

The Role of Electricity

Economics of Climate Change

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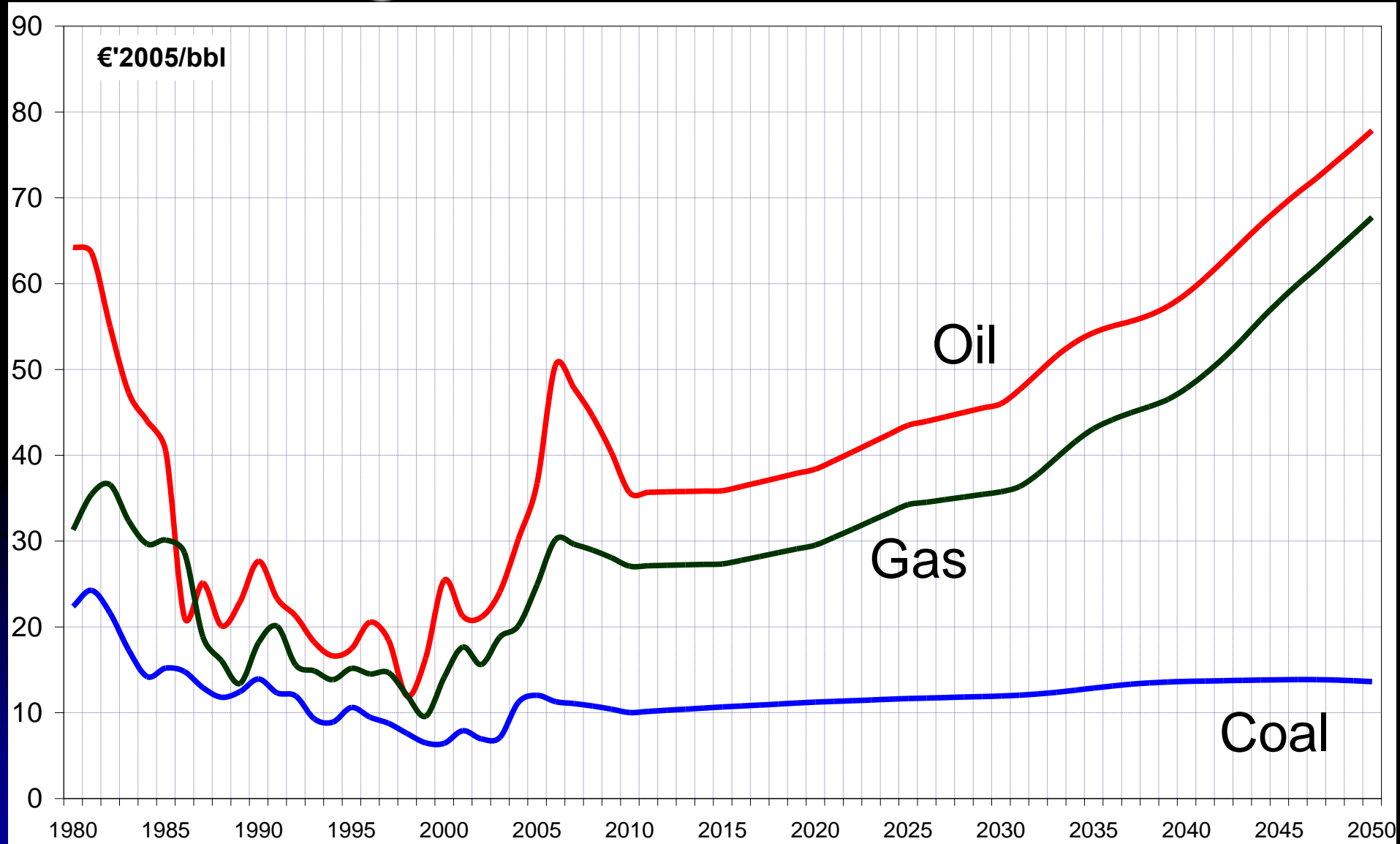
Scenarios

- Scenarios built with energy systems models for all EU countries
 - Detailed up to 2030 with PRIMES Model
 - World wide for the long term (2030 – 2050) with Prometheus model (Deterministic mode)
- Inputs from bottom-up parts of the project
 - Demand-side data on new electrical technologies, including heat pumps, efficient lighting, plug-in hybrid cars
 - Supply-side data on new power generation technologies, including CCS

Baseline Scenario

- A Business as Usual projection
 - Economic growth 2% pa on average
 - Relatively high world oil and gas prices
 - Gas to coal competitiveness deteriorates
 - Current legislation applies but no new policies
- No climate change policy, but continuation of subsidies to renewables
- Nuclear phase out in some countries and no extension of life time

High Oil and Gas Prices



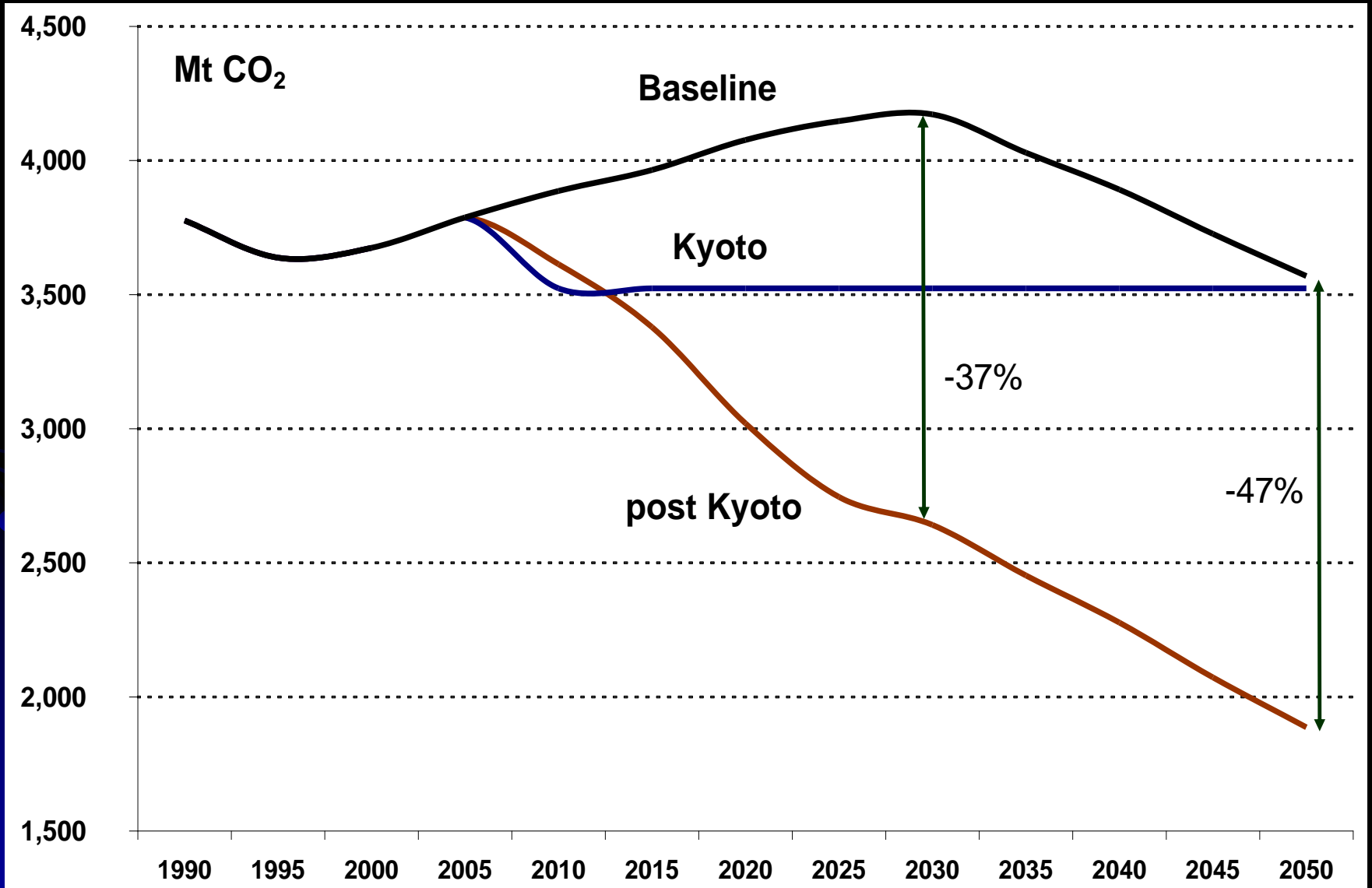
EU-25: Baseline Outlook

Year 2005	Prospects to 2030
✓ 460 million people	✓ Stable
✓ 9,715 billion € GDP	✓ 2.0% per year
✓ 1,744 Mtoe Gross Energy Needs	✓ 0.3% per year
✓ Energy Intensity of GDP	✓ -1.7% per year
✓ 904 Mtoe Imported Energy	✓ 1.5% per year
✓ 3,177 TWh Electricity Generation	✓ 1.3% per year
✓ 726 GW of Power Capacity	✓ 33 GW new Plants per year
✓ 3,800 Mt of CO ₂ Emissions	✓ 0.3% per year

Unsustainable future under Baseline

- Import Dependence rises from 50% to 68% in 2030
- Carbon Dioxide emissions deviate from targets

Baseline: CO₂ emissions deviate



Alternative Scenarios

Three Goals

1. Cap on CO₂ emissions (from 1990: -20% in 2020, -30% in 2030, -50% in 2050)
2. Alleviate security of supply vulnerability
3. Optimise effects on energy costs and prices

Means

1. Accelerated Energy Efficiency
2. Higher Development of Renewables
3. Demand-side electro-technologies
4. Nuclear policy: no phase-out, extension of life time, new technology
5. Carbon capture and storage technology

Alternative Scenarios

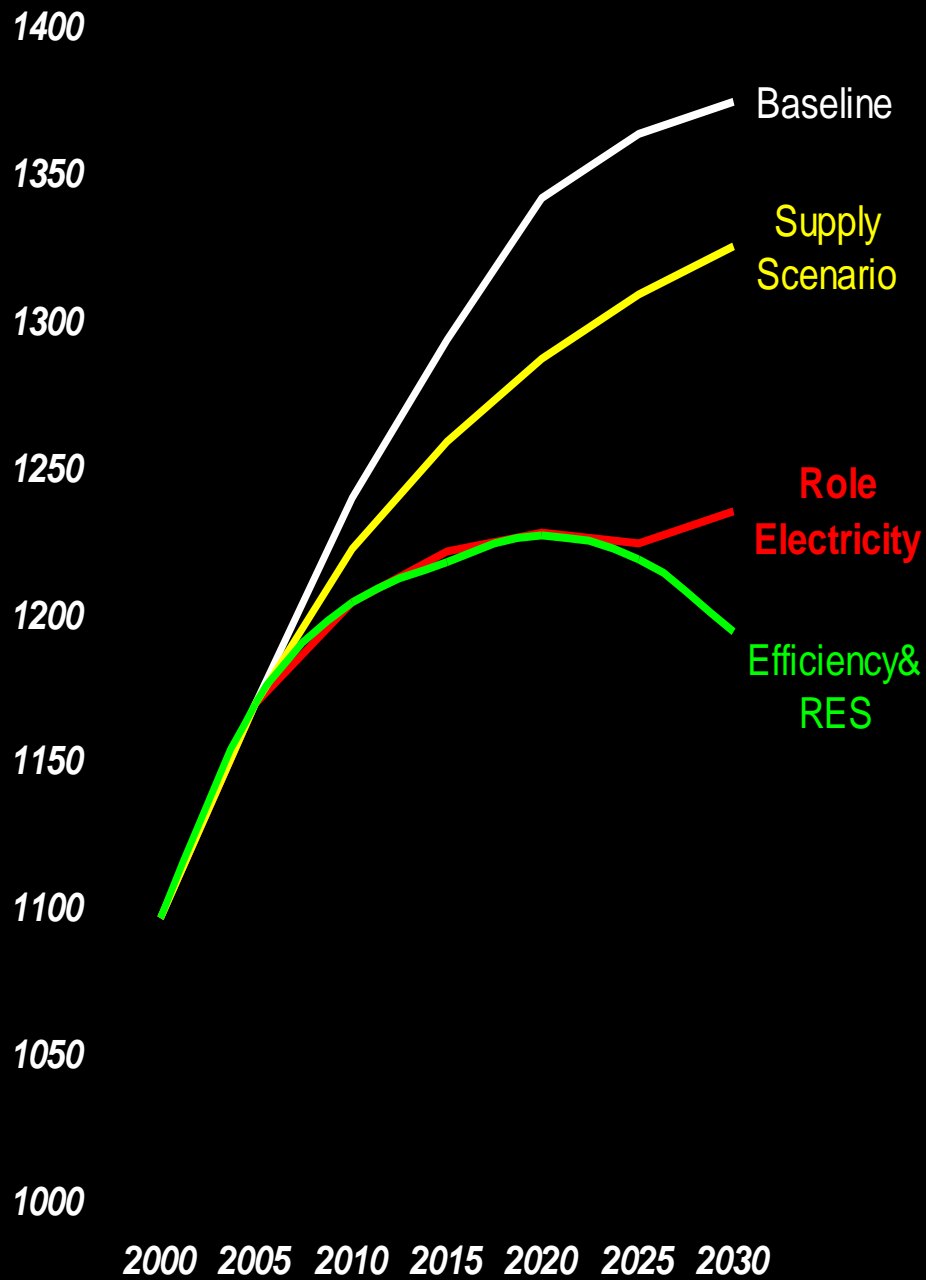
Scenarios	Role of Electricity	Supply Scenario	Efficiency & RES
High Energy Efficiency	YES	NO	YES
Electro-technologies	YES	NO	NO
High Renewables	YES	NO	YES
New Nuclear Policy	YES	YES	NO
Carbon Capture and Storage	YES	YES	NO

Performance of Scenarios

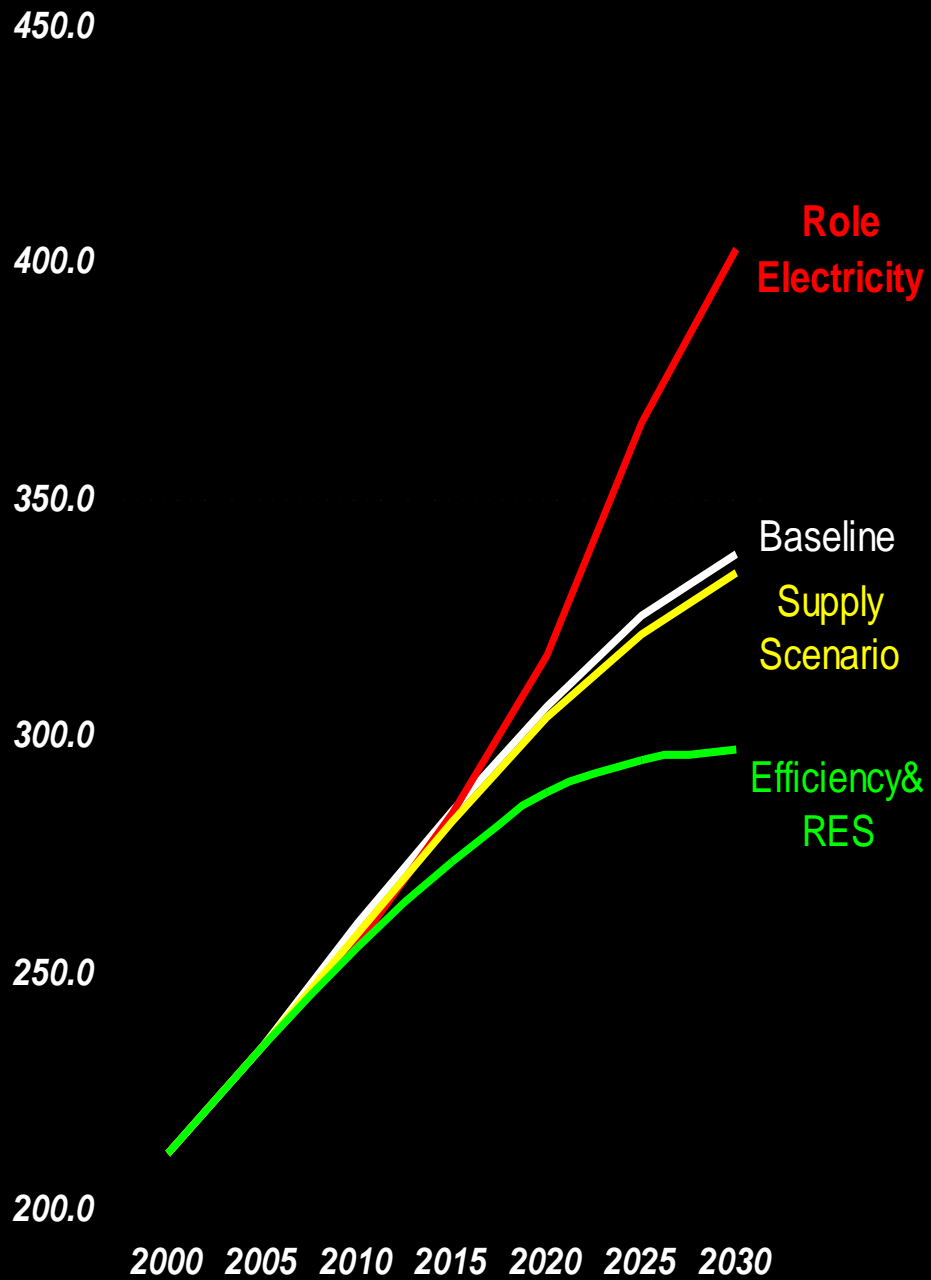
Scenario results for 2030 (2005=100)	Baseline	Supply Scenario	Efficiency & RES	Role of Electricity
CO ₂ Emissions	110	70	70	70
Total Cost of Energy	146	161	156	147
Oil&Gas Import Dependence	126	115	128	105

- For equal emission mitigation, “Role of Electricity” performs better
- Advantage of a “portfolio” approach

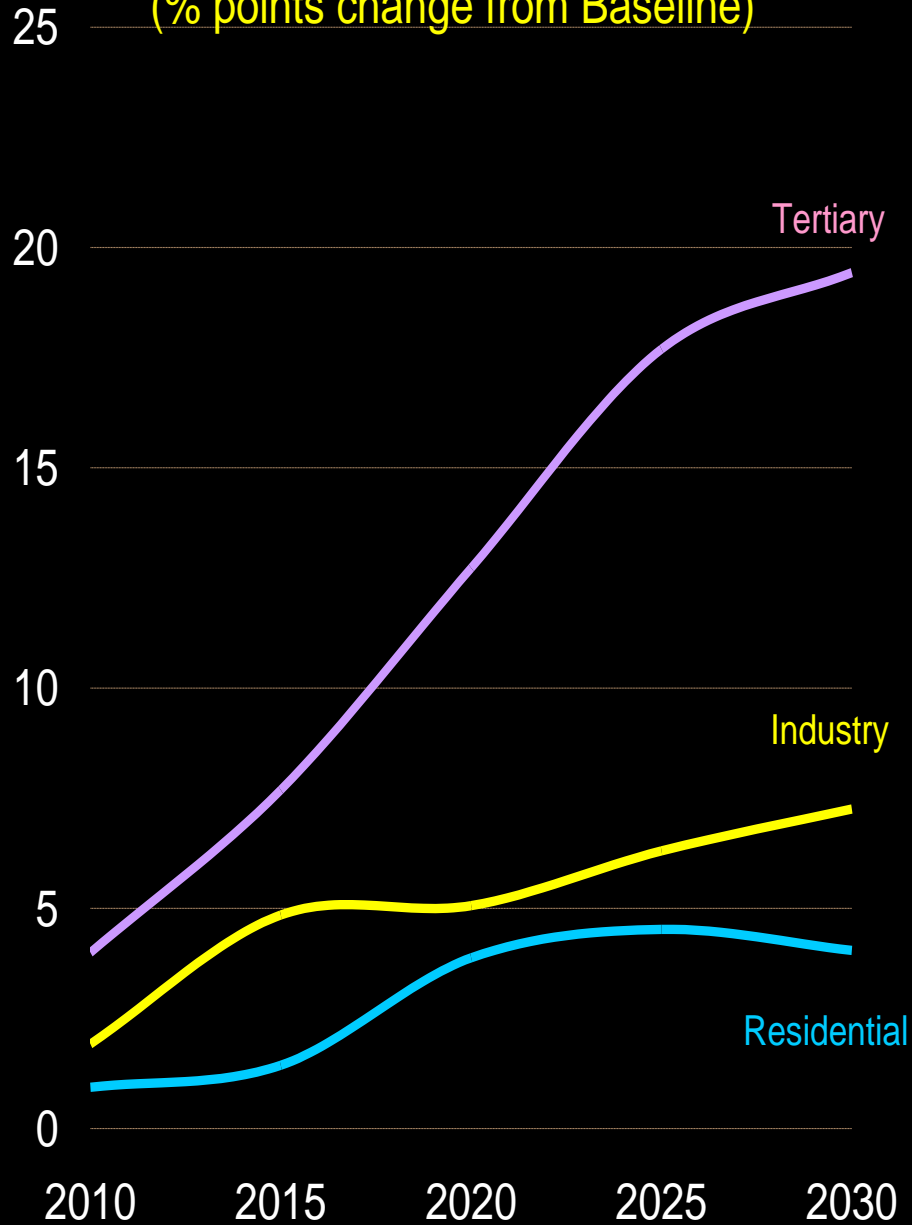
Total Final Energy (Mtoe)



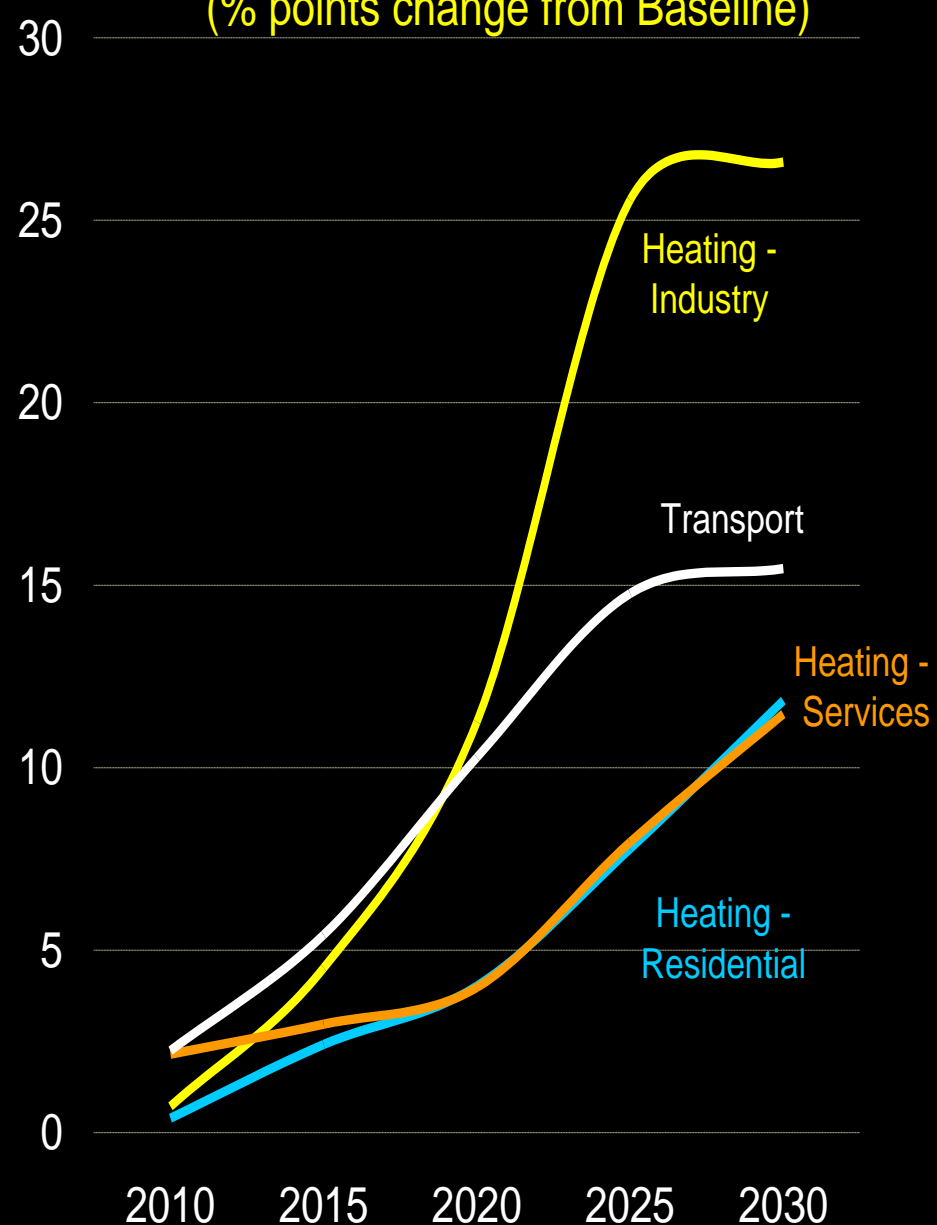
Electricity Consumption in Mtoe



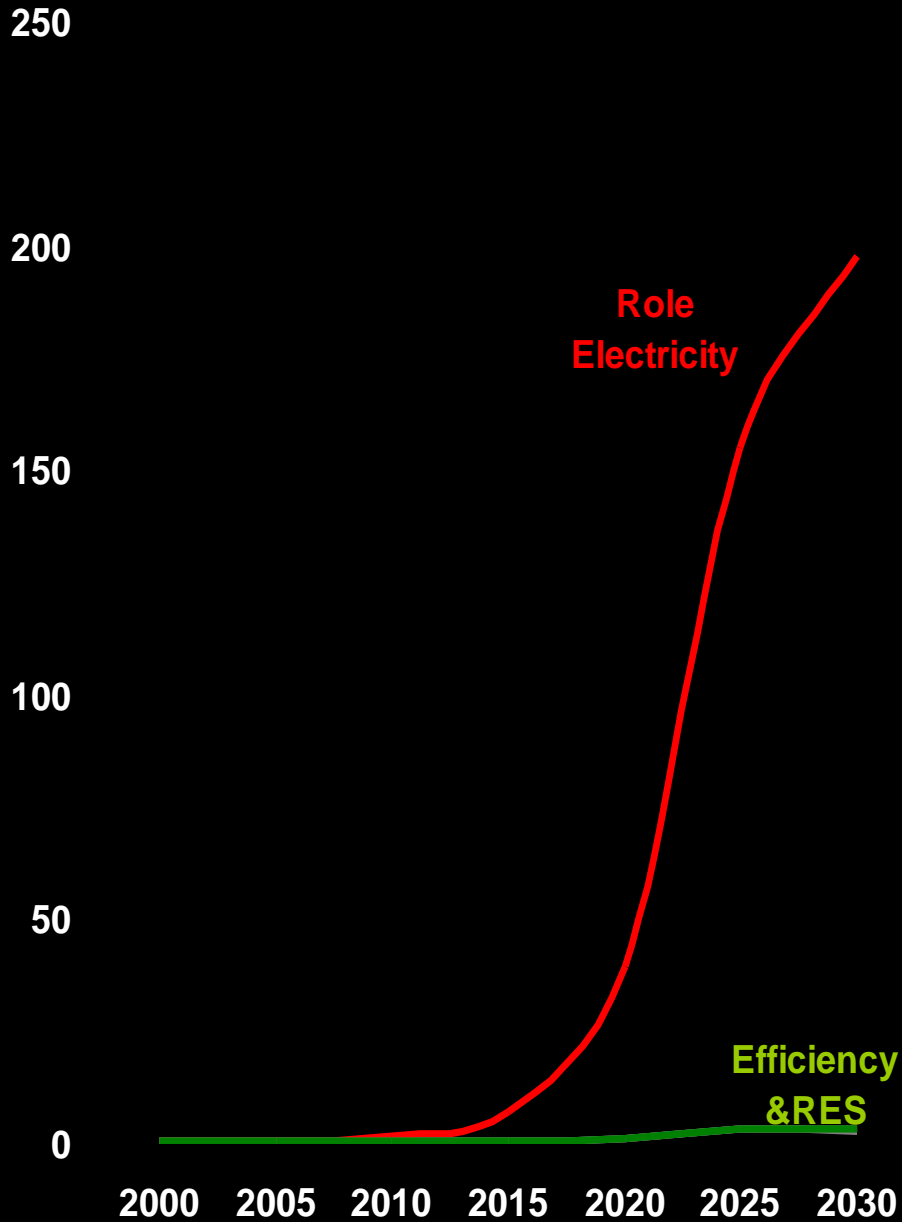
Role of Electricity: Efficiency in electricity specific uses (% points change from Baseline)



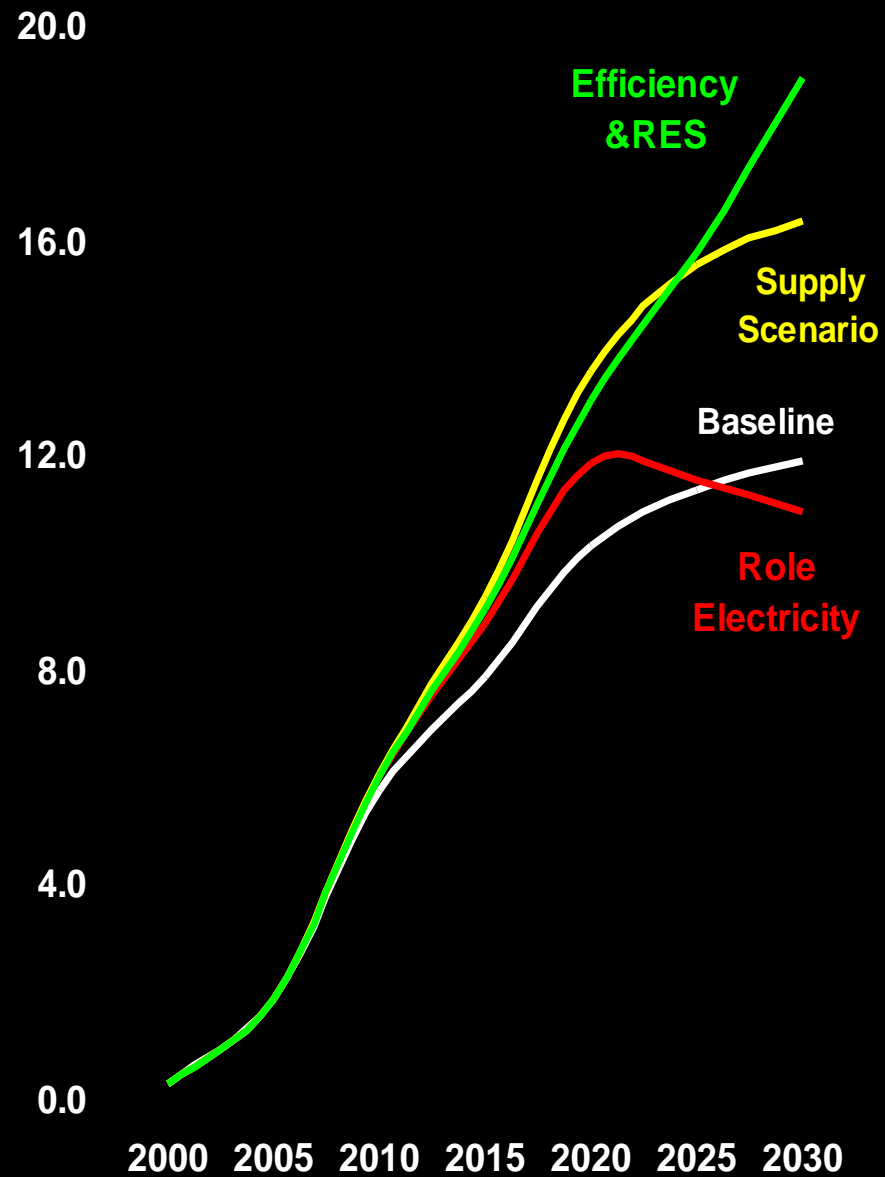
Role of Electricity: Efficiency effect in substitutable uses (% points change from Baseline)



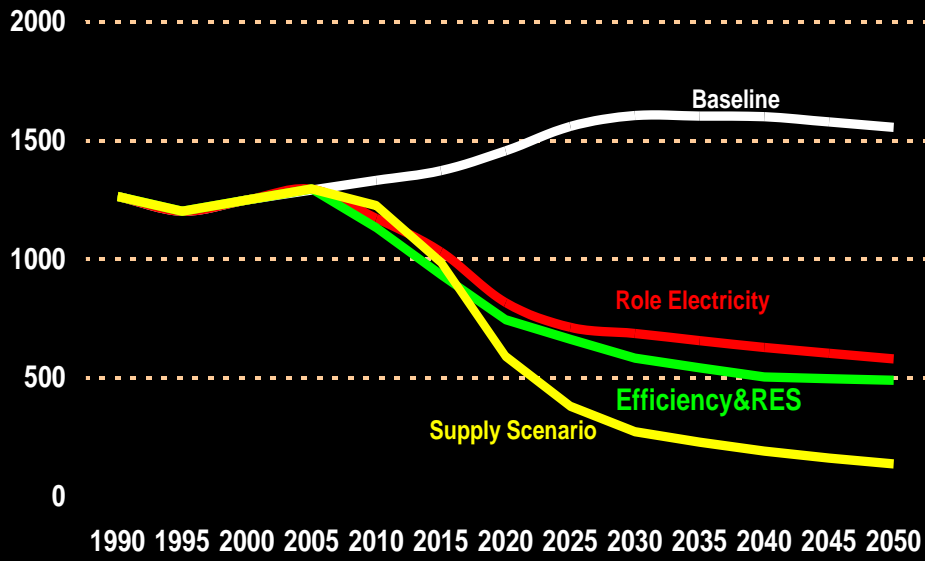
Electricity in Passenger Cars (TWh)



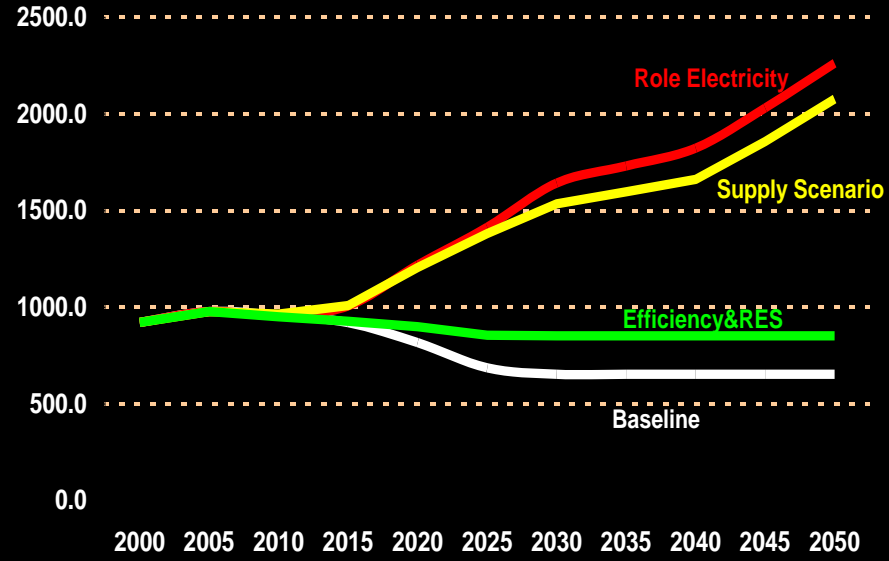
Share of Biofuels in Road Transport



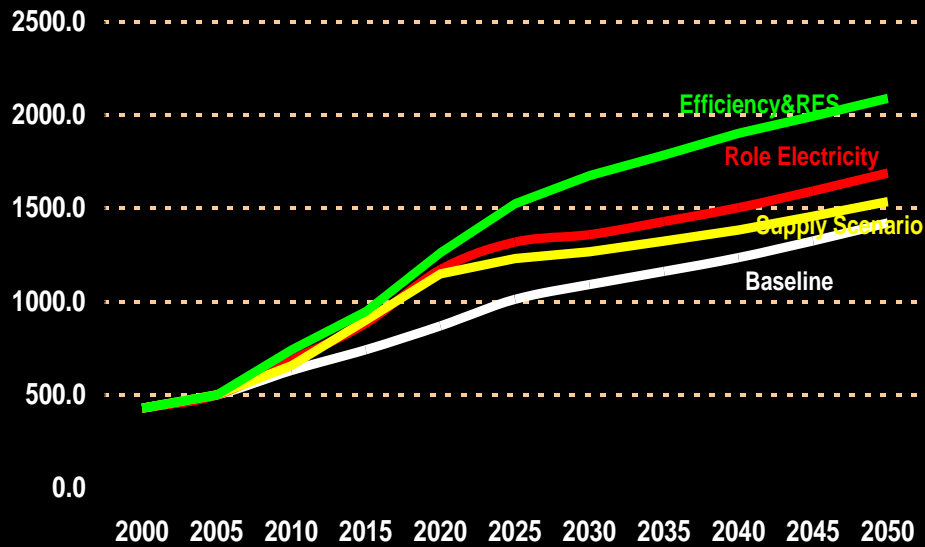
CO2 Emissions from Power Generation (Mt)



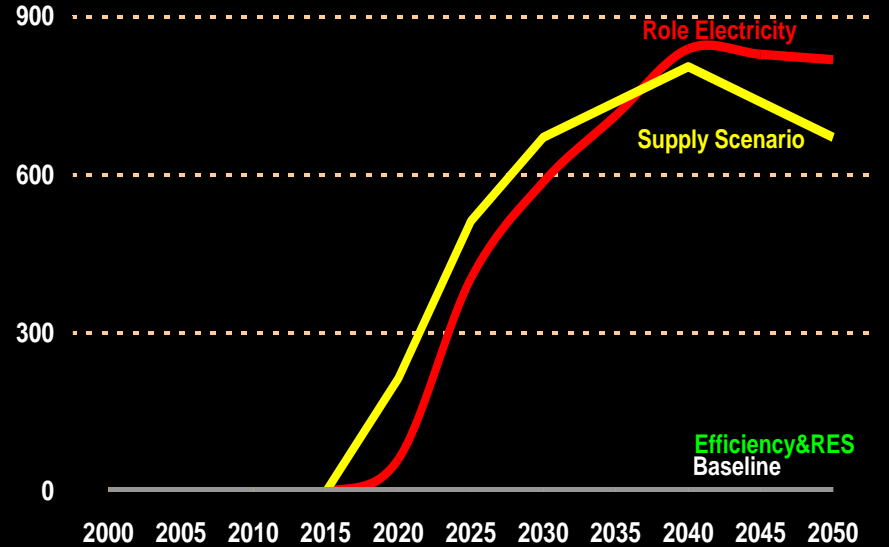
Electricity from Nuclear in TWh



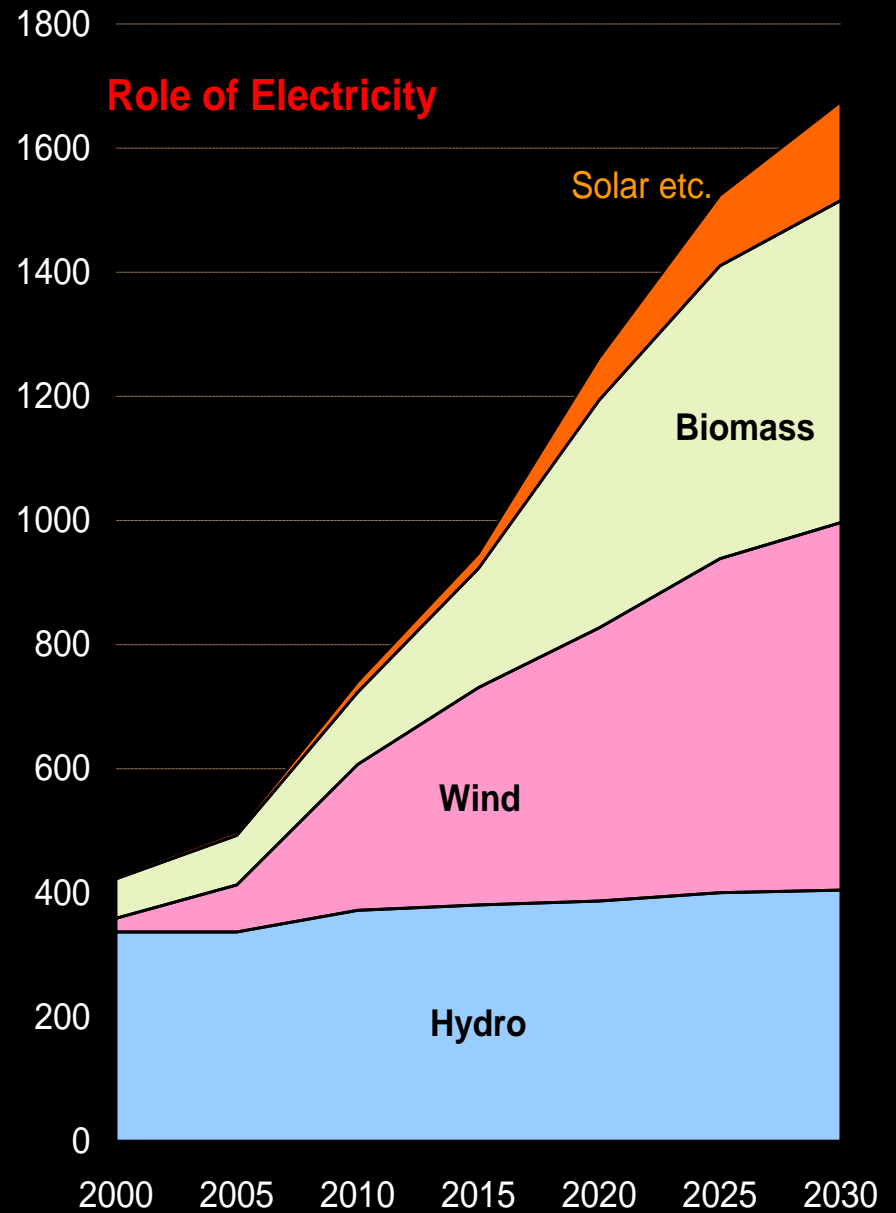
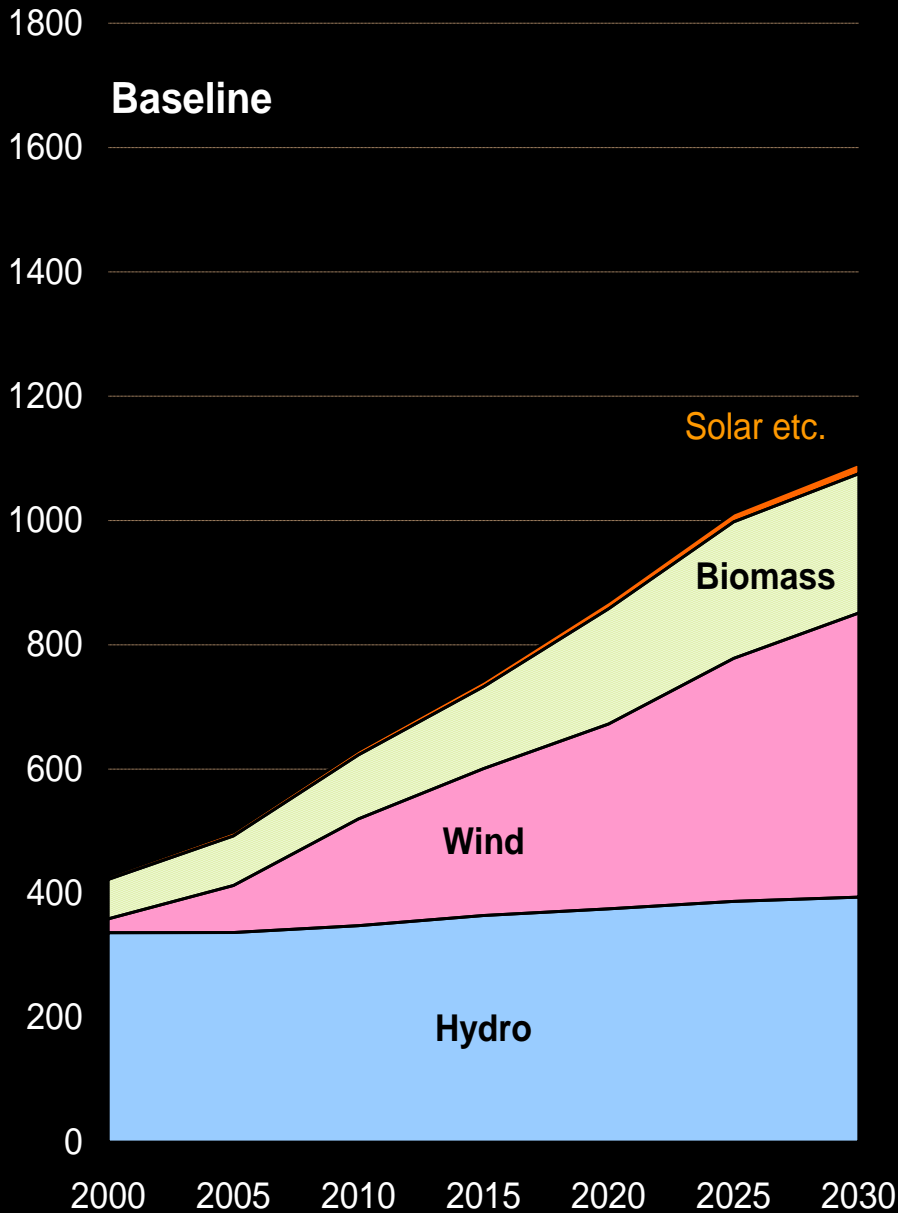
Electricity from Renewables in TWh



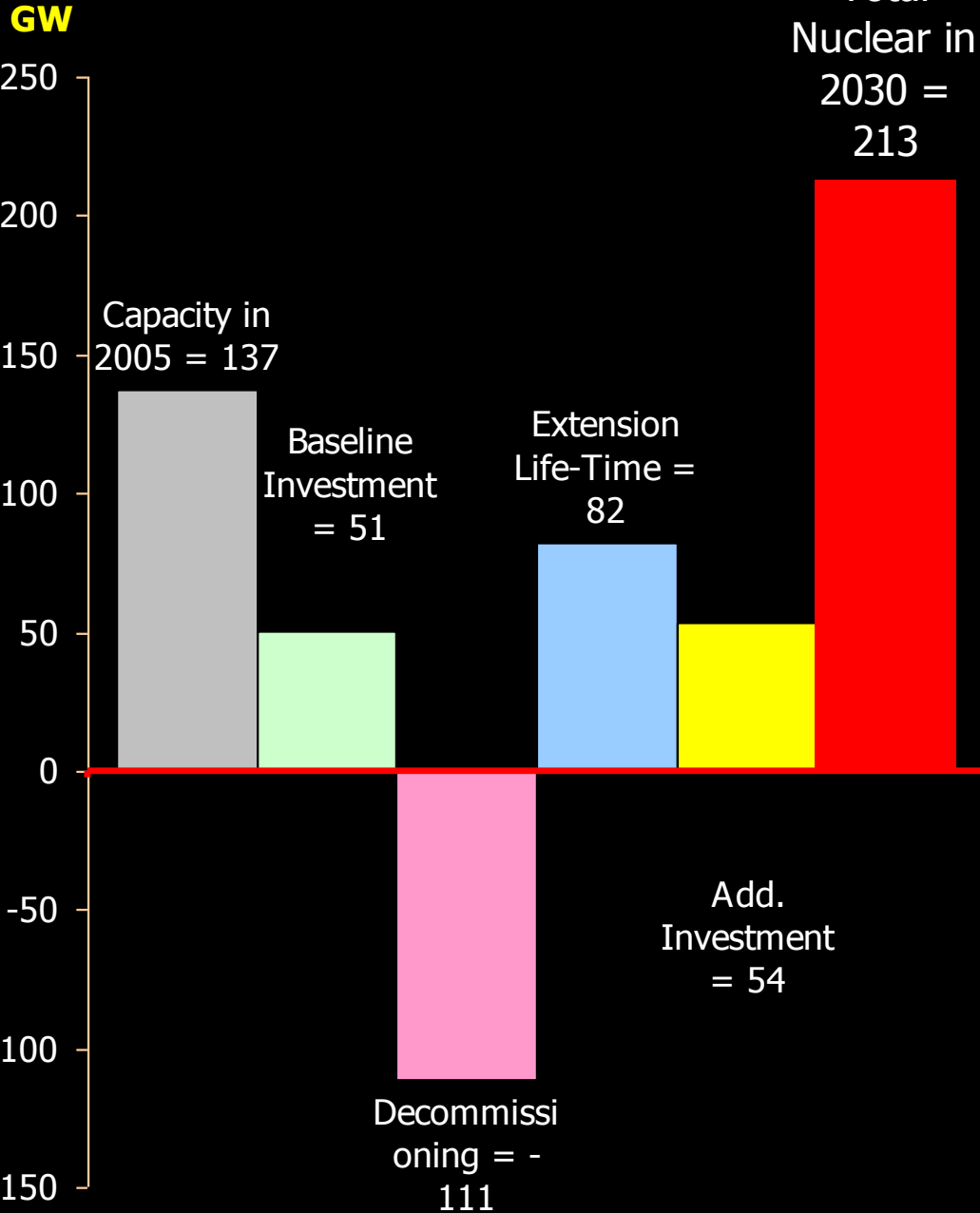
CO2 Captured and Stored (Mt)



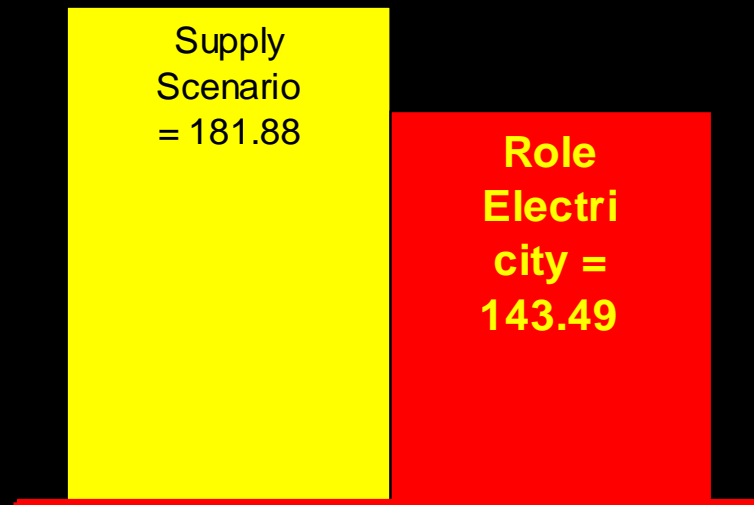
Power from Renewables (TWh)



Role of Electricity Scenario (2030)

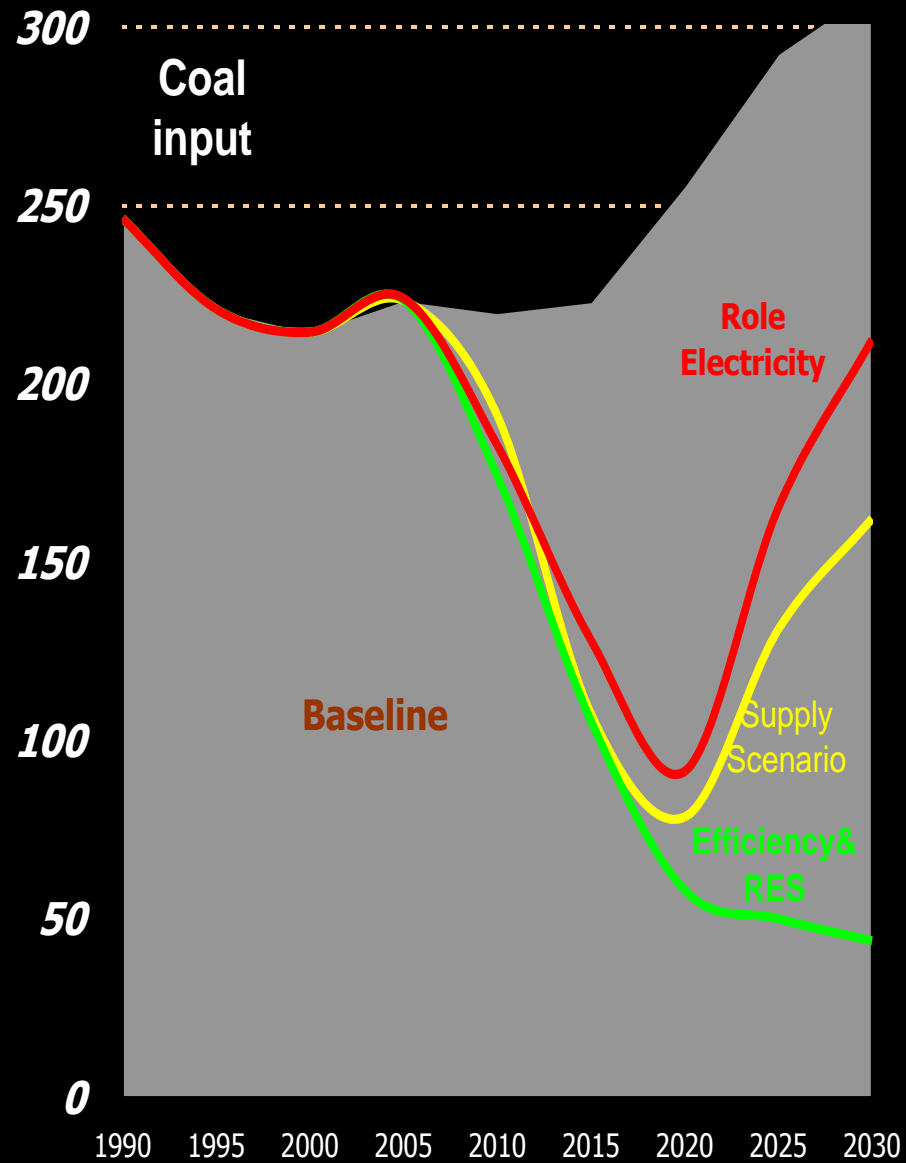
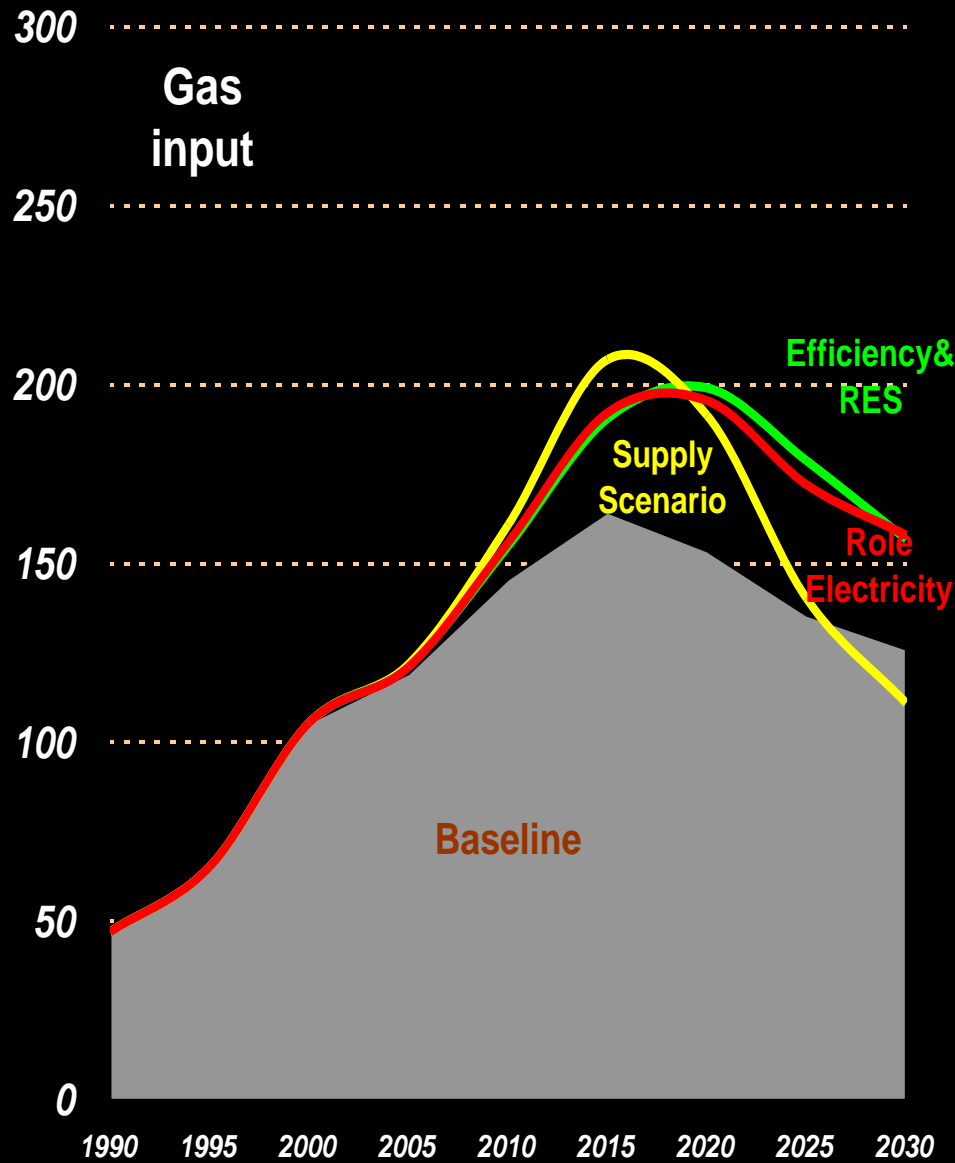


CCS Capacity in 2030 (GW)



Use of Gas and Coal in Power Generation

(Mtoe) PRIMES - EU25



Conclusions – Baseline scenario

- The baseline scenario clearly represents a non sustainable future in terms of environmental impacts (climate) and security of supply (import dependence)
- The baseline scenario improves if the nuclear option is freed (no phase out and extension of lifetime) and if efficiency and renewables policies prove more effective

Conclusions – Role of Electricity

- Given an ambitious target (e.g. a 30% reduction of CO₂ emissions between 1990 and 2030), an electricity-related package of options that combines changes in both demand and supply can be very cost-effective
- The package
 - delivers considerable benefits reducing dependence on imported oil and gas
 - enables high technology progress in all electricity domains and can induce positive economic growth effects
 - implies an additional cost to consumers, but this is reasonable and optimised

Conclusions – Cost Effectiveness

- Higher but intelligent electricity use on the demand-side is combined with very low carbon power generation: this is the key to cost-effectiveness
- This is enabled by success of a series of technologies and policies, such as
 1. Plug-in hybrid cars and vehicles
 2. Heat pumps, efficient lighting etc.
 3. Ambitious development of energy efficiency
 4. Higher potential of renewables
 5. Carbon capture and storage
 6. Nuclear energy

Conclusions – Portfolio Approach

- Cost-effectiveness relies on the “portfolio” character of the electricity-related package and the intelligent use of electricity
- All options, demand or supply, must be open so as to exploit their highest cost-effectiveness potential
 - Approaches that exclude certain options are not cost – effective
- The sensitivity analyses, the long run projections (up to 2050) and also scenarios assuming very high fossil prices confirm the above results and show their robustness.