

ETSAP WORKSHOP

The Greek Energy System in 2050 GHG mitigation options

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Background

Policy Drivers for this Analysis:

- Renewable Energy Directive – Targets for 2020 analysed in NREAP.
- Roadmap for Low Carbon economy in 2050 from the EC:
Study of the targets for the Greek System for the Min. Of Energy
Environment and Climate Change.

- NREAP was developed for 2020 using a MARKAL model for Greece (detailed description of the sectors – annual time periods).
- 2050 analysis → TIMES model with a smaller sector disaggregation. Starting point is the achievement of the 2020 target.



Background

NREAP -> analysed with a detailed MARKAL model: 10 Sub-sectors for tertiary, 13 for industry (ETS, non-ETS) and differentiation between interconnected non-interconnected electricity grids.

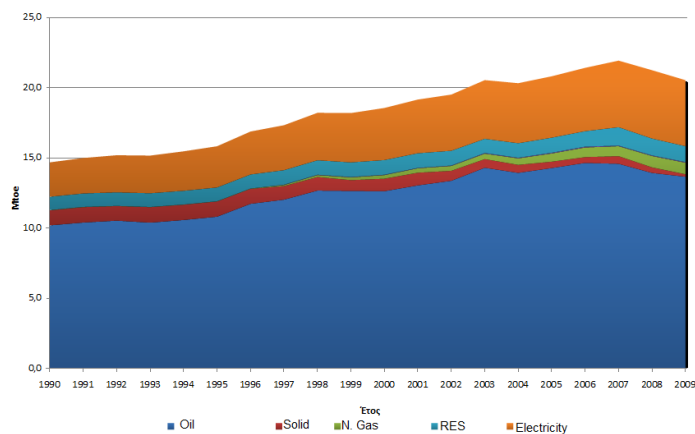
2050 Scenarios – TIMES model tertiary sector aggregated to two subsectors, 10 subsectors for industry only one electricity grid (most of it is interconnected), 12 time slices, 50 year time horizon with 5 year intervals.

Basic assumptions about economic and population indicators development taken from official forecasts, imported fuel costs from IEA-WEO.

CO₂ tax according to the reference of 2050 roadmap (20€/t in 2020, 30€/t in 2030, 50€/t after 2035)



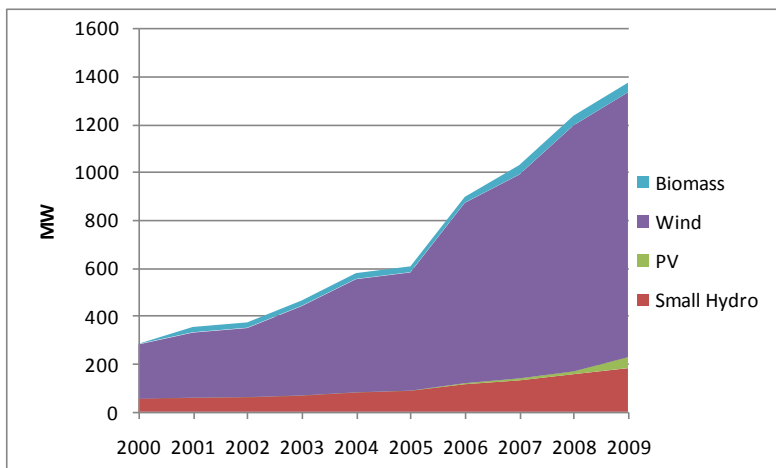
Background



Final Energy Consumption per fuel until 2009.

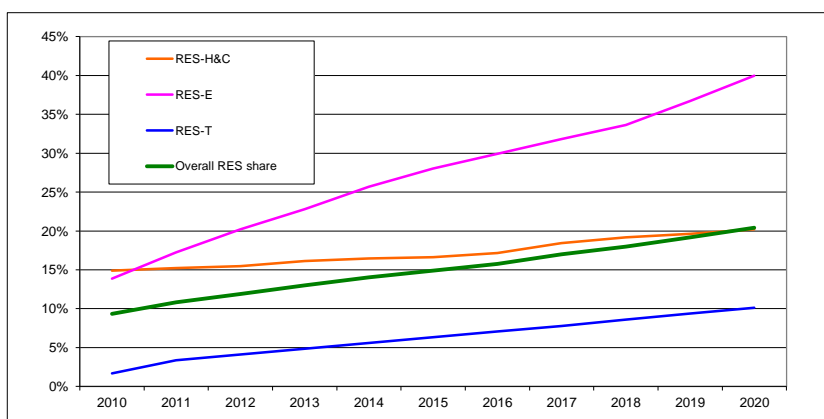


Background



RES Installed Capacity

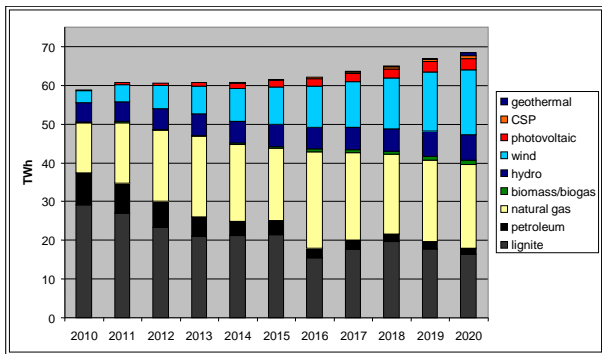
NREAP 2010-2020



Share of renewable in Final Energy – NREAP Projection



NREAP 2010-2020

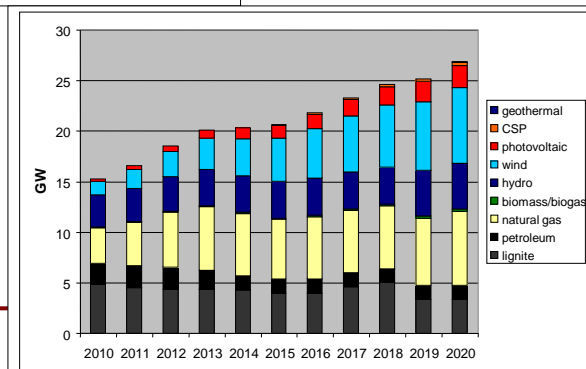


Electricity System Development

NREAP Projection



KAPE
CRES



2050 Scenarios

Three Scenarios analysed for 2050:

- Baseline Scenario.
- 100% RES Electricity (RES-E) and 60% reduction of CO₂ emissions from energy.
- GHG emissions targets achievement – 60% CO₂ emissions reduction (GHG).



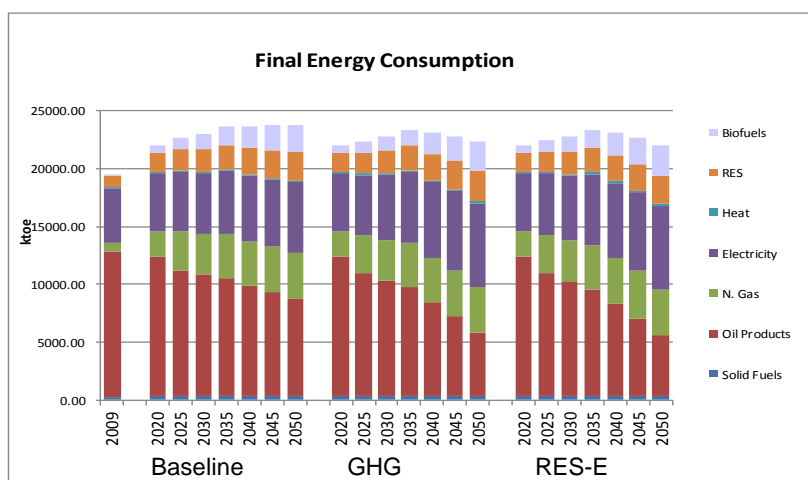
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Scenarios definitions

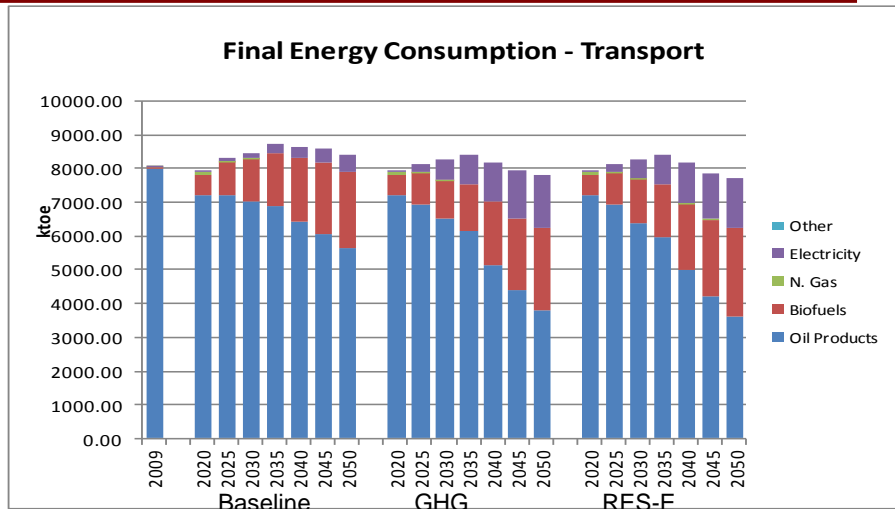
	Baseline	GHG	RES-E
Emission reduction	40% w.r.t 2010	60% w.r.t 2010	60% w.r.t 2010
Emission Tax	20-50€/tn	20-50€/tn	20-50€/tn
RES in Electricity production	Free development	Free development	100%
Energy Saving	Baseline introduction	High penetration in buildings and transport	High penetration in buildings and transport
Interconnection of island etc.	✓	✓	✓
RES Technologies penetration	Medium	High	High
CHP and micro-CHP technologies penetration	Medium	High	High



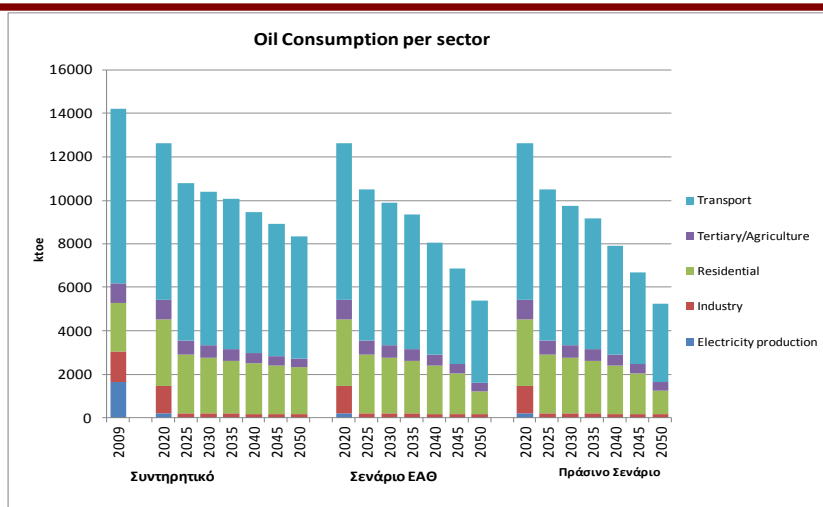
2050 Scenarios



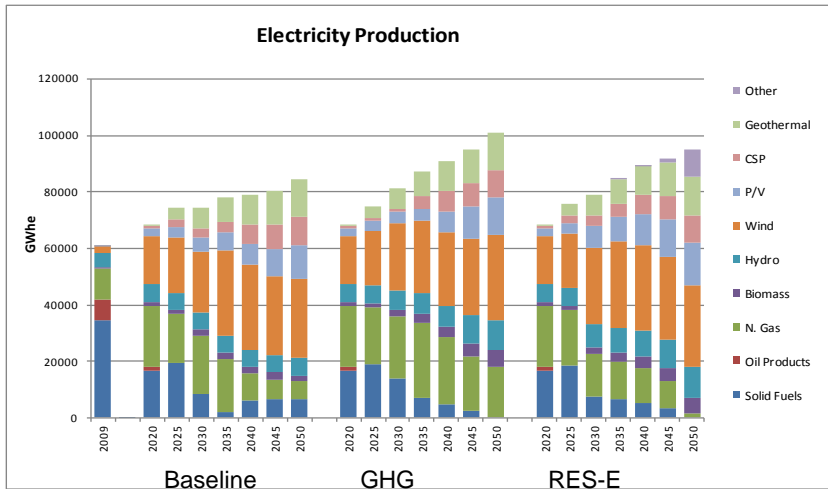
2050 Scenarios



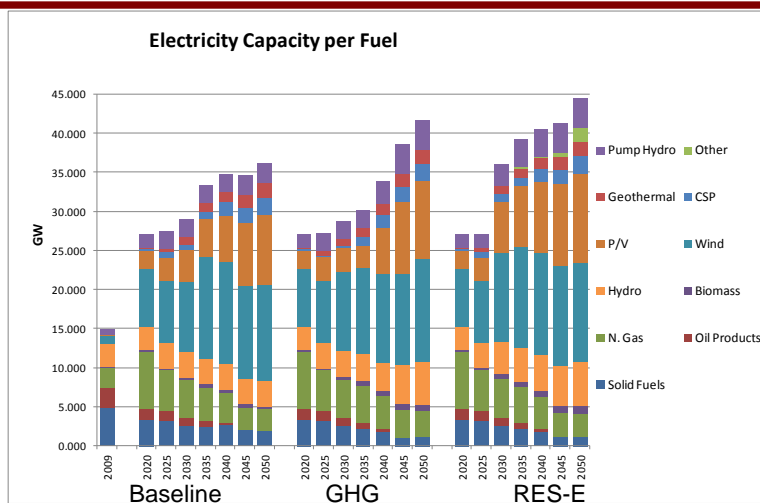
2050 Scenarios



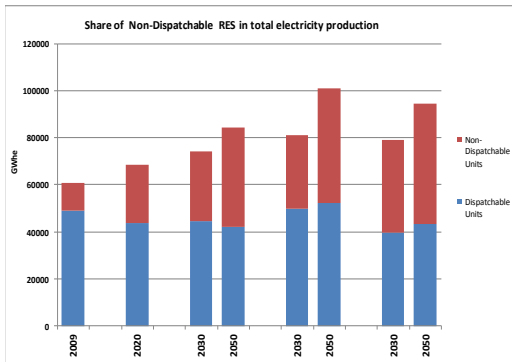
2050 Scenarios



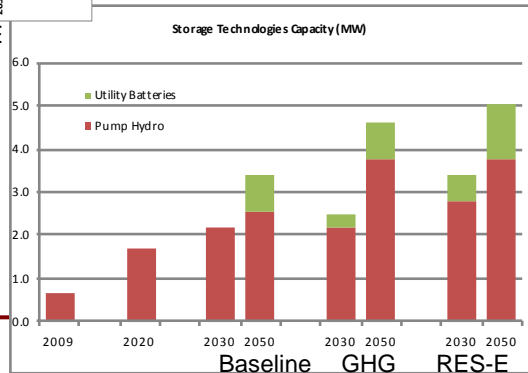
2050 Scenarios



2050 Scenarios



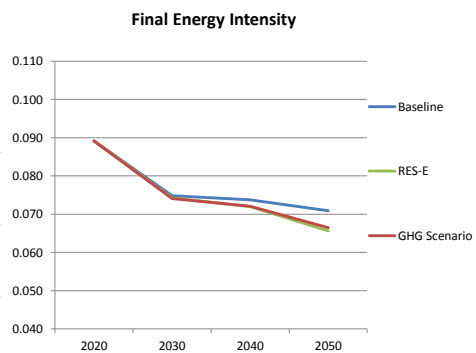
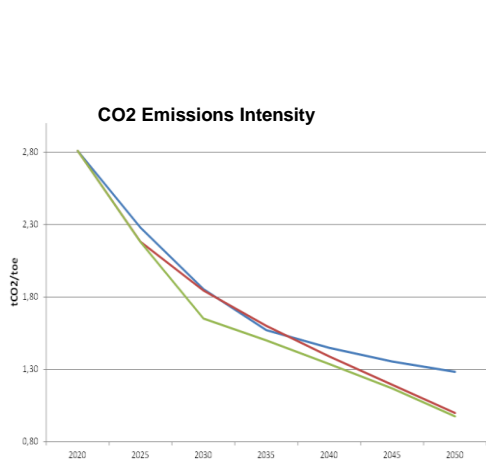
Baseline GHG RES-E



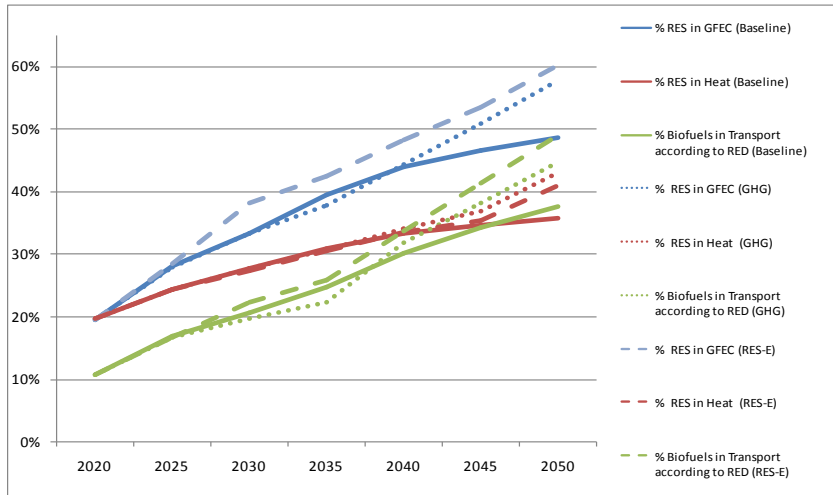
Electricity system under high RES penetration



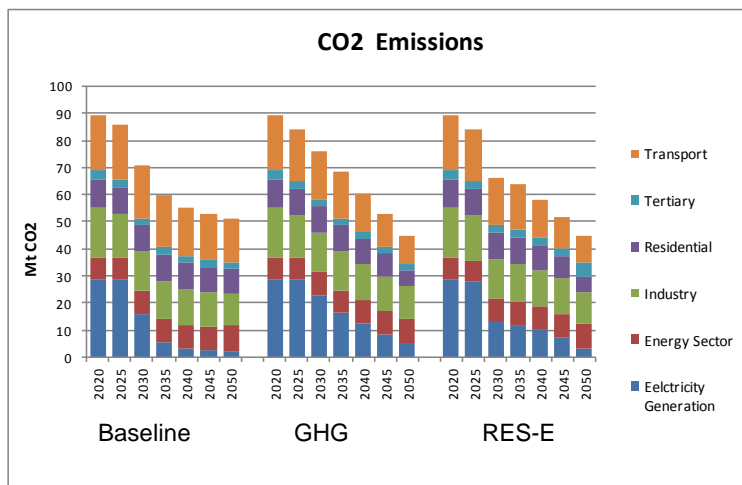
2050 Scenarios



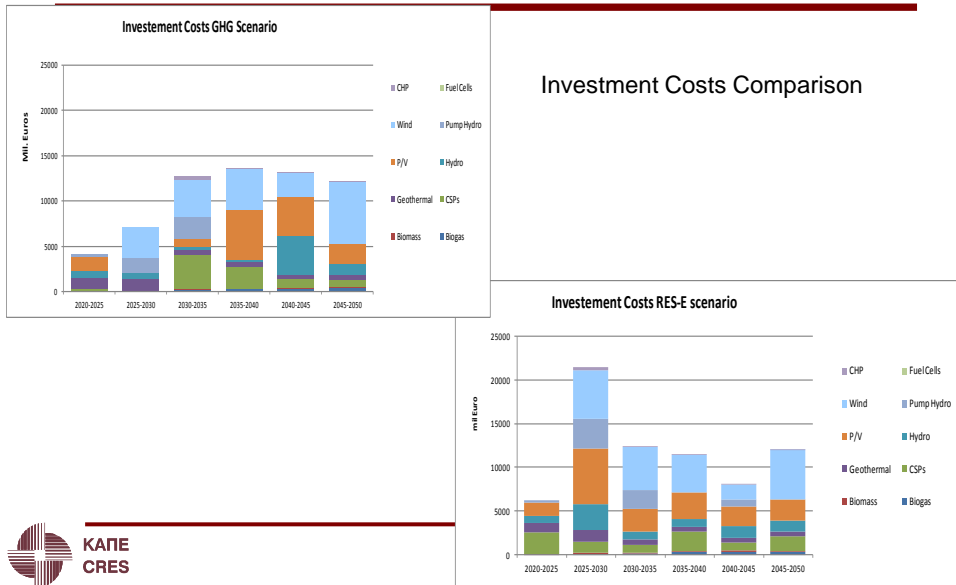
2050 Scenarios



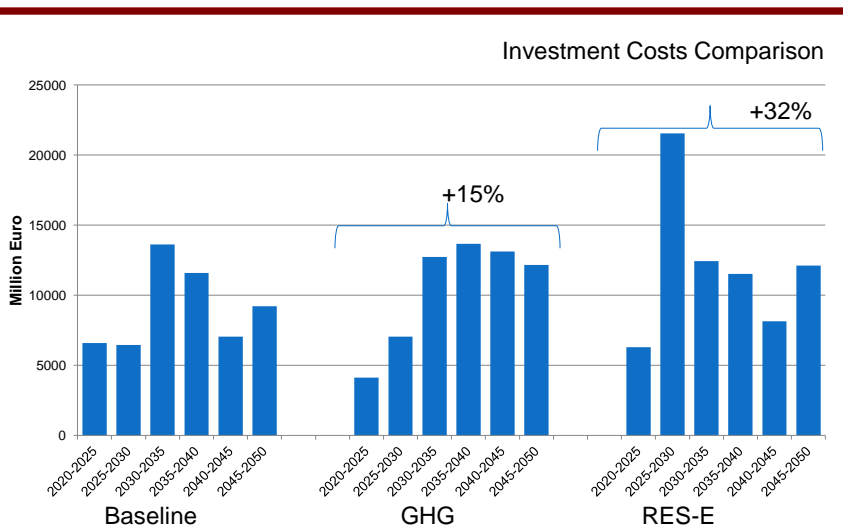
2050 Scenarios



2050 Scenarios



2050 Scenarios



Conclusions

- The Share of renewable energy can reach 60% of GFEC.
- 100% RES Electricity is possible but it is connected with investments for storage technologies to minimise curtailment.
- The same reduction of GHG emission is possible with a higher share of renewables in heat production in the final energy sector, and it is associated with 14% less investment cost compared to the RES-E scenario.

