Energy Security and Energy Transition in SE Europe

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INSTITUTE OF ENERGY
FOR SOUTH EAST EUROPE

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Raison d' Être – Why are we Interested in SE Europe?

- **For several reasons:** The prime being the geographical proximity to the main European landmass but also because of the substantial economic and trade connections of SEE to the rest of Europe.

- SE Europe (lately including the East Med), on the strength of its history, cultural background and current urban and industrial setting, constitutes a region both geographically and geopolitically important with a strong impact on the rest of Europe.

- SE Europe is fast emerging as a **unique energy bridge** between Eastern energy suppliers (Russia, Caspian region, Gulf area) and Western markets.

- An in-depth study of the energy prospects and perspectives of a particular geographic region, such as SE Europe, has an impressive cumulative effect, as the **sum often exceeds the value of its constituent parts**. Very much along the lines of Aristotle's logic when he proclaimed the *"The whole is greater than the parts"*. Hence, IENE's "SEE Energy Outlook 2016/2017".

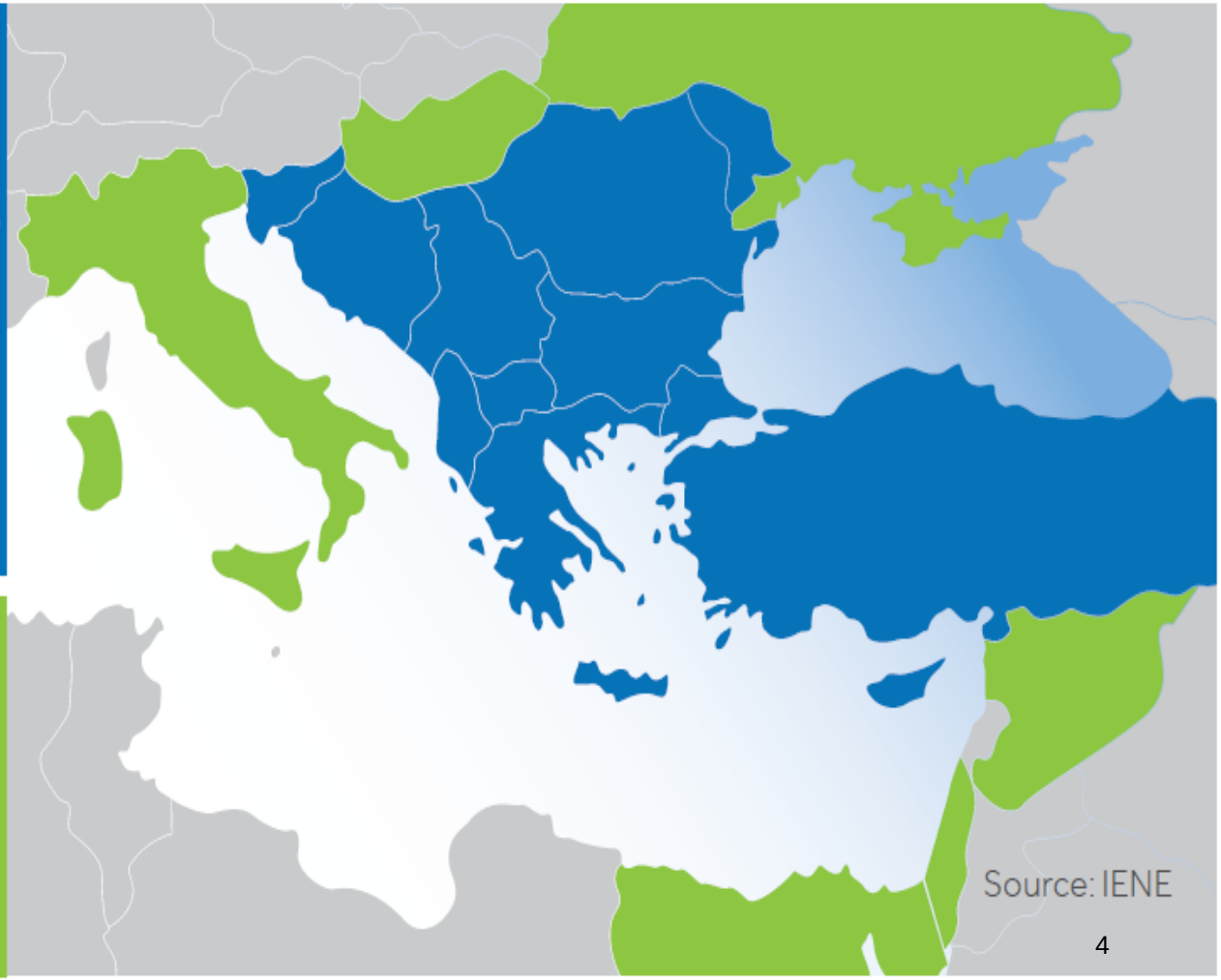
The SE European Region Defined

Core Countries

- Albania
- BiH
- Bulgaria
- Croatia
- Cyprus
- FYROM
- Greece
- Kosovo
- Montenegro
- Romania
- Serbia
- Slovenia
- Turkey

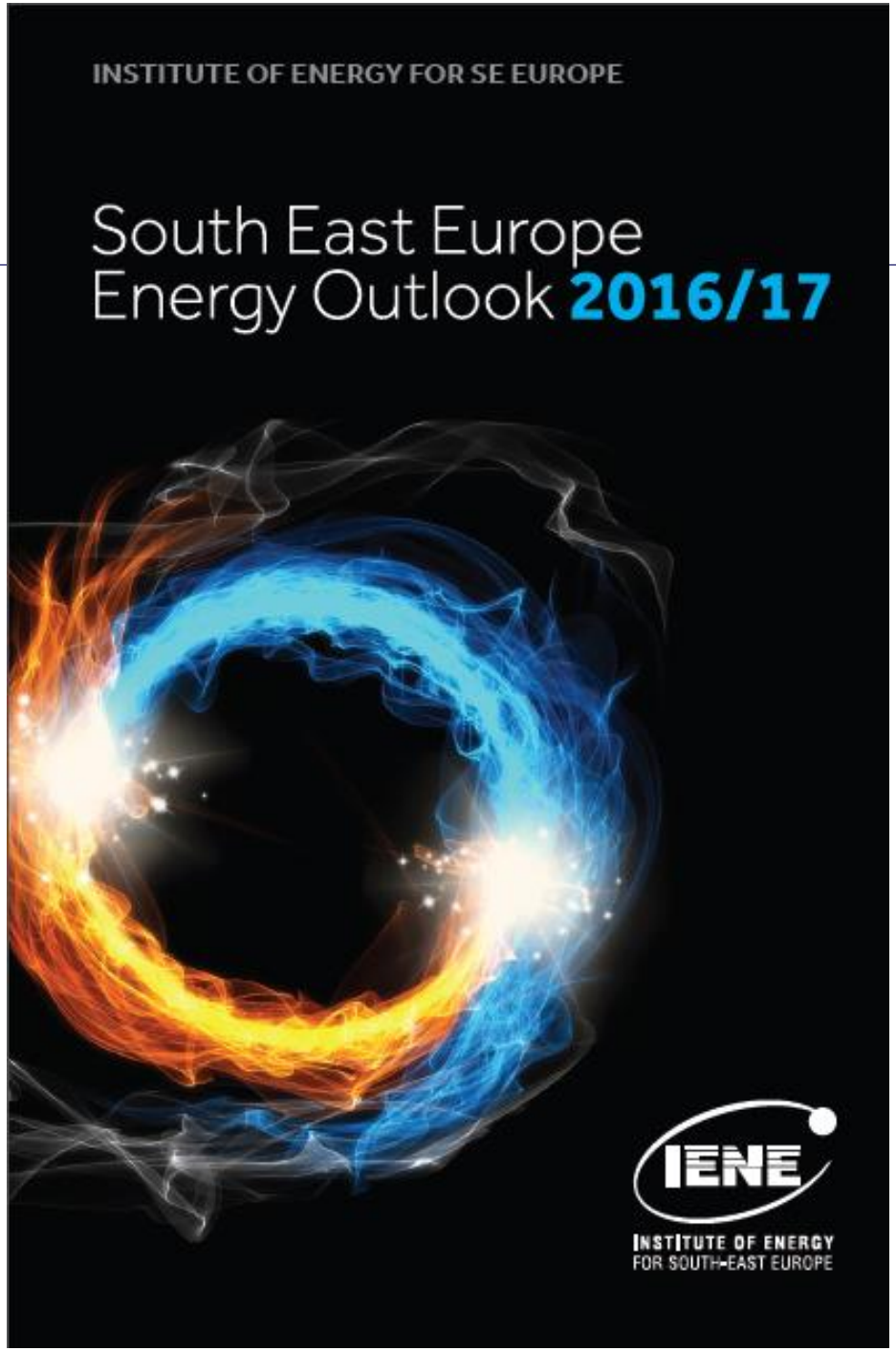
Peripheral Countries

- Egypt
- Hungary
- Israel
- Italy
- Lebanon
- Moldova
- Syria
- Ukraine



Energy Market Integration and Transition in SE Europe

- As the economies of SEE countries are catching up with those of the rest of Europe, energy plays an **important role** both from financial/investment perspective but also because of market development (i.e. liberalization, competition, etc.)
- Although **considerable progress** has been achieved in recent years on energy market integration, the region faces today serious challenges when it comes to adapting its energy systems and energy markets to meet EU basic targets (i.e. decarbonization, RES penetration, energy efficiency)
- Today, we observe **great divergence** in the degree of adaptation between the different country groups of the region. EU member states having achieved market integration to a large extent with further progress ahead, while West Balkan countries, with the help of Energy Community, trailing behind but on a firm footing as their regulatory authorities and other institutions are now taking the lead.
- In today's exposition, we are greatly assisted from the work undertaken by IENE in its latest **"SEE Energy Outlook 2016/2017"**, published late June 2017. A tremendous amount of data and analysis is contained in this publication which helps us understand the economic and energy dynamics of the region.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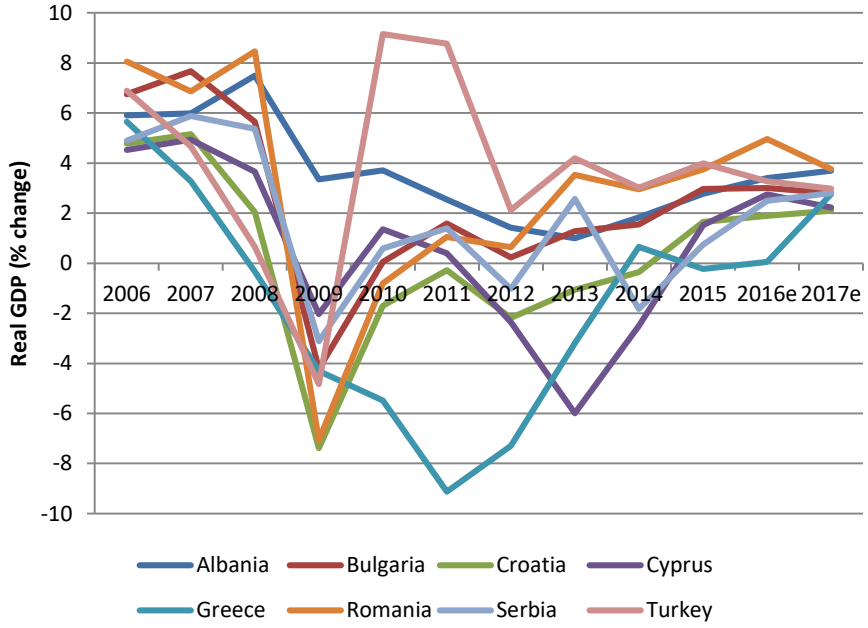
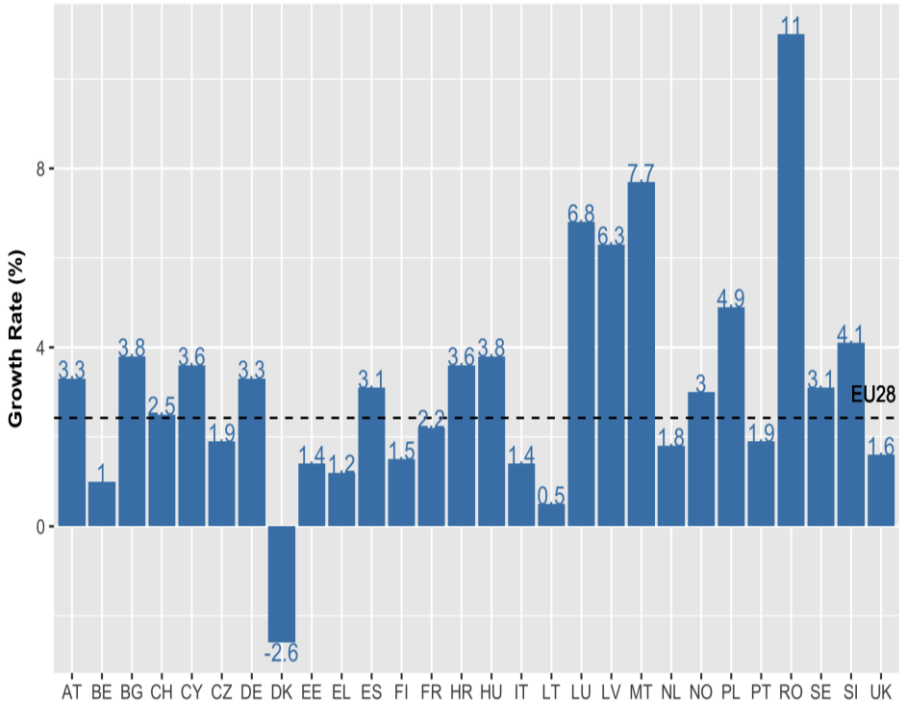
The Economies of SE Europe vs EU-28 – Real GDP



Source: World Economic Outlook Database (IMF, October 2016) and IENE

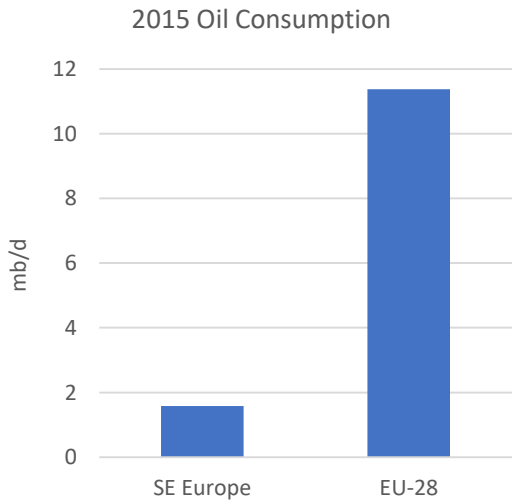


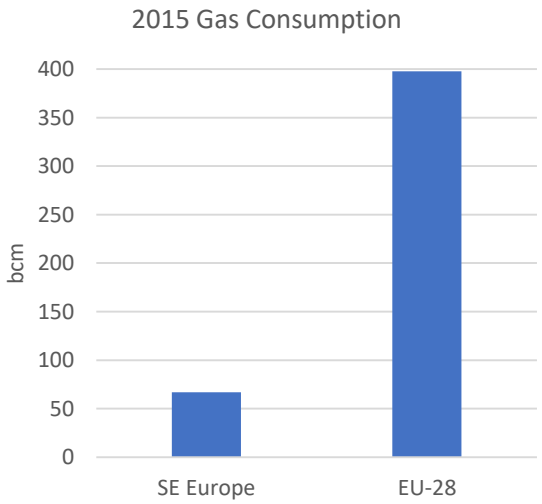
Source: Eurostat (Q32017)

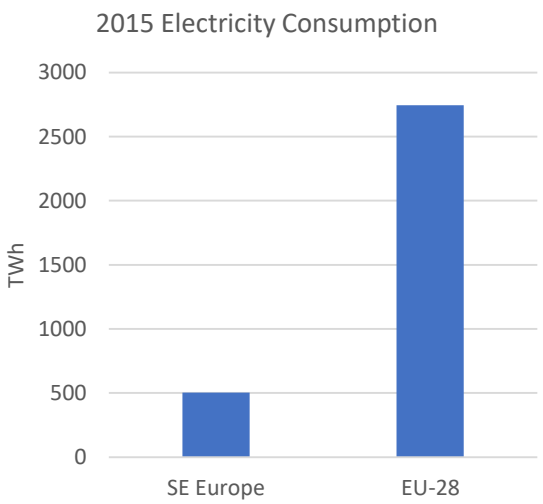
2015 Basic Energy Data for SE Europe

Region	Oil Consumption (b/d)	Gas consumption (bcm/y)	Electricity consumption (TWh)
SE Europe	**1,579,870 (≈13.9% of EU-28)**	**67.00 (≈16.8% of EU-28)**	**504.2 (≈18.4% of EU-28)**
EU-28	**11,376,680**	**397.7**	**2,745**

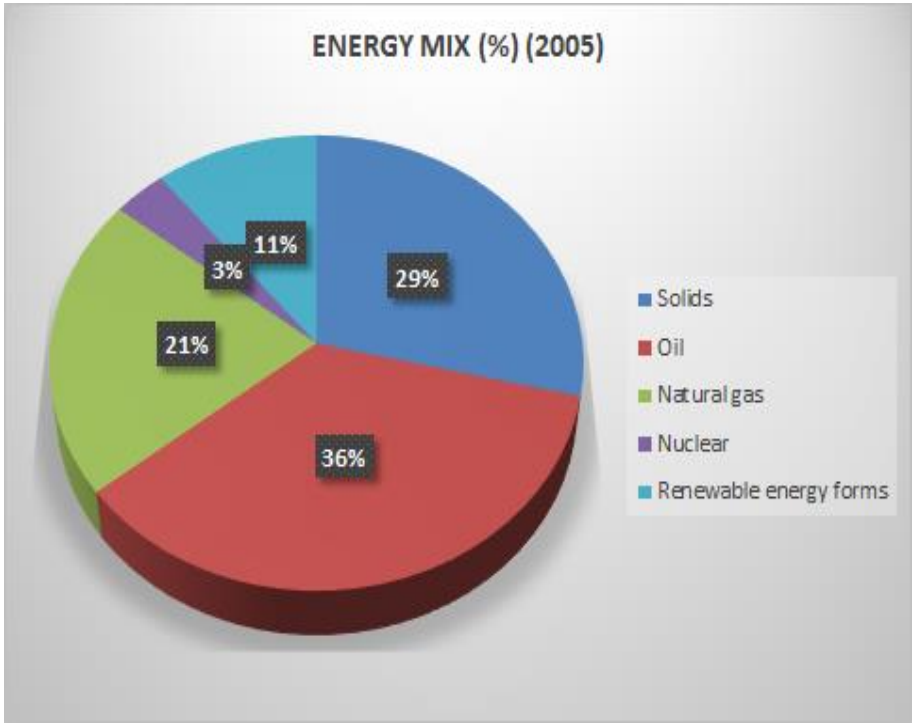
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

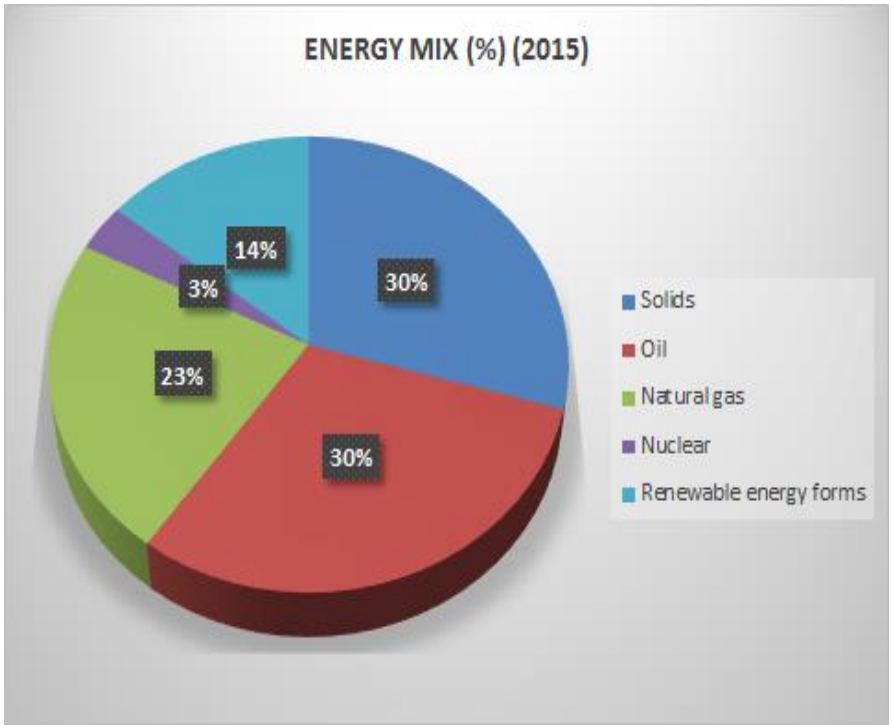






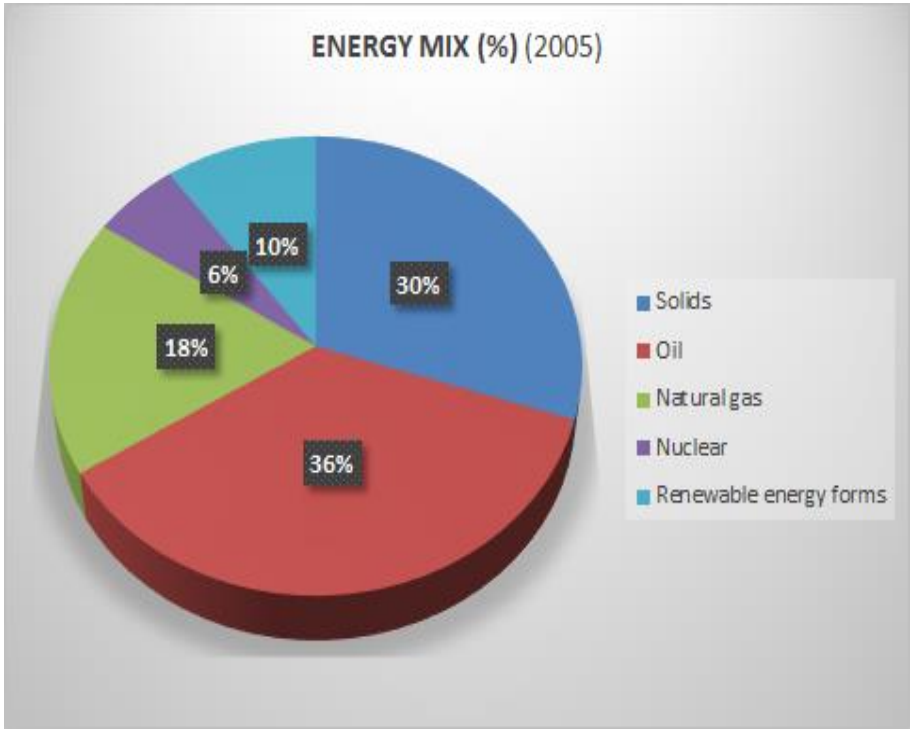
SE Europe: Gross Inland Consumption by Source, **Including Turkey** (2005 and 2015)

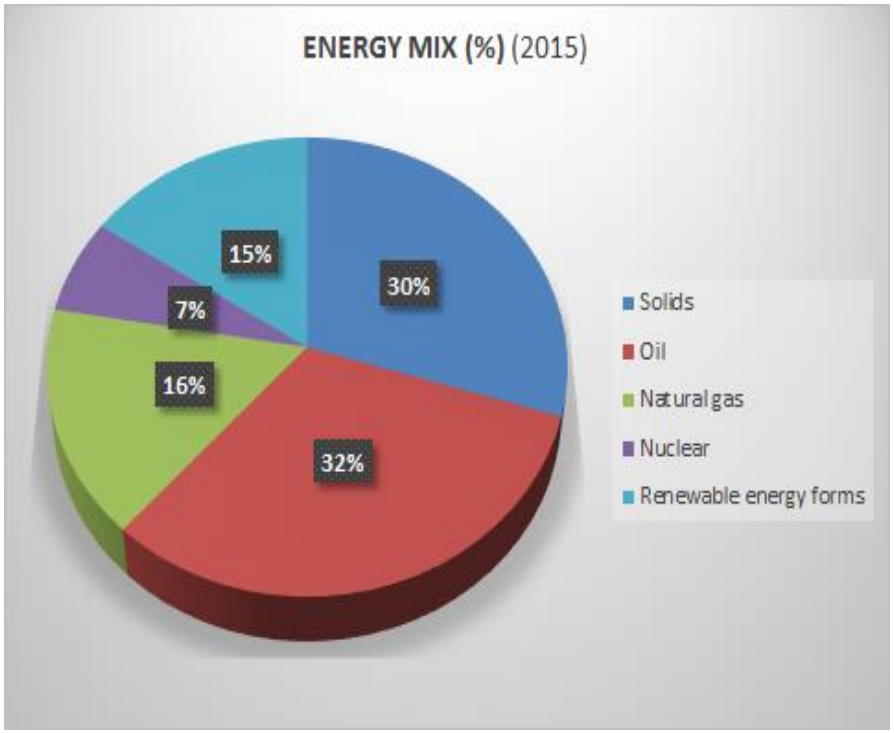




Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Gross Inland Consumption by Source, **Without Turkey** (2005 and 2015)

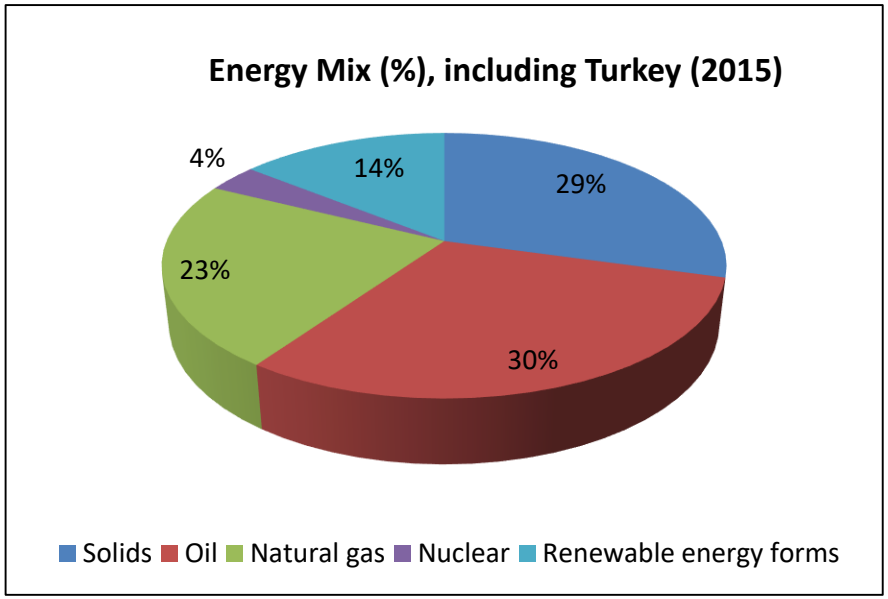


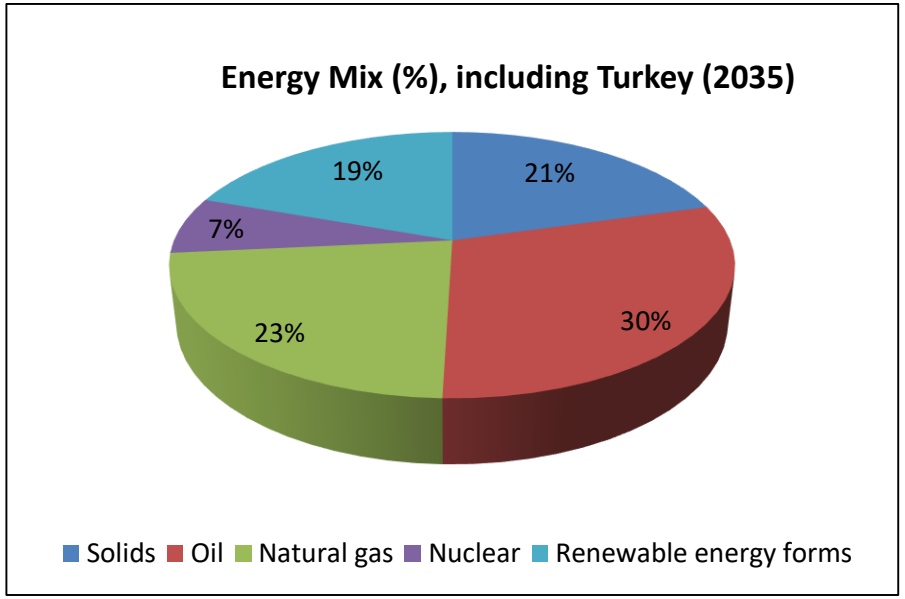


Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

Regional Energy Mix: What Lies Ahead?

- The region's changing energy mix (Comparison between 2015 and 2035)
  - Substantial changes are foreseen over next 20 years with lower use of coal (lignite), stable contribution of gas and oil, more RES penetration and higher use of nuclear power.



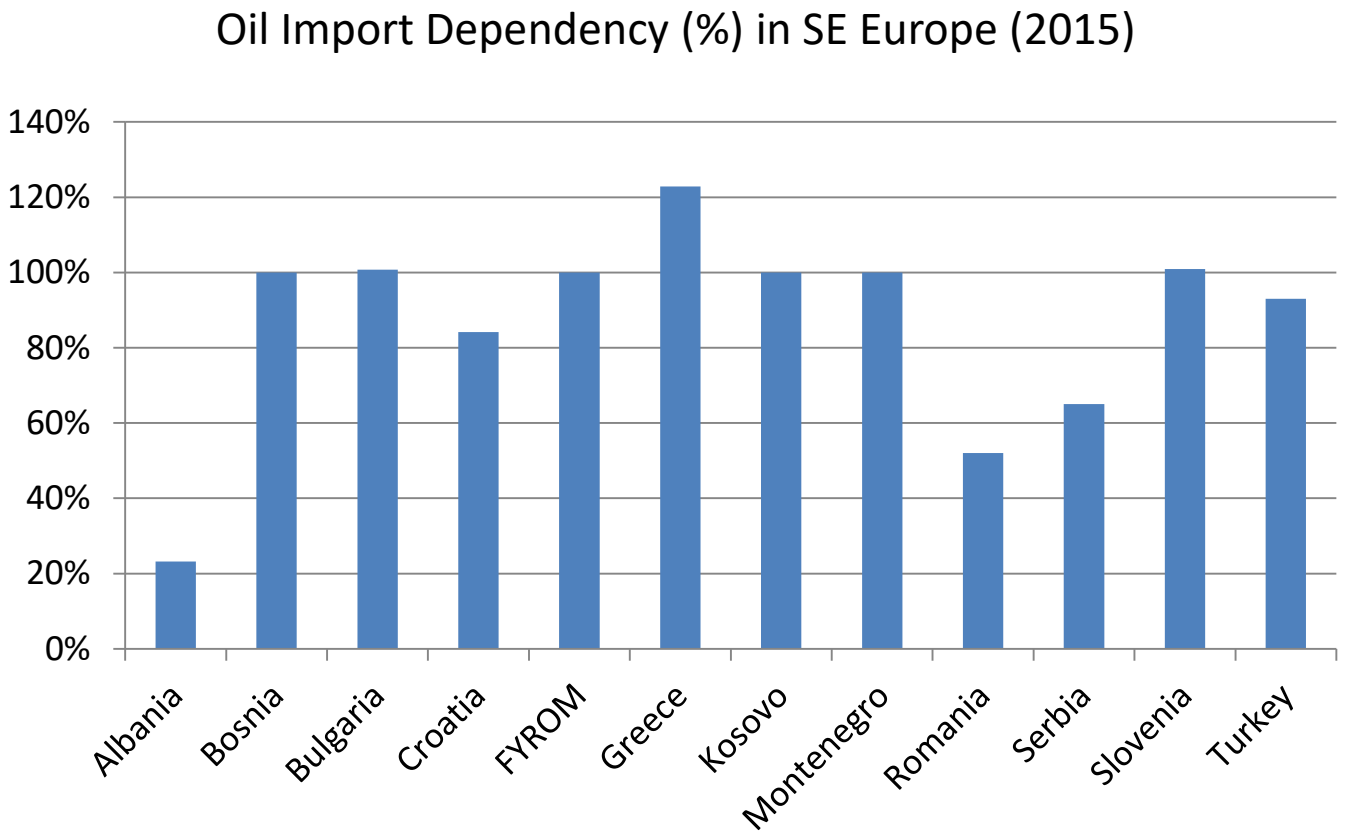


Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

Key Regional Energy Issues

- Marked divergence between EU and SEE energy strategies
- SEE is more energy security vulnerable than the rest of Europe
- Energy supply diversification in SE Europe is less important than security of energy transportation and transmission (oil, gas and electricity)
- SEE's high hydrocarbon dependence
- Electricity's newcomer gas alters supply balance
- Lack of adequate electricity and gas interconnections
- Coal is and will continue for sometime to be relevant
- SEE's path towards decarbonisation is difficult and uncertain
- Nuclear remains a viable option for SEE power generation
- RES growth impeded due to repeated policy failures and electricity grid constraints
- Energy poverty is emerging as a regional concern mainly related to deteriorating social conditions

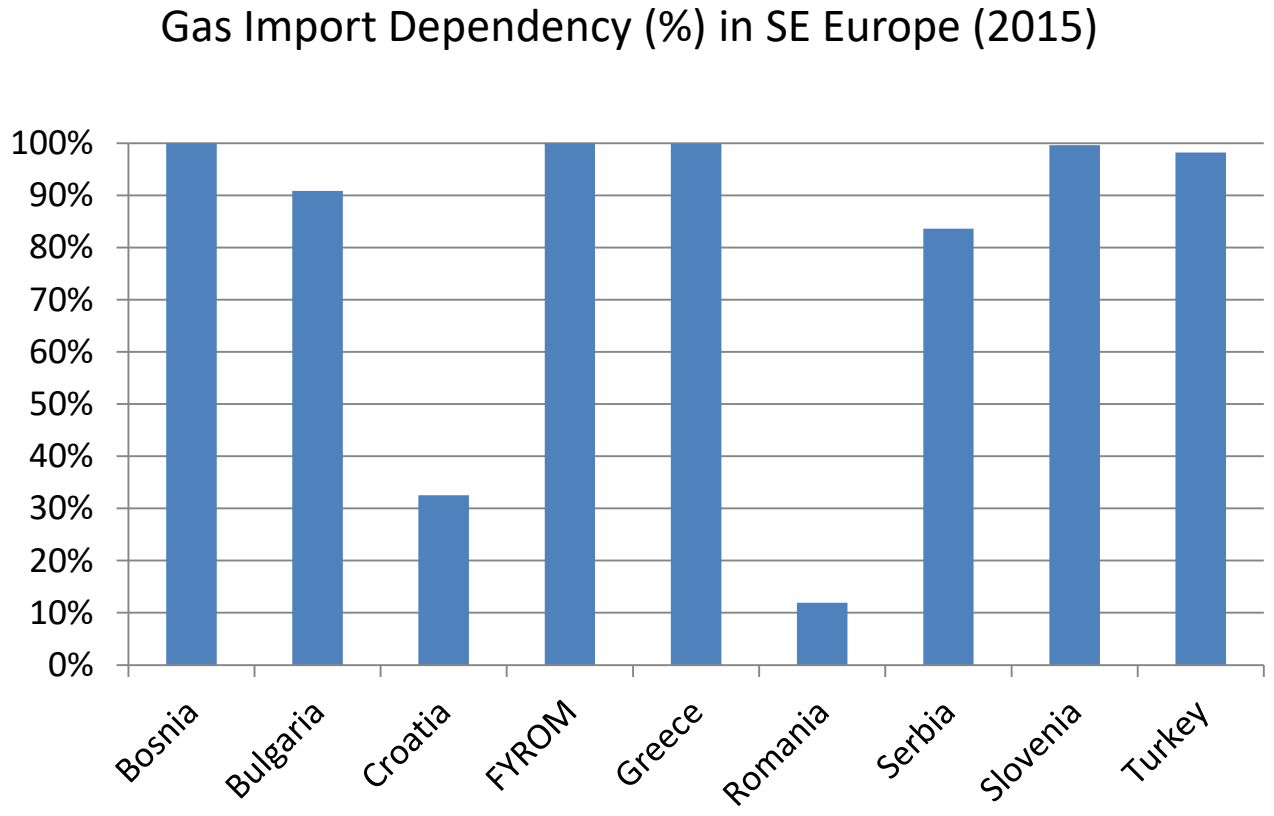
Key Regional Energy Issues – Oil Import Dependency



Note: A dependency rate in excess of 100% relates to the build-up of stocks.

Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

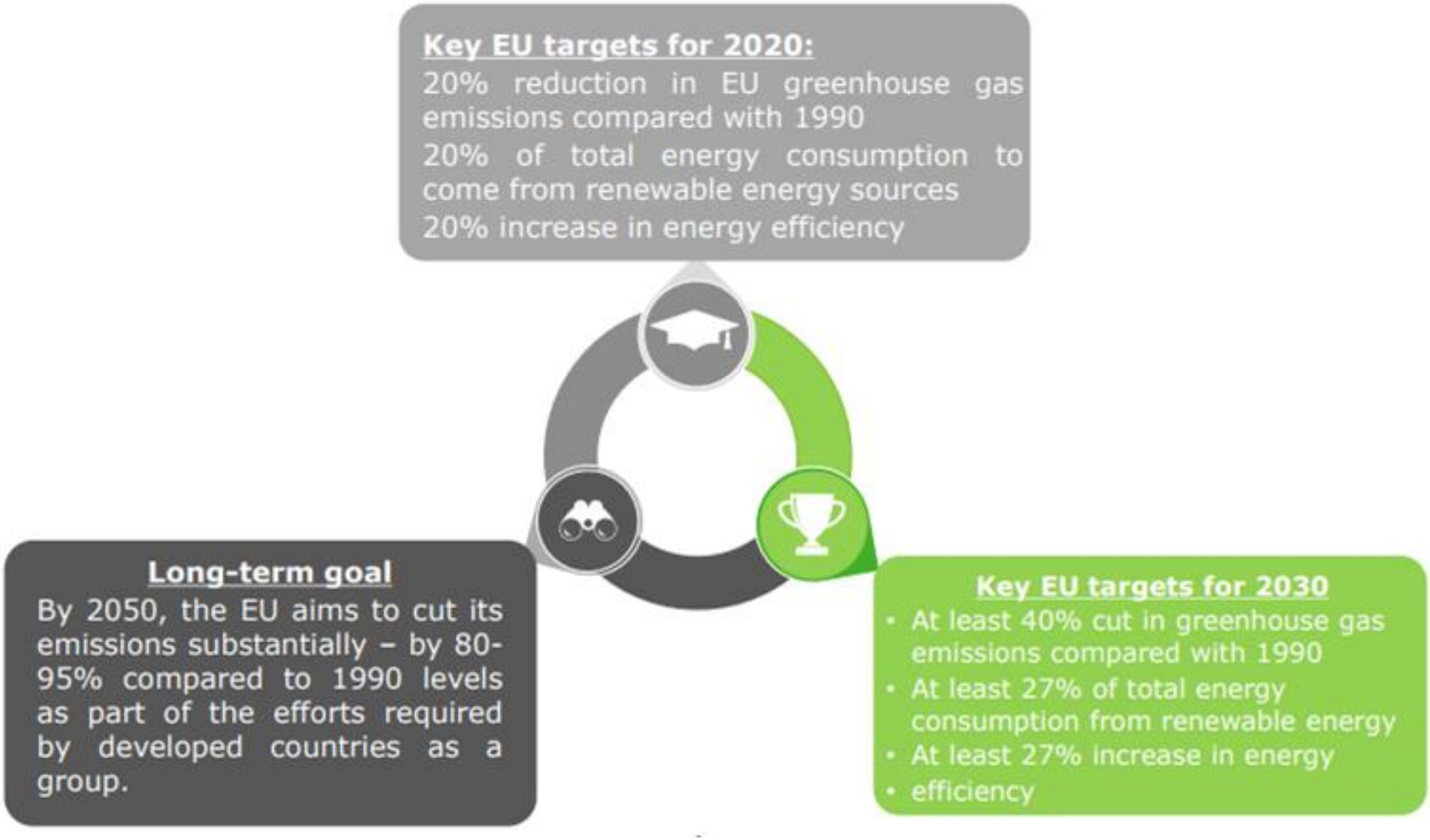
Key Regional Energy Issues – Gas Import Dependency



Note: Albania, Cyprus, Montenegro and Kosovo do not produce, import or consume natural gas

Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

EU Energy Policy Framework (by 2020, 2030 and 2050)



Source: European Commission

EU Energy Policy Framework: How Does This Stand for SE Europe?

- It seems that an **inverted pyramid arrangement** has been developed in SE Europe, compared to pursued official Energy Union policies and stated targets.

- The energy policy priorities of most SEE countries would appear as follows:
  - Further large scale development of **coal and lignite resources** without any recourse CCS/CSU provisions and plans
  - Promotion of **oil and gas exploration activities (onshore and offshore)** aiming towards maximizing production in the mid- and long-term
  - Further development of **renewables** in all application areas (i.e. solar, wind, biomass, hydro and geothermal) without necessarily adhering to the specific ceiling targets set by the EU
  - Promotion of **energy efficiency**, focusing primarily on the building sector
  - Further development of **electricity and gas interconnections**
  - **Diversification** of energy supply routes and supplies
  - Reduction of CO_2 emission levels

Key Regional Energy Issues – Decarbonisation in SE Europe

Challenges and Trends Towards SE Europe's Decarbonisation:

- The **coal predicament** of SE Europe – the region's great dependence on coal-fired power generation vs GHG reduction targets
  - According to IENE estimates, the **share of solid fuels to power generation** is anticipated to **increase steadily** in several countries of the region (most notably in Serbia, Kosovo, Croatia, Bosnia and Herzegovina, Montenegro and Turkey) over the next 10-15 years, as they will struggle to meet increased demand.
  - **FYROM and Serbia are the second most coal dependent countries after Kosovo at regional level**, while future proposed lignite-based coal-fired power plants in Bosnia and Herzegovina and Serbia would not be in line with EU climate targets, and would downgrade the solar PV, wind, hydropower, and biomass opportunities in the region.
  - **Effective climate change policies in SE Europe have not been implemented so far**, but there is still room for change in order to avoid becoming further "locked in" to the use of fossil fuels.
  - In SE Europe, **economic development**, largely based on the utilization of indigenous lignite/coal resources, **will have to be reconciled with COP 21 commitments**. Therefore, the planning of clean-cut and compatible long-term energy and economic strategies becomes a real challenge.
    - A lot more analytical and assessment work (e.g. examine CCS/CCU options) needs to be undertaken before introducing realistic policies for decarbonisation.

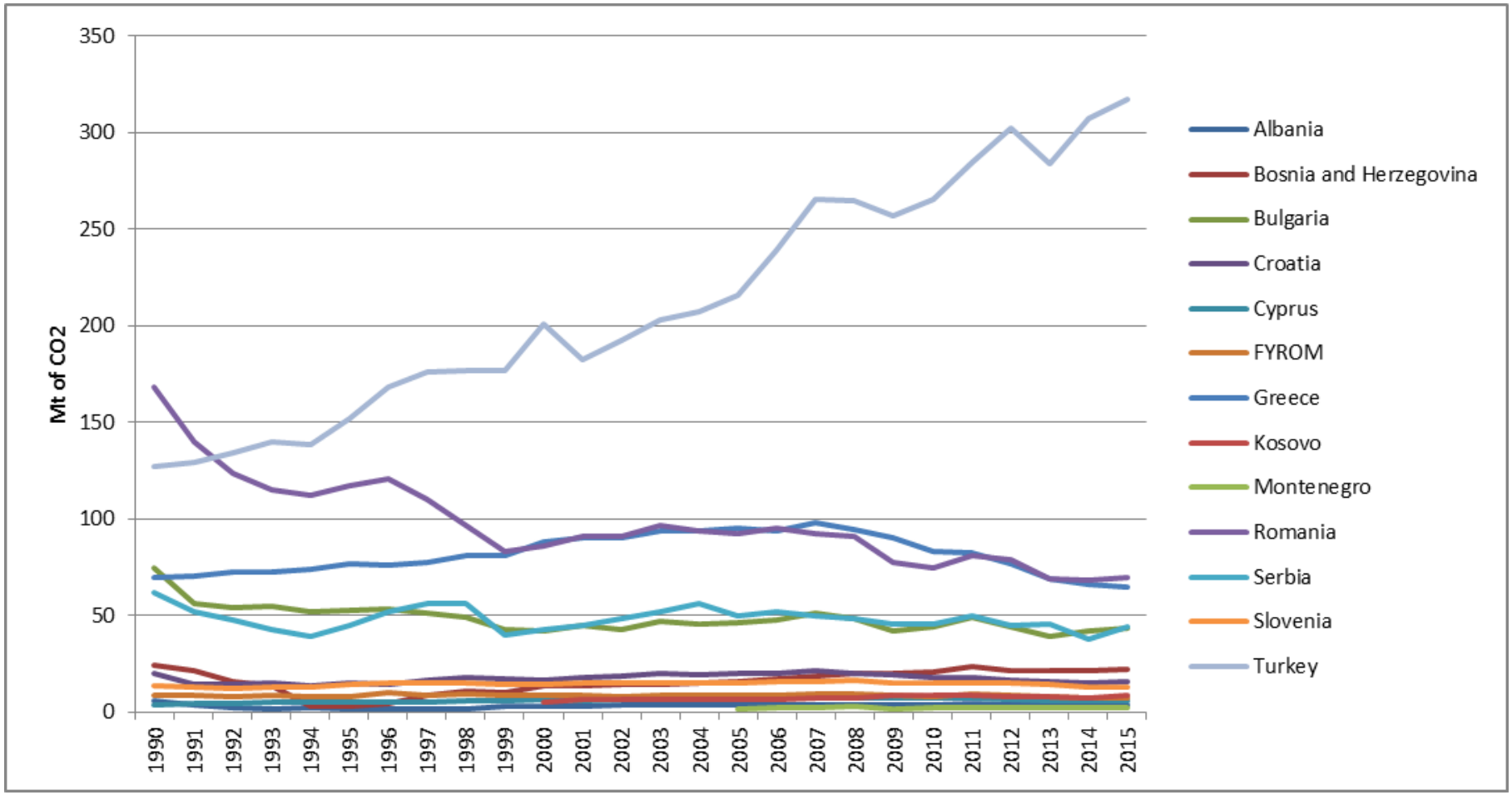
Coal Plants in SEE Countries (as of July 2017) (MW)

Country	Announced New Plants	Pre-permit	Permitted	Announced + Pre-permit + Permitted	Under Construction	Shelved	Operating	Cancelled (2010-2017)
Turkey	22,410	28,991	8,229	59,630	2,640	19,469	16,012	26,654
Bosnia and Herzegovina	1,800	0	1,700	3,500	0	0	2,065	1,450
Serbia	2,550	350	0	2,900	0	0	4,294	320
Greece	450	0	0	450	660	0	4,925	800
Albania	0	0	0	0	0	0	0	800
Kosovo	0	500	0	500	0	0	1,290	330
FYR of Macedonia	300	125	0	425	0	300	699	0
Montenegro	0	254	0	254	0	0	225	1,410
Romania	0	600	0	600	0	0	5,460	5,105
Bulgaria	0	0	0	0	0	0	5,014	2,660
Slovenia	0	0	0	0	0	0	1,194	0
Croatia	0	0	0	0	0	0	335	1,300

Note: Includes units of 30 MW and larger

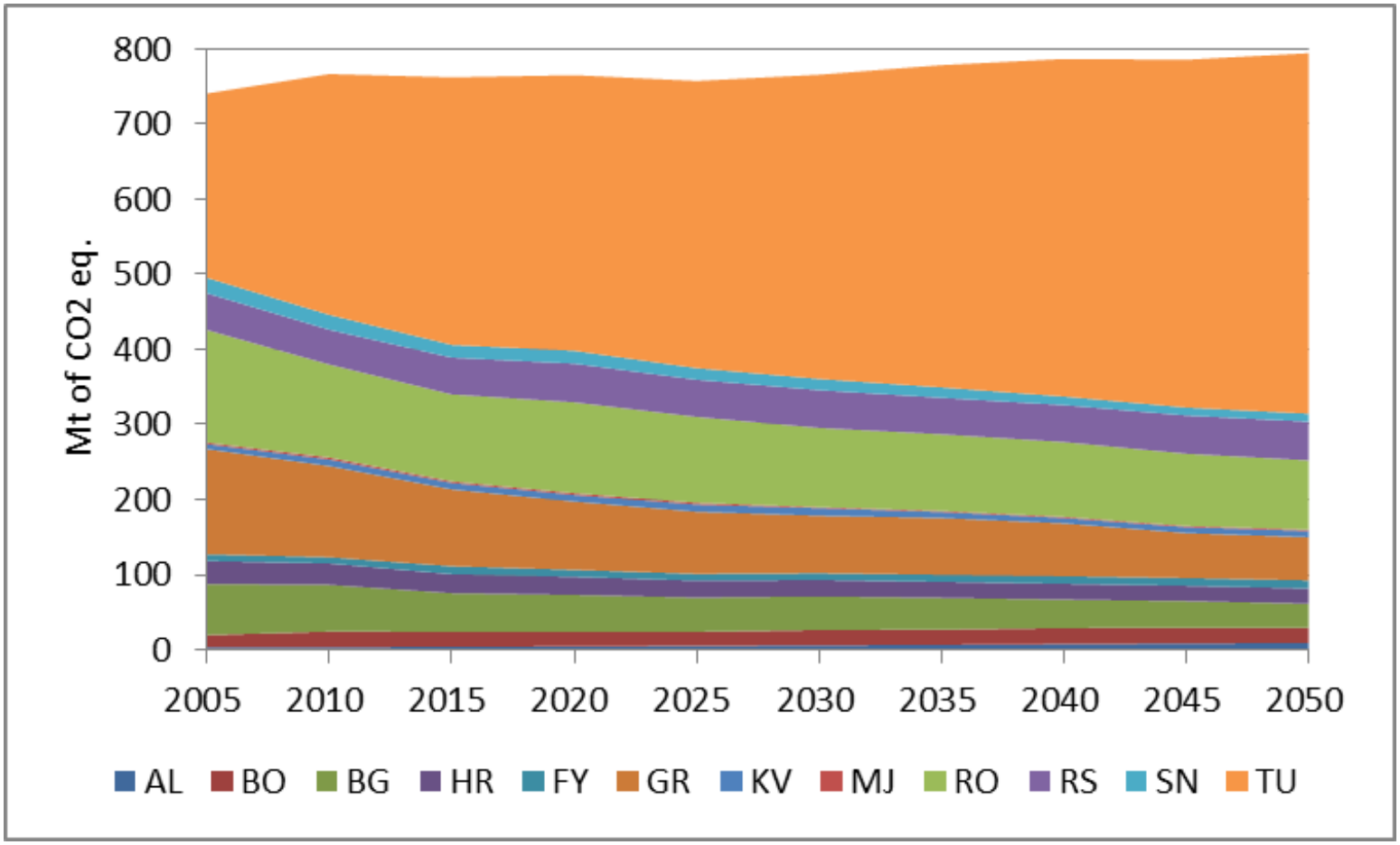
Sources: Endcoal, IENE

CO_2 emissions in SE Europe over 1990-2015



Sources: IEA, IENE

Total GHG Emissions (Mt of CO_2 eq.) in SE Europe over 2005-2050



Source: IENE

Decarbonisation and Related Technologies

- The road to decarbonisation can be approached at two levels:
  - through **policy**, which incorporates the aforementioned energy mix issue and economic assessment through which the rate of decarbonization is determined.
    - The main question arising therefore is **how the rate of decarbonization can be related to economic development and what the investment implications are** and
  - through **technology**, whose degree of deployment depends on the policies to be implemented and could contribute significantly towards decarbonisation through, for instance, the use of CCS/CCU or dual-fuel power plants.

- More information about energy technologies used in SE Europe is available at: www.iene.eu/microsites/technologies

Key Regional Energy Issues - RES growth in SE Europe is Hindered (I)

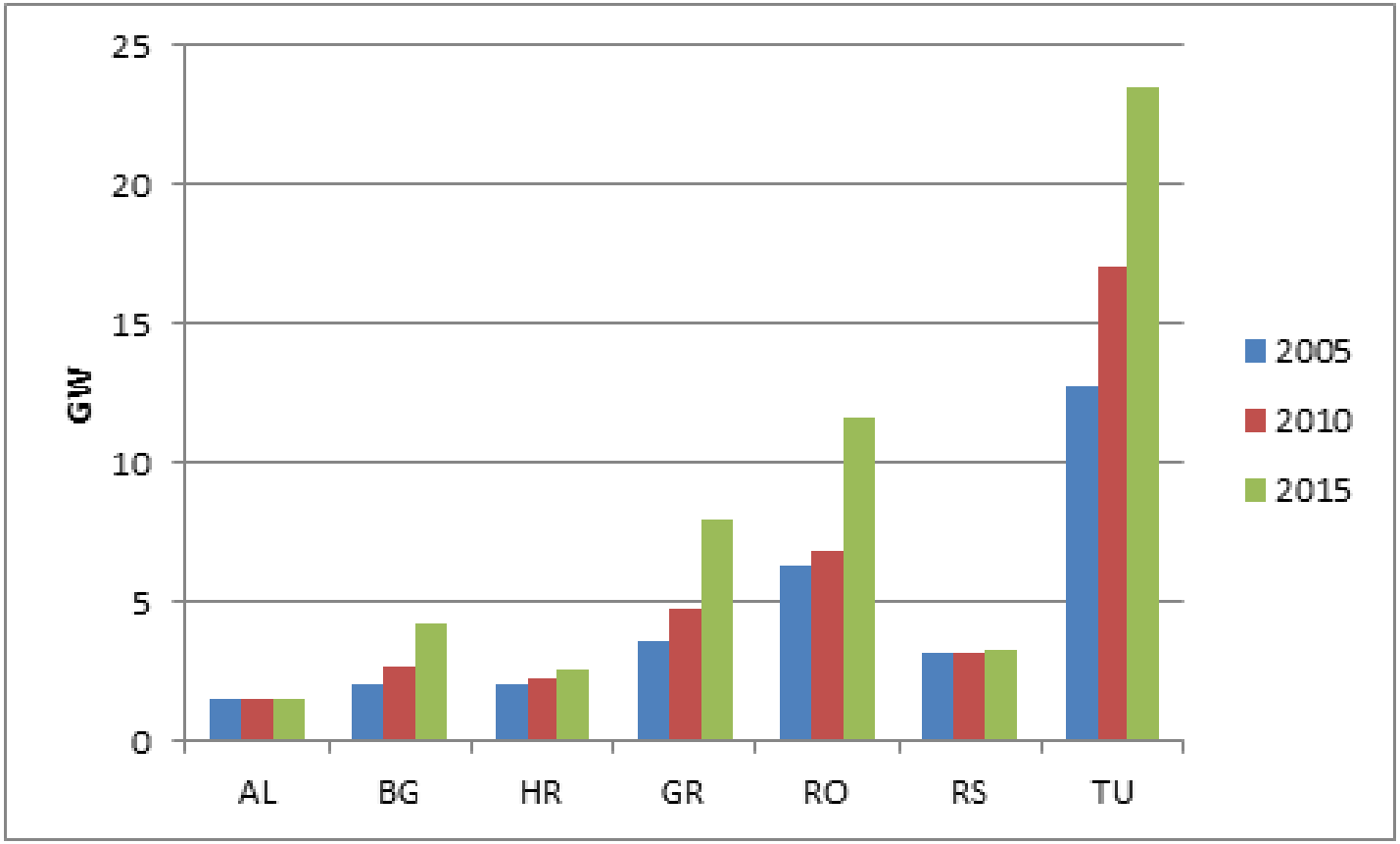
- **Greece** and **Bulgaria** introduced exceptionally high FiTs without a proper financial analysis and cash flow projections showing the impact that RES would have on the national accounts and electricity market operation over a long time period.
- This rapid and unplanned buildup of RES based on high FiTs had a dramatic impact on the electric system leading to large financial deficits for the market operator with big payments delays to producers.
- **Bulgaria** currently has an overcapacity problem and is exporting electricity to Turkey, Greece and the rest of the Balkans, meaning there is little motivation for investment in yet more RES generation capacity.
- **Romania** decided to slash incentives for renewable electricity generation following a dramatic boom in the sector between 2010 and 2013. Bucharest's generous "green certificate" incentive scheme attracted numerous international investors from Europe and Asia, in addition to local companies.
- **Greece** has two main support mechanisms for renewable energy: a feed-in premium and investment subsidies. Latest legislation addresses the shortcomings of the above mechanisms in order to improve market development.

Key Regional Energy Issues - RES growth in SE Europe is Hindered (II)

- The slowing of RES applications over the last 3-4 years has raised questions about whether countries in the region will meet medium- and long-term renewables targets. The abrupt changes to incentive schemes have discouraged many investors and it is uncertain whether they can be lured back.

- A strong RES growth is expected in **Turkey**. According to Turkey's NREAP, the **target for RES generation capacity was set to 61 GW by 2023**; mostly in the forms of hydro, wind and solar generation.
  - 34 GW of hydro generation capacity
  - 20 GW of wind
  - 5 GW of solar and
  - 1 GW in both geothermal and biomass generating capacity by 2023. Geothermal energy will play a small part too, increasing to 600 MW within a decade.

Key Regional Energy Issues - RES growth in Selected Countries



Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

Installed RES Capacity (MW) in SE Europe (2016)

Countries	Wind	Solar	Hydro	Deep Geothermal	Bioenergy	Total RES Installed Capacity
Albania	0	1	2,033	0	0	**2,034**
BiH	0	13	2,140	0	0	**2,153**
Bulgaria	700	1,032	3,219	0	64	**5,015**
Croatia	422.7	49	2,209	0	63	**2,743.7**
Cyprus	157.5	85.7	0	0	9.7	**252.9**
FYROM	37	17	658	0	4	**716**
Greece	2,374	2,611	3,392	0	58	**8,435**
Montenegro	0	3	671	0	0	**674**
Romania	3,130	1,372	6,730	0.05	124	**11,356.05**
Serbia and Kosovo	11	13	3,074	0	11	**3,109**
Slovenia	5	257	1,295	0	64	**1,621**
Turkey	5,376	827	26,710	775	395	**34,083**
Total	**12,213.2**	**6,280.7**	**52,131**	**775.05**	**792.7**	**72,192.65**

Sources: IRENA (2017), IENE study “South East Europe Energy Outlook 2016/2017”, Athens, 2017

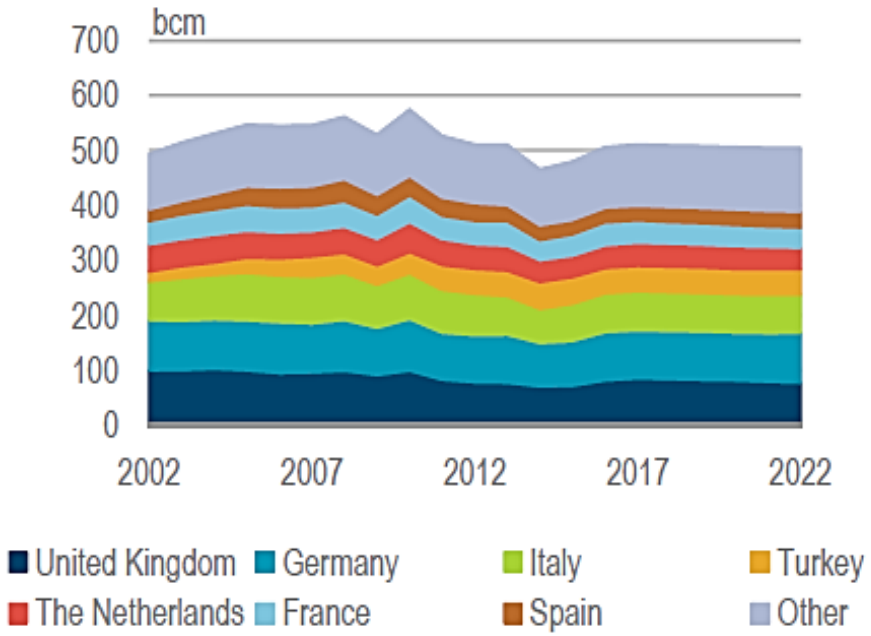
Key Regional Energy Issues
- Energy Security in SE Europe (I)

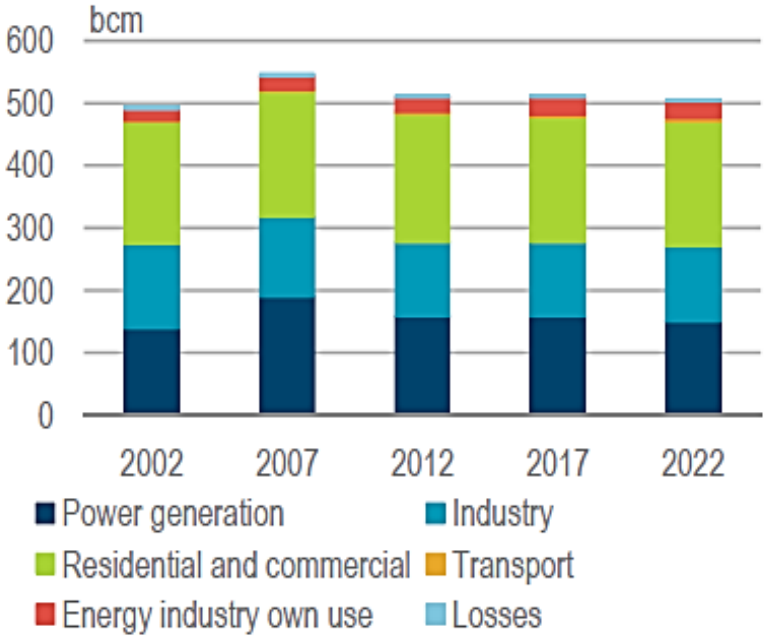
- **Energy security is a complex issue** and as such cannot be considered in isolation.
  - SE Europe because of its geography, its proximity to high risk conflict zones (i.e. Syria, Iraq, Ukraine), a growing and uncontrolled refugee flow from the Middle East and North Africa and the location of some of its countries (i.e. Turkey, Greece, Romania) at vital energy supply entry points, faces **higher energy security threats** than the rest of Europe.
- There is a need to strengthen available mechanisms
  - The **strengthening of Emergency and Solidarity Mechanisms** and the **maintenance of adequate oil, coal and gas stocks**, constitute a short- to medium-term relief solution.
  - The achievement of a **balanced energy mix** provides the best long-term option in enhancing energy security both at country and regional level.
- Security of **supply/demand** and **differentiation of supply sources**
  - In the case of gas, it is becoming more important and pressing compared to other fuel sources, such as electricity, oil, coal and possibly uranium.
  - Gas is a primary area of concern largely because of its rather inflexible transmission method, mainly by means of pipelines.

Energy Security in SE Europe (II)

- Security of **transportation**, shipment of **oil and gas**
  - Gas deliveries were twice disrupted (i.e. 2006 and 2009) with the shipment of Russian gas, through Ukraine, to Europe but also from Turkey and Greece (i.e. 2011 and 2016). More recently (2014), Gazprom halted completely gas supplies to Ukraine for several months.
  - Since then, EU has strengthened its energy solidarity mechanism and created **CESEC** as yet another EU initiative, in order to speed up energy market integration.
- **Smooth supply of electricity** and urgent need to connect various island groups to the mainland grid
  - Mitigation of possible power supply failures and shortfalls and minimization of environmental impact through the retirement of fuel oil or diesel powered electricity generators on several islands.
- **Effective protection of energy infrastructure**
  - Mitigation of terrorist threats and advanced level of safety against of physical hazards (e.g. hurricanes, floods, earthquakes) and cyber threats.
- The various vulnerable key energy infrastructure locations in SE Europe constitute **potential energy security hot spots** and as such should be properly identified (***see following Map***), while also crisis management plans must be prepared in order to meet any emergencies (e.g. physical hazards, large scale industrial accidents or terrorist actions).

OECD Europe's Gas Demand by Country and Sector, 2002-22





Source: IEA Gas Report 2017

Natural Gas Imports to EU

- In 2017, the **total gas imports to EU were 408.7 bcm** – a 21.45 bcm (5.5%) y-o-y growth. By providing over 40% of total gas imports, Russia continues to be the main EU supplier.

By country, % | bcm

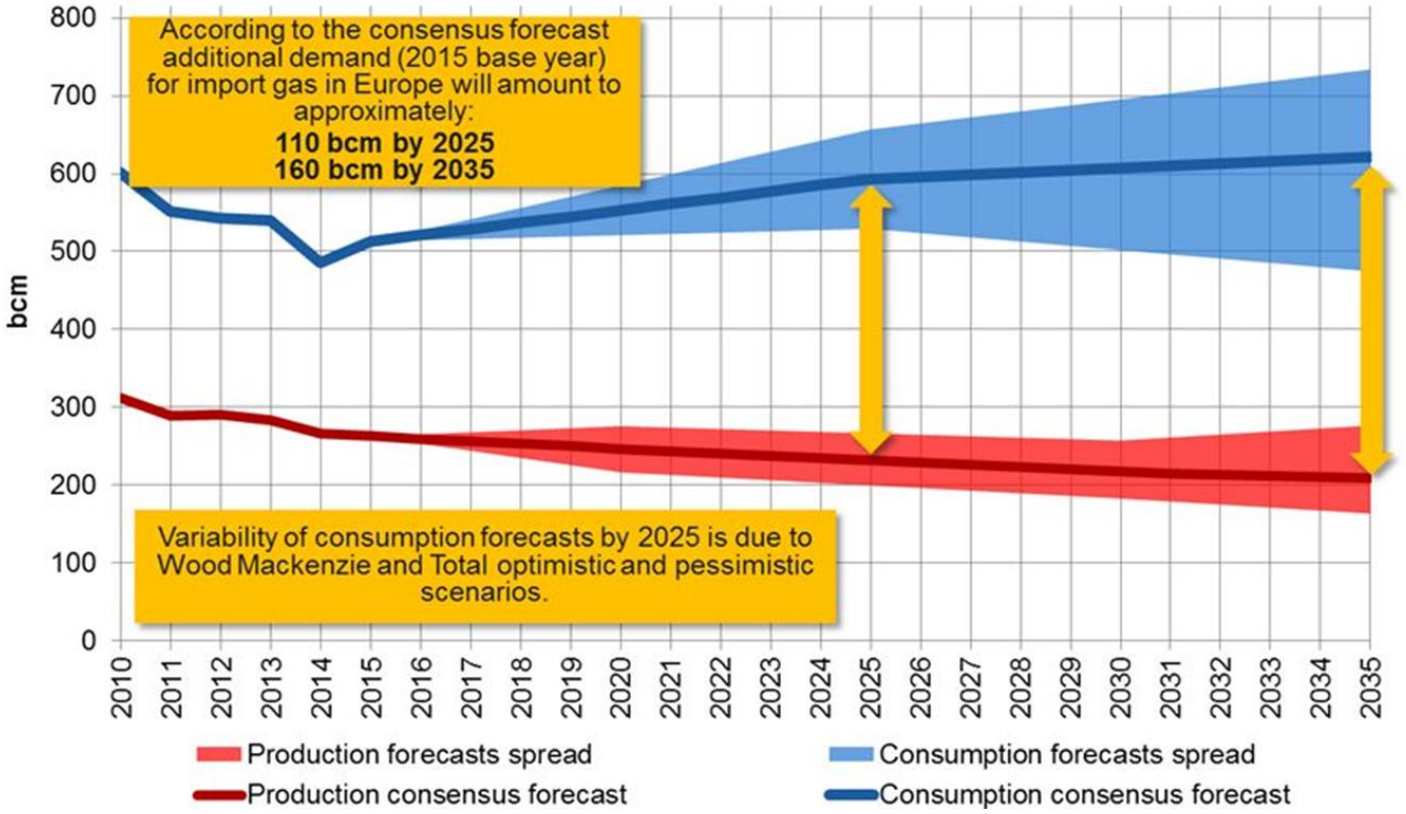
Turkey	0.14% | 0.6bcm -0.05bcm YoY
Algeria	7.91% | 32.3bcm -0.84bcm YoY
LNG	11.61% | 47.4bcm 5.51bcm YoY
Libya	1.08% | 4.4bcm -0.18bcm YoY
Netherlands	10.18% | 41.6bcm -10.25bcm YoY
Norway	27.28% | 111.5bcm 8.91bcm YoY
Other	1.49% | 6.1bcm 3.56bcm YoY
Russia	40.32% | 164.8bcm 14.81bcm YoY

	2017 bcm	2016 bcm
Russia	164.8	150.0
Norway	111.5	102.6
LNG	47.4	40.9
Netherlands	41.6	51.8
Algeria	32.3	33.2
Libya	4.4	4.6
Turkey	0.6	0.6
Other	6.1	2.5

Source: McKinsey Energy Insights

European Gas Demand and Production Gap

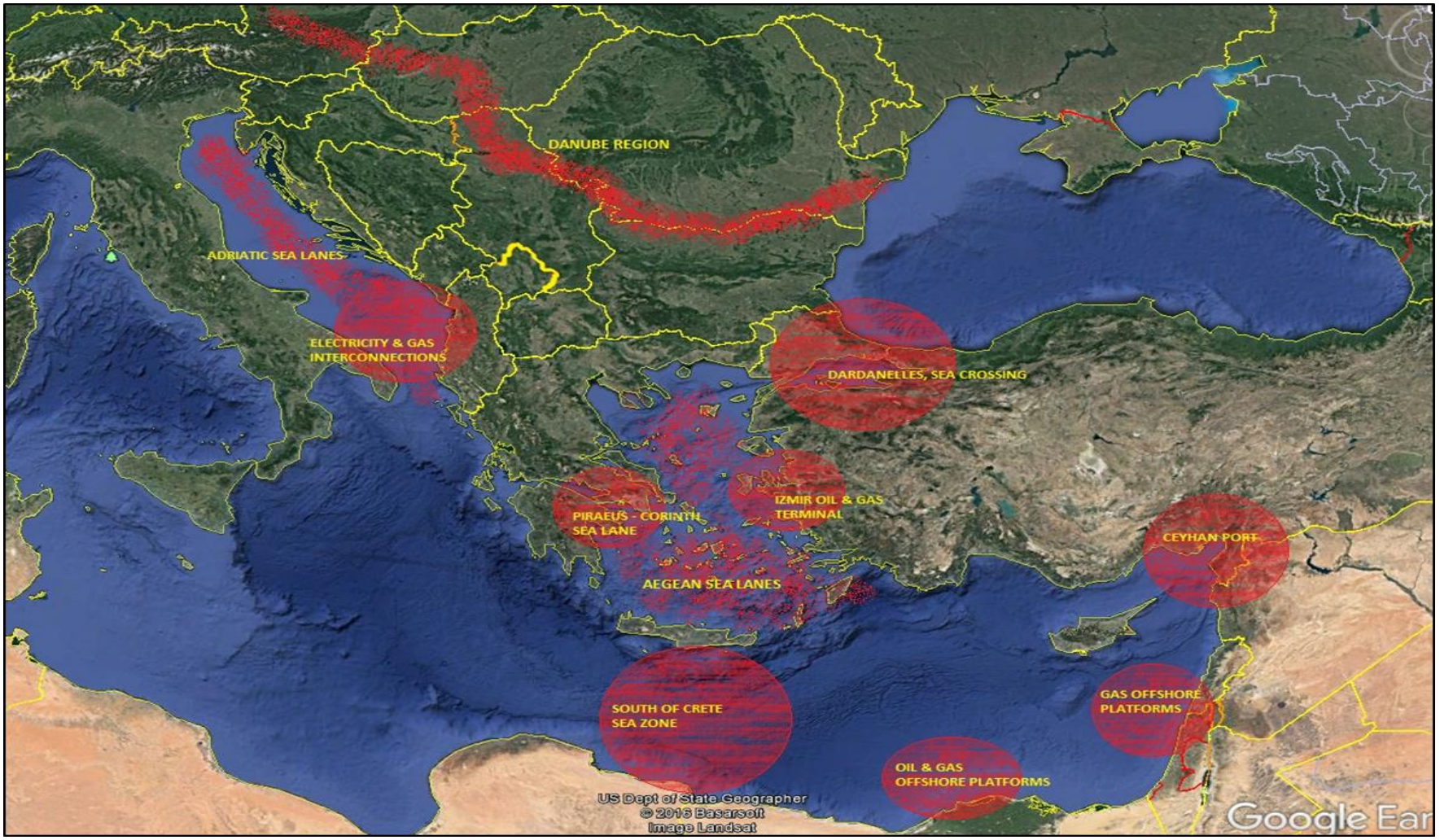
- Due to the falling indigenous production, European demand for additional gas imports may be **110 bcm by 2025** and **160 bcm by 2035**, according to Gazprom Export.



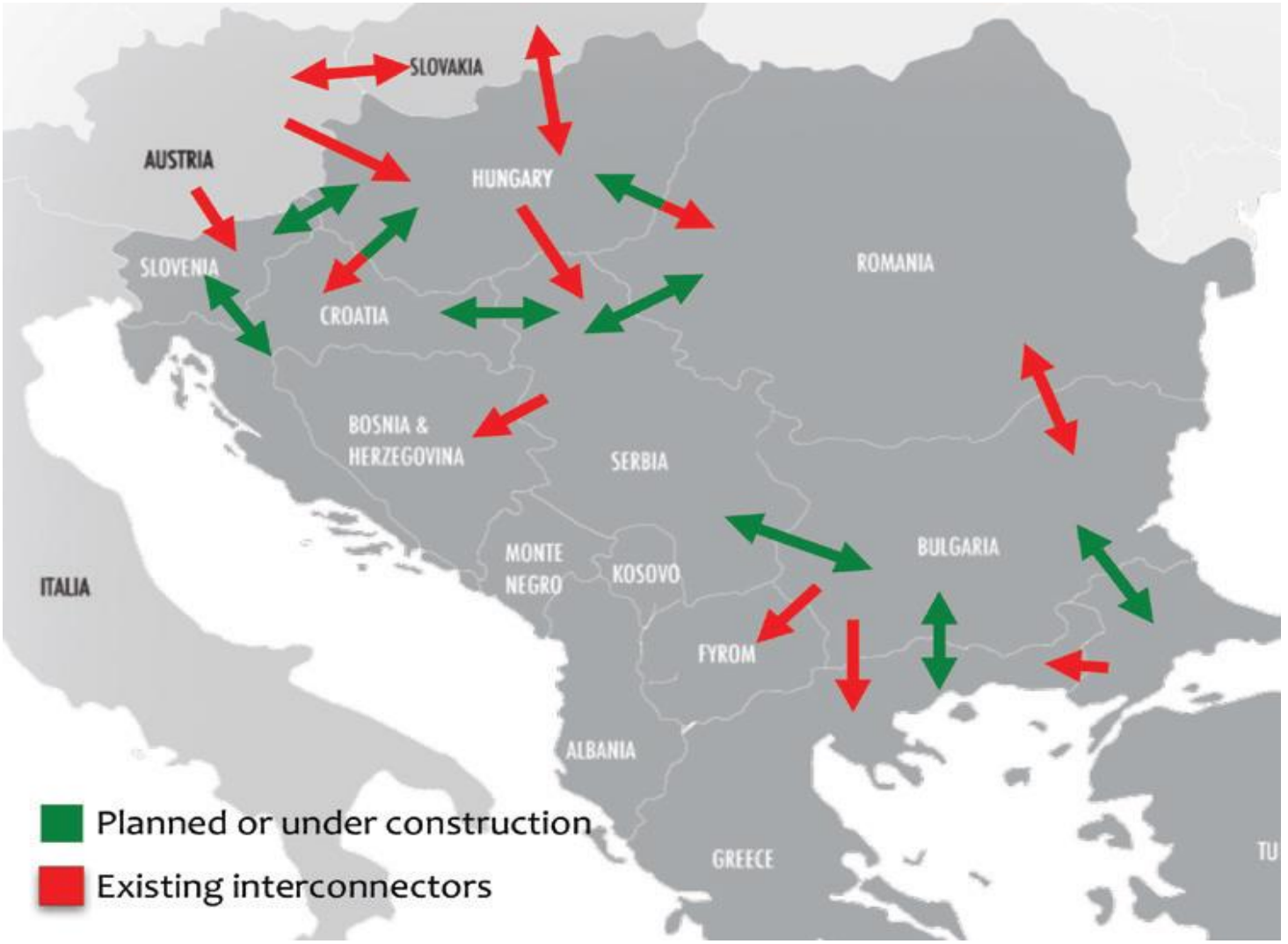
Source: Gazprom Export

Energy Security in SE Europe (III) – The Role of Turkey and Greece as Transit Countries in Securing Energy Supplies to European Markets

- Oil, Gas, Electricity and Security implications



Gas Interconnections in SE Europe



Source: IENE study “South East Europe Energy Outlook 2016/2017”, Athens, 2017

Energy Security in SE Europe (IV) – Diversification of Supply Sources and Transportation Routes

- Opening up a new South route to bring gas from **new supply sources** (other than Russian) to meet (then) rising European gas demand became an EC energy strategy priority in the early 2000's.

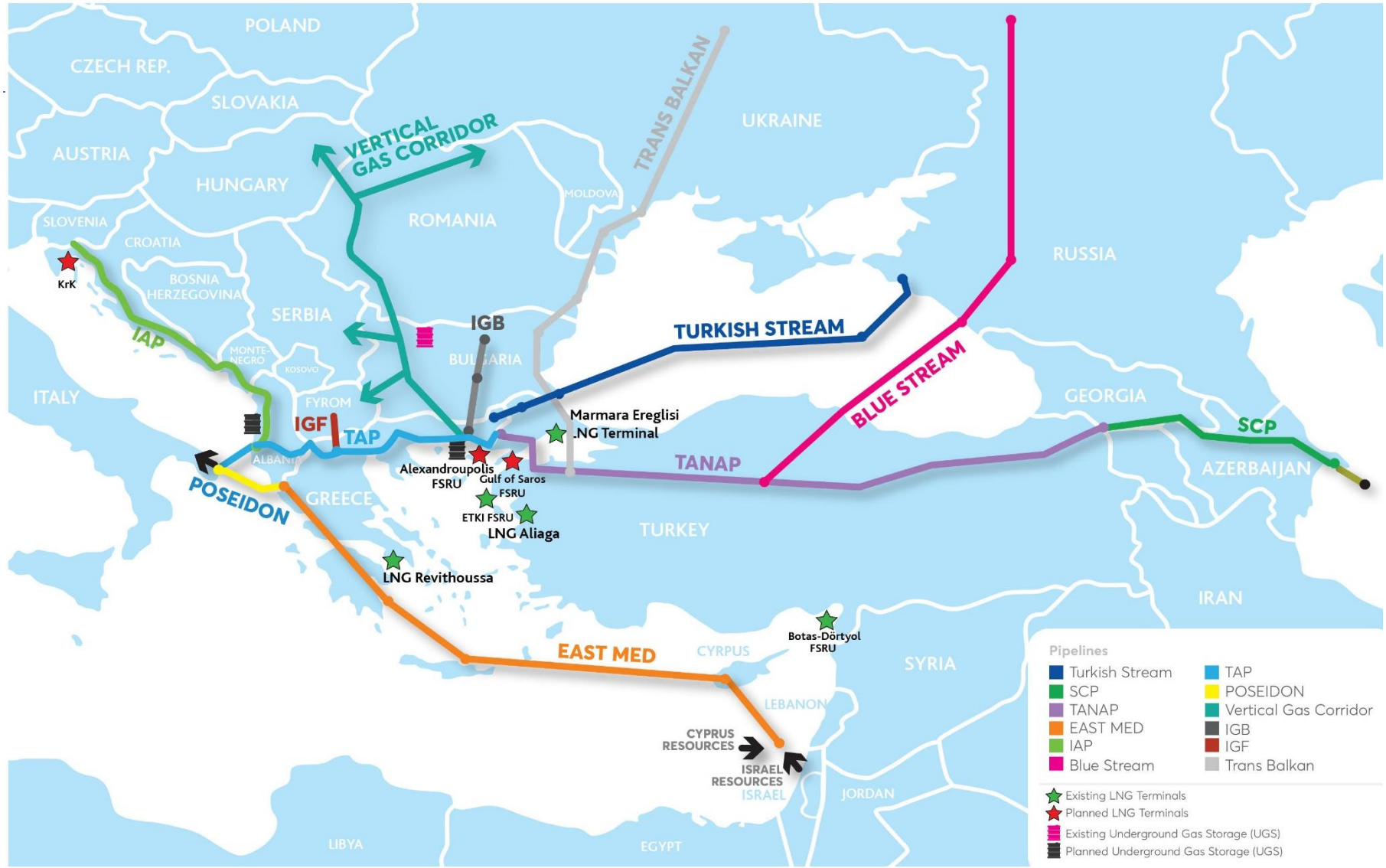
- The key objective, then as now, being the **diversification of gas supply sources and gas supply routes**.

- The South Corridor, in its present status, **satisfies the "route" diversification requirement**, but not necessarily the "supply" one.

- There is a **new architecture** to be considered in how the South Corridor is shaping up with multiple pipelines and LNG terminals, several entry points and a number of suppliers (e.g. Azerbaijan, Turkey basket, Russia, LNG).

- In view of the failure of securing sizeable gas quantities outside Russia and the changing architecture of the South Corridor, there is a need for a **wider debate** in order to redefine and reconsider priorities and expectations.

An Expanded South Gas Corridor



NB.: The TANAP and TAP gas pipelines as well as Turkish Stream are under construction, with IGB at an advanced planning stage with FID already taken. The IAP, the IGI Poseidon in connection with East Med pipeline and the Vertical Corridor and the IGF are still in the study phase. Blue Stream and Trans Balkan are existing pipelines.

Source: IENE (February 2018)

Turkish Stream (Under Construction)

Source: Gazprom

Turkish Stream	
Length	1,100 km
Diameter	Outer diameter of 32 inches (812.8 mm) and will be installed in water depths up to 7,220 ft (2,200 m).
Capacity	Two stretches: Each stretch will have a capacity of 15.75 bcm/y.
Anticipated Operational Date	2020

Contribution of Russian Gas Deliveries to SEE After 2020 Remain Uncertain

- According to repeated statements by Gazprom's senior executives over the last 18 months, gas exports via Ukraine and destined to SEE will cease from 31.12.2019.

- This means that Russian gas to Romania, Bulgaria, FYROM, Greece and Turkey will not be delivered via the currently positioned Trans Balkan Pipeline.

- Turkey will instead obtain its corresponding gas supplies exclusively via the new Turkish Stream Pipeline.

- Hence, Romania, Greece, Bulgaria and FYROM will only be able to obtain their gas supplies from Russia via Turkey, through a reverse flow operation of the Trans-Balkan Pipeline.

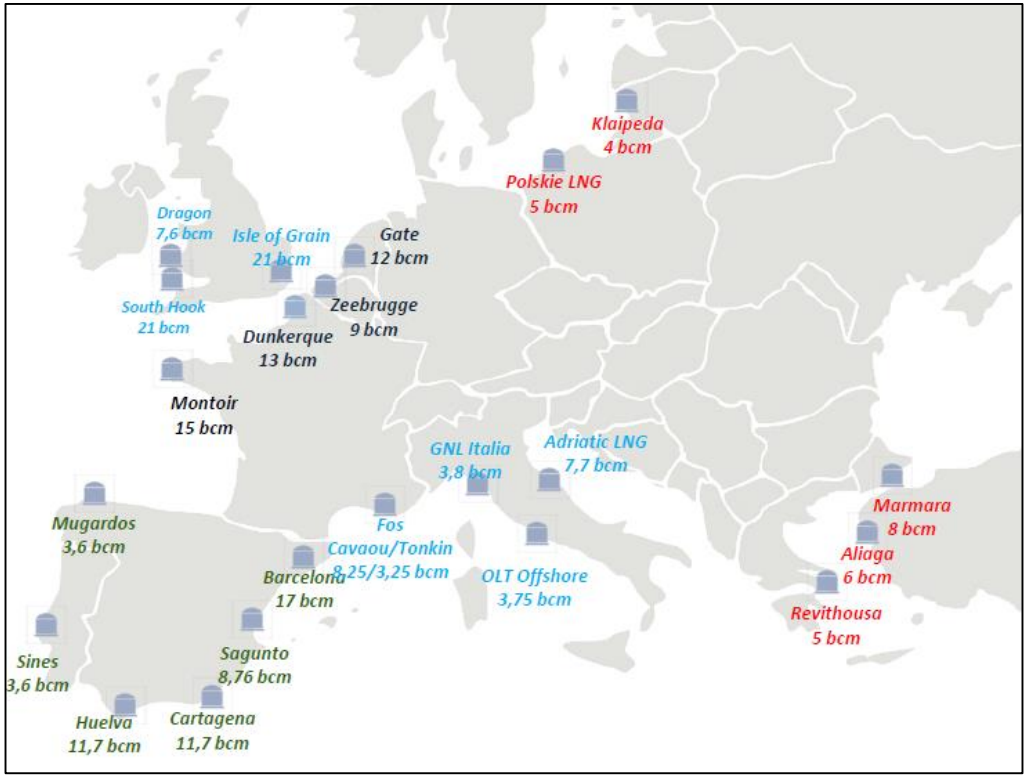
- Additional Gazprom exports to European markets via the Expanded South Corridor could be channeled in three ways:
  1. By booking capacity through TAP (which is a blow to EU's gas supply diversification policy)
  2. Limited quantities via the Vertical Corridor
  3. Through a new (to be built) pipeline through Greece and Italy (i.e. revival of the old ITGI and Poseidon plan), which will certainly face stiff opposition from Brussels and the USA government.

LNG Terminals in SE Europe

Source: IENE (February 2018)

Great Spare LNG Capacity in Europe

- **221 bcm capacity available** but many constraints
- Markets with very limited liquidity
- Physical markets with limited interconnection, low liquidity and limited ability to absorb LNG
- Markets with high access costs, regulatory constraints, and/or volatile spreads markets to hedging hubs
- OMV estimate suggests **40-50 bcm capacity in efficient price hedging locations**
- Of this, OMV estimates **>50% is already booked; >20-25 bcm offered**
- Fuel switch potential becomes limited in the EU as coal units phase out

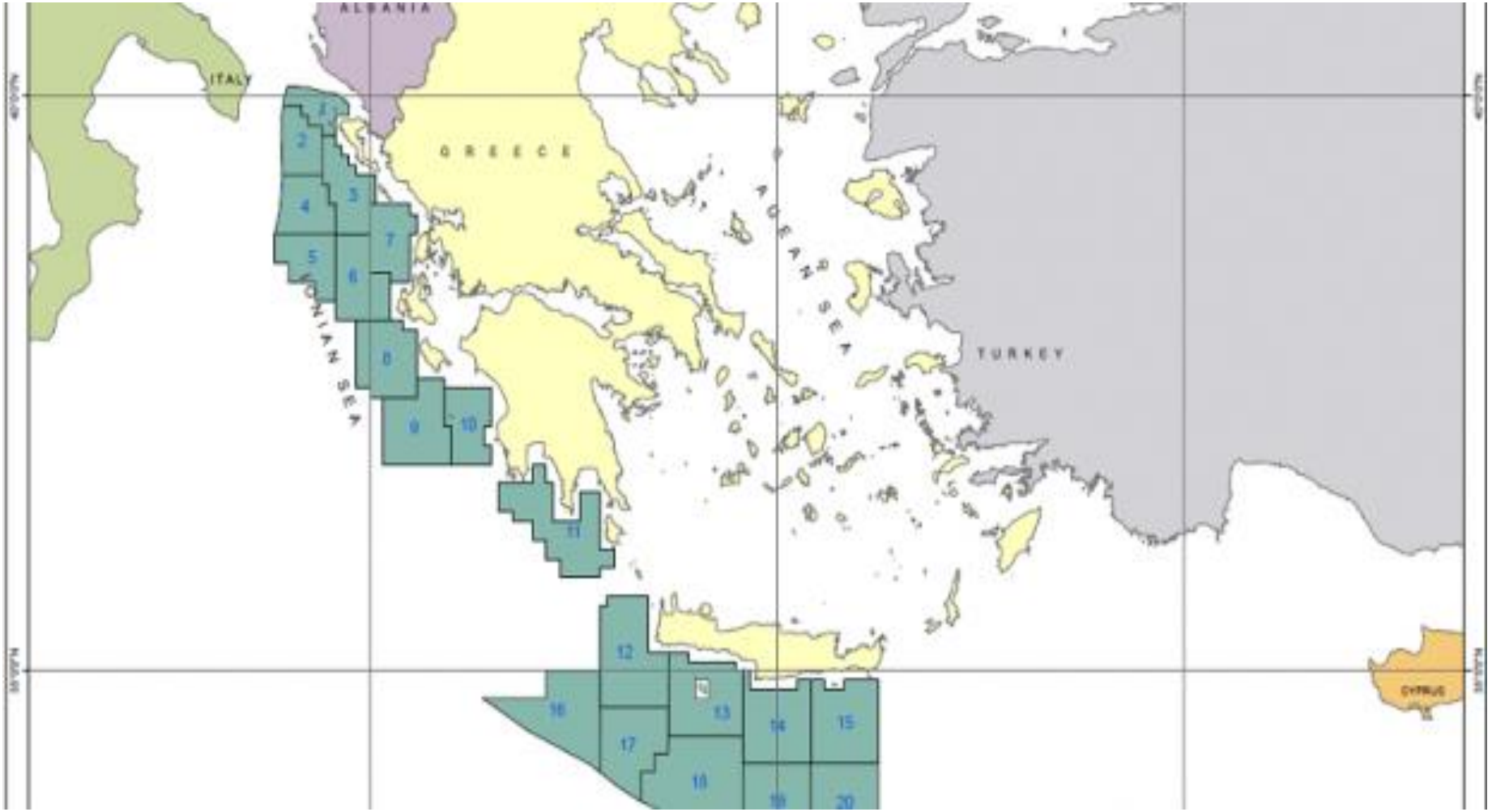


Source: OMV Gas

Recent Gas Discoveries in Offshore Eastern Mediterranean Could Provide an Alternative Gas Supply to Europe

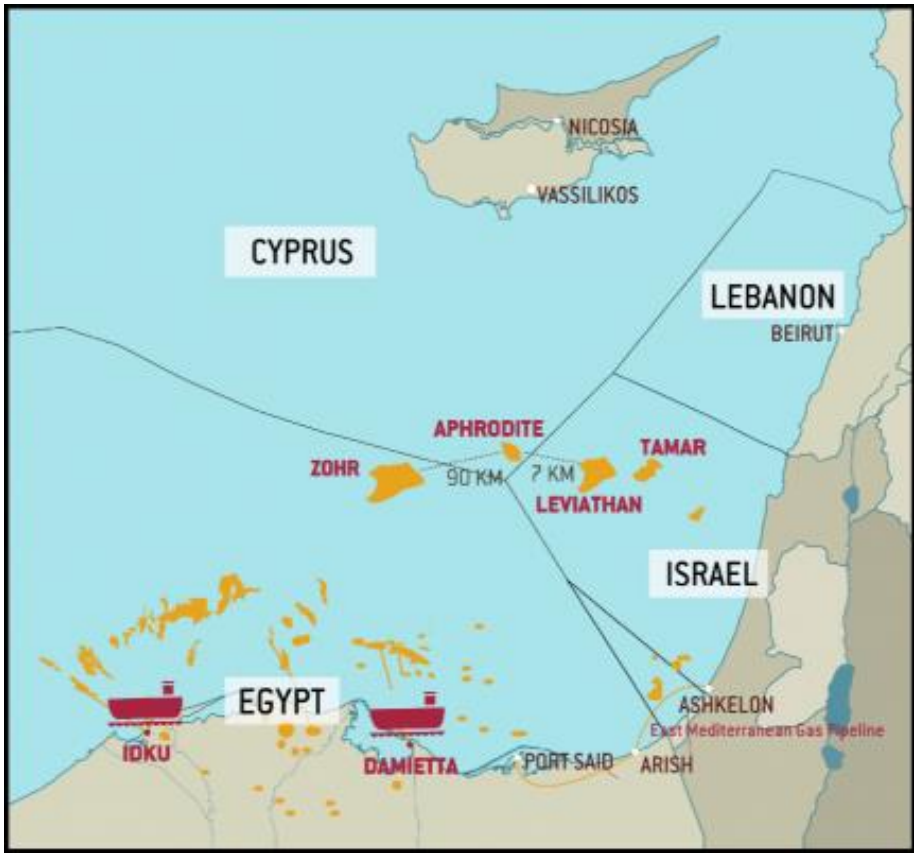
Sources: European Parliament, Financial Times

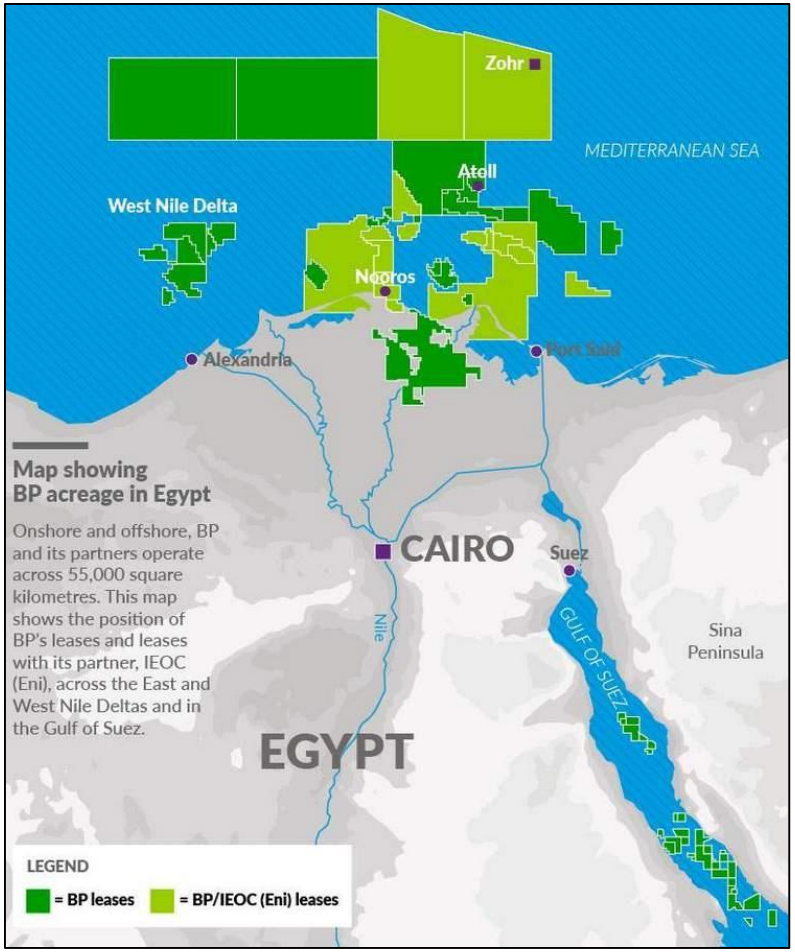
Hydrocarbon Activities in Greece



Source: Greece's Energy Ministry

Hydrocarbon Activities in Egypt





Sources: BP and ENI

Can an Expanded South Corridor Provide an Alternative Gas Supply to European Markets?

- **Yes**, if total gas quantities (of now Russian origin) to be delivered to European destinations will exceed 60 bcm, i.e. more than 20% of anticipated European gas imports by 2030.
- In view of current development rate and problems faced at Shah Deniz II, Azeri gas could contribute 15-20 bcm by 2025 and 25 bcm by 2030.
- An additional 10 bcm could (?) be delivered by East Med by 2025.
- It is unlikely that the difference of 35 bcm or more can be delivered by East Med originated LNG – a figure near 10-15 bcm is more likely.
- Consequently, a shortfall of 20-25 bcm will need to be covered from other sources which could be developed by 2030, but this will not be easy. Where this gas might come from?
  - Additional Azeri gas if Absheron field is developed meanwhile.
  - Turkmenistan, provided that political agreement is reached between Baku and Ashgabat for the construction of Trans-Caspian pipeline. Some 10-15 bcm may be expected from Turkmen fields.
  - Additional LNG deliveries via Idku and Damietta terminals without excluding a Cyprus based (greenfield) liquefaction plant, provided that additional gas becomes available from various fields.

Gas Market Liberalization in SE Europe

- During the past five years, evolutions regarding the long-term development of the natural gas market in SE Europe have been unprecedented.
- The most important of those developments can be summarized as follows:
  - In October 2011, the Ministerial Council of the Energy Community adopted the so-called **Third Energy Package (TEP) for electricity and gas**, with a general implementation deadline of 1 January 2015, for all the Contracting Parties of the Energy Community Treaty.
  - In April 2013, the **Regulation EU 347/2013** was published, setting the rules for the development of the so-called Union-wide list of energy **Projects of Common Interest (PCI)**, which was almost immediately followed by the establishment of the list of the **Projects of the Energy Community Interest (PECI)**.
  - In June 2013, the selection of the Trans-Adriatic-Pipeline (TAP) as the **preferred option for the transportation of the gas produced in that field to Europe**, which signaled the initiation of the Southern Gas Corridor project.
  - In February 2015, the EC launched the **Central East South Connectivity (CESEC) initiative** to enhance political support for the identification and implementation of crucial gas infrastructure projects in CS European region.
- There is a **highly fragmented landscape** for the gas market development in the SEE region.

Electricity Market Liberalization in SE Europe

- In SE Europe, the electricity market liberalization has faced **several difficulties and numerous non-technical obstacles** in the past as the incumbent companies in almost all countries solidly resisted any change on the grounds of losing control of the market and hence weakening of their bureaucratic hold.

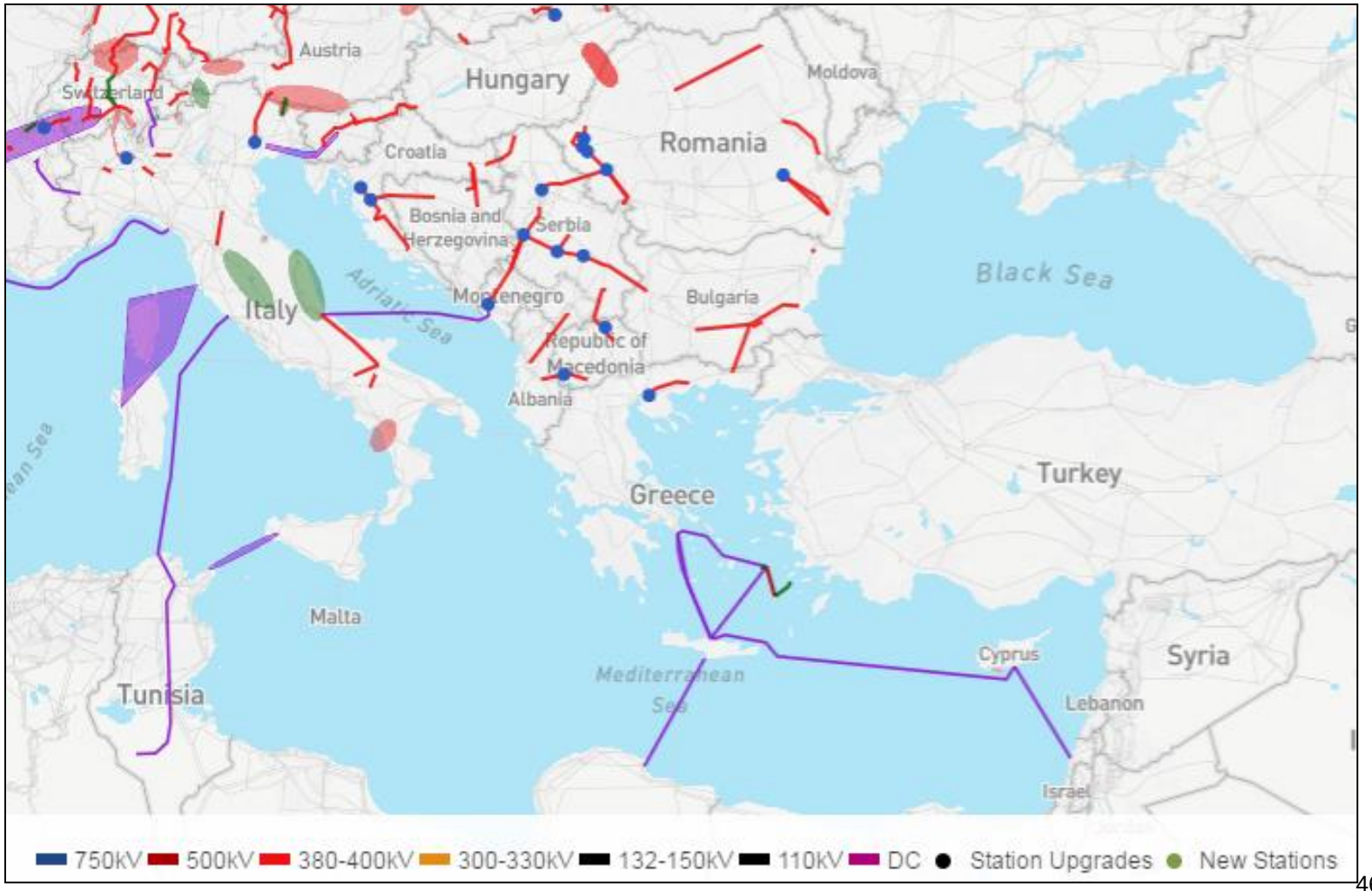
- Currently, the situation in **EU member countries** looks varied with certain countries having managed to complete what appeared to be an anomalous transition period and other countries still trying to adapt to EU competition rules.

- Hence, some solid steps have been made towards electricity market competition. However, progress is not very satisfactory in most contracting parties, largely because of the inflexible market structure and the stiff hold of the state over market mechanisms.

Electricity Interconnections in SE Europe

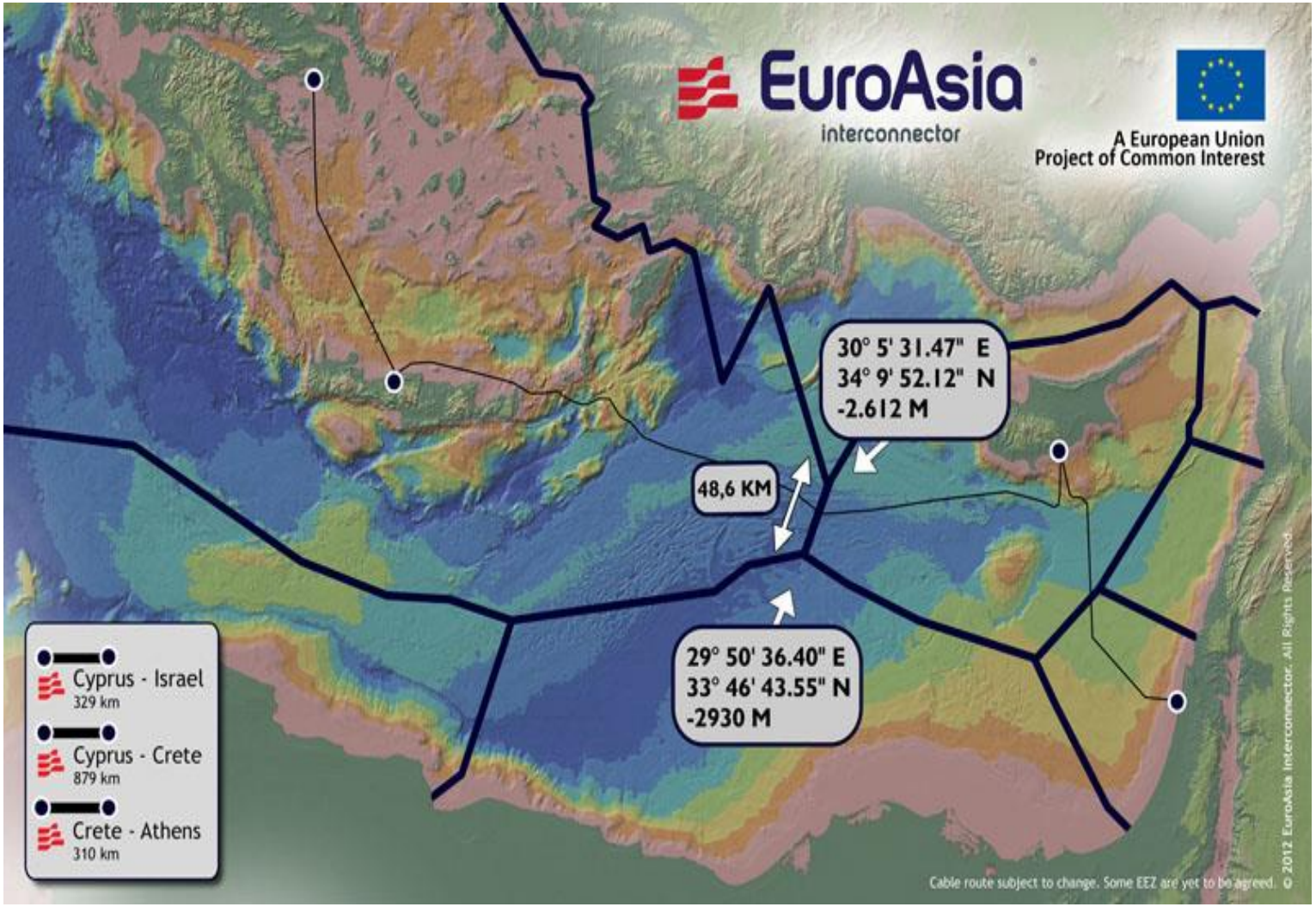
Source: IPTO's Ten Year Network Development Plan 2017-2026

ENTSO-E's 10-year Power Network Development Plan



Source: ENTSO-E

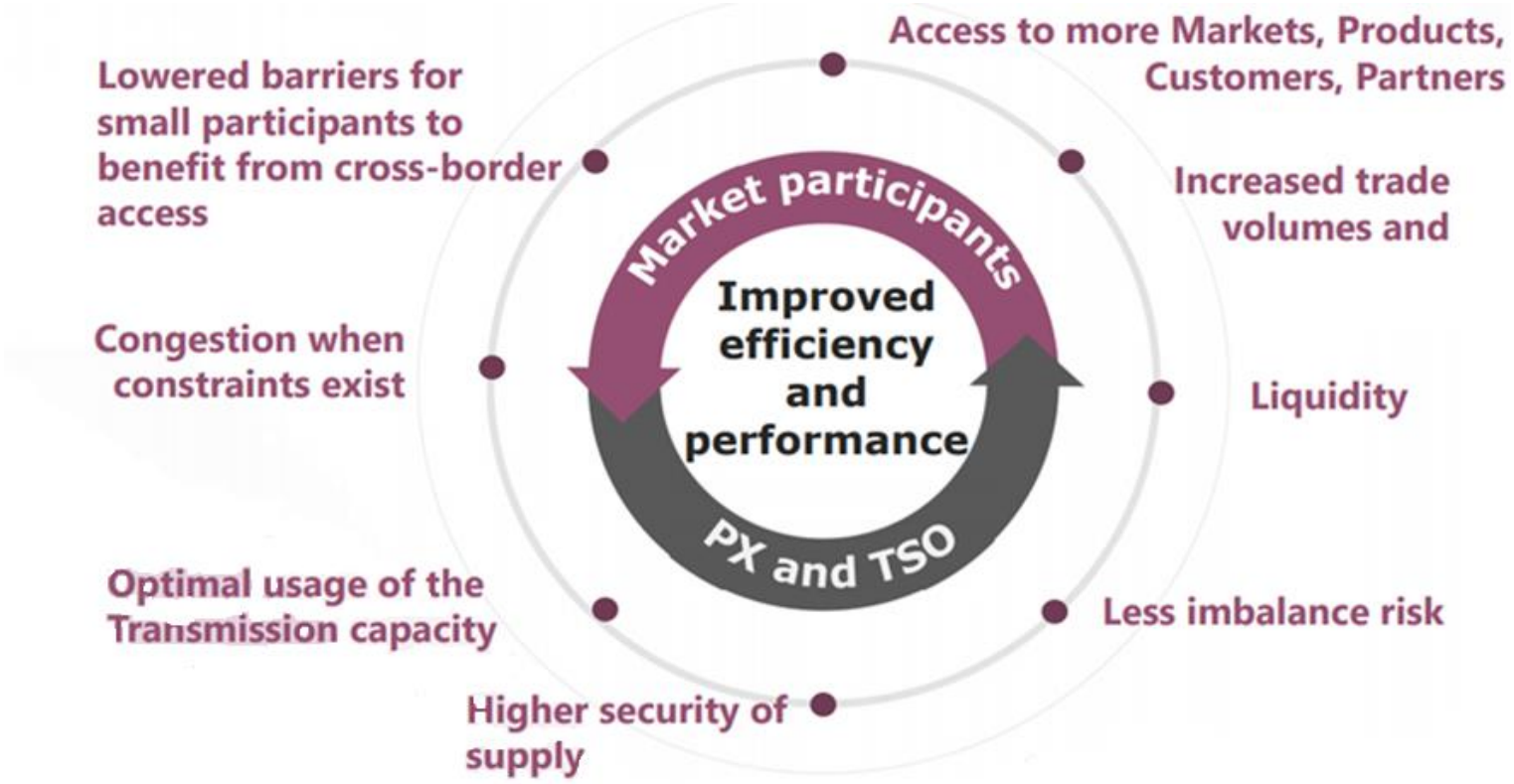
EuroAsia Interconnector



Source: EuroAsia Interconnector

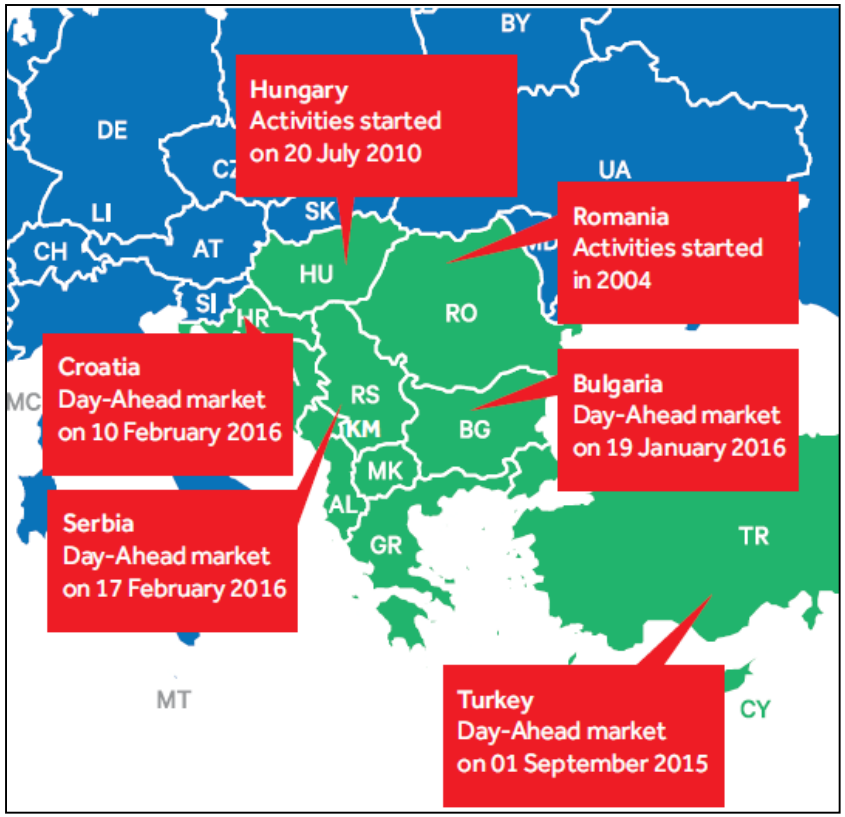
Market Integration Benefits

- **Electricity Exchanges** and **Gas Trading Hubs** can play an important role in facilitating regional market integration and trading activity in general.



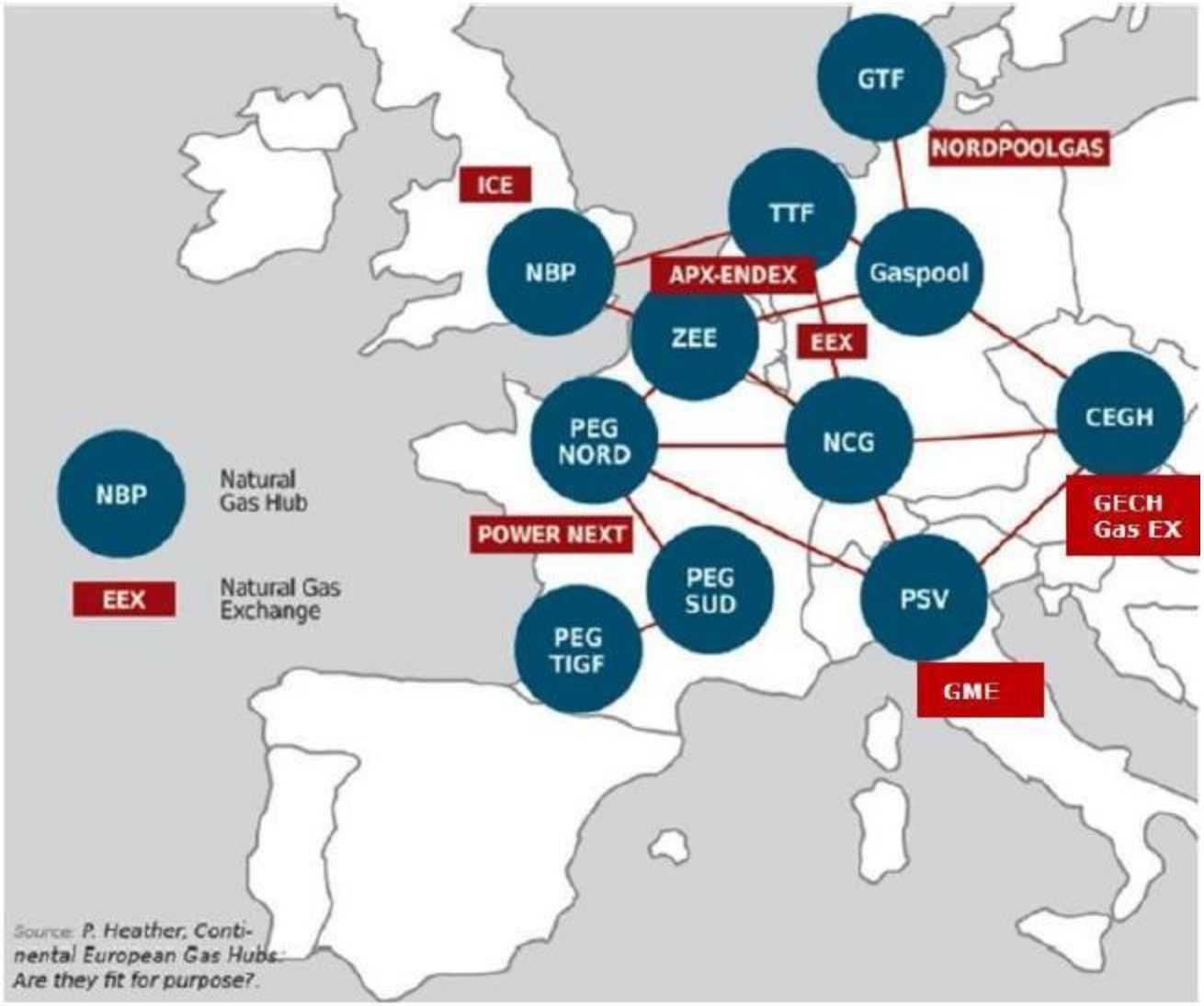
Market Integration Benefits: Power Exchanges in SE Europe

- Currently, there are **six active power exchanges** in SE Europe: in Bulgaria, Croatia, Serbia, Romania, Slovenia and Turkey.
- However, there are plans for the establishment of power exchanges in Greece, Montenegro and a joint energy market between Albania and Kosovo.



Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

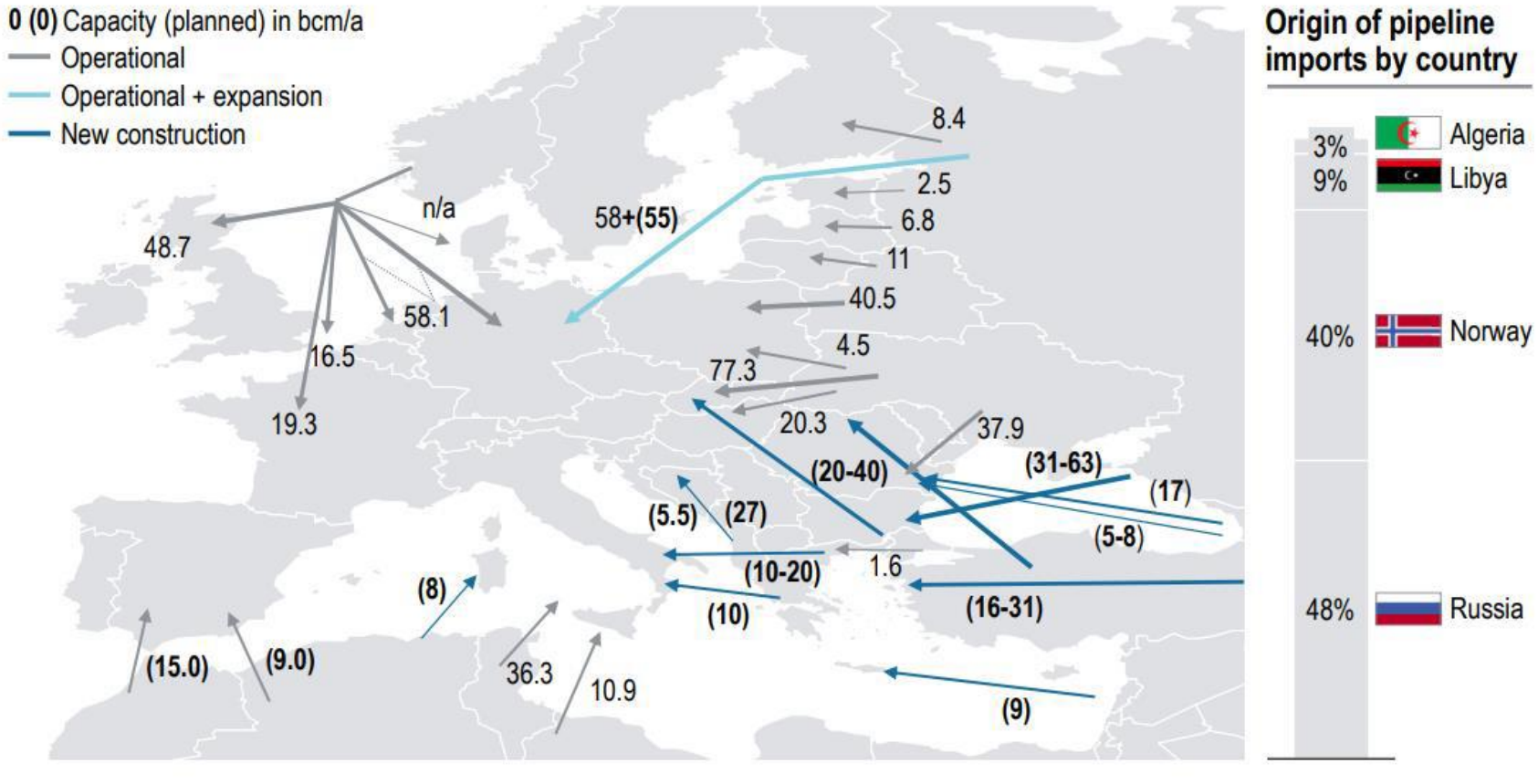
Market Integration Benefits: European Gas Hubs and Exchanges



Creating a Natural Gas Trading Hub in SE Europe Remains a Real Challenge

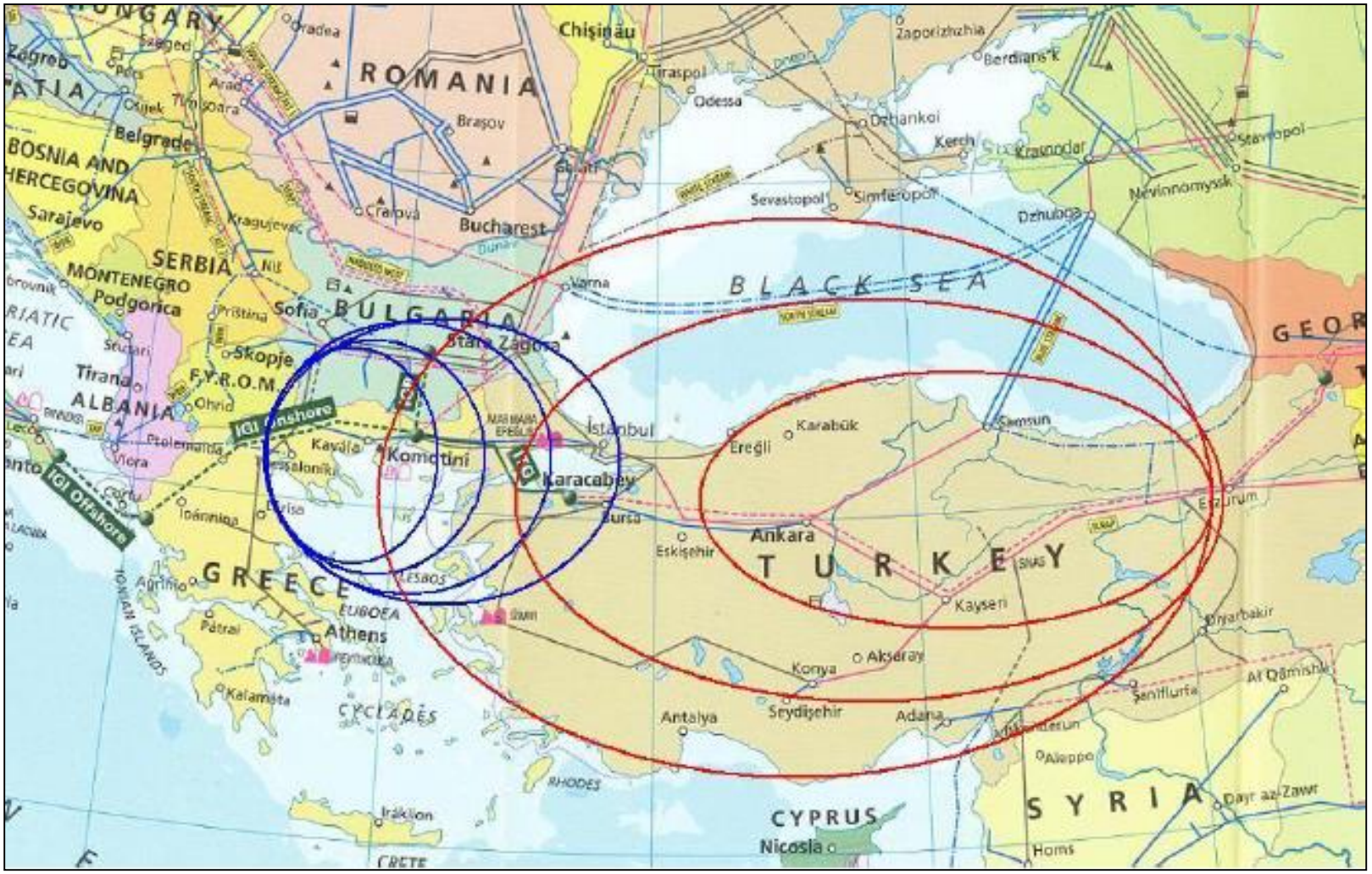
- Today, there is not a single gas trading hub east and south east of Vienna whose CEGH could act as a pivot for organizing gas trading in this region.
- As gas volumes increase in SE Europe attracting more market players, there is a need for the establishment of a gas trading hub. This will facilitate **gas supply and demand to meet in a marketplace** by providing a platform for physical and/or financial transaction.
- It will **enable competitive markets to function**, even though it will probably have an administrative role in the beginning of its operation.
- Although it is difficult, at this stage, to predict market behaviour and impact on spot prices, once the hub enters full operation, based on European hub operation experience, one could safely assume that **spot prices determined through hub trading will be lower than oil-indexed ones**.
- Once the interconnections are in place and an effective gas exchange mechanism exists, traders would be willing to buy available gas, which will become available from main gas importers, by placing bids through the “hub” for both physical quantities and gas futures. Such trading activity will inevitably lead to the **formation of a new climate of competitive prices**, exerting pressure on traditional suppliers to revise their contract prices.

Existing and Planned Import Pipelines to Europe



Sources: European Commission, IEA, ENTSOG, BP

Gas Hubs in Greece and Turkey Can Coexist



Source: IENE study, “The Outlook For a Natural Gas Trading Hub in SE Europe”, (M19), Athens, September 2014

Energy Demand and Supply Projections in SEE (I)

- One scenario, namely the **"Base" scenario**, was developed by the **E3M-Lab of the National Technical University of Athens (NTUA)**, which has a long-established track record and considerable in-house expertise in energy modeling work under the supervision of professor **Pantelis Capros**.

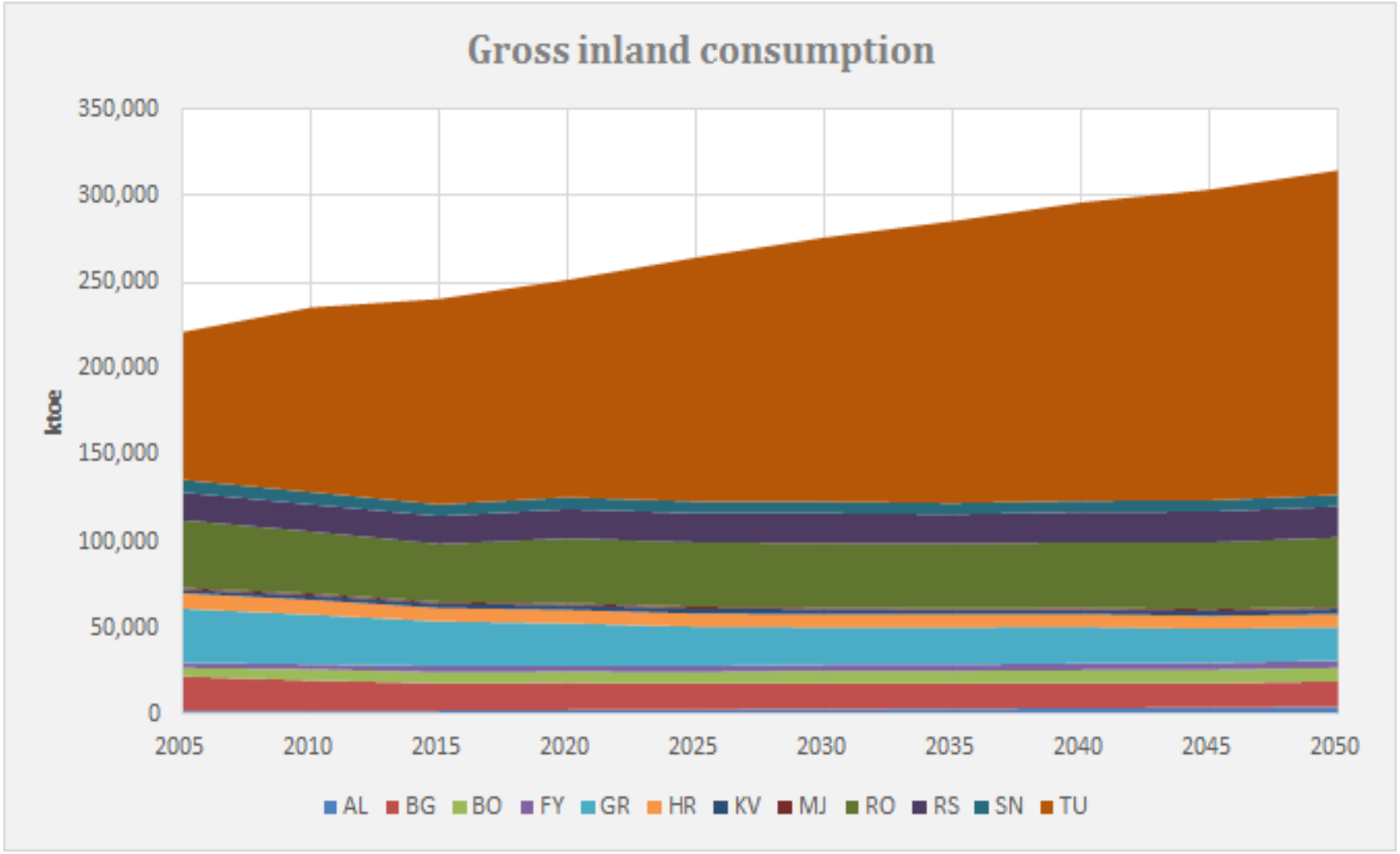
- Certain assumptions were formulated in the Base scenario concerning basic parameters which are likely to govern future energy demand and supply:

  - **Macroeconomic** and **demographic information**
    - Current trends on regional population and economic development, including latest statistics by EUROSTAT and most recent projections by international organisations of GDP growth in SE Europe
  - **Technological progress**
    - **Penetration of new technologies**, notably in power generation and transport, largely based on RES.

Energy Demand and Supply Projections in SEE (II)

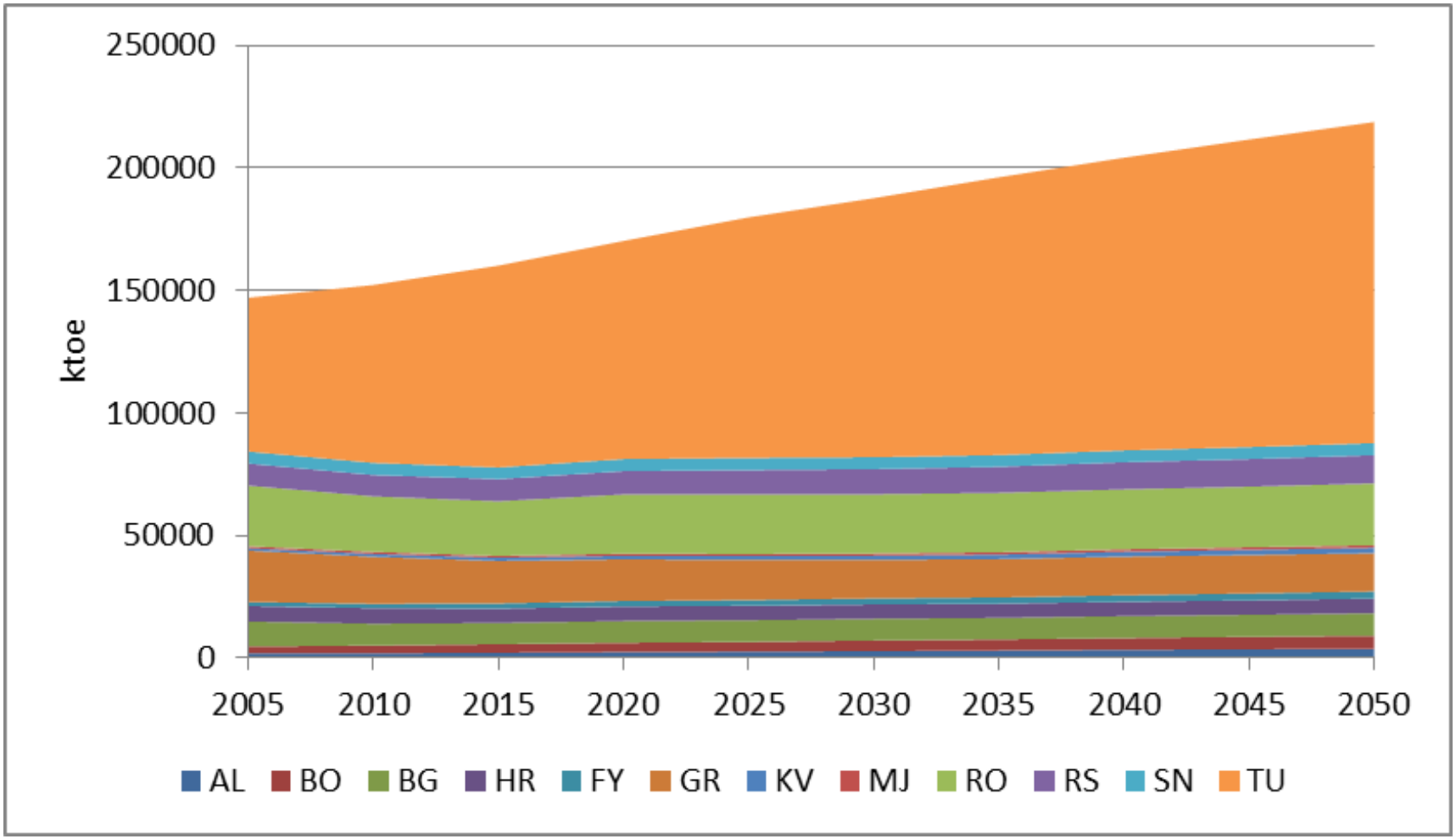
- **Policy information**
  - Reflects current policies in the SEE countries as already adopted
    - **Does not include** policies which may be enacted in the future
  - For the non-EU countries, the projection assumes a moderate adjustment of the energy mix, notably for RES, towards EU's aspirations.
  - For the EU countries, the Base scenario includes all binding targets set out in EU legislation regarding development of RES and reductions of GHG emissions, as well as the latest legislation promoting energy efficiency.
  - The Copenhagen-Cancun pledges are expected to be respected through carbon prices as well as dedicated policies and measures.
    - **Does not include** the Paris 2015 commitment in this scenario as the corresponding policies have not yet been adopted.

SE Europe: Gross Inland Consumption, **including Turkey** (2005-2050)



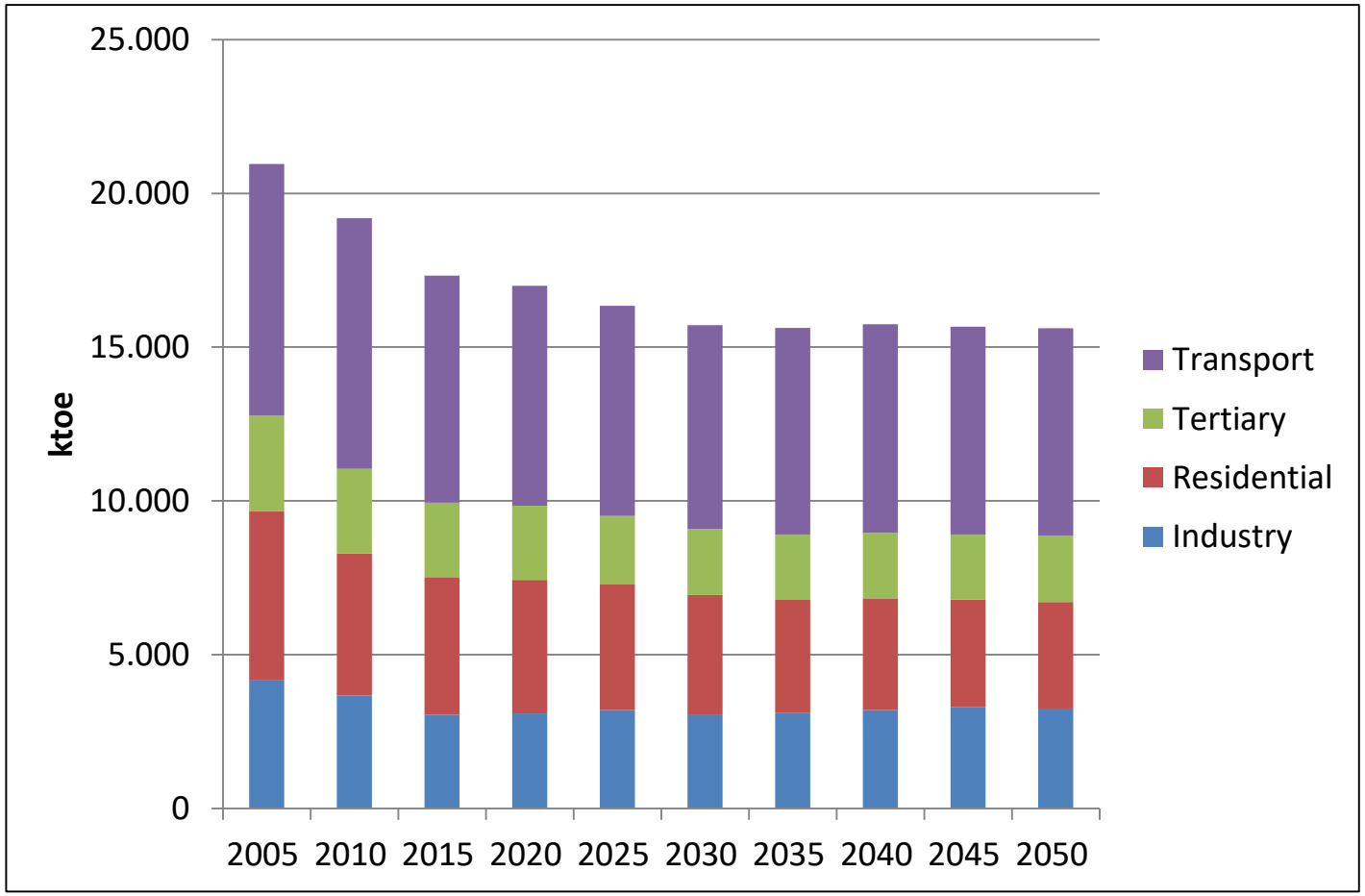
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Final Energy Demand, **including Turkey** (2005-2050)



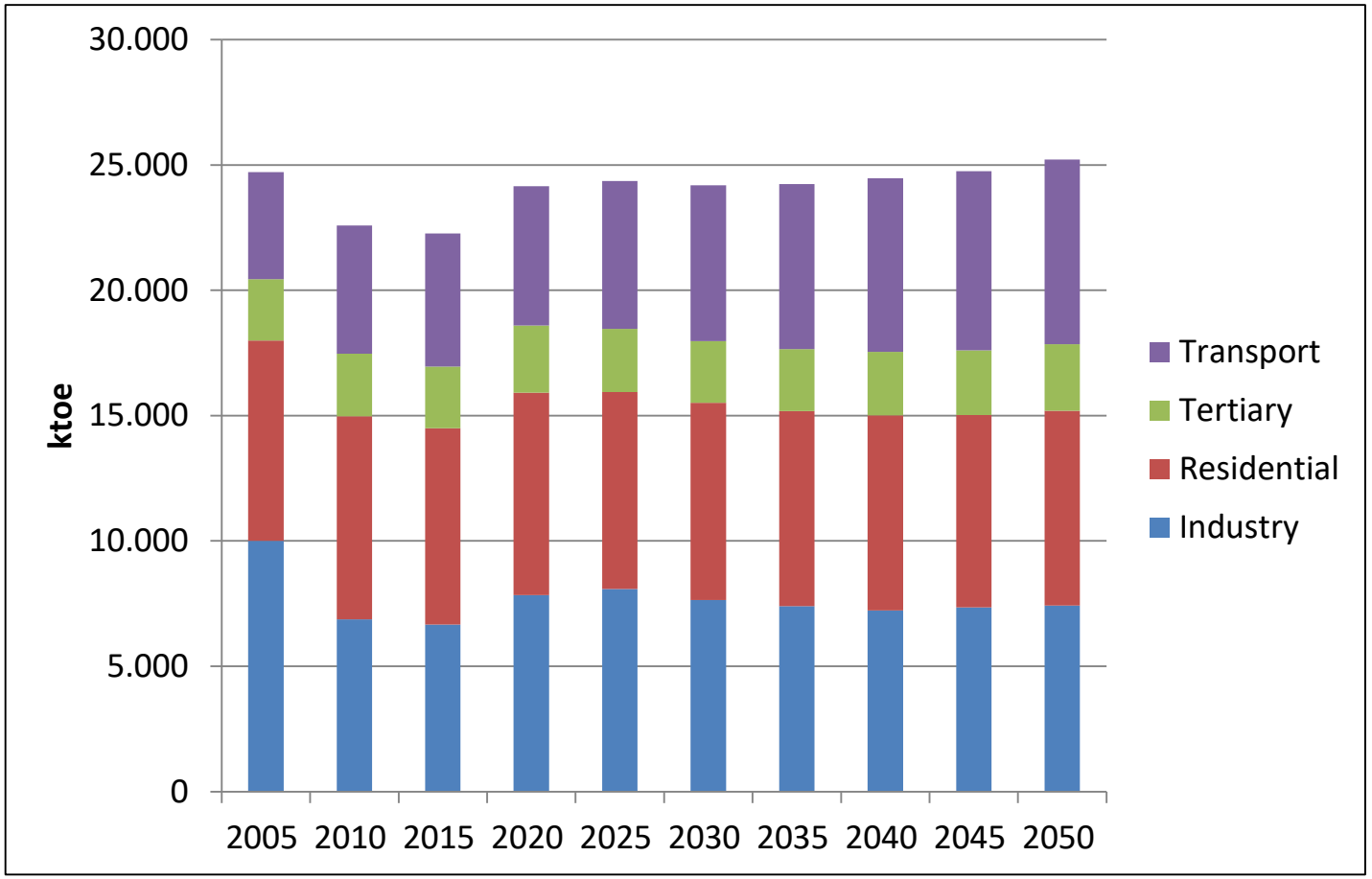
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

Greece: Final Energy Demand by Sector (2005-2050)



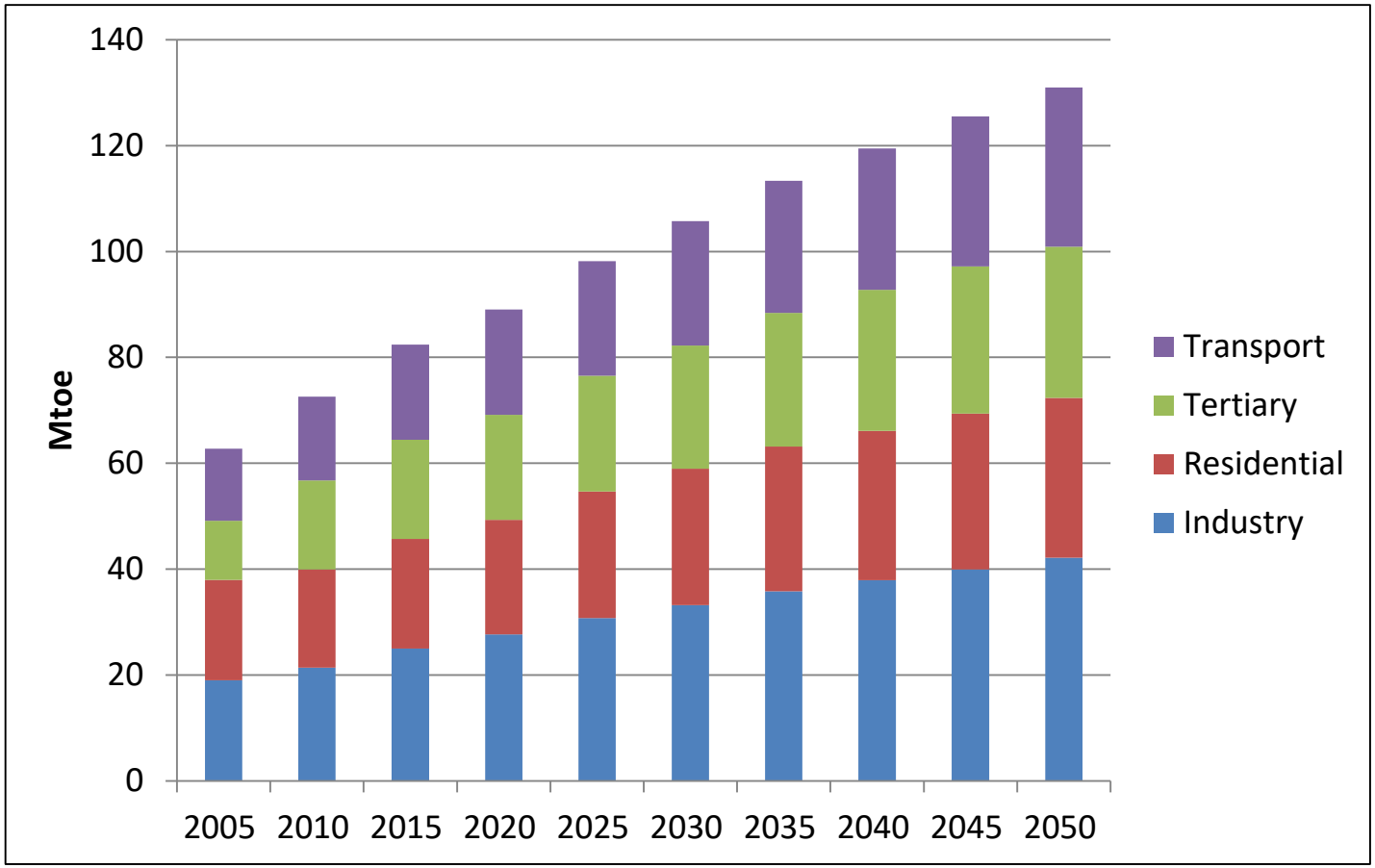
Source: IENE study “South East Europe Energy Outlook 2016/2017”, Athens, 2017

Romania: Final Energy Demand by Sector (2005-2050)



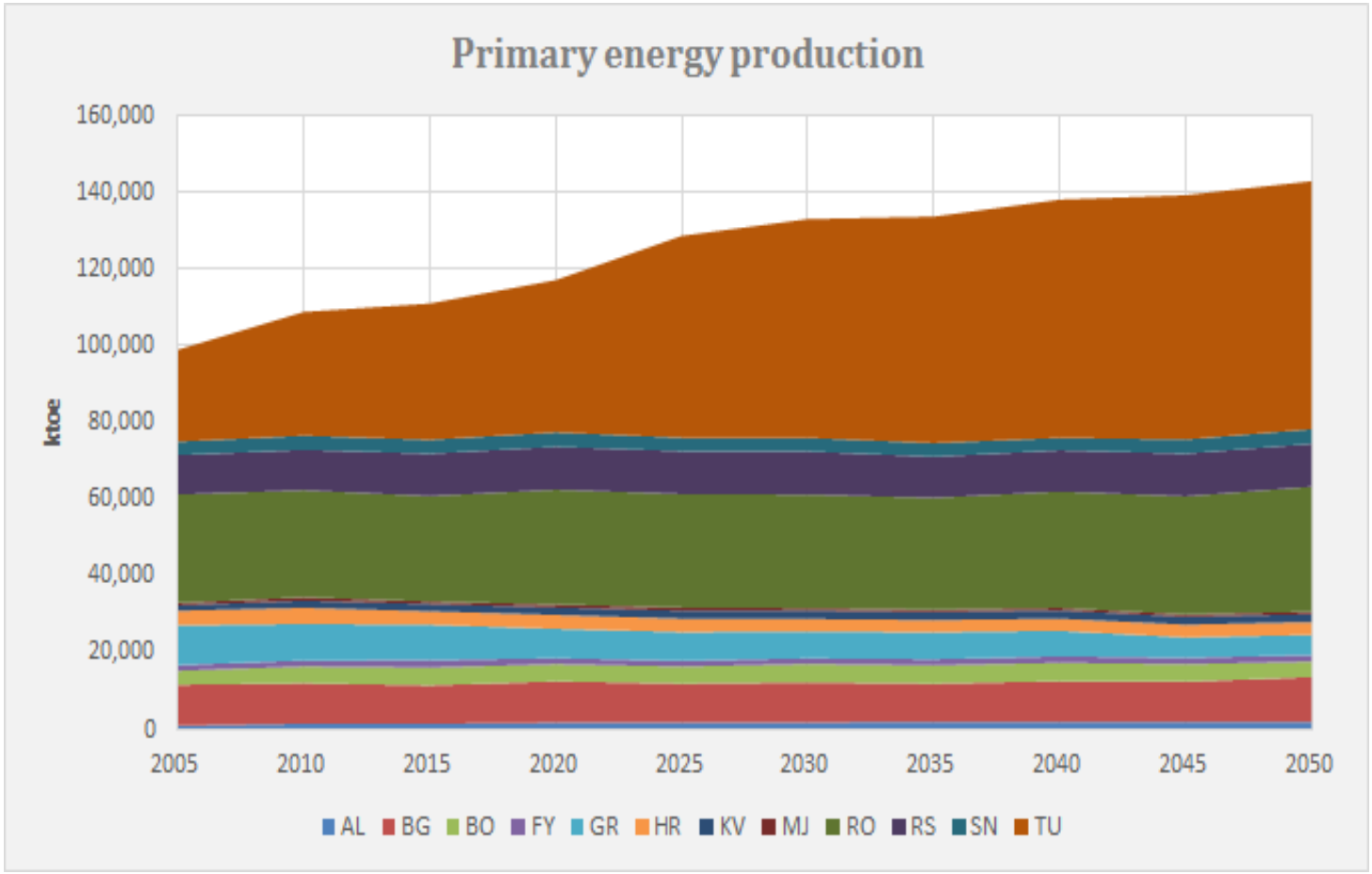
Source: IENE study “South East Europe Energy Outlook 2016/2017”, Athens, 2017

Turkey: Final Energy Demand by Sector (2005-2050)



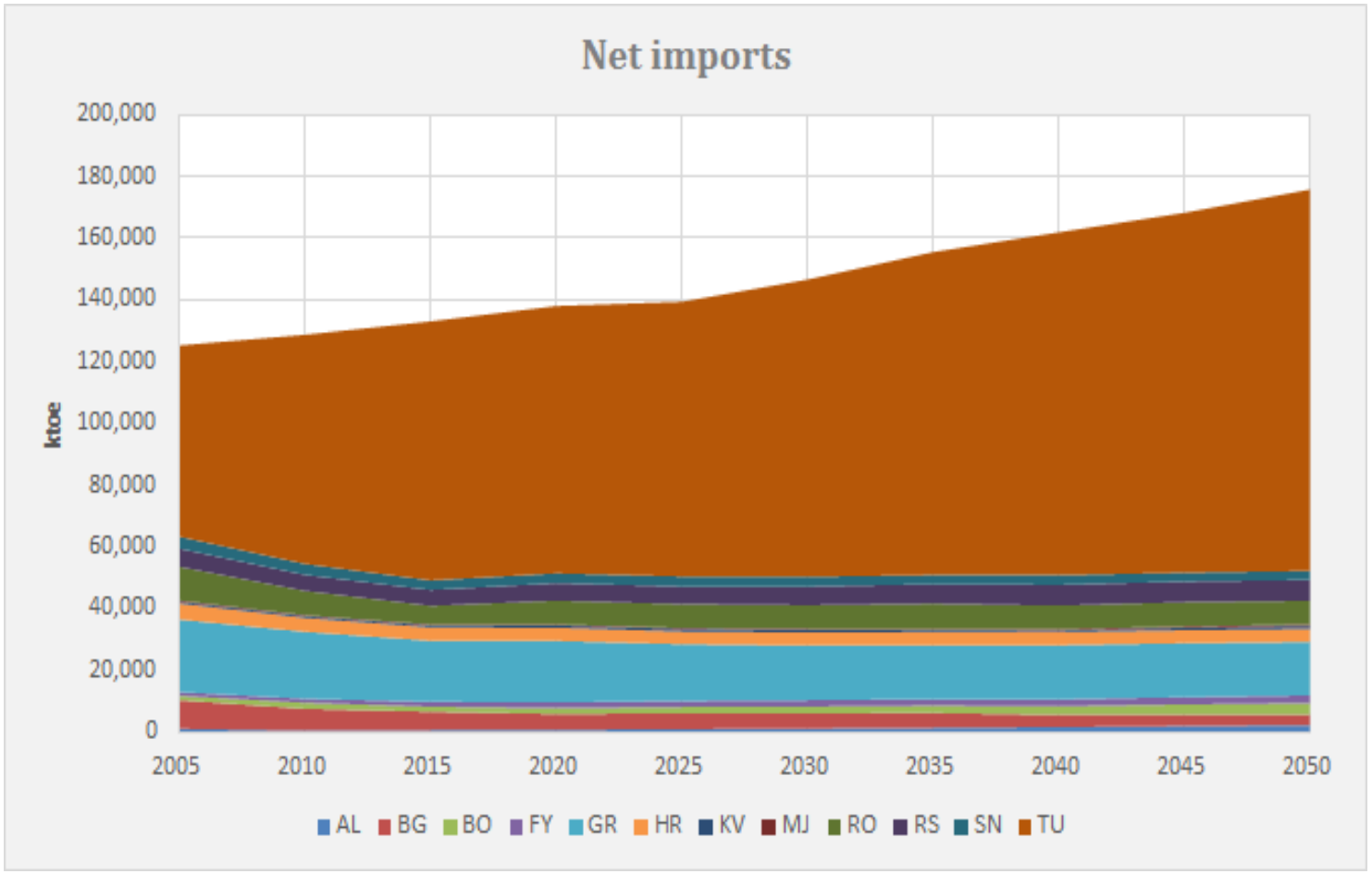
Source: IENE study “South East Europe Energy Outlook 2016/2017”, Athens, 2017

SE Europe: Primary Energy Production, **including Turkey** (2005-2050)



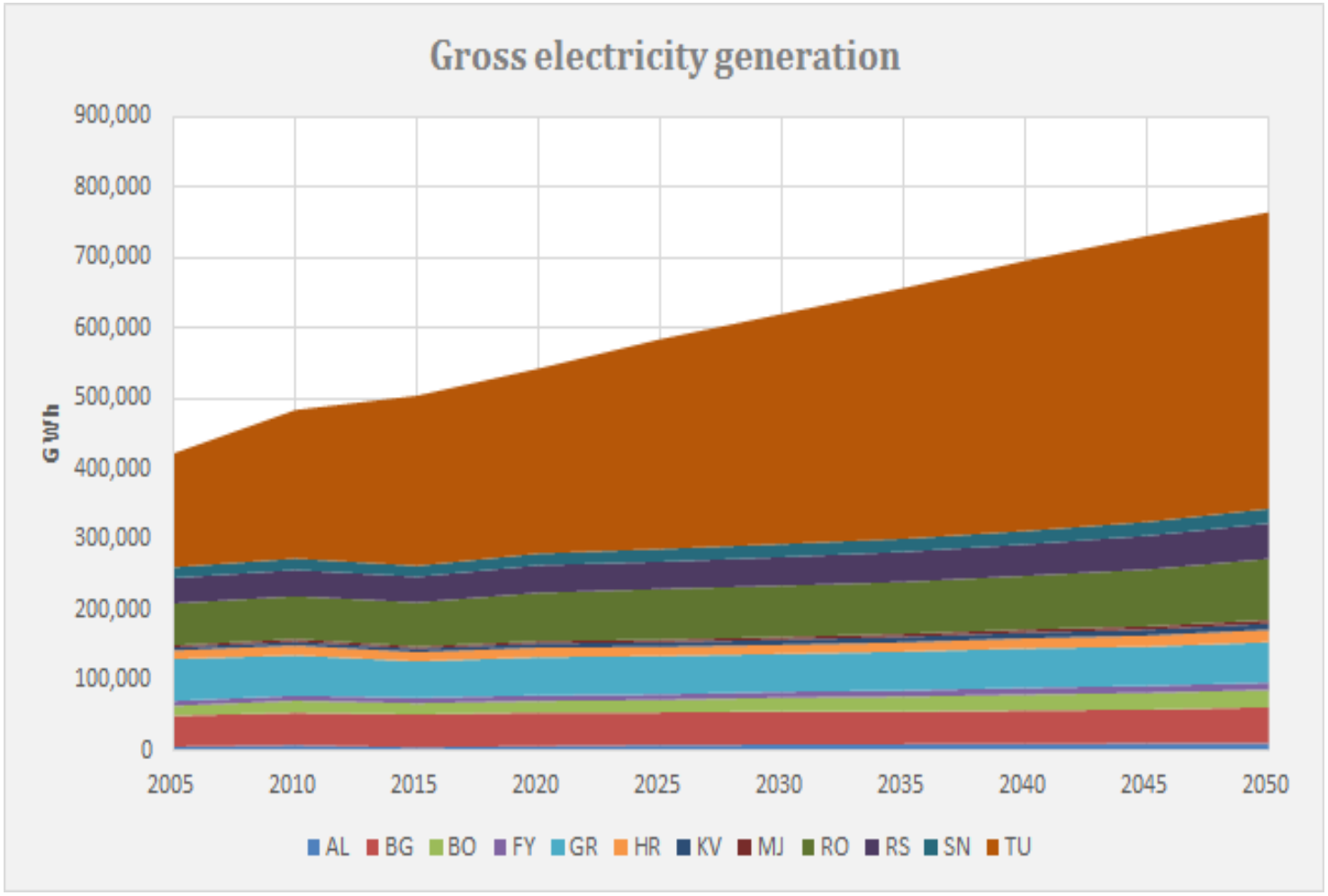
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Net Imports, **including Turkey** (2005-2050)



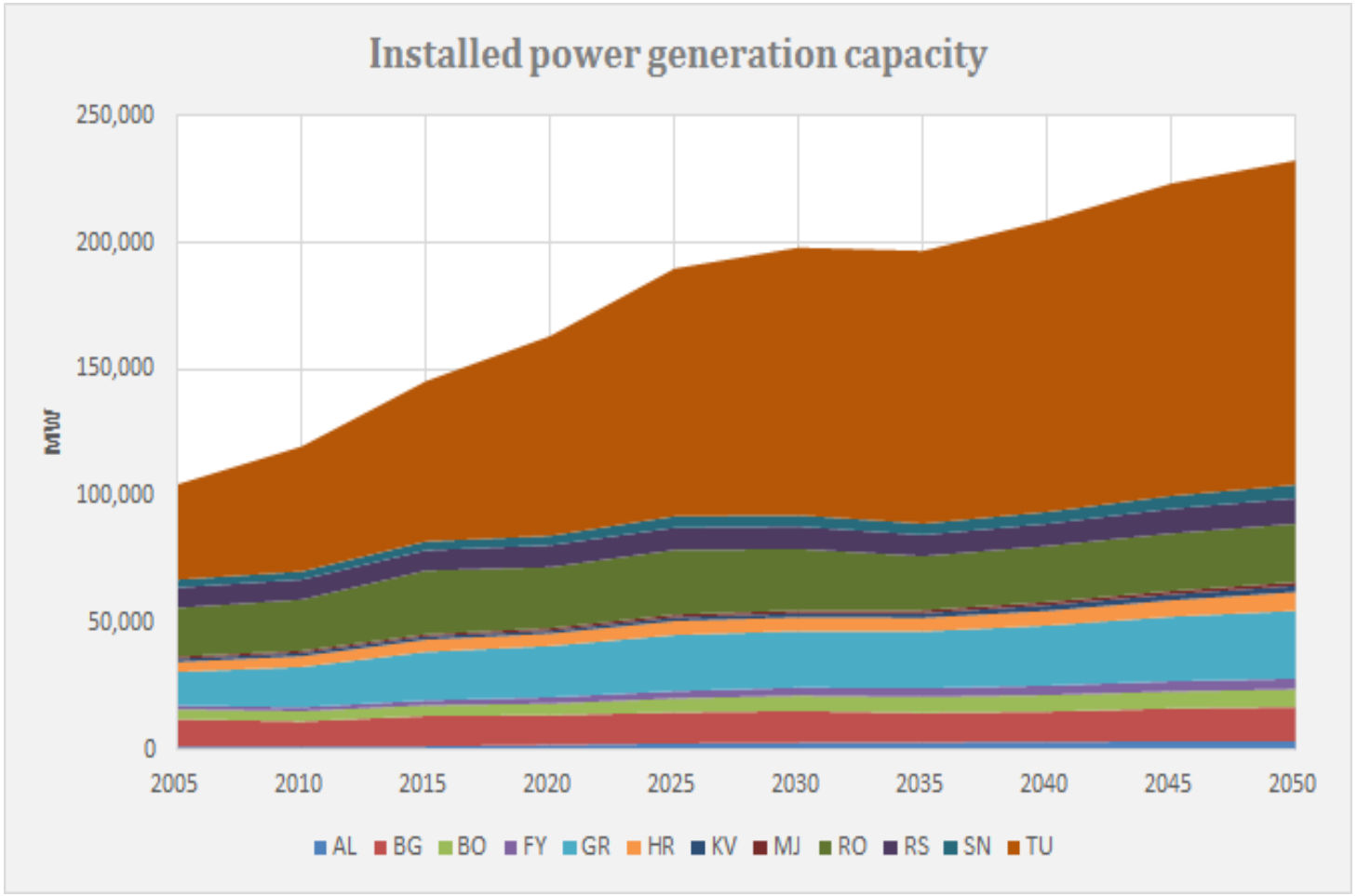
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Gross Electricity Generation, **including Turkey** (2005-2050)



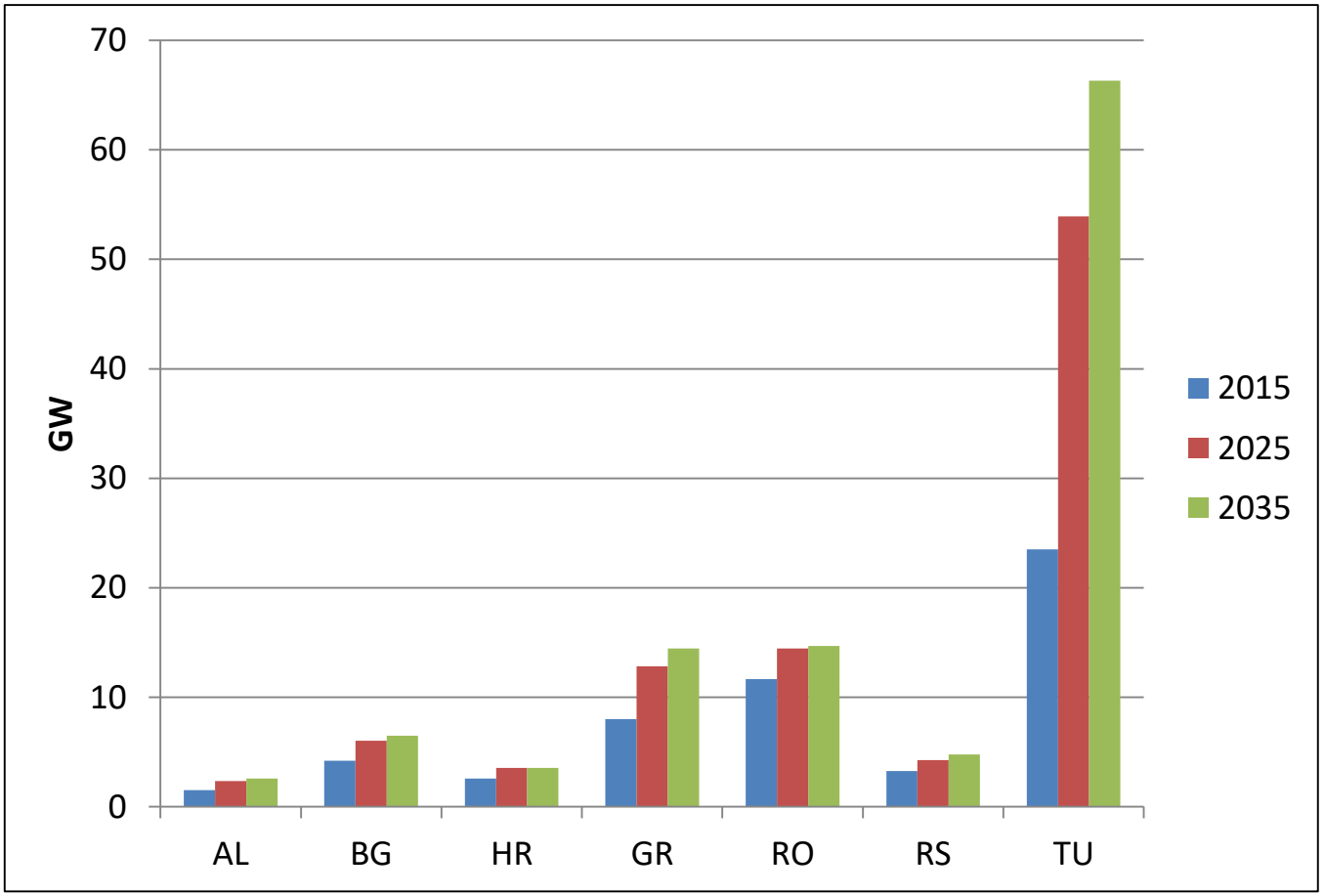
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Installed Power Generation Capacity, **including Turkey** (2005-2050)



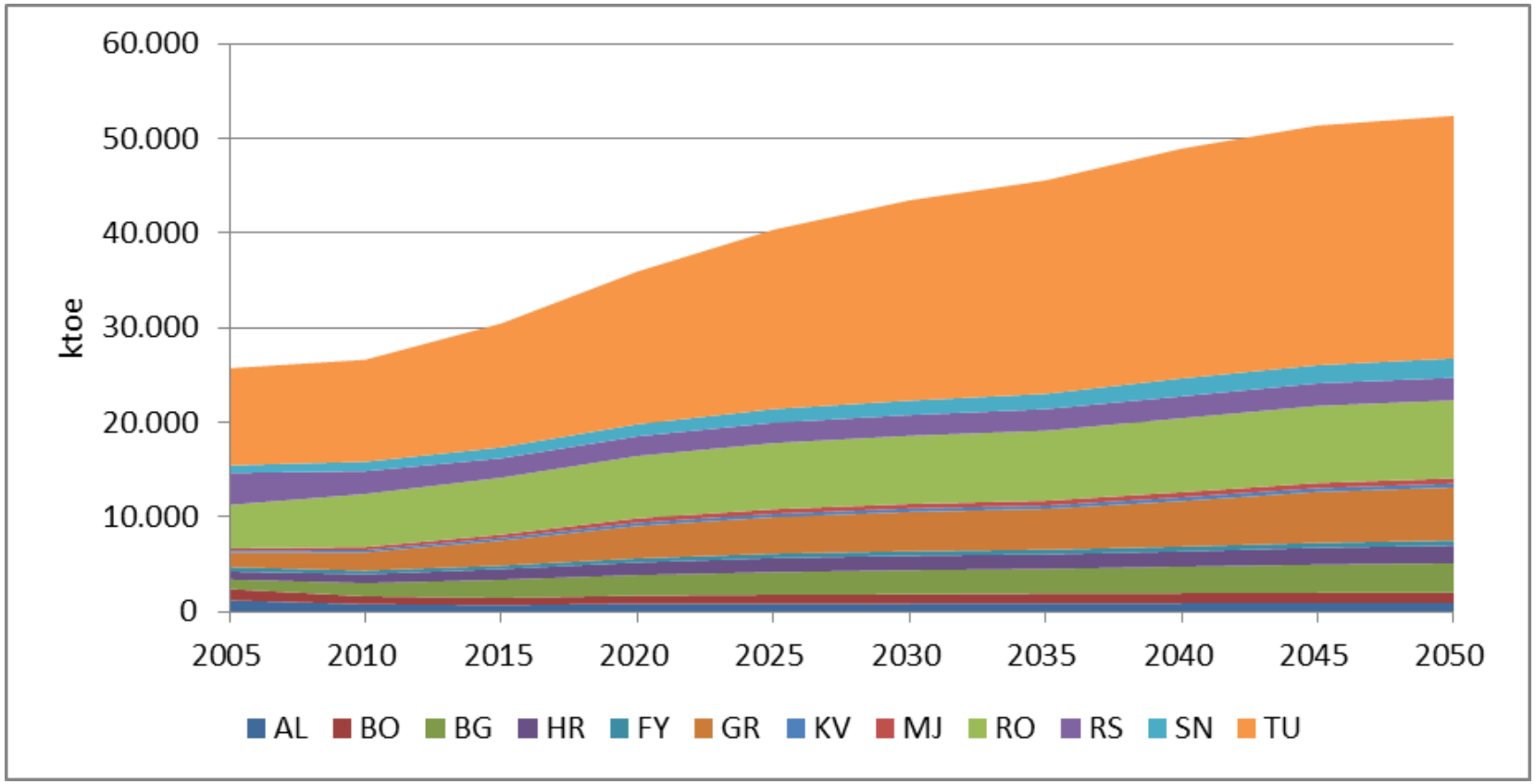
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Net RES Generation Capacity in 2015, 2025 and 2035



Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

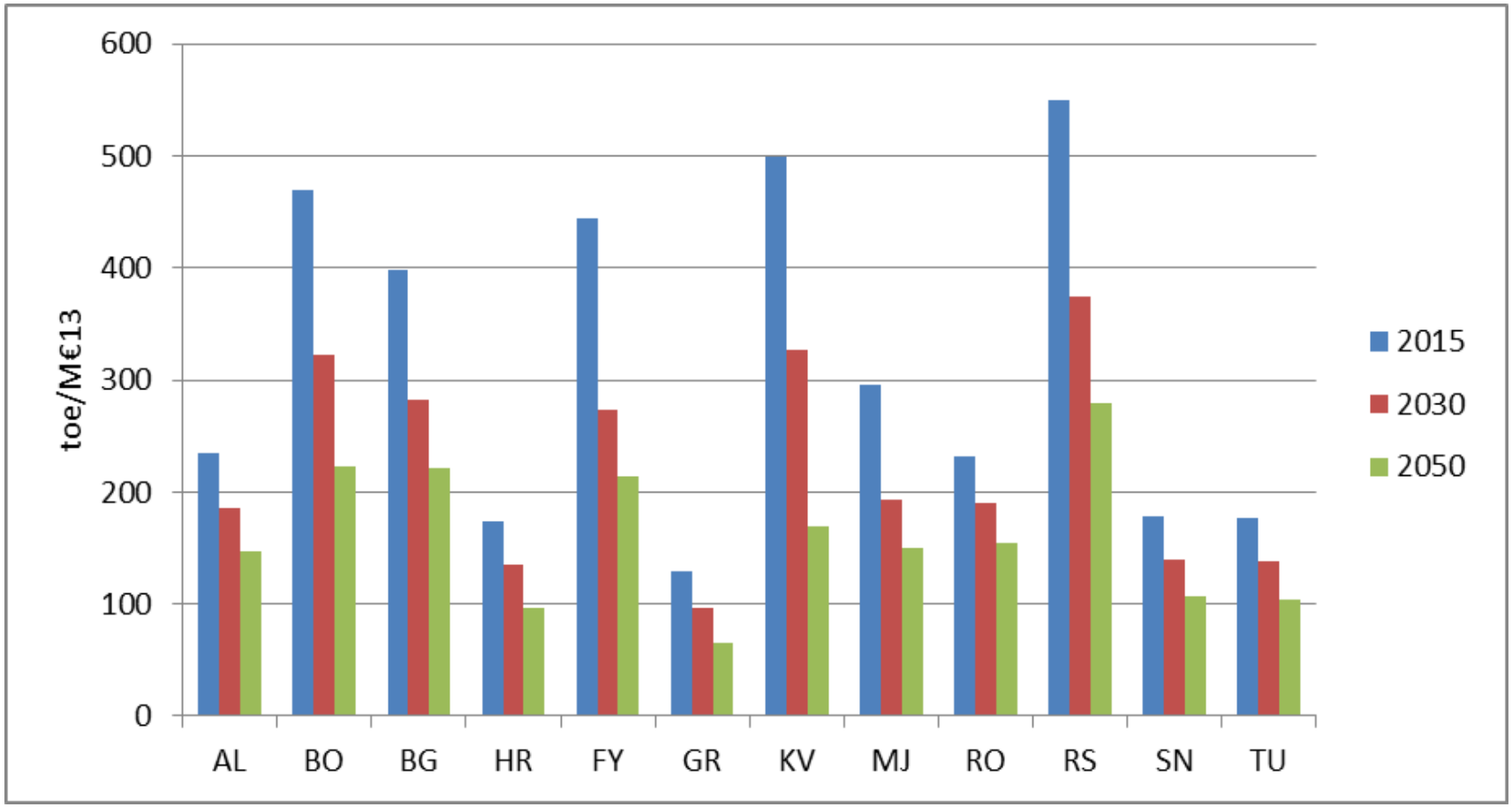
SE Europe: RES in Gross Final Energy Consumption*, **including Turkey** (2005-2050)



*including the part of electricity and heat generated by RES

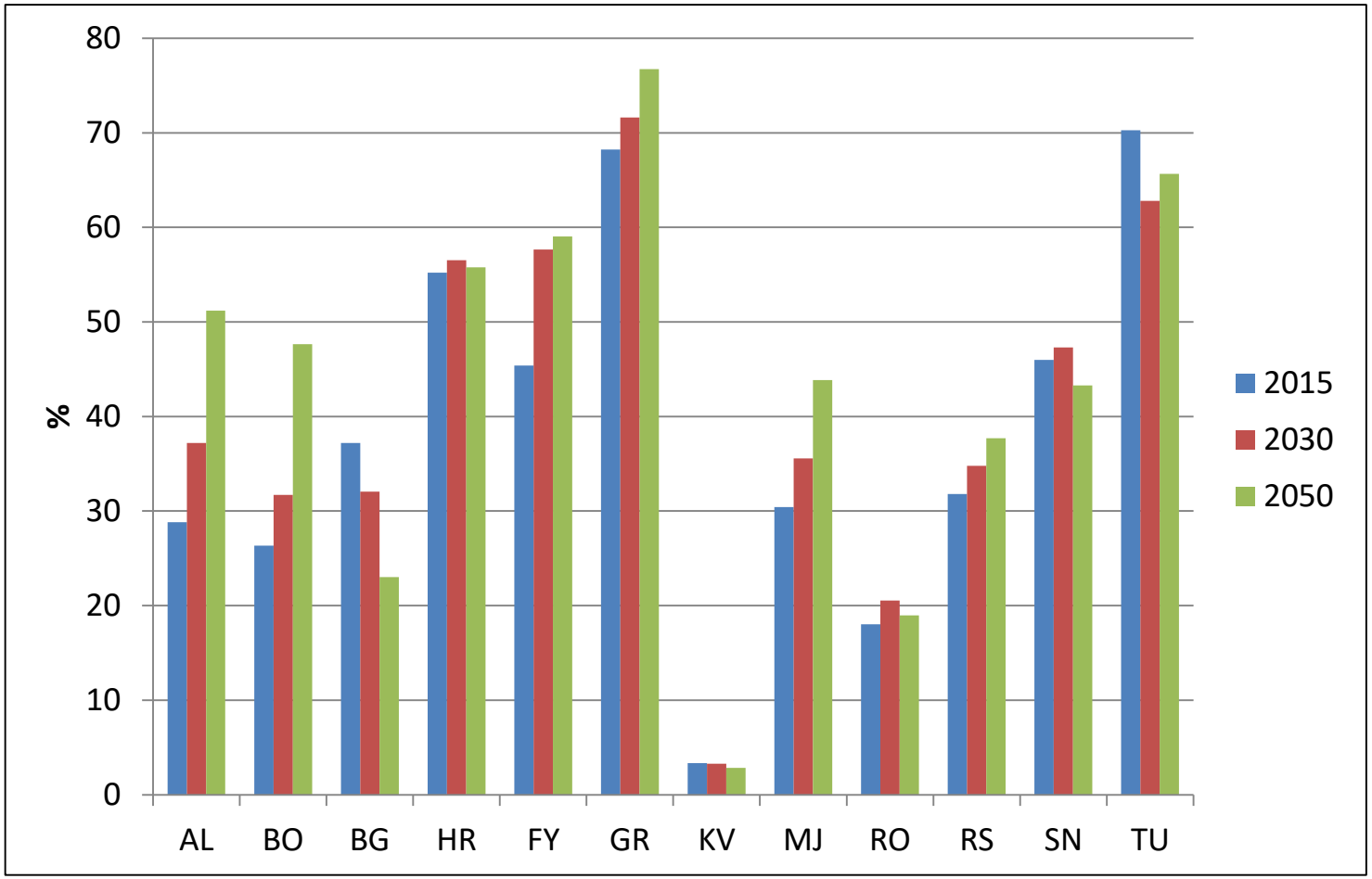
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Energy Intensity in 2015, 2030 and 2050



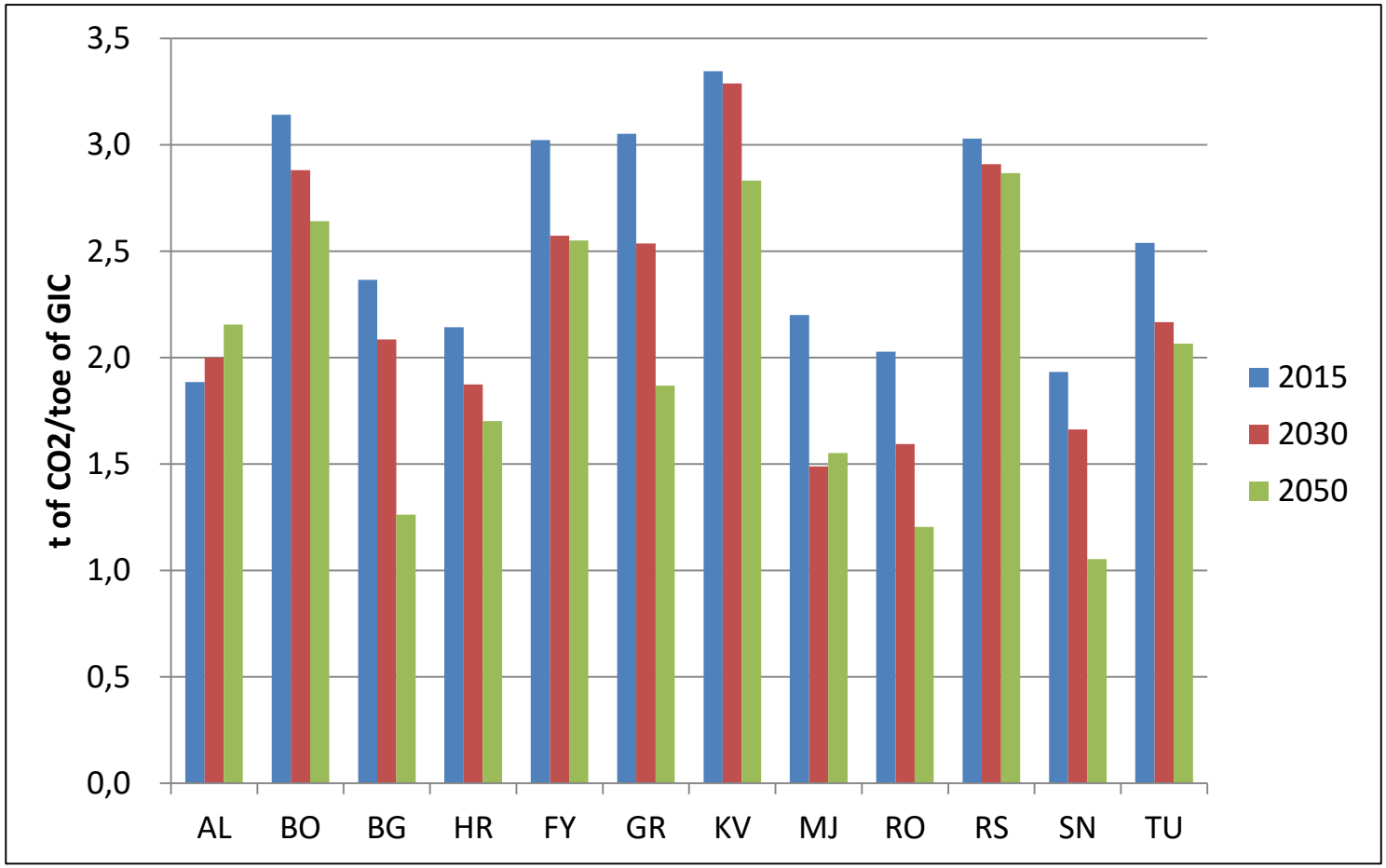
Source: IENE study “South East Europe Energy Outlook 2016/2017”, Athens, 2017

SE Europe: Import Dependency in 2015, 2030 and 2050



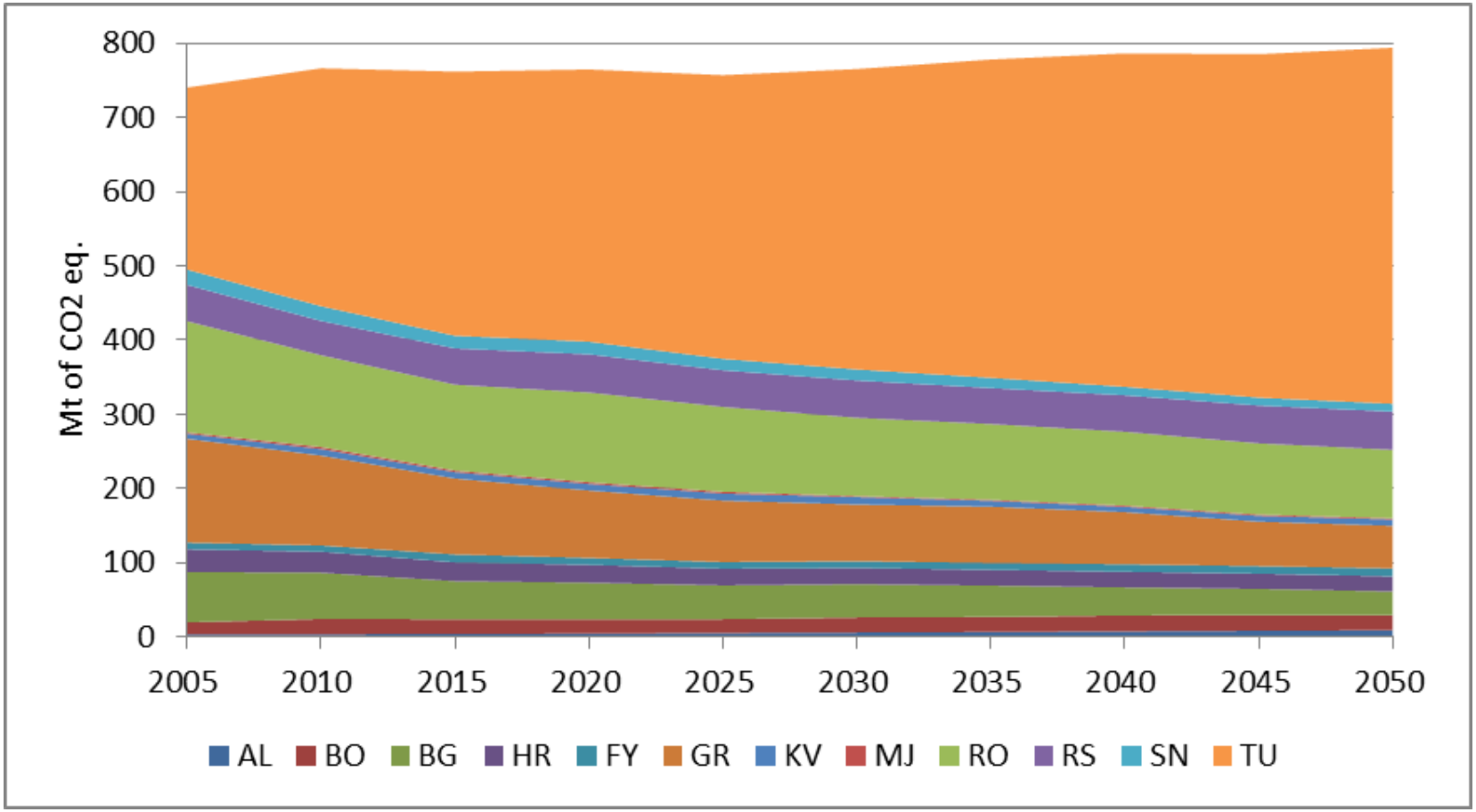
Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Carbon Intensity in 2015, 2030 and 2050



Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SE Europe: Total GHG Emissions, **including Turkey** (2005-2050)



Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

SEE Energy Investment Outlook 2016-2025

- The **investment prospects** in the energy sector of SE Europe over the next 10 years can only be described as **positive**.

- In terms of planned investments, a group of **five countries (i.e. Turkey, Bulgaria, Romania, Serbia, Greece)** appear to be moving **much faster than others** in attracting the needed investment for a variety of energy projects, while progress in the rest of the countries is moving more slowly.

- The region as a whole can be considered as presenting **attractive business opportunities in almost all branches of the energy sector**. The present analysis shows that investment in the energy sector will be spread as follows between countries and interregional projects. This analysis involves **two scenarios:**
  - An **optimistic one** (with an average real GDP growth of 3% over 2016-2025 and maximum investments) and
  - A **reference one** (with an average real GDP growth of 1% over 2016-2025 and substantial part of investments).

Findings of SEE Energy Investment Outlook 2016-2025 per country

SEE Countries	Scenario A: Total Investments (in million euros)	Scenario B: Total Investments (in million euros)
Albania	7,460	8,258
Bosnia & Herzegovina	8,722	10,060
Bulgaria	11,050	12,663
Croatia	8,525	9,178
Cyprus	7,350	8,769
FYROM	3,400	4,373
Greece	23,300	30,192
Kosovo	2,605	3,377
Montenegro	2,400	3,653
Romania	20,630	22,716
Serbia	11,260	13,527
Slovenia	3,185	4,891
Turkey	124,935	141,623
TOTAL	**234,822**	**273,280**

Source: IENE study "South East Europe Energy Outlook 2016/2017", Athens, 2017

Findings of SEE Energy Investment Outlook 2016-2025 per sector

Sector	Total Investment (in million euros)	
	Scenario A	Scenario B
Oil Upstream (Research, Exploration and Production)	25,450	32,288
Oil Downstream/Midstream (incl. liquid biofuels)	13,340	18,757
Electricity		
Thermal Plants		
Nuclear Plants	139,473	146,369
Lignite Mine Development		
Grids - Upgrade and Expansion		
HV Transmission Lines		
Gas		
Main and branch gas pipelines		
Gas Storage	16,550	26,460
Town grids		
LNG Terminals and Liquefaction plants		
RES (Wind, PV, Biomass, Mini Hydro, Geothermal)	40,009	49,406
TOTAL	**234,822**	**273,280**
Intraregional Mega Projects		
Oil Pipelines	-	1,000
Gas Pipelines	33,350	51,361
Electricity Interconnectors	4,700	7,150
Grand Total	**272,872**	**332,791**

Source: IENE study “South East Europe Energy Outlook 2016/2017”, Athens, 2017

Key Messages (I)

- Geography, followed by economy, have emerged as key factors in SEE's energy assessment
- **Energy strategies and policies:** There is considerable divergence between stated objectives and actual progress on the ground (e.g. Decarbonisation, RES penetration, regional co-operation)
- There is **clear failure at EU policy level** in achieving national targets especially in RES, as conflict is in evidence over strict budgetary rules and allowed deficit levels
- A robust upward trend in final energy demand in SE Europe over the projection period up to 2050 is forecasted, reaching 219 Mtoe in 2050, up by 59 Mtoe compared to 2015 levels
- The **persisting relevance of solid fuels** which contributed about 33% of the gross inland consumption and 38% of gross electricity generation of the SEE region respectively in 2015
- **High oil and gas import dependence** with crude oil and oil product imports corresponding to 82.65% of total oil consumption and 69.5% of natural gas, compared to 53.5% on the EU average.
- **Peripheral countries** are playing an increasingly more influential role in the channeling of energy flows into the SEE region
- Natural gas, although not fully utilized, is becoming increasingly important to the energy mix of the various SEE countries, both for power generation and commercial/domestic use

Key Messages (II)

- In terms of security of energy supply, the SEE region as a whole appears **more vulnerable** than the rest of Europe. Regional connectivity of electricity and gas grids is a priority.
- Market liberalization in the electricity sector has made **huge strides** over the last five years with unbundling having taken place and competition in the retail area now evident after many years of protectionism.
- **Less impressive** is progress in the natural gas sector where competition, is largely limited to the industrial sector with retail lagging seriously behind.
- Nuclear power, although it supplies only 6.0% of the electricity mix in SEE remains a viable option since it covers important base load in certain key countries (Romania, Bulgaria, Croatia and Slovenia) and is fully compatible and supportive of EU's decarbonisation policies.
- For RES to achieve greater penetration in the SEE energy mix, and thus facilitate the region's decarbonisation, **clear policy measures** (backed by EU funds where necessary) **will be required to enable RES participation in market mechanisms.**
- **Energy efficiency in SE Europe is not being given enough priority or attention** although its role has been recognized in all EU Member States. Further efforts are required to introduce energy efficiency as an integral part of national energy planning.
- Energy Transition process is in evidence but it will take a lot more effort and much greater regional cooperation in order to fall in line with stated EU targets.

"There are facts only about the present and past; about the future there are only interests and aspirations."

- Aristotle

INSTITUTE OF ENERGY
FOR SOUTH-EAST EUROPE

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