eurelectric
ELECTRICITY FOR EUROPE

Power Choices

Pathways to Carbon-Neutral Electricity in Europe by 2050

# Power Choices, pathways to carbon-neutral electricity in Europe by 2050

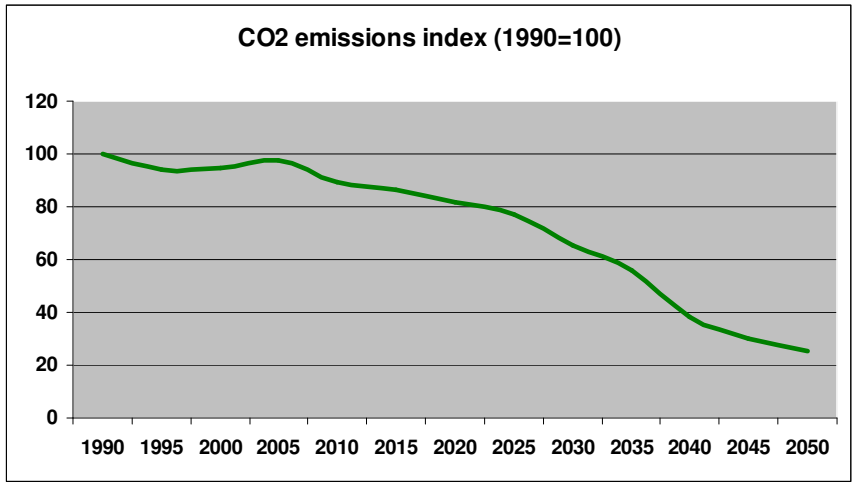
**Hans ten Berge**
**Secretary General**

IENE 15th Energy & Development 2010 Conference
Athens, 23 November 2010


# 1. POWER CHOICES STUDY : MAIN ASSUMPTIONS

# Main assumptions for Power Choices scenario

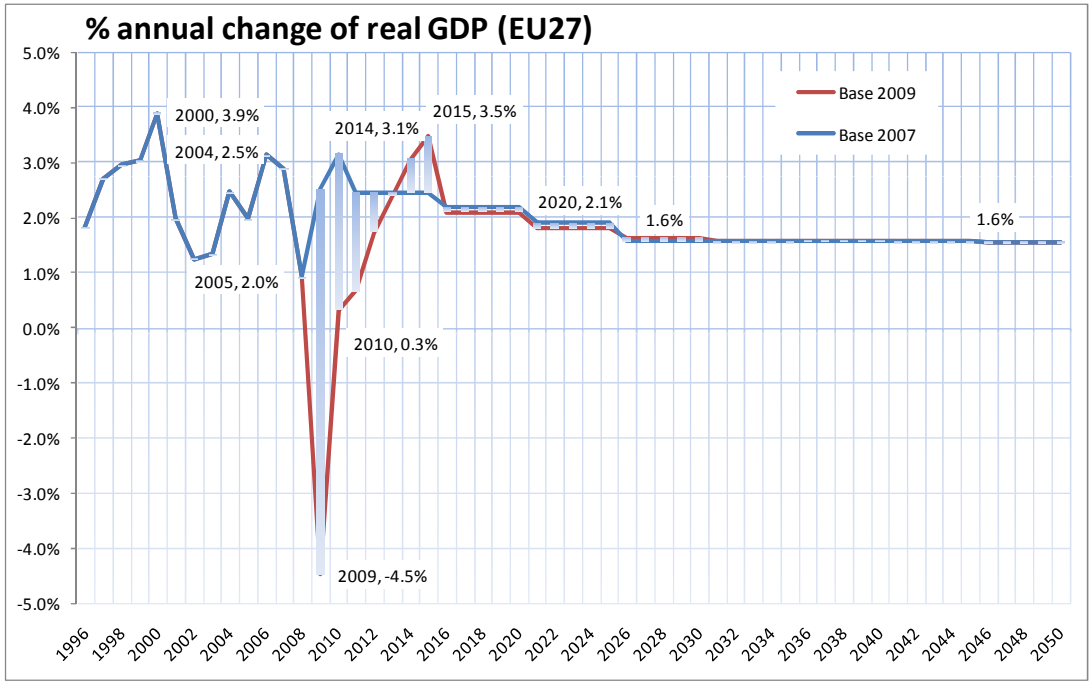
## 75% GHG cut EU-wide

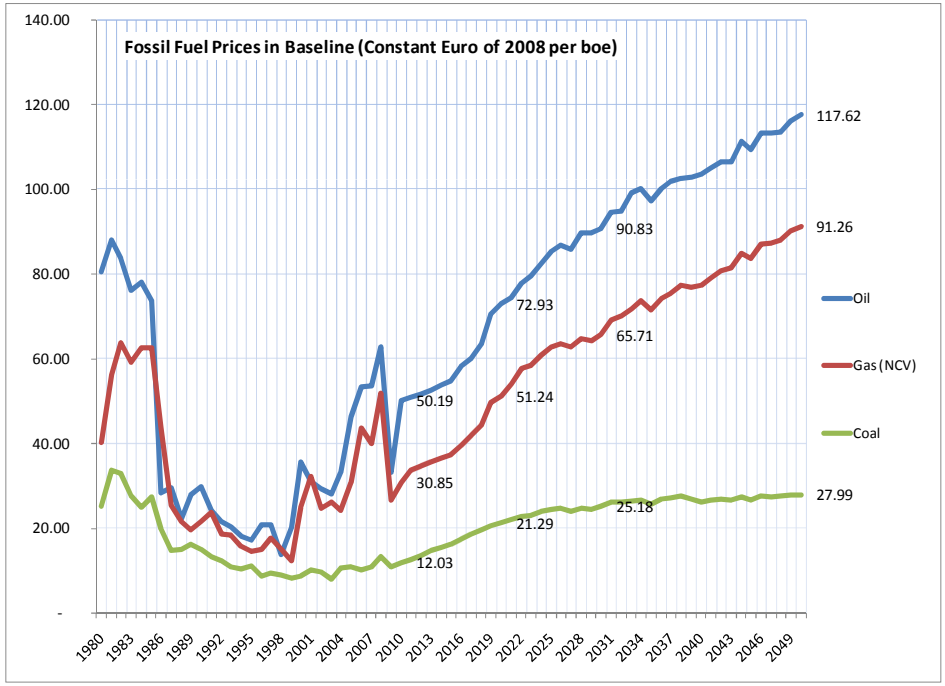



## *POWER CHOICES SCENARIO*

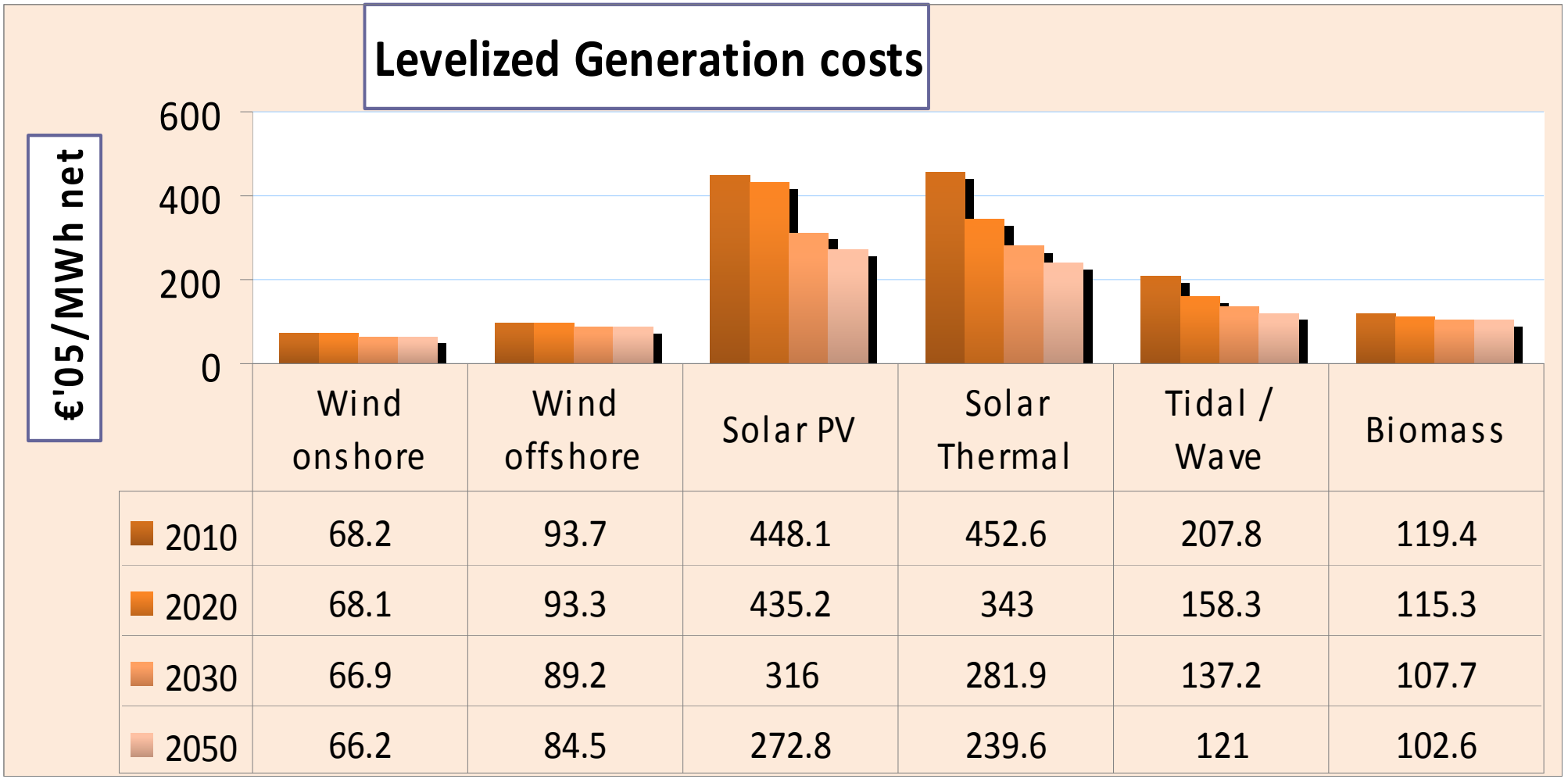
- **75% GHG cut across whole EU economy**
- **$CO_2$ price applied uniformly to all sectors**
- **Power becomes major transport fuel**
- **All power generation options available (with CCS commercially available as of 2025)**
- **Major policy push in energy efficiency**
- **No binding RES target post-2020**
- **$CO_2$ price is the only driver for low-carbon generation post 2030**

# Macroeconomic assumptions



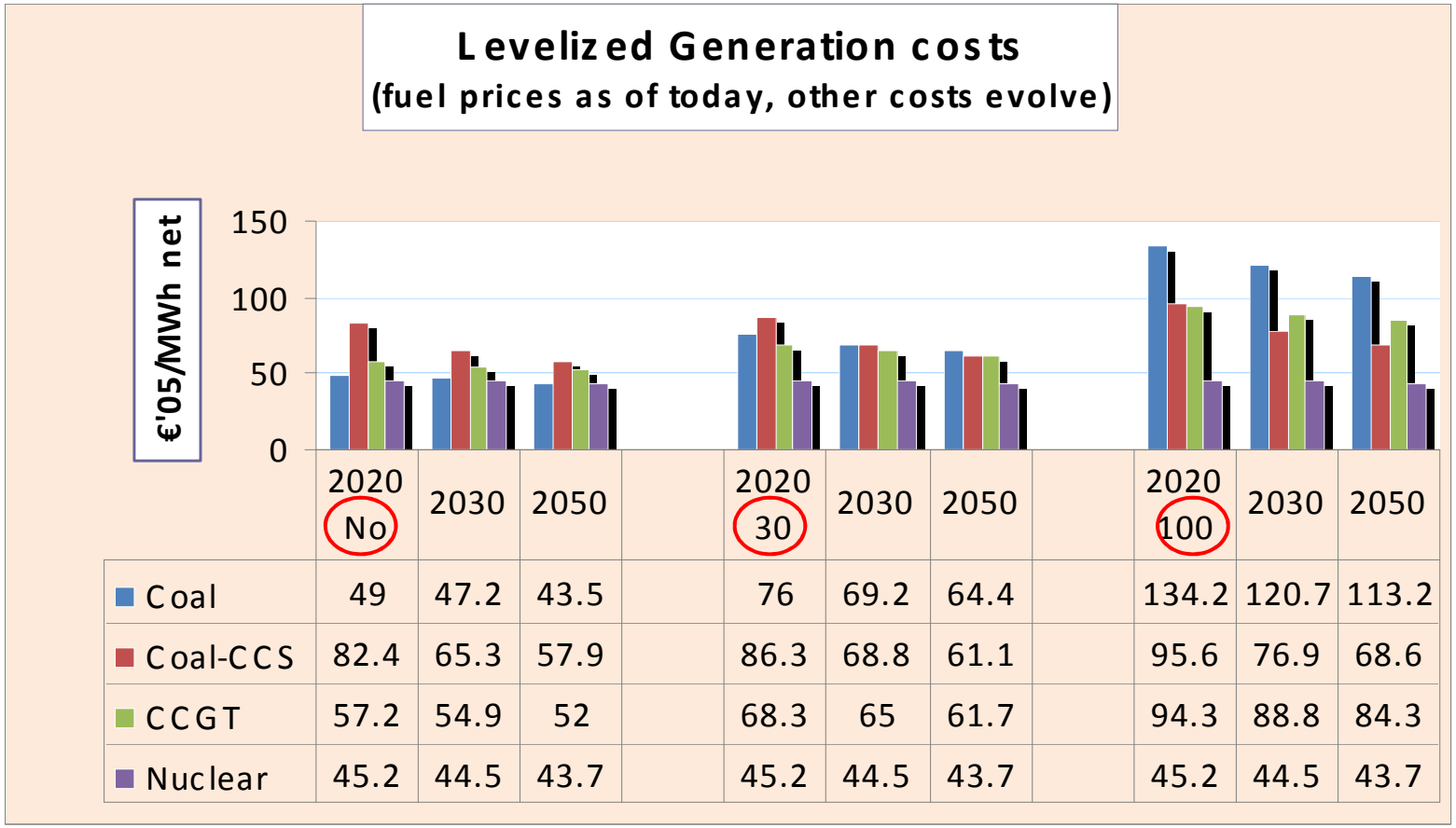



# Generation cost assumptions for RES




| | Wind onshore | Wind offshore | Solar PV | Solar Thermal | Tidal / Wave | Biomass |
|---|---|---|---|---|---|---|
| 2010 | 68.2 | 93.7 | 448.1 | 452.6 | 207.8 | 119.4 |
| 2020 | 68.1 | 93.3 | 435.2 | 343 | 158.3 | 115.3 |
| 2030 | 66.9 | 89.2 | 316 | 281.9 | 137.2 | 107.7 |
| 2050 | 66.2 | 84.5 | 272.8 | 239.6 | 121 | 102.6 |

# Levelised generation costs of thermal technologies at different carbon prices

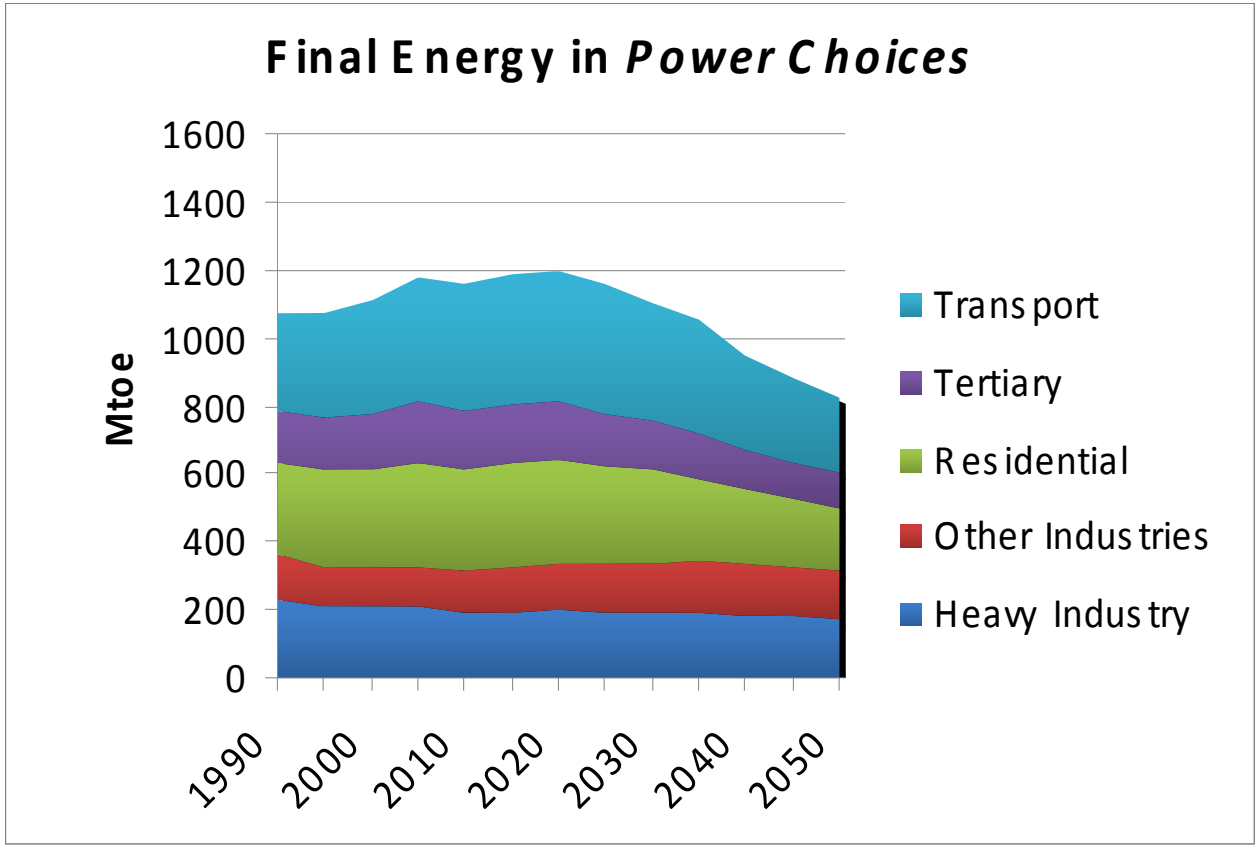


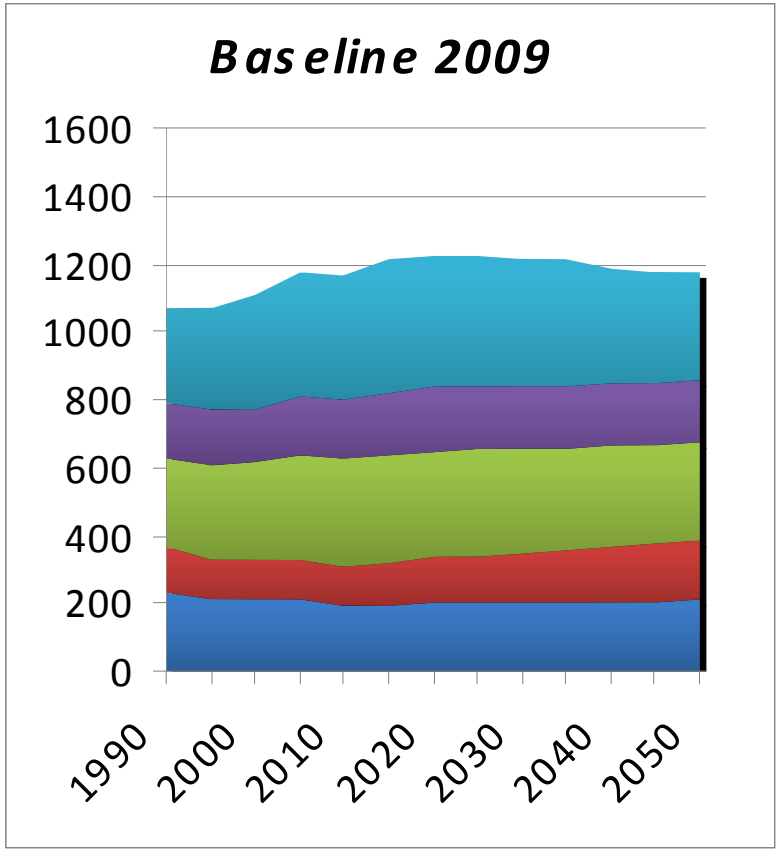

| | 2020 No | 2030 | 2050 | 2020 30 | 2030 | 2050 | 2020 100 | 2030 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| Coal | 49 | 47.2 | 43.5 | 76 | 69.2 | 64.4 | 134.2 | 120.7 | 113.2 |
| Coal-CCS | 82.4 | 65.3 | 57.9 | 86.3 | 68.8 | 61.1 | 95.6 | 76.9 | 68.6 |
| CCGT | 57.2 | 54.9 | 52 | 68.3 | 65 | 61.7 | 94.3 | 88.8 | 84.3 |
| Nuclear | 45.2 | 44.5 | 43.7 | 45.2 | 44.5 | 43.7 | 45.2 | 44.5 | 43.7 |

◯ = carbon price in € at '08 prices

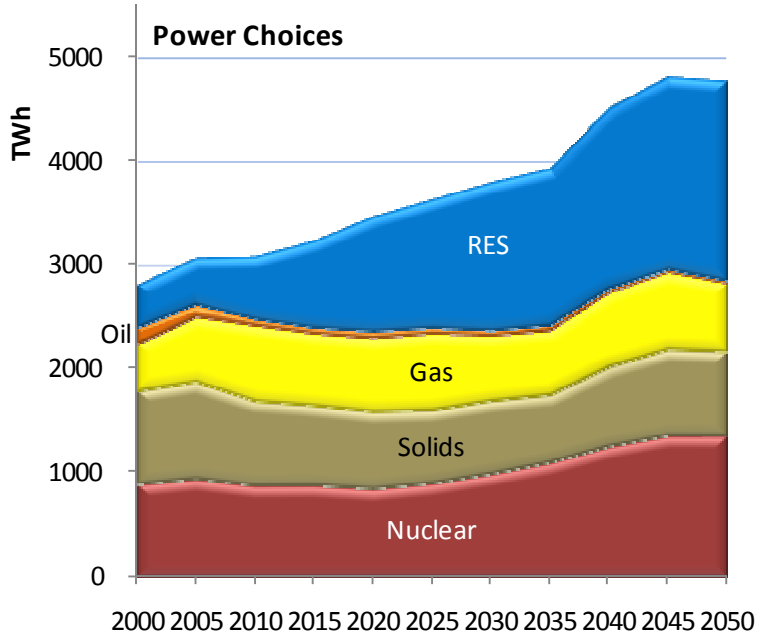
# 2. KEY RESULTS

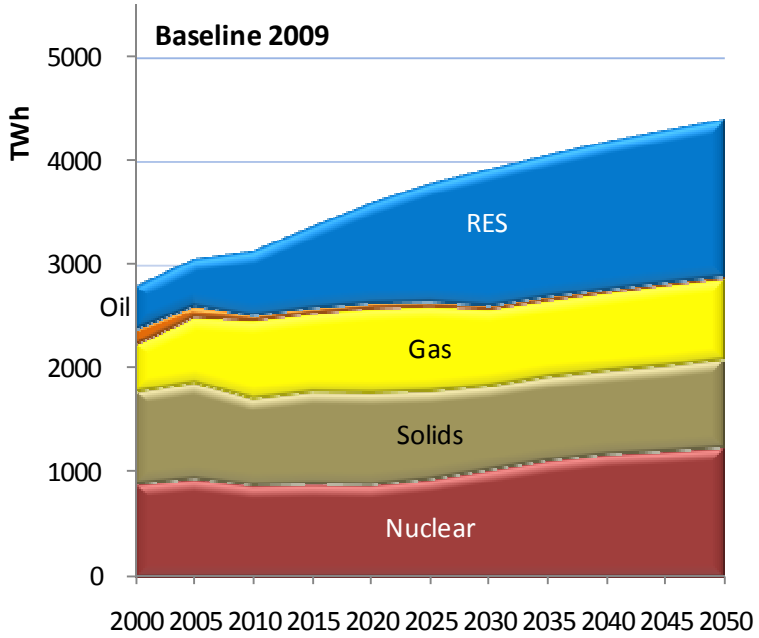
# Final energy consumption drops



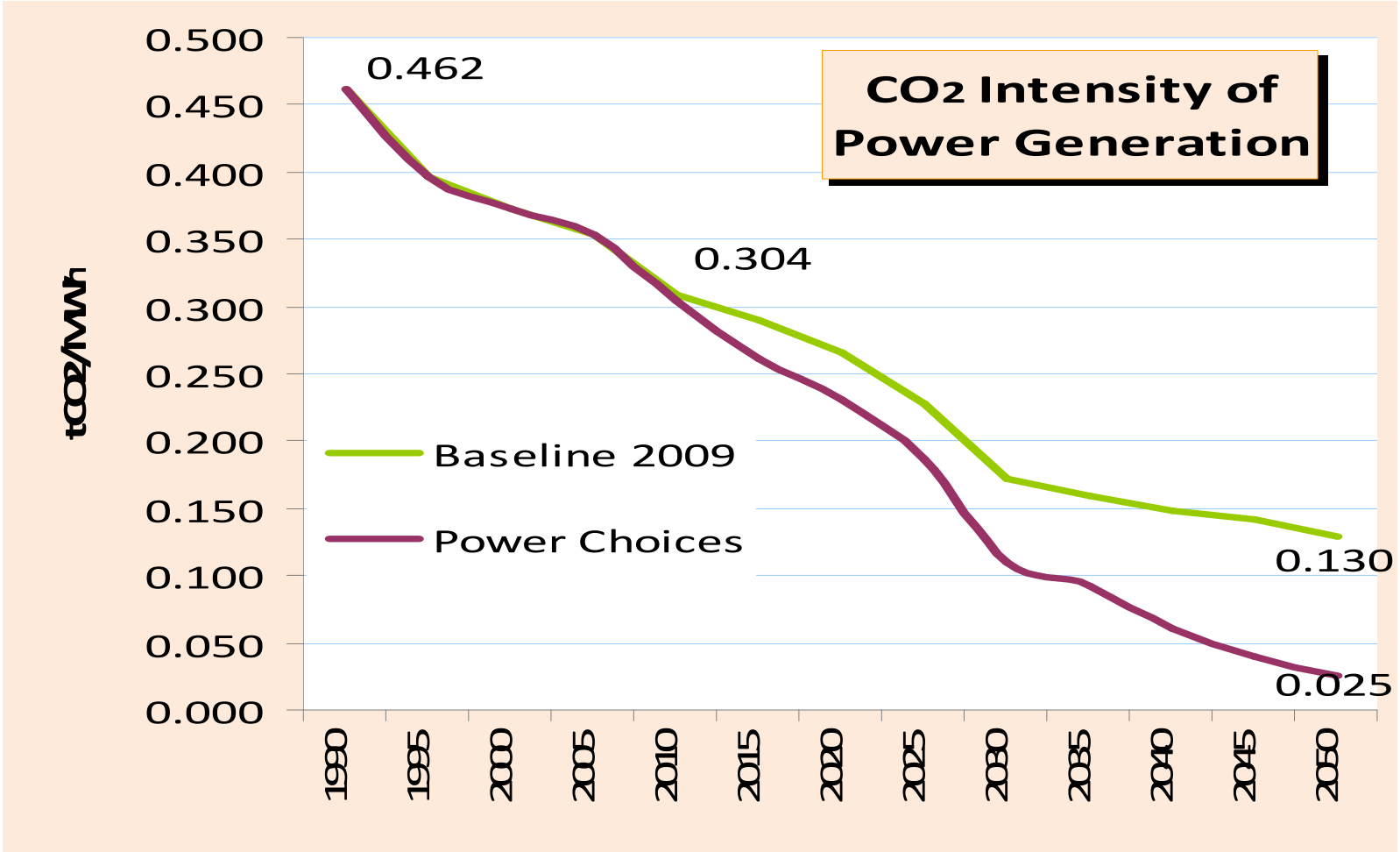
# Power generation mix evolving



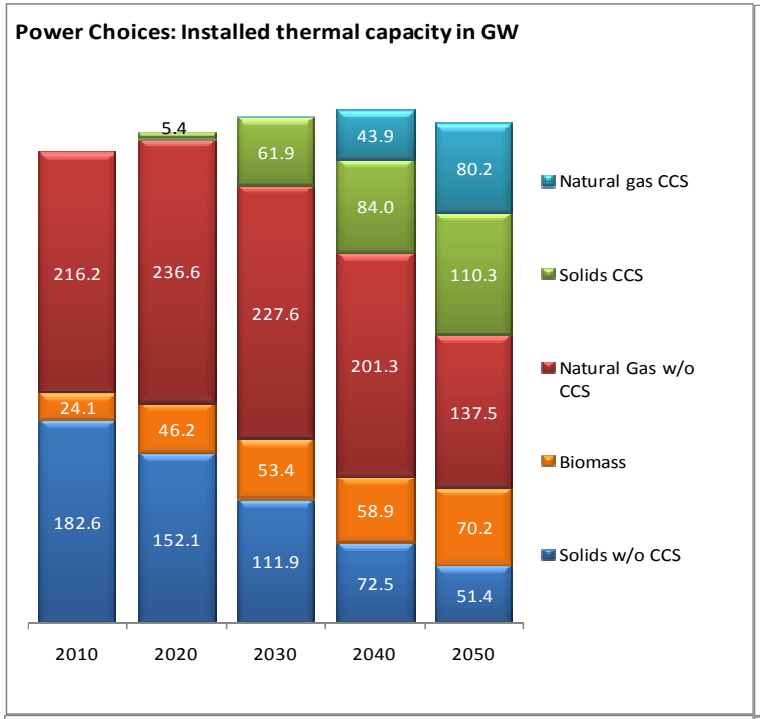



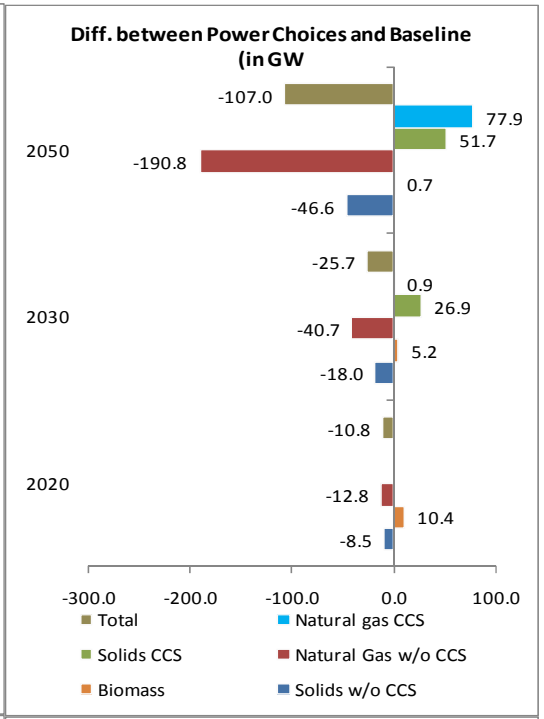

| % | 2005 | 2020 | 2030 | 2050 | 2020 | 2030 | 2050 |
|---|---|---|---|---|---|---|---|
| | | Power Choices | | | Baseline 2009 | | |
| RES | 14.8 | 32.0 | 37.7 | 40.4 | 26.7 | 33.3 | 34.2 |
| Oil | 5.6 | 1.8 | 1.2 | 0.7 | 1.9 | 1.2 | 0.9 |
| Gas | 16.0 | 20.3 | 16.5 | 13.6 | 22.2 | 18.5 | 17.3 |
| Solids | 31.9 | 21.4 | 18.5 | 16.9 | 24.7 | 20.8 | 19.3 |
| Nuclear | 31.7 | 24.5 | 26.1 | 28.4 | 24.5 | 26.2 | 28.3 |

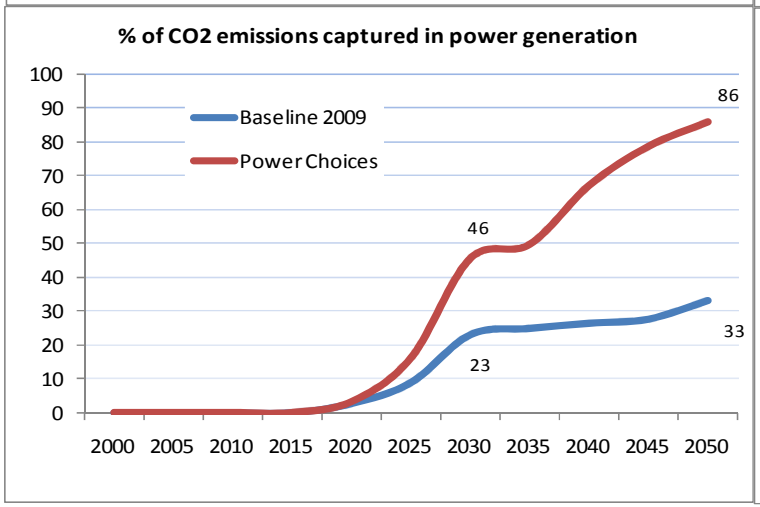
# 90% drop in $CO_2$ emissions from electricity generation by 2050

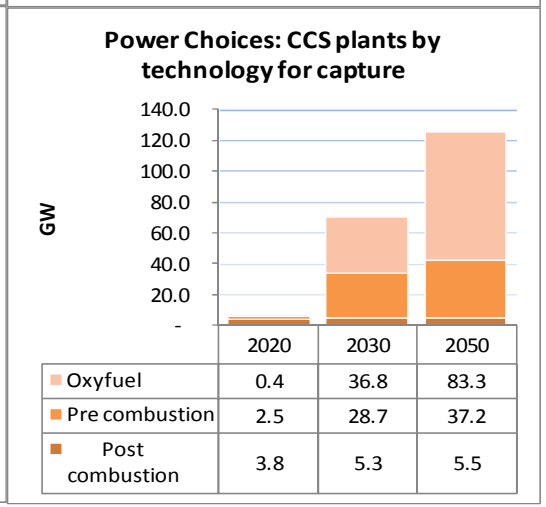


eurelectric
ELECTRICITY FOR EUROPE




| | 2020 | 2030 | 2050 |
|---|---|---|---|
| Oxyfuel | 0.4 | 36.8 | 83.3 |
| Pre combustion | 2.5 | 28.7 | 37.2 |
| Post combustion | 3.8 | 5.3 | 5.5 |

# Details on CCS:

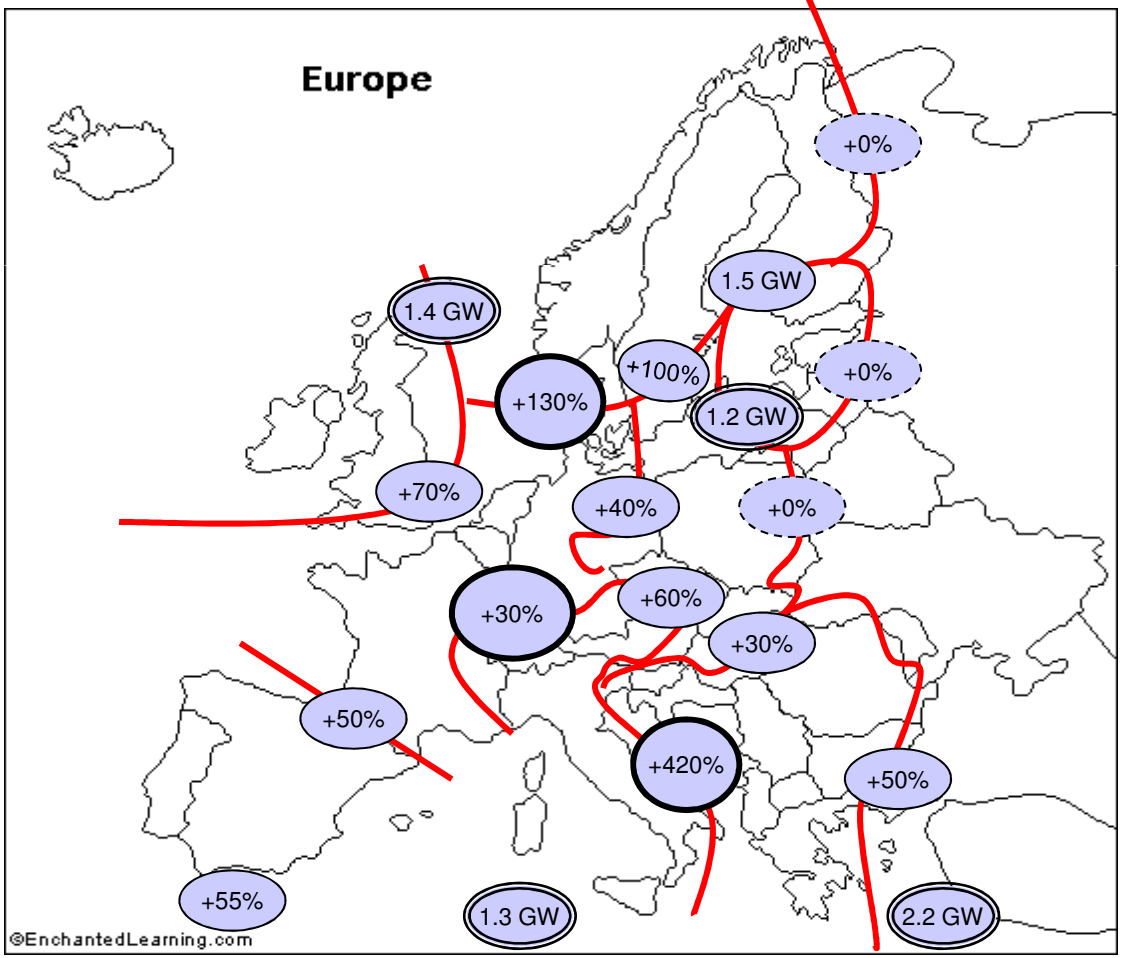
**Pilots operational in 2020, mass deployment starting in 2025 – at its maximum after 2030.**

**CCS storage infrastructure and regulations operational after 2020.**

**Cumulative CO2 storage until 2050 (16 Gt) represents only 9.4% of storage EU potential.**

**Long-term average storage and transportation cost: 10€/ tCO2 in 2030; 20 €/ tCO2 on average between 2030 and 2050.**

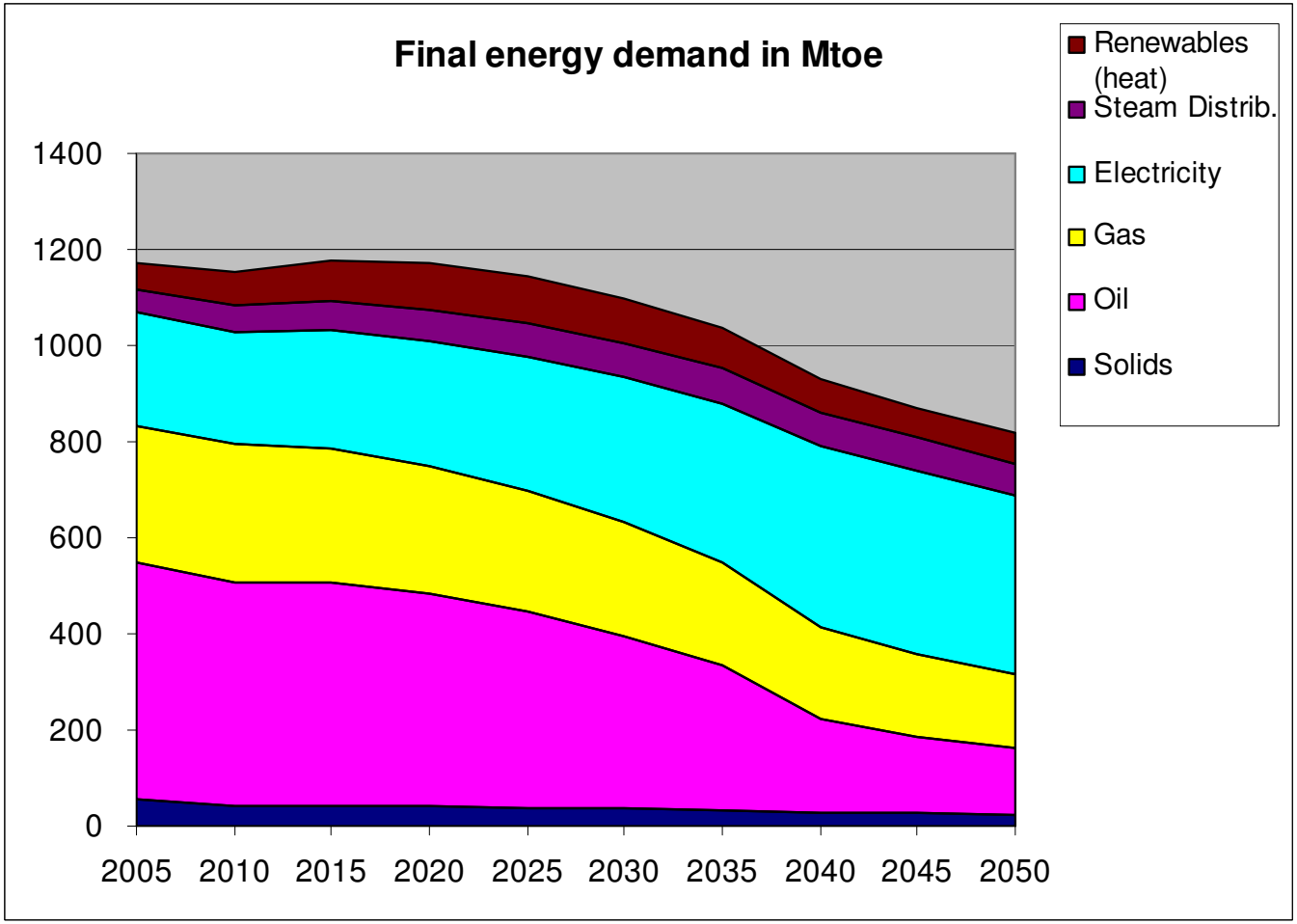
# Intra-regional transmission capacity in 2030 versus 2005



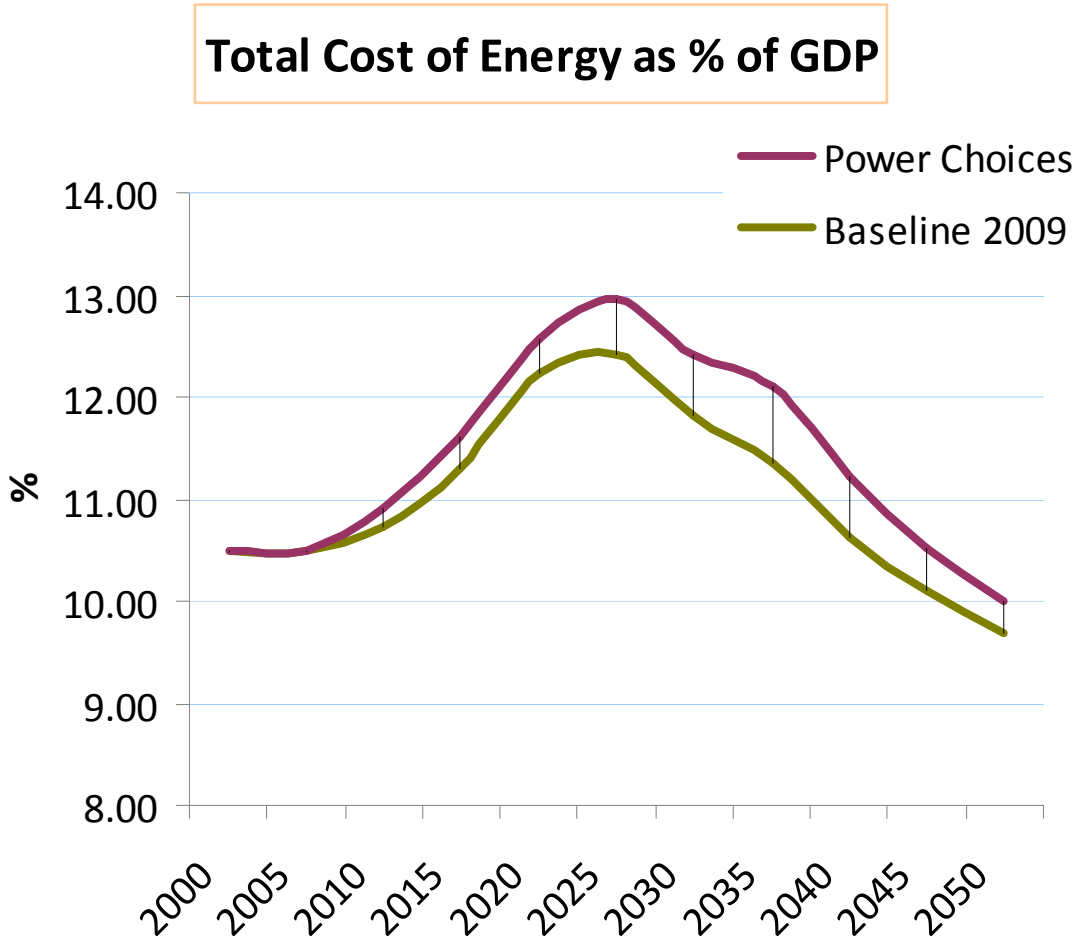

**The model considers existing and announced new transmission line interconnections.**

**Total grid capacity (incl. inter-regional investment): + 40% between 2005 and 2030, and then stable until 2050.**

# Role of electricity in reducing energy demand

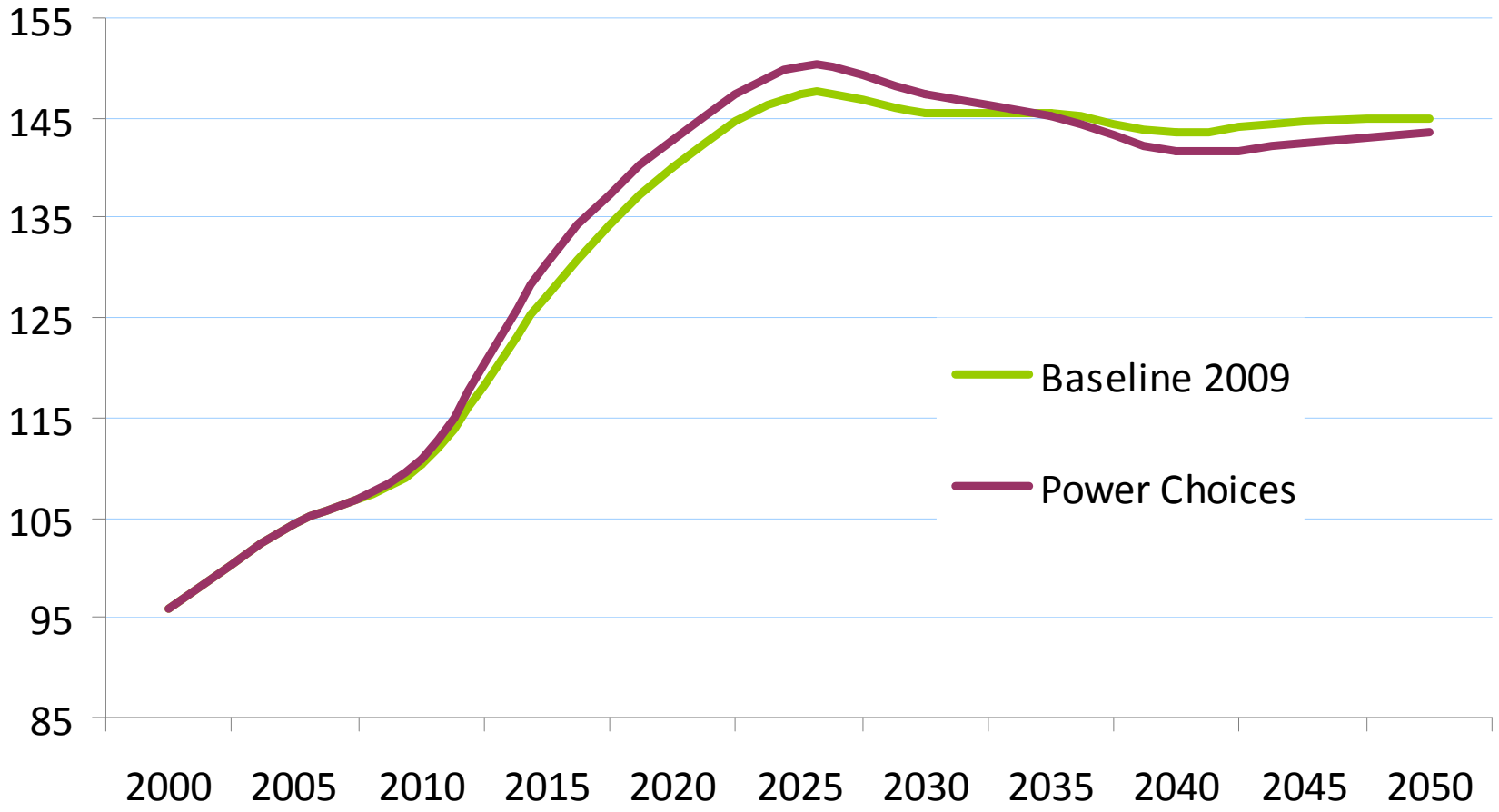


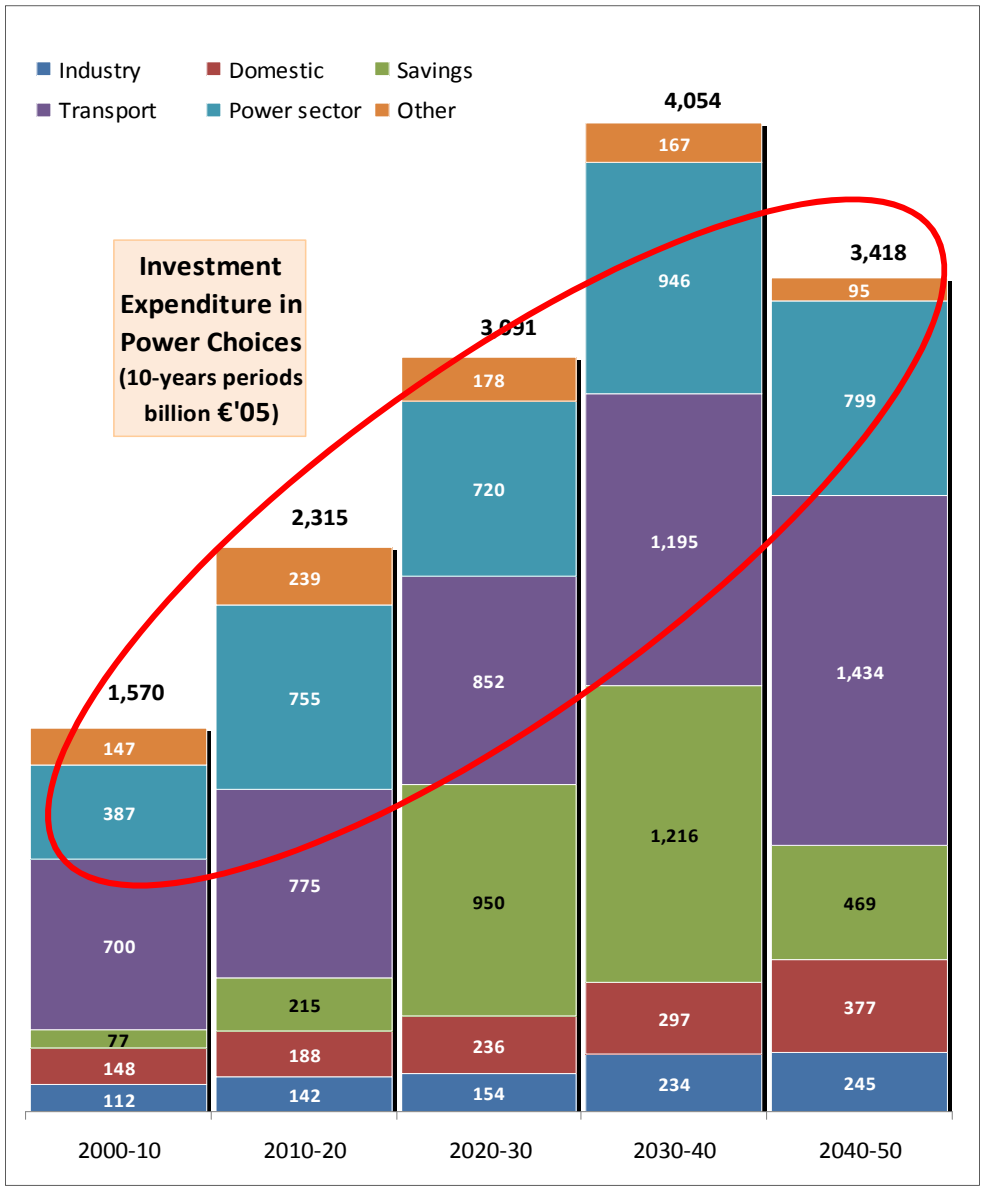
# Overall energy cost in the economy



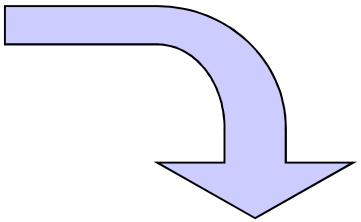

- **By 2025, total cost of energy in relation to GDP increasing from 10.5% in 2010 to 13%, up to 0.6% higher than in Baseline.**
- **By 2050 the cost of energy under *Power Choices* falls back to 10% at 2050, just 0.3% higher than under Baseline (which has a less ambitious GHG emissions reduction target).**

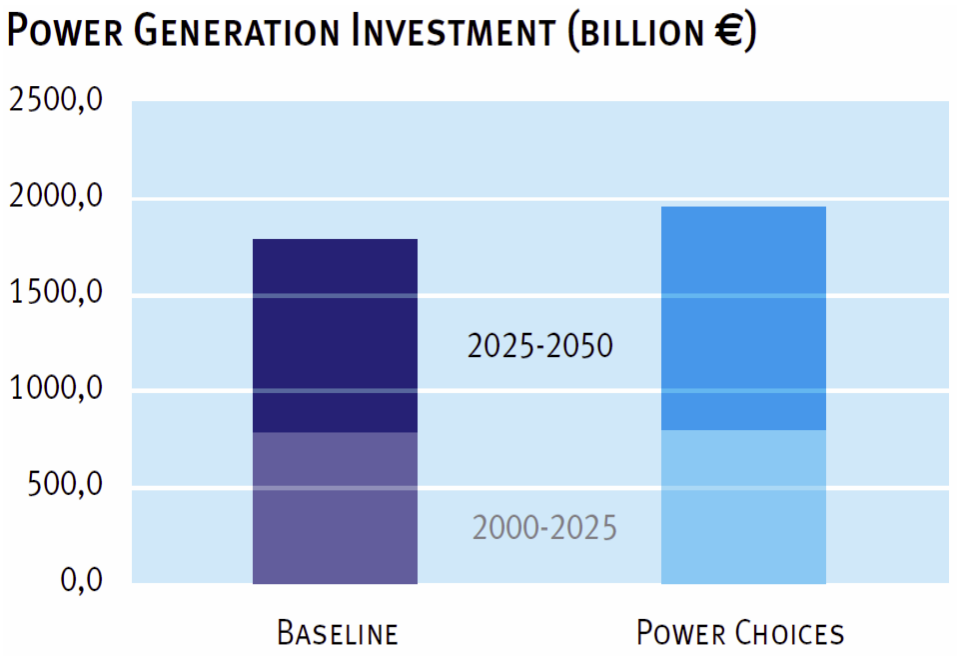
# Average Price of Electricity (€'05/MWh)






# Investments needed





# 3. SENSITIVITIES

eurelectric
ELECTRICITY FOR EUROPE

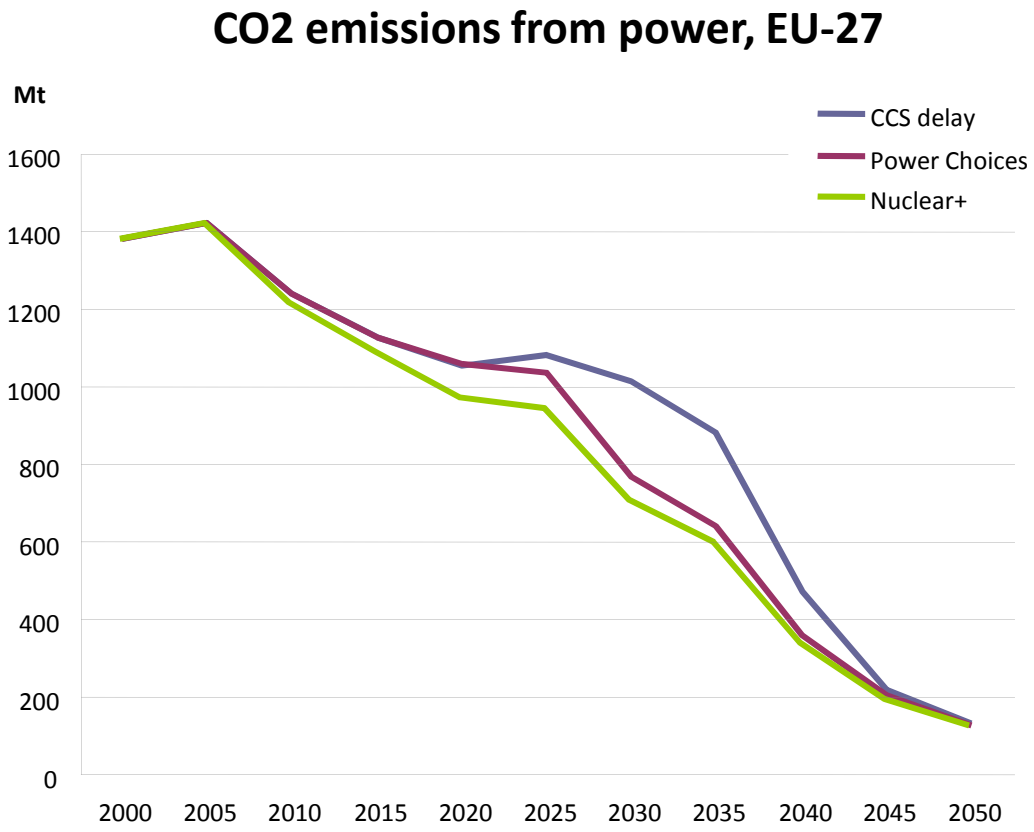
# What if…

**Nuclear phase-out is reversed in Germany and Belgium?**

**Commercial deployment of CCS is delayed to 2035?**

**One-third of onshore wind power is not built due to planning problems?**

# All technologies are *really* needed




- 10-year delay of CCS = delayed $CO_2$ emission reductions from power & whole economy!
- More nuclear = more rapid reduction curve
- 1/3 onshore wind not built = more CCS & nuclear, off-shore wind not likely to fill gap.

# 5. POLICY RECOMMENDATIONS

eurelectric
ELECTRICITY FOR EUROPE

## Technology Choices

- Enable the use of all low-carbon technologies and ensure investments in transmission and distribution lines
- Encourage public acceptance of modern energy infrastructure

## Energy Efficiency

- Facilitate the electrification of road transport and efficient electro-technologies for heating and cooling
- Ensure that public authorities take a leading role in energy efficiency, adopting standards and incentives to help consumers choose energy-efficient technologies

## Carbon and Electricity Markets

- Support well functioning carbon and electricity markets so as to deliver carbon reductions at least cost
- Ensure that all sectors internalise the cost of greenhouse gas emissions
- Actively promote an international agreement on climate change

## Costs

- European and national budgets should radically refocus towards supporting a new intelligent energy economy
- Recognise that the cost of technology deployment differs substantially across the EU Member States and distribution effects will vary

# Follow-up recommendations

- Wholesale market design in relation to massive penetration of renewables (and nuclear)
- Investments needed in grid enhancements (both transmission and distribution)
- Regional analyses, a scale at which effects may substantially diverge from the European average
- eMobility, how to properly ensure the rolling out of electric transportation
- Risks mitigation for investments in energy infrastructures
- Impact of EU moving from -20% to -30% GHG emissions by 2020


# Thank you for your attention!