PRIMES model

What is needed to Plot the Path to a Decarbonised Future in the EU

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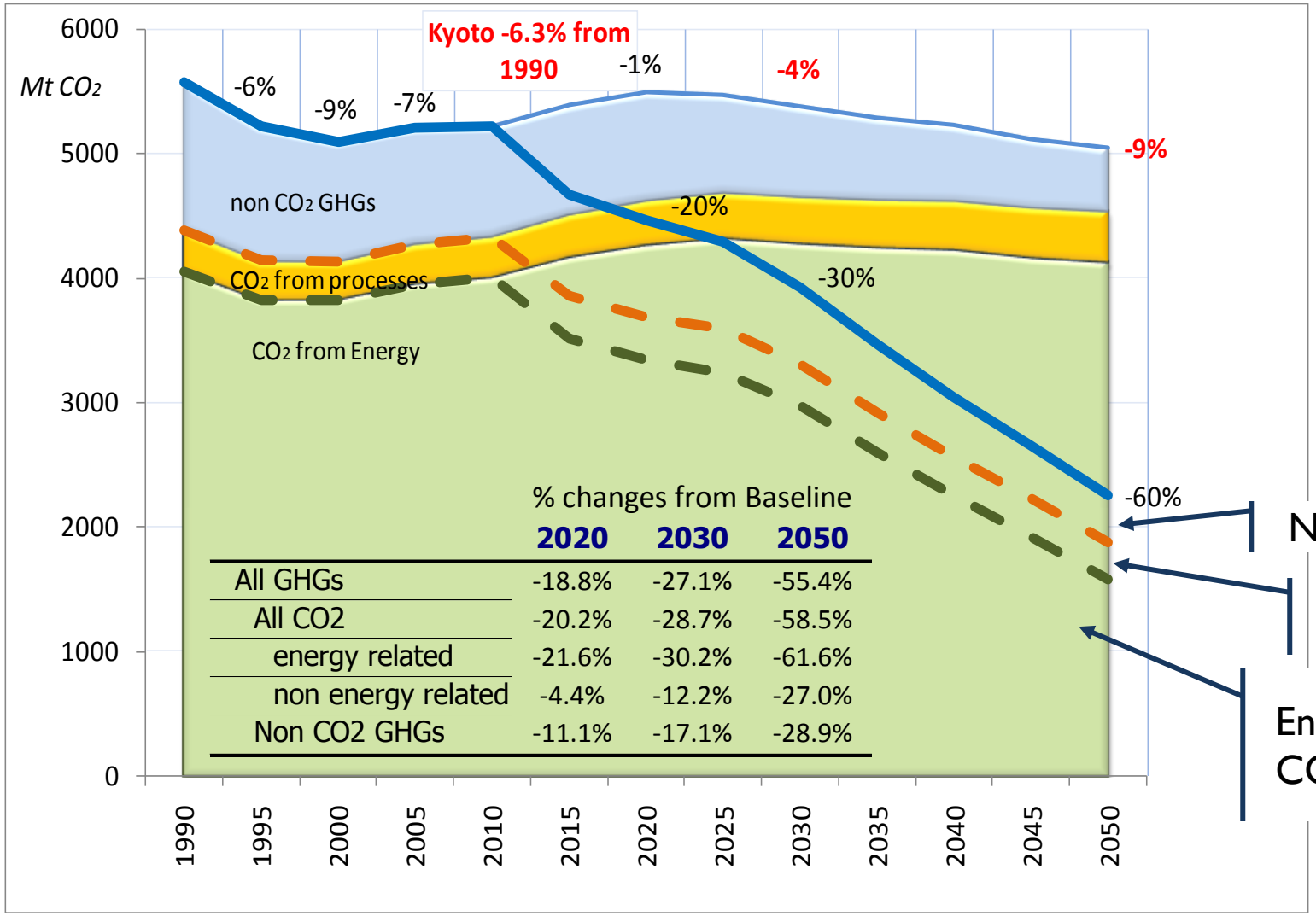
Preparing for a Decarbonised Future in the EU is now an Obligation

- New Legislation adopted by the end of 2008
  - GHG Emissions of the EU in 2020 : 20% (mandatory) and under world conditions 30% down from 1990
  - Renewables as % of Final Energy Demand in 2020: 20%
  - Biofuels in 2020 : 10% of total liquids in transport
  - Energy Efficiency (-20% energy consumption) but not a binding objective
  - EU ETS reinforced and based on full auctioning for power generation
  - Specific emission reduction targets by Member-State for Non EU ETS sectors
  - Specific targets for Renewables binding each Member-State, trading among MS is allowed
  - Technology Push actions and Budgeting

Use of the PRIMES Model

- The energy model PRIMES of E3MLab has been used as the main tool in the impact assessment of the proposal of the European Commission
- Each effort sharing scheme has been fully quantified with PRIMES as an energy system scenario 2005 – 2030 with full details by sector (demand – supply) and by Member-State
- The E3MLab models were used also to analyse changes over the time horizon towards 2050:
  - EURELECTRIC Role of Electricity project, 2006-2007
  - EU Presidency by Portugal in late 2007

The Emission Reduction Targets are Ambitious



% changes from Baseline

	2020	2030	2050
All GHGs	-18.8%	-27.1%	-55.4%
All CO2	-20.2%	-28.7%	-58.5%
energy related	-21.6%	-30.2%	-61.6%
non energy related	-4.4%	-12.2%	-27.0%
Non CO2 GHGs	-11.1%	-17.1%	-28.9%

The New EU Climate Action and RES policy is Challenging Power Generation

- By 2020 the Power Sector will have to:
  - Reduce CO_2 Emissions in 2020 by 21% compared to 2005 and purchase all CO_2 emission allowances through auctions at a price estimated between 30 and 40 €/t CO_2
  - Generate 30 – 35% of power by using renewables (hydro, biomass, wind, solar, etc.), because of the overall RES obligation
  - Pass through to consumers allowances costs (since purchased) and restructuring costs, driving high electricity prices
  - Face lower electricity demand than in Baseline because by 2020 energy efficiency reduces demand for energy, including electricity
  - Increase Investment in Power Generation and Grids relative to Baseline
- Beyond 2020, towards 2030 and 2050
  - New options, such as CCS and Nuclear and more advanced RES, can develop allowing power generation to reduce drastically carbon emissions
  - It will become cost-effective to partly substitute fossil fuels in final energy demand by electricity: e.g. plug-in hybrid cars, heat pumps; thus, electricity demand will again start increasing

A Sequence of Milestones

- **Power Generation**
  - System Operation and Transmission with large-scale RES
  - Carbon Capture technology and Infrastructure for Storage
  - New Nuclear policy and technology
  - Preservation of gas-based generation and security in gas provision
  - Smart Grids to develop small CHP and small RES
- New resources: biomass

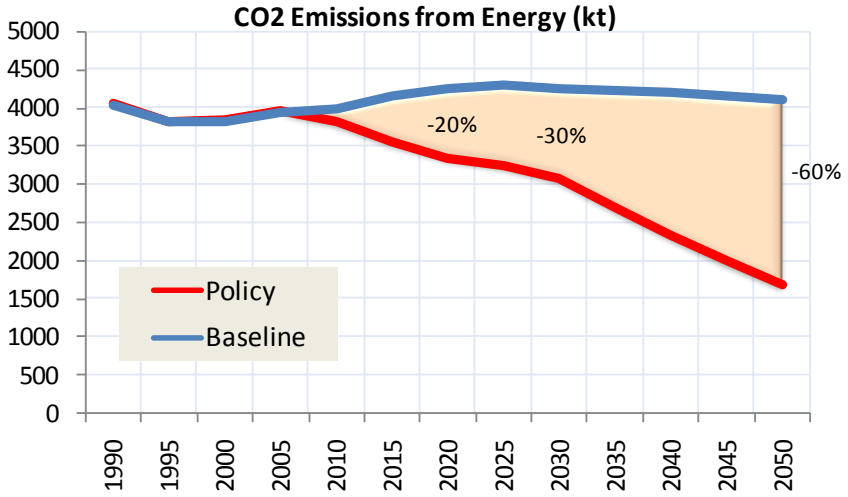
- **Demand for Energy**
  - Large-scale energy savings in buildings and houses
  - CHP in industrial and urban applications
  - Heat pumps, advanced motor drives, and efficient electric appliances
  - Plug-in hybrid cars and other alternative fuels in transportation
  - Modal shifts in transportation

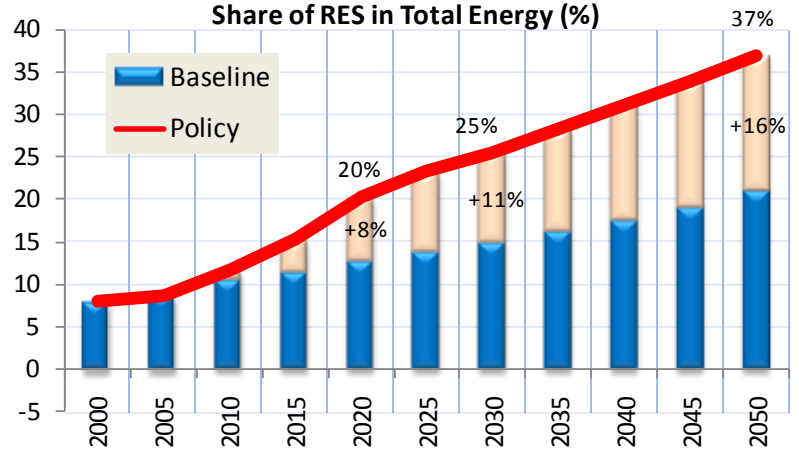
Decomposition of GHG reduction Effort by type of change (indicative values)

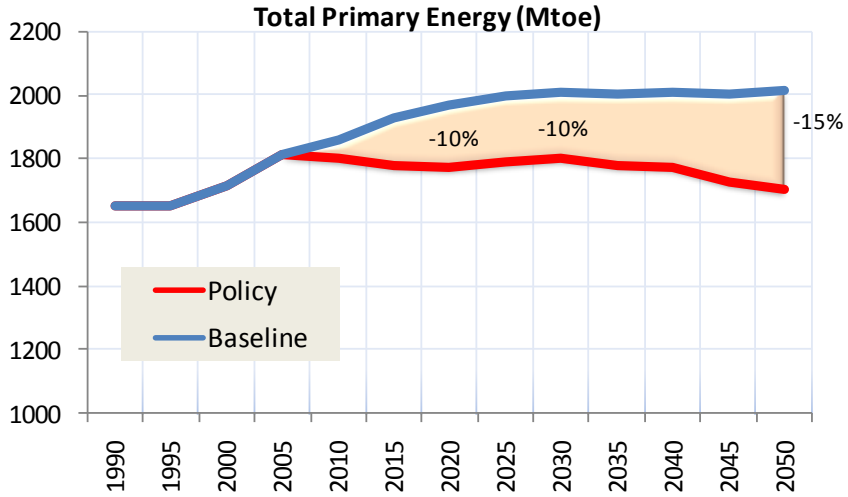
% contribution to abatement	Energy Efficiency	Use of Carbon Free Energy	Fossil Fuel Mix	Shift to Electricity/ and CHP	SUM
Policy Scenario	36	45	4	15	100

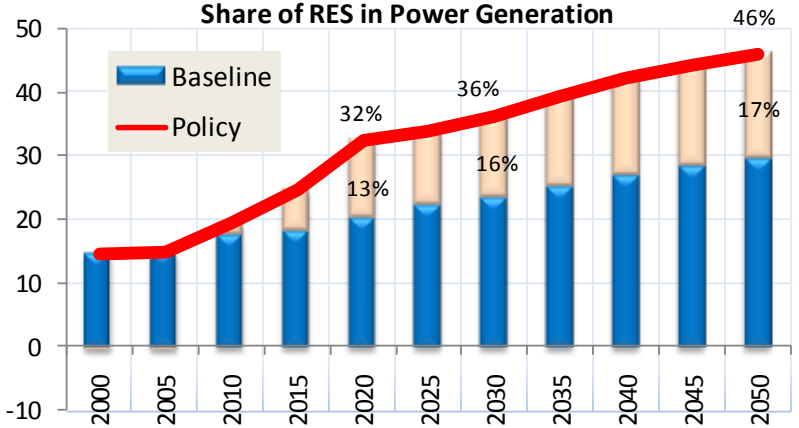
- The Role of Electricity project, but also the recent EPRI Prism project, confirmed that keeping all decarbonisation options open is the most cost-effective strategy
- Both projects also confirmed that intelligent deployment of electricity applications is also a cost-effective response

Normative Scenario Results until 2050 Quantified with PRIMES









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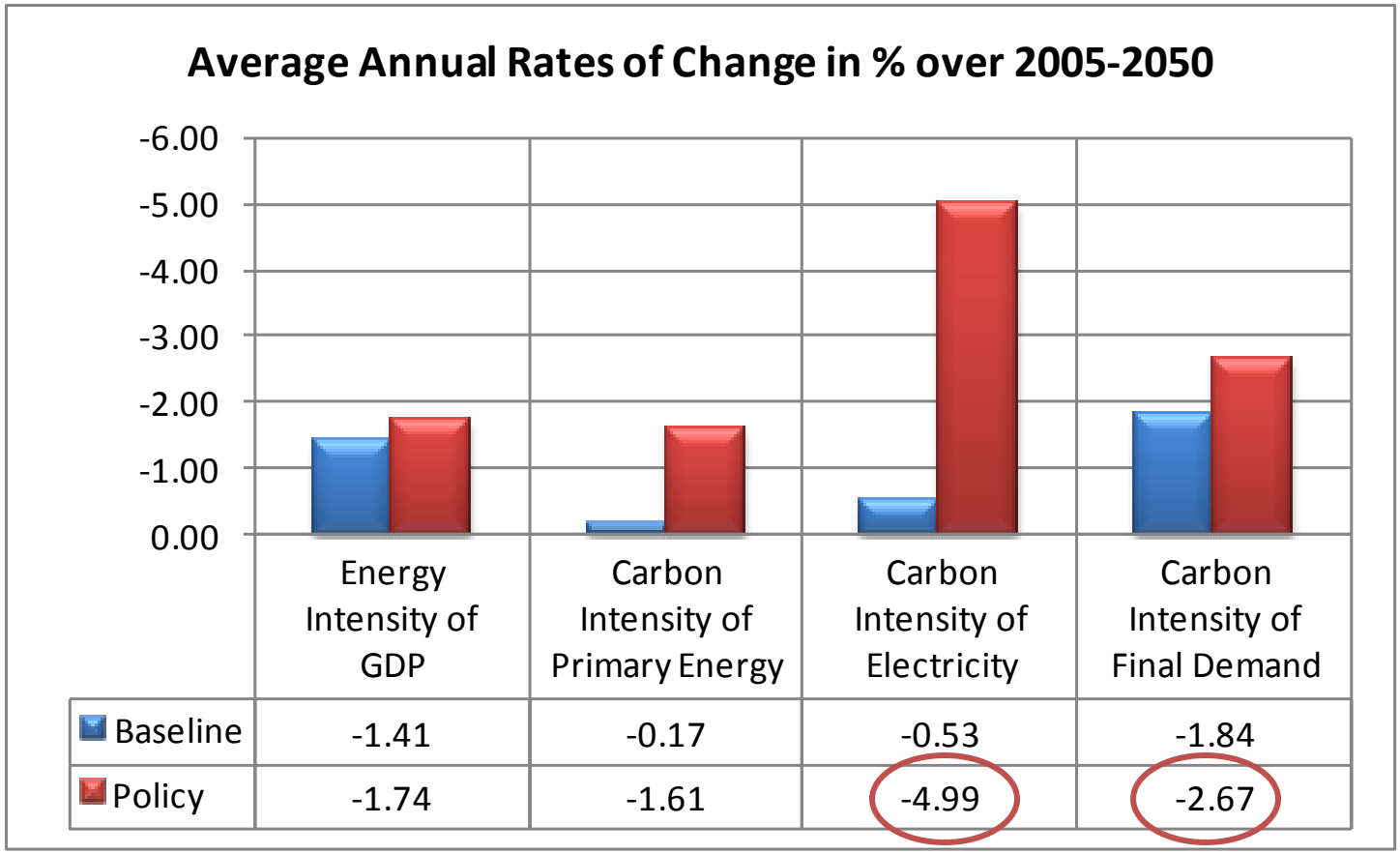
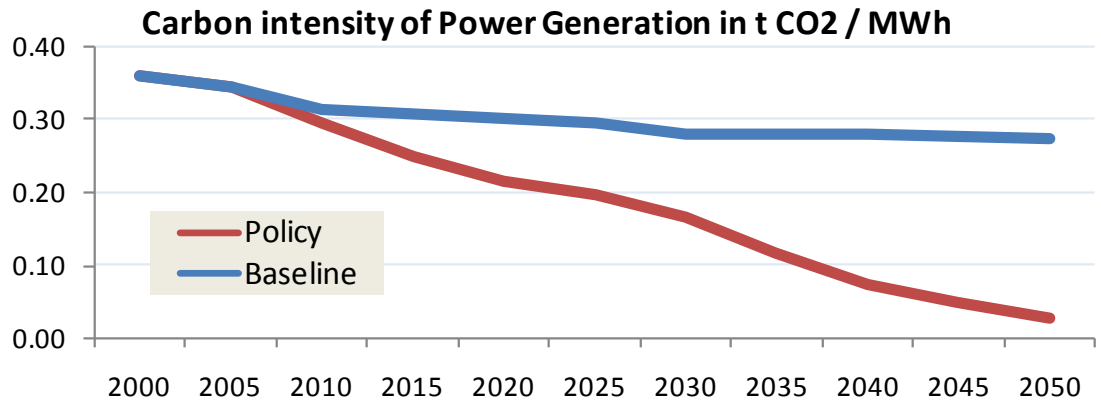
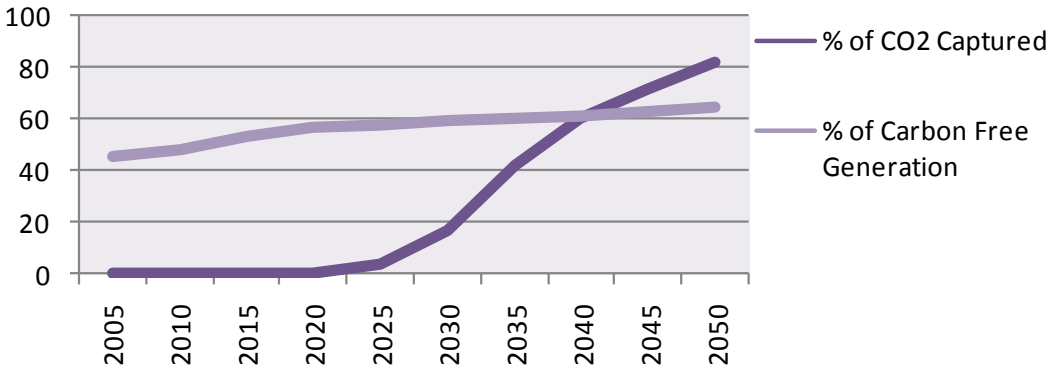
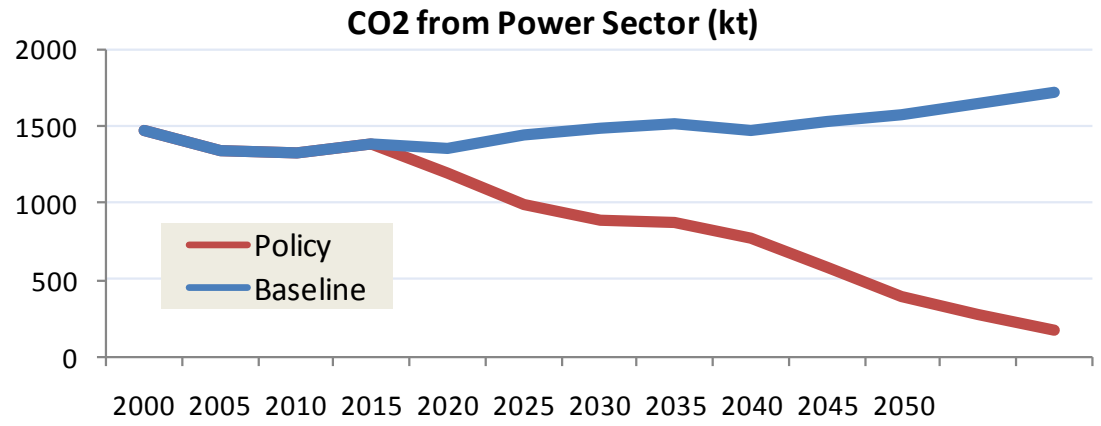


	Energy Intensity of GDP	Carbon Intensity of Primary Energy	Carbon Intensity of Electricity	Carbon Intensity of Final Demand
Baseline	-1.41	-0.17	-0.53	-1.84
Policy	-1.74	-1.61	-4.99	-2.67





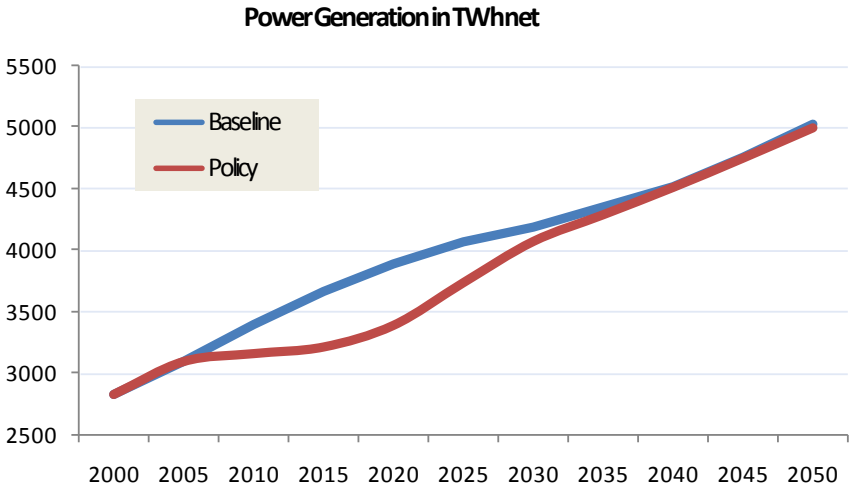


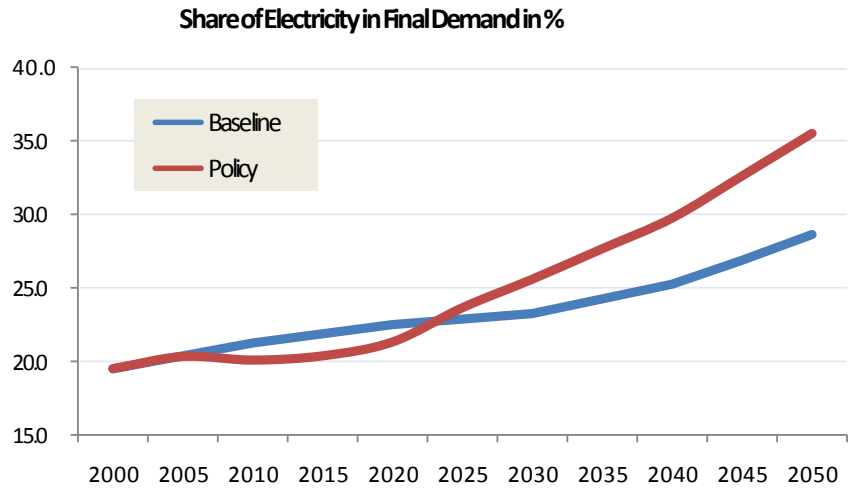
Power Sector

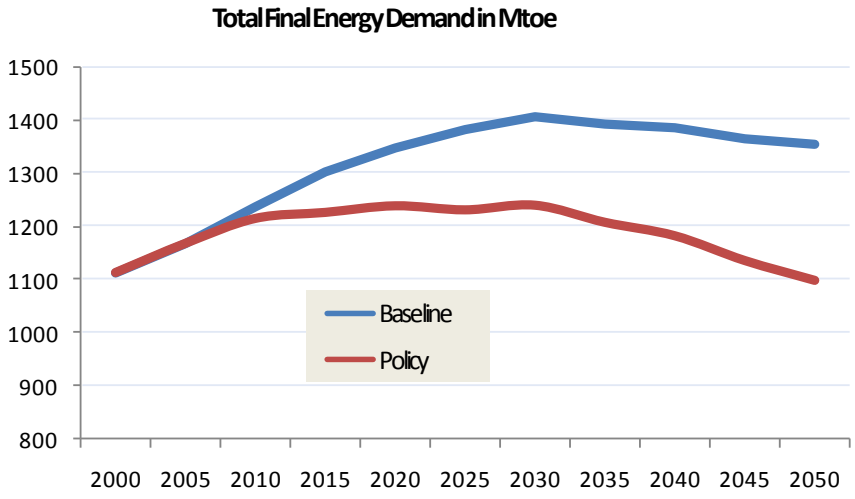
Considerable Decarbonisation of Power Generation is possible; accelerated pace beyond 2020.

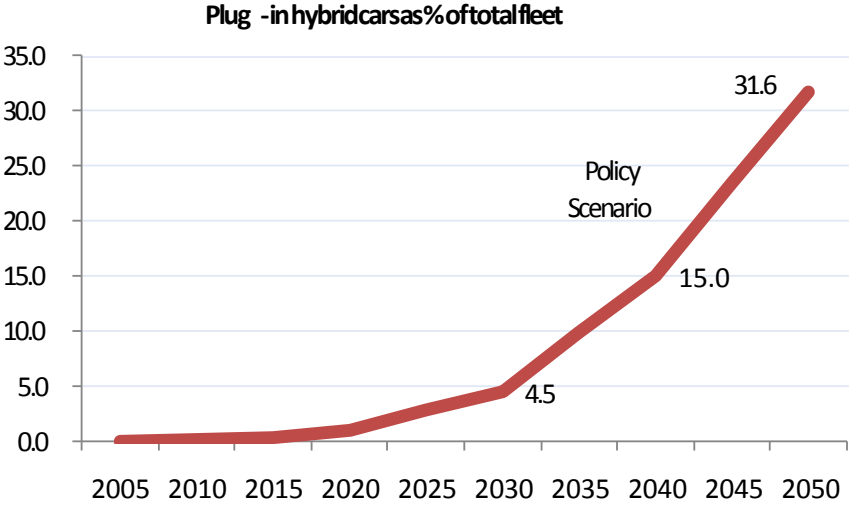
In terms of climate change mitigation, it is cost-effective to use more electricity in selected efficient applications in final demand and replace fossil fuels

Role of Electricity in the Policy Scenario

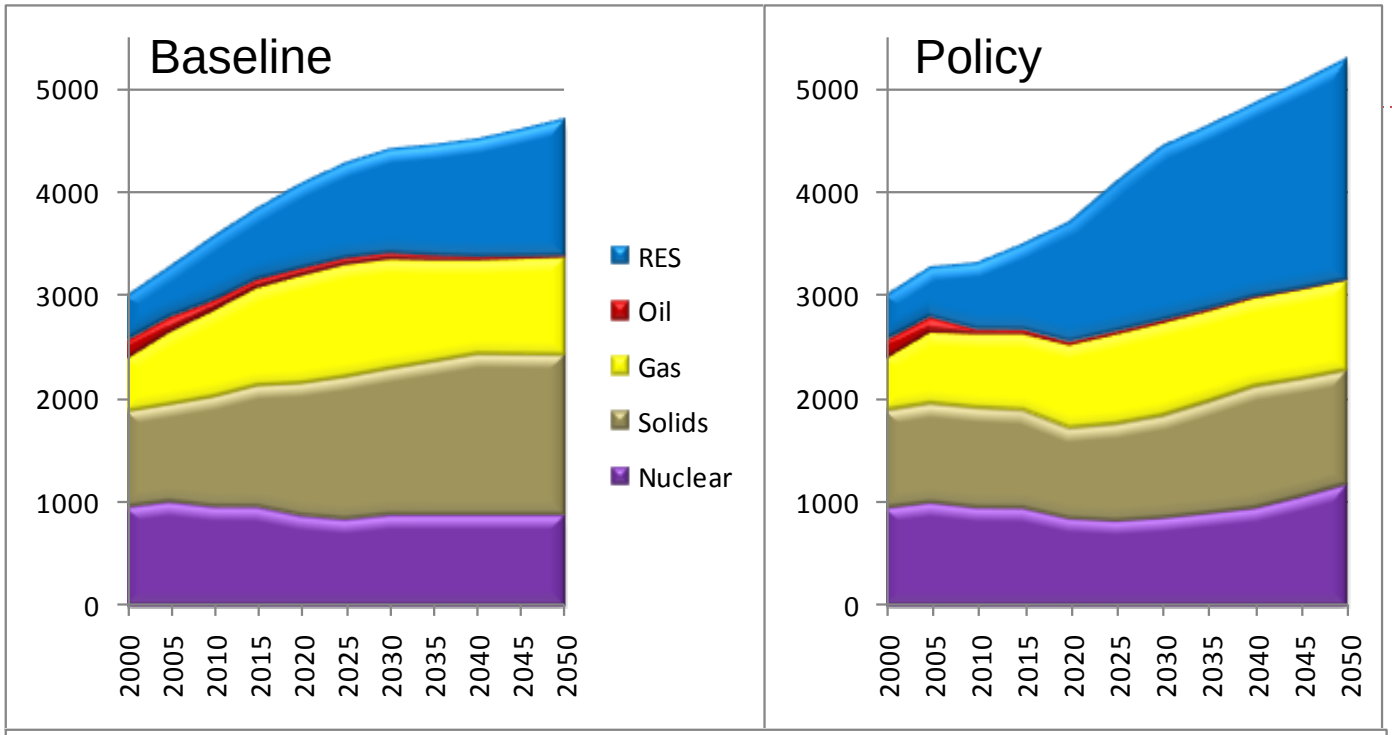


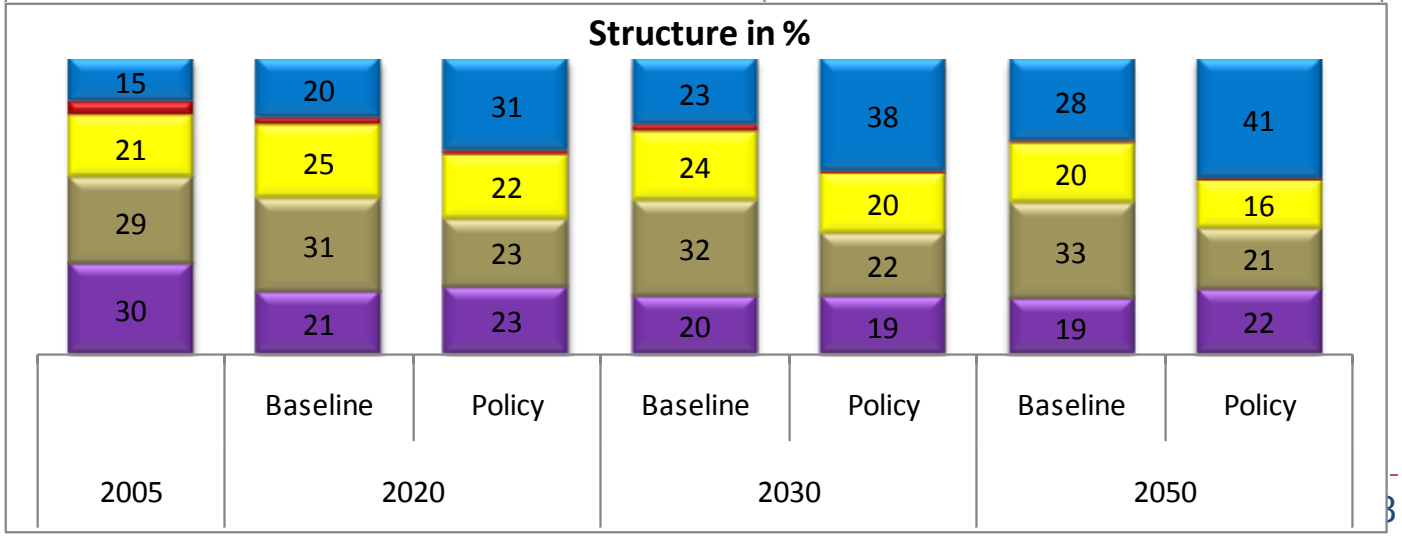




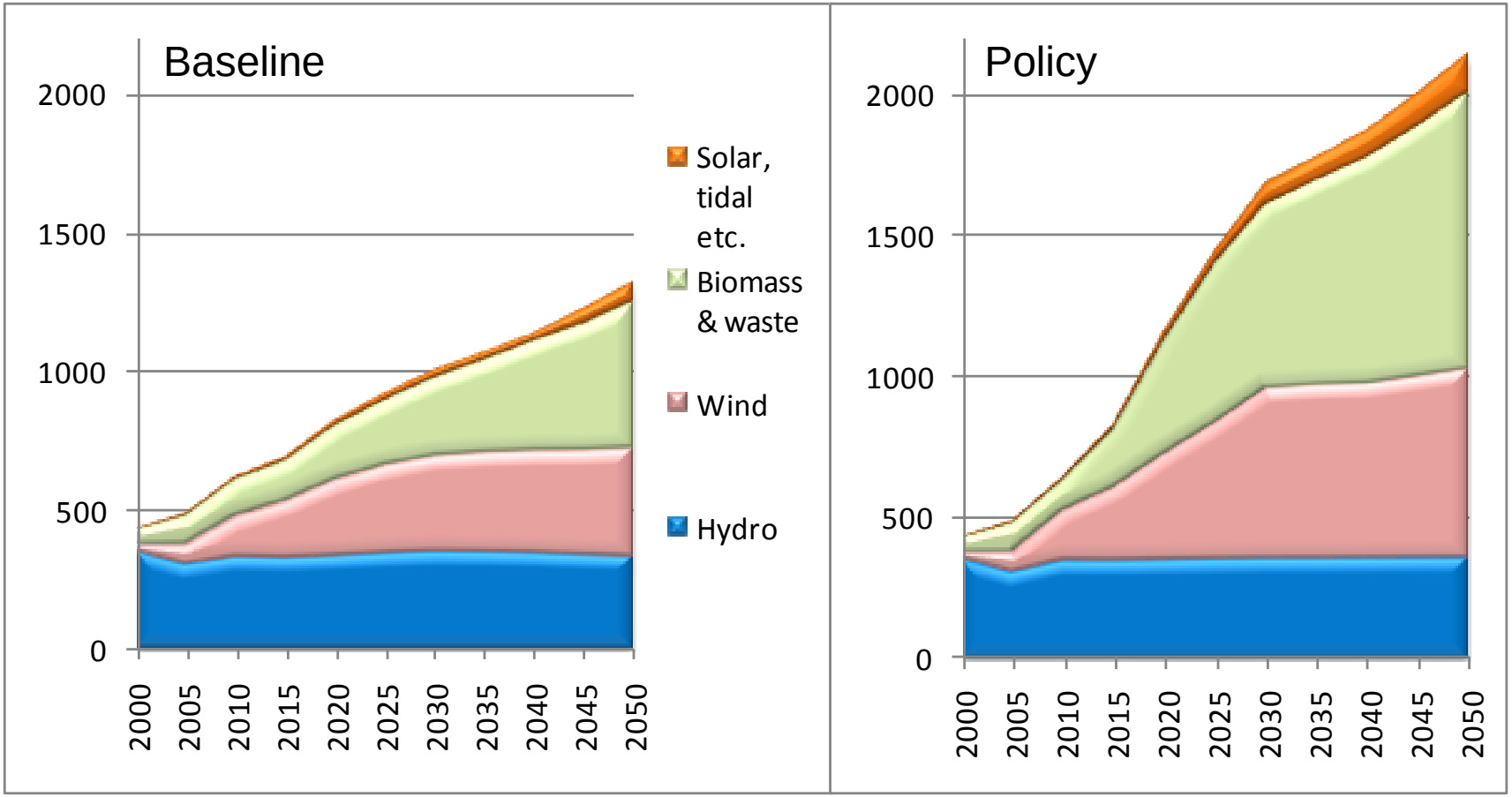


Power Generation by Source (Twh Net)

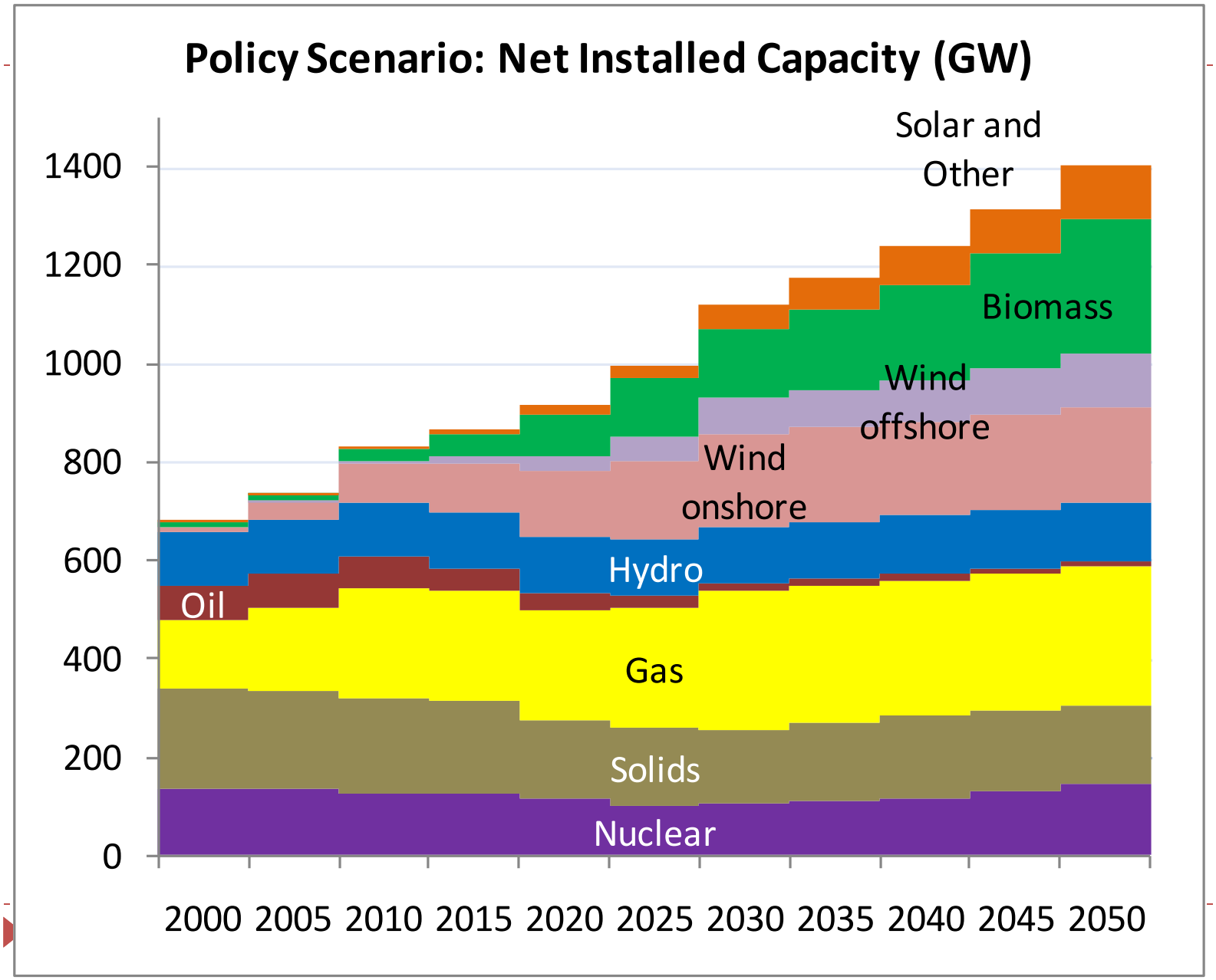


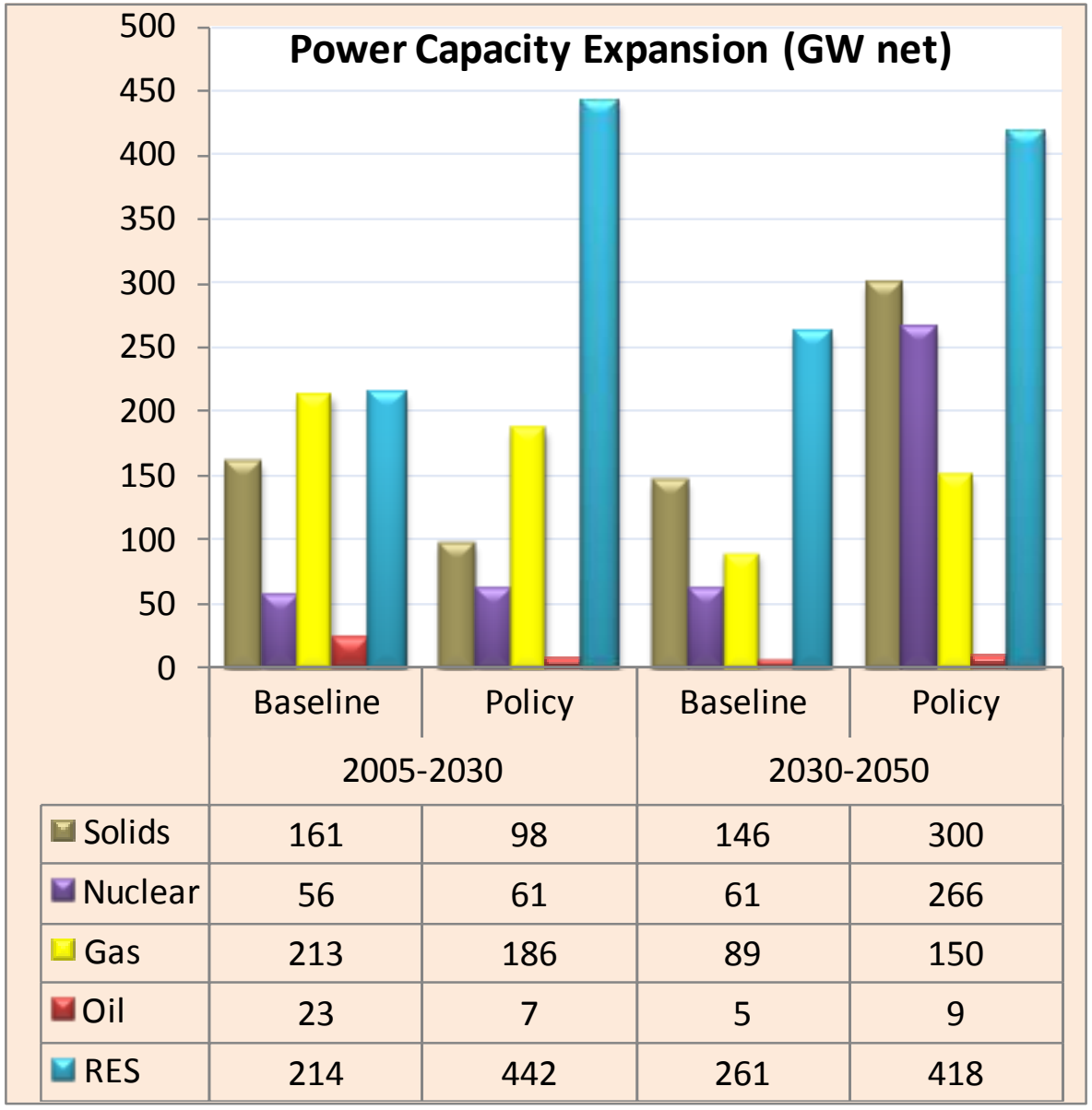


Renewables in Power Generation (Twh net)



Operating Capacities in the Policy Scenario





	2005-2030		2030-2050	
	Baseline	Policy	Baseline	Policy
Solids	161	98	146	300
Nuclear	56	61	61	266
Gas	213	186	89	150
Oil	23	7	5	9
RES	214	442	261	418

Investment

Considerable investment in RES throughout the projection period

CCS facilitates investment in advanced coal technology

Gas-firing plants continue to be important for the system as RES penetration is high

Nuclear investment after 2030 is needed mainly to replace old plants – expansion of total nuclear being rather limited

Conclusions

The new binding GHG and RES targets of the EU including the auctioning of ETS allowances imply considerable restructuring of the EU energy systems

Even more ambitious decarbonisation objectives are feasible towards 2030 and 2050, but important milestones must be met

Electricity will play a central role, decarbonising power generation and expanding in final demand.

Energy efficiency, plug-in hybrid cars, heat pumps and smart grids in demand sectors. Large-scale RES, biomass, CCS, Nuclear in the supply sector.