2050 Energy Roadmap Scenarios and Stakeholder Consultation

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Energy

Proceedings at http://www.lowcarbon-societies.eu/

Outline of presentation

1. Stakeholder consultation
2. Scenario design
3. Assumptions
4. Results
5. Conclusions

Stakeholder consultation on 2050 Energy Roadmap

- Launched in December 2010
- 400 replies received, half organisations, half citizens
- Open and multiple choice questions regarding:
  - Credibility of the work
  - EU's position in global context
  - Societal challenges and opportunities
  - Policy developments at EU level
  - Milestones in the transition
  - Key drivers for the future energy mix
  - Additional thoughts and contributions
- Report on public consultation published

Broad agreement on:

- Need for intermediate milestones allowing for flexibility in reaction to unforeseen developments during transition
- Progress on decarbonisation to be verified regularly; some argue for compulsory targets others for checkpoints
- Stable, clear and predictable legislative framework for encouraging investment
- Importance of technology development and innovation
- Energy Efficiency and Renewables important courses of action
- Global fossil fuel prices and long term security of supply considered key drivers on future EU energy mix

➔ GHG milestones from Low Carbon Economy Roadmap used as benchmark;

High level of certainty inherent in modelling approach coincides with stakeholder expectations of stable framework (future course of action known);

Energy Efficiency and RES deserve particular attention

Different views expressed on

- Pure market-based approach with minimal intervention versus additional sector-specific policies and targets
- Important role of international environment, but divided opinions on use of offsetting (CDM and JI)
- Potential for electrification of transport and heat
- Potential for different options: renewables, gas, nuclear CCS with critical comments notably on nuclear and CCS
- Feasibility of high share of intermittent RES in power sector

➔ Roadmap set-up had to look at both genuine market (carbon price) driven and targeted policy scenarios

Scenario analysis to explore electrification and intermittency in an almost completely decarbonised electricity sector

Need to test decarbonisation pathways if nuclear or CCS face difficulties

Stakeholder involvement

- Consideration of many other stakeholder contributions: position papers, reports, scenario analyses, papers from MS
- Summary on stakeholder scenarios compiled and put on internet together with Energy Roadmap scenarios
- Many talks with industry, MS, NGOs, etc during the modelling and drafting process of the RM
- Task force within Energy DG encompassing all policy domains; interservice consultation spanning from Environment and Climate DGs to Enterprise, Employment, Economic and Finance DGs
- Advisory group on 2050 Energy Roadmap
- Ongoing discussions with stakeholders also with a view to the need to update the Roadmap over time

➔ The Energy Roadmap is a milestone in a broad debate

Overall scenario modelling approach

- Currently deployment of a suite of models built around the PRIMES energy system model: GEM-E3 for macro- and sectoral economy; PROMETHEUS for world energy developments; TRANSTOOLS for transport activity, GAINS and other models for non-CO2;
- Modelling by a consortium led by National Technical University of Athens;
- Most models (e.g. PRIMES) run for all MS;
- Regular publication of assumptions and modelling results; feedback from stakeholders; published Impact Assessment of Roadmap plus Annex providing assumptions and results on 190 pages;
- For trend scenario: consultation on assumptions and results with energy experts from all MS (Energy Economic Analysts Group); also for set up of sensitivities and policy scenarios;
- Regular contacts with interested stakeholders getting feedbacks

Key tool: PRIMES energy system model

- Available for all MS and most neighbouring countries up to 2050
- Energy system model based on micro-economic representation of individual agents (e.g. households, services, industry, power generators, etc.)
- Simulation of individual economic decision making determining supply and demand behaviour in about 30 sectors for as many fuels;
- A large number of technological details on supply and demand side;
- Endogenous investment decisions with different technology vintages;
- Market clearing and determination of energy and ETS prices;
- Calculation of energy system costs;
- Key assumptions relate to demographics, sectoral value added and income, world energy prices, taxes, discount rates, technology performance, degree days, policy instruments;
- New peer review of PRIMES in the context of Energy Roadmap confirming its usefulness for complex energy system analysis

Context for decarbonisation scenarios

- Global climate action (similar efforts of developed countries) reflecting objective of European Council
  - Global action entails lower world fossil fuel demand and prices
- Aim at reaching 80% GHG reductions by 2050 (implying minus 85% for CO2)
  - Scenarios show full energy impacts, which would be less pronounced in case of less ambitious fragmented action or safeguard measures for competitiveness
- Scenarios explore also consequences for the other policy objectives: energy security and competitiveness
- Purpose is not to choose one preferred scenario but rather to explore the energy consequences of a wide spectrum of decarbonisation options for the energy sector
- Aim is to identify policy challenges – not to present a strategy, nor the demonstration of advantages for certain pathways or to follow a normative approach

Rationale for scenario design

- Four main routes to cut energy related CO2 emissions:
  - Reducing energy consumption through efficiency
  - Making energy supply less carbon intensive – RES, Nuclear and CCS
- Market driven approach (fully mirrored in one scenario) complemented by additional features:
  - by targeted support policies where very broad support (energy efficiency and RES) in two cases
  - Difficulties with some technologies (nuclear, CCS)
- Comparison with no further action (trend scenarios)

Scenarios explore routes to decarbonisation of energy system

Current trends scenarios

- Reference scenario (as of March 2010)
- Current Policy Initiatives (as of April 2011)

➔ 40% GHG reduction by 2050

Decarbonisation scenarios

- High Energy Efficiency
- Diversified Supply Technologies
- High RES
- Delayed CCS
- Low Nuclear

➔ 80% GHG reduction

Reference scenario

- **GDP growth rate**: 1.7 % pa on average for 2010-2050
- **Oil price**: 106 $/barrel in 2030 and 127 $/barrel in 2050 (in 2008-dollars)
- **Main policies included**: cut-off date March 2010 Eco-design and Labelling directives; Recast of the Energy Performance of Buildings Directive, EU ETS directive; RES directive (20% target); Effort Sharing Decision; Regulation on CO2 from cars and vans
- **Sensitivities** on GDP growth and energy import prices

Current Policy Initiatives scenario

- Same macro-economic and energy price assumption as in REF
- **Main policies included**: Energy efficiency Plan; facilitation policies for infrastructure and ENTSO-e Ten Year Network Development Plan; Nuclear Safety Directive; Waste management Directive and new Energy Taxation Directive
- Change in technology assumptions: consequences of Japan nuclear accident and slightly higher uptake of electric vehicles

Decarbonisation scenarios: common features

- Climate policies to reach 85% energy related CO2 reductions by 2050 consistent with the 80% GHG reductions (40% by 2030)
- Same cumulative GHG emissions
- All based on CPI scenario but with lower energy import prices reflecting global climate deal and lower world demand for fossil fuels (oil price: 79 $(08)/b in 2030 and 70 $(08)/b in 2050).
- Transport measures as reflected in the Transport White Paper
- Better Storage and interconnections

High Energy Efficiency

- Very stringent implementation of the Energy Efficiency Plan

- Strong energy efficiency policies are also pursued thereafter: high renovation rates of existing buildings; additional Eco-design, full rollout of smart grids and meters and significant penetration of decentralised RES

Diversified supply technologies scenario

- Carbon price driven with no additional targeted support policies for EE and RES
- MS and investors have confidence in CCS as a credible and commercially viable technology; acceptance of storage and CO2 networks is high
- MS, investors and society at large have confidence in nuclear as safety is considered adequate and waste issues solved

High RES

- Very strong policy measures to achieve a high overall RES share and very high RES penetration in power generation using mainly domestic resources
- Market integration allowing for more RES trade
- Infrastructure, back-up, storage and demand side management

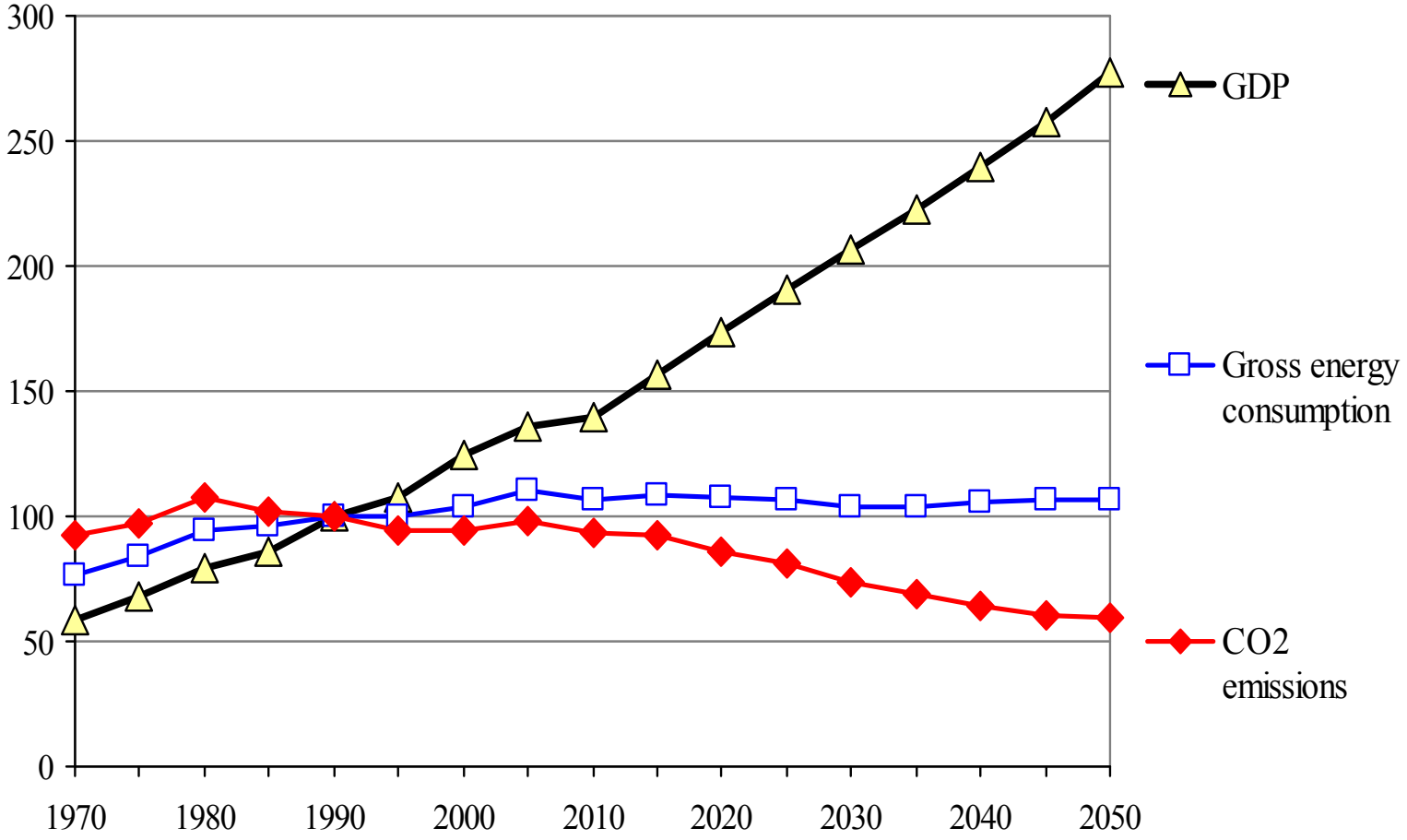
Delayed CCS

- Carbon price driven with no additional targeted support policies for EE and RES
- **Acceptance difficulties for CCS regarding storage sites and transport, which allow large scale development only after 2040**
- MS, investors and society at large have confidence in nuclear as safety is considered adequate and waste issues are solved

Low Nuclear

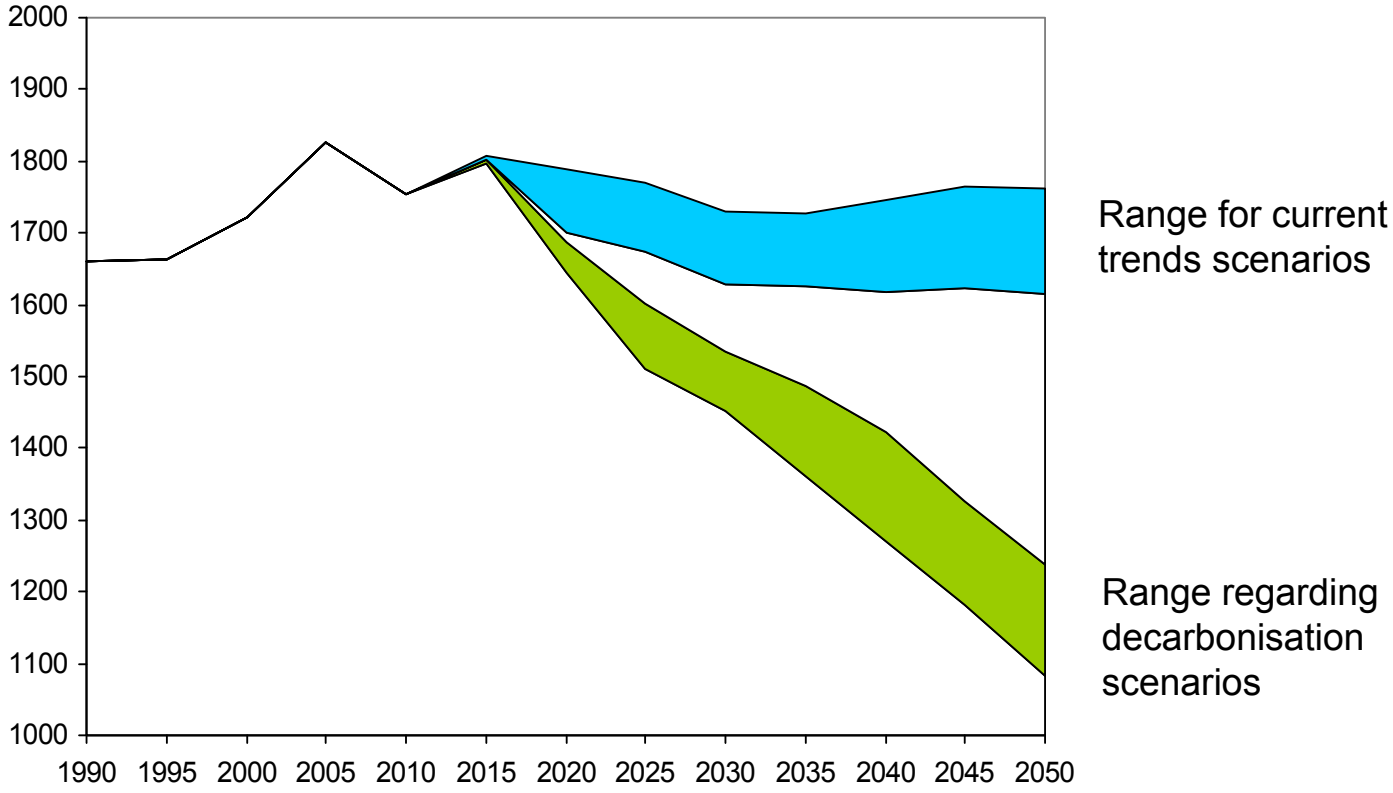
- Carbon price driven with no additional targeted support policies for EE and RES
- **Nuclear safety and waste issues considered unsolved** (no new nuclear plants are being built besides reactors under construction and no lifetime extension after 2030)
- MS and investors have confidence in CCS as a credible and commercially viable technology; acceptance of storage and CO2 networks is high

EU-27: Reference scenario: GDP, energy consumption and CO2 emissions 40 years back and ahead (1990 = 100)



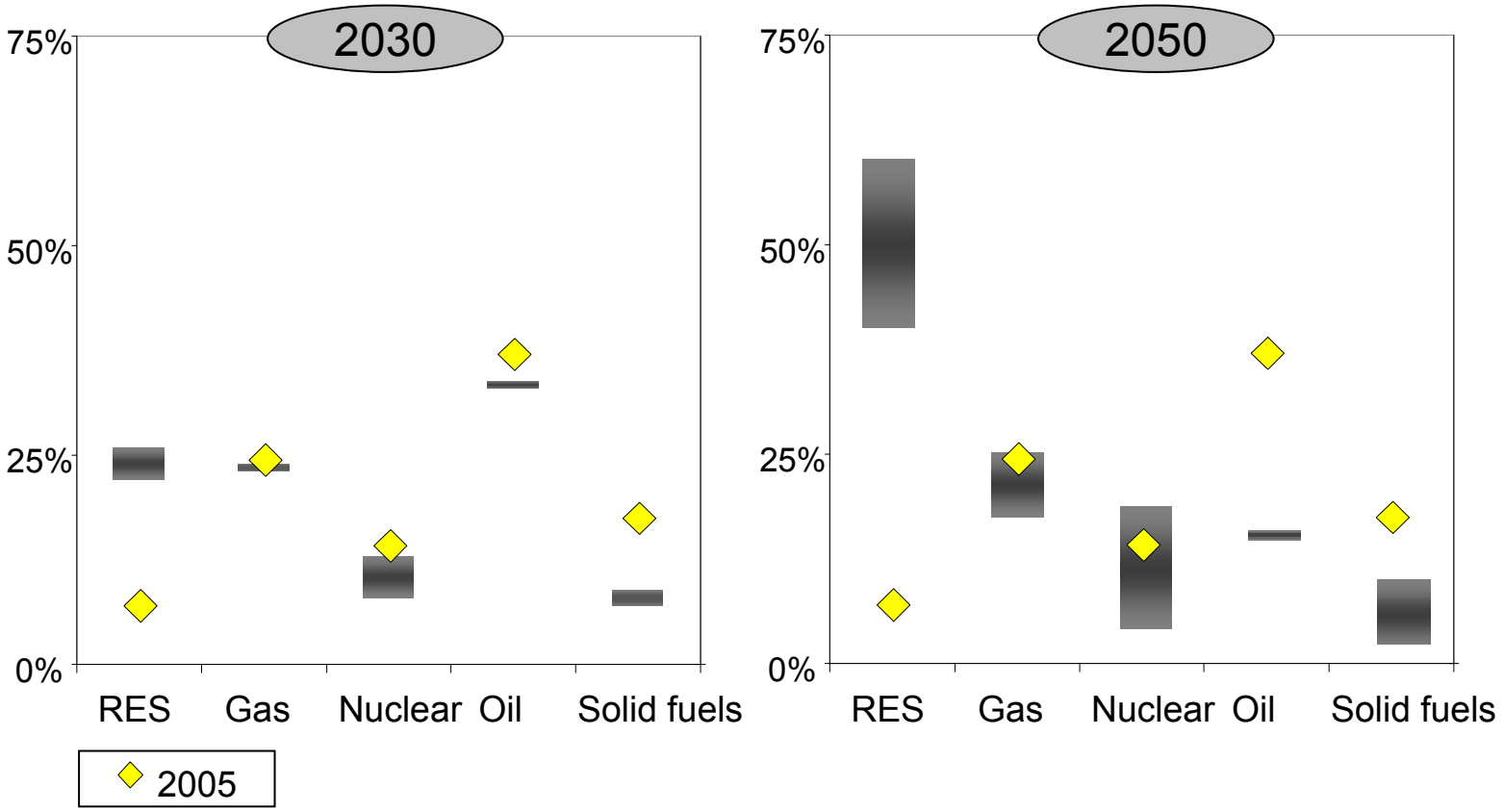
Energy savings throughout the system are crucial

Gross energy consumption - range in current trend (REF/CPI) and decarbonisation scenarios (in Mtoe)



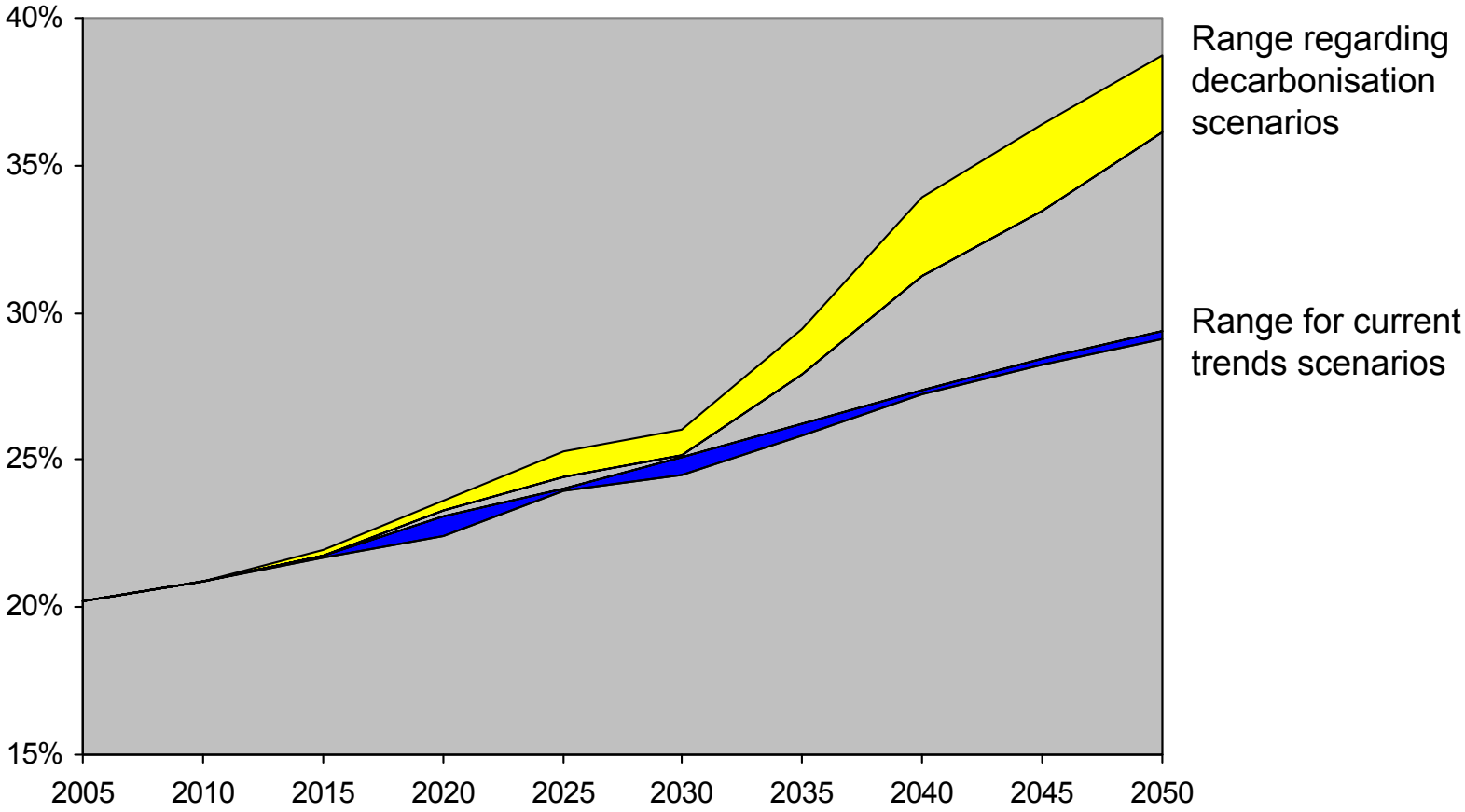
Renewables move centre stage – but all fuels can contribute in the long-run

Decarbonisation scenarios - fuel ranges (primary energy consumption in %)

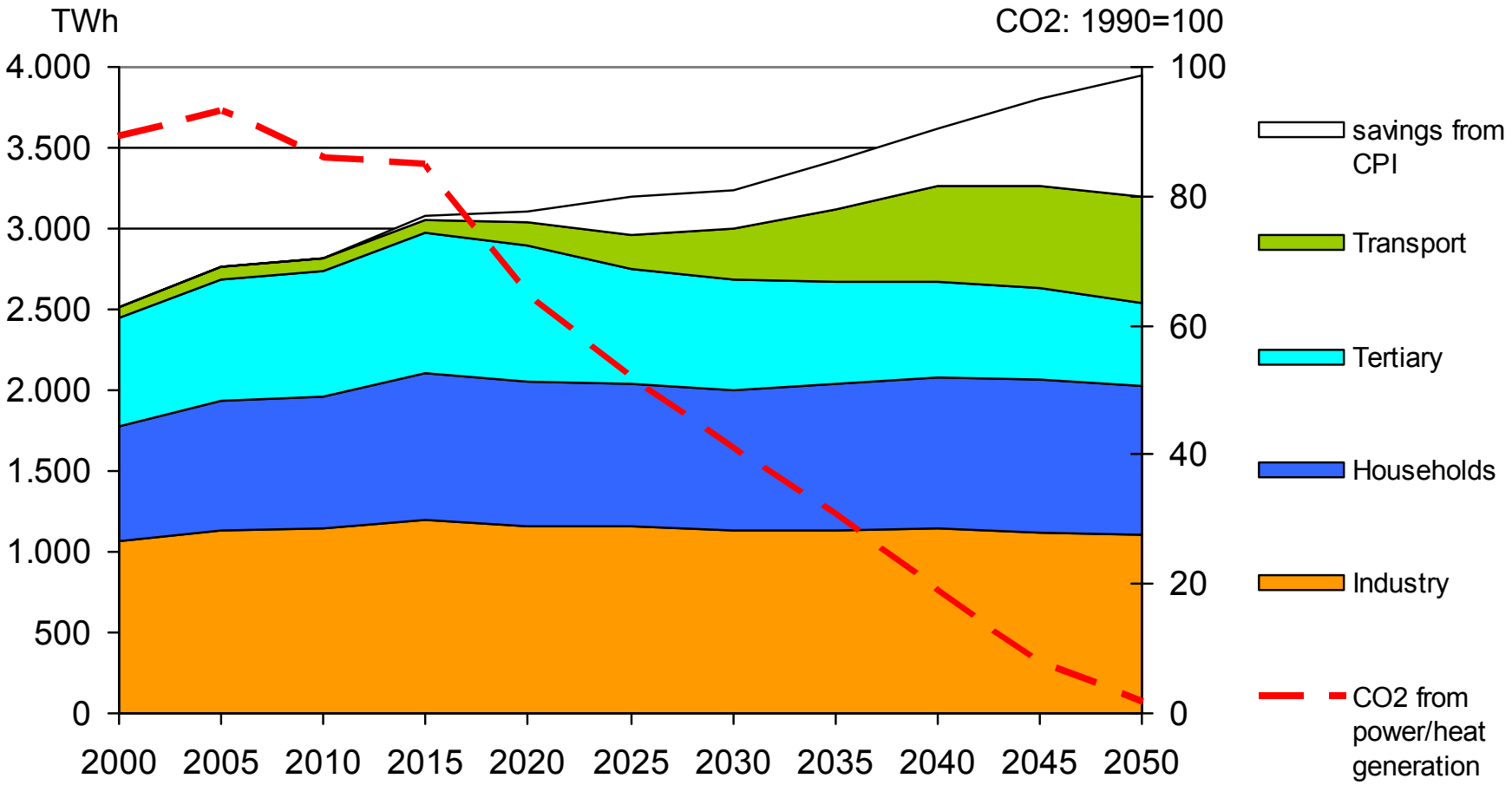


Electricity plays an increasing role

Share of electricity in current trend and decarbonisation scenarios
(in % of final energy demand)

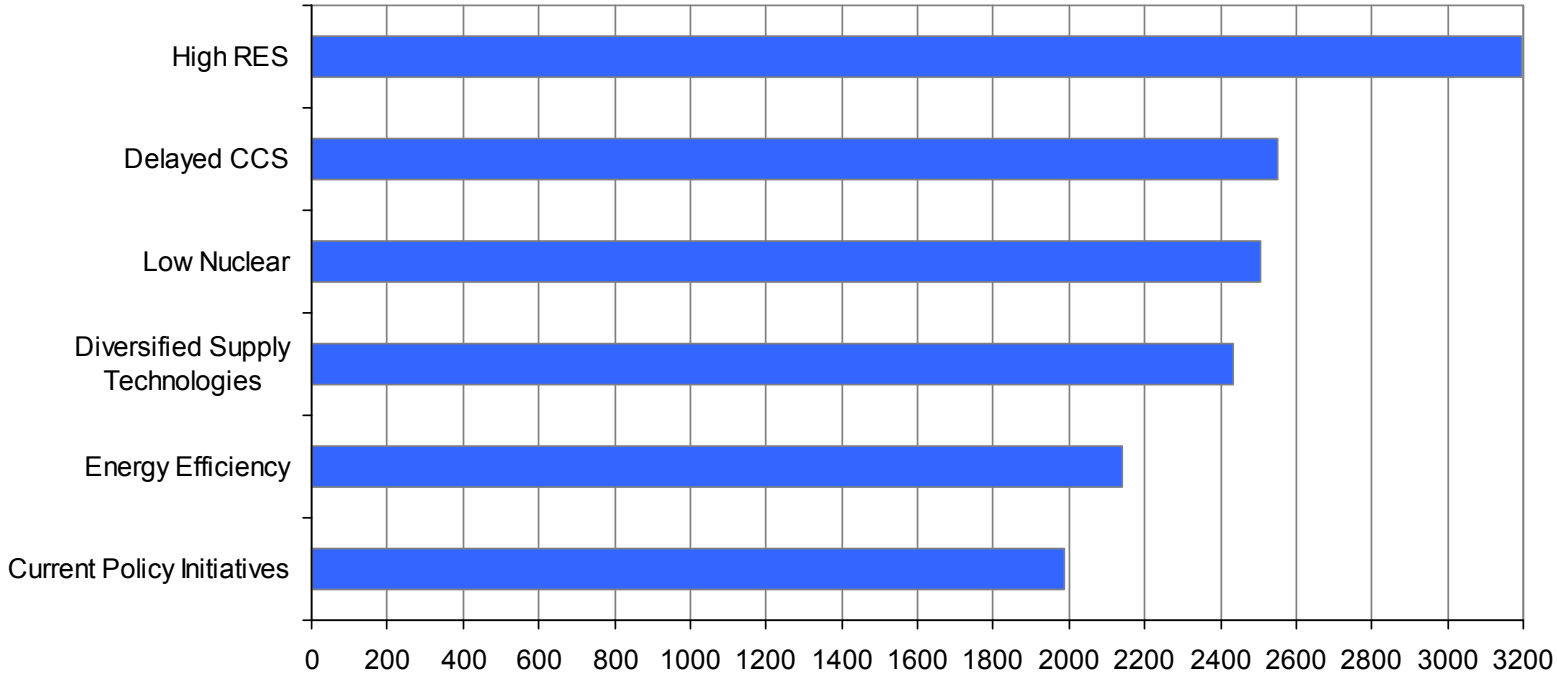


Final electricity demand and CO2 from power generation (Energy efficiency scenario)



Large investment for power generation is needed

Cumulative investment expenditure for power generation
from 2011 to 2050 (in billion €(08))



More investments are needed in power generation, grid infrastructure and storage.

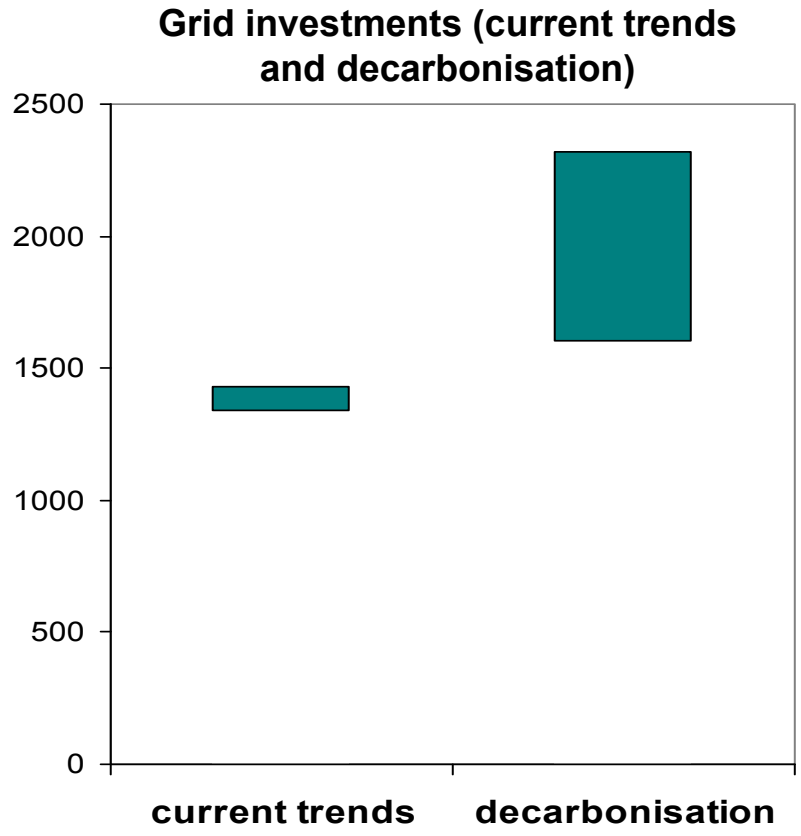
Directorate-General for Energy

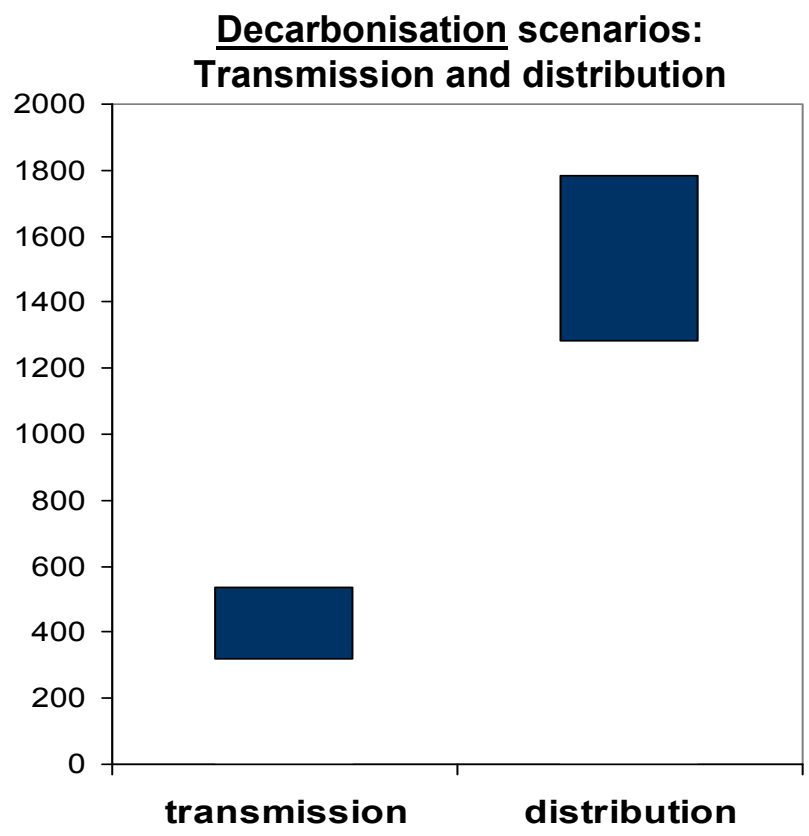
EUROPEAN COMMISSION

Source: European Commission |

Grid investment costs increase

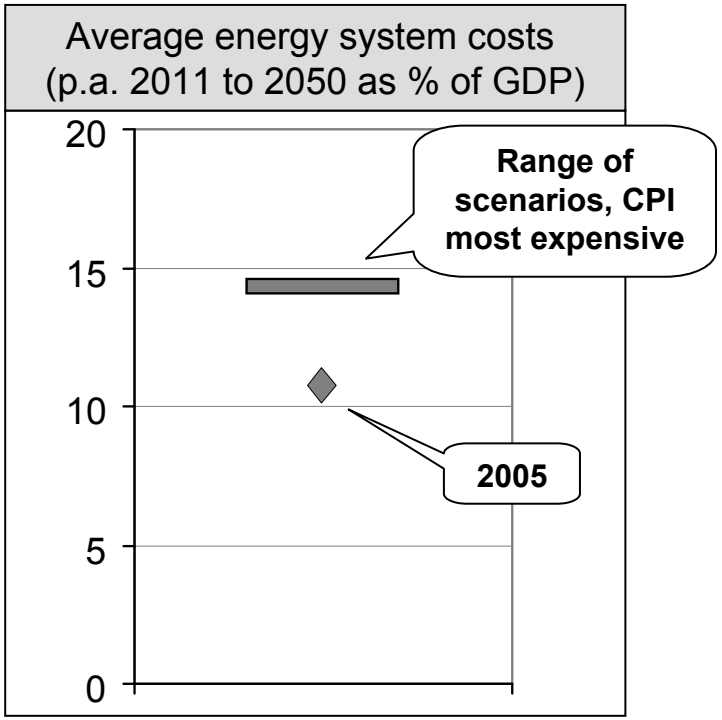
Cumulative costs in 2011-2050 in bn €(08)





In addition, costs for connecting off-shore wind to the grid (accounted for under generation investment cost - except for dedicated DC lines in High RES scenario): 100 -180 bn €(08) under decarbonisation

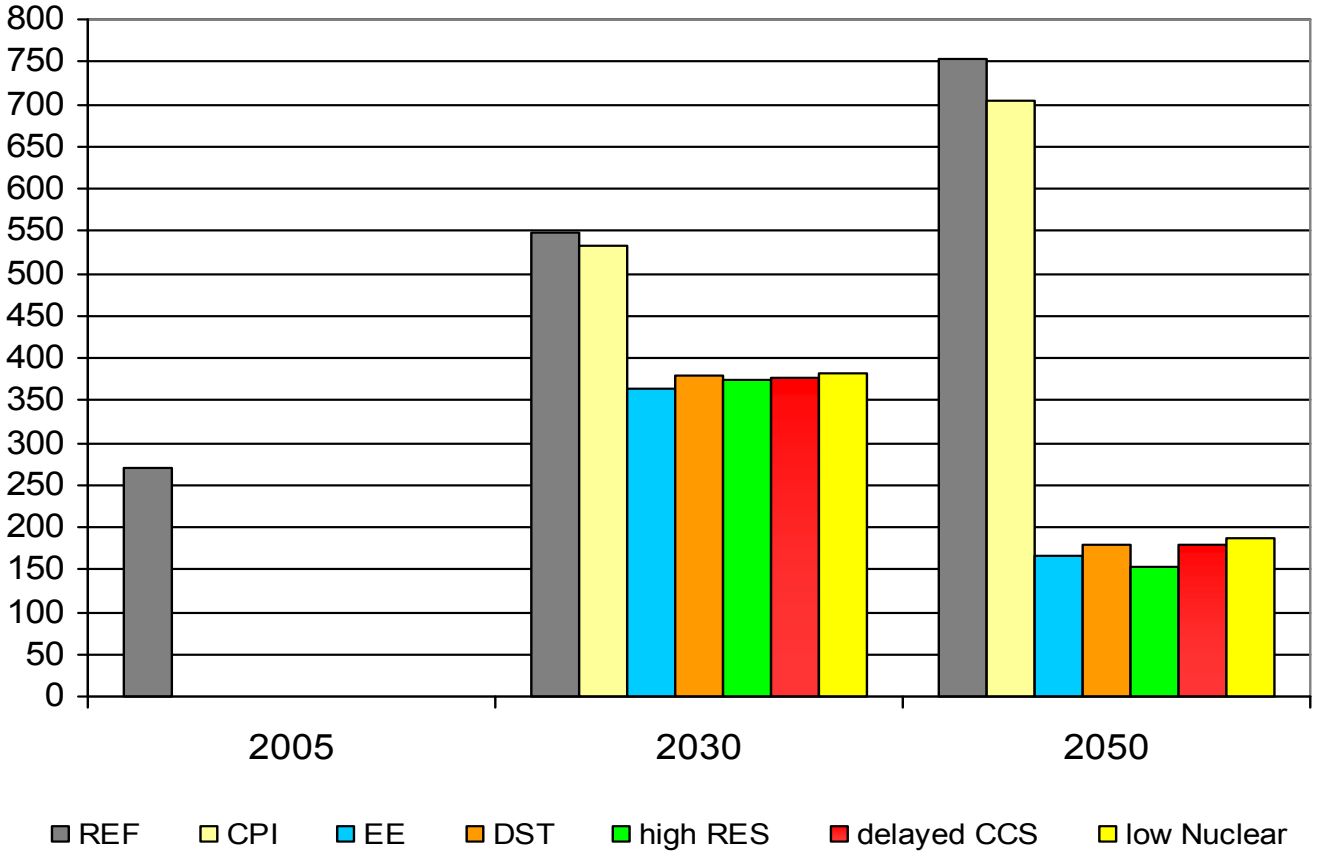
Decarbonisation is possible – and can be less costly than current policies in the long-run



- In all decarbonisation scenarios, total costs are similar to current policies (CPI scenario)
- Capital expenditure increases steadily over time, throughout the system
- Fuel costs drop in long-run
- Investment expenditure goes into the EU economy rather than to non-EU for energy imports; households can gain more control (e.g. as micro generation increases, use of smart appliances)

Source: European Commission |

EU: External Fossil Fuel Bill (in bn € of 2008)

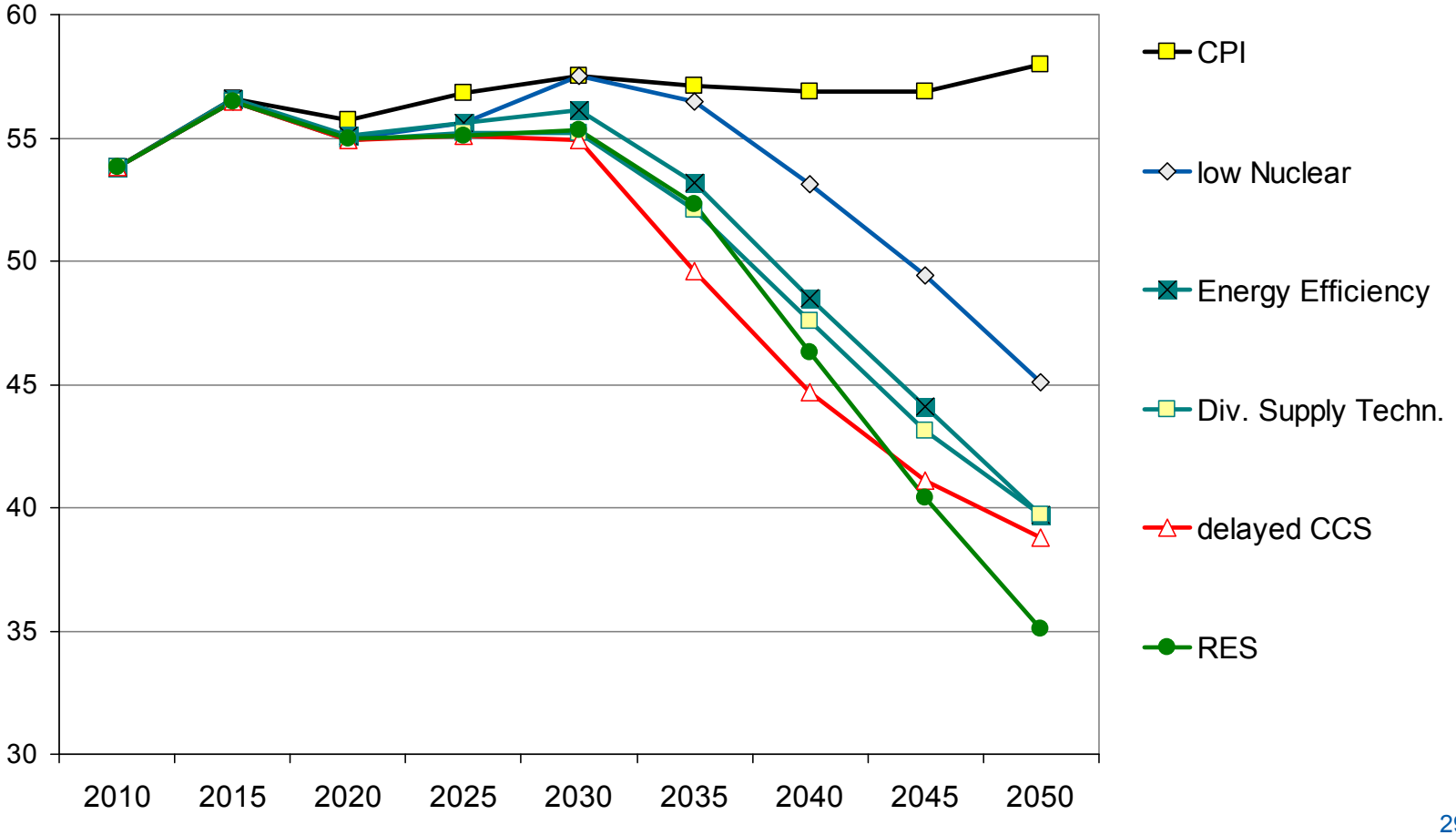


Decarbonisation brings substantial fuel bill savings in 2050 with respect to 2005 and Reference/CPI

Compared with CPI the EU economy could save between 518 and 550 bn € in 2050 through decarbonisation under global climate action

Savings are largest in the high RES scenario

Import dependency under current trends and decarbonisation (%)



Conclusions

- Current trends are unsustainable in terms of carbon emissions entailing also high costs and external dependence.
- Deep decarbonisation in a global effort is feasible and affordable, reducing also external dependence and moving costs towards EU actors' control.
- Energy costs shift to higher capital expenditure, creating income and jobs in the EU, away from operational expenditure largely for importing fuels.
- Decarbonisation can be achieved by a variety of routes having some common features:
- Energy efficiency and RES play a key role;
- Decarbonisation requires substantial investments in very low/zero carbon electricity generation, in transmission lines and smart grids, transport electrification, EE and RES in final demand;
- All this needs to be enabled by a stable framework for investors, a functioning internal market and clear carbon price signals (ETS).

Documents:

http://ec.europa.eu/energy/energy2020/roadmap/index_en.htm

Thank you very much for your attention