



On the Economics of Renewables: Costs, Infrastructure Challenges and Policies

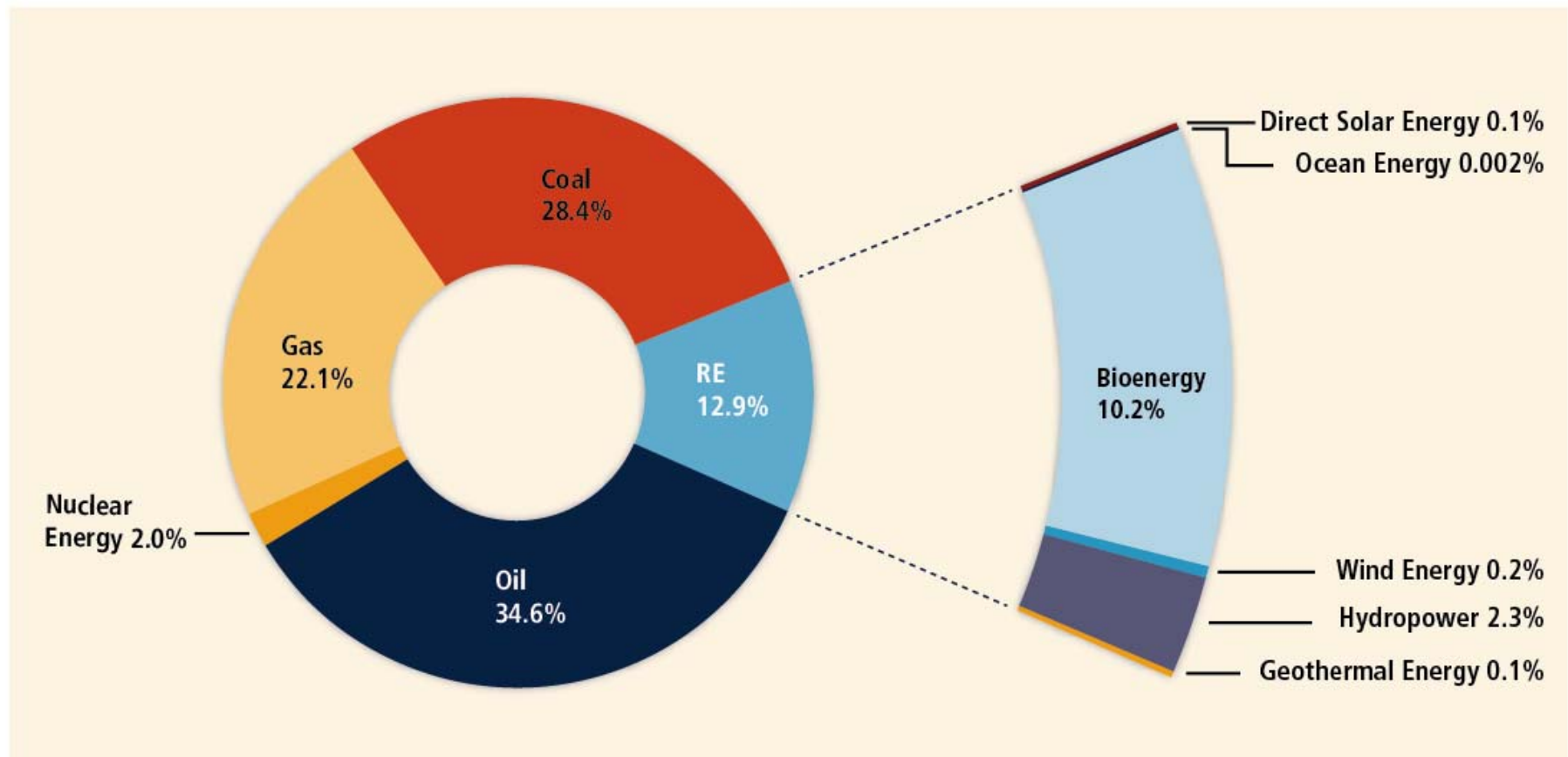
What technology mix in a controversial world?

Third Researchers Meeting
International Research Network for Low-Carbon Societies

Paris, 14th October 2011
Prof. Dr. Ottmar Edenhofer

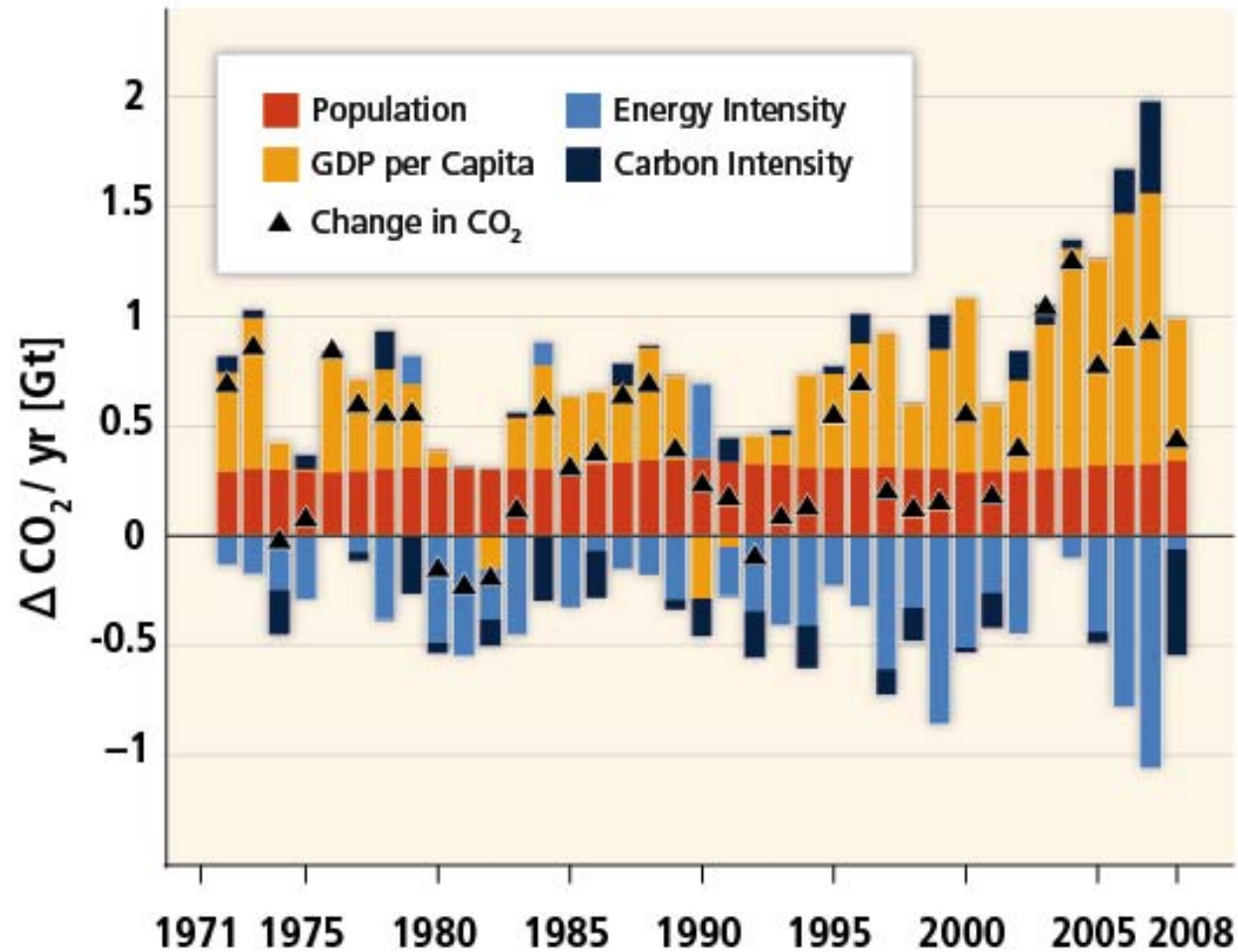


The current global energy system is dominated by fossil fuels.

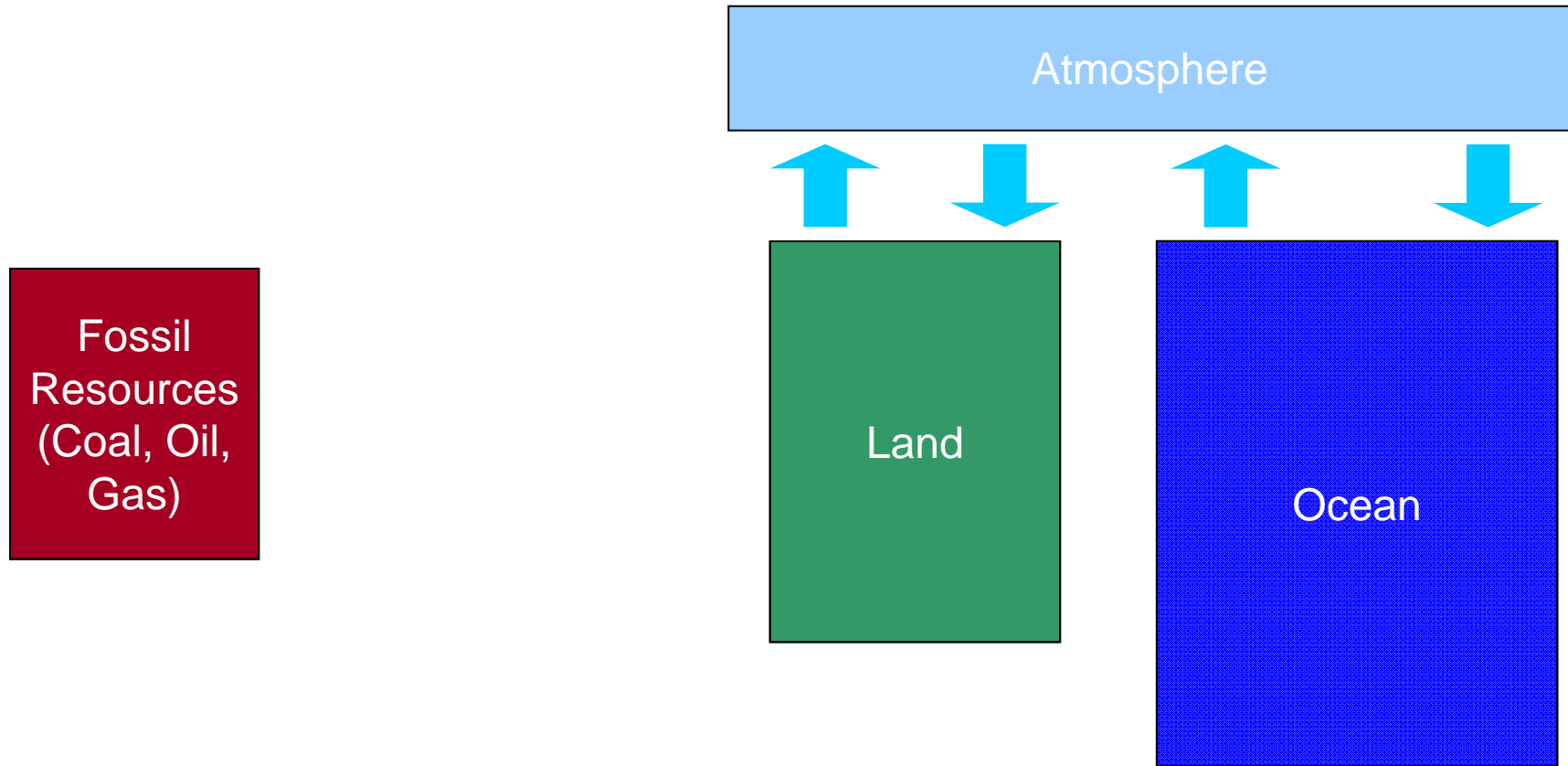


Shares of energy sources in total global primary energy supply in 2008

We are not on track – Renaissance of Coal!



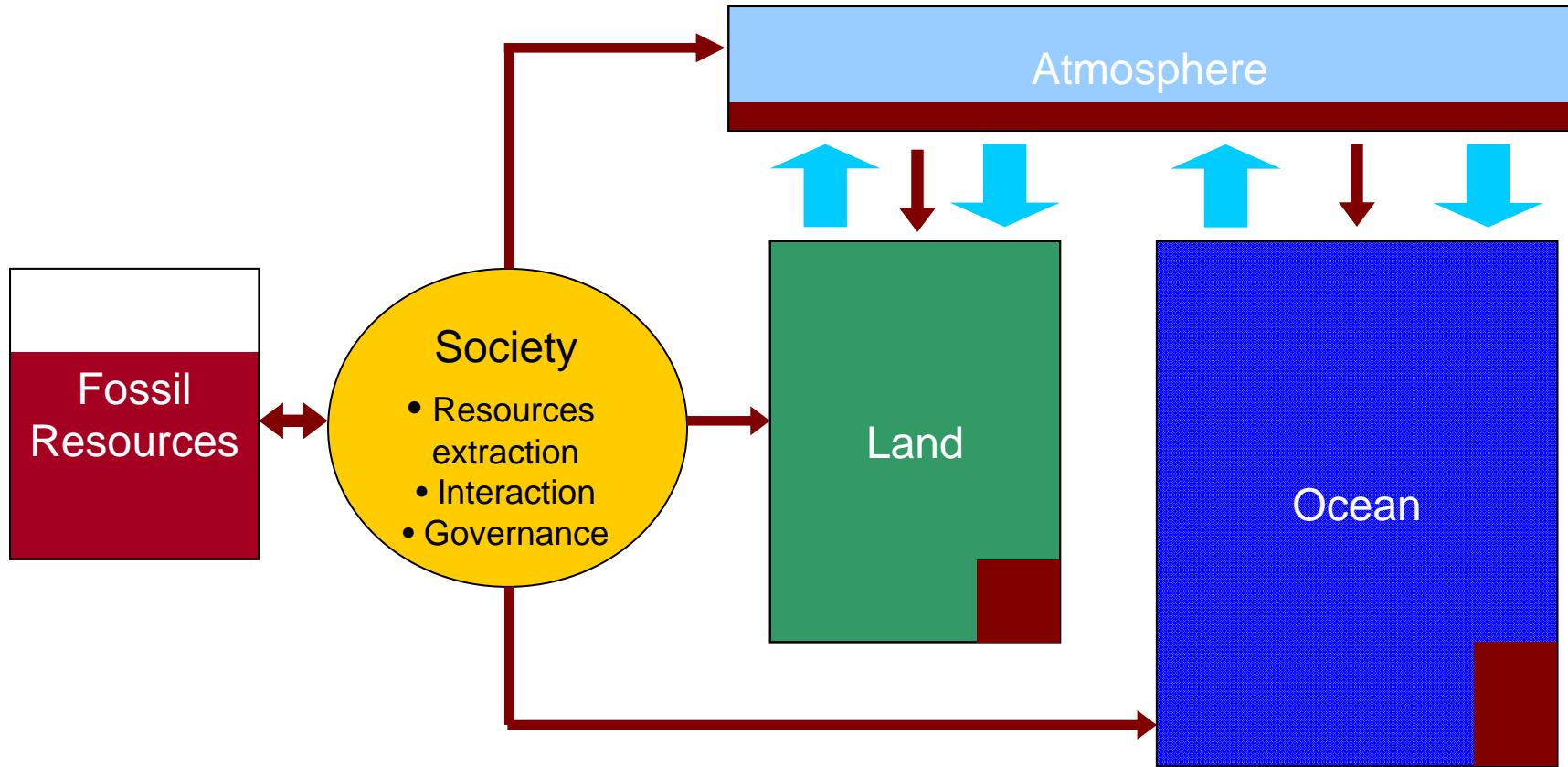
The Preindustrial Earth System – A Sketch



According to Lenton (2011)

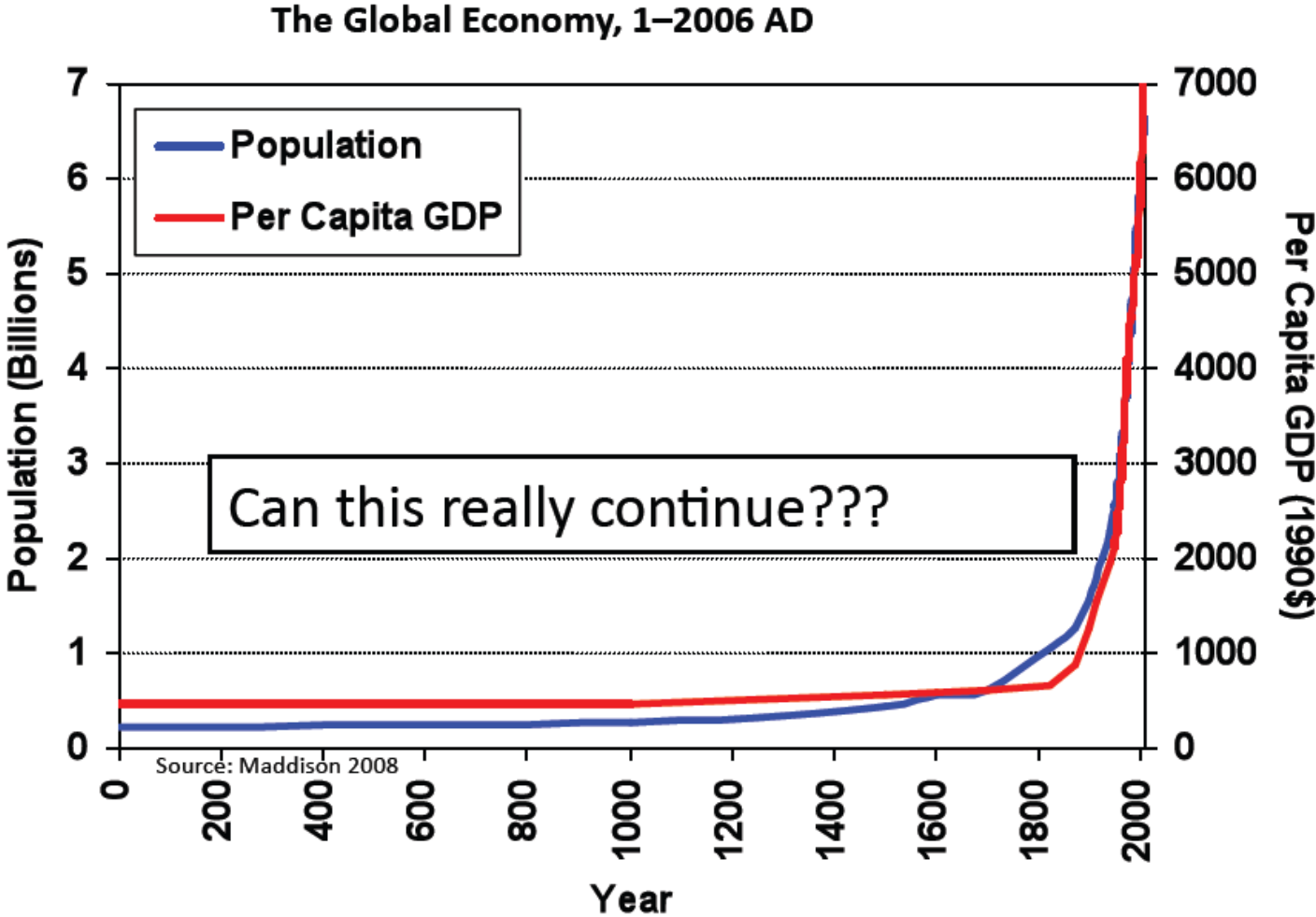
From a Solar to a Fossil Stock Economy

The Earth System of the Anthropocene

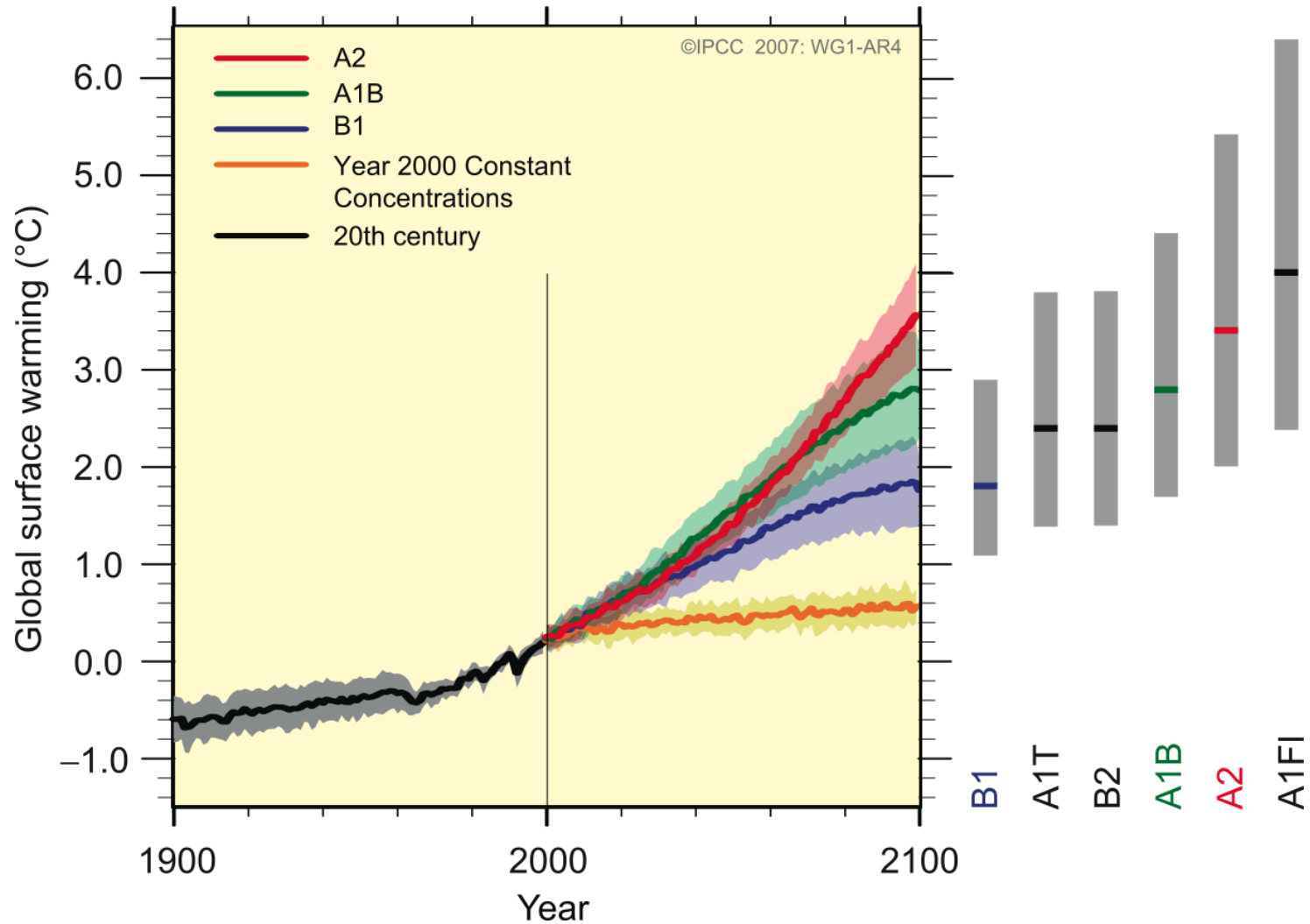


According to Lenton (2011) and Ostrom (2011)

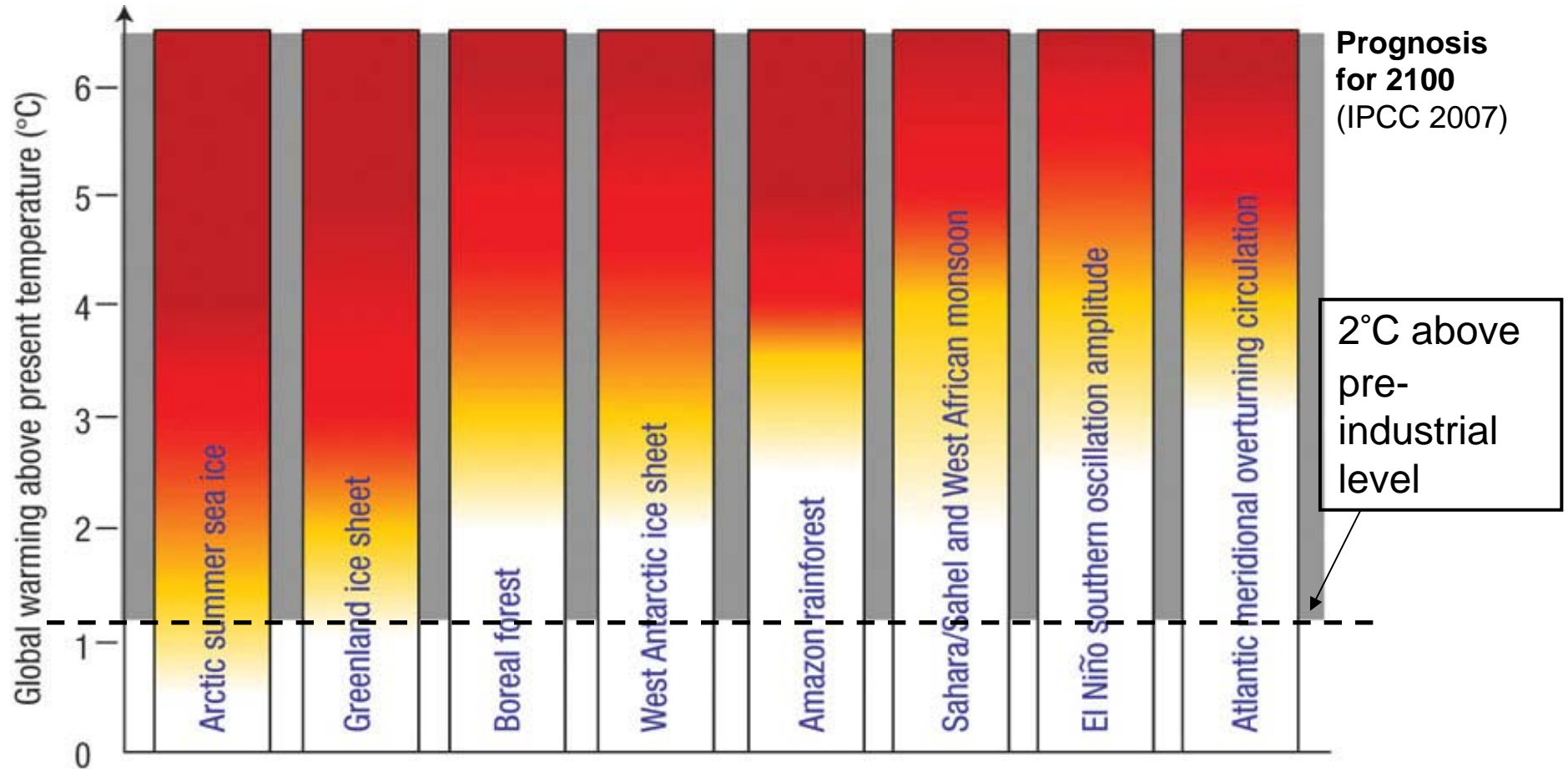
Fossil Resources Stock – A Lottery Prize!



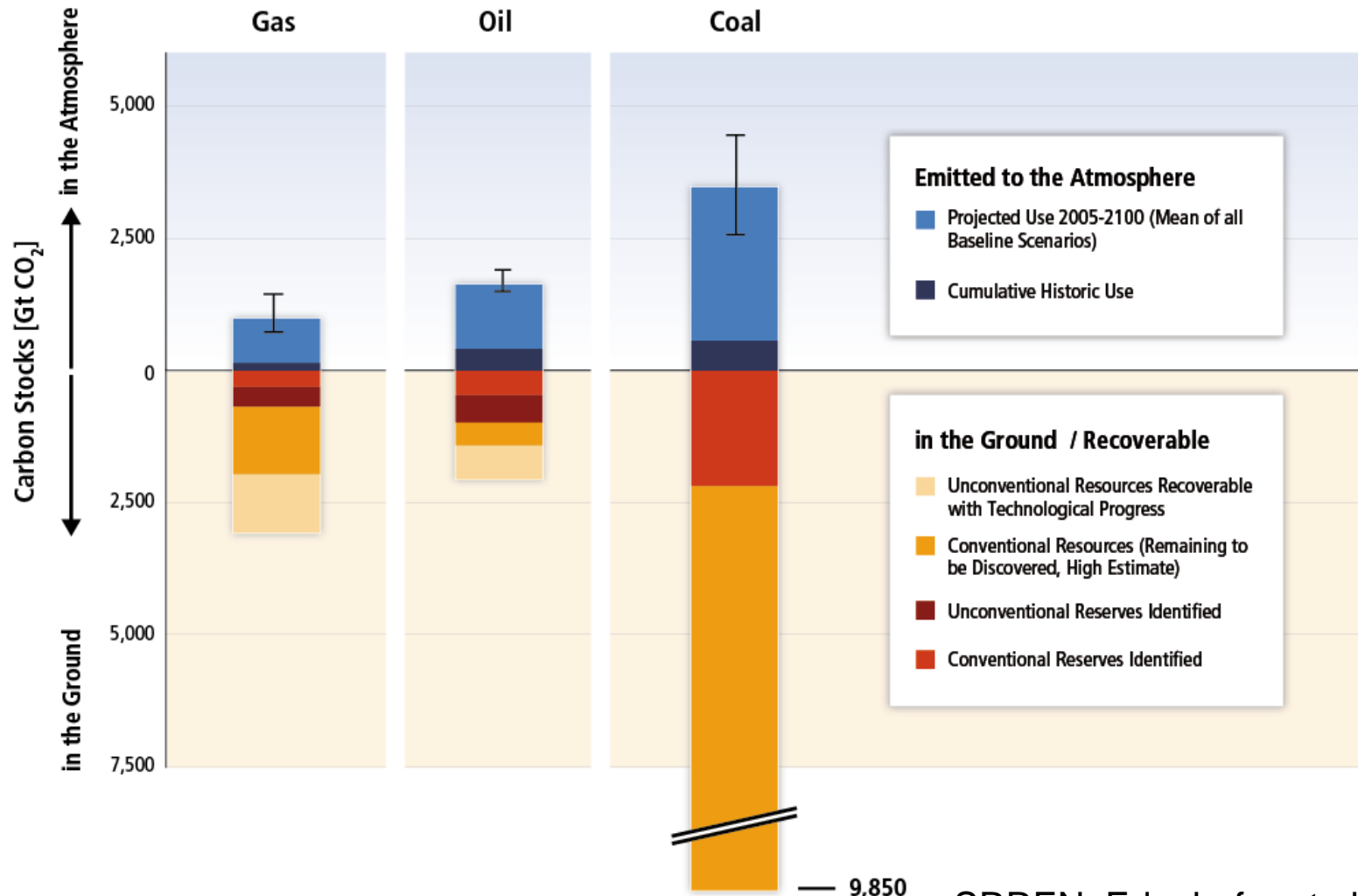
What are the Impacts on Climate?



Burning Embers Diagram

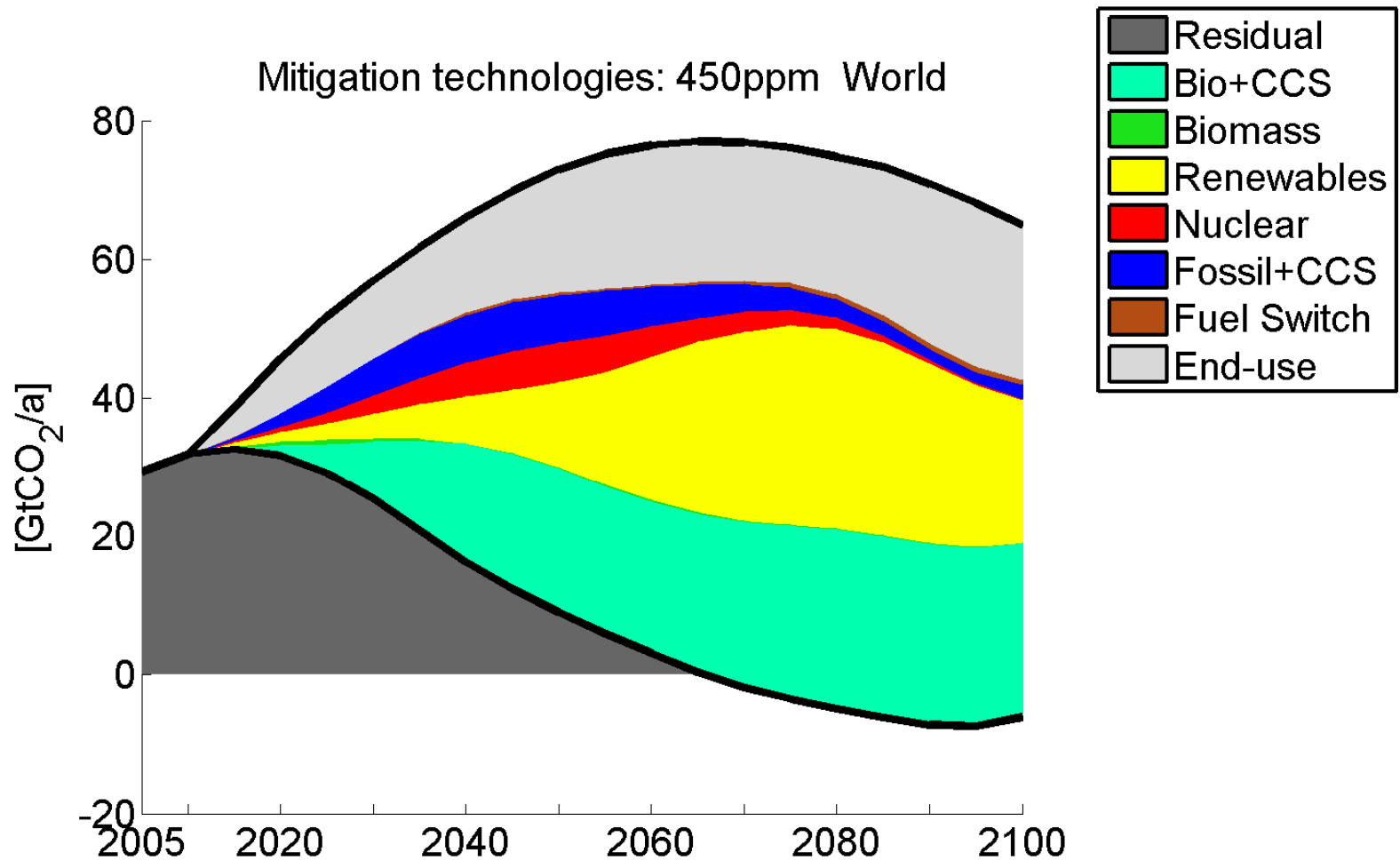


The BAU Scenarios Could Exceed the Level of Greenhouse Gas Concentration of 600ppm (~4° C Temperature Increase)



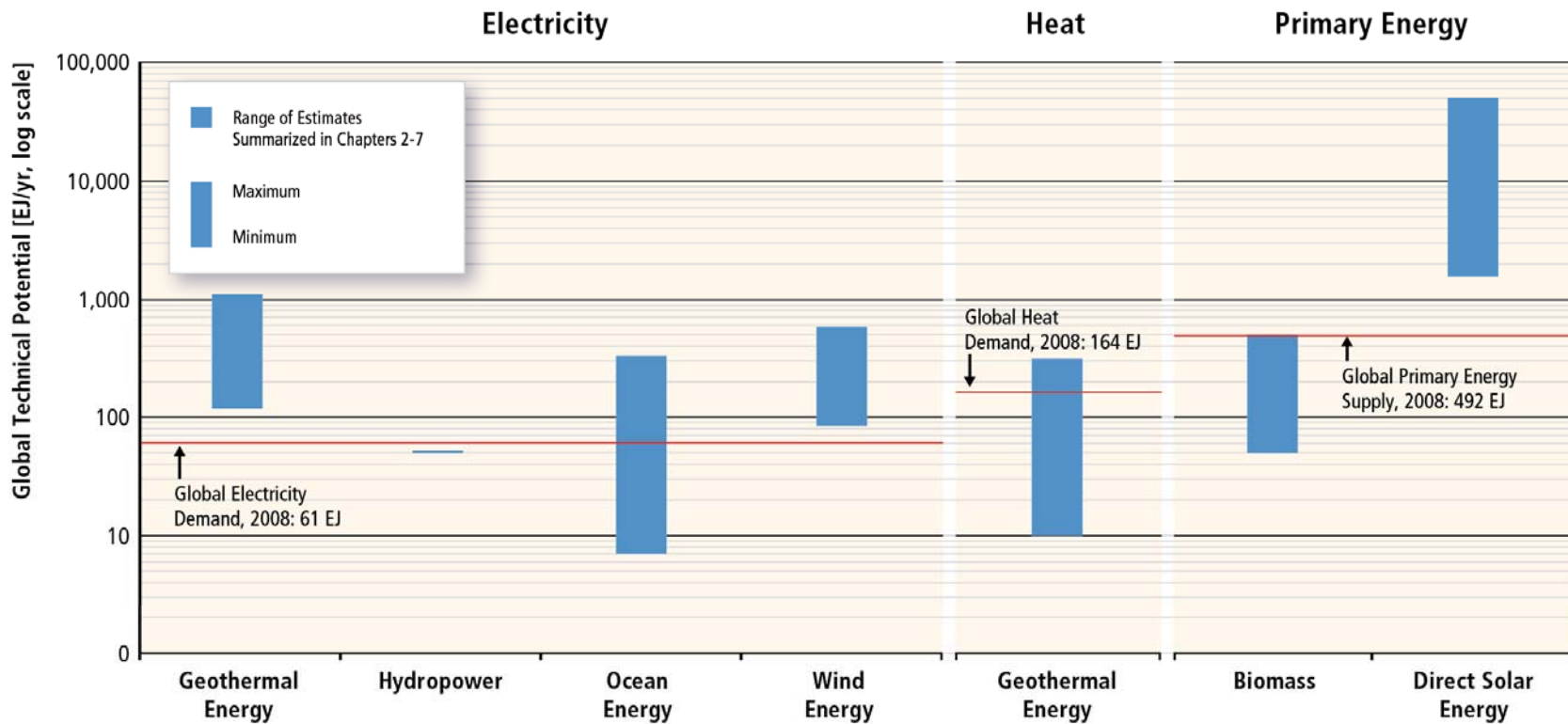
SRREN, Edenhofer et al. (2011)

The Great Transformation



(Luderer et al., 2011)

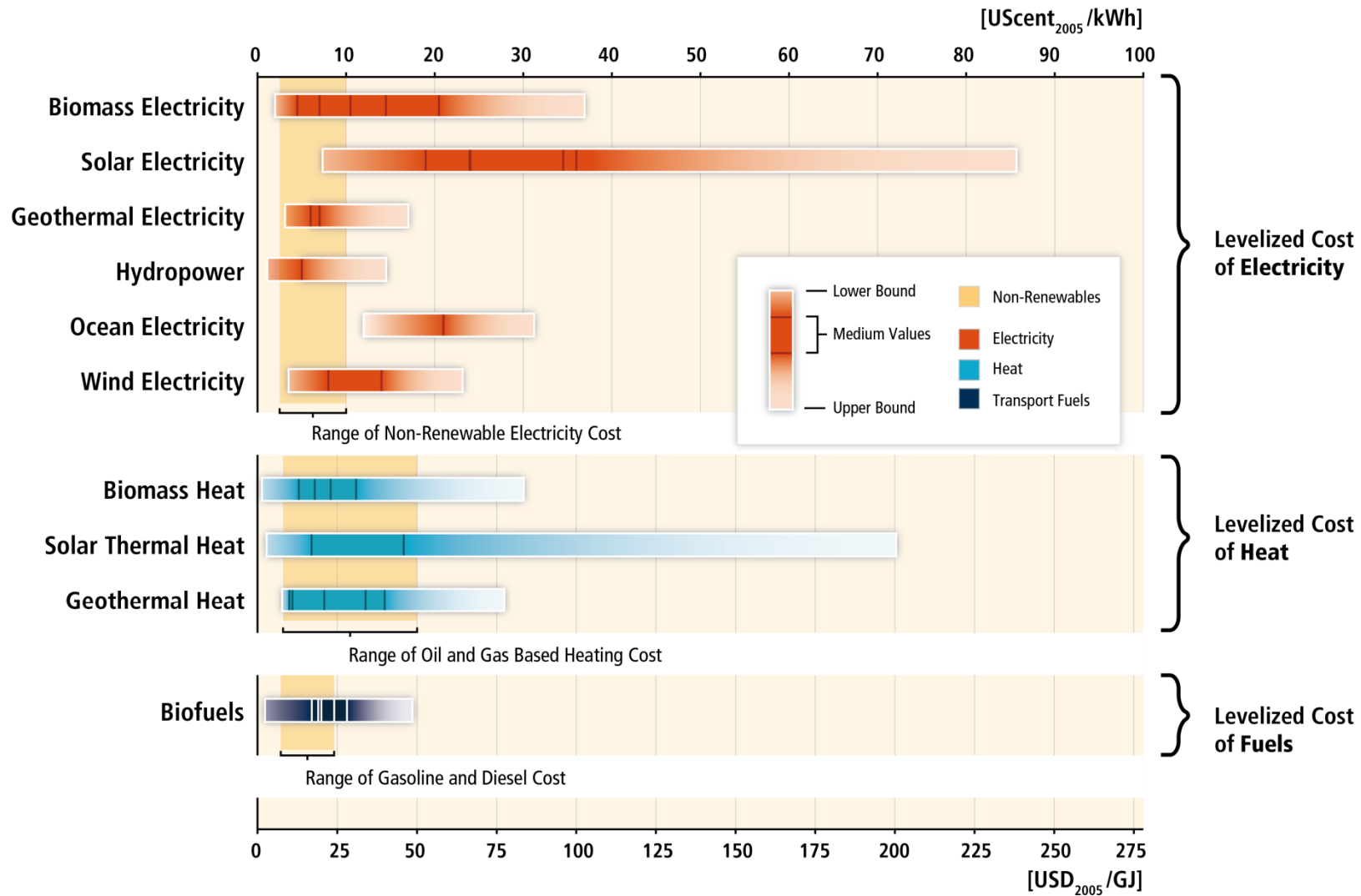
The Technical Potential of Renewable Energies



Range of Estimates of Global Technical Potentials

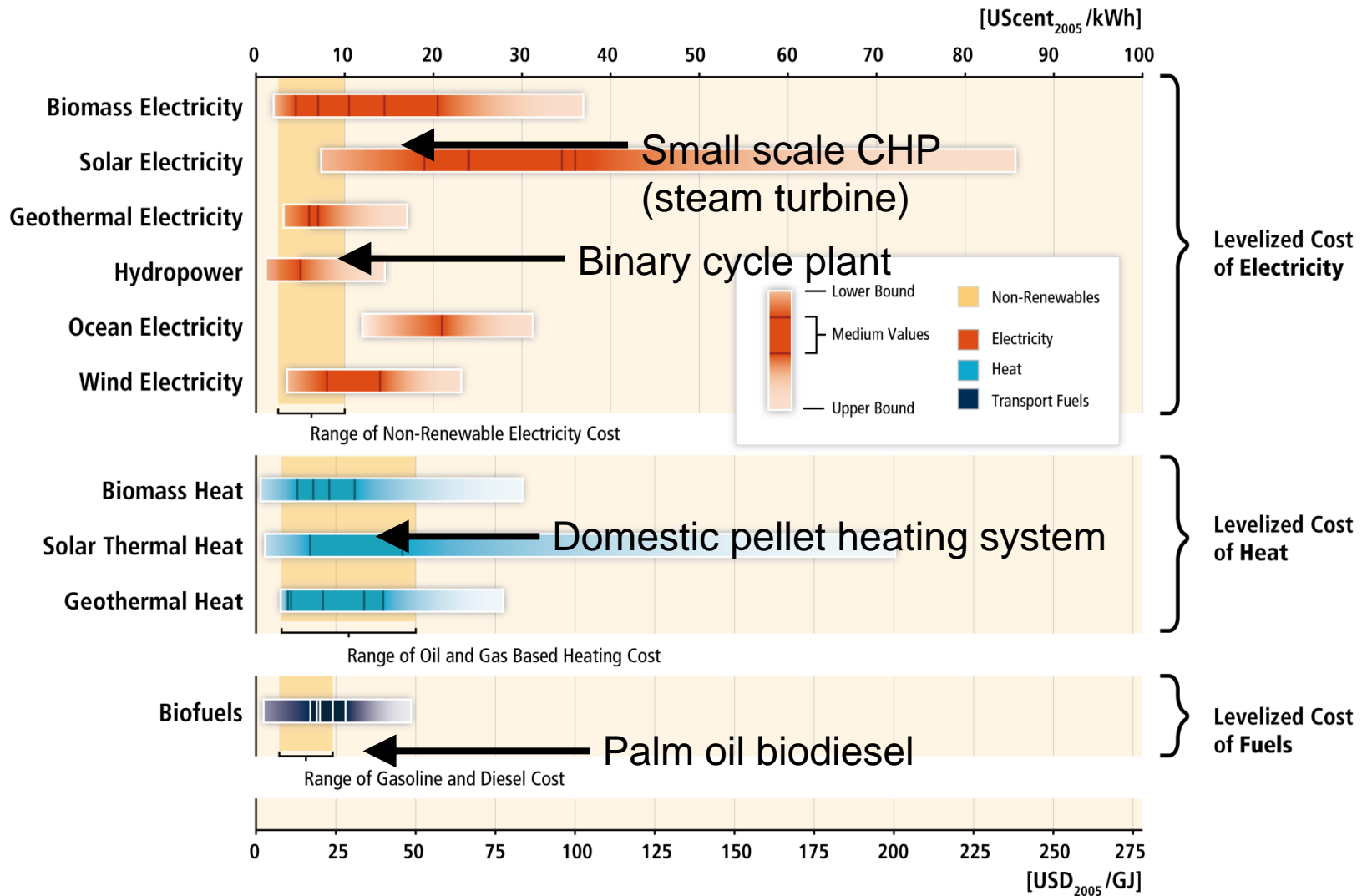
	Geothermal Energy	Hydropower	Ocean Energy	Wind Energy	Geothermal Energy	Biomass	Direct Solar Energy
Max (in EJ/yr)	1109	52	331	580	312	500	49837
Min (in EJ/yr)	118	50	7	85	10	50	1575

The Costs of Renewables Are Often Still Higher Than Those of Non-Renewables But...

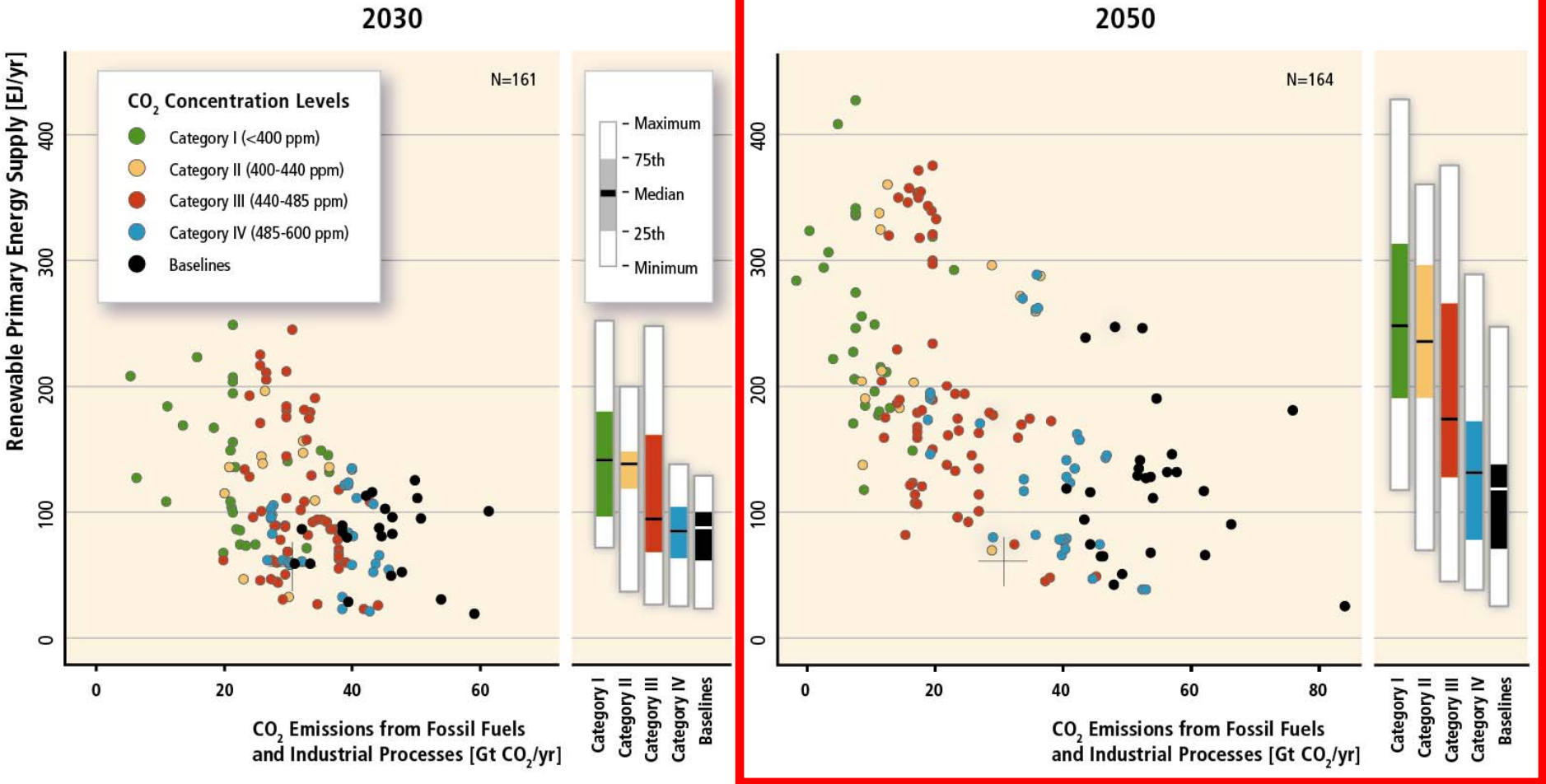


SRREN, Edenhofer et al. (2011)

...Some RE Technologies Are Already Competitive



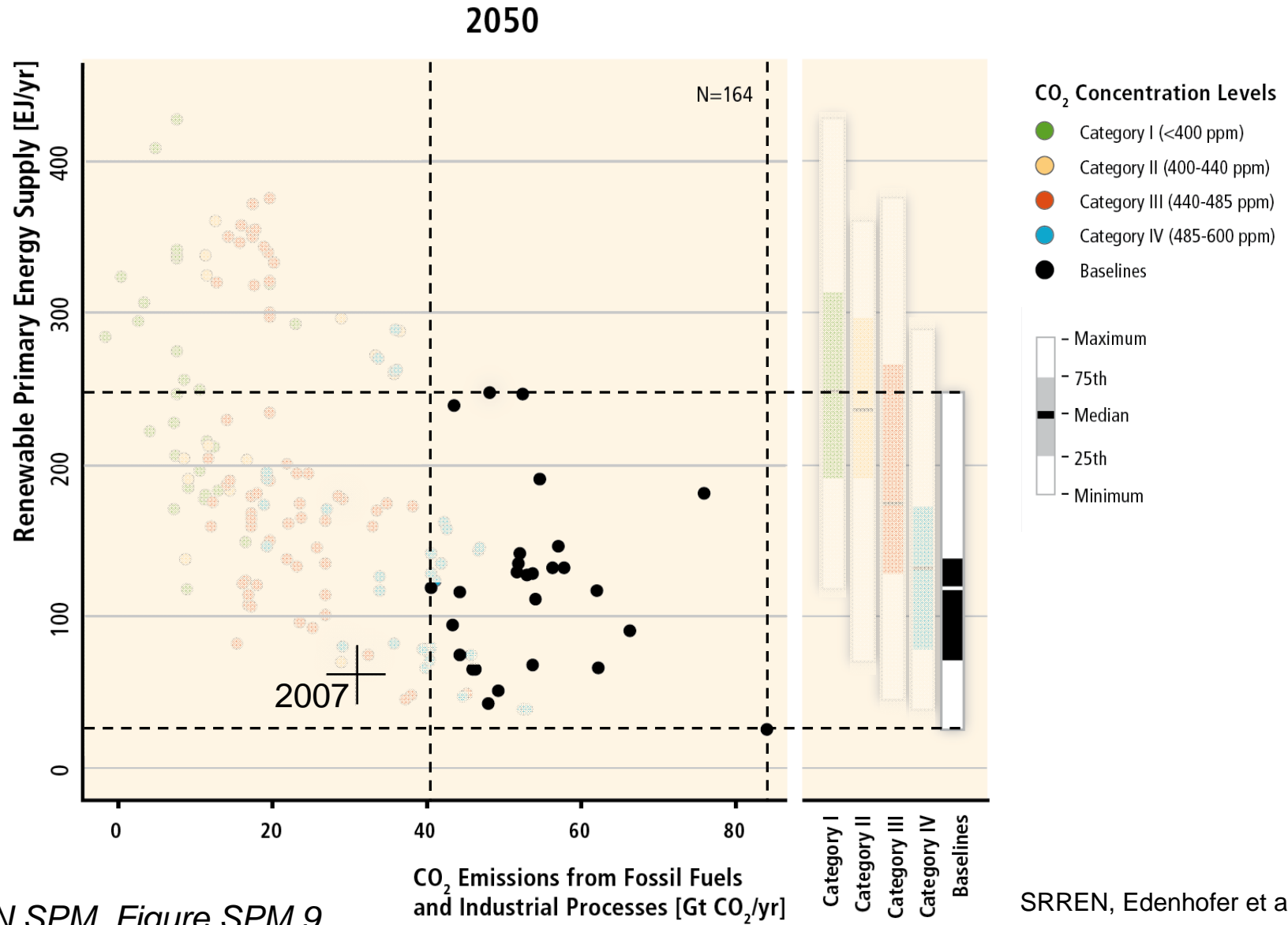
Global RE Primary Energy Supply from 164 Long-Term Scenarios versus Fossil and Industrial CO₂ Emissions



SRREN SPM, Figure SPM.9

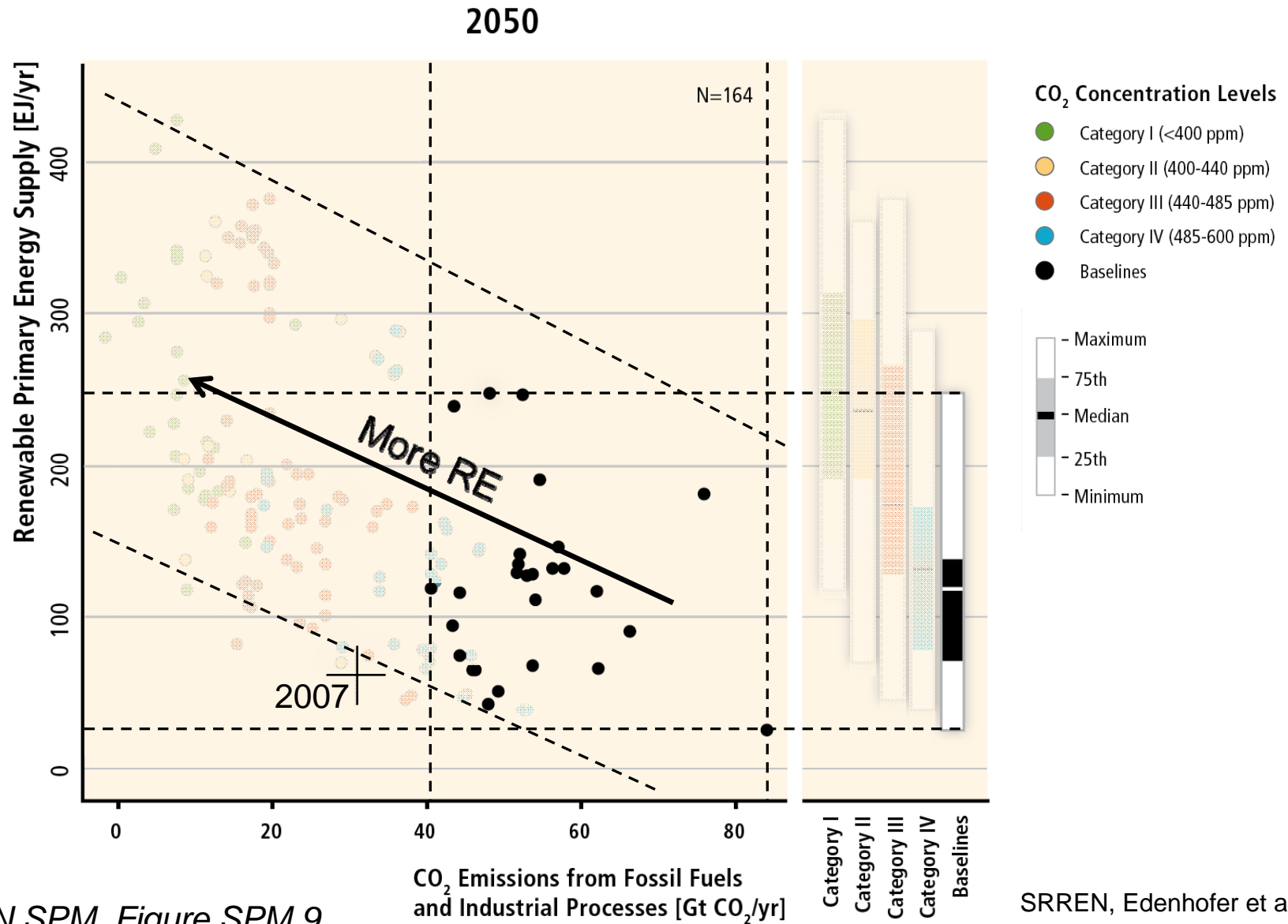
SRREN, Edenhofer et al. (2011)

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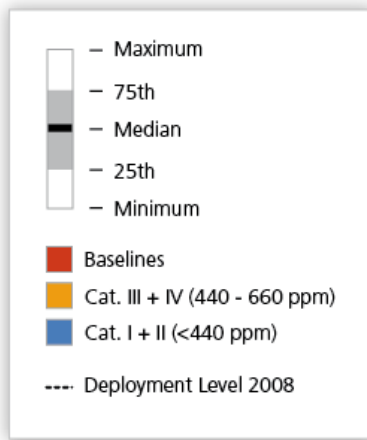
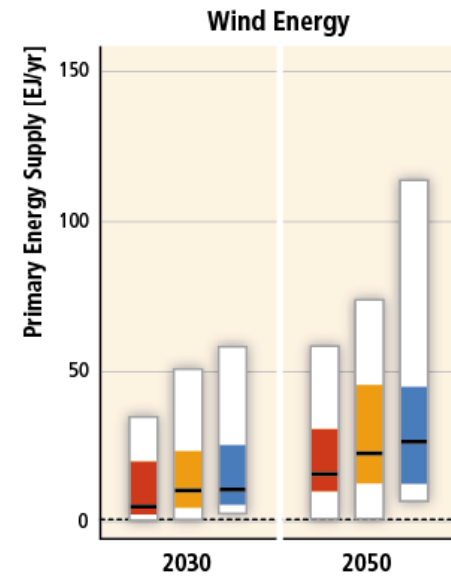
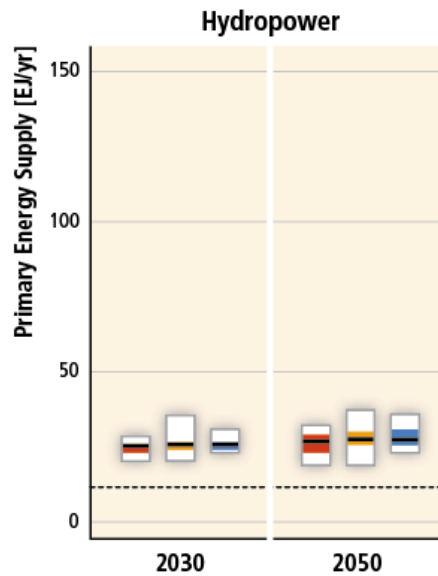
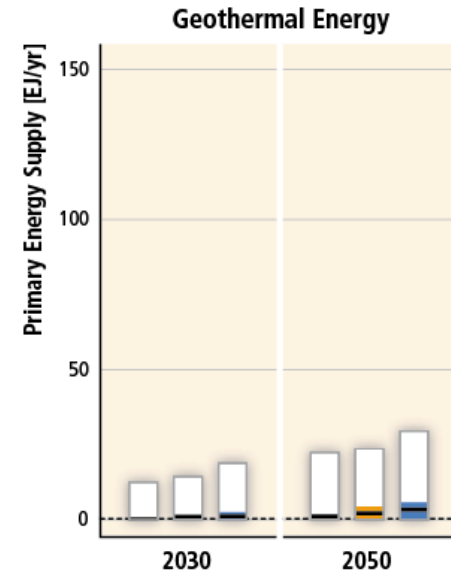
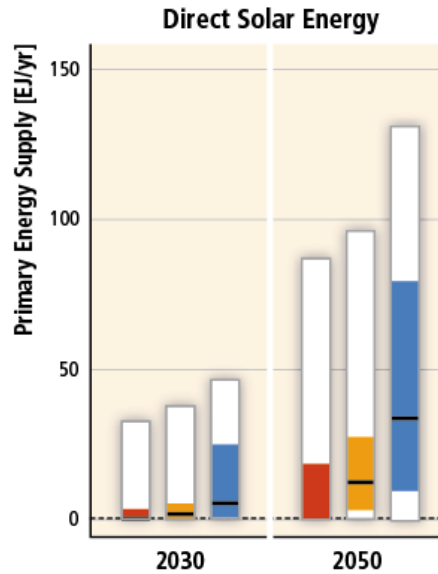
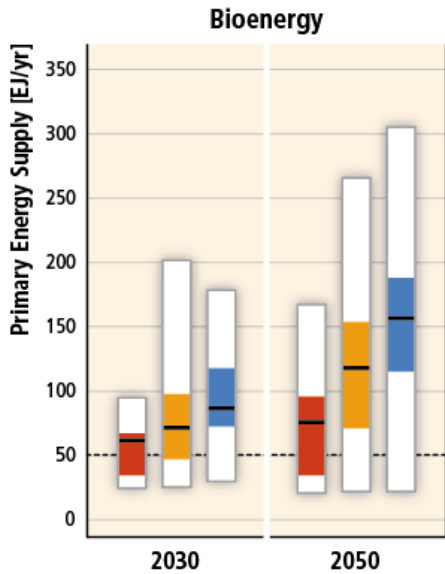
SRREN SPM, Figure SPM.9

Global RE Primary Energy Supply from 164 Long-Term Scenarios versus Fossil and Industrial CO₂ Emissions



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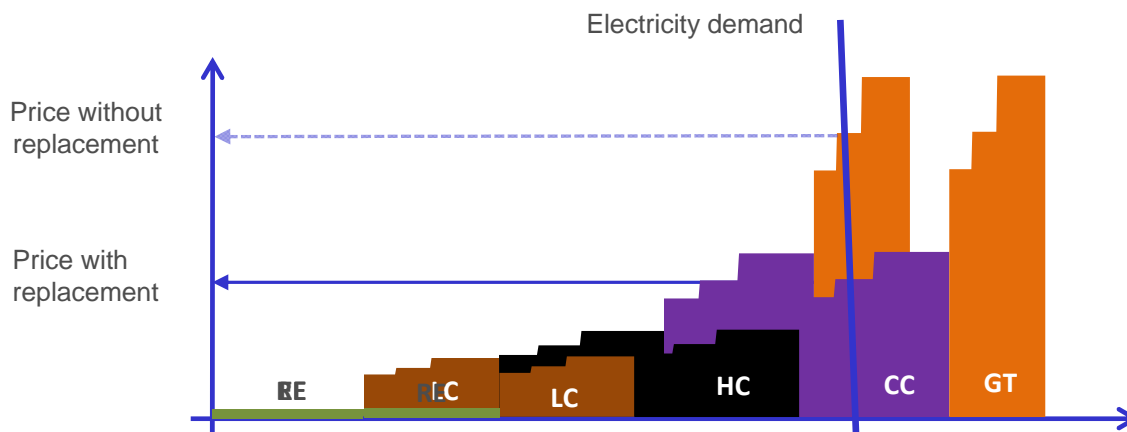
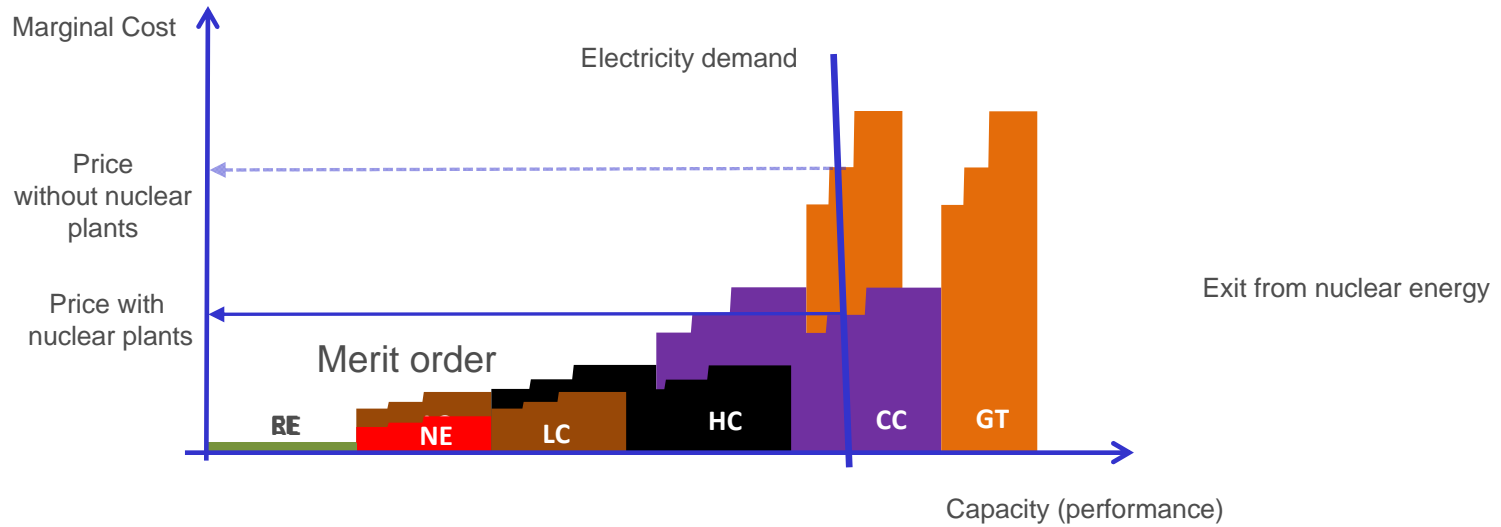
Potential Role of Renewables



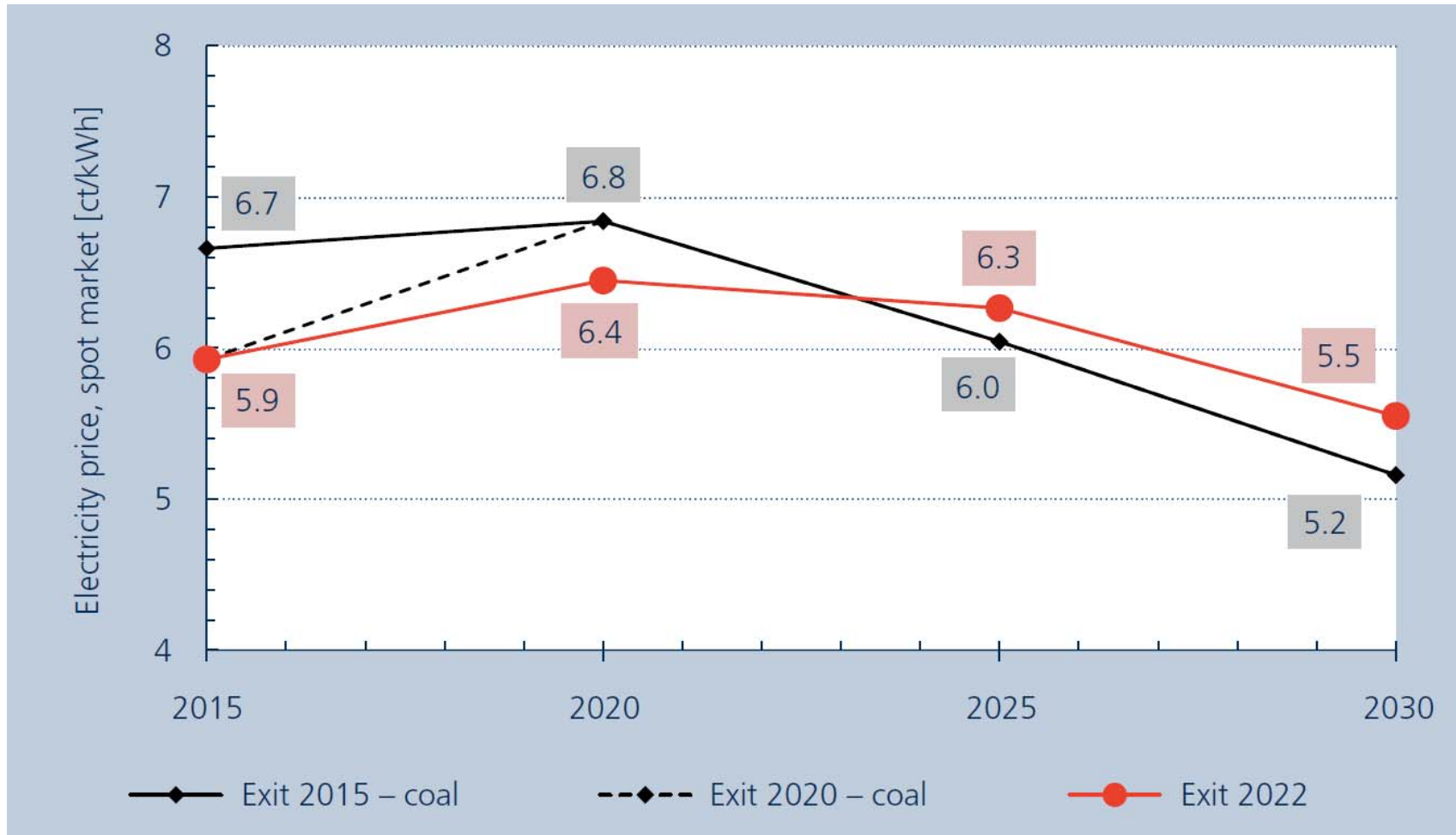
Bioenergy Supply is Accounted for Prior to Conversion

Primary Energy Supply is Accounted for Based on Secondary Energy Produced SRREN, Edenhofer et al. (2011)

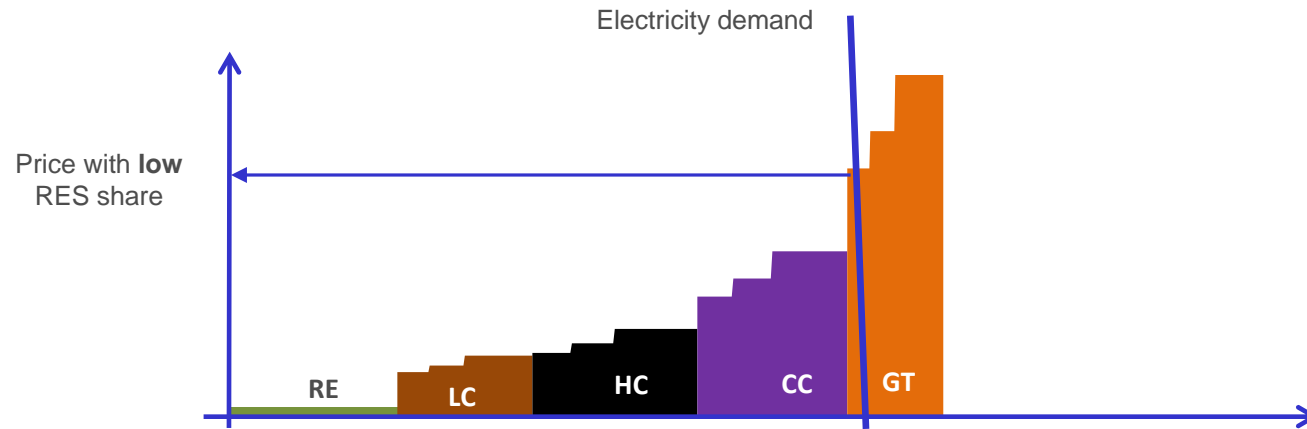
The German Case: Pricing in a Liberalised Electricity Market



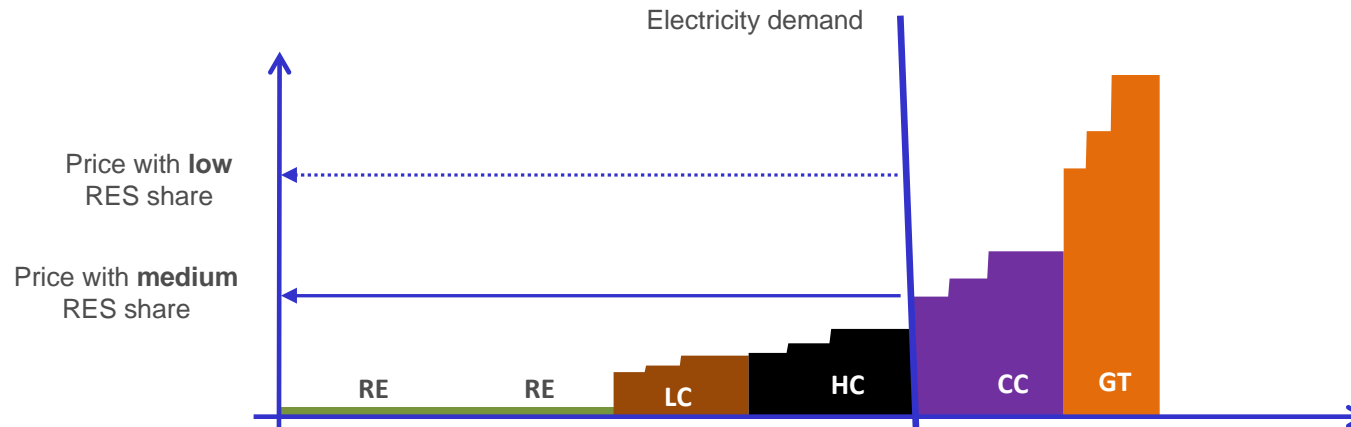
Wholesale Market Prices



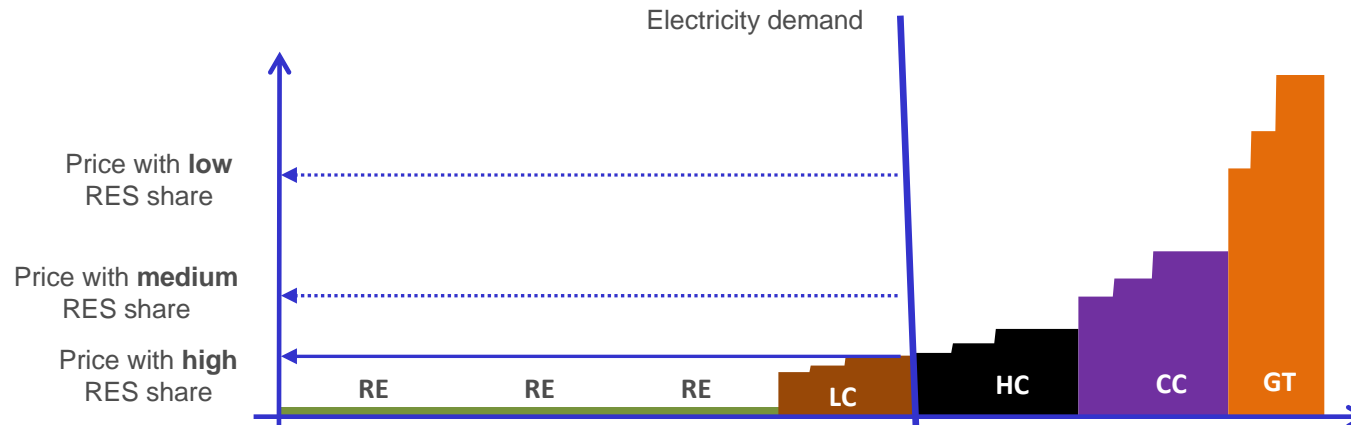
Impact of High Shares of REs on Price Formation



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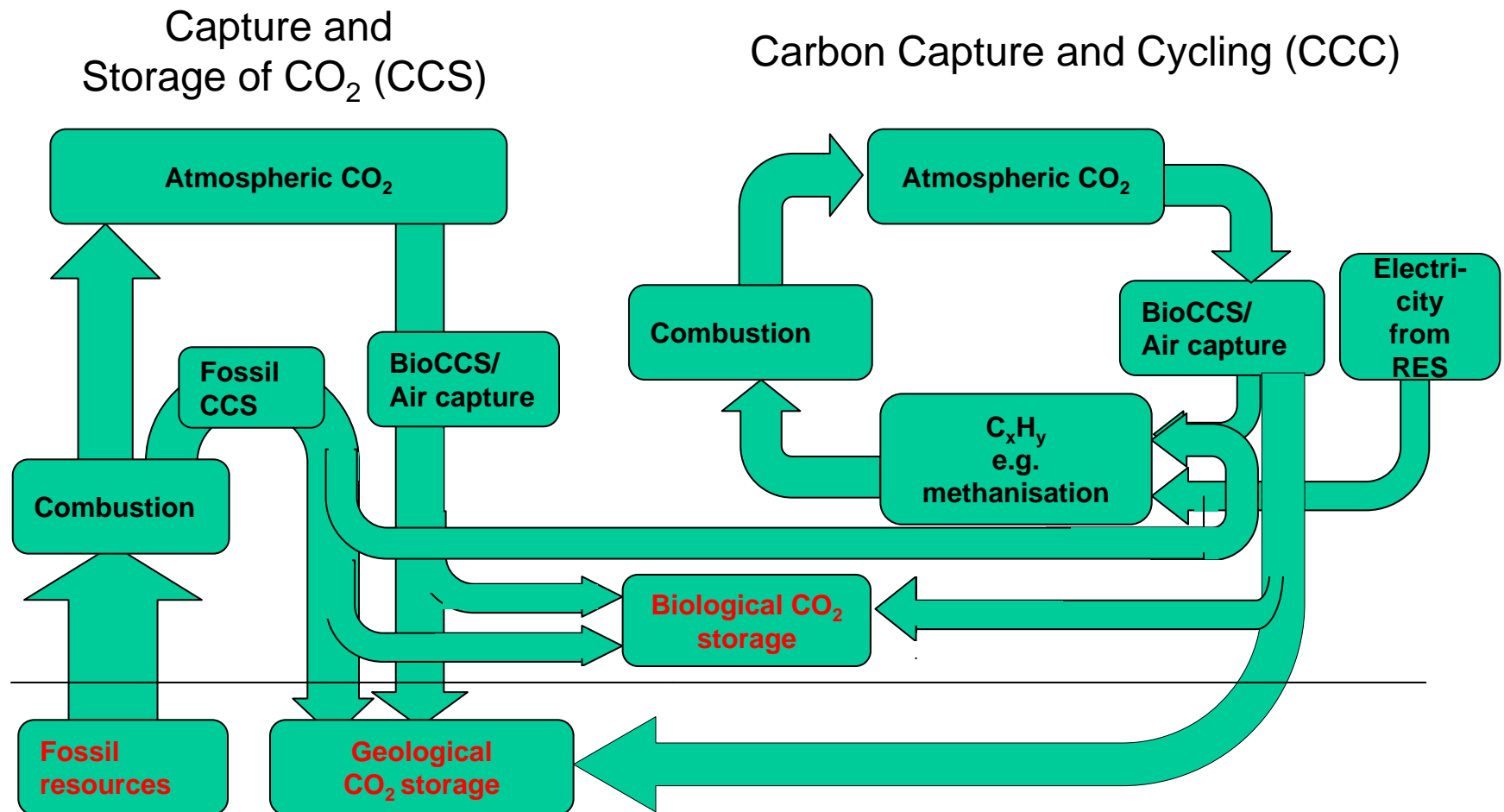
- Merit-Order effect of RES: Decreasing power prices
- Negative long-term impact:
 - Reduction of profitability of conventional technologies, less investments
 - Risk of capacity shortage in times of low RES generation (intermittency)
 - What kind of capacity instruments are needed?

Options of Integration

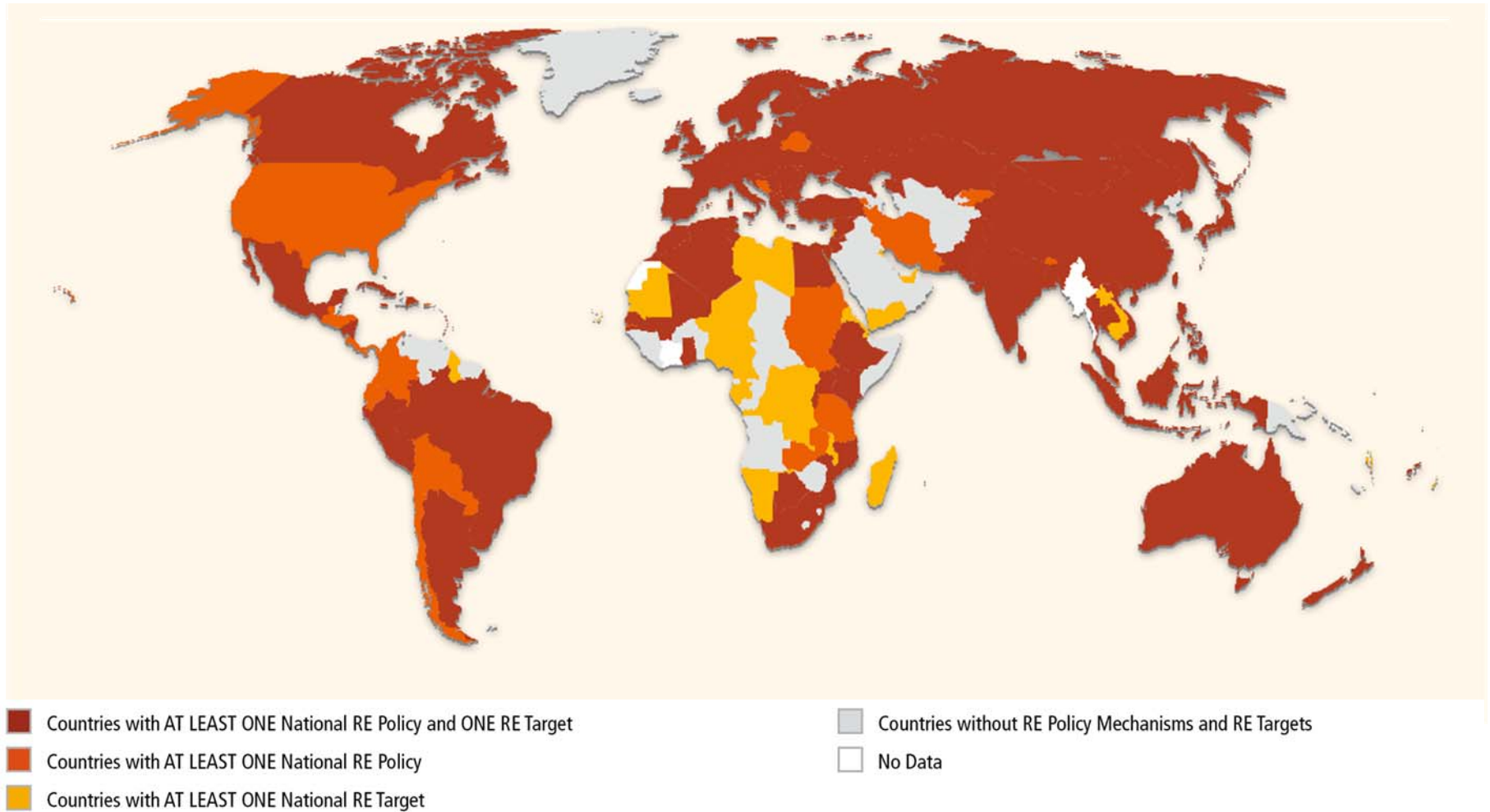
- Demand management
- Network expansion
- Improvement of weather forecast
- Flexible power plants
- Energy storages

CCX

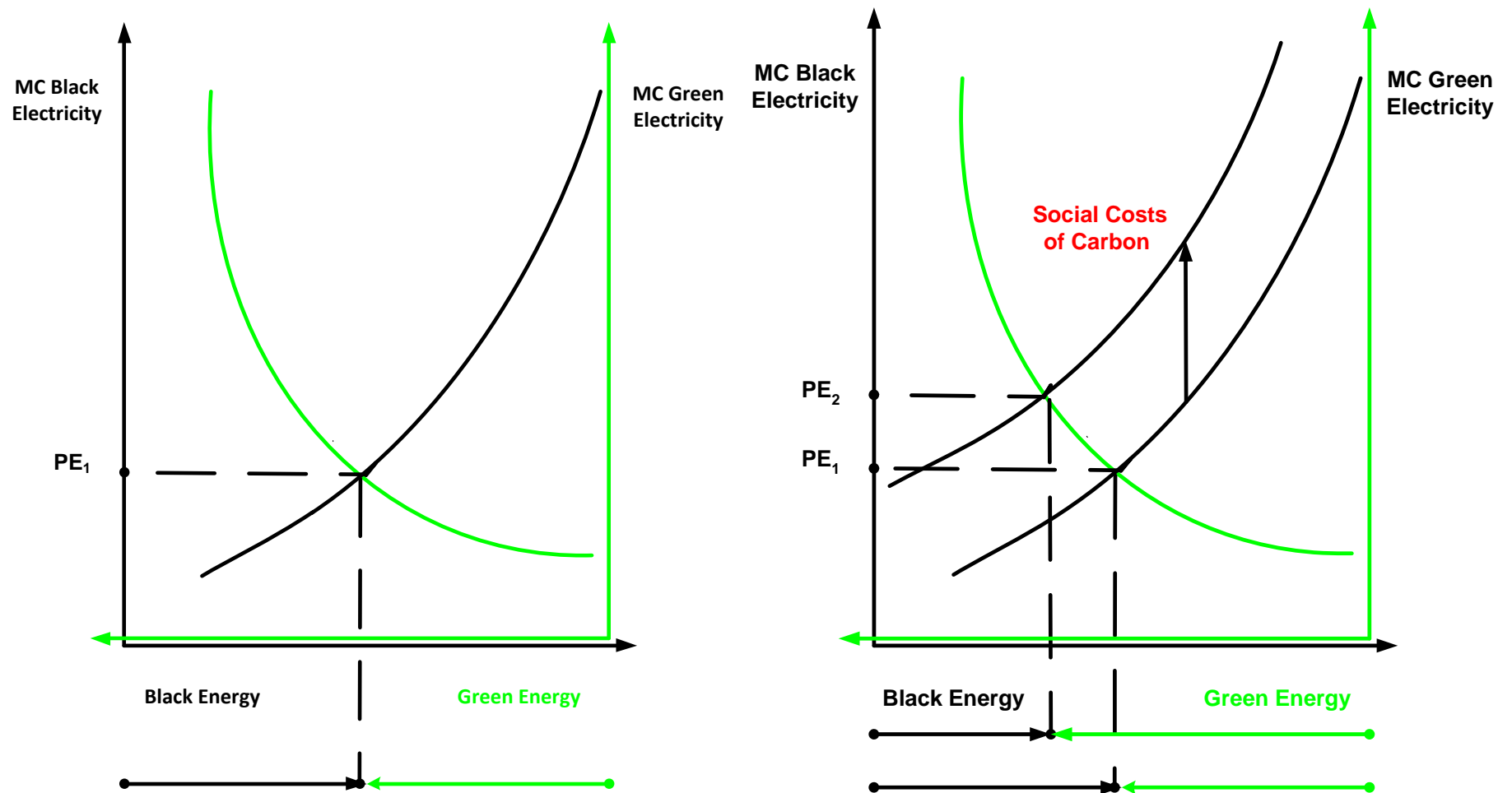
X = **C**ycling, **S**torage, **U**tilitization



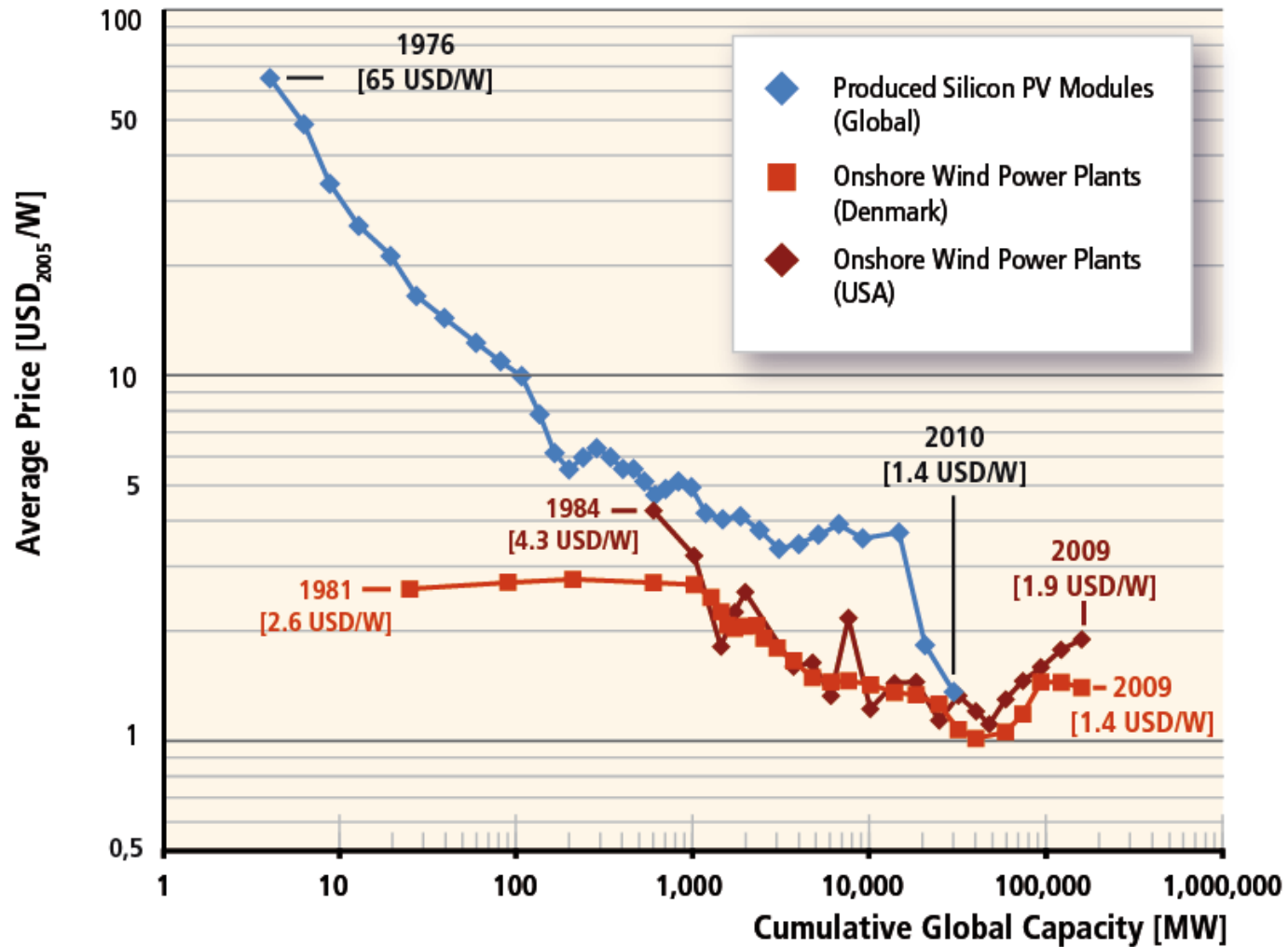
RE-Specific Policies and RE Targets (2011)



Case 1: Emissions Trading is Necessary and Sufficient

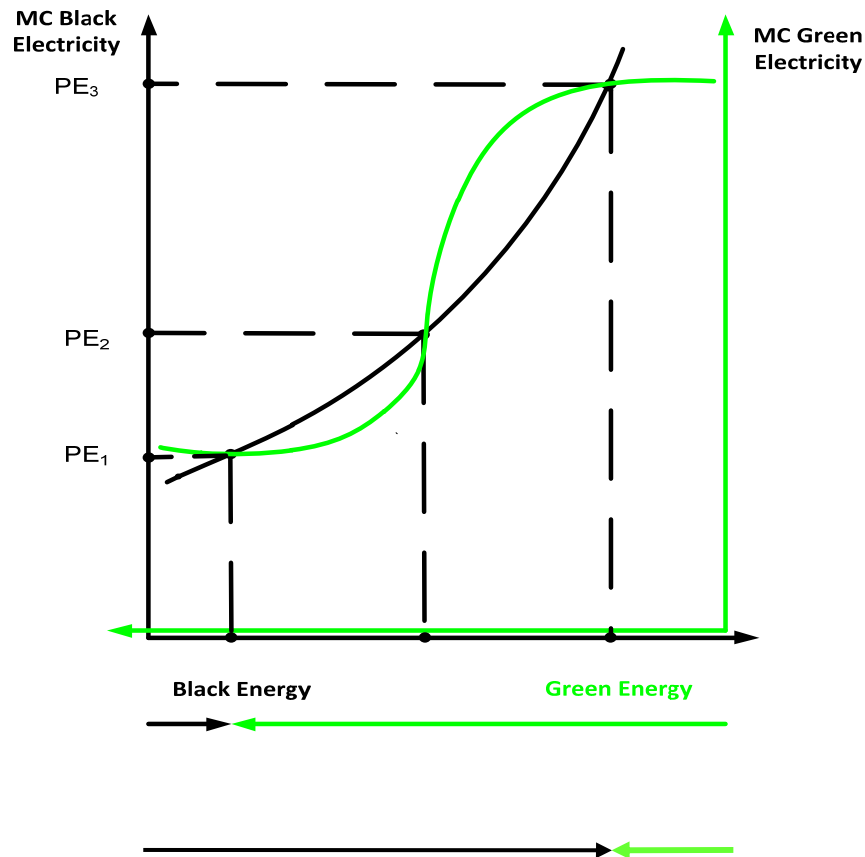


Renewable Energies Have a Potential to Lower Costs



SRREN, Edenhofer et. al. 2011

Promotion of Renewable Energies Is Worthwhile!

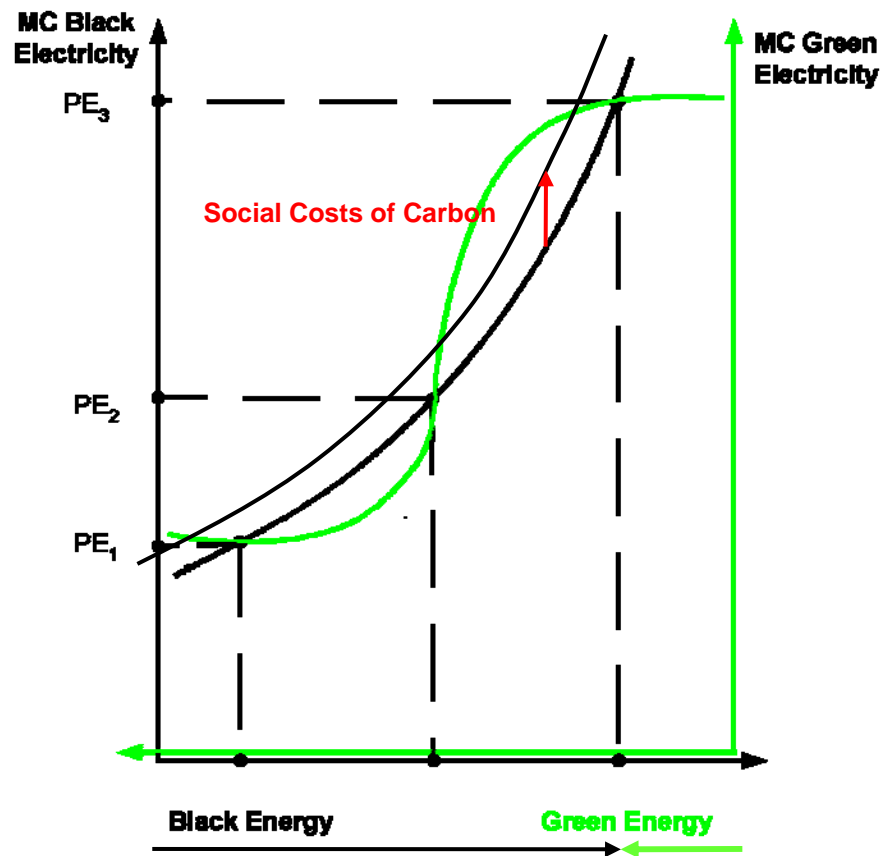


► Several stable equilibrium points (PE_3 and PE_1) are possible if the supply curves show a non-convex behavior (PE_2 is not stable).

► Without additional policy support, the system will steer towards the neighboring equilibrium point PE_3 .

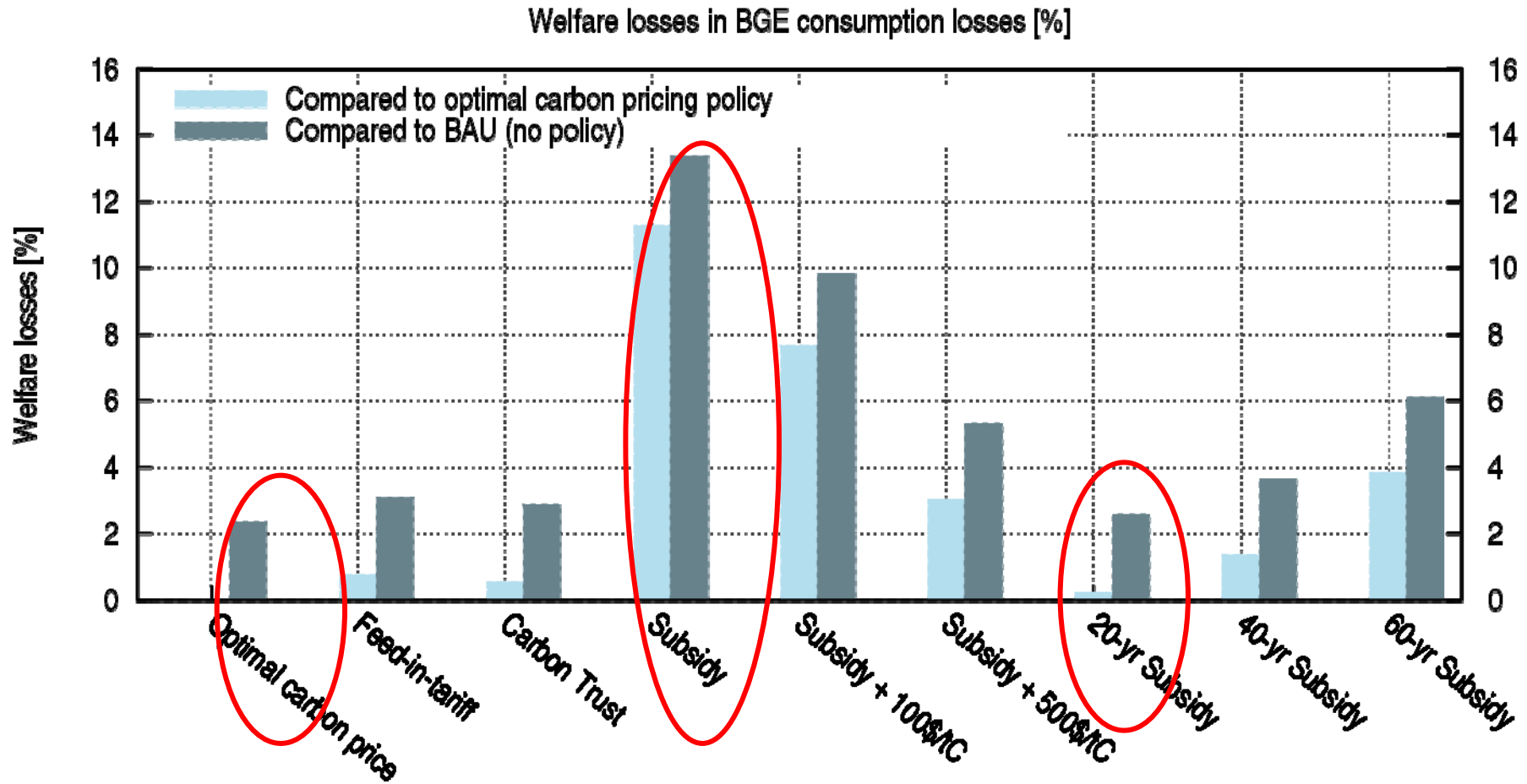
► $PE_3 > PE_1$: the system is **efficient**.

Promotion of Renewable Energies is Worthwhile!



- ▶ The internalization of the social costs of energy supply (e.g. via a cap and trade system) improves the competitiveness of renewable energies
- ▶ As long as the cross-over point PE_3 does not vanish, this, however, still results in an inefficient state.
- ▶ *Trio infernale*: a) learning spillovers, b) high substitutability between carbon-free technologies, c) increasing returns to scale

Efficient Technology Politics



Recommendable Literature

<http://srren.ipcc-wg3.de/report>