Decarbonisation Policies in SE Europe

Joint ROEC/IENE Event in Bucharest

EC Representation in Bucharest

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Chairman and Executive Director, IENE

INSTITUTE OF ENERGY
FOR SOUTH EAST EUROPE

The SE Europe, as Defined by IENE

Core countries

- Albania
- Bosnia and Herzegovina
- Bulgaria
- Croatia
- Cyprus
- Greece
- Hungary
- Israel
- Kosovo
- Montenegro
- North Macedonia
- Romania
- Serbia
- Slovenia
- Turkey

Peripheral countries

- Austria
- Egypt
- Italy
- Lebanon
- Moldova
- Slovakia
- Syria
- Ukraine

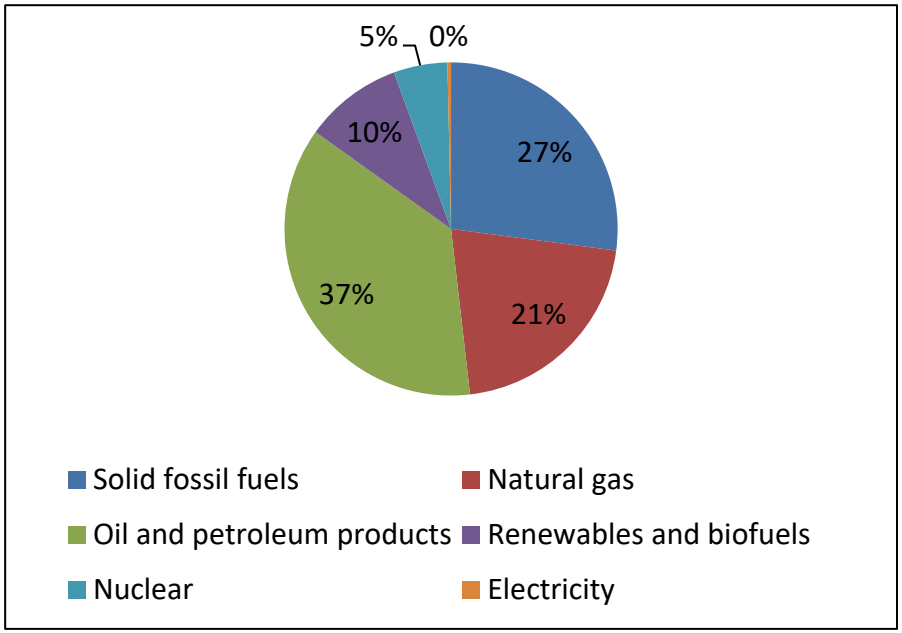
Source: IENE

The Realities of the Energy Scene in SE Europe

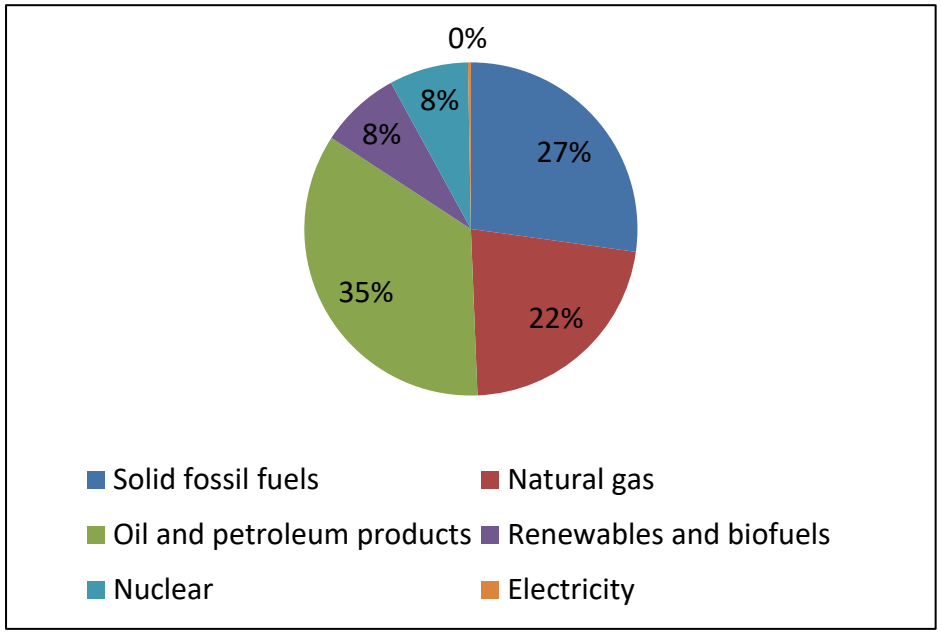
- The differentiation of the regional energy mix, which in spite of the consistent rise of RES and gas penetration, remains bound to high solid fuel consumption and sizeable oil and gas imports. The large amounts of indigenous coal and lignite deposits provide relatively cheap and easily accessible energy supplies for most countries of the region.
- There is resistance at local level to EC's determined move away from fossil fuels.
- We notice a major policy challenge, which governments and the EC will have to address. There is a huge incompatibility between stated and adopted EU goals for decarbonisation.
- Although several countries in the region appear determined to exhaust their coal/lignite deposits, they are in parallel developing renewables and other carbon free resources such as nuclear power.
- Given the financial and legal constraints in most countries, the rise of RES, especially for electricity generation, over the last five years appears impressive.
- Because of the intermittent nature of power generation from RES and undeveloped large-scale energy storage, their contribution to electricity production of the different countries appears limited.
- Given the strong market dynamics of the RES sector, the introduction of viable large-scale storage schemes in the mid-term and hydrogen in the long- term are distinct options in the years ahead.

Gross Inland Consumption (%) in SE Europe, with and without Turkey, 2001

With Turkey



Without Turkey



Sources: Eurostat, IENE

Gross Inland Consumption (%) in SE Europe, with and without Turkey, 2011

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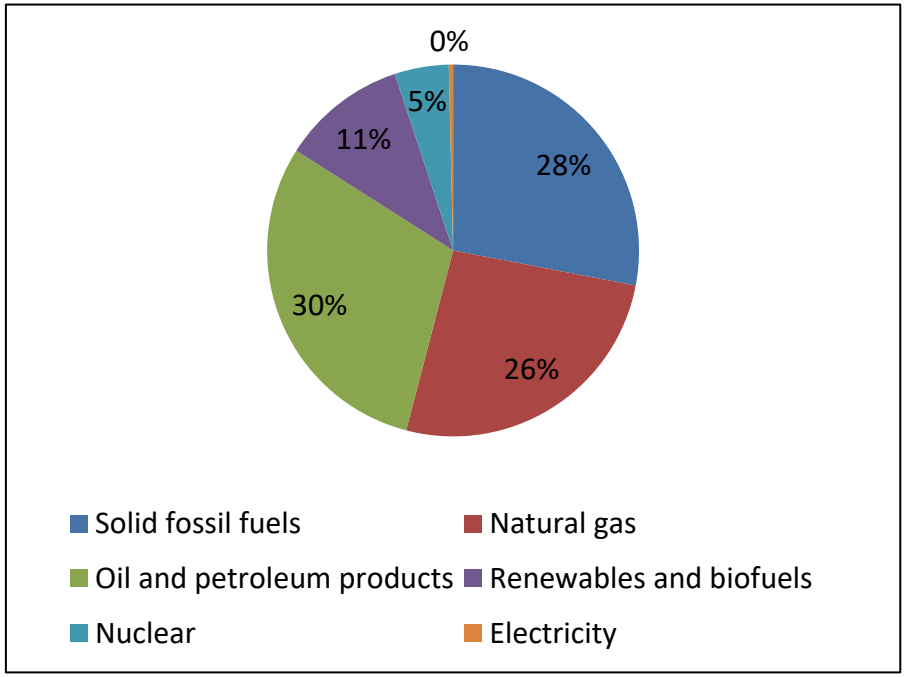

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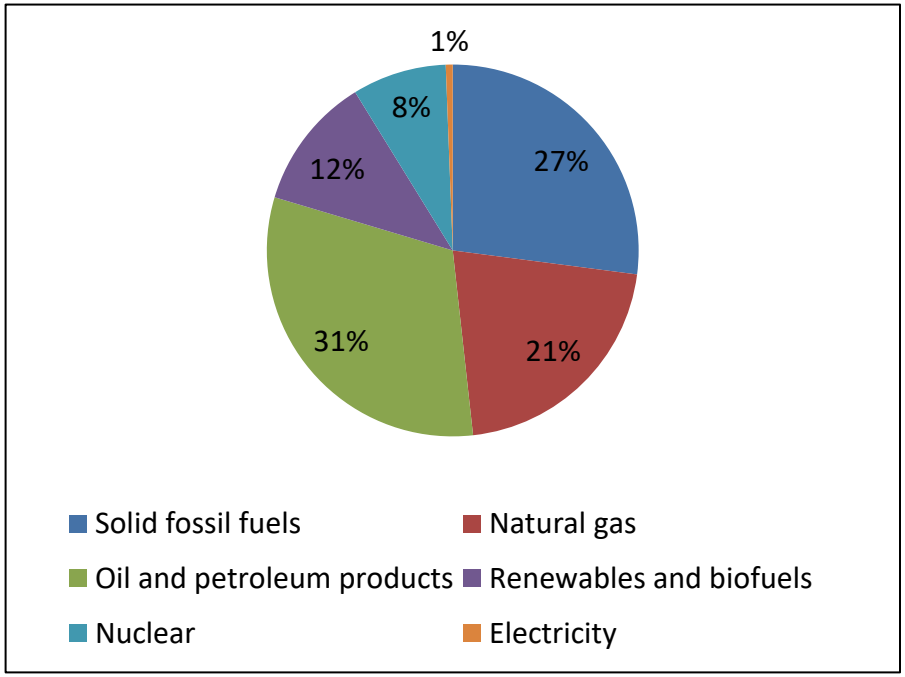
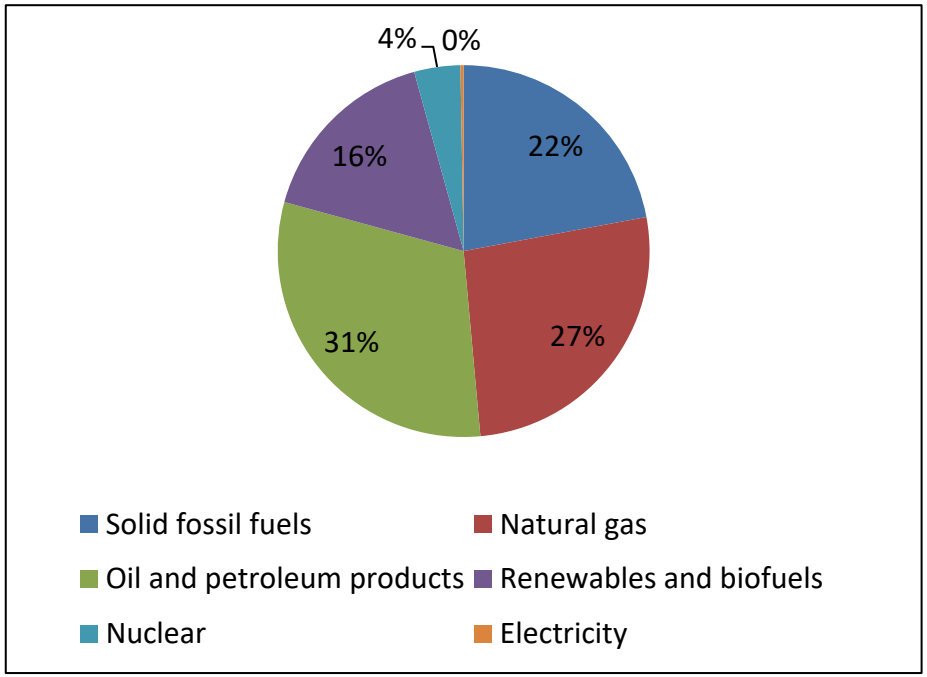


Sources: Eurostat, IENE

Gross Inland Consumption (%) in SE Europe, with and without Turkey, 2021

With Turkey



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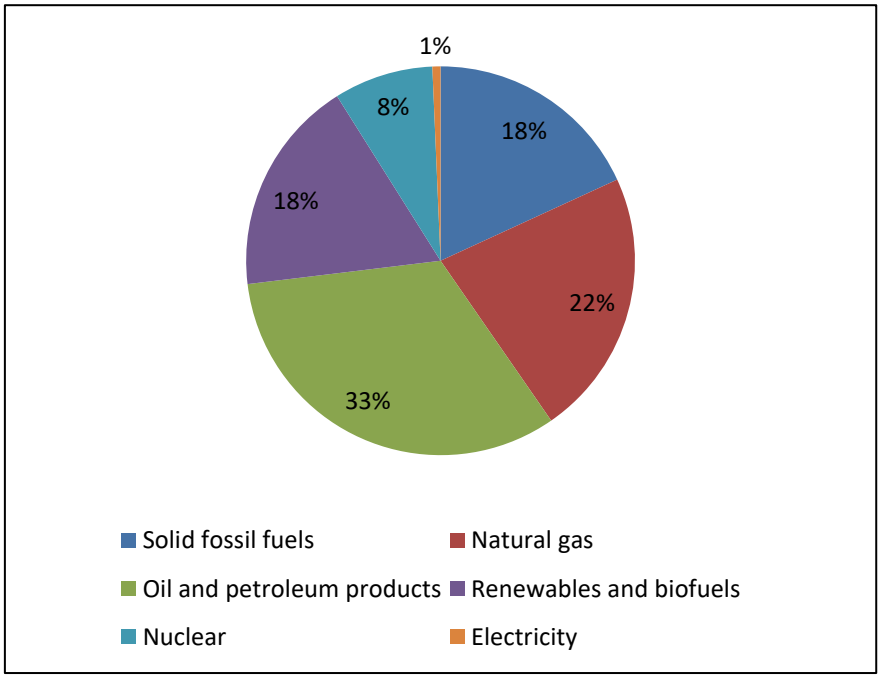
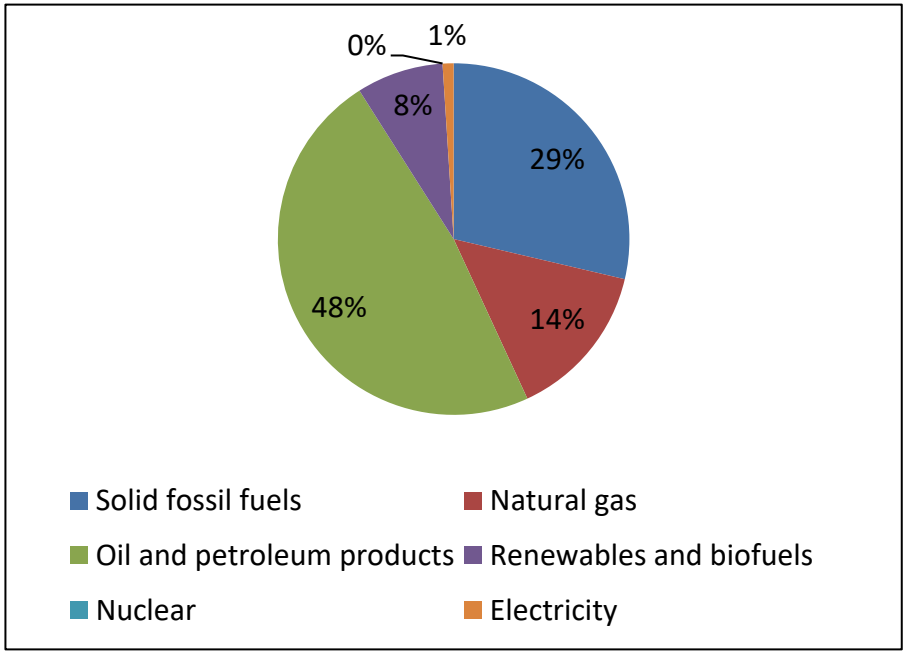


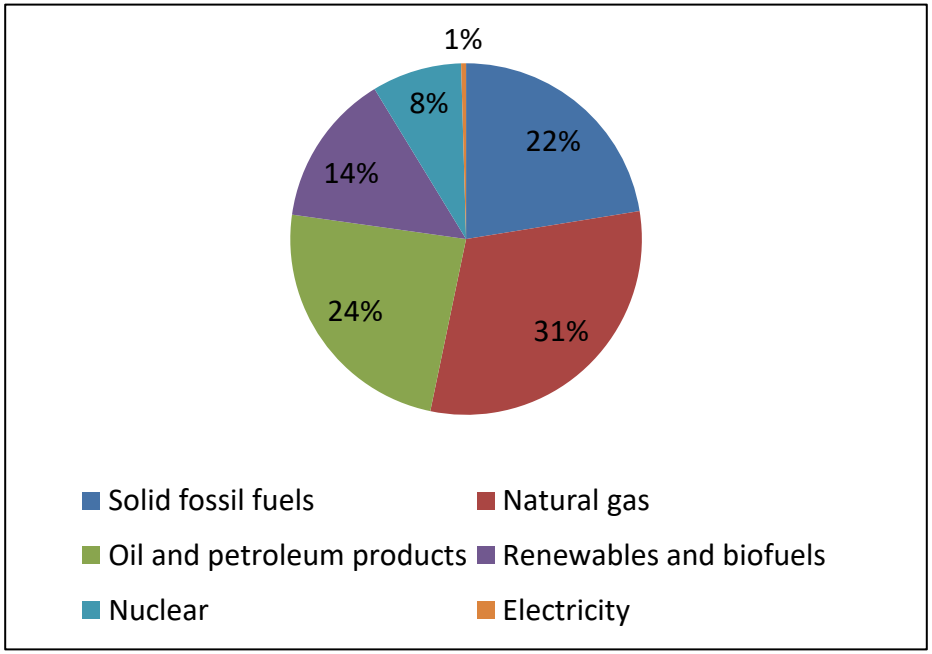
Sources: Eurostat, IENE

Gross Inland Consumption (%) in Greece and Romania, 2011

Greece



Romania



Sources: Eurostat, IENE

Gross Inland Consumption (%) in Greece and Romania, 2021

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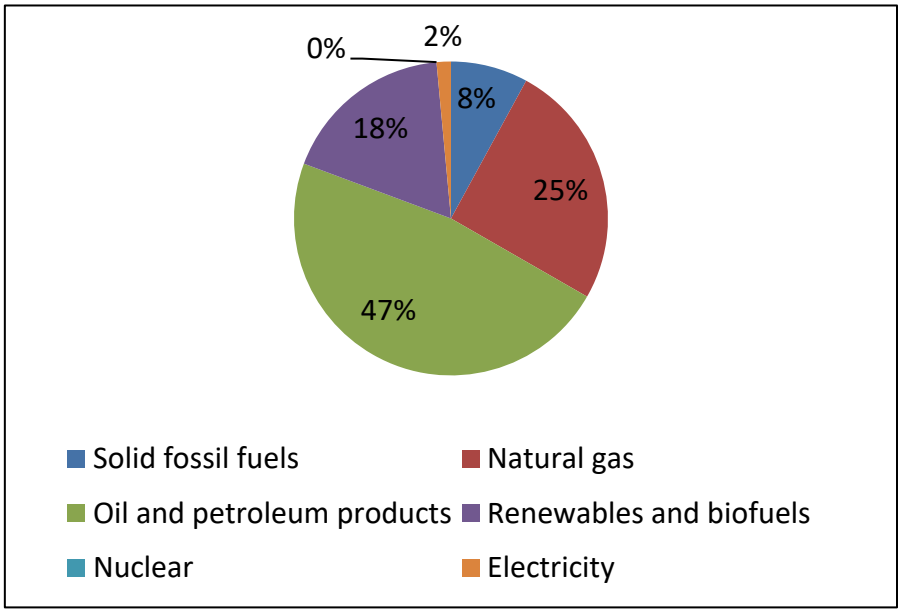
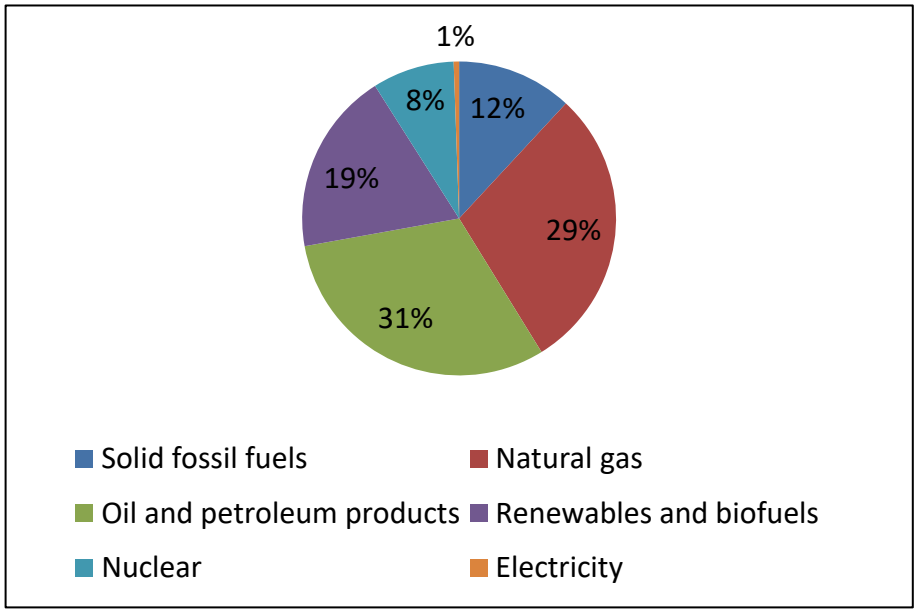


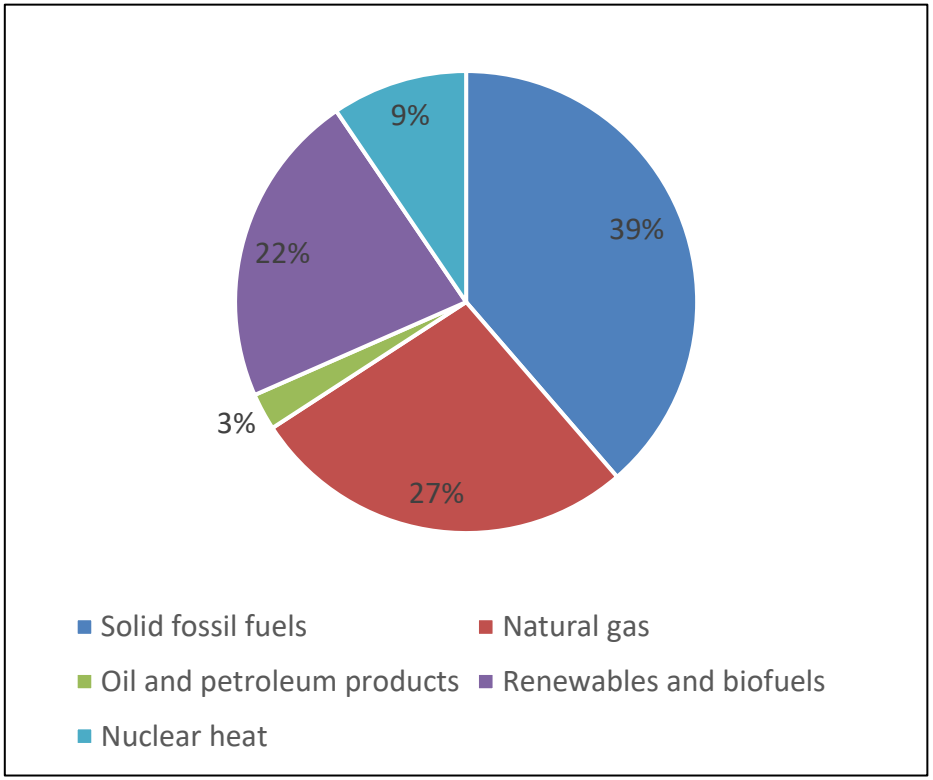
Romania



Sources: Eurostat, IENE

Power Generation Mix (%) in SE Europe, 2011

With Turkey



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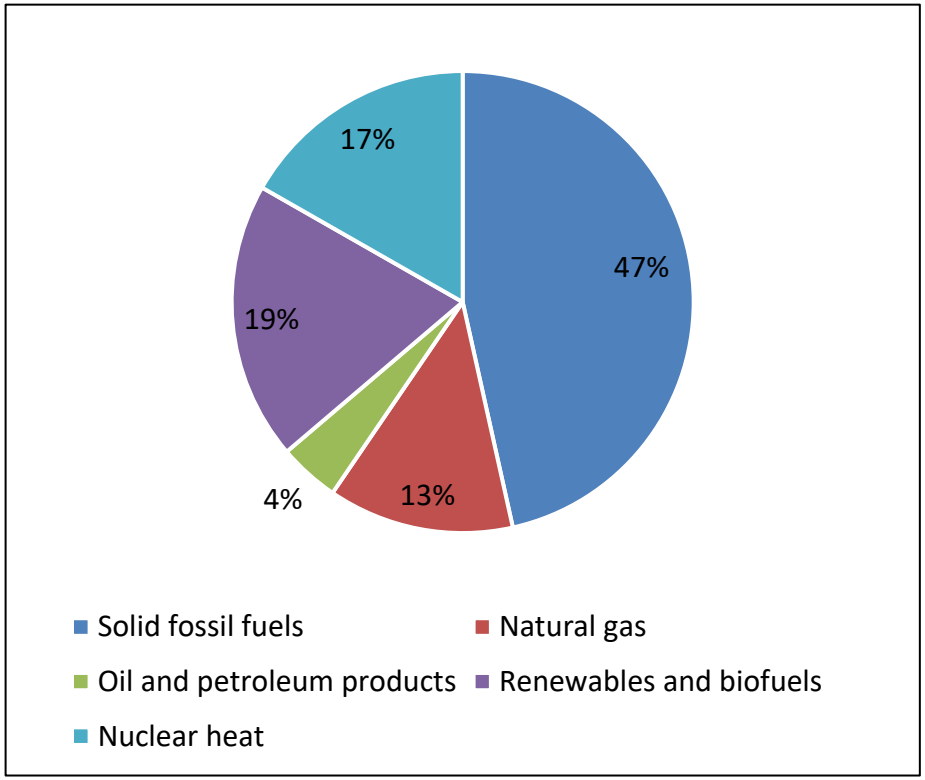
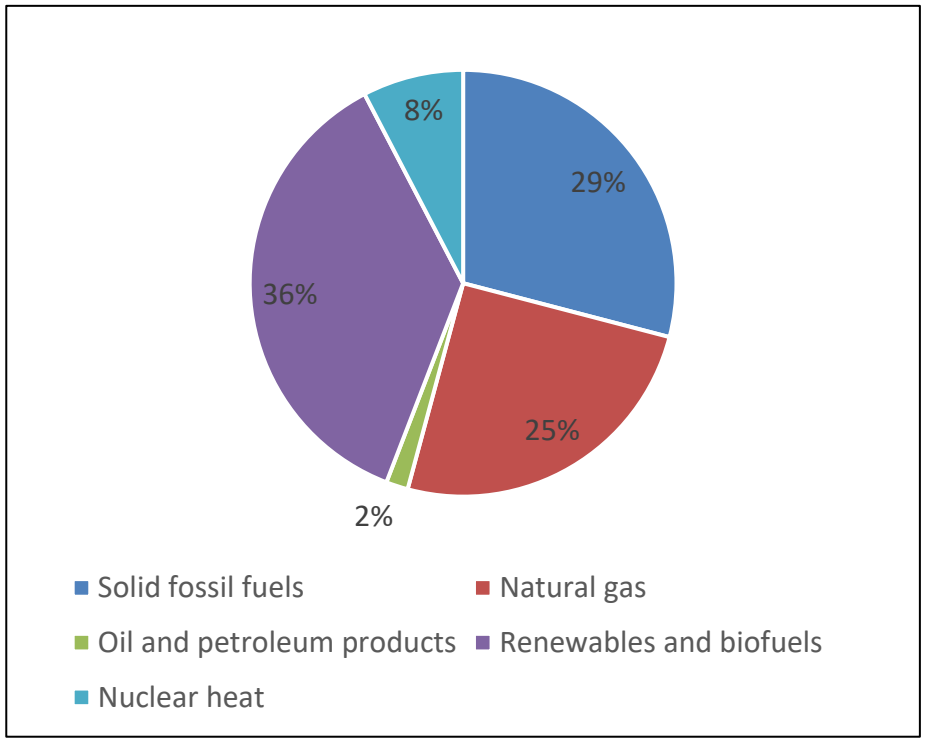


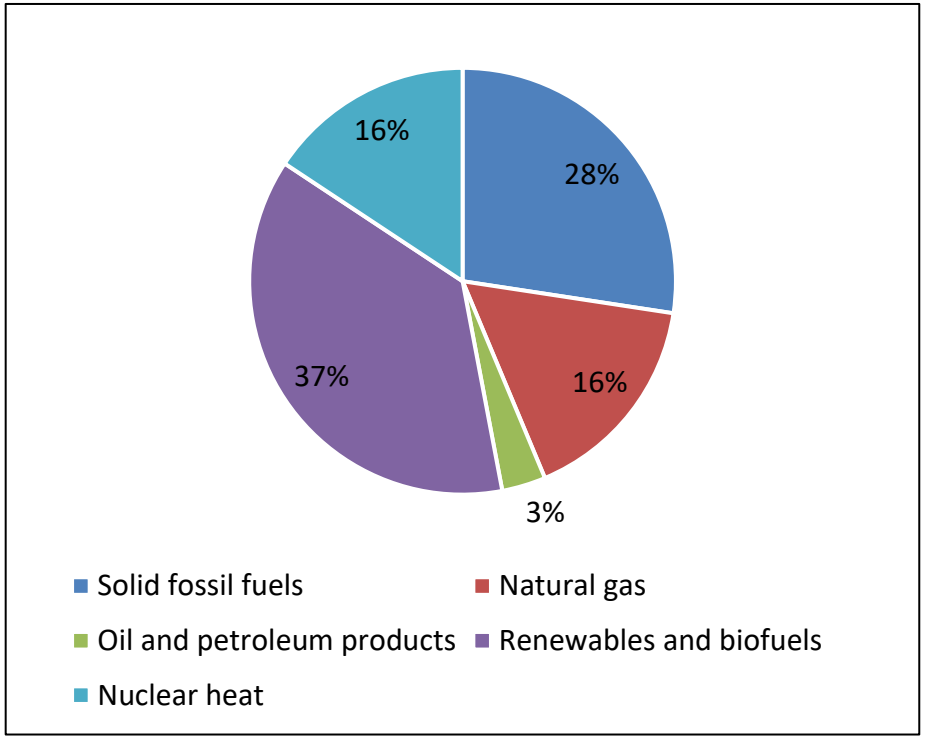
Sources: Eurostat, IENE

Power Generation Mix (%) in SE Europe, 2021

With Turkey



Without Turkey



Sources: Eurostat, IENE

Power Generation Mix (%) in Greece and Romania, 2021

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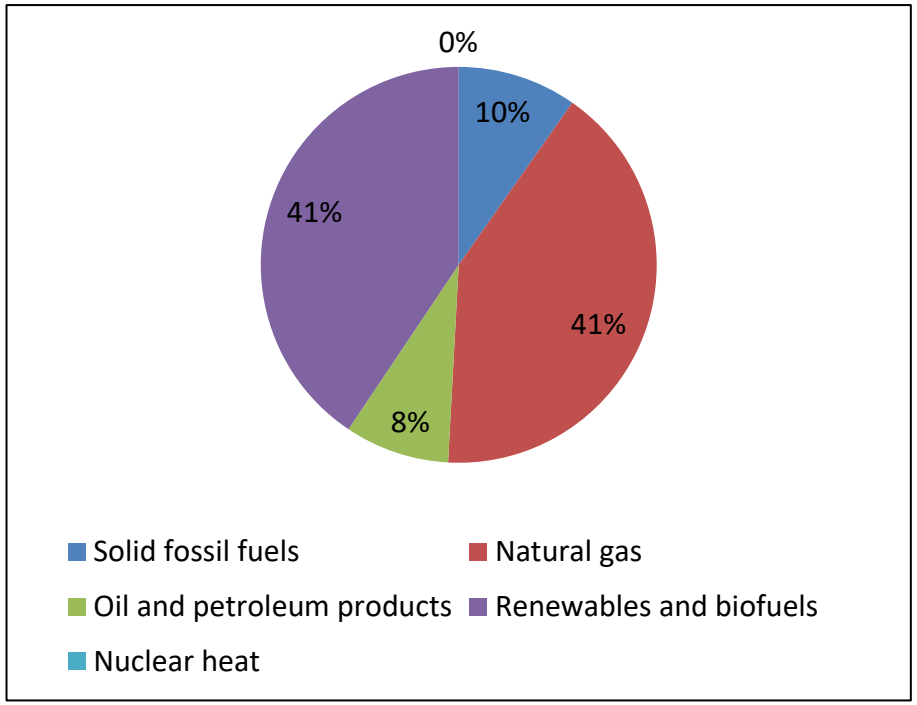
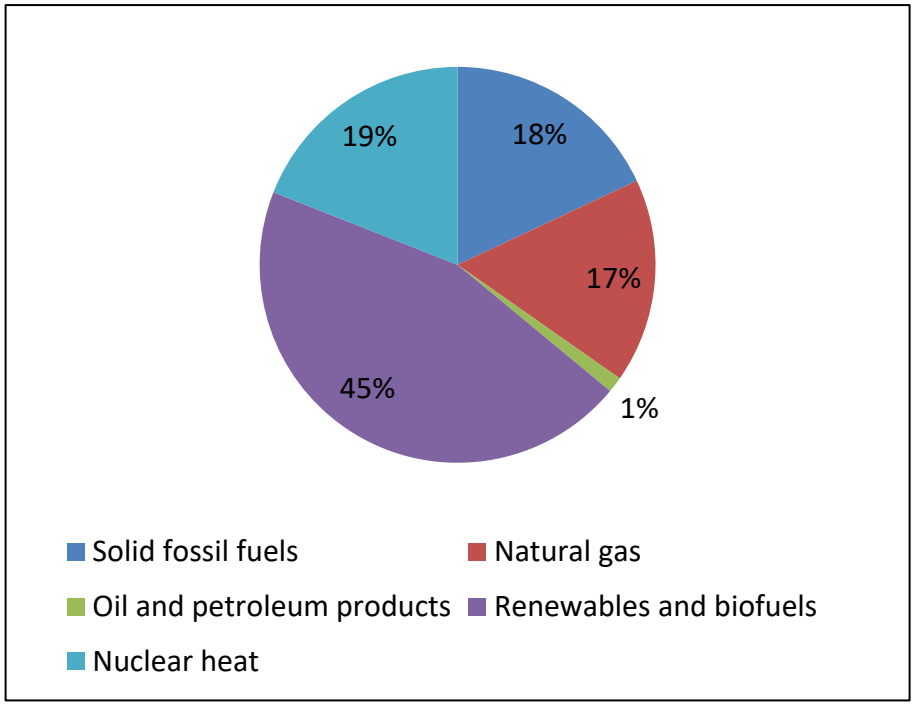


Romania



Sources: Eurostat, IENE

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 emission 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.
  - **North Macedonia and Serbia are the second most coal dependent countries after Kosovo at regional level**, while 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 28 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.

Decarbonisation and Related Technologies

- Decarbonisation in the region can be pursued in two parallel streams:
  - 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.
- There is no agreed regional roadmap towards decarbonisation, while cooperation between the countries in the region focus on energy security.
- There is an urgent need to introduce latest technologies in order to improve decarbonisation efforts, energy efficiency and upgrade operation of existing networks (e.g. CCUS, solar thermal systems, power electronics, energy storage)

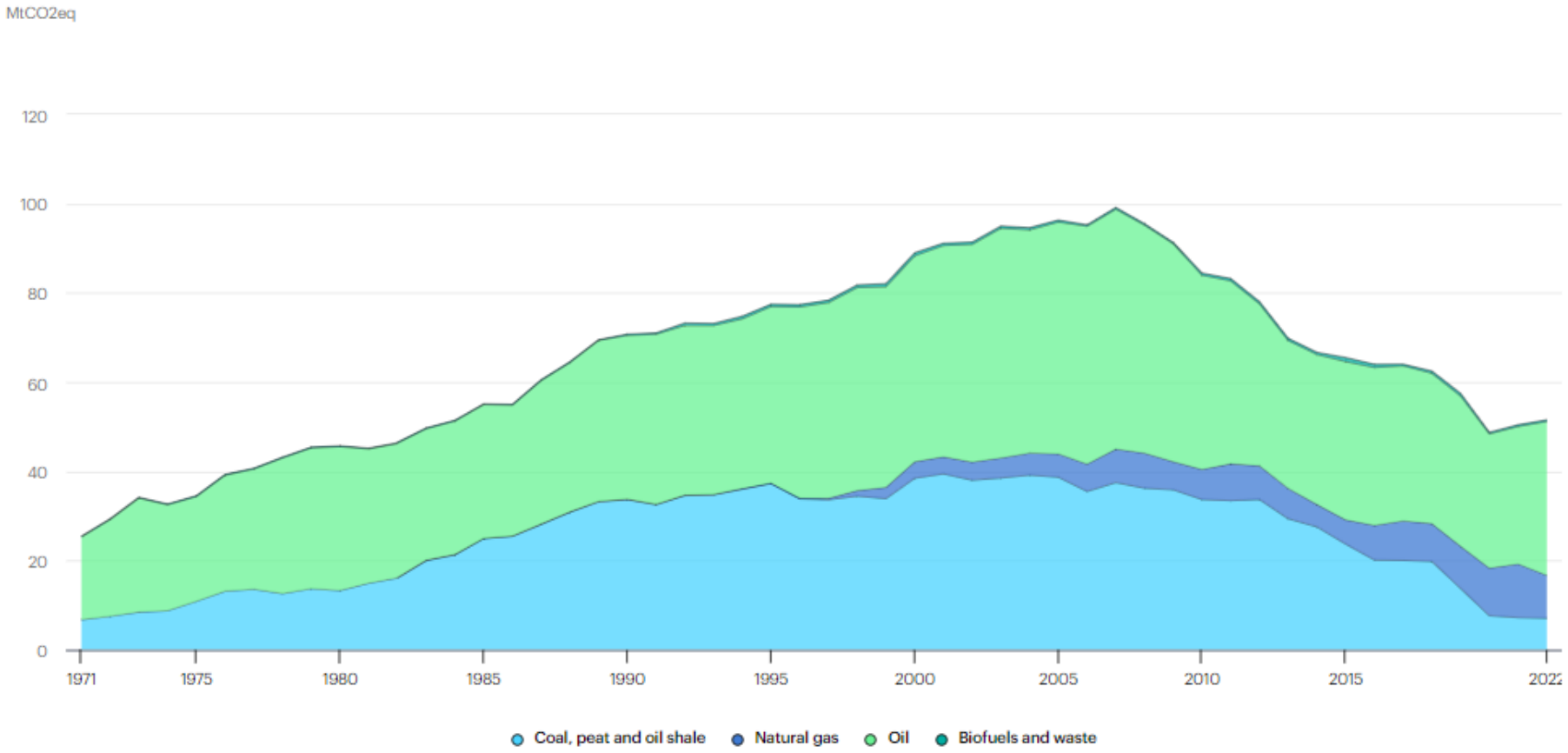
Under Construction and Planned Coal Plants in SEE Countries (MW)*, as of January 2024

Country	Announced	Pre-permit	Permitted	Announced + Pre-permit + Permitted	Construction	Shelved	Operating	Mothballed	Cancelled 2010-2023	Retired 2000-2023
Albania	0	0	0	0	0	0	0	0	800	0
Bosnia and Herzegovina	0	1.350	0	1.350	0	350	2.090	0	3.500	0
Bulgaria	0	0	0	0	0	0	4.569	540	2.660	1.380
Croatia	0	0	0	0	0	0	217	125	1.300	0
Greece	0	0	0	0	0	0	2.885	0	1.250	3.053
Hungary	0	0	0	0	0	0	944	250	3.080	515
Kosovo	0	0	0	0	0	0	1.290	0	830	190
Montenegro	0	0	0	0	0	0	225	0	1.664	0
North Macedonia	0	0	0	0	0	0	824	0	730	0
Romania	0	0	0	0	0	0	2.310	645	5.705	4.780
Serbia	0	0	0	0	350	1.350	4.435	32	1.445	0
Slovenia	0	0	0	0	0	0	1.069	0	0	535
Turkey	1.000	888	2.920	4.808	145	4.820	20.473	400	89.068	0

***Note:** Includes units 30 MW and larger

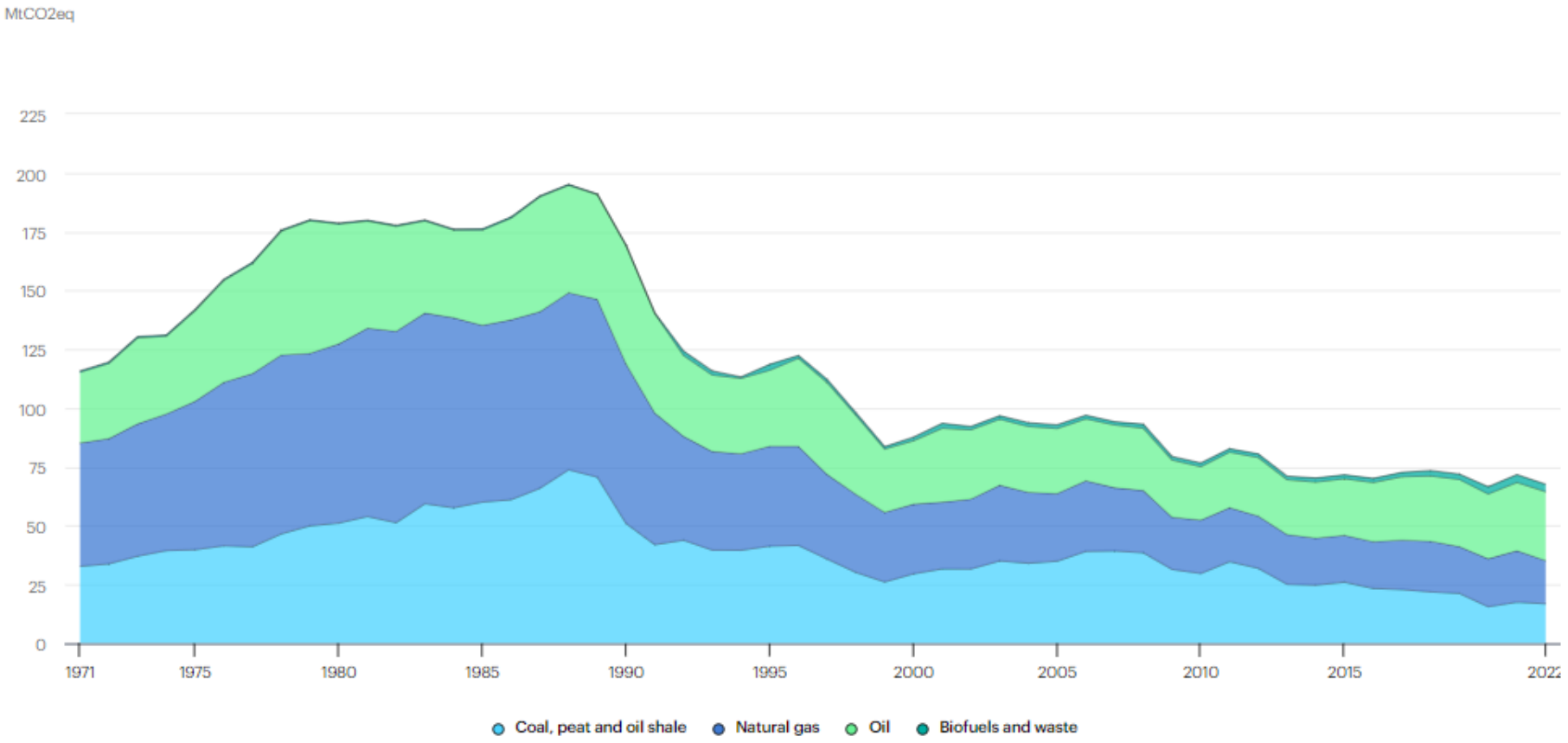
Sources: EndCoal, IENE

Share of GHG Emissions and Total Energy Supply by Product in Greece, 2022



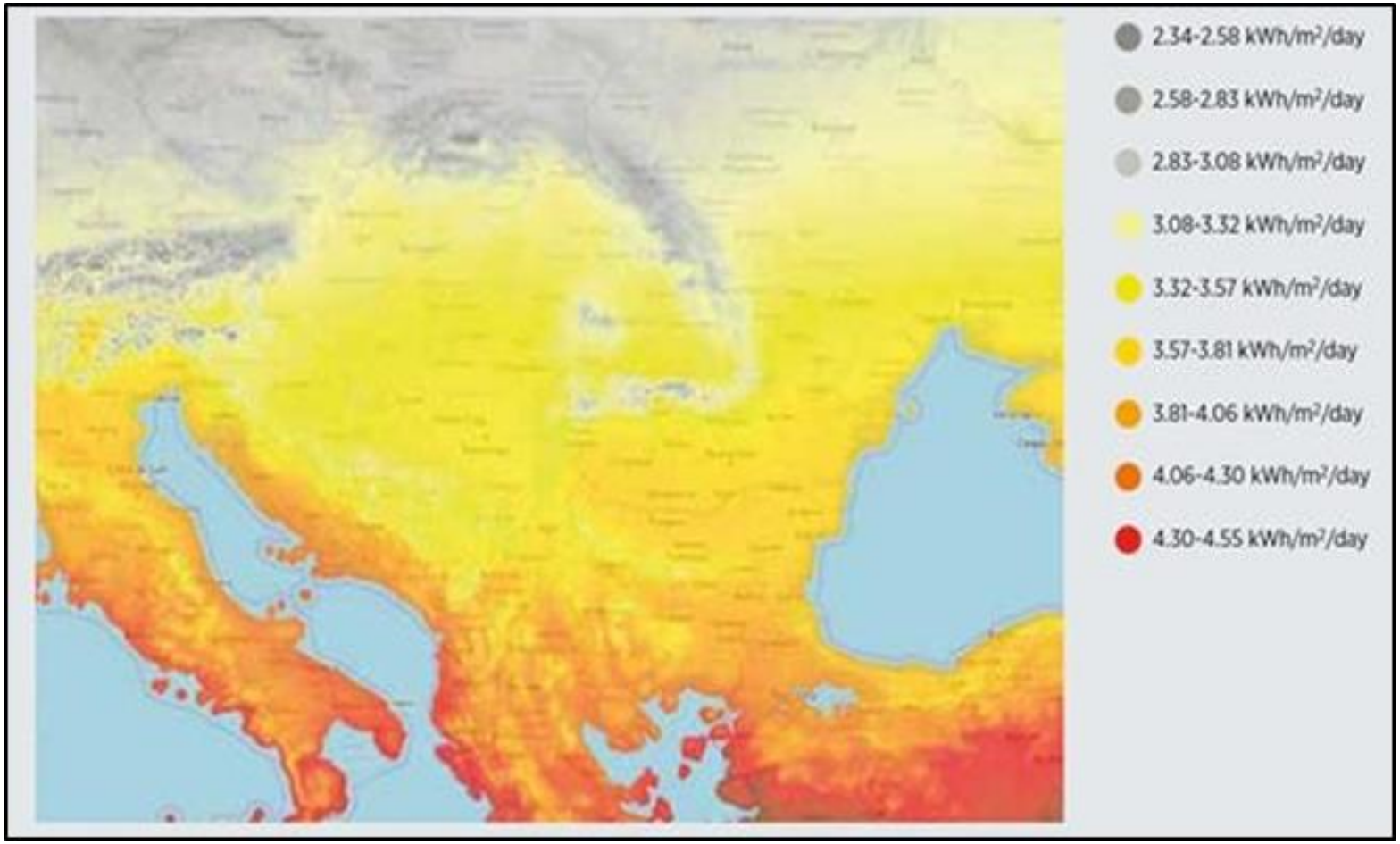
Source: IEA

Share of GHG Emissions and Total Energy Supply by Product in Romania, 2022



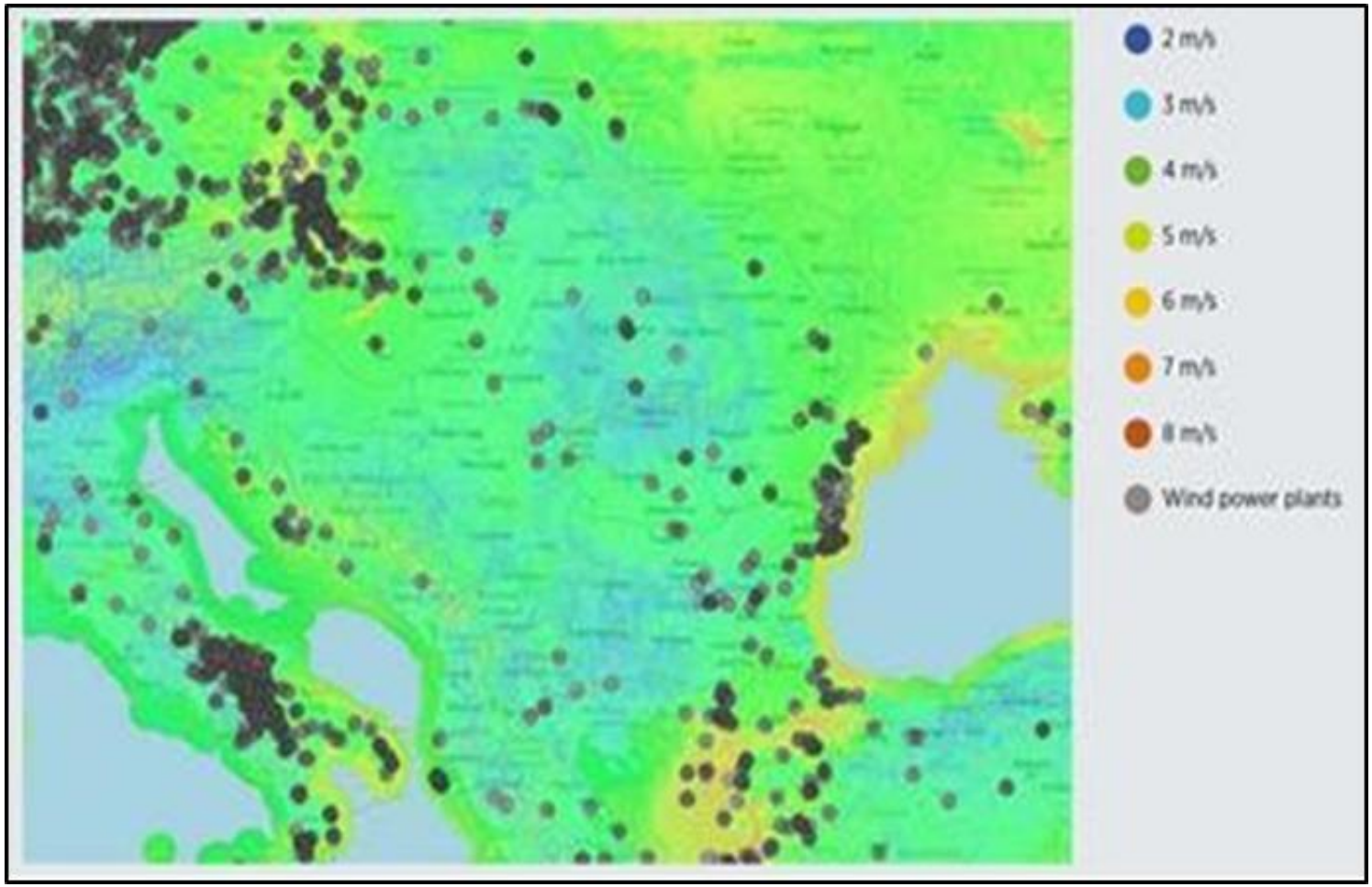
Source: IEA

Solar Resources in the SEE Region and Surrounding Countries, 2019



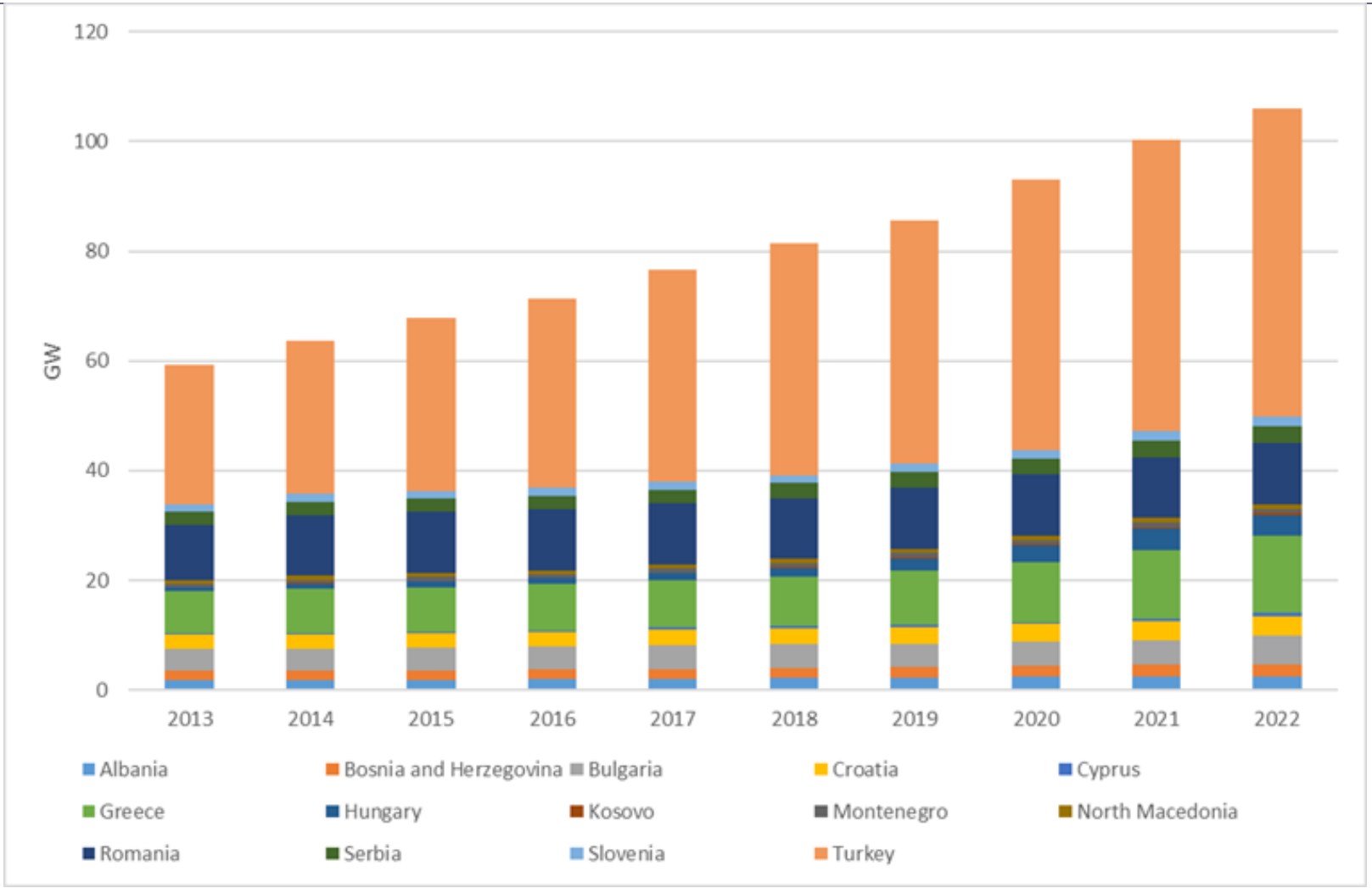
Source: IRENA

Wind Speed and Wind Power Plants in the SEE Region and Surrounding Countries, 2019



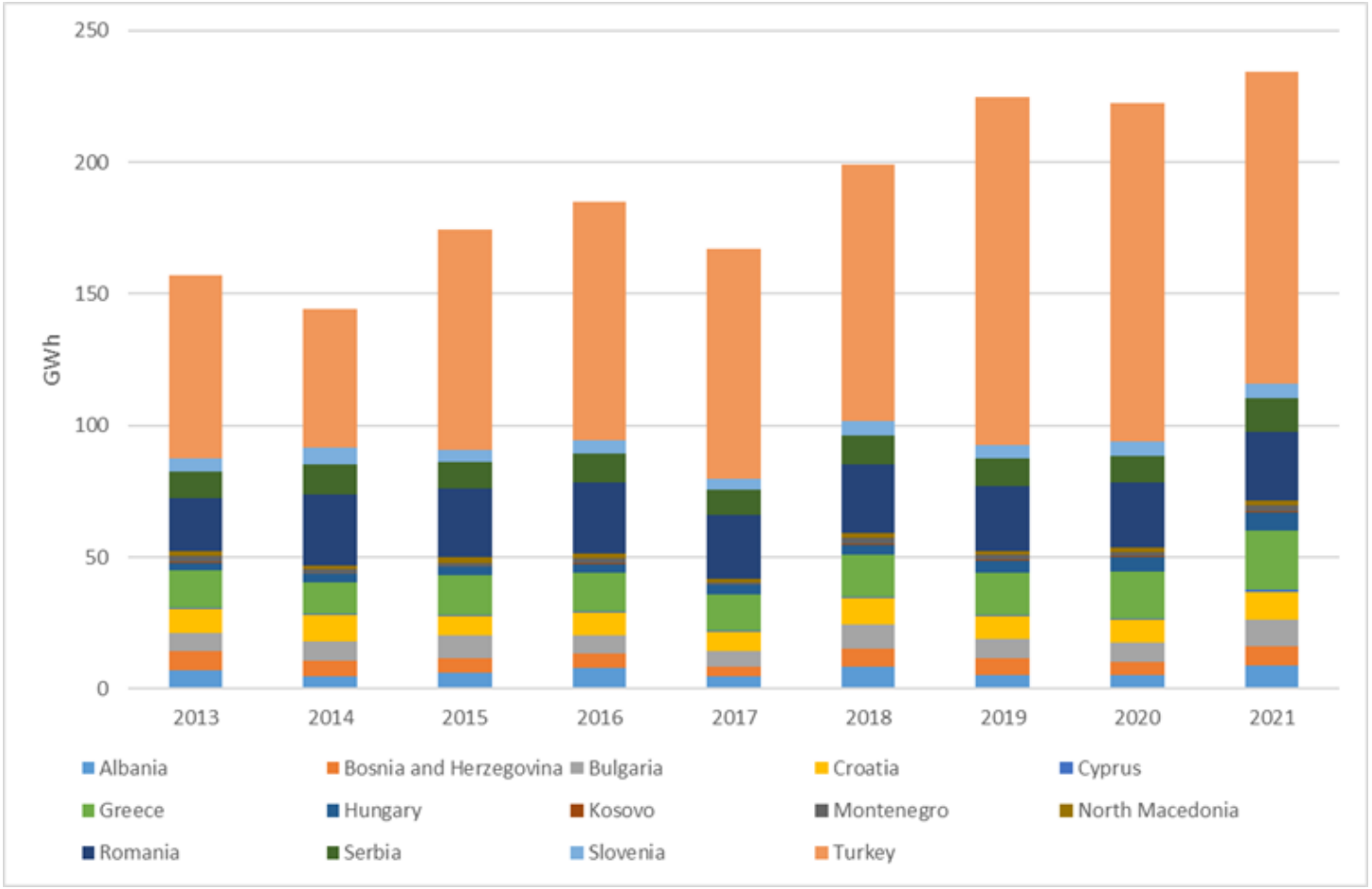
Source: IRENA

Total Installed RES Capacity (GW) by Country in SE Europe, 2013-2022



Source: IRENA

Power Generation (GWh) from RES, Including Hydro, by Country in SE Europe, 2013-2021



Source: IRENA

Global Weighted Average Total Installed Costs, Capacity Factor and Levelised Cost of Electricity Trends by Technology, 2010 and 2022

	Total installed costs (2022 USD/kW)			Capacity factor (%)			Levelised cost of electricity (2022 USD/kWh)		
	2010	2022	Percent change	2010	2022	Percent change	2010	2022	Percent change
Bioenergy	2 904	2 162	-26%	72	72	1%	0.082	0.061	-25%
Geothermal	2 904	3 478	20%	87	85	-2%	0.053	0.056	6%
Hydropower	1 407	2 881	105%	44	46	4%	0.042	0.061	47%
Solar PV	5 124	876	-83%	14	17	23%	0.445	0.049	-89%
CSP	10 082	4 274	-58%	30	36	19%	0.380	0.118	-69%
Onshore wind	2 179	1 274	-42%	27	37	35%	0.107	0.033	-69%
Offshore wind	5 217	3 461	-34%	38	42	10%	0.197	0.081	-59%

Source: IRENA

Operational Nuclear Power Plants in SE Europe

Country	Name	Type of reactor	Capacity (MWe)	Operation since
Bulgaria	Kozloduy 5	PWR	1003	1987
	Kozloduy 6	PWR	1003	1991
Hungary	Paks 1	PWR	479	1982
	Paks 2	PWR	477	1984
	Paks 3	PWR	473	1986
	Paks 4	PWR	473	1987
Romania	Cernavoda 1	PHWR	650	1996
	Cernavoda 2	PHWR	650	2007
Slovenia/Croatia	Krsko	PWR	688	1981
Turkey	Akkuyu 1	VVER	1200	2024*

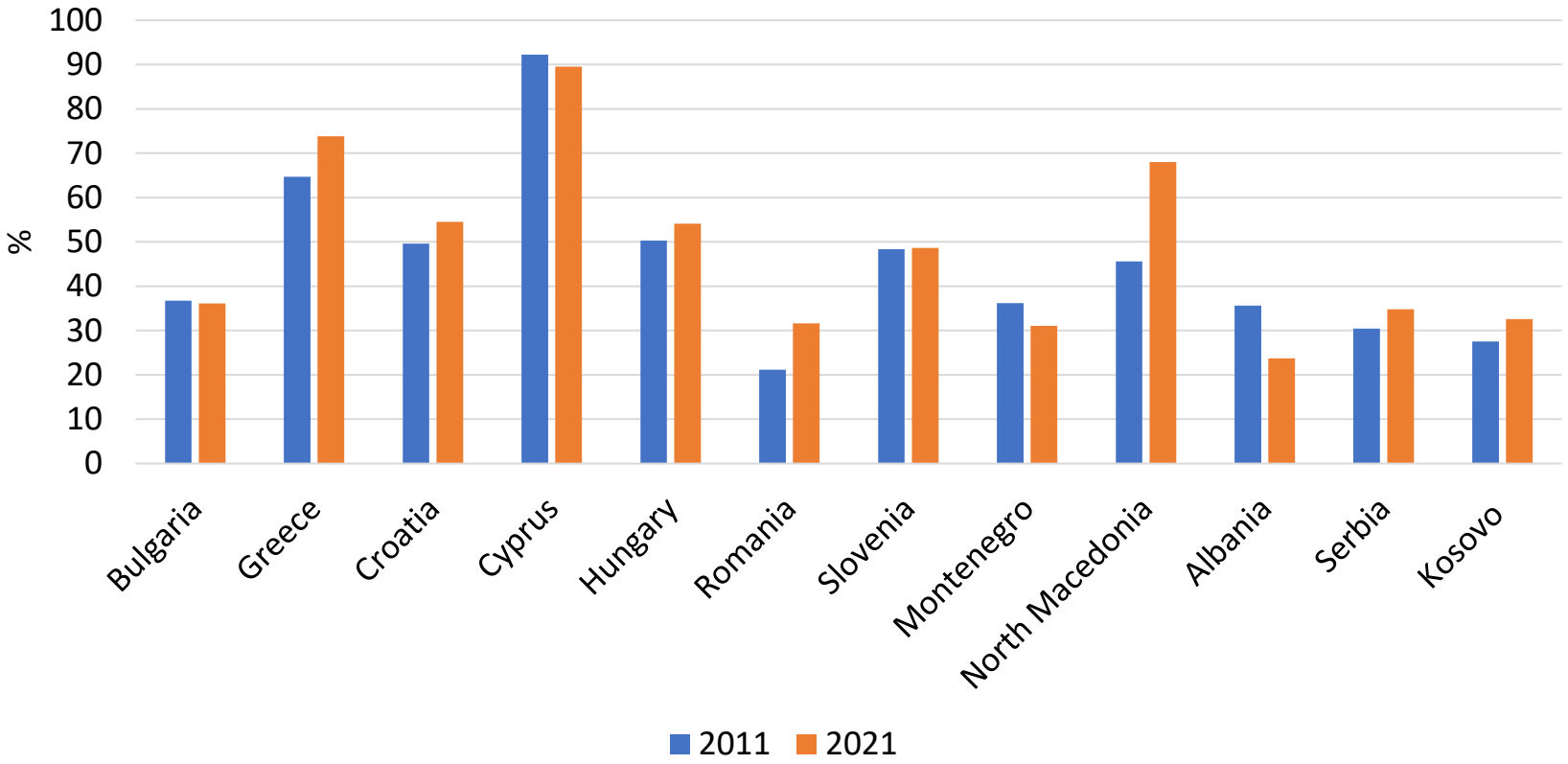
*The first unit of Akkuyu nuclear power plant is expected to be operational by the end of 2024.

Source: World Nuclear Association

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), 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 Dependence (%) in SE Europe, 2011 and 2021



Sources: Eurostat, IENE

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).
- **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 (*IENE organised an Ad hoc meeting for energy security on March 15, 2017*).
- The various vulnerable key energy infrastructure locations in SE Europe constitute **potential energy security hot spots** and as such should be properly identified, 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).

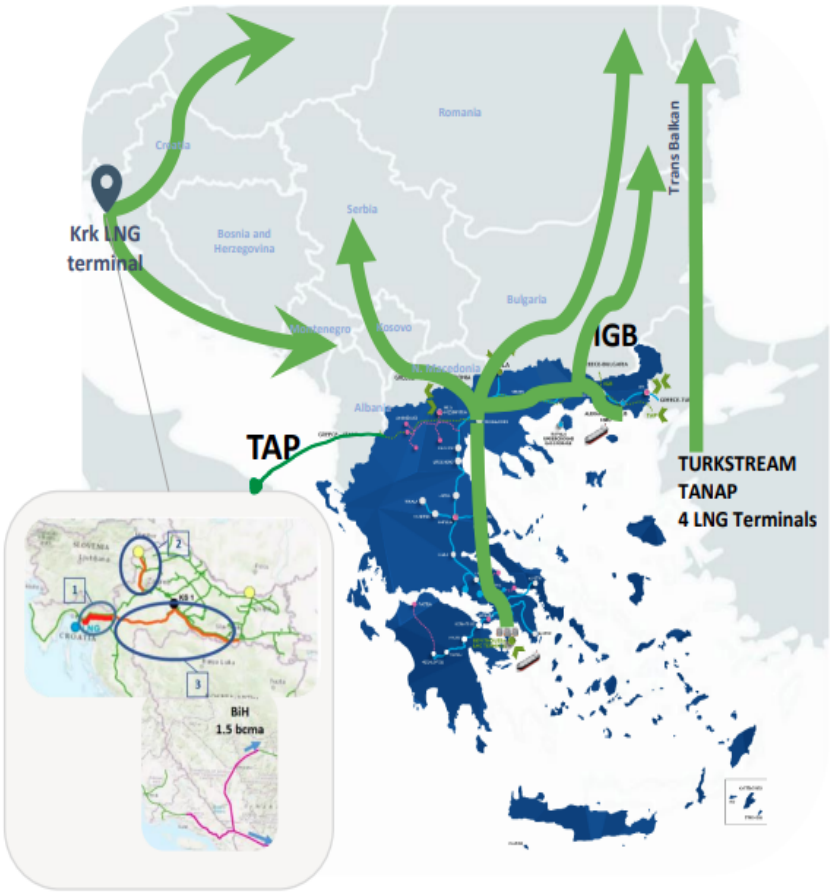
Energy Security in SE Europe (III)
- Towards a Redefinition of the South Corridor

- Meanwhile, several gas exploration projects are in the development stage in the **East Mediterranean** region, with important gas discoveries such as the Leviathan and Tamar fields in Israel, Zohr in Egypt and Aphrodite (which borders with Zohr), Zeus and Cronos in Cyprus's EEZ.

- A number of alternative plans are under discussion for channeling this gas to Greece and Turkey, for local consumption, but also to Europe proper for transit to the continent's main gas markets. These plans include gas pipelines, liquefaction plants for LNG export and FSRU terminals to be tied up into the TANAP-TAP system.

- Another option apart of TAP – TANAP system is the **East Med Pipeline** which again, due to the significant technical challenges, could also accommodate limited quantities of gas in the regions of 8.0 to 12.0 BCM's per year. Meanwhile, EC is actively exploring the possibility of massively increasing the member countries' LNG capabilities as part of Energy Union priorities, despite the recent negative stance from the US.

Greece Has Emerged as an Important Source of LNG For Europe But is Facing Stiff Competition in the Potential Supply Routes For Gas in SE Europe



CROATIA

- ✓ Closer to the main lines that bring gas to Central Europe & Ukraine
- ✓ Has a newly built FSRU - **Krk LNG**
- ✓ The Croatian **government is financially supporting the de-bottlenecking of the national network** to accommodate transit flows
- — Challenges related to expansion of transit capacity

Greece

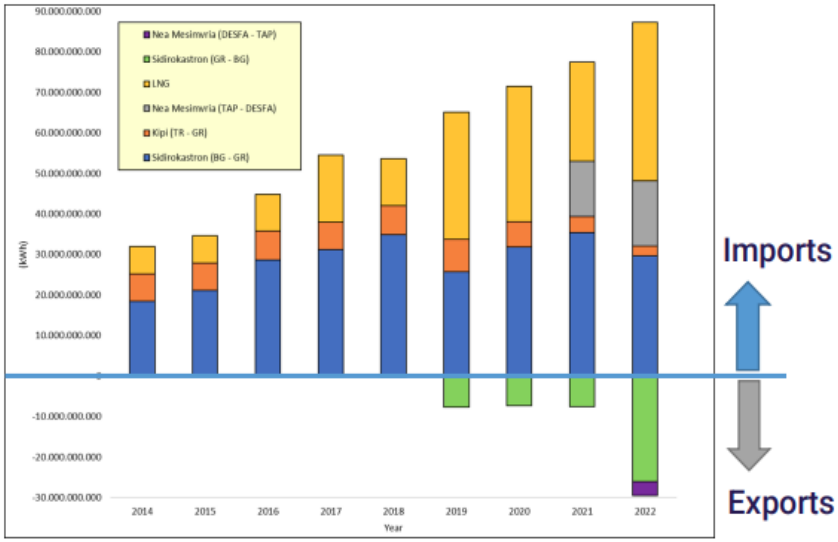
- ✓ Very well placed, with one large LNG import Terminal
- ✓ One FSRU under construction and a 2nd in planning phase
- ✓ Two connections to Bulgaria which grant access to Trans Balkan pipeline
- — Congested national gas network & large **investments needed for the upgrade for LNG Transit**
- — No "free money" any longer for natural gas but only for H2

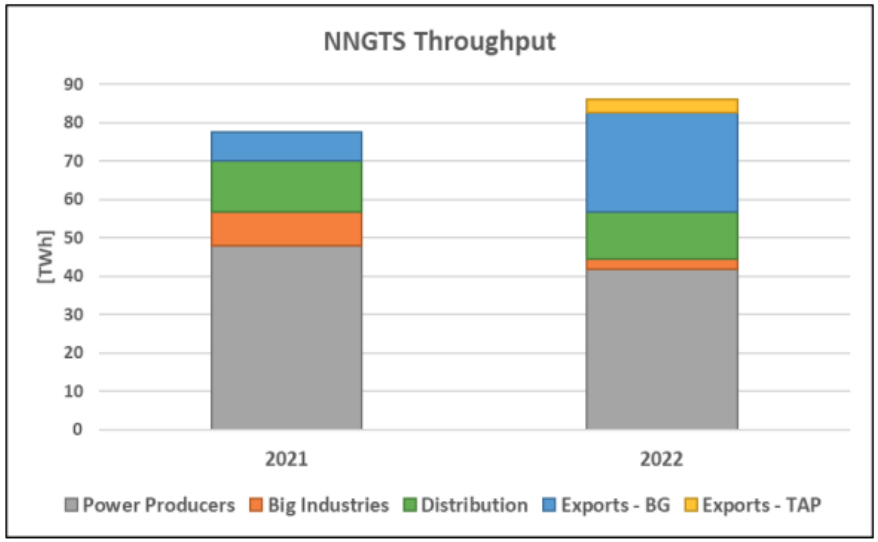
Turkey

- ✓ Most diversified gas supply portfolio in the region & Important transit country, largest connection to the Transbalkan pipeline
- ✓ 4 LNG Terminals in operation and a 5th in planning phase
- ✓ Large consumer with modern Energy Exchange in operation
- ✓ EU is hoping for gas from Turkey;
- — Large domestic needs, especially in the European part of the country
- — National grid needs reinforcement for exports to EU
- — Non EU member with protectionism for national champions – no TPA
- — Ambiguous relations with Russia on gas issues

Source: DESFA

The Gas Landscape is Changing with Greece Becoming an Exporting Country





- ✓ Annual throughput has been steadily increasing during the last nine years (from 32 TWh in 2014 to 87 TWh 2022)
- ✓ Exports increased by appr. 300% in 2022 compared to the average of the preceding three years period
- ✓ Domestic demand was decreased by 19% in 2022, compared to the previous year
- ✓ LNG imports hit a max in 2022 (more than 39 TWh)

Source: DESFA

Energy Demand and Supply Projections in SEE - Methodology (I)

- In the context of the "SEE Energy Outlook" and given the amount of data collected and analysed, it is important to be in a position to estimate future demand and supply trends under certain assumptions.
- The **TIMES model** was used for estimating future demand and supply trends.
  - It combines two different, but complementary, systematic approaches to energy modelling: a technical engineering approach and an economic approach. TIMES is a technology rich, bottom-up model generator, which uses linear-programming to produce a least-cost energy system, optimized according to a number of user constraints, over medium to long-term time horizons.
- The projections for the development of the energy systems of the SEE countries under **a "Baseline" scenario** approach was considered appropriate in order to present the possible future pathways paved by current policies.
- The **most recently available studies** and the **official country submissions of strategic documents** (such as the Integrated National Energy and Climate Plans) were used in order to collect and analyse these projections.
- The purpose is to present the evolution of the national energy systems corresponding to a **"where we are heading" storyline**, providing a simple but comprehensive picture of the energy and GHG emissions dynamics under the "current policy" efforts until 2040.
- **It should be noted that most of the available analyses do not include the effect of the COVID-19 pandemic and its possible long-term effects to the macroeconomic development and the energy systems of the countries in the region.**

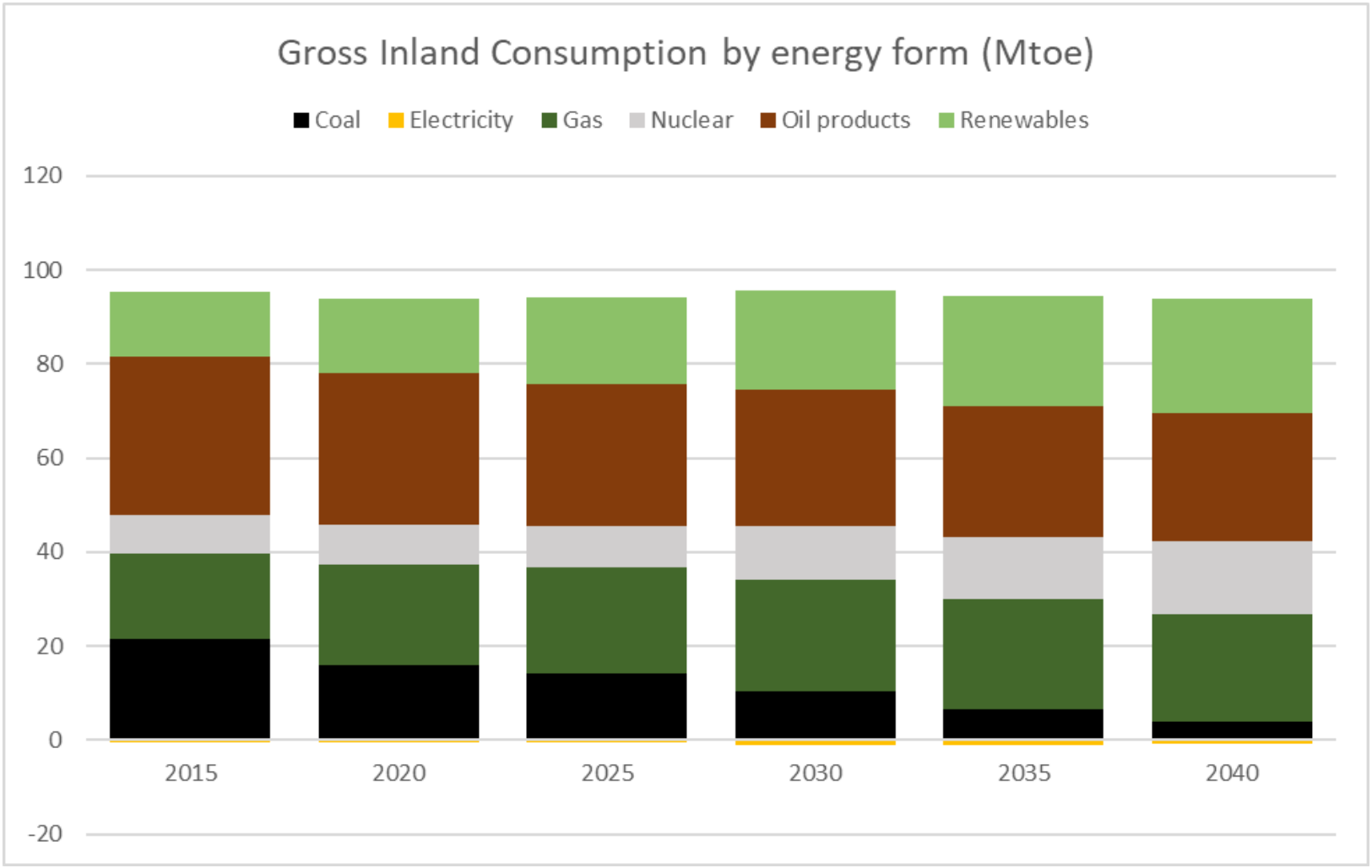
Energy Demand and Supply Projections in SEE - Methodology (II)

- The analysis has been conducted by means of a review of the **most recent published sources** at country and regional level. **Data have been extracted, converted and in some cases processed, and used to generate six main energy and climate indicators at country level:**
  - Net import by energy commodity.
  - Gross Inland Consumption (GIC) by energy commodity.
  - Electricity generation by type.
  - Final Energy Consumption (FEC) by energy commodity.
  - Final energy consumption by sector.
  - GHG emissions (excluding LULUCF) with the GDP evolution.
- **Additional indicators and analyses** were derived from the combination of the above-mentioned basic information; for example, intensities were calculated as ratios (e.g. FEC over GDP or GHG emissions over GIC).
- A **consistency check of the data** has been carried out to validate and keep full consistency over the reported energy chains (energy imports - gross inland consumption – transformation sector - final energy consumption – related GHG emissions). In some cases, it was necessary to make a **few inserts or adjustments to the original data to fill in some gaps**.

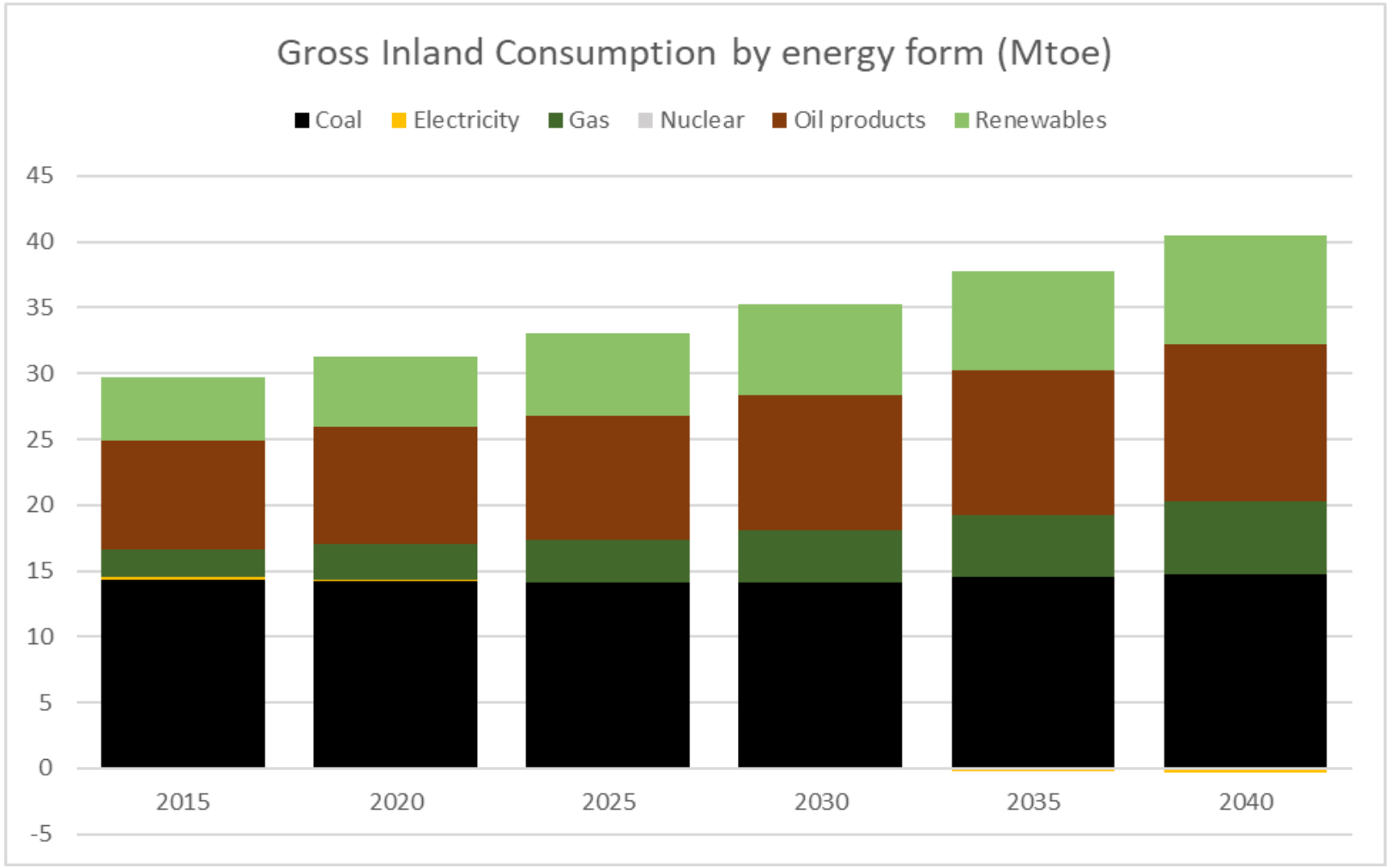
Scenario Results per Group of Countries

- **Results are presented per Group of Countries - EU Member States, West Balkans and Turkey**
- Looking at the projection of the gross inland consumption in the **EU member states of the SEE region** (Bulgaria, Croatia, Cyprus, Greece, Romania, Slovenia), the overall tendency shows a stabilisation and even a small reduction in the time horizon to 2040.
  - The decrease of the use of coal is evident, reaching a minimum level by 2040 while oil products lose part of their share in the GIC. The winners to this change are renewable energy and nuclear energy. The group remains a net importer in the time horizon until 2040, but the import dependency is reduced between 2020 and 2030 and then stabilised at a level close to 42% until 2040. Crude oil and oil products cover the majority of imports (68% in 2040), imports of coal are reduced significantly, while imports of natural gas remain at a level close to 12 Mtoe after 2030.
- The projection of Gross Inland Consumption in the **six Western Balkan countries** (WB6: Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia) presents a rather different story from that of the EU member states in the region.
  - Following the expected growth of GDP, GIC is projected to increase by almost 40% between 2015 and 2040, with the amount of coal being held almost constant, close to 15 Mtoe. Natural gas is the emerging fuel with a constant gradual increase, connected with the pipeline expansion projects in the Western Balkans region. Crude oil and oil products increase by 45% reaching 12 Mtoe in 2040, and renewable energy increases substantially (by 70%) to 8.3Mtoe in 2040, but still covers only 20% of the total GIC of the group of countries. The group remains a net importer of energy and furthermore, import dependency increases to a level of 42% in 2040 (from 33% in 2015). Crude oil and oil products cover the largest part of imports reaching almost 11 Mtoe by 2040 and the imports of natural gas are continuously increasing, reaching 5.4 Mtoe in 2040.
- In **Turkey**, gross inland consumption is projected to increase by more than 50% between 2020 and 2040. The role of renewable energy is seen to increase notably, reaching 28% of the GIC in 2040, the amount of coal remains at the level of 50 Mtoe with its relative contribution being reduced to 23% in 2040 and the contribution of natural gas is decreased to 17% of the GIC. Nuclear energy appears for the first time in the GIC of Turkey after 2025 with the operation of the Akkuyu nuclear power plant and is increasing until 2050, following the nuclear expansion program of the country.

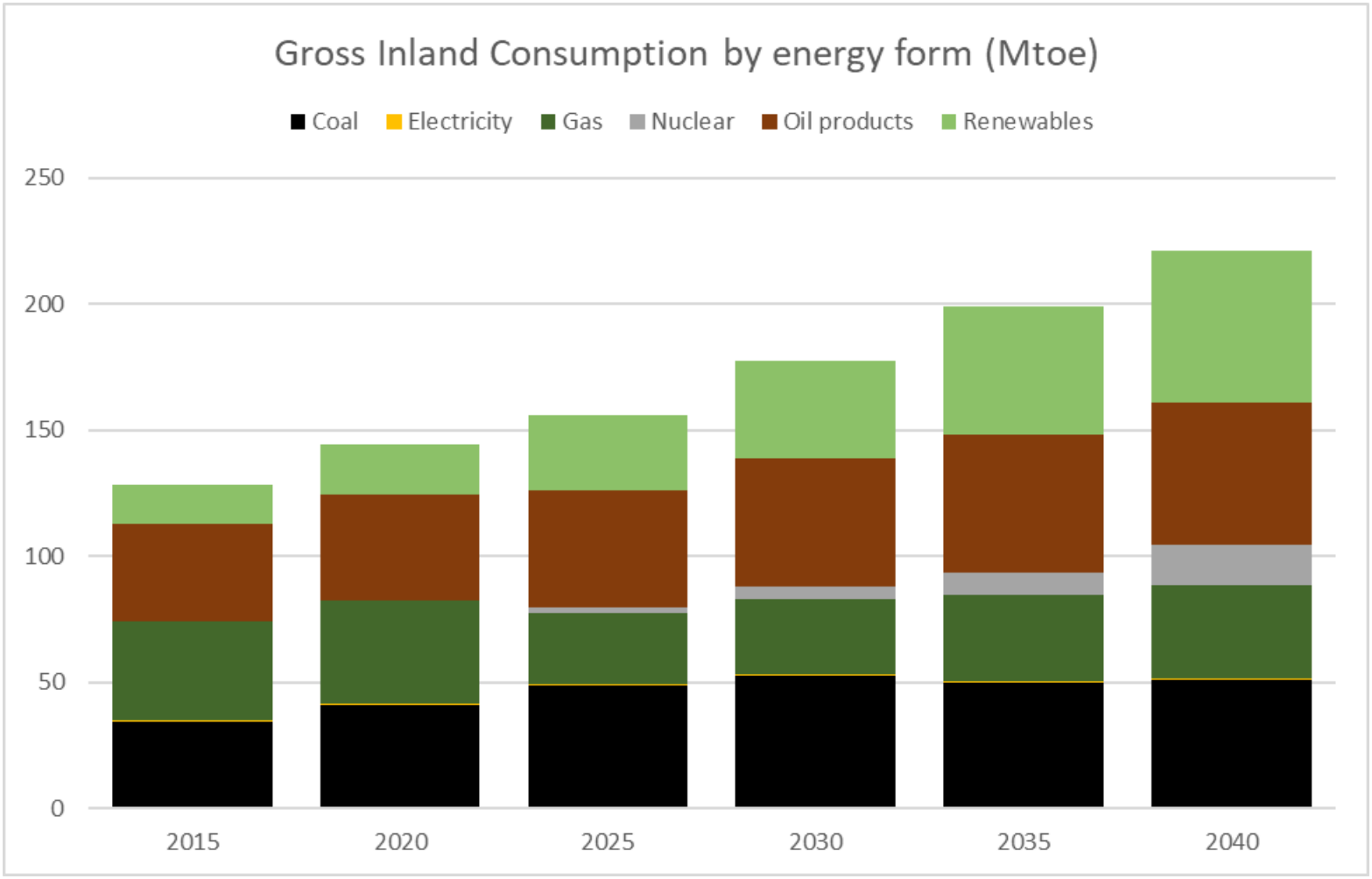
EU Member States in SE Europe: Gross Inland Consumption (2015-2040)



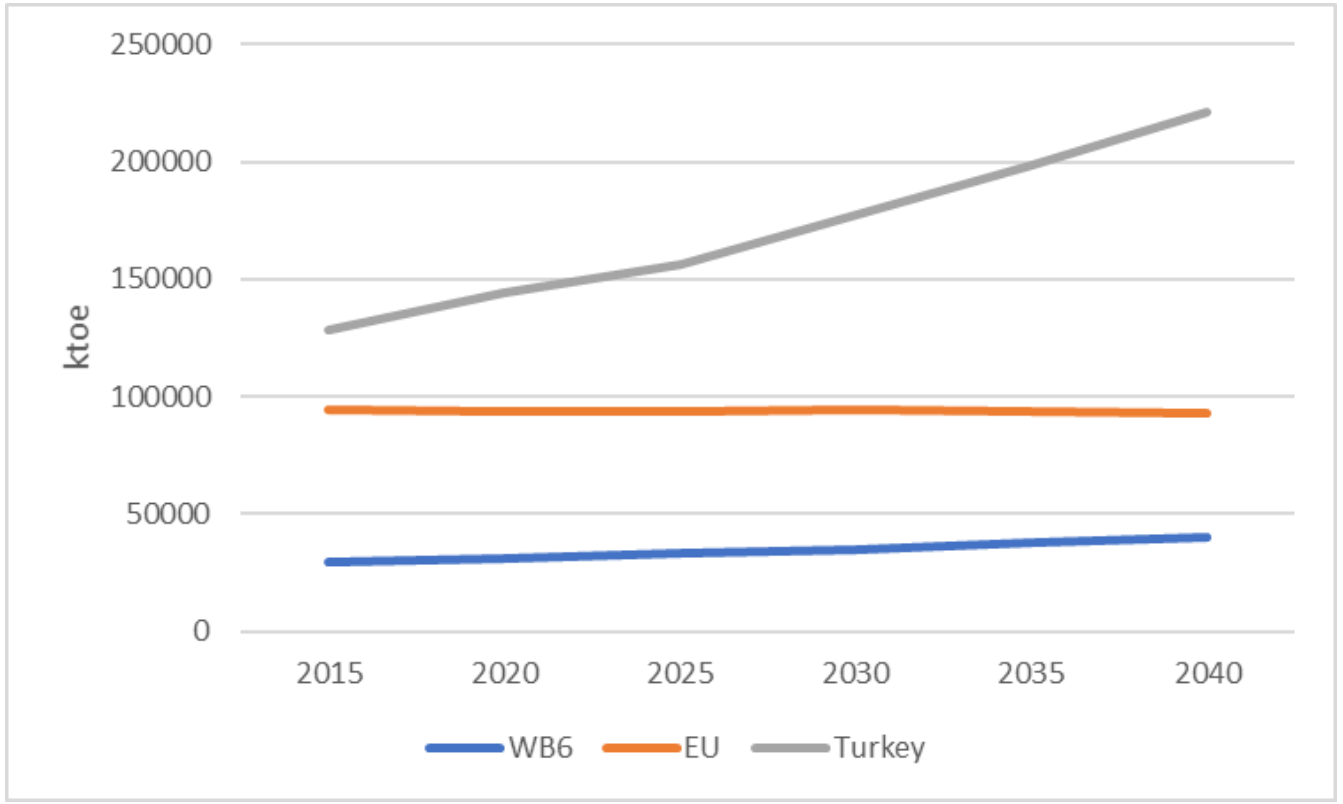
Western Balkan Countries: Gross Inland Consumption (2015-2040)



Turkey: Gross Inland Consumption (2015-2040)



Gross Inland Consumption in SE Europe per Group of Countries (2015-2040)



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Thank you for your attention

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