

EMERGING WORLD-WIDE ENERGY TRENDS AND LONG-RANGE ENERGY PLANNING OF GREECE

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Climate Change Conference

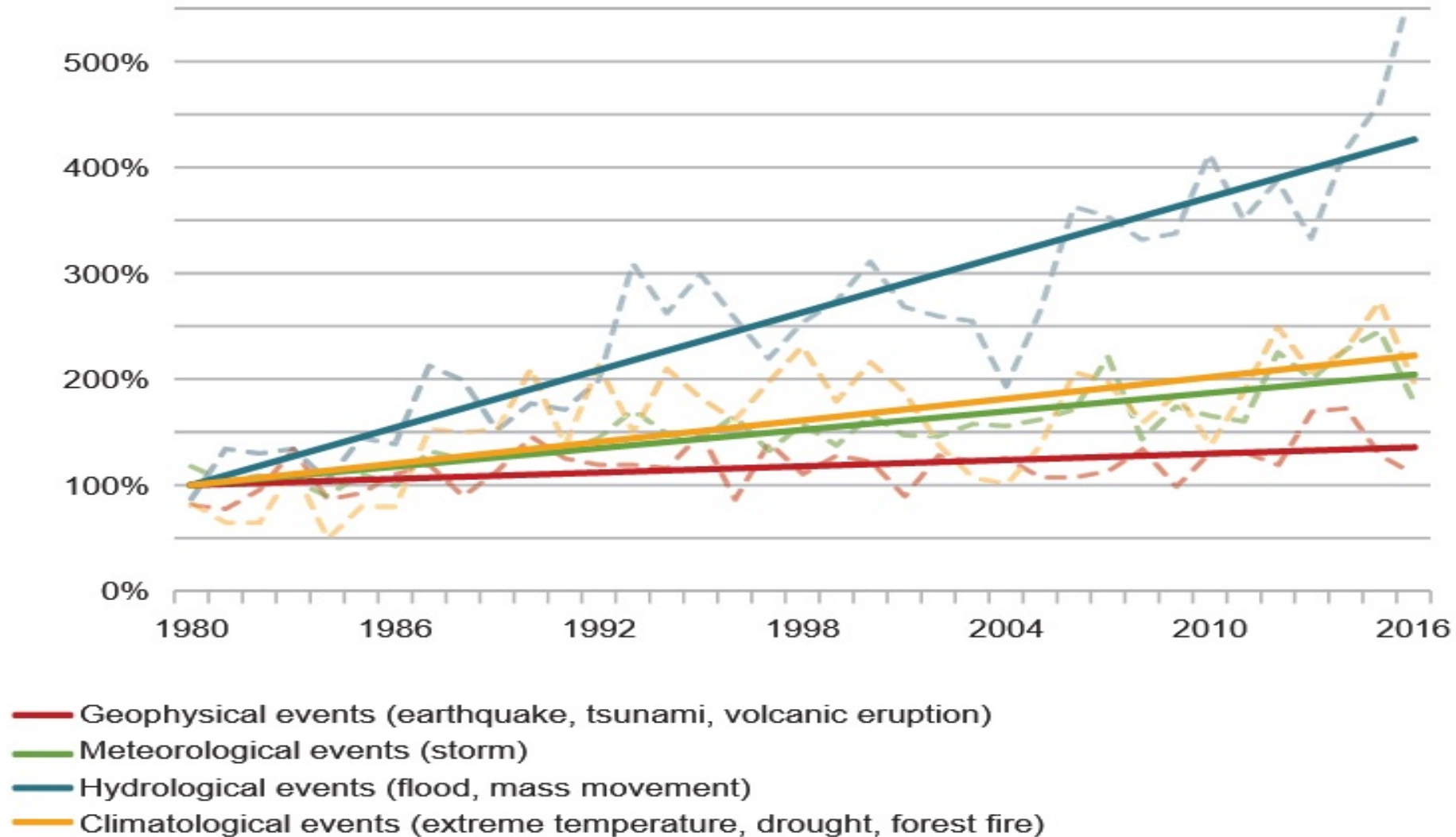
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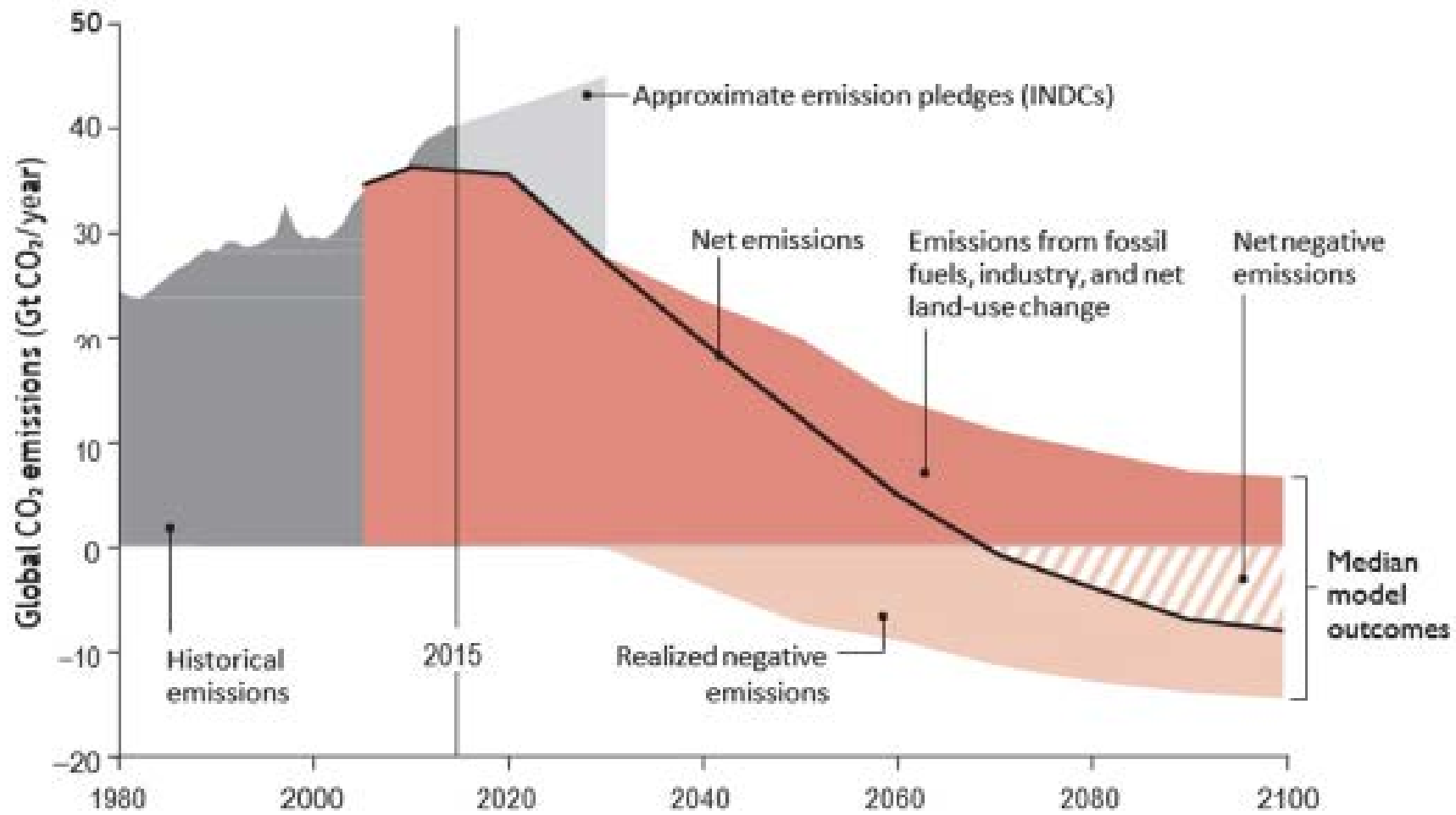
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Emerging World-Wide Facts Relating to Energy, Environment, Climate Change and Long-Range Energy Planning

- Energy is and will remain the most critical
 - parameter of every country's development;
 - human challenge in the struggle to alleviate world poverty;
 - factor in understanding human intervention in the environment and climate change.
- Recent (1980-2016) trends of different types of natural catastrophes are worrisome. Weather-related catastrophes recorded worldwide have increased from an annual average of **335** events for 1980-1989, to an annual average of **716** events for 2001-2011.
- **The factors driving climate change (mitigation) MUST be reduced.**

Trends in different types of natural catastrophe worldwide 1980–2016 (1980 levels set at 100%). MunichRe NatCatSERVICE.





A study by K. Anderson and G. Peters, Science 354, 14 October 2016, p.182, and two EASAC reports clearly show that:

Negative Emission Technologies (NET), i.e., removal of CO₂ and other GHG emissions (many hundreds of Gt of CO₂ per year) will NOT be possible, and urgent mitigation measures are needed at the source, foremost in the combustion industry.

The total world energy consumption continues growing (Fig. 4a).

AND

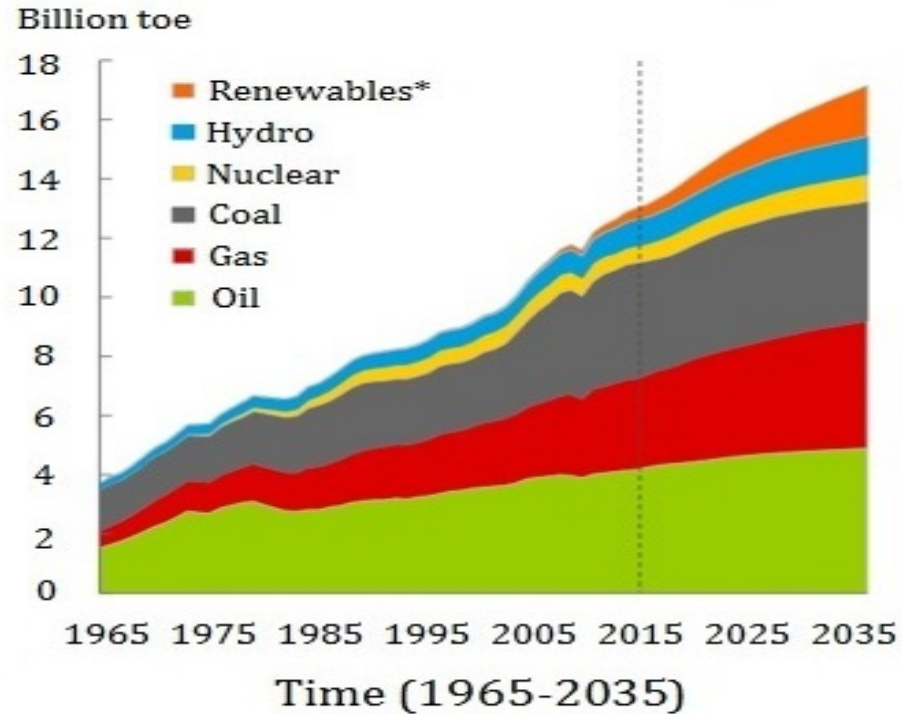
The world-energy mix continuous changing (Fig. 4b).

(a): TOTAL WORLD ENERGY CONSUMPTION GROWS

(b): THE WORLD ENERGY MIX CHANGES (Source: BP 2017, Energy Outlook).

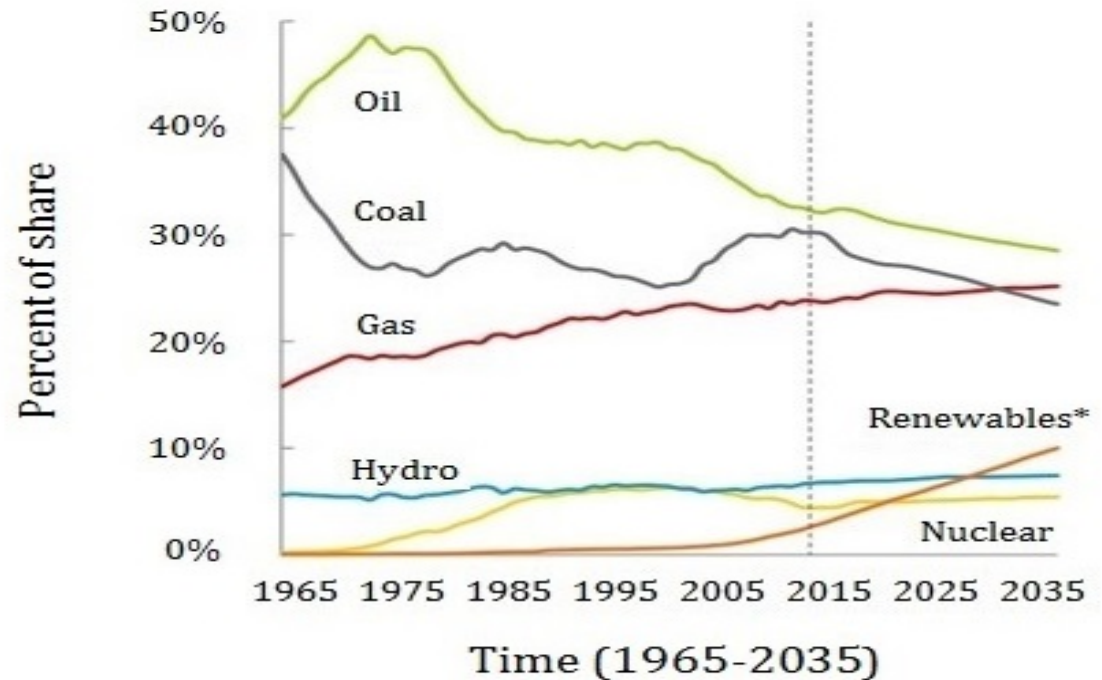
(a)

Primary energy consumption by fuel



(b)

Emerging primary energy mix



The use of oil and coal is decreasing and that of natural gas is increasing.

The use of oil, coal and natural gas will continue to dominate energy consumption for decades, and herewith lies the problem and the challenges.

There is a clear gradual shift in the energy fuel mix toward the renewable energy sources (RES), which will be increasing in the years ahead.

Irrespective of these changes in the global energy mix, in the coming decades, fossil fuels, oil and coal will continue to prevail and will therefore continue to exacerbate climate change.

The Global electricity sector is being transformed:

- Local autonomous electricity generation and distribution systems have been transformed into national and supranational interconnected systems.
- Electrical systems are gradually being characterized by scattered RES units, decentralized small systems, and scattered production and consumption.
- Production, storage, and consumer/electricity providers, constitute the upcoming model of the electrical system.

The main causes of these developments are: "decarbonisation" with strong penetration of RES; digitization of the electrical system; and participation in the market of decentralized energy resources.

The global energy landscape is being changing:

- **Digitization and modern telecommunications** ensure consumer access to and participation in the market.
- **Electricity storage** (e.g., at hydro, batteries, fuel cells) enhances the system's operational flexibility and reduces need for fossil fuels.
- **Natural Gas (NG)** is offered to cover system's reliability until (stochastic) RES are further developed.
- **Electricity and NG market** will be affected by the challenges in the **transport sector** (e.g., electrification, vehicle re-engineering, alternative fuel development, transport infrastructure).
- **These transformations will require large amounts of investment funds** (e.g., for interconnection networks; smart grids/meters; storage, security and control systems) **and will create jobs.**

The challenges are big

- **Security** of energy sources, stable **supply**, affordable **prices**.
- Transition to “**Clean energy**” (low-carbon or no carbon at all).
- New **ways to access existing sources of energy**.
- **New energy sources**.
- While **global action is not yet sufficient** to limit global average temperature rise to ≤ 2 °C, **four energy policies can help keep the 2 °C target alive**:
 - adopt specific **energy efficiency** measures,
 - **limit** construction and use of least-efficient **coal-fired power plants**,
 - **minimize methane emissions** from upstream oil and gas production, and
 - **phase-out of subsidies to fossil-fuel consumption**.

In Greece:

- **The use of lignite is decreasing, the use of natural gas and RES is increasing, and the use of imported oil continues at a high level.**
- **High levels of exhaust emissions continue, mainly due to the high use of fossil fuels in road transport.**
- **Among the primary energy sources, only RES, Lignite, and Energy Conservation constitute Greece's domestic energy sources. In the future may also be the "Greek" Hydrocarbons.**
- **This outline of domestic energy sources will determine Greek capabilities and policies in the future.**

The Greek Energy Landscape is Changing

- The energy sector of Greece will adapt to the framework of the European Union Policy, as well as to technological developments and national specificities.
- **An understanding of the dynamic interaction of energy markets with technology and policy-making is needed.**
- **As far as national specificities are concerned, the possibility exists of using revenue from the Emissions Trading Scheme to support innovative initiatives, energy saving, and the digitization.**

The Emerging Greek Energy Landscape: Significant Changes

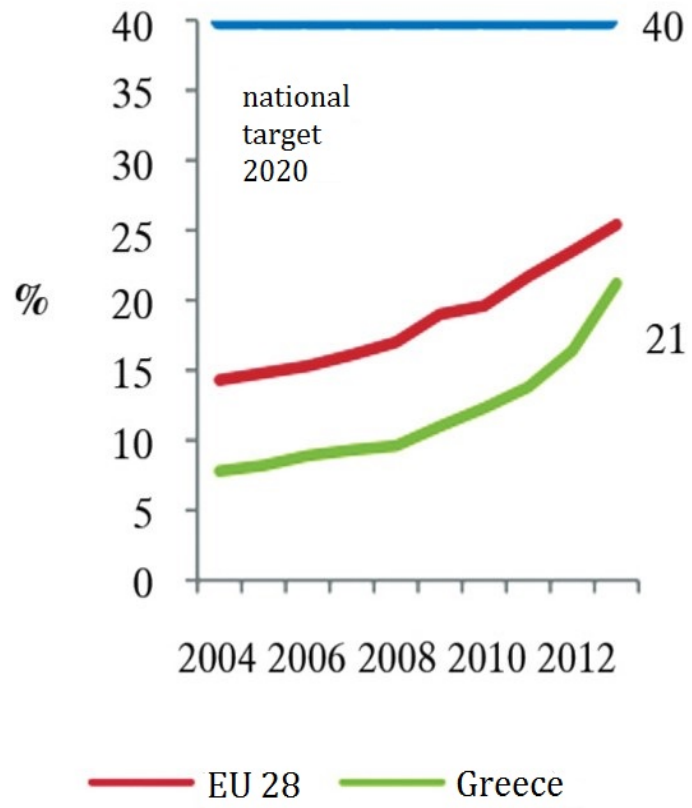
- Lignite

The rising mining and environmental costs will reverse lignite's competitive advantage and will determine **its continuous declining use.**

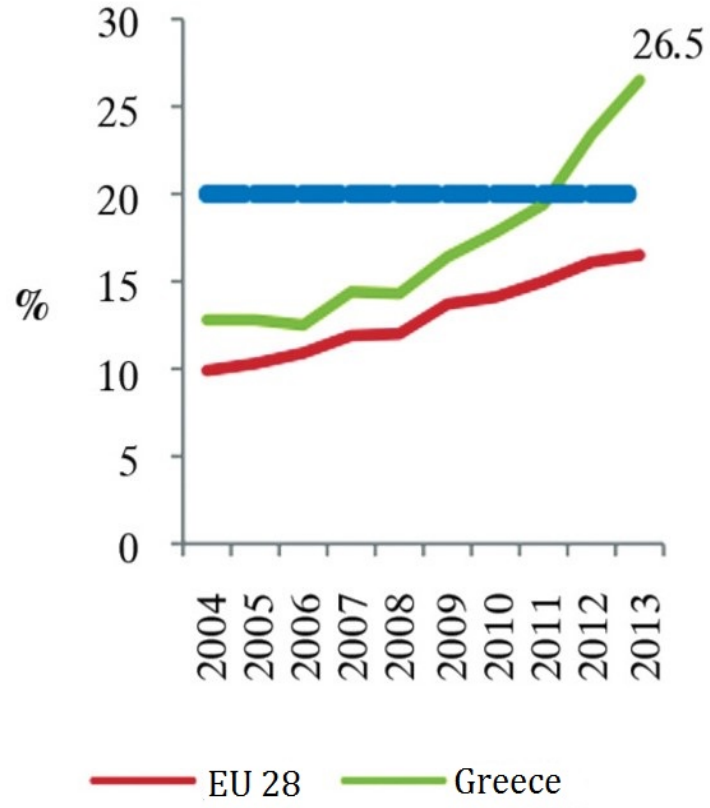
- RES

- They are emerging as the future energy resource of Greece.
- The increasing involvement of RES in the energy mix will contribute to increase competitiveness, provided their cost is reduced because of **technological developments and not because of subsidies.**
- The support of the current installed RES, burdens the electricity cost with 1.3 billion Euro per year, and for many years still. **It is therefore necessary to develop special policies for RES penetration.**
- **PVs on rooftops** provide the ability to manage demand to the consumer and they do not withhold fertile farmland.

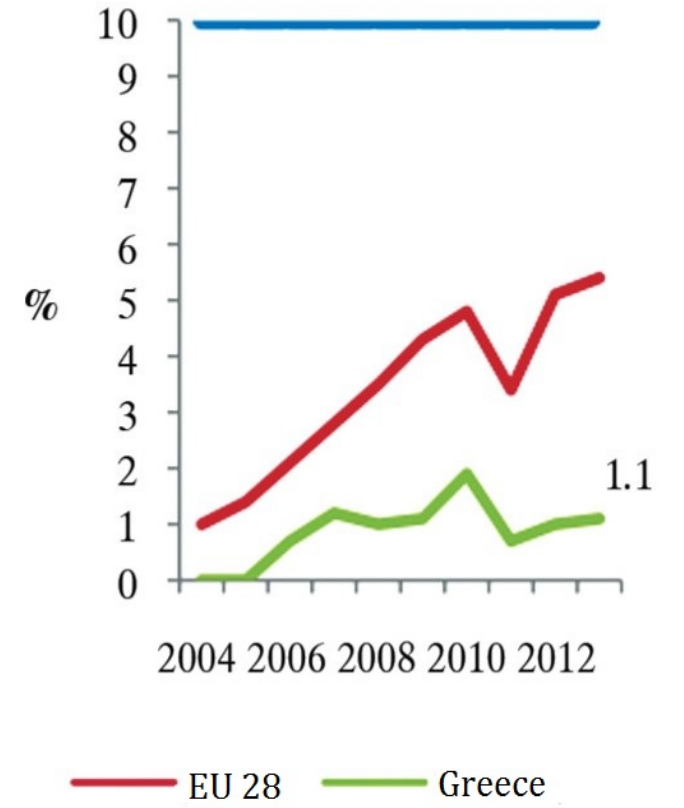
RES share in electricity



RES share in heating cooling



RES share in transport



Percentage structure of power generation and imports for Greece under the EUCO30 scenario of the EU.(P. Kapros, in *Greek Energy Outlook to 2030* with horizon to 2050, Energy Committee of the Academy of Athens, Athens 2018, p. 62).

	% in production (and imports)				
	2000	2015	2020	2025	2030
Hydroelectric	7.4	10.3	10.0	9.7	10.0
Aeolian (wind)	0.9	6.8	8.8	23.0	33.4
Solar	0.0	6.6	8.0	14.8	21.8
Geothermal	0.0	0.0	0.0	0.0	0.0
Biomass	0.3	0.3	0.6	1.2	1.5
Oil	17.1	8.2	8.3	4.0	0.2
Natural Gas	11.5	15.1	22.8	19.5	17.0
Lignite	62.8	40.4	33.6	22.8	12.3
Imports	0.0	12.3	7.9	5.0	3.8

• Natural Gas

- Increased participation in electricity generation, and expansion of distribution networks are foreseen.
- Designed and under construction pipelines will increase security of supply, contribute to regional markets, and to growth and competitiveness.

• Greek Hydrocarbons

- Any discovery and exploitation of **significant indigenous NG deposits or Oilfields** will be crucial for the country's development prospects.
- It is therefore appropriate to give priority to licensing areas that clearly have a greater chance for discovery of significant deposits of Natural Gas.

• Energy saving

- The saving and rational use of energy in all sectors remains **the most important of all domestic energy resources.**

Competitiveness, Investments, Development

Energy cost:

The energy sector of Greece has to limit further increases of the already very high energy costs. The energy cost in Greece has been rising when global trends go the other way.

- The cost of electricity and NG for the Greek industry is much higher compared to European / International competitors.
- The electricity cost can be reduced by improving the efficiency of distribution, limiting monopoly practices, and creating conditions of healthy competition.
- The NG cost can be reduced with increasing access to international markets and ensuring competitive internal distribution costs.
- The hasty withdrawal of lignite units must be avoided, so as not to further damage the competitiveness of Greek industry with the risk of moving production to neighboring non-EU countries.

Possibilities for improving competitiveness

- **The energy transition for Greece will offer an opportunity for major investment initiatives across the entire range of energy infrastructure:** smart grids, distribution systems, power storage support networks, interconnections for the full integration of Greek markets, and large-scale energy upgrades of buildings and homes.
- **The contribution of these investments to employment and GDP growth is expected to be substantial:** The energy sector could make a real contribution to growth by adopting a modern regulatory framework, encouraging **technological innovation**, providing incentives for investment, and strengthening the link between future energy and information technology .

In closing, I wish to emphasize two important areas for the energy planning of Greece in the decades ahead

1. The importance of a long-term energy strategy:

(i) to take advantage of the technological advances that lead to a low-CO₂ energy mix at a competitive cost,

and

(ii) to **proceed** immediately with the necessary infrastructure and investment in energy storage technologies, smart grids and digitization.

2. The essential role of the energy sector must be emphasized in:

- The protection of the environment and curtailment of climate change.
- Improving the competitiveness of the economy.
- Energy savings.
- The expansion of RES, especially PV in the structured environment.
- The extension of the provision of NG across the country, and the promotion of the use of NG and LNG in transport.
- The interconnection of Greece with the EU through infrastructures and market mechanisms.
- Reducing road transport, producing and using biofuels, and electrification including railways.
- Moderating the price of electricity by improving the efficiency of production and distribution.

It is hoped that these findings and recommendations for Greece, suggested by the Energy Committee of the Academy of Athens, can similarly help other countries in the Mediterranean and Middle East.

Thank you!