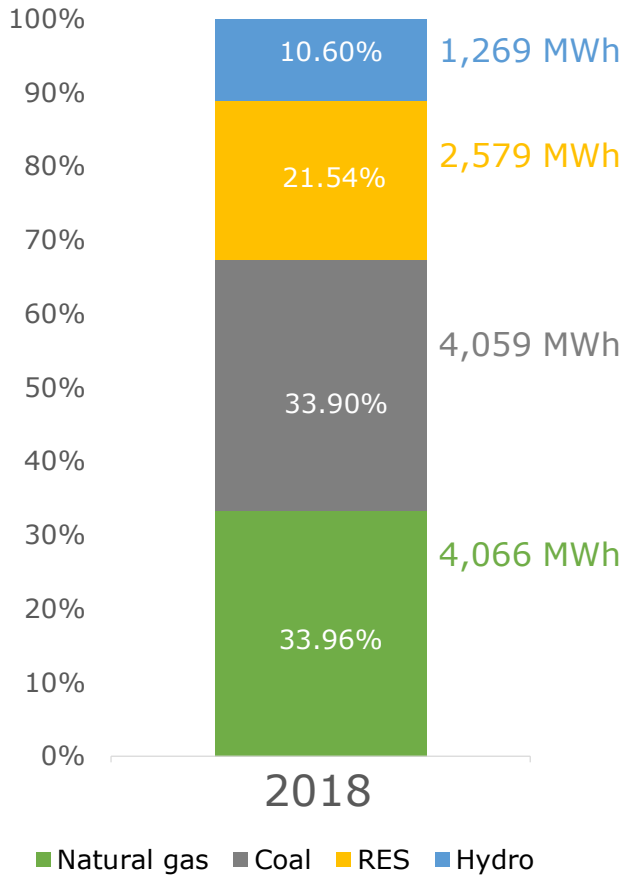
Source: Eurostat & HEnEx

Lignite generation is expected to decrease as lignite plants retire, with gas-fired generation and RES expected to further strengthen their position in the mix

Gross electricity generation by fuel (%), [1990 – 2016]



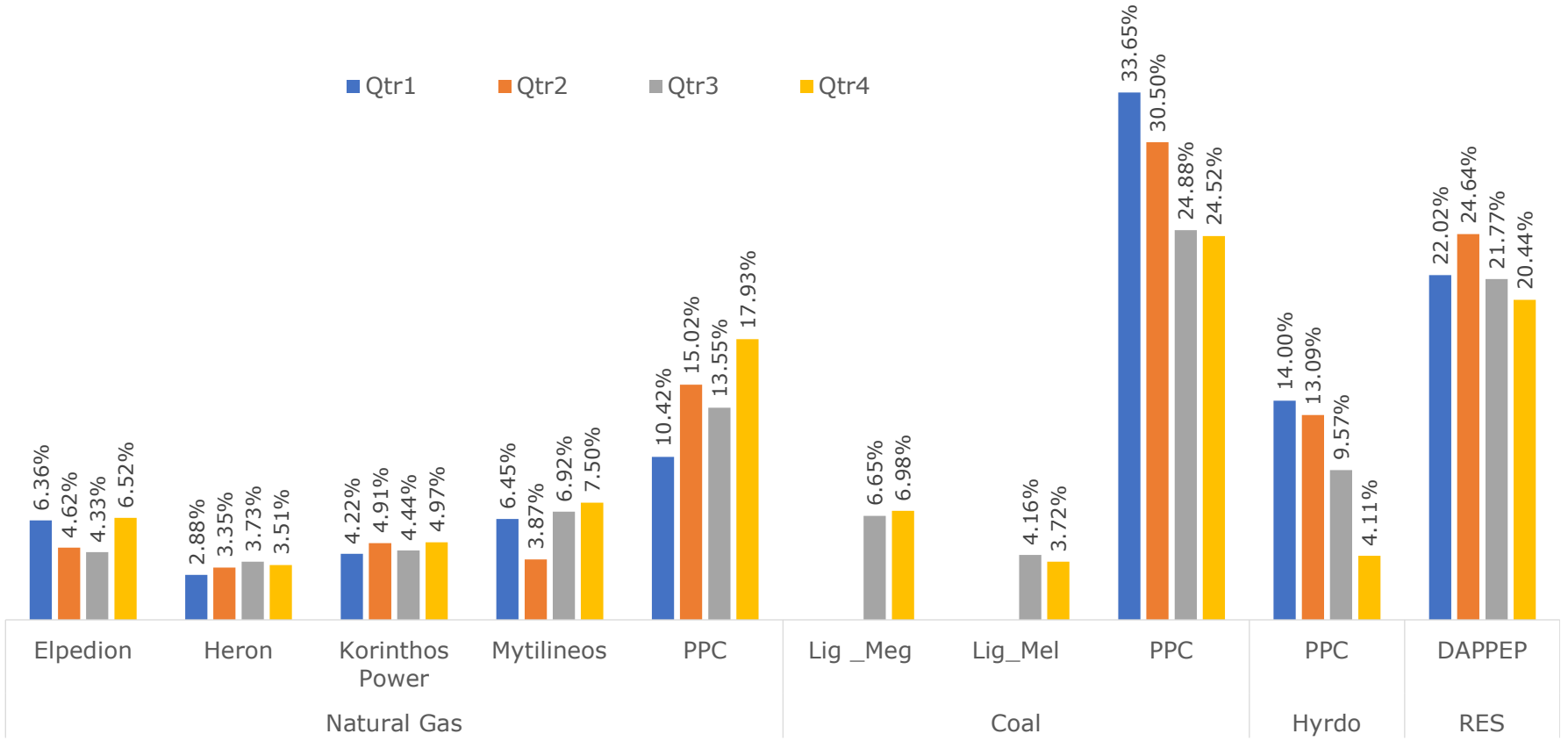
Gross electricity generation by fuel (% and MWh), [2018]



Source: Eurostat & HEnEx

The incumbent (PPC), still has a dominant share in electricity generation (52,51%, for 2018), while the remaining 47,49% consists of RES and alternative generators

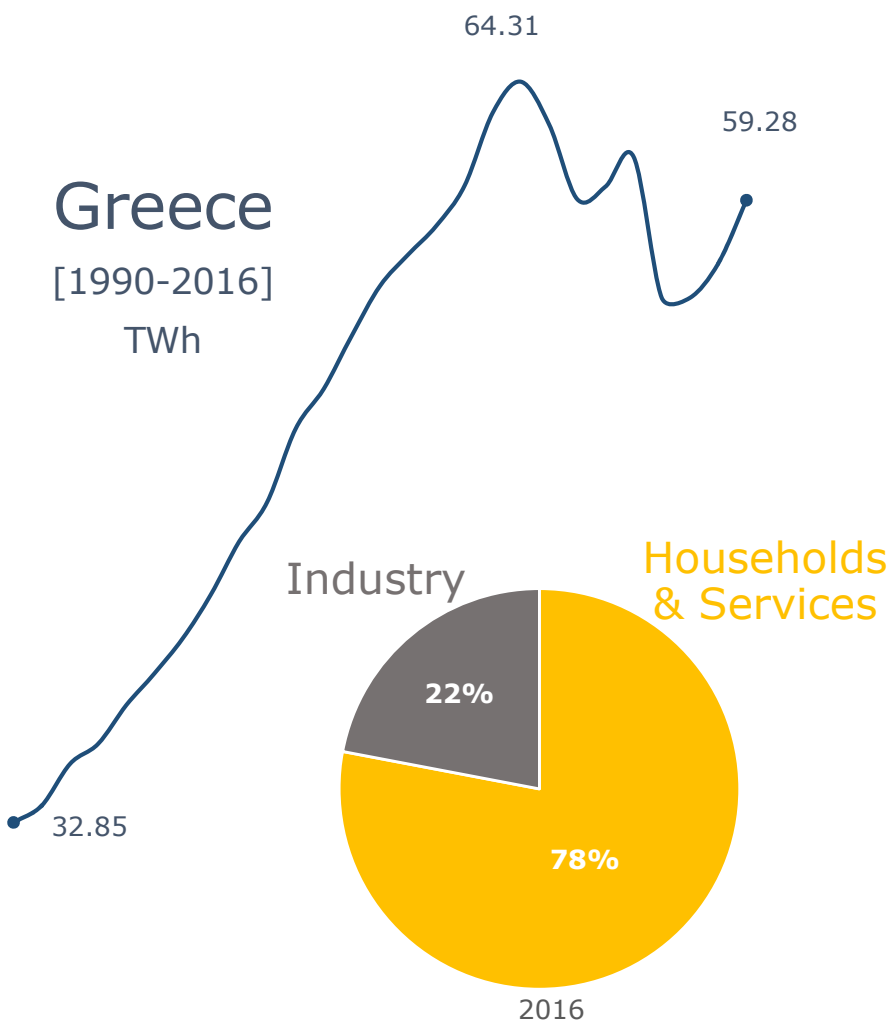
Percentage of total quarterly generation per participant and fuel type (%), [2018]

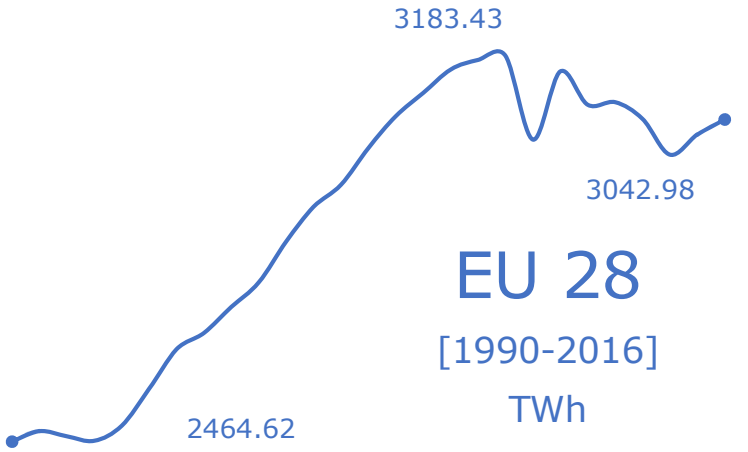


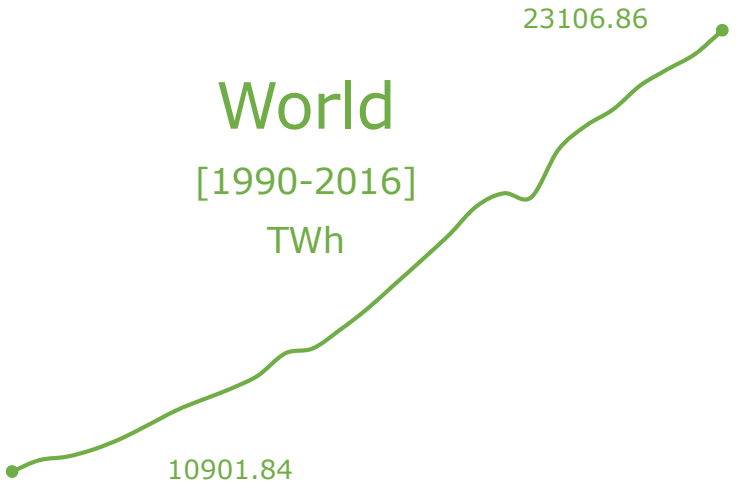
Source: HEnEx

Electricity consumption is anticipated to rapidly increase over the upcoming years, in line with the projected economic recovery

Total electricity consumption in Greece, EU 28 and World (TWh), [1990-2016]





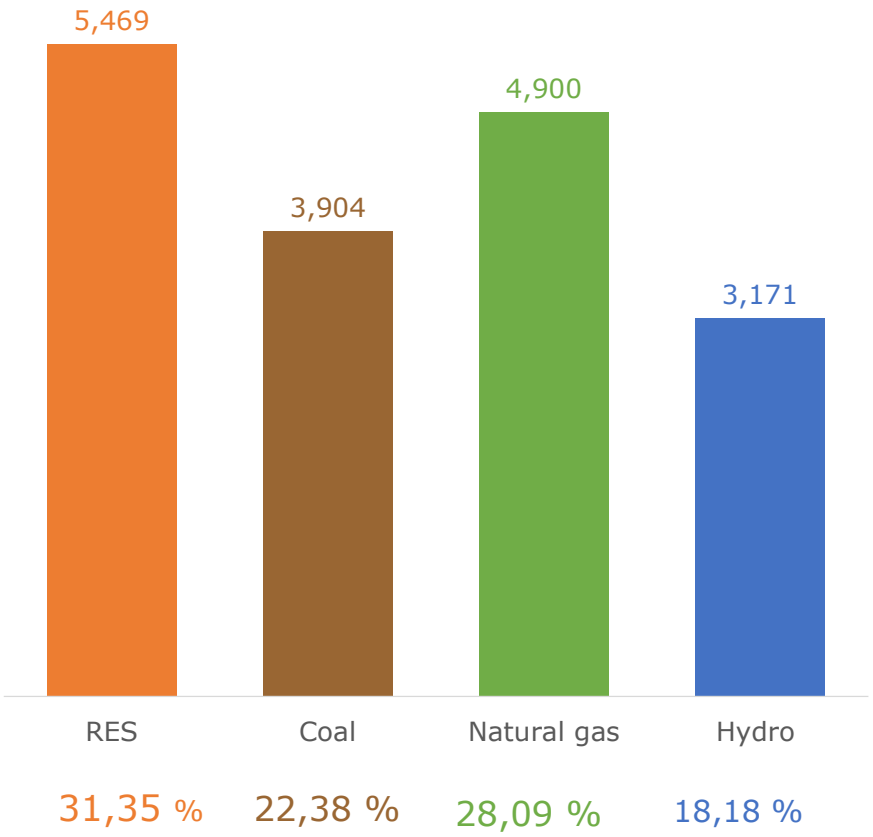


Source: IEA

RES and hydro stand at 49.5% of total electricity capacity for 2018, while alternative generators represent 21.5% of conventional units capacity

Total electricity capacity per fuel (MW), [2018]

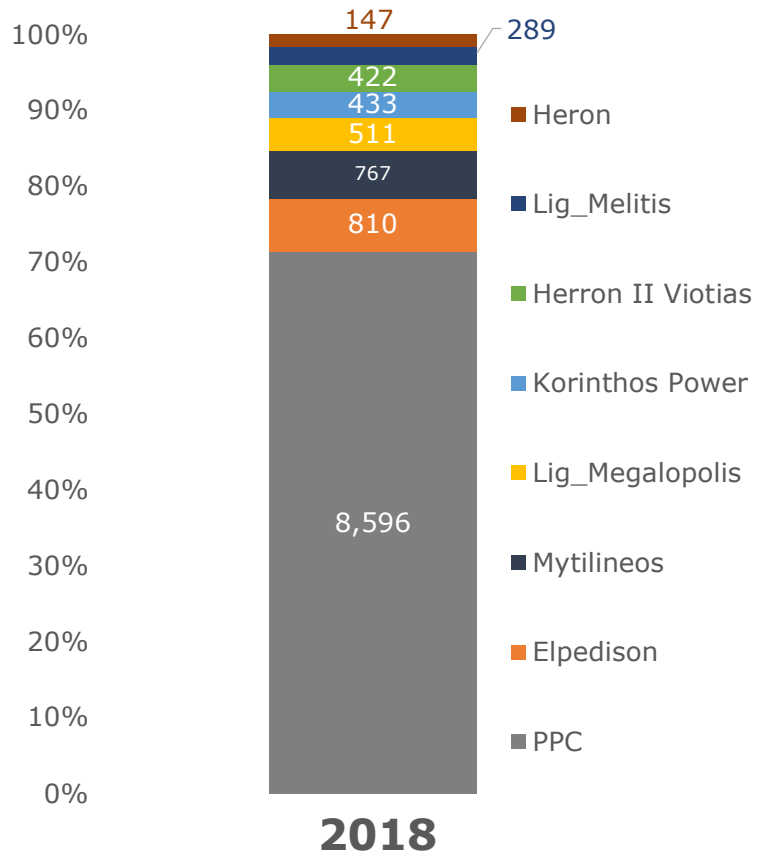
17,444 MW



Electricity capacity of conventional units per producer (MW), [2018]

11,975 MW

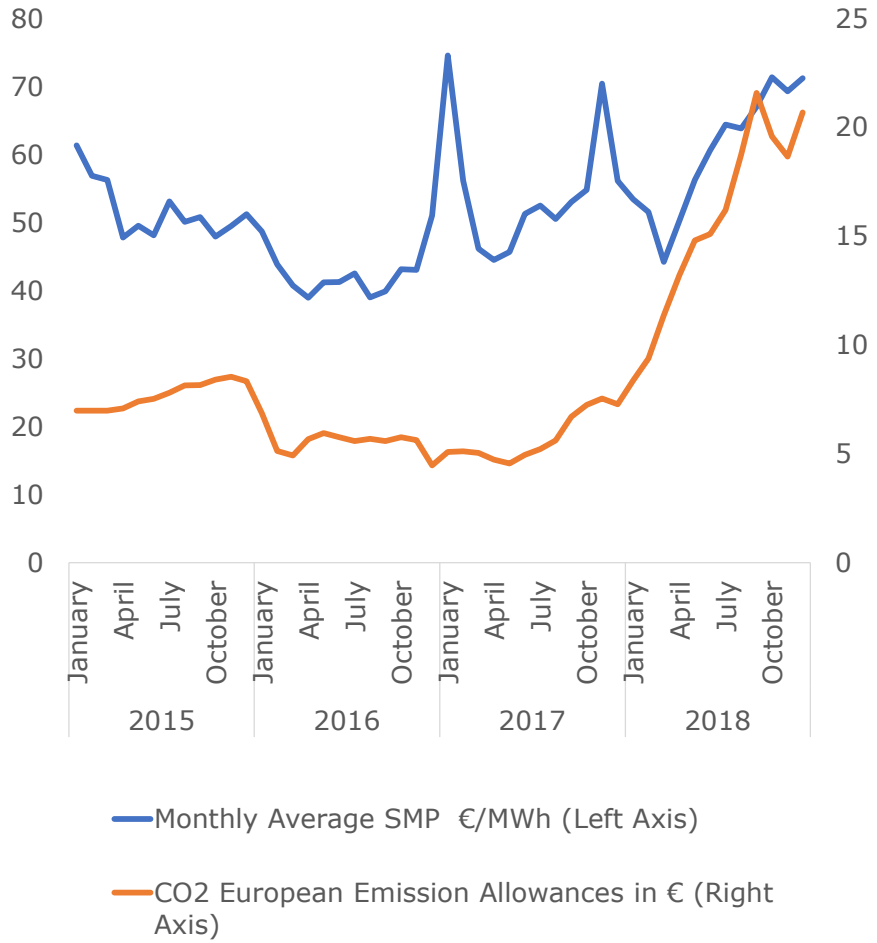
(68.6% of total)



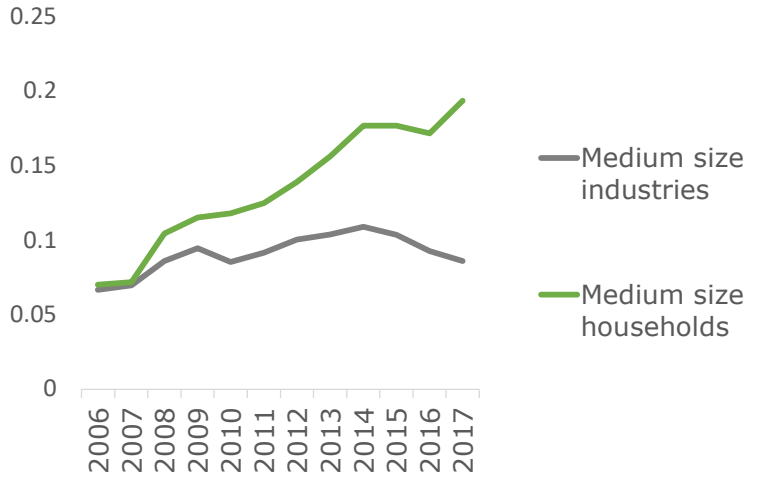
Source: HEnEx

The ability to pay the bills for electricity has developed to the greatest challenge for the Greek households

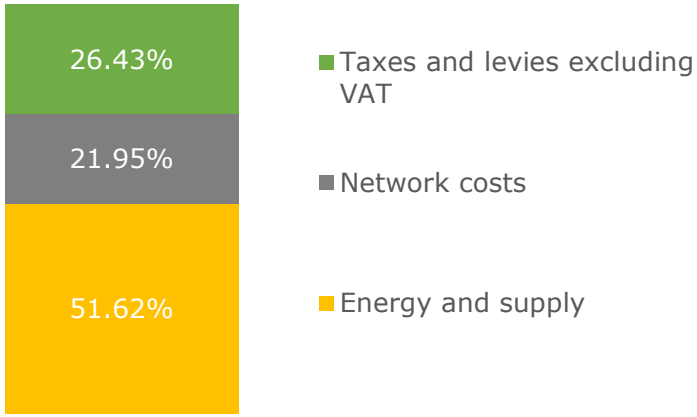
System marginal price and CO2 Prices [2015-2018]



Electricity prices by type of user, (€/kWh), [206-2017]



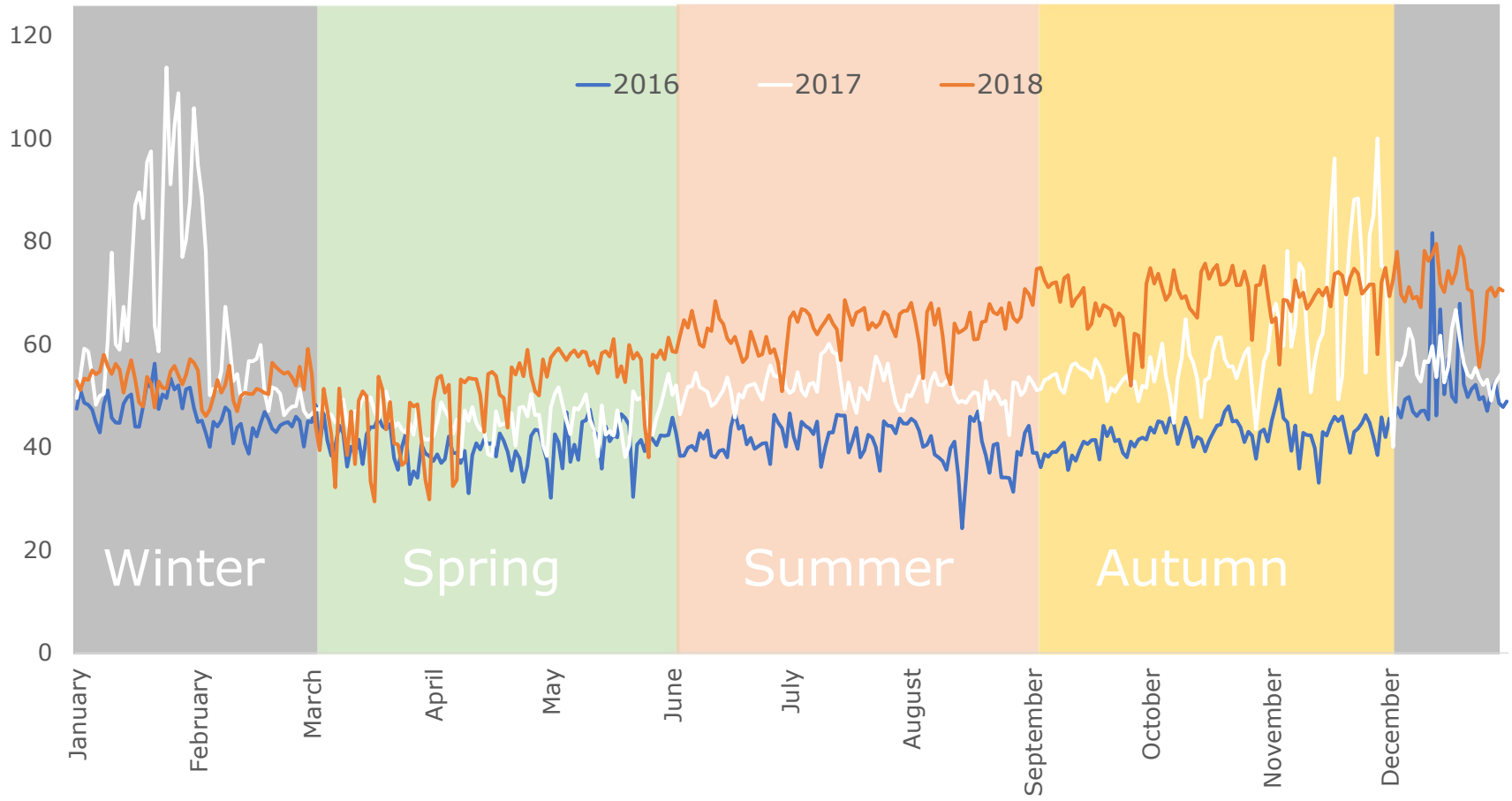
Electricity prices components (%), [2016]



Source: Eurostat & HEnEx

Considering the period 2016 - 2018, there is no apparent trend to justify seasonal volatility in electricity prices of the Greek wholesale market

Seasonal daily system marginal price, (€/MWh), [2016 – 2017- 2018]

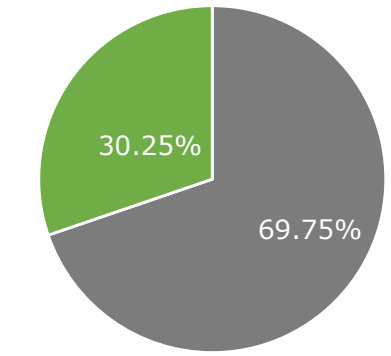


Average SMP 2016 : 42,8 €/MWh **Average SMP 2017: 54,6 €/MWh** **Average SMP 2018: 60,3 €/MWh**

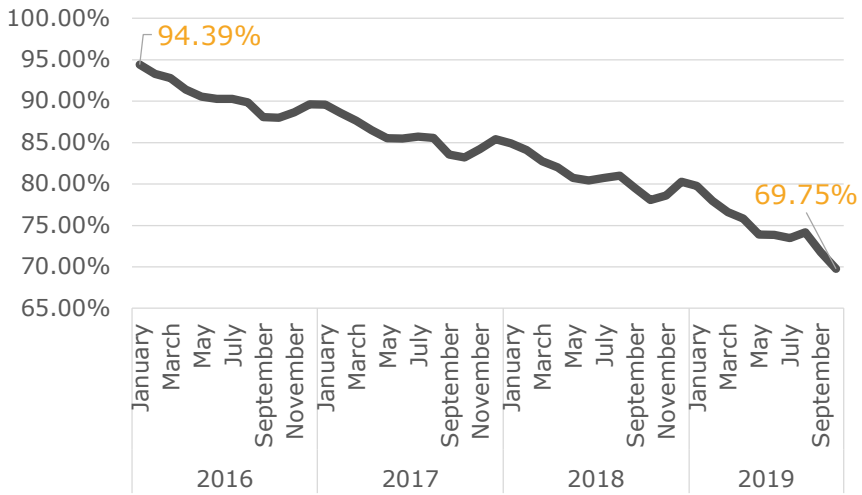
Source: HEnEx

Despite the fact that NOME auctions have been withdrawn, the share of PPC is constantly being reduced

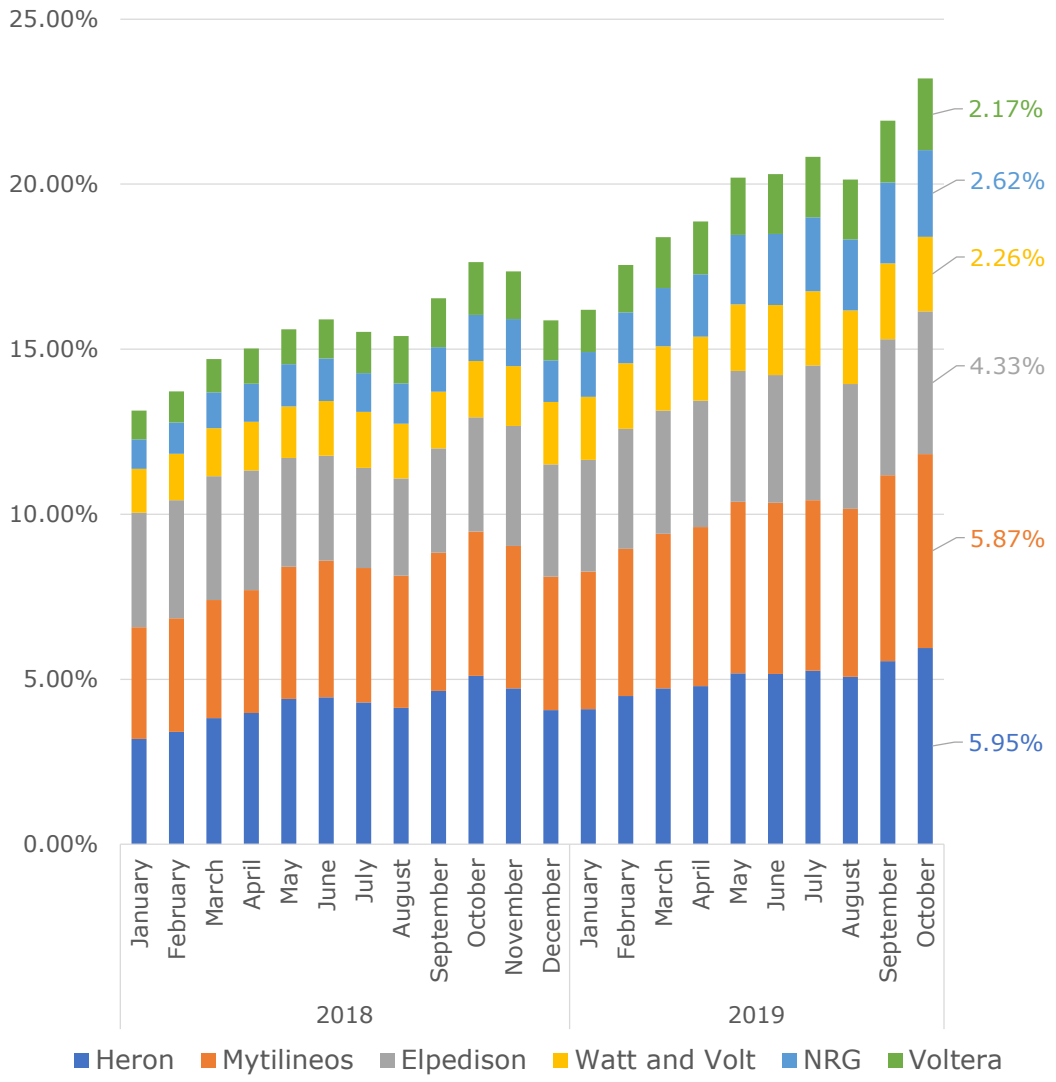
Market share (%), [October 2019]



PPC's market share (%) [2016- Oct. 2019]



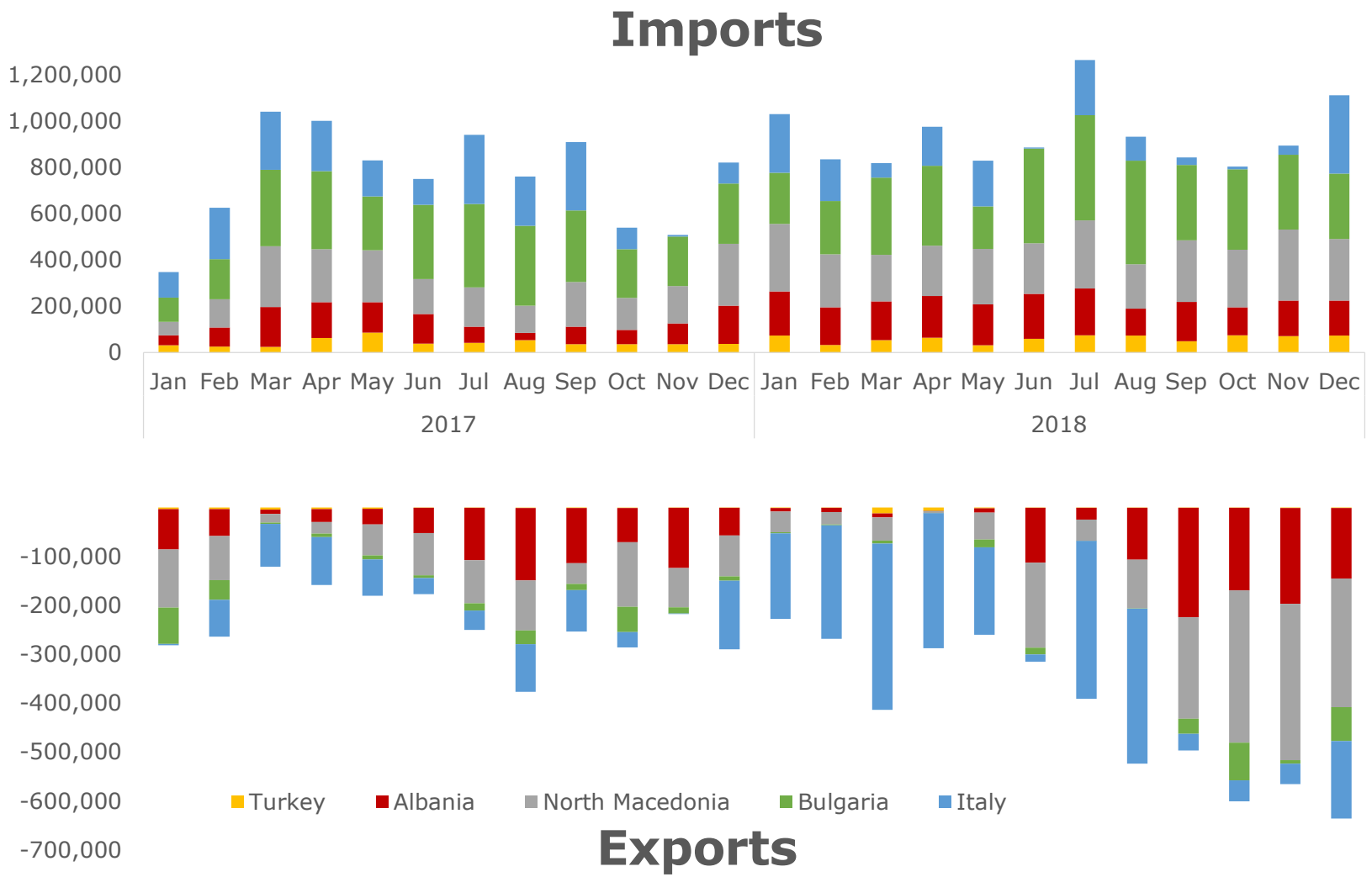
Companies with market share > 2%, [2018 – Oct. 2019]



Source: HEnEx

The adequacy of the system is expected to depend significantly on imports, in order for the system to meet adequately the load peaks

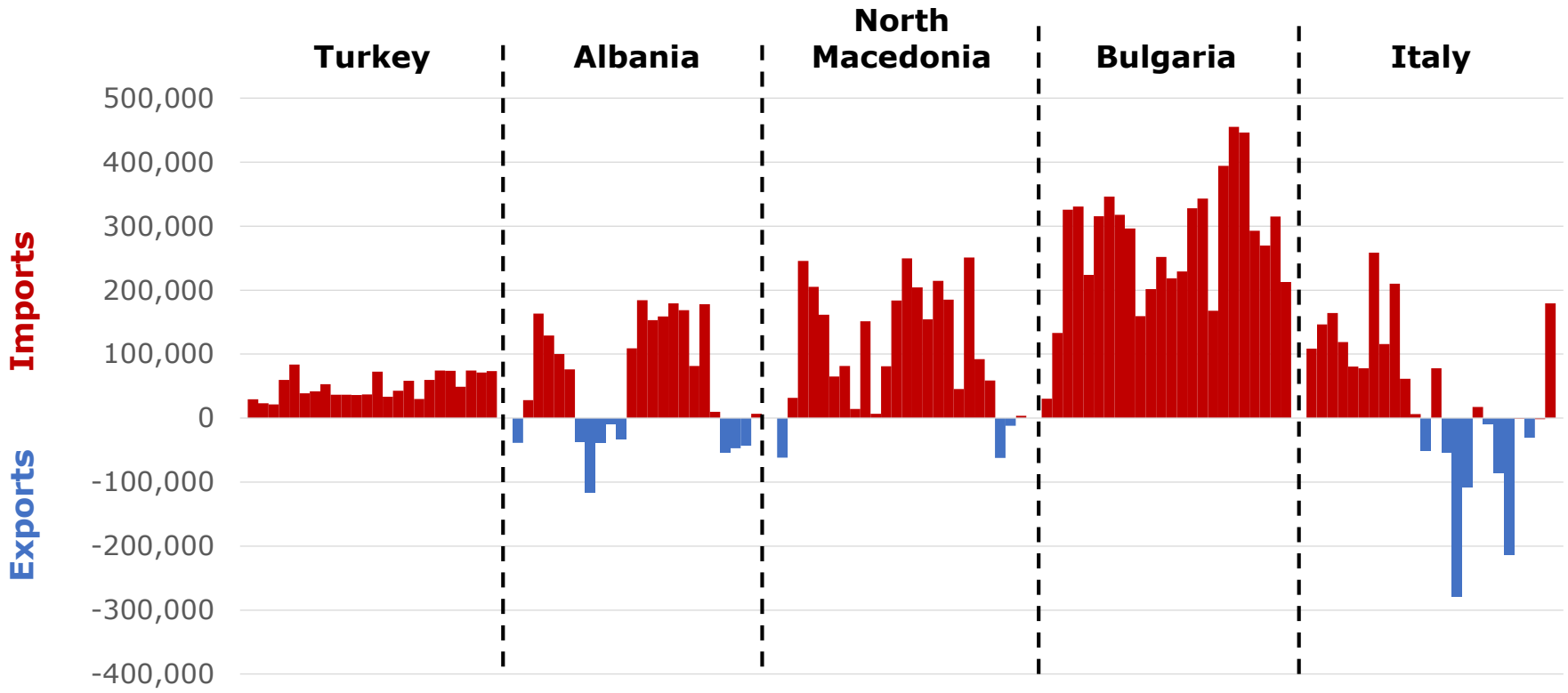
Imports and exports with neighboring countries (MWh), [2017-2018]



Source: ADMIE

During the period 2017 to 2018, Greece was mainly a net importer of electricity, mainly from Bulgaria and North Macedonia

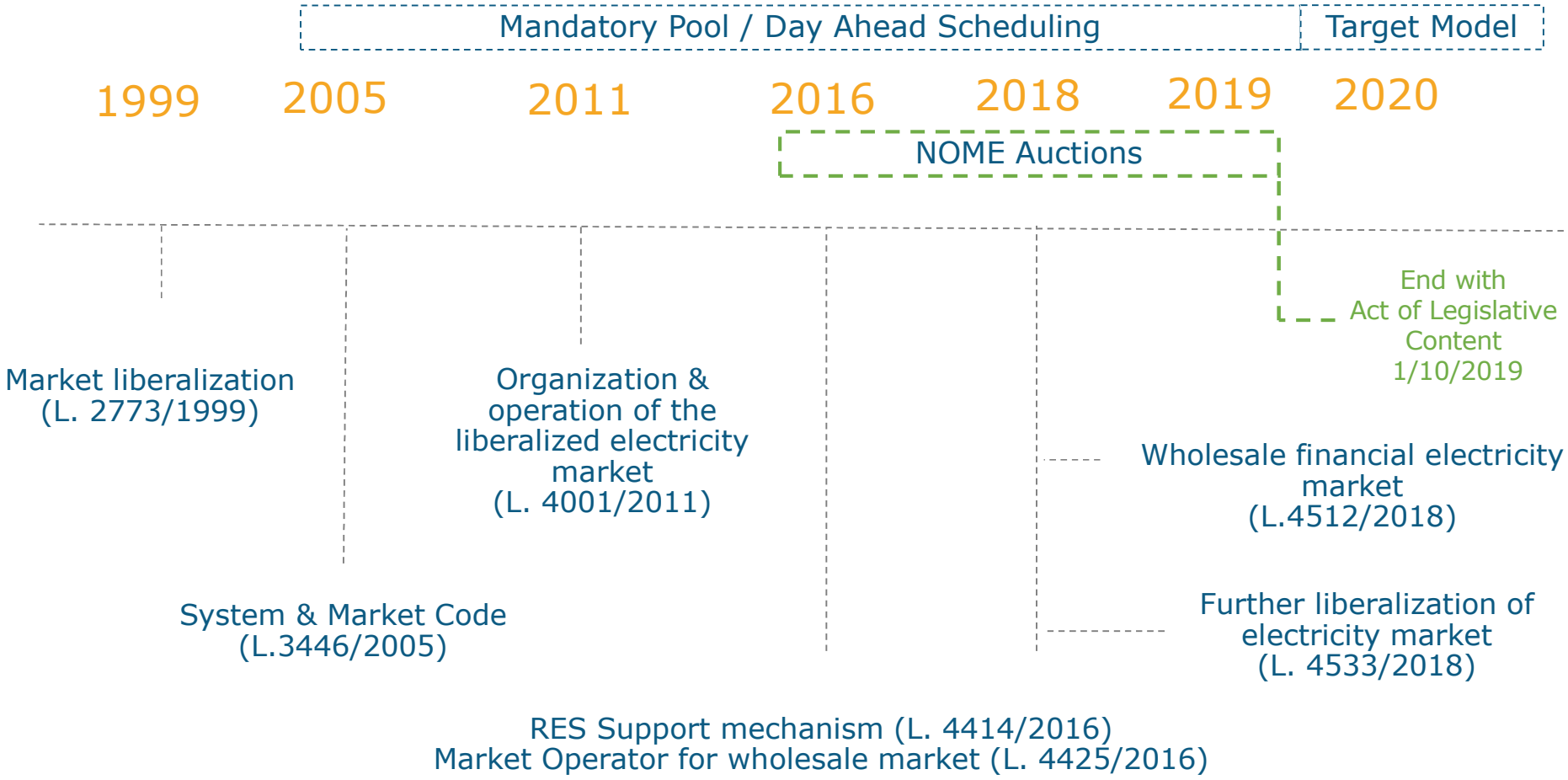
Balance of Power between Greece and neighboring countries
(Imports – Exports) (MWh), [2017-2018, Monthly]



Source: ADMIE

Greece's electricity market legislative framework could be characterized as strongly governed by law and regulation

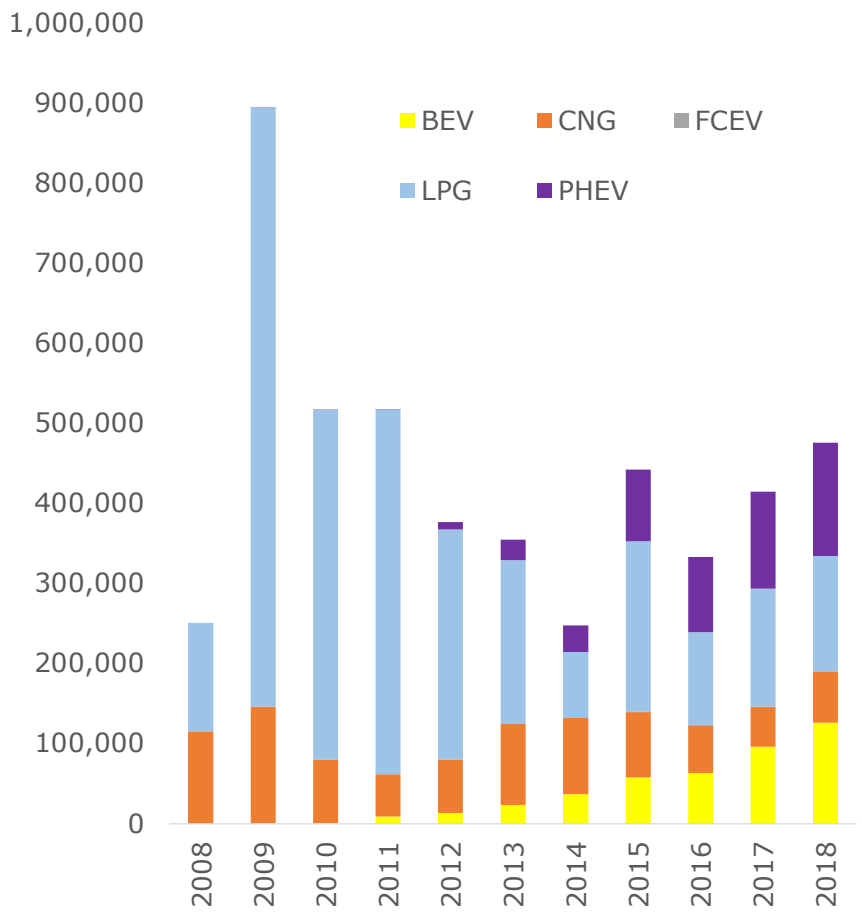
Electricity market legislative framework



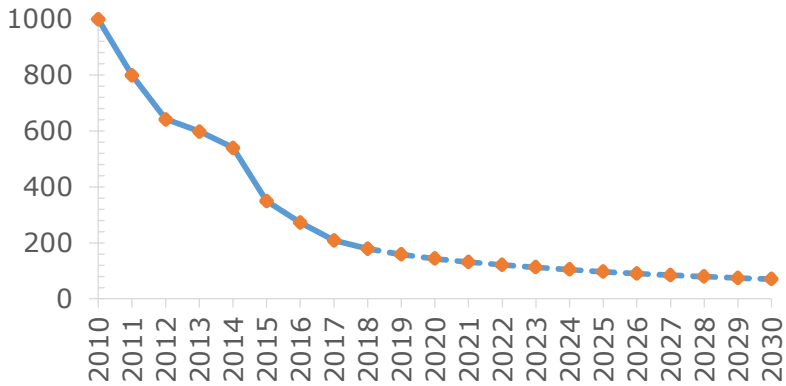
Source: HAEE

Eco-mobility is still at infant stage in Greece, however, over the next decade it is anticipated to gain growing importance

Alternative fuel vehicle registrations in Europe [2008-2018]



Battery price ($/KW), [2010-2030]



Car Sales in Greece [2017-2018]

	2017	2018	Growth
Electric cars (BEV)	50	87	74%
Plug-in Hybrid (PHEV)	141	228	61,70%
Hybrid (HEV)	2356	3635	54,30%
Alternative fuel vehicle (NG)	359	1030	186,90%
Gasoline	46068	61320	33,10%
Diesel	39014	36885	-5,50%
Total	**87988**	**103185**	**17,30%**

Source: Alternative Fuel Observatory, BNEF

The promotion of both fiscal and non-fiscal incentives in Greece will lead to a sharp increase in the share of electrical vehicles

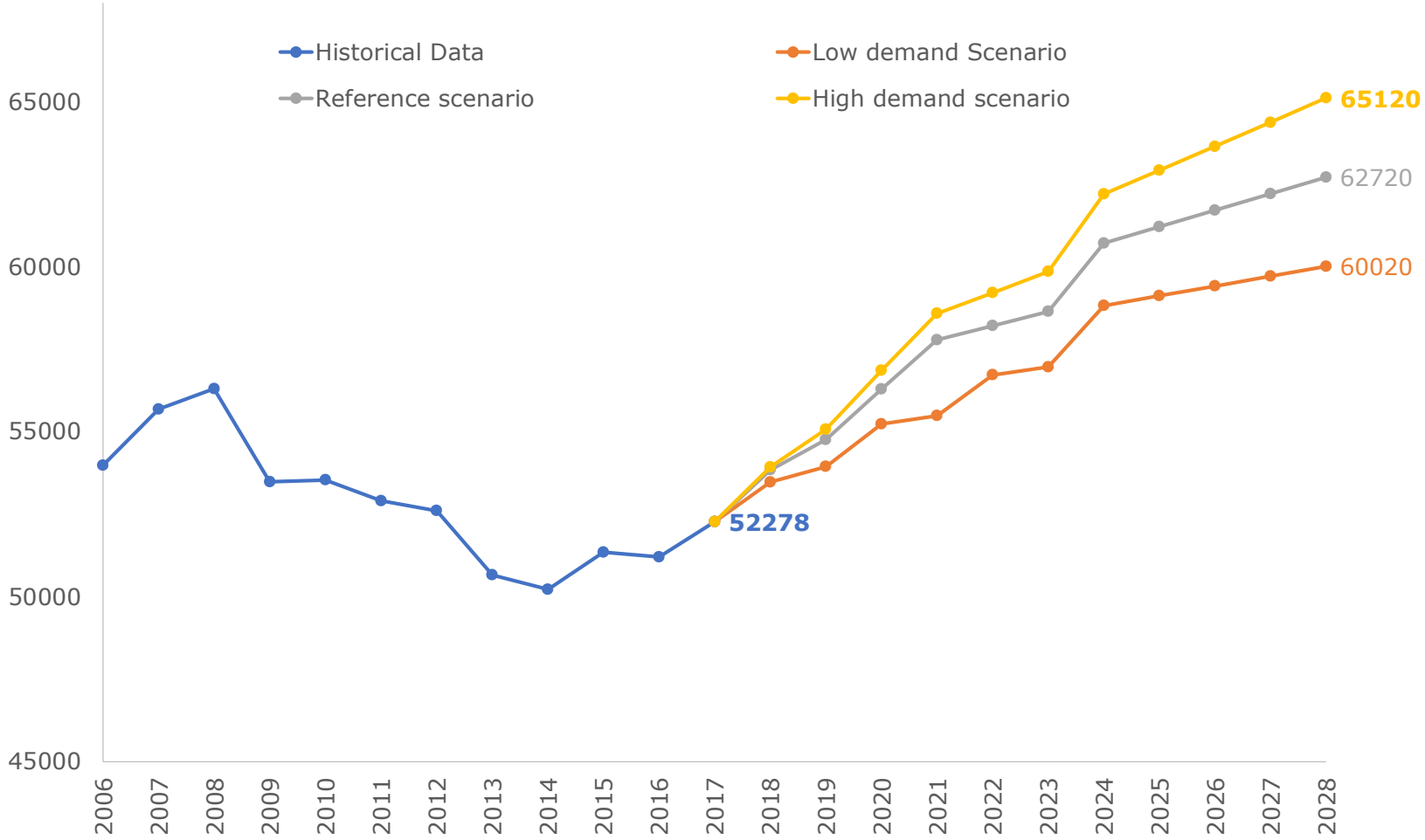
Fiscal and non-fiscal incentives towards Eco-mobility for all EU countries

Country	Purchase incentive or subsidies	Tax benefits and exemptions	Other Benefits (i.e. free parking)	Infrastructure promotion measures	Traffic Regulations (i.e. bus lanes, low emission zones)
Austria	•	•	•		
Belgium	•	•			
Bulgaria	•				
Croatia		•			
Cyprus		•			
Czech Republic		•			
Denmark		•		•	
Finland	•	•			
France	•	•	•	•	
Germany	•	•	•	•	•
Greece		•			
Hungary		•	•		•
Iceland	•	•	•	•	
Ireland	•	•	•	•	
Italy		•		•	
Latvia		•	•		•
Lithuania		•	•		•
Luxembourg		•			
Malta	•	•			
Netherlands		•			
Norway	•	•	•	•	•
Portugal	•	•	•		
Slovakia	•	•			
Spain	•	•	•		•
Sweden	•	•		•	•
Switzerland	•	•			
United Kingdom	•	•	•	•	•

Source: European Fuel Observatory, HAEE's analysis

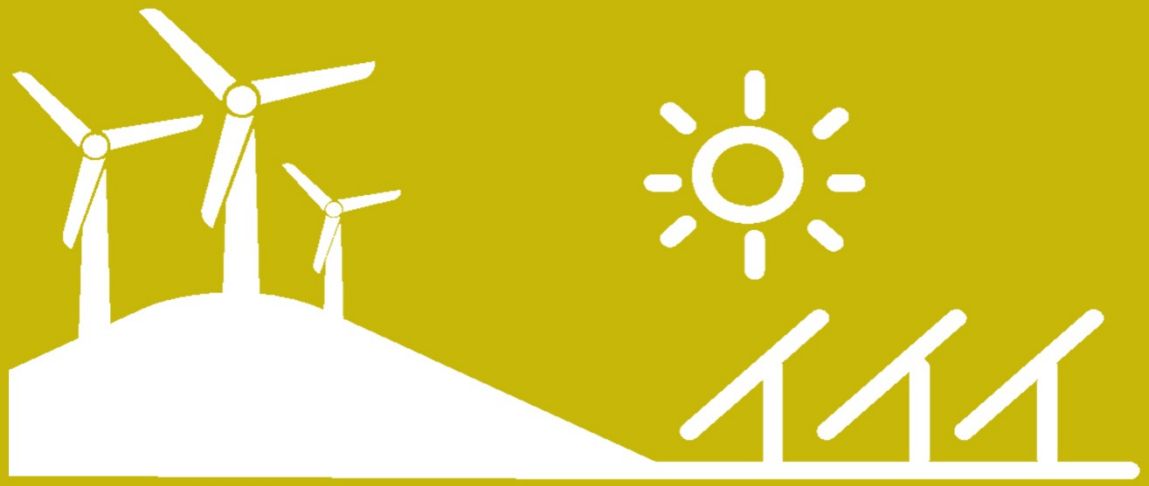
Regulators need to understand the changes underway and seek new solutions and market designs that can support the transition of electricity market

Forecast of total annual demand for electricity (GWh), [2006-2028]



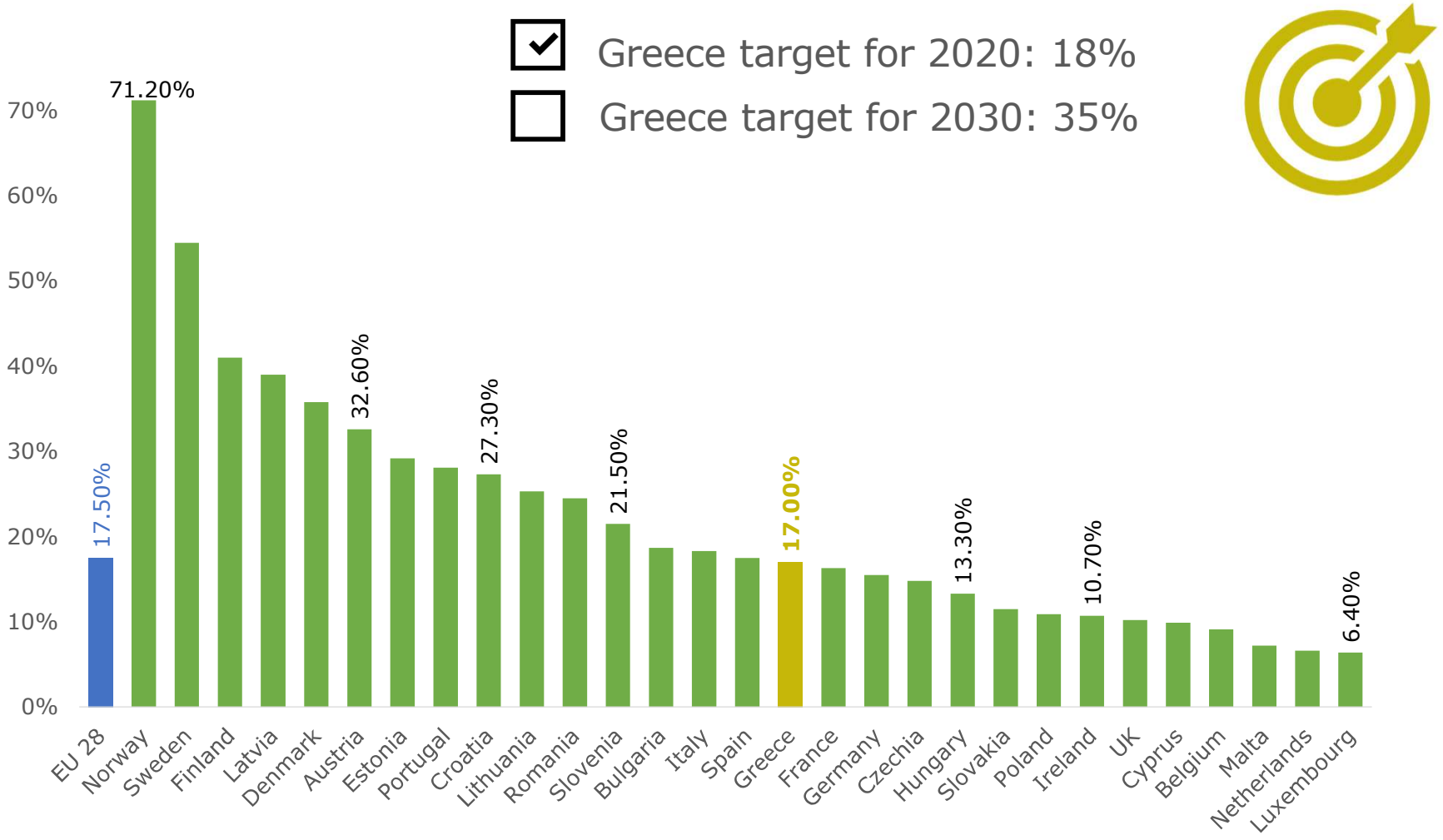
Source: ADMIE

6. Renewable Energy Sources



Greece shows a high potential for exploiting renewable energy technologies in all sectors of final consumption

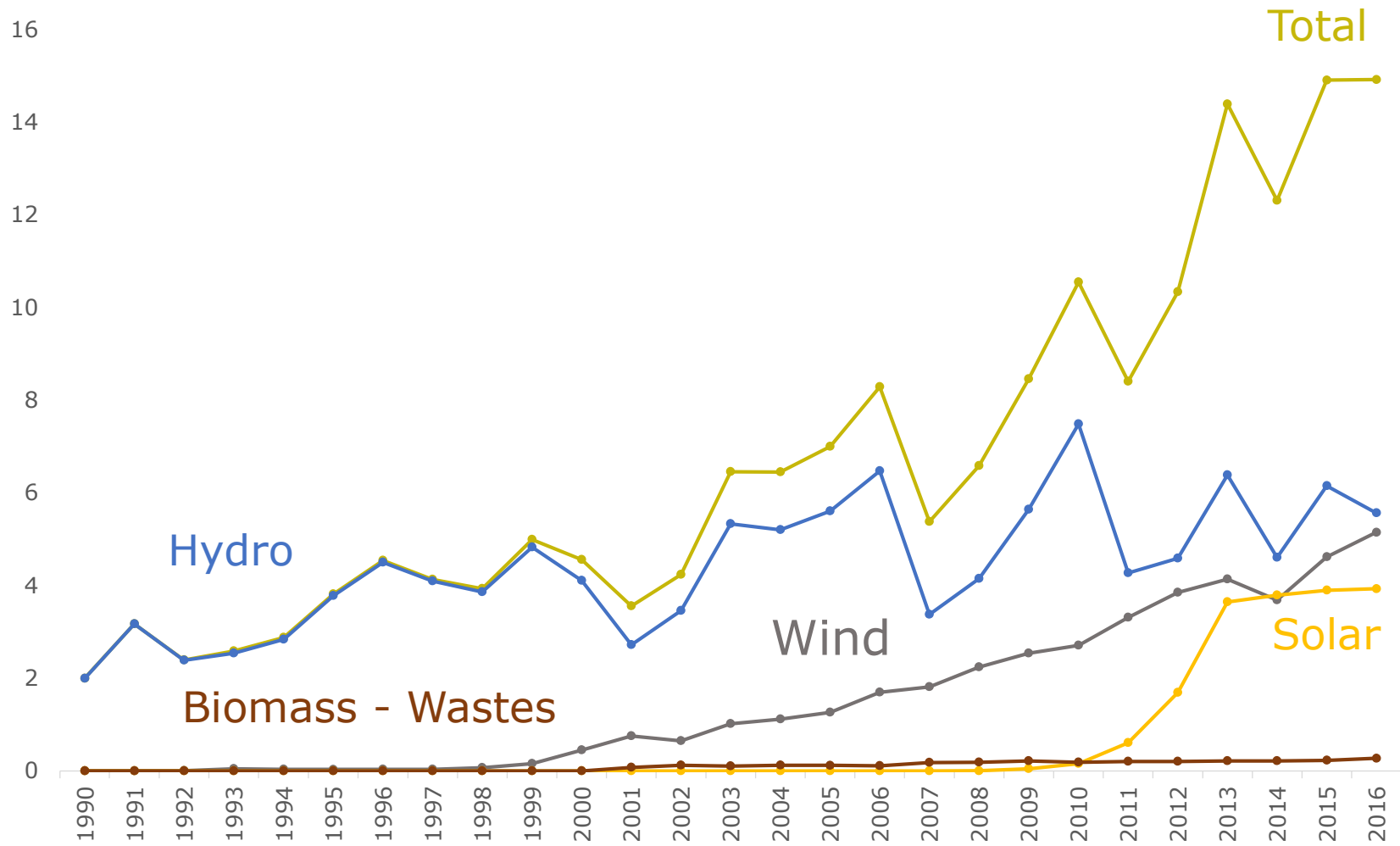
Share of energy from renewable sources in the EU Member States (%), [2017]



Source: Eurostat

Over the past years, a significant effort has been observed towards increasing the share of RES in electricity generation

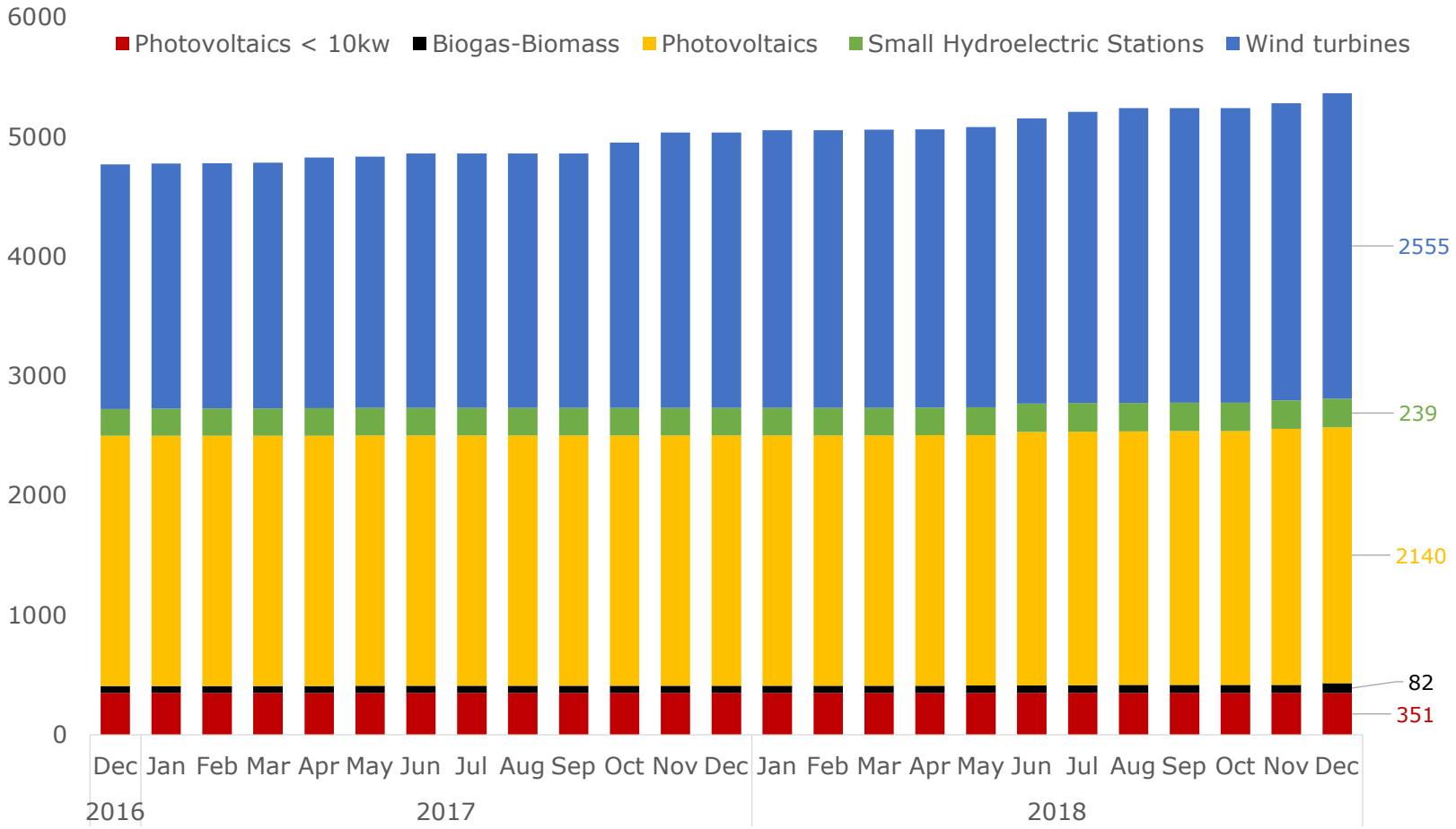
Historical data of RES electricity generation in Greece (TWh), [1990-2016]



Source: IEA

The process of reforming and strengthening the RES support mechanism aims to increase investment confidence for RES projects in Greece

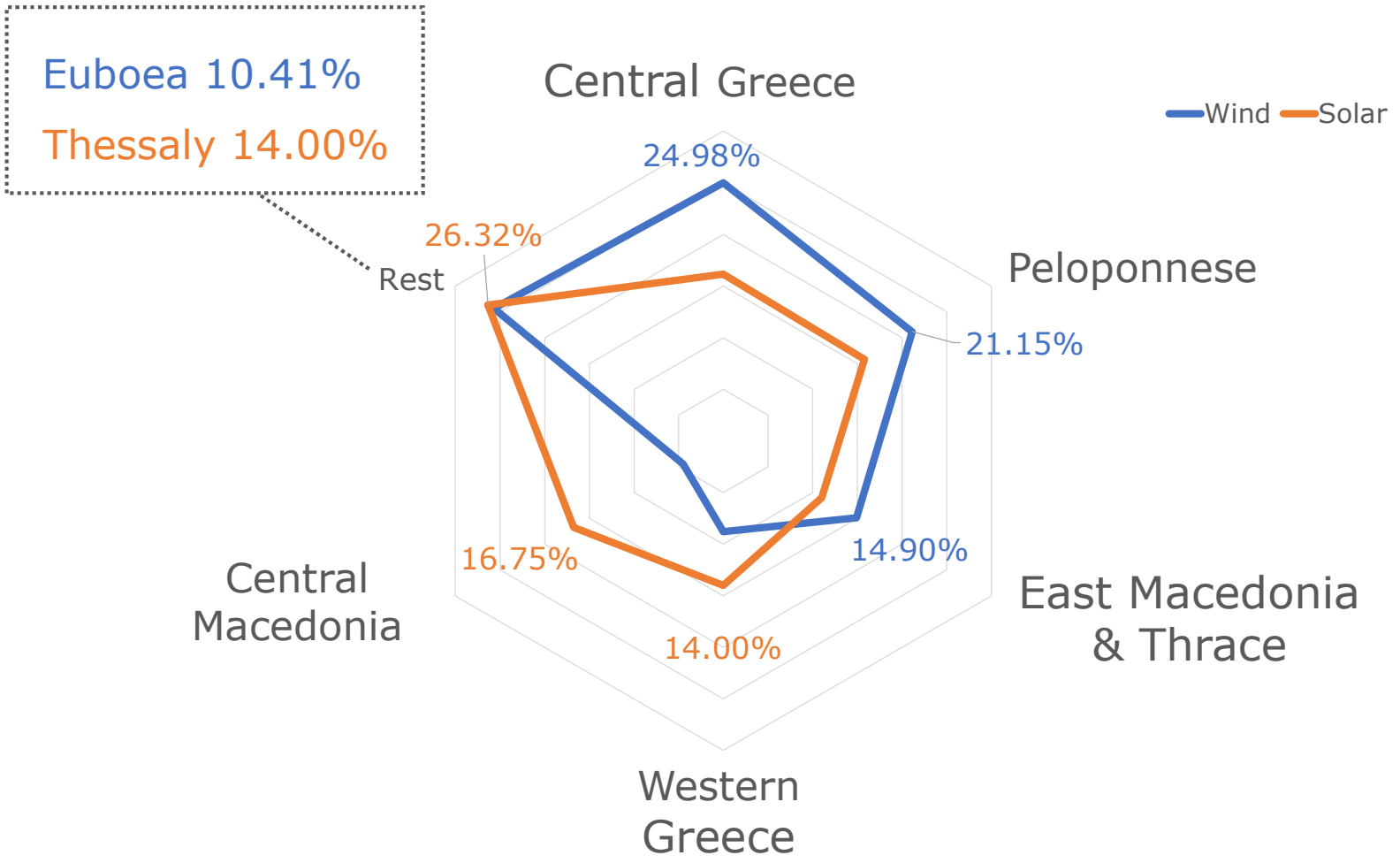
Installed Capacity of RES in Greece by type (MW), [Dec 2016 - Dec 2018]



Source: DAPEEP

Five regions in Greece cover almost 74% of the total installed capacity for both wind and solar power

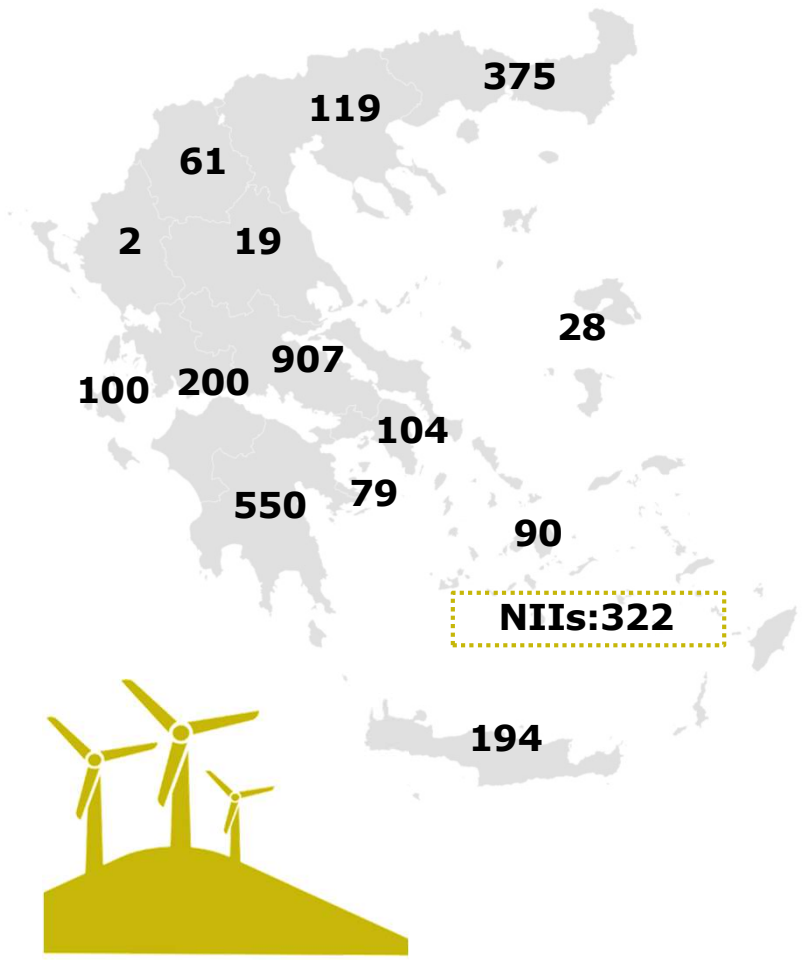
Installed capacity by region (%), [2018]



Source: DAPEEP

Thanks to the progress of technology, wind energy is the cheapest option for new power plants

Cumulative wind capacity by region (MW), [2018]



Installed MW per wind energy producer, [2018]

TERNA Energy	536.1
ANEMOS (ELLAKTOR)	285.6
IBERDOLA Rokas	250.7
EDF HELLAS AE	238.2
EREN GROUP	210.9
ENEL GREEN POWER	200.5
MYTILINEOS GROUP	153.5
CF VENTUS	85.0
PPC Renewables	67.5
ENTEKA	67.0
EUNICE	60.6
RF ENERGY	60.4

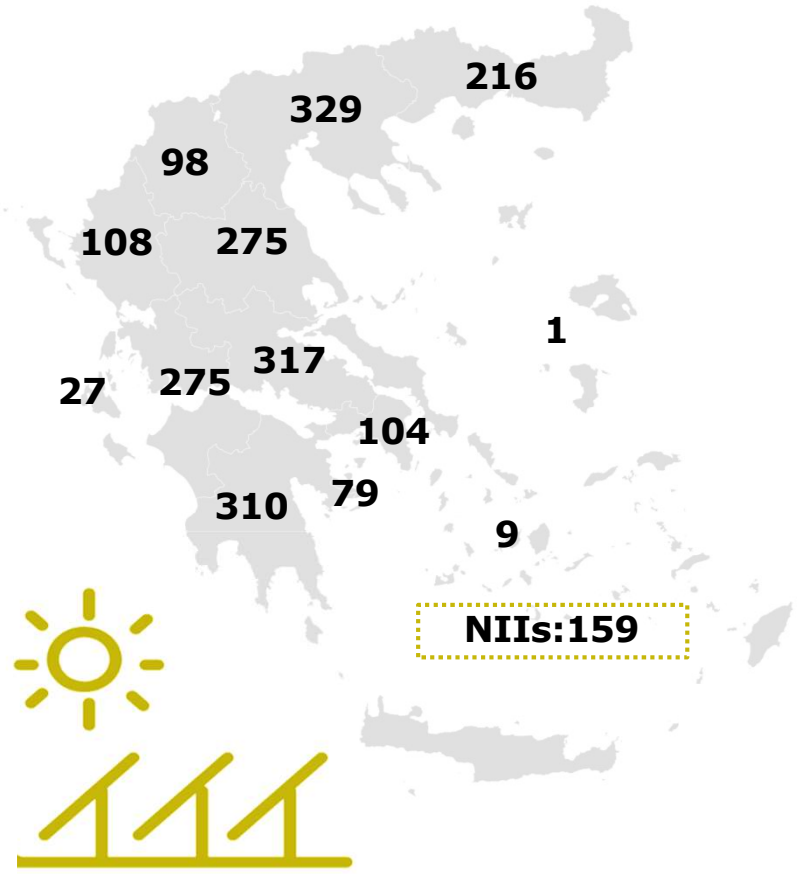
Installed MW per manufacturer [2018]

VESTAS	1483.6
ENERCON	621.8
SGRE	538.7
NORDEX	150.1
OTHERS	34.4

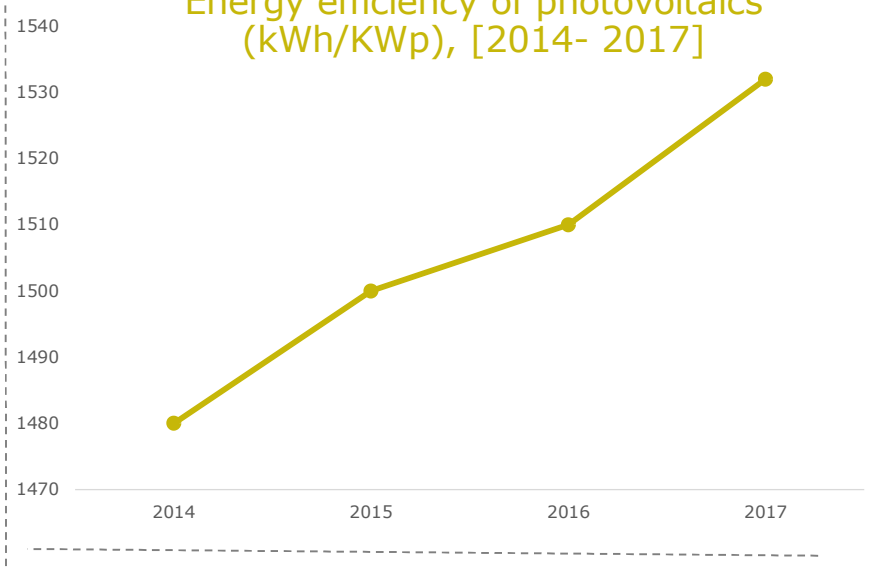
Source: HEDNO & ELETAEN

Massive growth of solar power will offer valuable support in various appliances in society, industry and business

Cumulative solar PV capacity by region (MW), [2018]



Energy efficiency of photovoltaics (kWh/KWp), [2014- 2017]



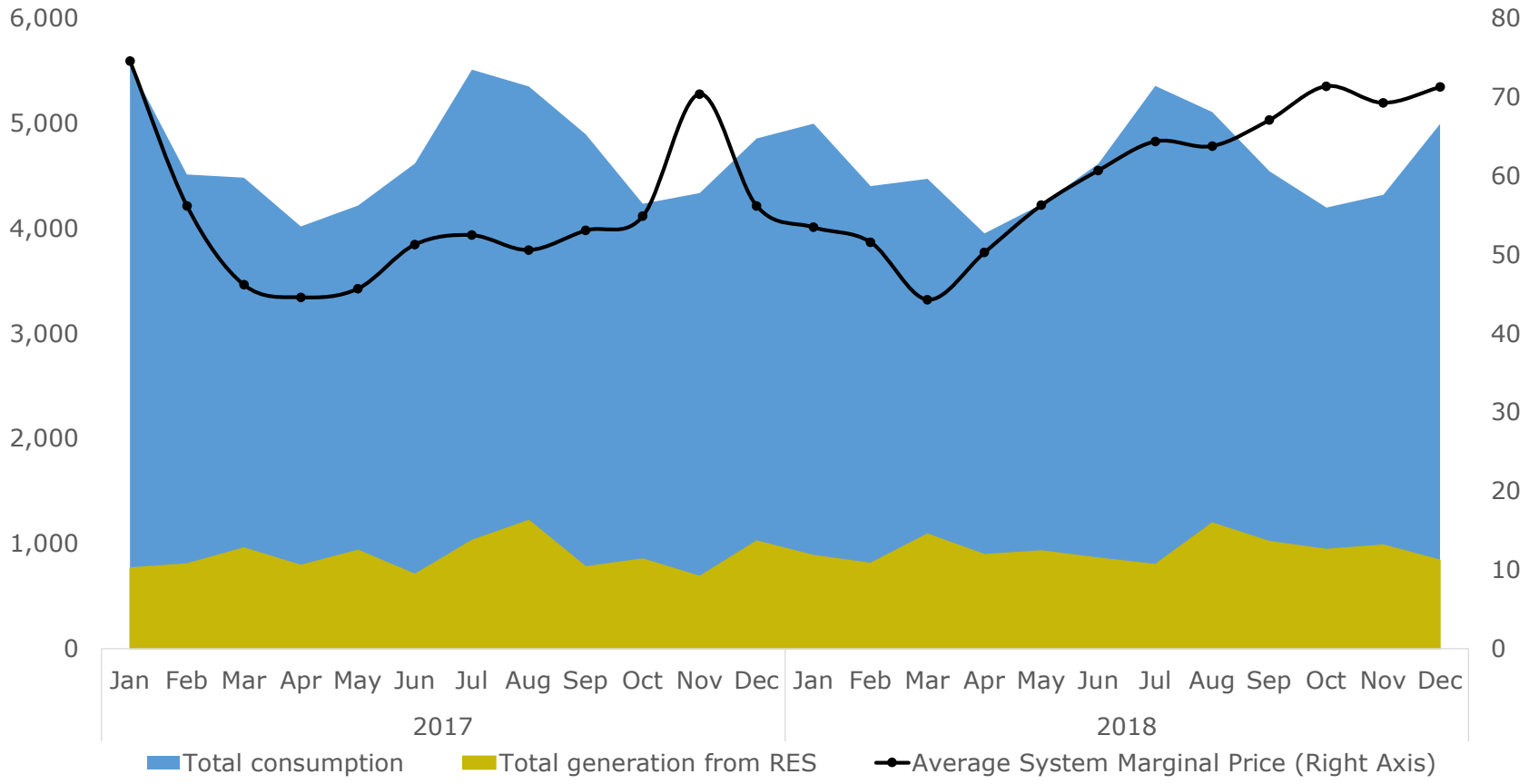
The total land area occupied by Photovoltaics is about **40.000** acres

The area occupied by lignite stations and lignite mines is about **253.000** acres

Source: DAPEEP, HEDNO & HELAPCO

Despite the stochastic nature of RES, their contribution to electricity demand is 19.7% on average for 2017 and 2018

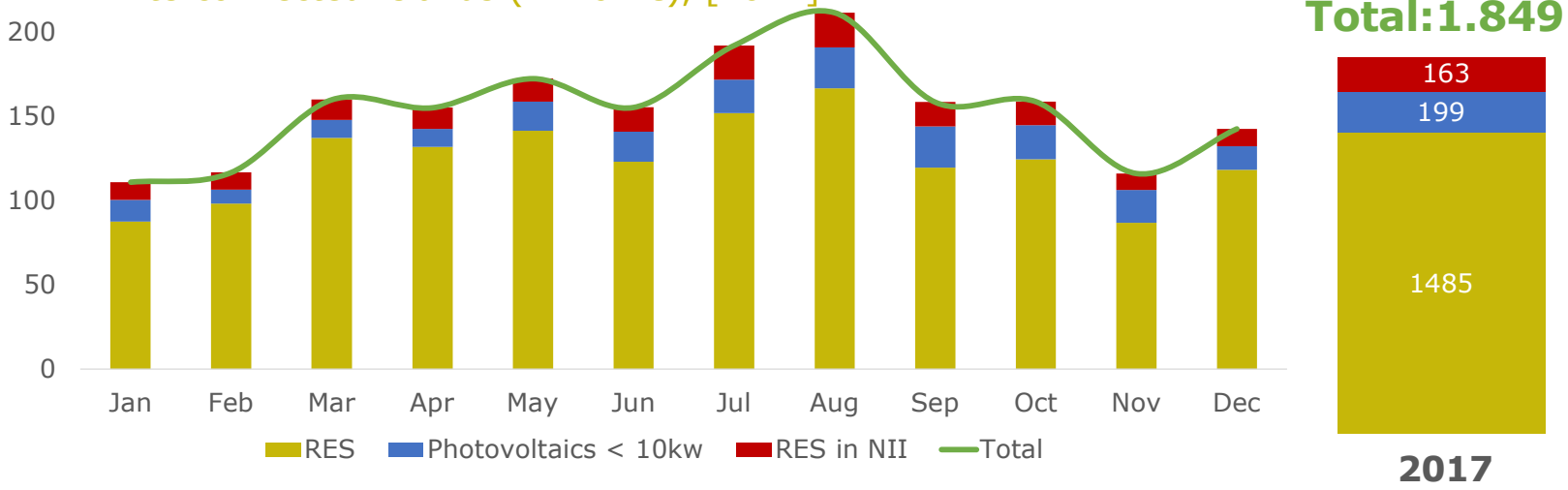
Total electricity consumption (GWh), total electricity generation from RES (GWH) and average system marginal price (€/MWh), [2017-2018]



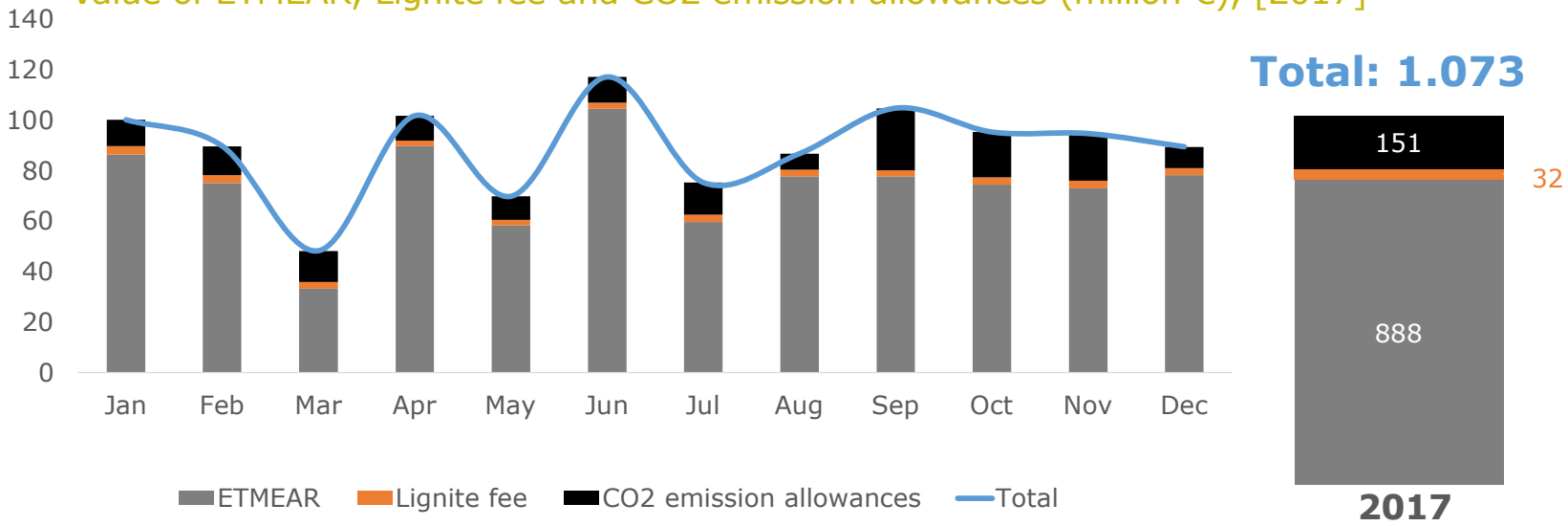
Source: DAPEEP

The new RES support scheme is anticipated to reduce the cost burdened by the society

Value of RES supporting scheme including Photovoltaics <10 kw and RES in Non Interconnected Islands (million €), [2017]



Value of ETMEAR, Lignite fee and CO2 emission allowances (million €), [2017]



Source: DAPEEP

ETMEAP: Ειδικό Τέλος Μείωσης Εκπομπών Αερίων Ρύπων

Market Information

Current Situation

- The current status consists of Auctions System, held by RAE (Regulator), usually 2 times per year

- The auctions are held separately for each technology (Wind, Solar) for Solar<20MW & Wind < 50MW

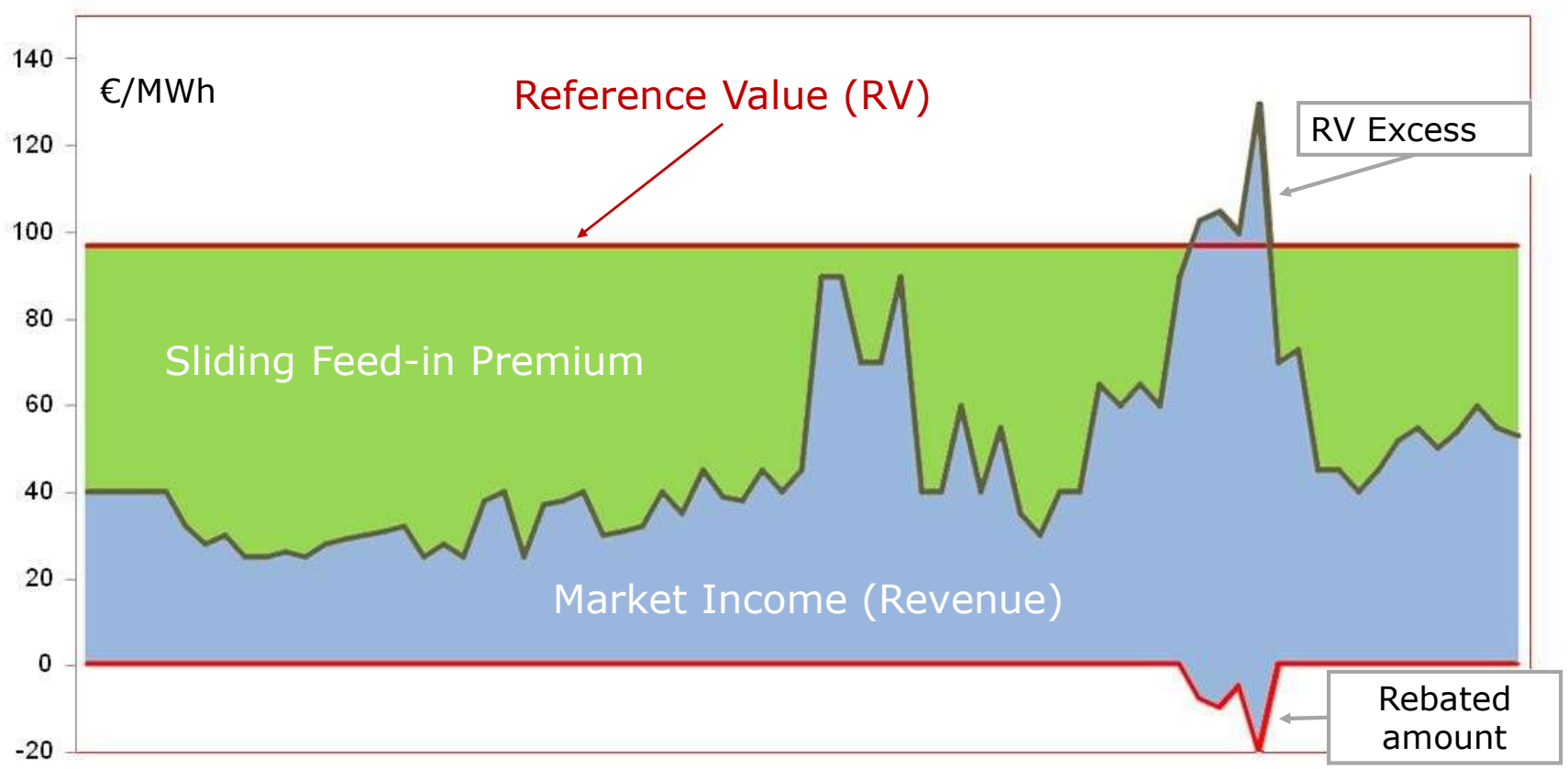
- Common Auctions are held for Solar>20MW & Wind>50MW
- A project is in a Ready to Auctions Status, after the issuance of the Final Connection Offer by the TSO (ADMIE)

Near Future Market Situation

- The Greek Energy Market is expected to reach the target model at the end of June 2020
  - Participation in the market. Energy Exchange will operate since June 2020
  - Option for private PPAs (typical length 5-7 years). The auctions system will also remain as an option
- Regulatory Authority of Energy (RAE)
  - Currently more than 10.000 MW capacity have been submitted and are awaiting to be issued
  - Due to the extent of the awaiting applications, there is a strong possibility that RAE will shortly suspend the submission of new applications for some period
- Competition in the Wind and Solar market

Since 2016, a new support scheme for renewable projects has been adopted, based on Feed-in Premiums (FiP)

Snapshot of the FiP based support scheme



Source: HAEE

During the last two years, three auctions for renewable energy projects have been held by the Regulating Authority for Energy (RAE)

RES Auctions 2018

June 2018

Category I (PV<1 MWp)

83 Projects – Auctioned Power 53,4835 MWp
Starting Price: 85 €/MWh
Minimum Price: 75,87 €/MWh
Maximum Price: 80 €/MWh
Weighted Average Price: 79,0196 €/MWh

Category II (1 MWp < PV < 20 MWp)

8 Projects – Auctioned Power 52,91896 MWp
Starting Price : 80 €/MWh
Minimum Price : 62,97 €/MWh
Maximum Price : 71 €/MWh
Weighted Average Price : 63,81281 €/MWh

Category III (3 MWp < Wind < 50 MWp)

8 Projects – Auctioned Power 170,925 MW
Starting Price : 90 €/MWh
Minimum Price : 68,18 €/MWh
Maximum Price : 71,93 €/MWh
Weighted Average Price : 69,53437 €/MWh

December 2018

Category I (PV<1 MWp)

192 Projects – Auctioned Power 60,35 MWp
Starting Price: 81.71 €/MWh
Minimum Price: 63 €/MWh
Maximum Price: 68 €/MWh

Category II (1 MWp < PV < 20 MWp)

27 Projects – Auctioned Power 86,46 MWp
Starting Price : 71.91 €/MWh
Minimum Price : 63 €/MWh
Maximum Price : 71.9 €/MWh

Category III (3 MWp < Wind < 50 MWp)

14 Projects – Auctioned Power 170,925 MW
Starting Price : 79.77 €/MWh
Minimum Price : 55 €/MWh
Maximum Price : 65,15 €/MWh

Source: RAE

RES Auctions 2019

April 2019

Common Category – Big Projects
(PV>20 MWp & Wind>50MWp)
8 Projects of 637.78MWp (7 Projects succeeded)
Auctioned Capacity: 455.56 MWp
Final Capacity: 437.78 MWp
Starting Price: 64.72 €/MWh
Minimum Price: 53 €/MWh
Maximum Price: 64.72 €/MWh
Weighted Average Price: 57.03 €/MWh

June 2019

Category II (1MWp < PV < 20MWp)
Planned Auctioned Capacity: 430 MWp
Starting Price: 69.26 €/MWh
Minimum Price: 61,95 €/MWh
Maximum Price: 67,7 €/MWh
Weighted Average Price: 62.78 €/MWh

Category III (3 MWp < Wind < 50 MWp)
Planned Auctioned Capacity: 400 MWp
Starting Price : 69.18 €/MWh
Minimum Price : 59,09 €/MWh
Maximum Price : 69,18 €/MWh
Weighted Average Price: 67.32 €/MWh

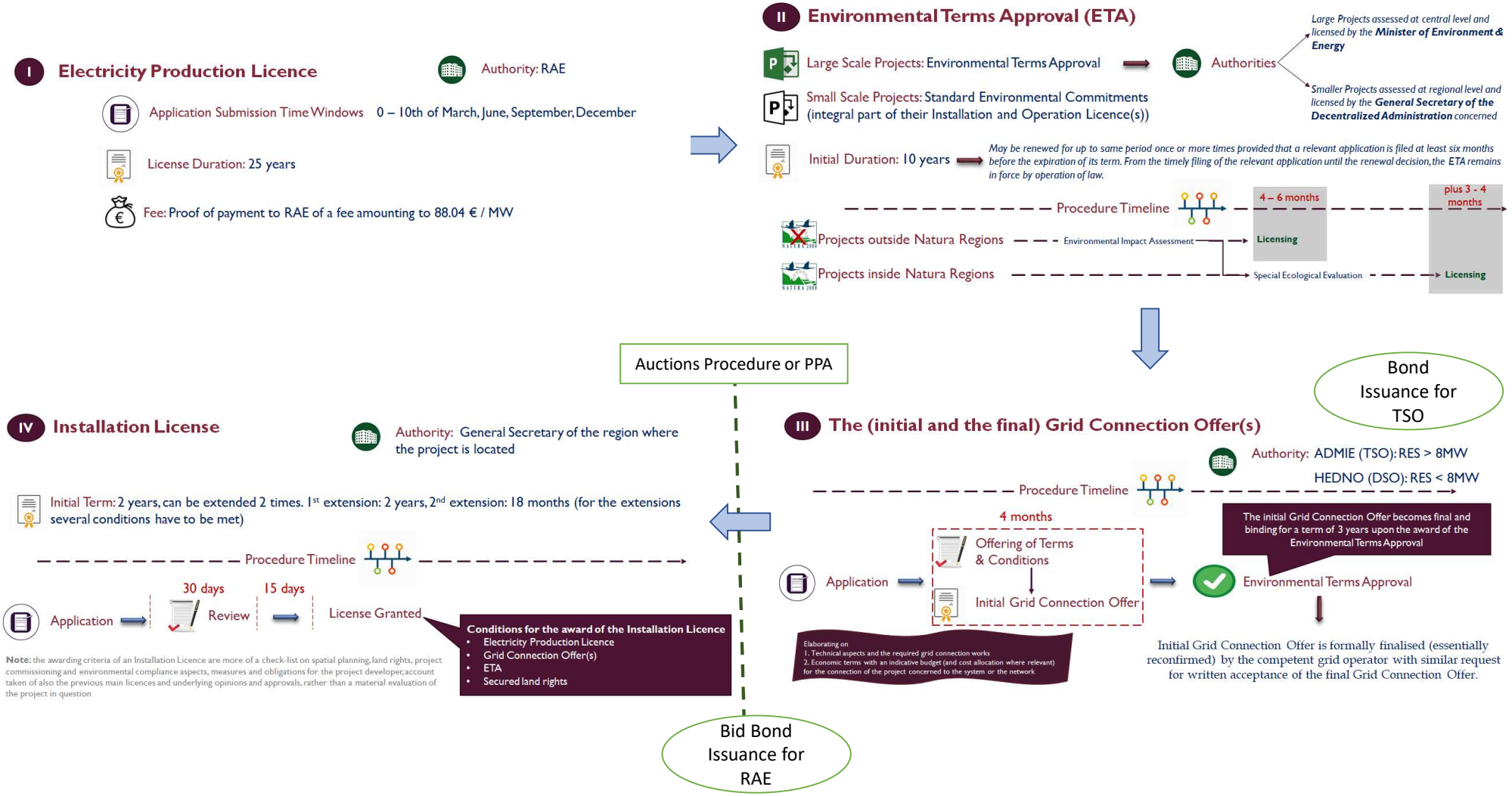
12 of December 2019

Category II (1MWp < PV < 20MWp)
43 Projects
Planned Auctioned Capacity: 105,464 MW

Category III (3 MWp < Wind < 50 MWp)
16 Projects
Planned Auctioned Capacity: 225,450 MWp

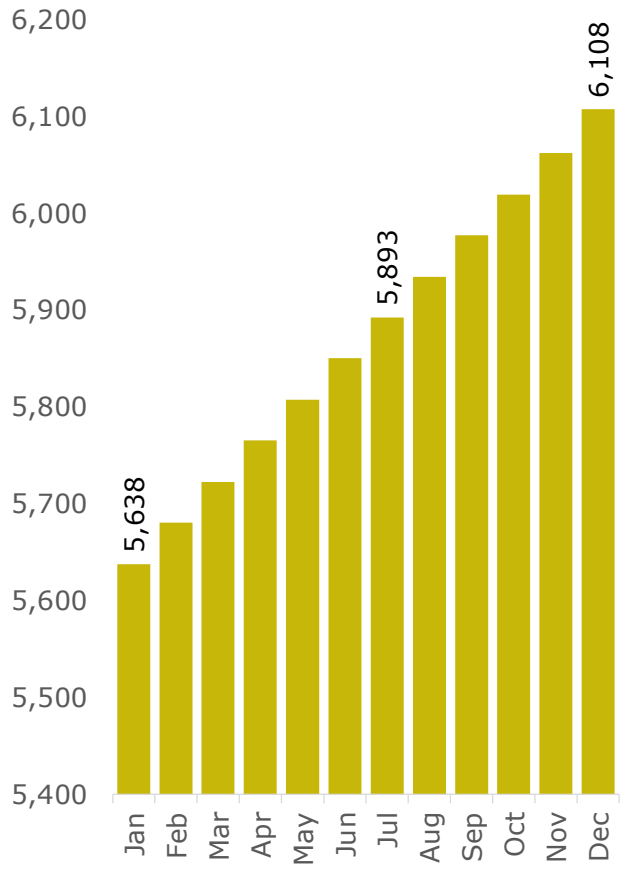
Source: RAE

Regulatory Framework – Development Stages

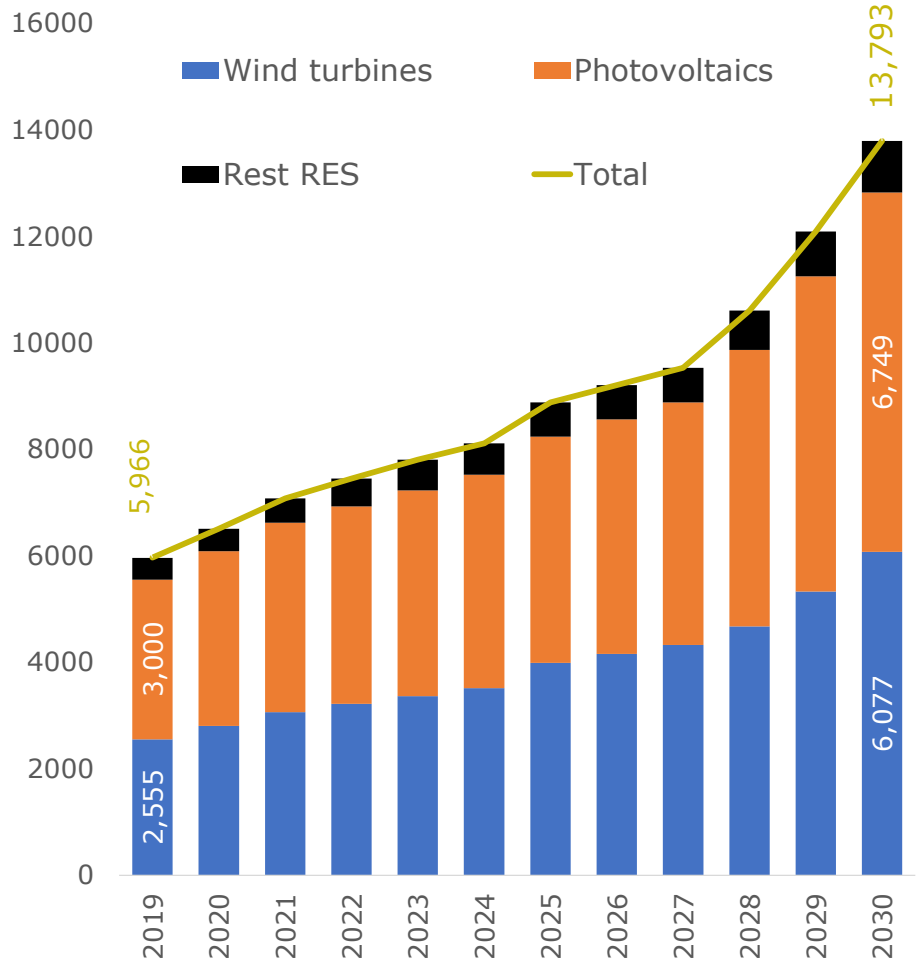


Compared to current levels, solar power installed capacity is expected to grow by 51% in 2027, while wind power installed capacity to grow by 69%

Short-term forecast of RES installed capacity in Greece (MW), [2019]



Long-term forecast of RES installed capacity in Greece (MW), [2019 – 2030]

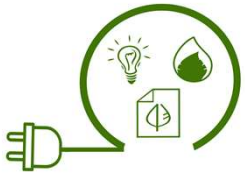


Source: DAPEEP & ADMIE

Coffee Break

Duration (16:00 – 16:30)

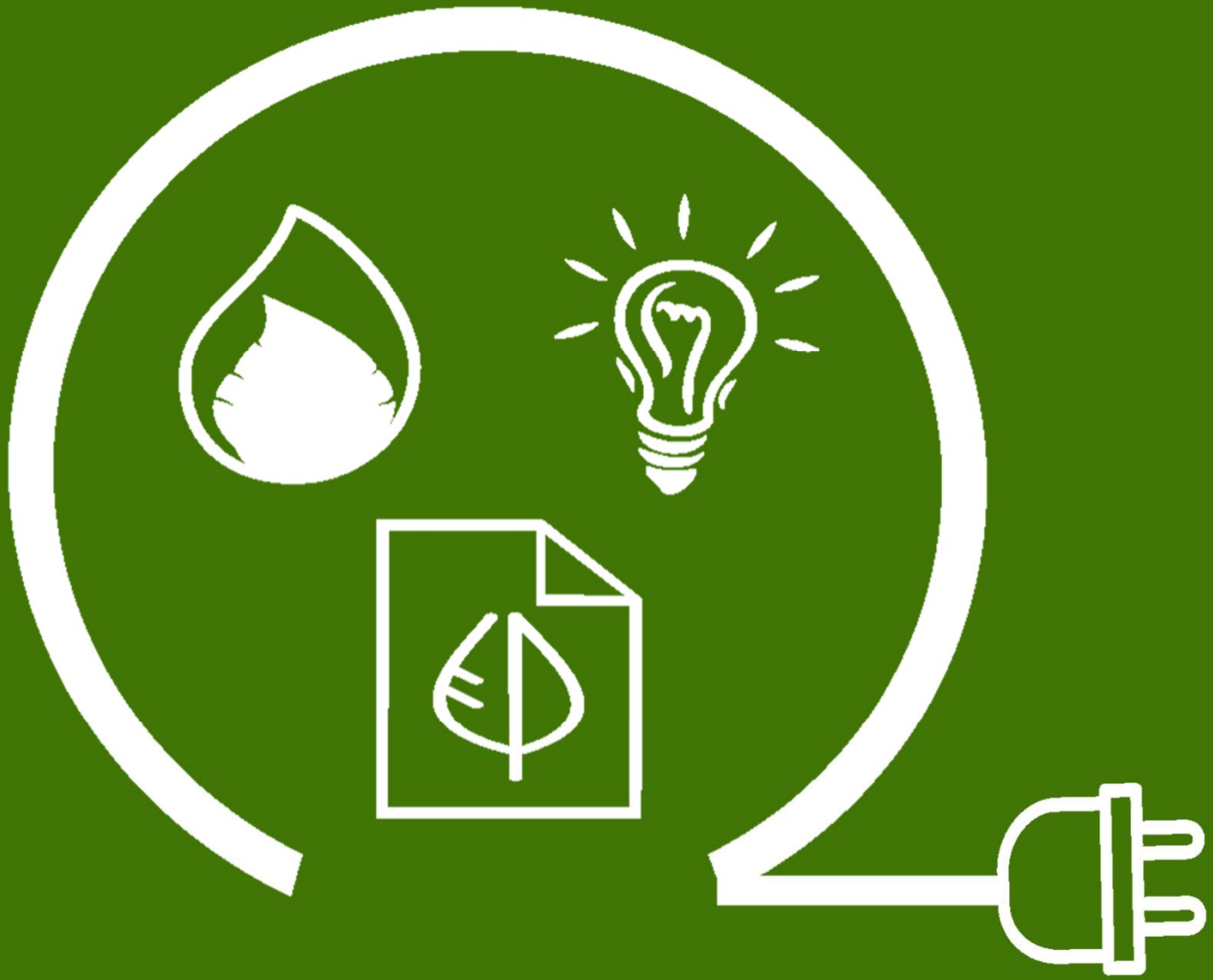
Part 4



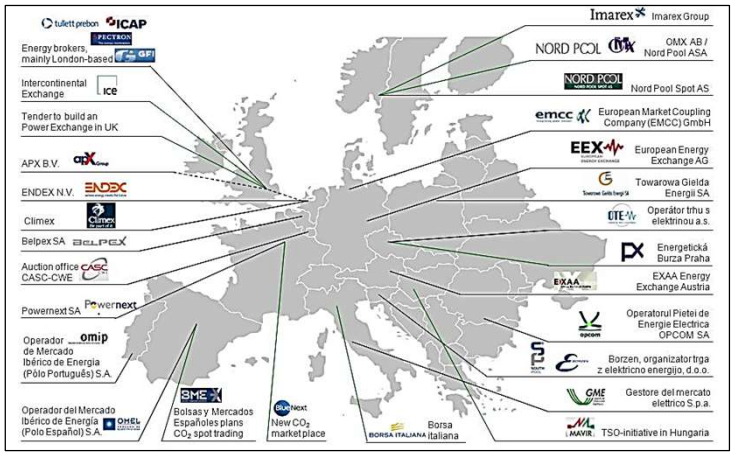
7. Hellenic Energy Exchange

Duration (16:30 – 18:00)

7. Hellenic Energy Exchange



PXs in Europe & in South East Europe



Spain & Portugal (1997)
Electricity / Natural Gas
OMIE

Poland (1999)
Electricity / Natural Gas
TGE

Netherlands & UK (1999)
Electricity
APX

Norway, Sweden, Denmark (2001)
Electricity
Nord Pool

Germany (2002)
Electricity / Natural Gas
EEX

Czech Republic (2007)
Electricity / Natural Gas
PXE

Slovenia (2008)
Electricity
South Pool

Central Europe (2008)
Electricity / Natural Gas
EPEX Spot

Italy (2009)
Electricity / Natural Gas
GME / IPEX

Hungary (2010)
Electricity / Natural Gas
HUPX

Romania (2000)
Electricity / Natural Gas
OPCOM

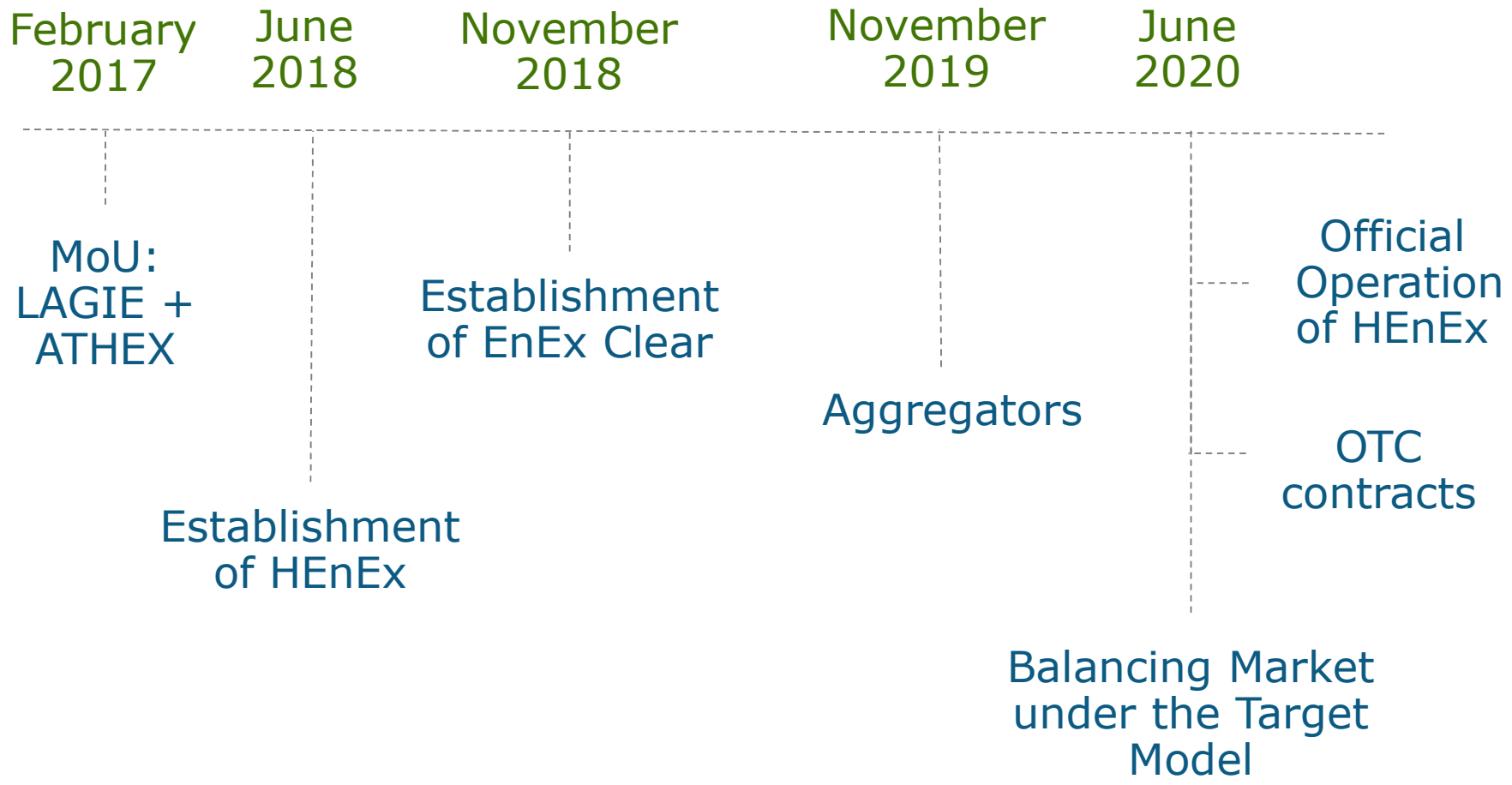
Bulgaria (2014)
Electricity
IBEX

Serbia (2015)
Electricity
SEEPEX

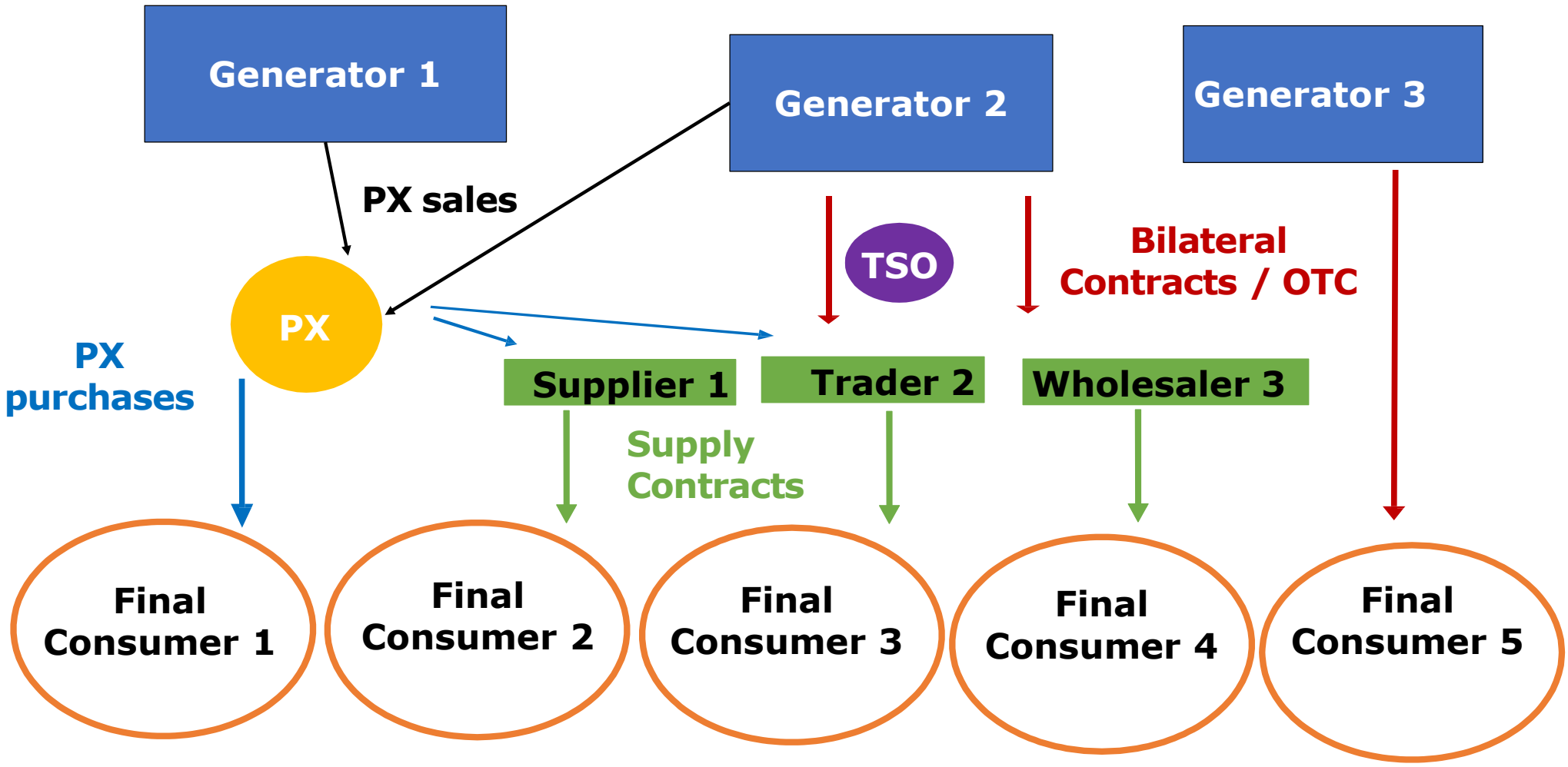
Croatia (2016)
Electricity
CROPEX

The Hellenic Energy Exchange is expected to launch operations by June 2020, as part of a plan to restructure the domestic electricity energy market, lower energy cost and strengthen security of supply

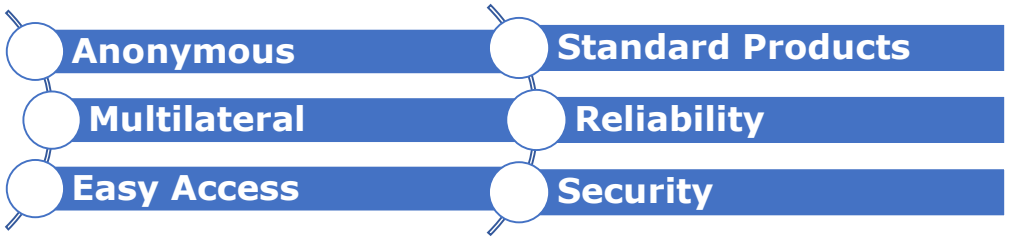
Timeline

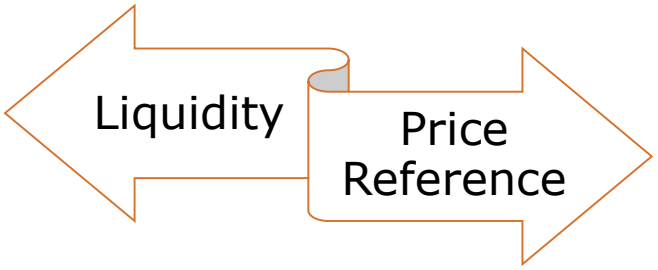


Commercial Relationships in Competitive Markets

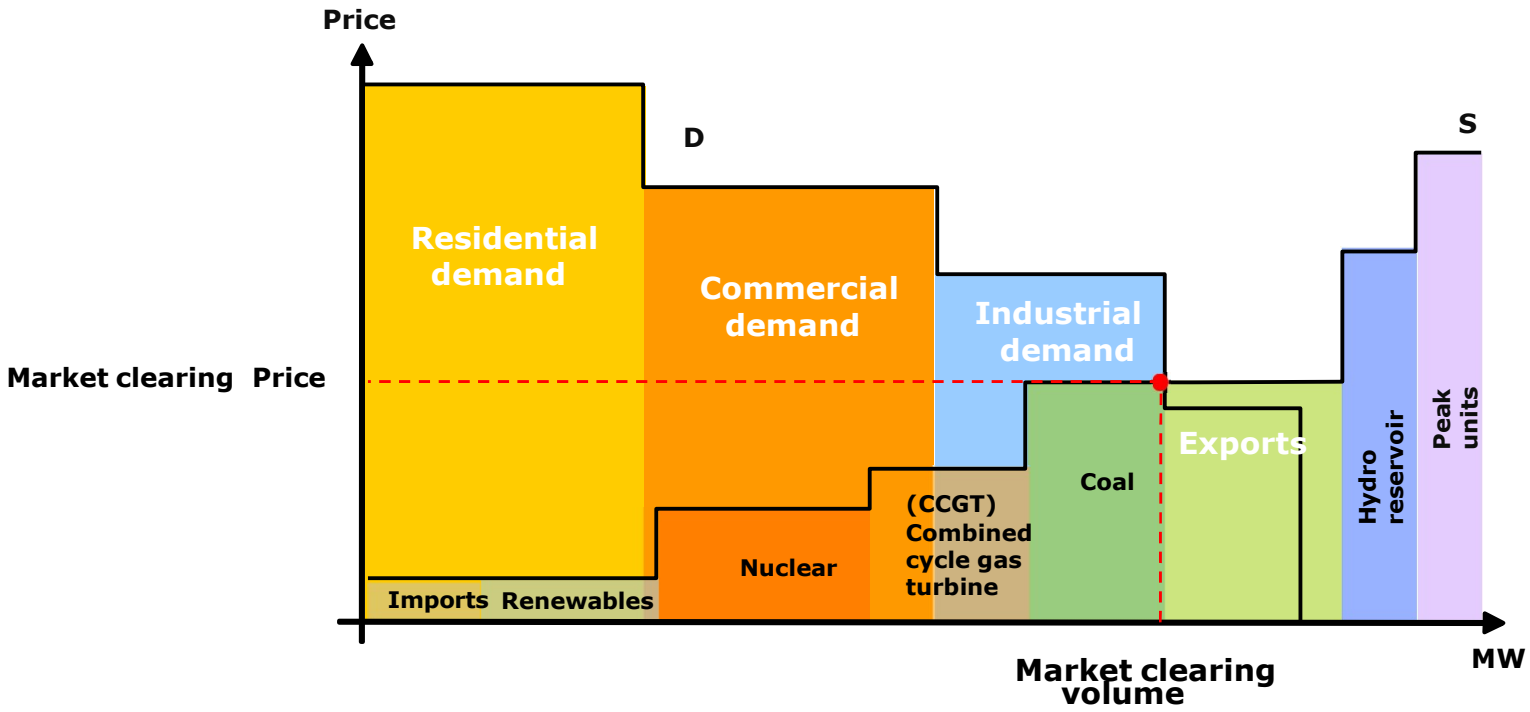


Power Exchanges Functions & Characteristics

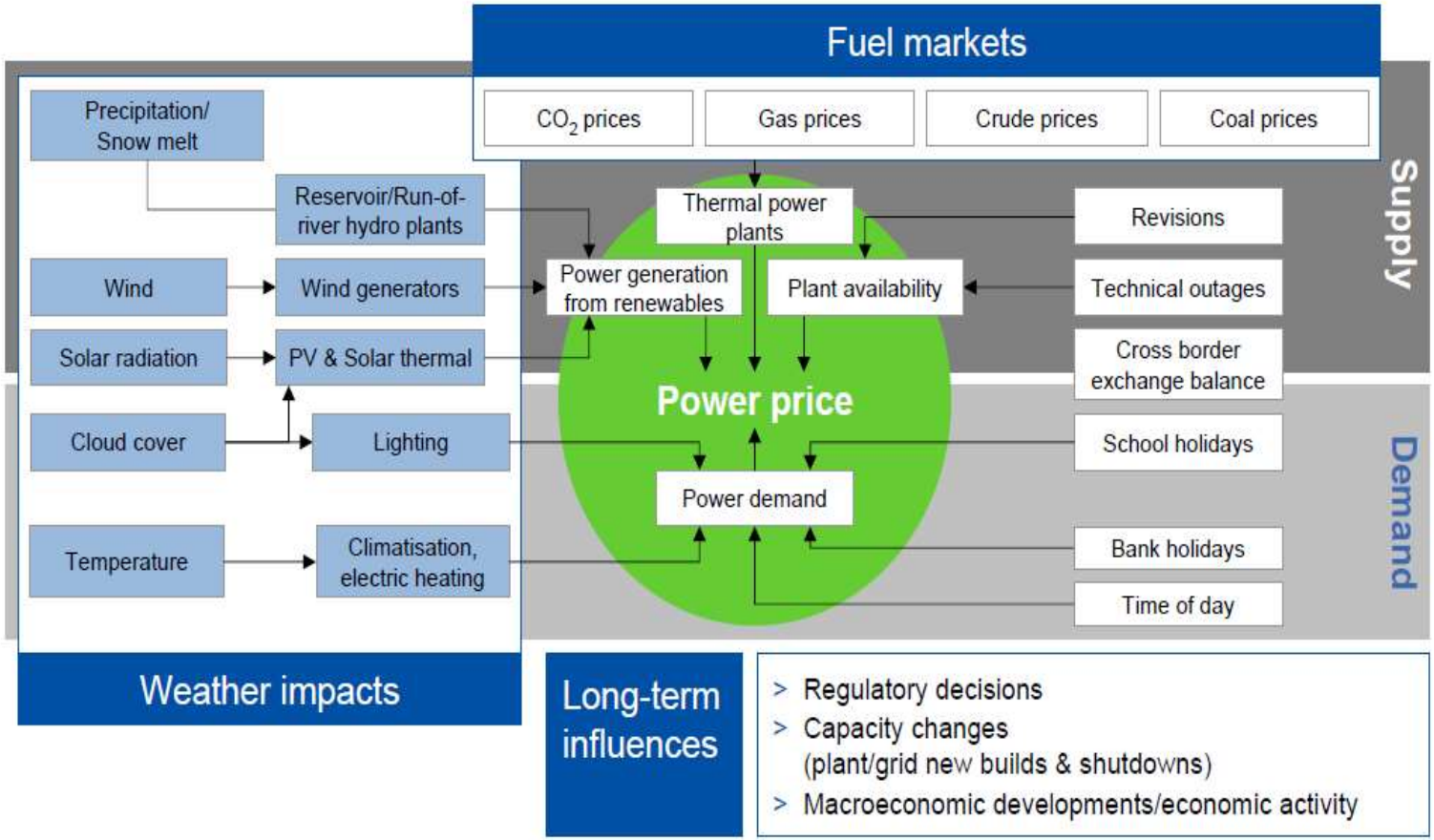




DAM price formation: Supply/Demand balance

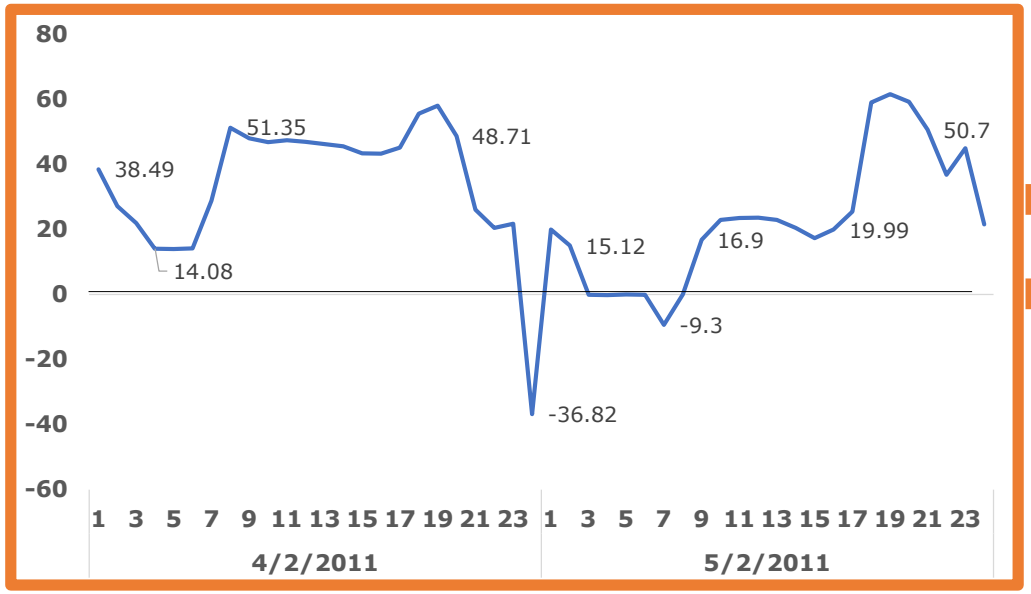


Price Drivers



Impact of RES on market prices

Snapshot of the appearance of negative prices in Day-Ahead Prices of EEX per hour (€/MWh), [4/2/2011 – 5/2/2011]



Greater Volatility of Prices

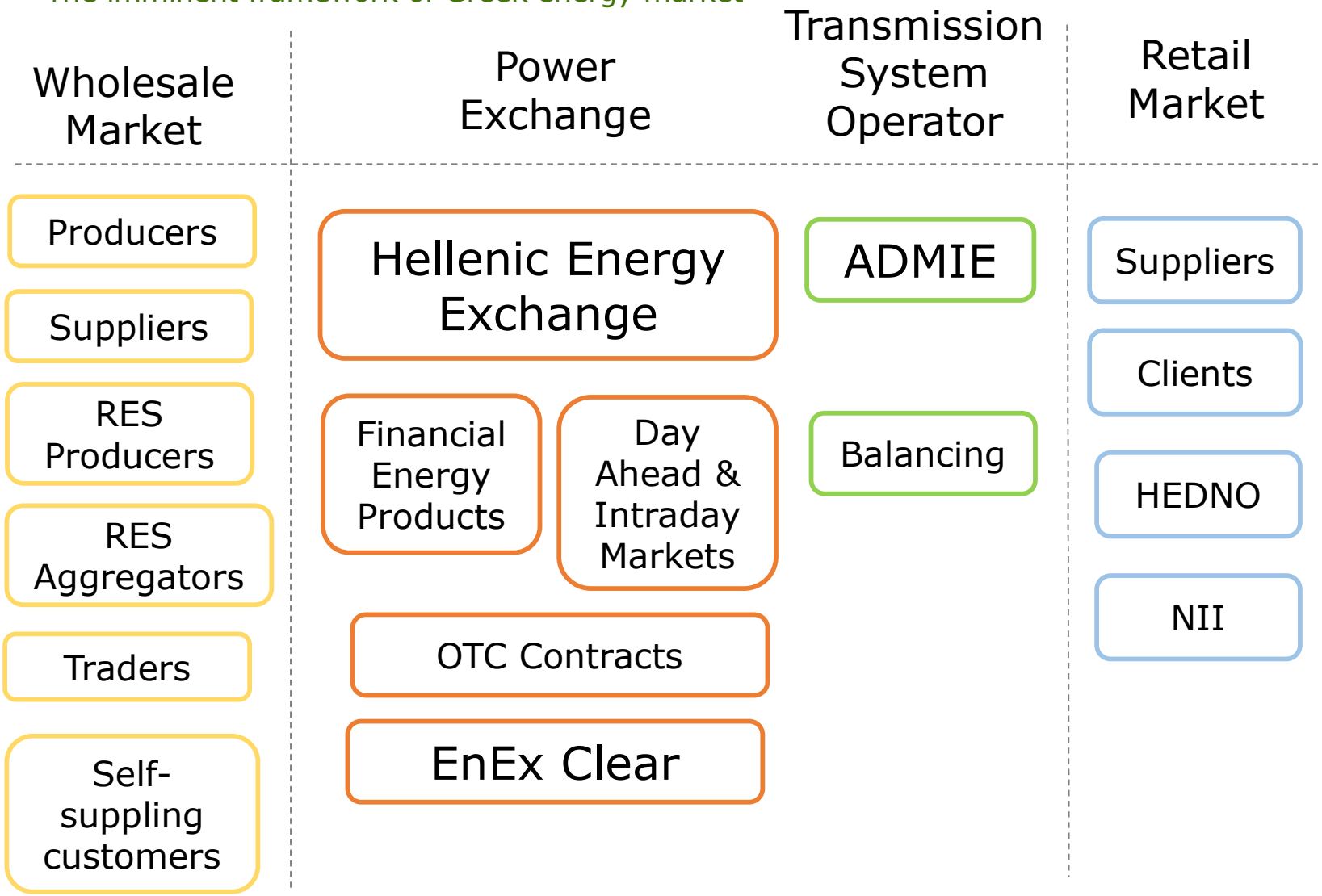
Higher Occurrences of Negative Prices coming from:

- Must-run nature of wind and solar energy
- Lack of Flexible back-up generation

Source: EEX

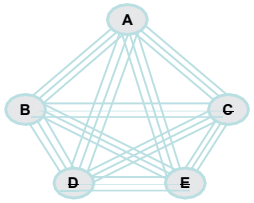
Hellenic Energy Exchange will organize and operate Greece's new electricity, natural gas and environmental markets

The imminent framework of Greek energy market



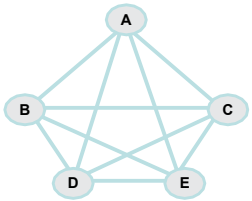
Settlement and clearing is an important part of a market

Bilateral trading without netting



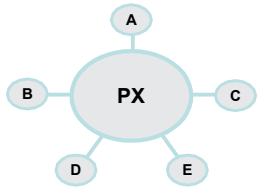
Several counterparties and transactions

Bilateral trading with netting



One transaction for each counterparty

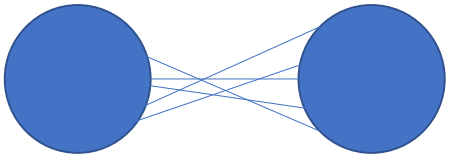
Trading with several counterparties



Always only one counterparty!

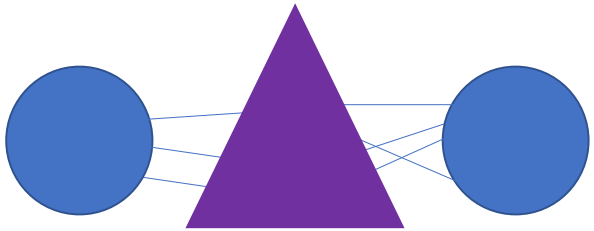
OTC vs Clearing House Indicators

OTC



Dimension	Low	Mid	High
Market Information	X		
Transaction Cost			X
Matching Efficiency	X		
Counterparty Risk			X
Regulation	X		
Operational Risk			X
Transparency	x		

Clearing House



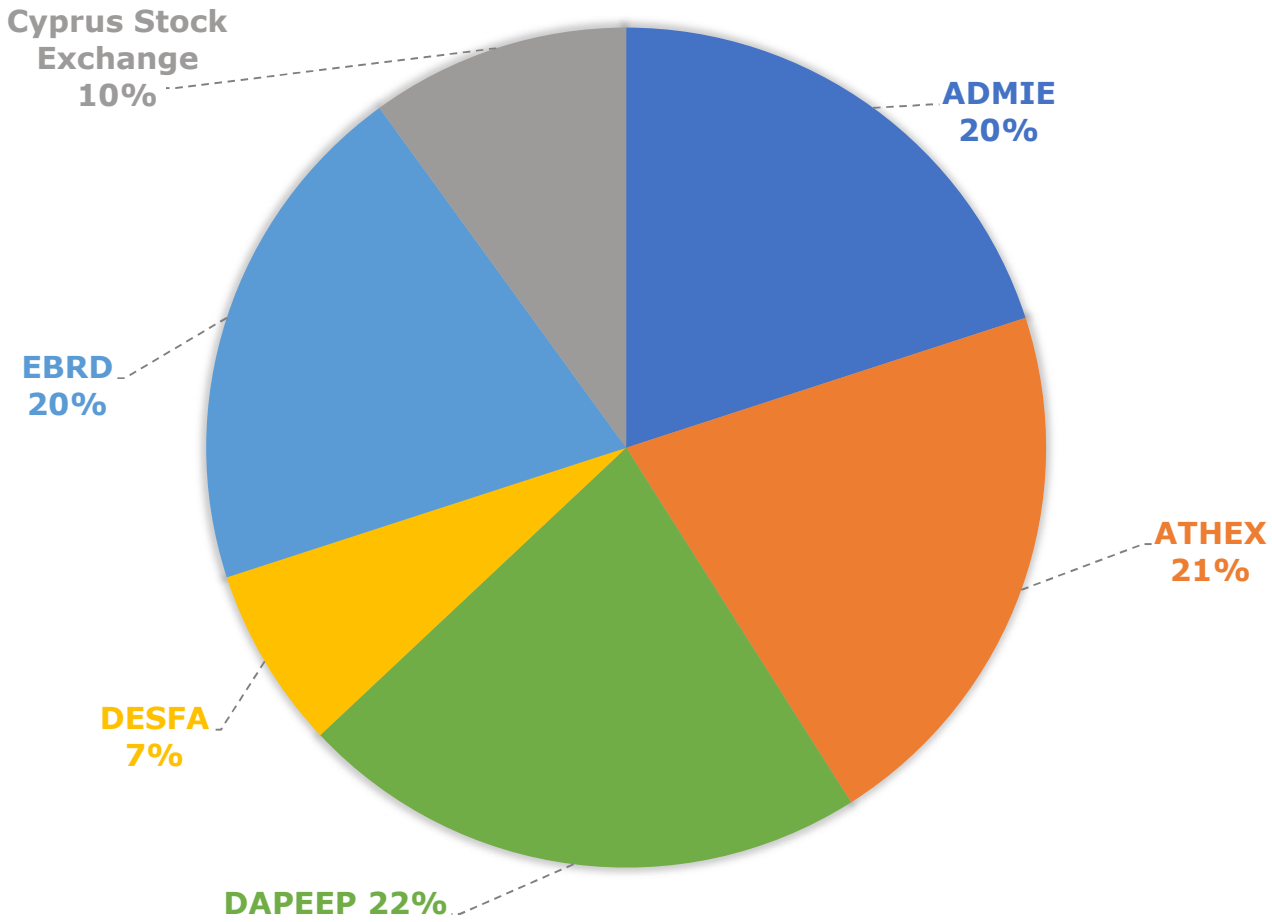
Dimension	Low	Mid	High
Market Information			X
Transaction Cost	X		
Matching Efficiency			X
Counterparty Risk	X		
Regulation			X
Operational Risk	X		
Transparency			x

Liquidity Indicators

Stability Indicators

HEnEx is anticipated to encourage competition, guarantee transparency, enhance liquidity and facilitate integration with the rest European electricity markets

Hellenic Energy Exchange ownership structure



Source: HEnEx

The two pillars of the imminent wholesale power market are the power exchange and Over the Counter transactions (OTC)

Wholesale market structure