



## Prospects for further RES Penetration in Greece's Energy Market

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INSTITUTE OF ENERGY  
FOR SOUTH EAST EUROPE



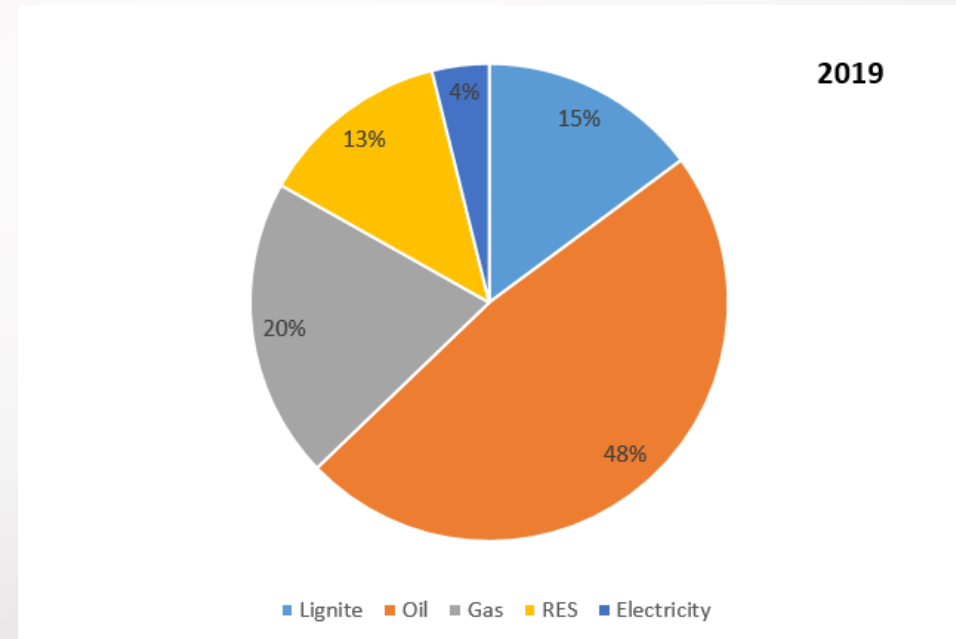
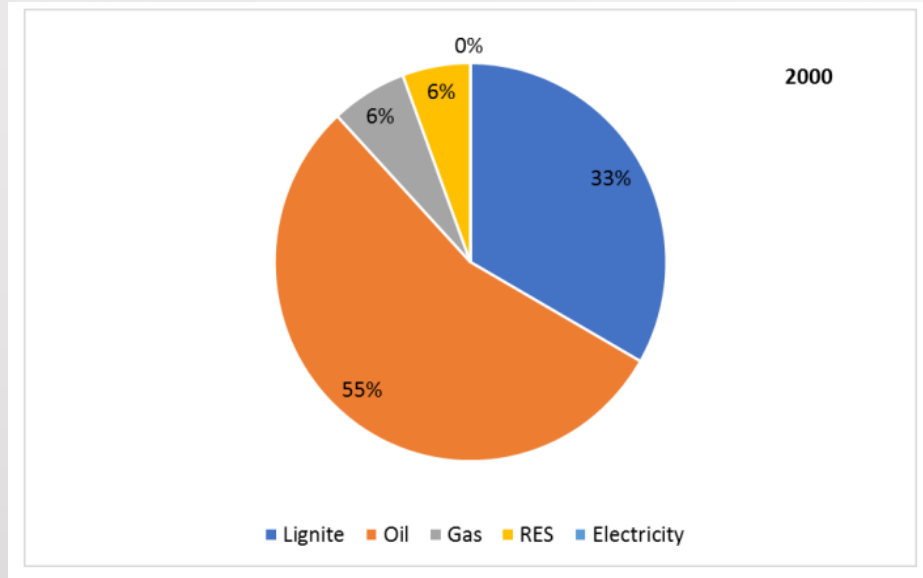
# Some observations on Greece's Energy Mix

- Hydrocarbons, oil & gas, are still the main stay of Greece's primary energy supply
- Oil is used mainly for transport but also for power generation in several islands especially the big ones (i.e. Crete, Rhodes, Lesbos, Limnos, Chios, etc.)
- Natural gas which first entered the energy mix in 1996 is gradually taking over lignite for power generation and also displacing oil for space heating as town grids continue to expand.
- Renewables, including large hydro, biomass, solar thermal, solar PC and wind have gained ground and from 6.0% in 2000 have more than tripled, to approx. 20% by 2020 with Greece attaining its EU target.

# Greece's fast changing electricity mix

- Even before the Greek government's decision in September 2019 for full decarbonization by 2028, lignite use had been retreating on account of rising CO<sub>2</sub> emission costs.
- The government's effort in 2018/2019, under pressure for the European Commission, for Public Power Corporation (PPC) to sell off its lignite power stations – on competition grounds – failed spectacularly as market conditions had changed and no company wanted to invest in coal generation.
- The above development which among others resulted in huge losses for PPC (above €1.2 million in 2019) acted as catalyst for further RES use.

# Total Primary Energy Supply in Greece, 2000 and 2019



# RES Penetration in Greece's Electricity Mix (1/2)

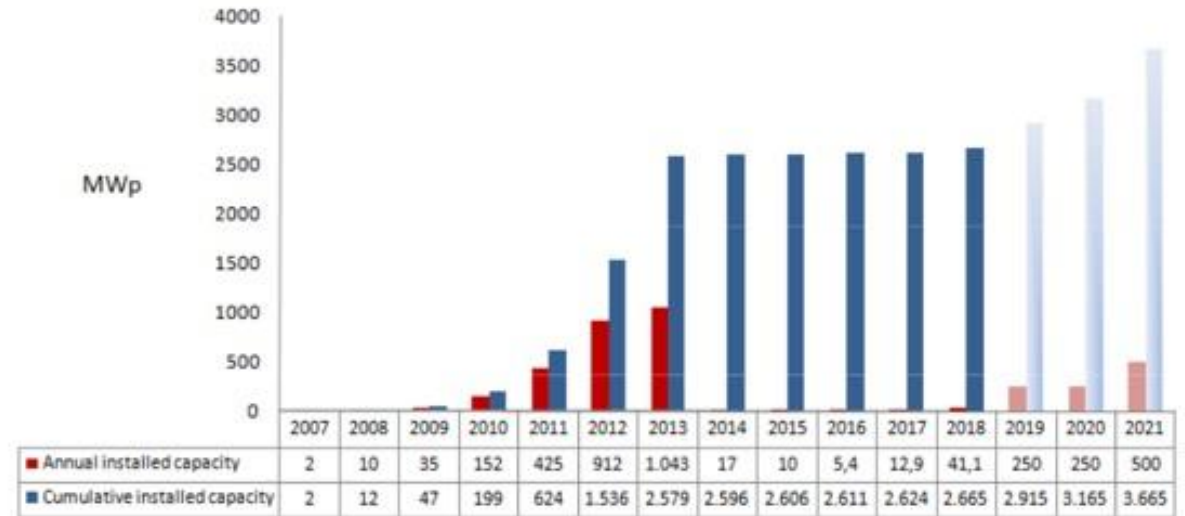
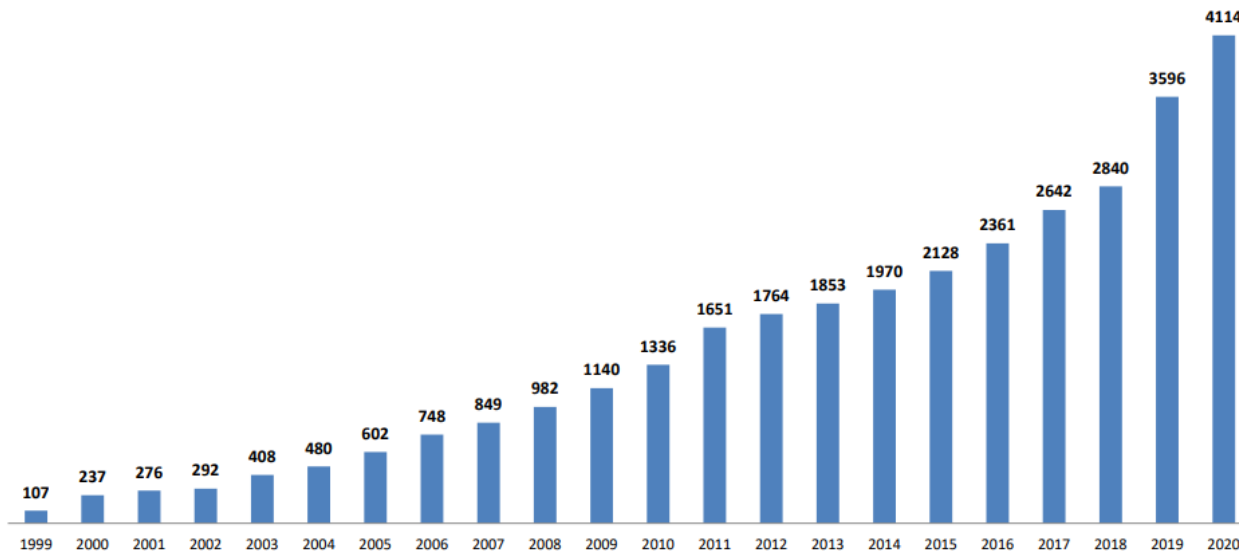
- Over the last 15 years or so we have seen a steady increase of RES's contribution in the country's electricity mix.
- With RES comprising wind, solar PV, biogas and small hydro
- If we look closer over the last 3 years we see a rise from 18% participation in the electricity mix in 2018 to 21% in 2019 rising to 28% in 2020.
- At the same time, as expected, we see a rise in natural gas use from 20% in 2018 to 28% in 2020.
- The question arises as to the upper limit of RES penetration without substantial increase of energy storage
- The main challenge ahead for higher RES use for power generation on Greece is the increase of large hydro availability and pumped storage in particular since no major addition of installed capacity is foreseen before 2025/2026.

# Installed RES Capacity in Greece, 2020

## HWEA Wind Energy Statistics – 2020



Total capacity to the grid (MW) per year



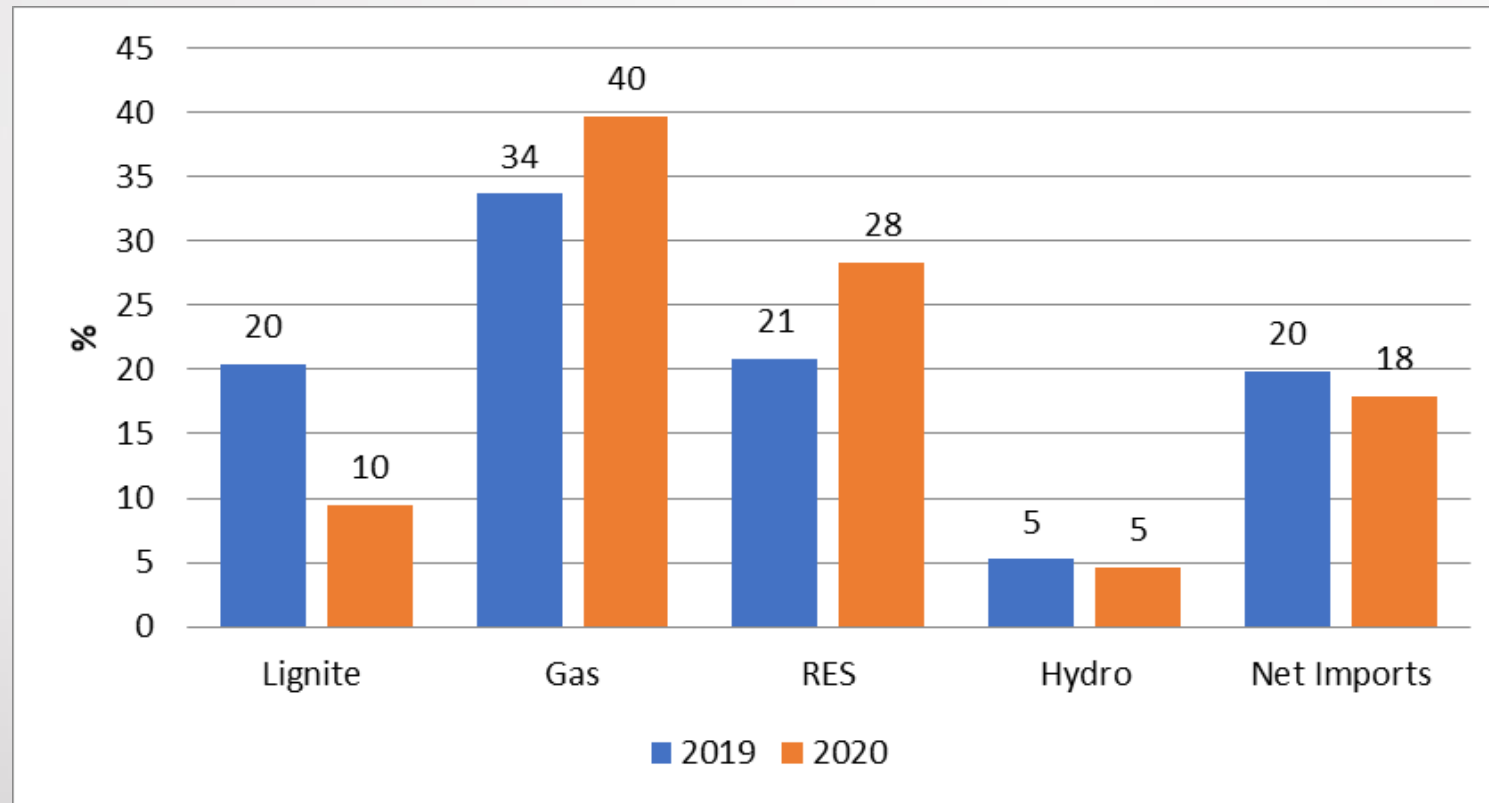
Greek PV market development (source: helapco.gr, Greek PV Market Investment opportunities)

The HWEA Wind Energy Statistics take into account the wind capacity which is in commercial or test operation in Greece and are based on sources from the market actors. HWEA has made effort to crosscheck and confirm the data. However, HWEA does not guarantee the accuracy of them and do not undertake any relevant liability.

Source: HWEA

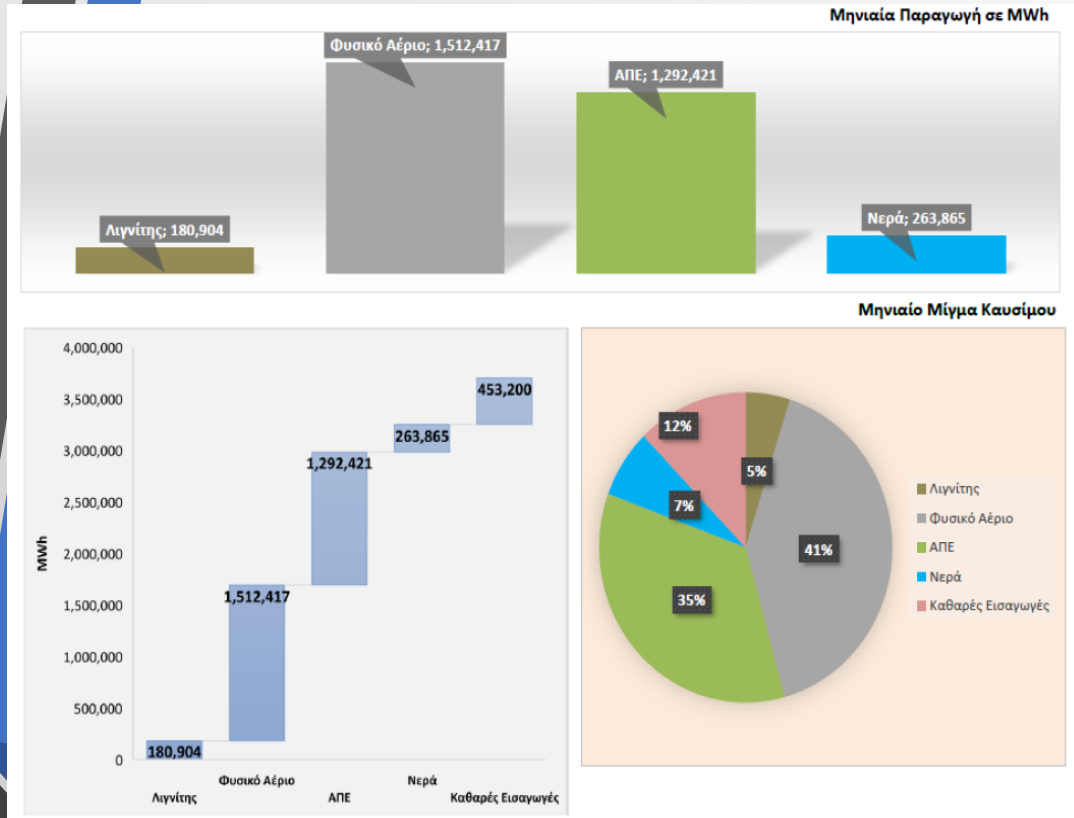
Source: HELAPCO

## Fuel Mix in Greece's Electricity Generation, 2019 and 2020

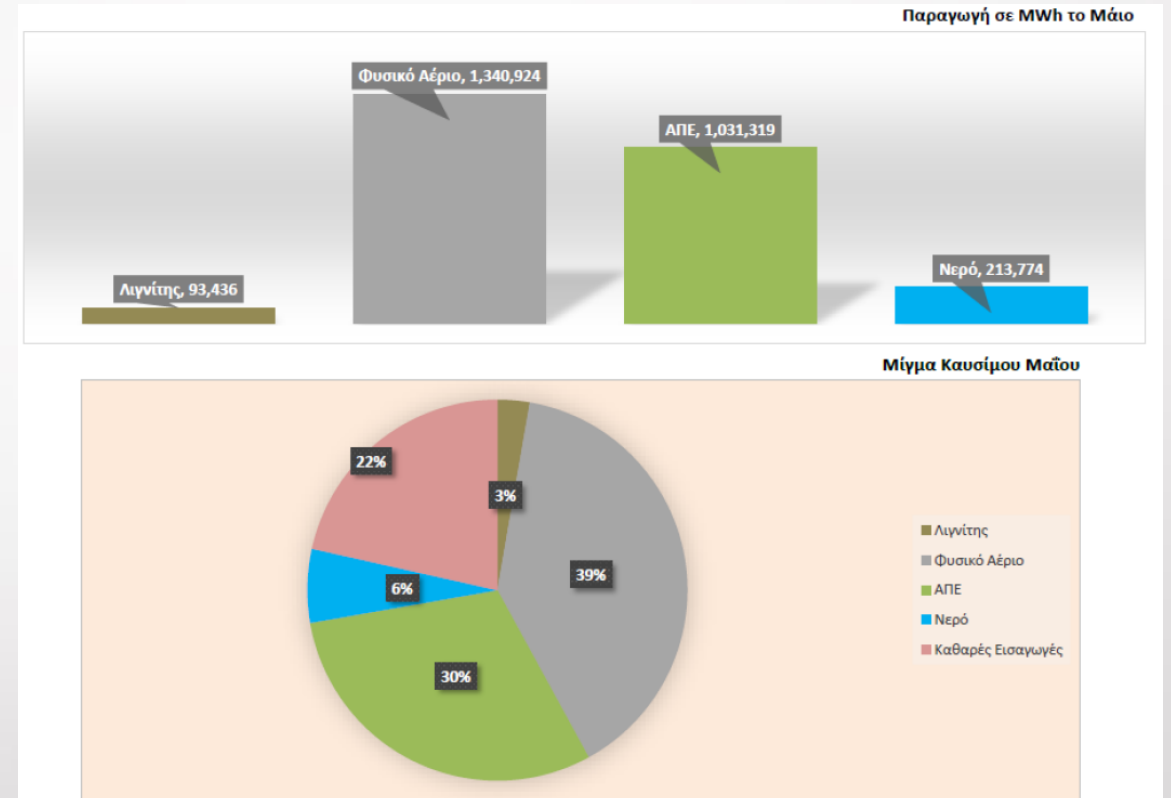


Source: IENE

# Greece's Energy Production (MWh) and Fuel Mix (1/3)



May 2021

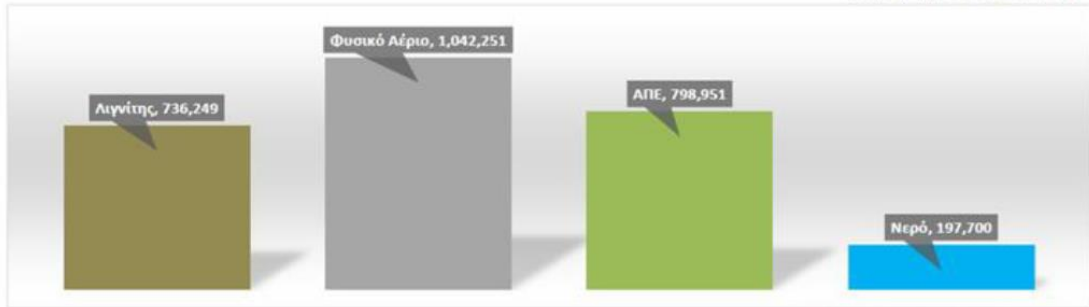


May 2020

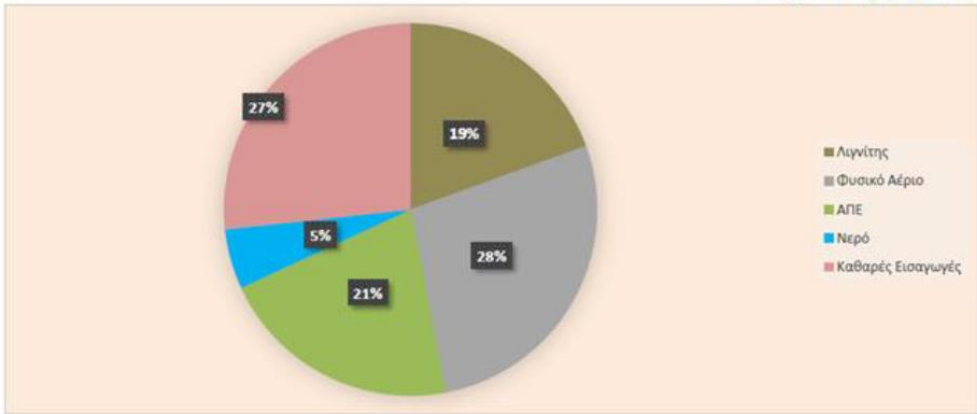


# Greece's Energy Production (MWh) and Fuel Mix (2/3)

Παραγωγή σε MWh το Μάιο

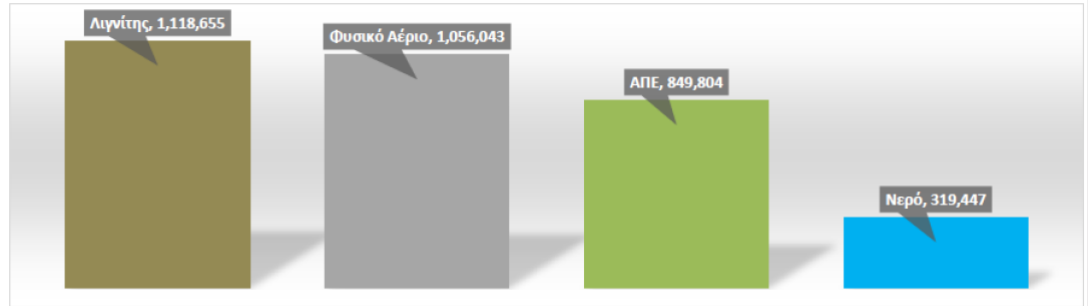


Μίγμα Καυσίμου Μαΐου

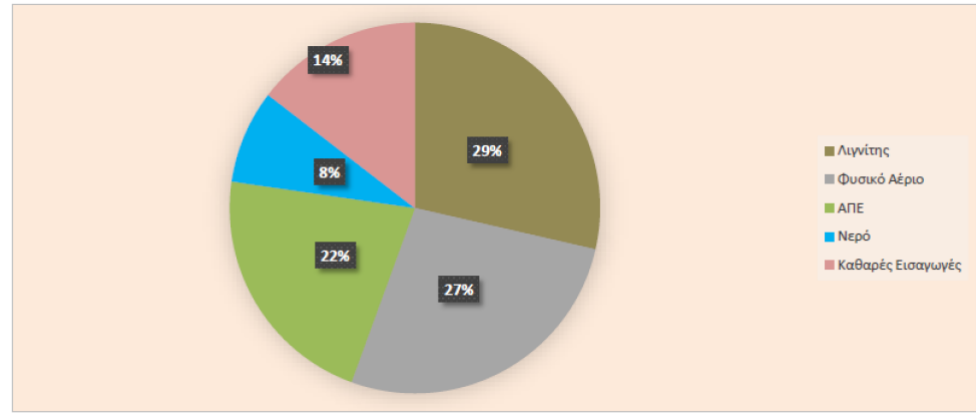


May 2019

Παραγωγή σε MWh το Μάιο



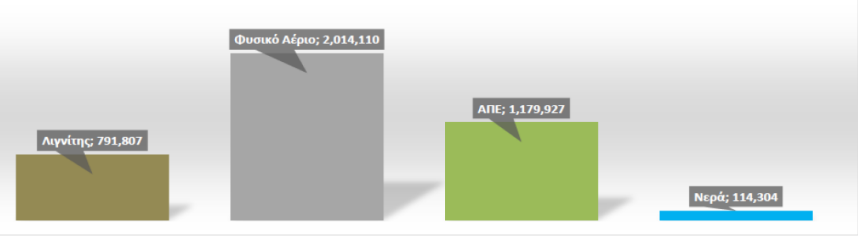
Μίγμα Καυσίμου Μαΐου



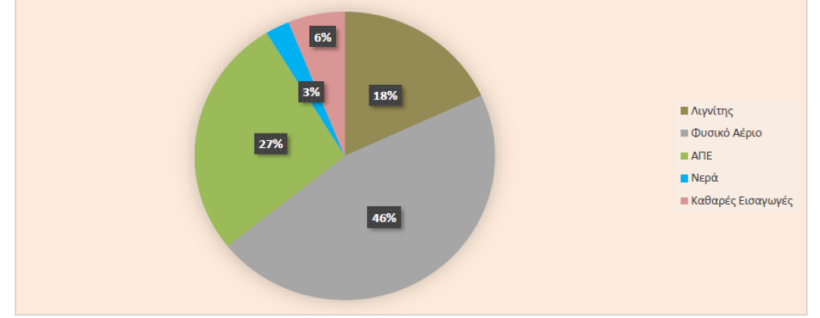
May 2018

# Greece's Energy Production (MWh) and Fuel Mix (3/3)

Μηνιαία Παραγωγή σε MWh

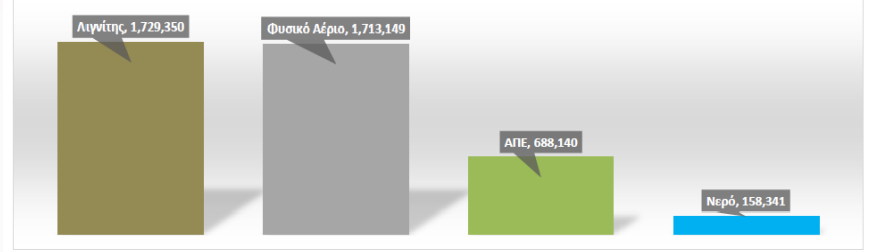


Μηνιαίο Μίγμα Καυσίμου

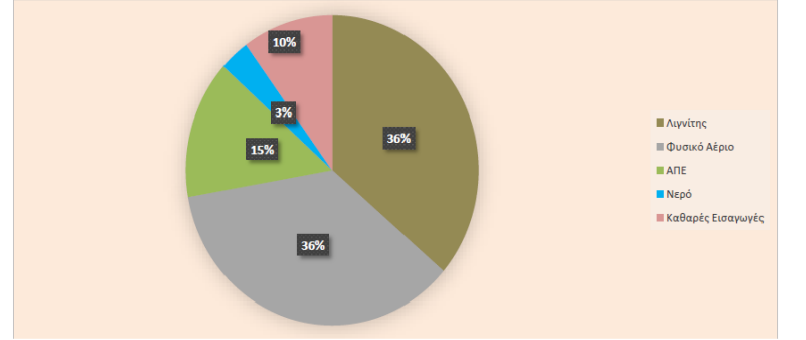


December 2020

Παραγωγή σε MWh το Δεκέμβριο

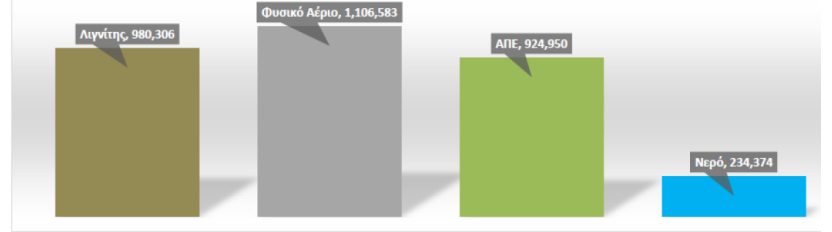


Μίγμα Καυσίμου Δεκεμβρίου

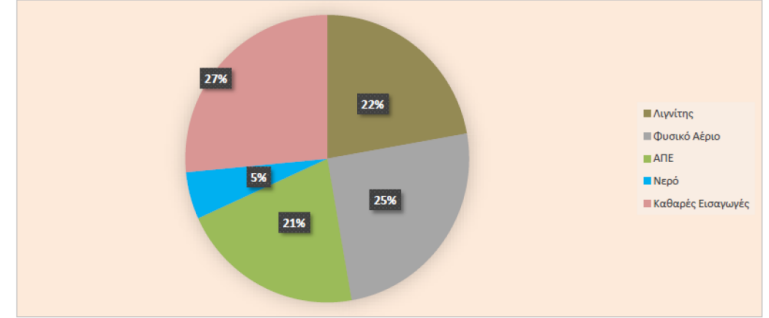


December 2018

Παραγωγή σε MWh το Δεκέμβ



Μίγμα Καυσίμου Δεκεμβρίου



December 2019

Source: IENE

## RES Penetration in Greece's Electricity Mix (2/2)

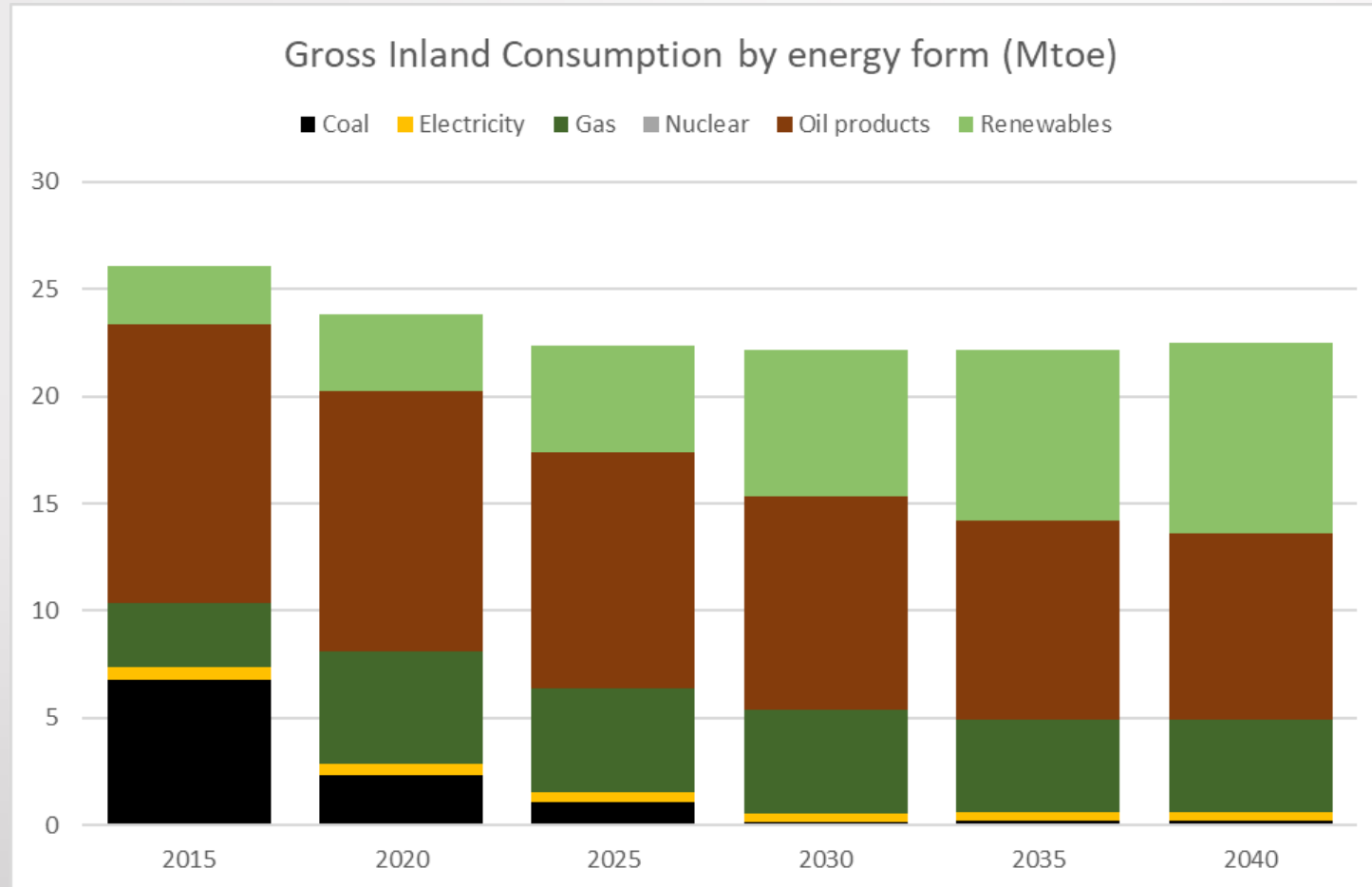
- The introduction of battery storage although anticipated with 1.5 – 2.0 GW planned by 2023/2024 is not expected to lead to much higher RES use – but instead will help with peak shaving and also help achieve better distribution of RES output over 24hour period.
- Higher use of natural gas, more electricity imports from neighboring countries and bigger penetration of RES are the main characteristics of Greece's changing electricity mix.
- As more RES capacity, together with energy storage, are expected over the next years it is safe to predict that by 2030 Greece will be able to double its RES's input into its energy mix (ie. 40%) and also attain even higher RES contribution into the electricity mix (>60%).

# Greece's National Objectives in the Context of the NECP

Year of objective: 2030	Final NECP	Initial NECP draft	New NECP objectives compared to EU objectives
RES share in gross final energy consumption	≥35%	31%	More ambitious than the corresponding core EU objective of 32%
RES share in gross final electricity consumption	≈61-64%	56%	
Final energy consumption	≈16.1-16.5 Mtoe (≥38% compared to the 2007 predictions)	18.1 Mtoe (32%) (referring to 17.3 Mtoe without ambient heat)	More ambitious than the corresponding core EU objective of 32.5% and attainment of the objective on the basis of a new EU indicator for reducing consumption compared to 2017
Share of lignite in power generation	0%	16.5%	
Reduced GHG	≥42% compared to 1990, ≥56% compared to 2005	33% compared to 1990, 49% compared to 2005	Identical with core EU objectives and overperformance compared to national commitments in non-ETS sectors

Source: Greece's National Energy and Climate Plan

# Greece: Gross Inland Consumption (2015-2040)



Source: IENE's "SEE Energy Outlook 2020/2021"

# Greece's Anticipated Energy Investments, 2020-2030

Sector	Total estimated investments (€ million) for the period 2020-2030
1. Electricity generation from RES	9,000
2. Electrical system infrastructure	5,500
3. New thermal electricity generation plants and central storage plants	1,300
4. Works for the development of an electricity distribution network – Digitisation	3,500
5. Cross-border natural gas pipelines	2,200
6. Natural gas networks and storage	2,000
7. Research and innovation	800
8. Energy efficiency	11,000
9. Investments in the refinery sector	1,500
10. Climate change, flood management, forests	2,000
11. Circular economy, recycling	5,000
<b>TOTAL</b>	<b>43,800</b>

Source: Greece's National Energy and Climate Plan

	Expected Investments in million €
<b>Oil</b>	<b>7,700</b>
<b>Natural Gas</b>	<b>2,800</b>
<b>Electricity</b>	<b>21,200 *</b>
<b>Energy Efficiency</b>	<b>11,000</b>
<b>Residential and Commercial Solar Power Applications</b>	<b>1,500</b>
<b>Research &amp; Innovation</b>	<b>1,000</b>
<b>Total</b>	<b>45,200</b>

\* With RES and Storage ~13.000 GW

Source: IENE's Annual Report 2020 on Greece's Energy Sector

## Greece's RES Investment Cost by Technology (€/kW)

		2015	2020	2030	2040	2050
Wind	NECP-2019	1250	1161	860		
	LTS2050		1200	1066	915	848
PV	NECP-2019	1000	552	420		
	LTS2050		721	690	567	495
PV roofs	NECP-2019	1400	1019	816		
	LTS2050		1435	930	745	610
Solar thermal with storage	NECP-2019	4700	4100	3370		
	LTS2050		5500	4237	3437	3075
Geothermal	NECP-2019	4400	4400	3400		
	LTS2050		4970	4586	3749	3306
Hydro-Small	NECP-2019	1950	1900	1900		
	LTS2050					
Biomass-Large	NECP-2019	2750	2700	2700		
	LTS2050		2000	1800	1700	1700
Biomass-Med./Small	NECP-2019	3500	3500	3500		
	LTS2050					
Biogas	NECP-2019	4450	4350	4350		
	LTS2050		1300	1250	1150	1050

Sources: Greece's National Energy and Climate Plan, Long-term Strategy





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**Thank you for your attention**

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