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The Vision of a 2000-Watt Society: An Energy-Economic Analysis for Switzerland

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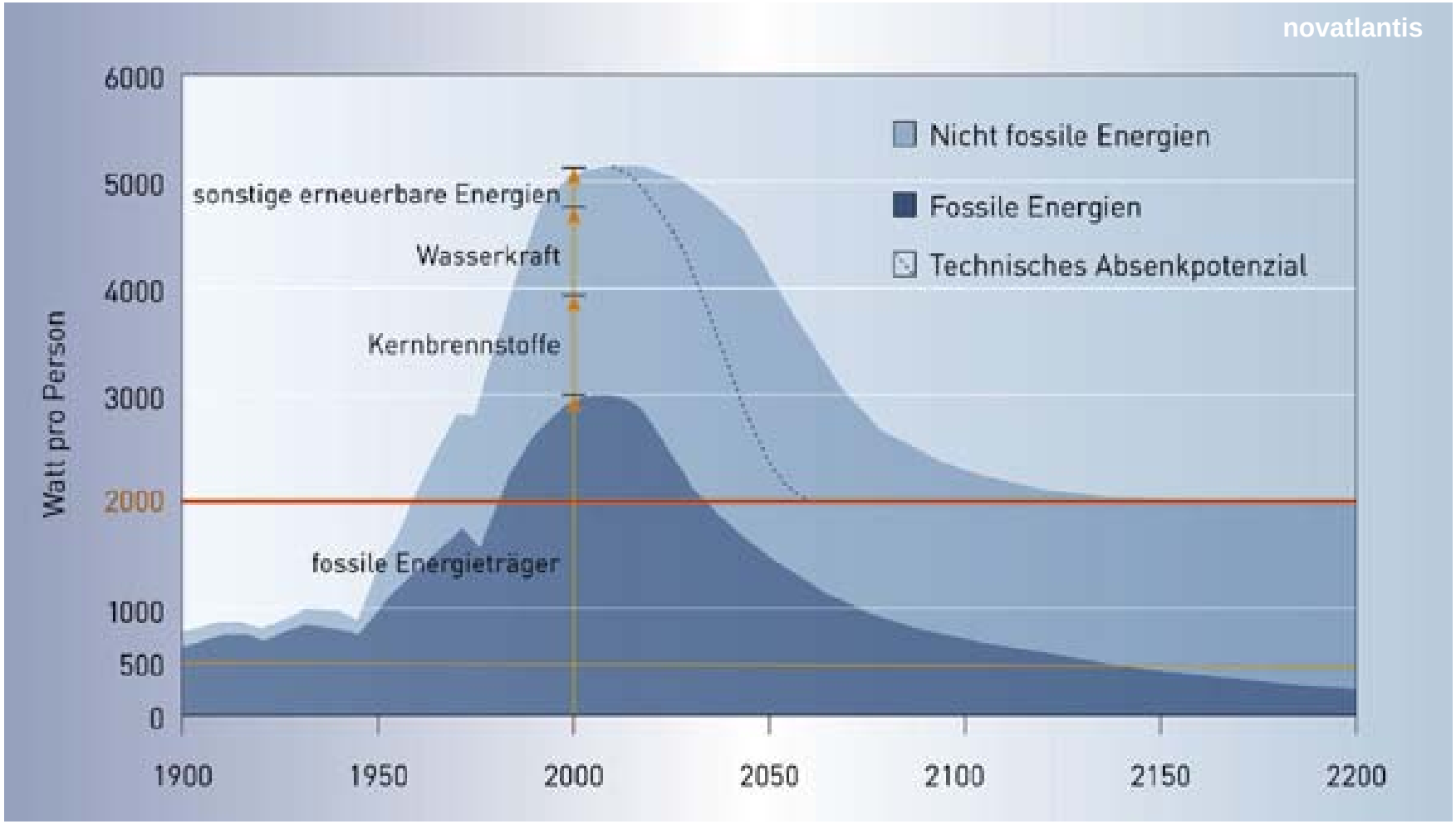
Switzerland

The vision of the 2000-Watt society



Research questions

- How much can the **primary-energy per capita** consumption be lowered until 2050?
- What are the cost-optimal **technical choices** until 2050?
- Will energy-related **CO_2 emissions** reduce substantially?
- What are the **costs** and the **Welfare losses** of reducing the primary energy and CO2 emissions per unit of GDP ?

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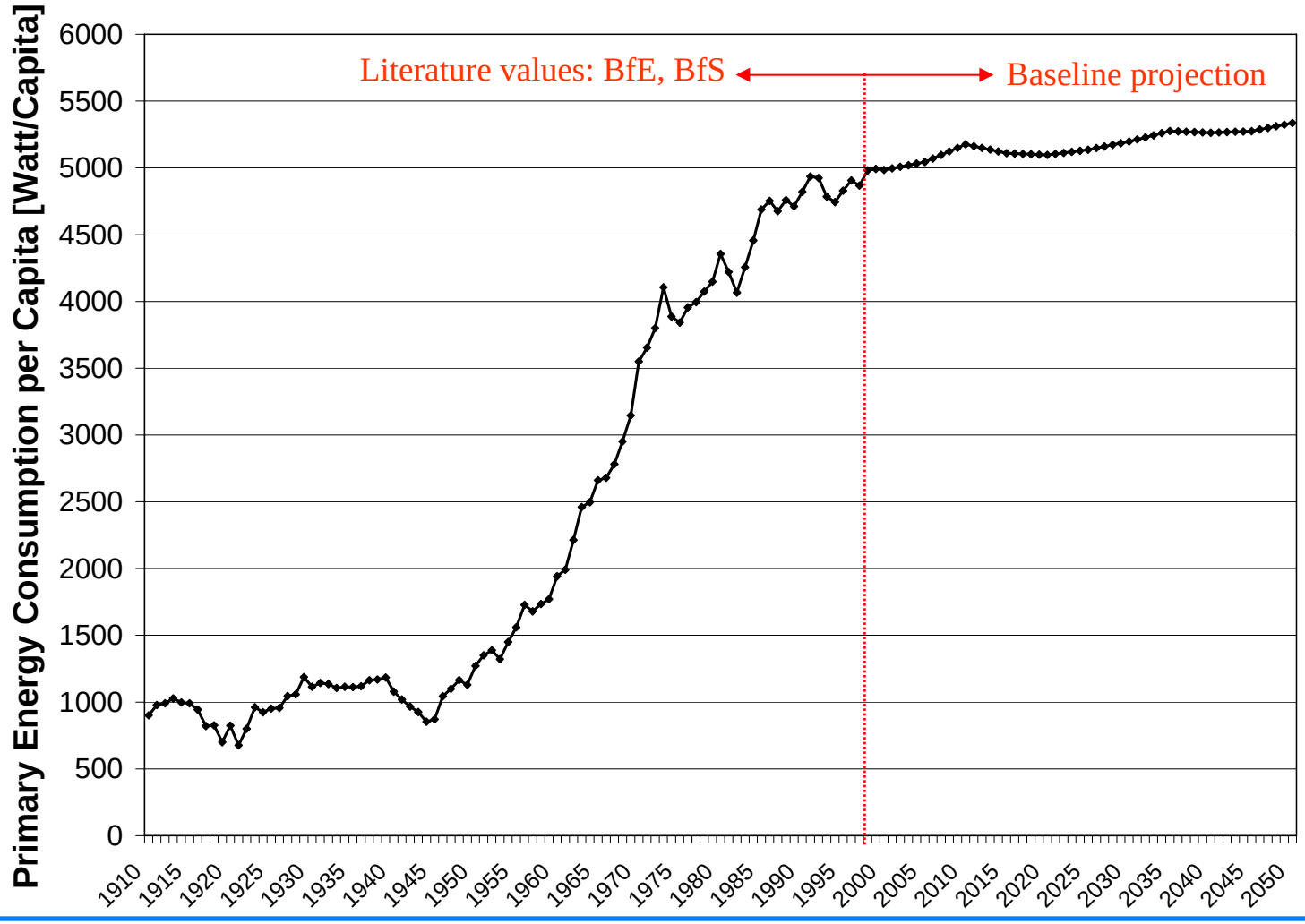
Methodology: The tool

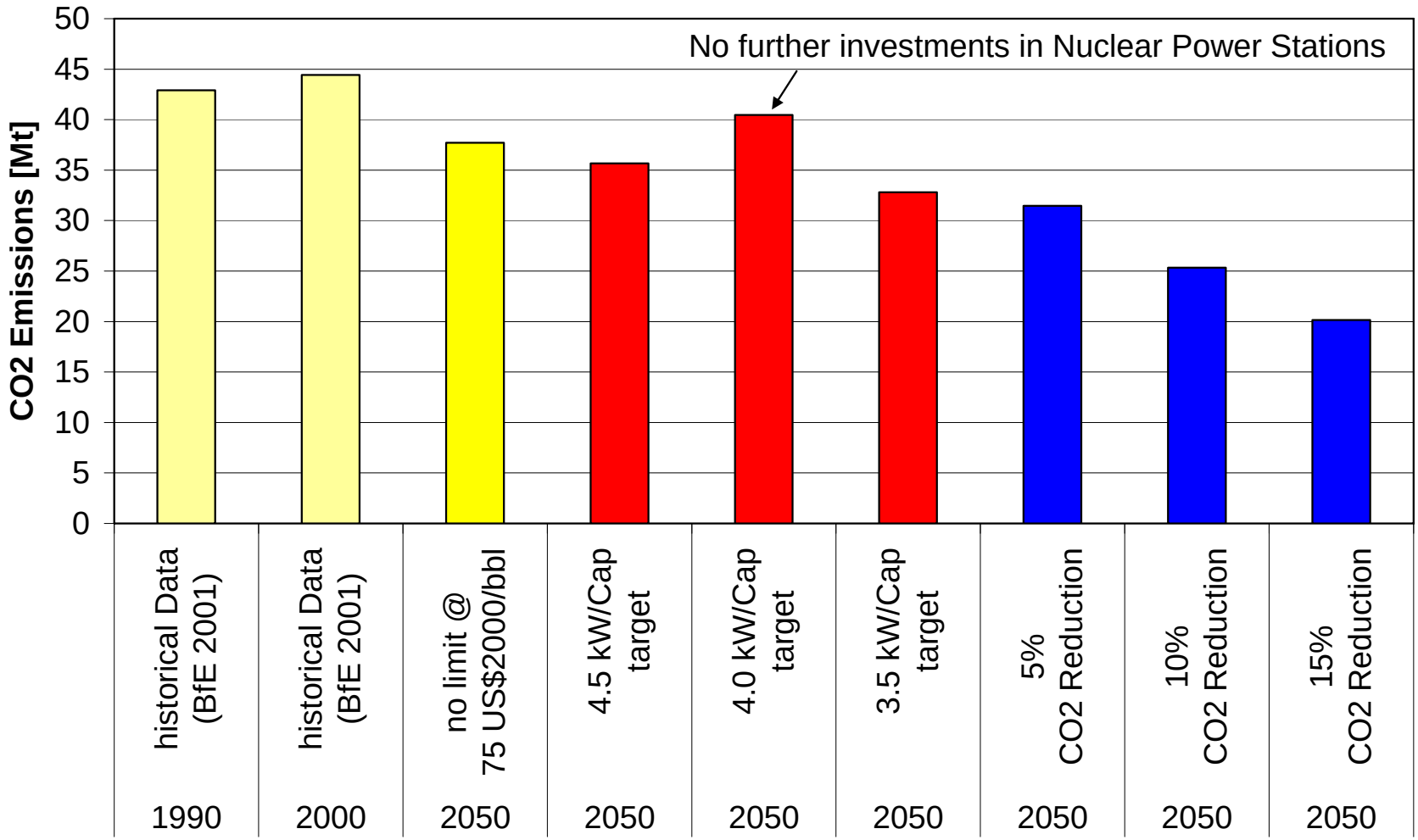
Swiss-MARKAL is a bottom-up perfect-foresight partial-equilibrium engineering model able to:

- identify least-cost energy systems across time
- and cost-effective responses to restrictions on emissions and primary energy constraints
- perform prospective analysis of long-term energy balances under different scenarios
- evaluate new technologies
- evaluate the effects of regulations, taxes, and subsidies

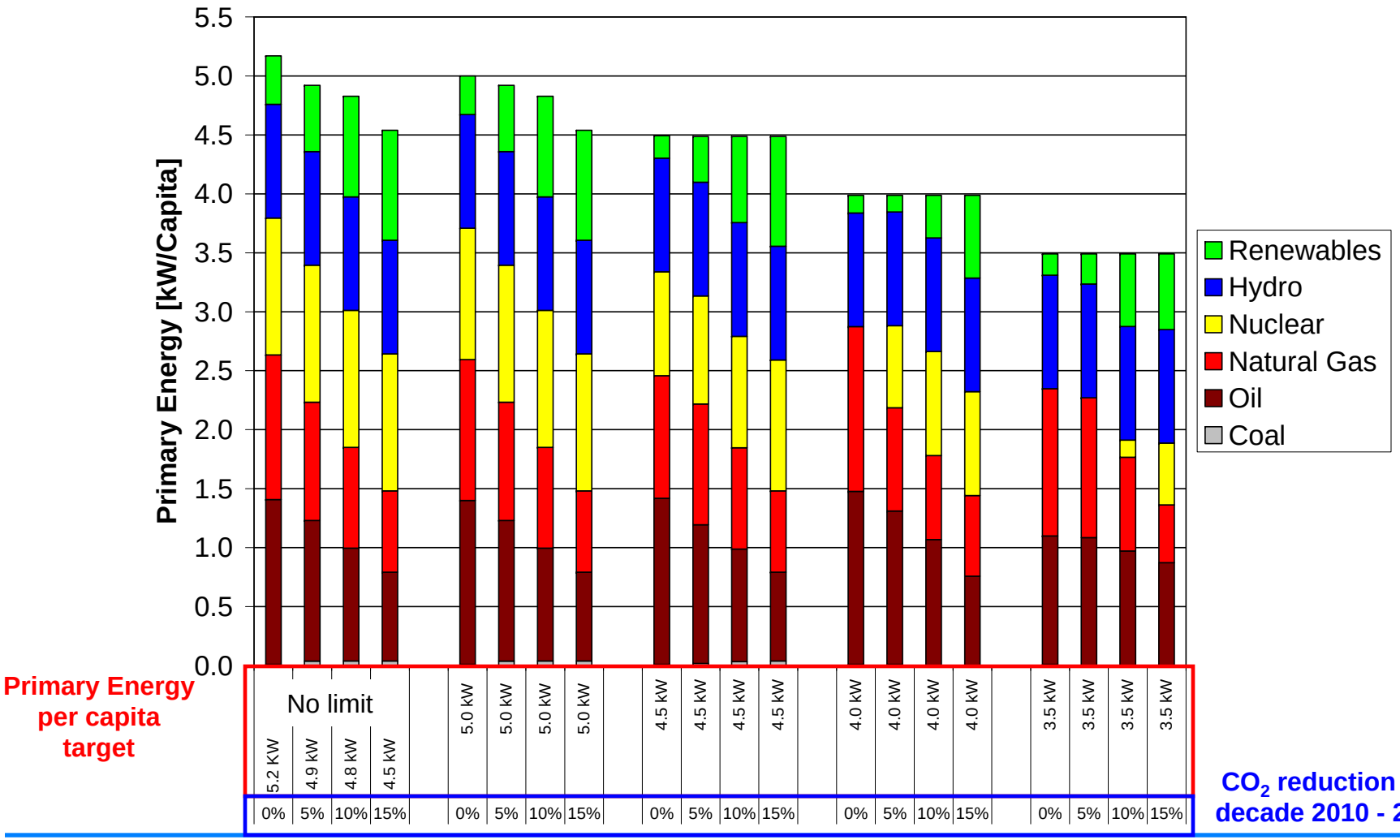
Literature & Baseline: Primary energy per capita



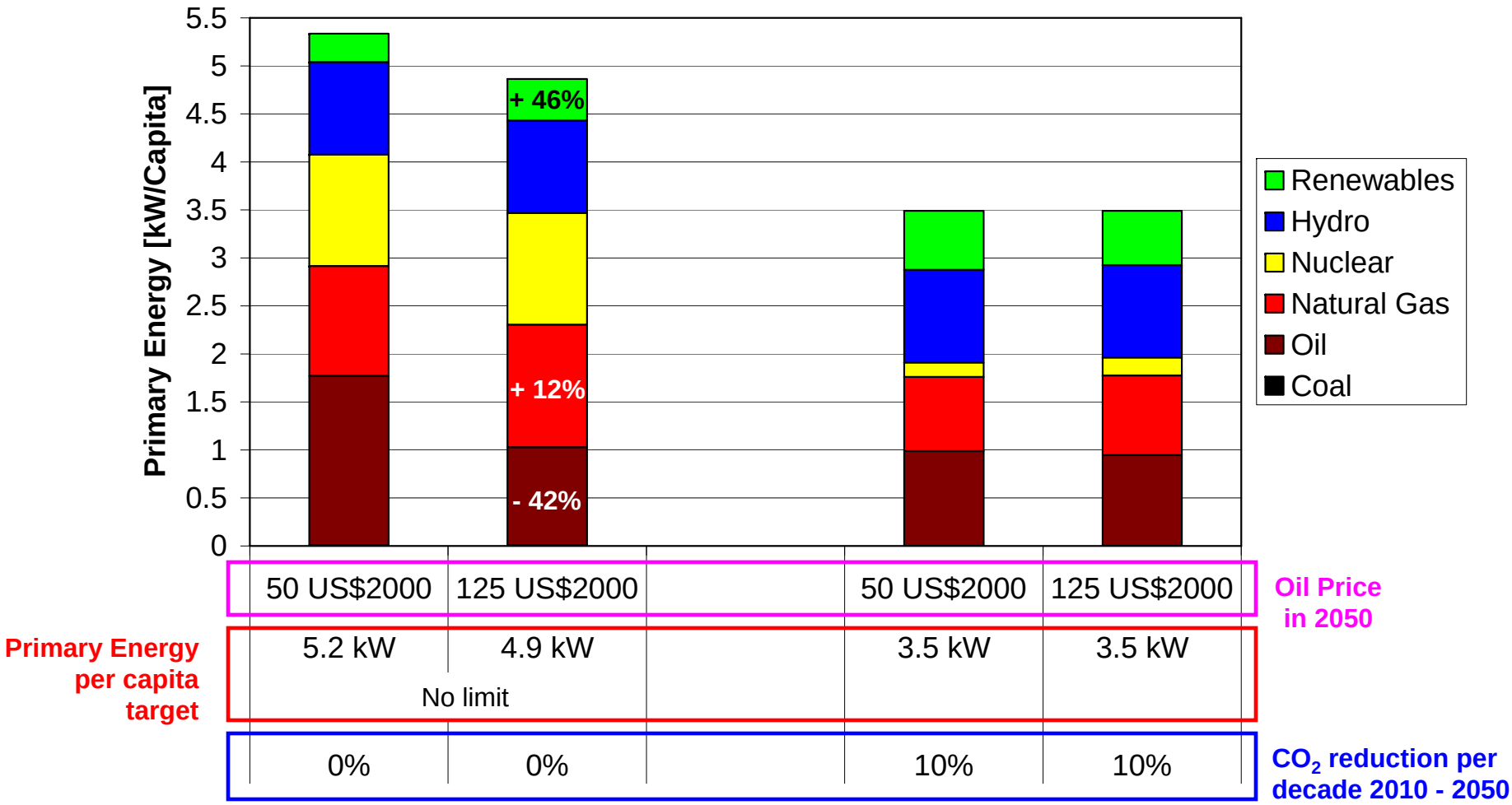
CO_2 emissions & imposed Constraints



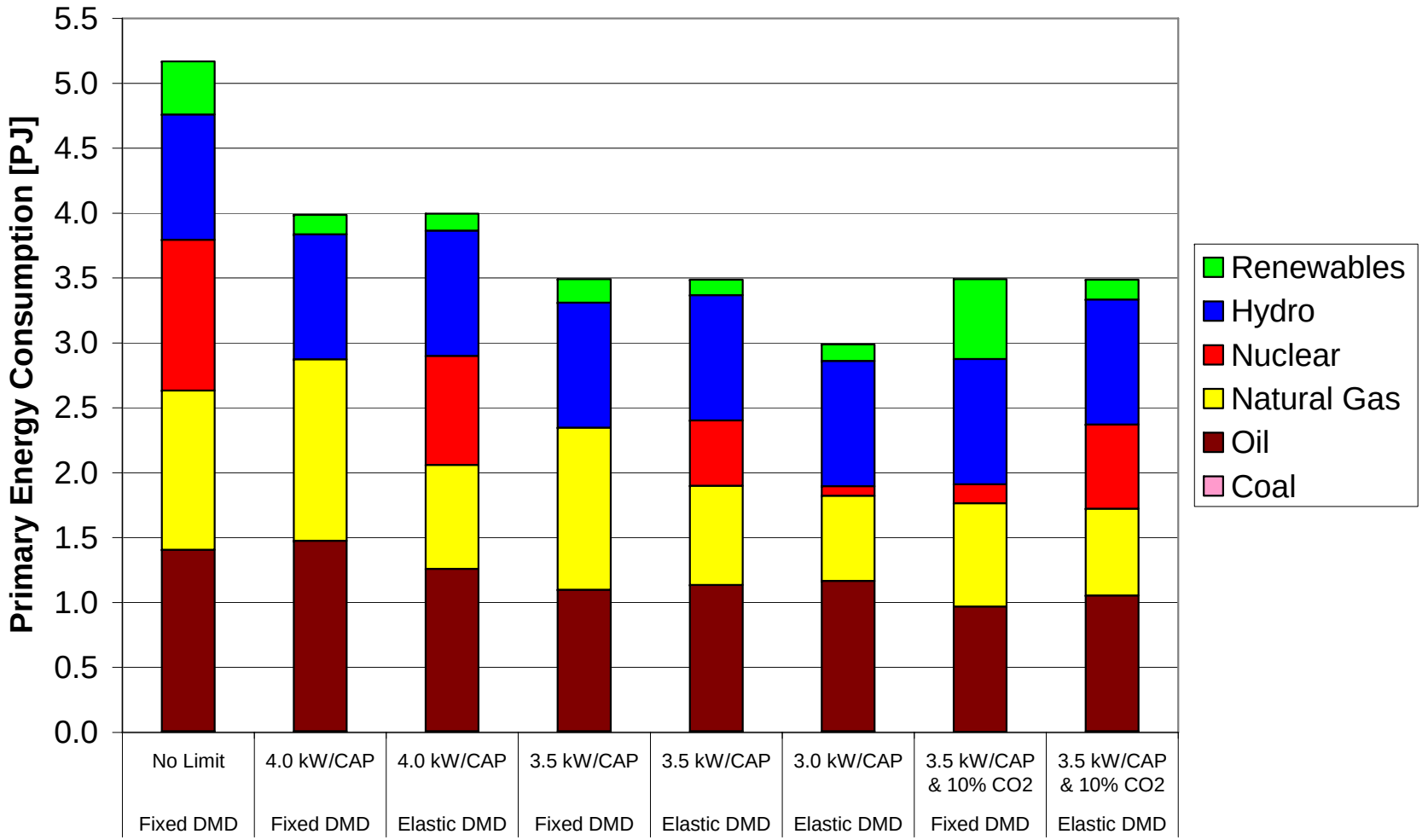
Primary energy per capita consumption



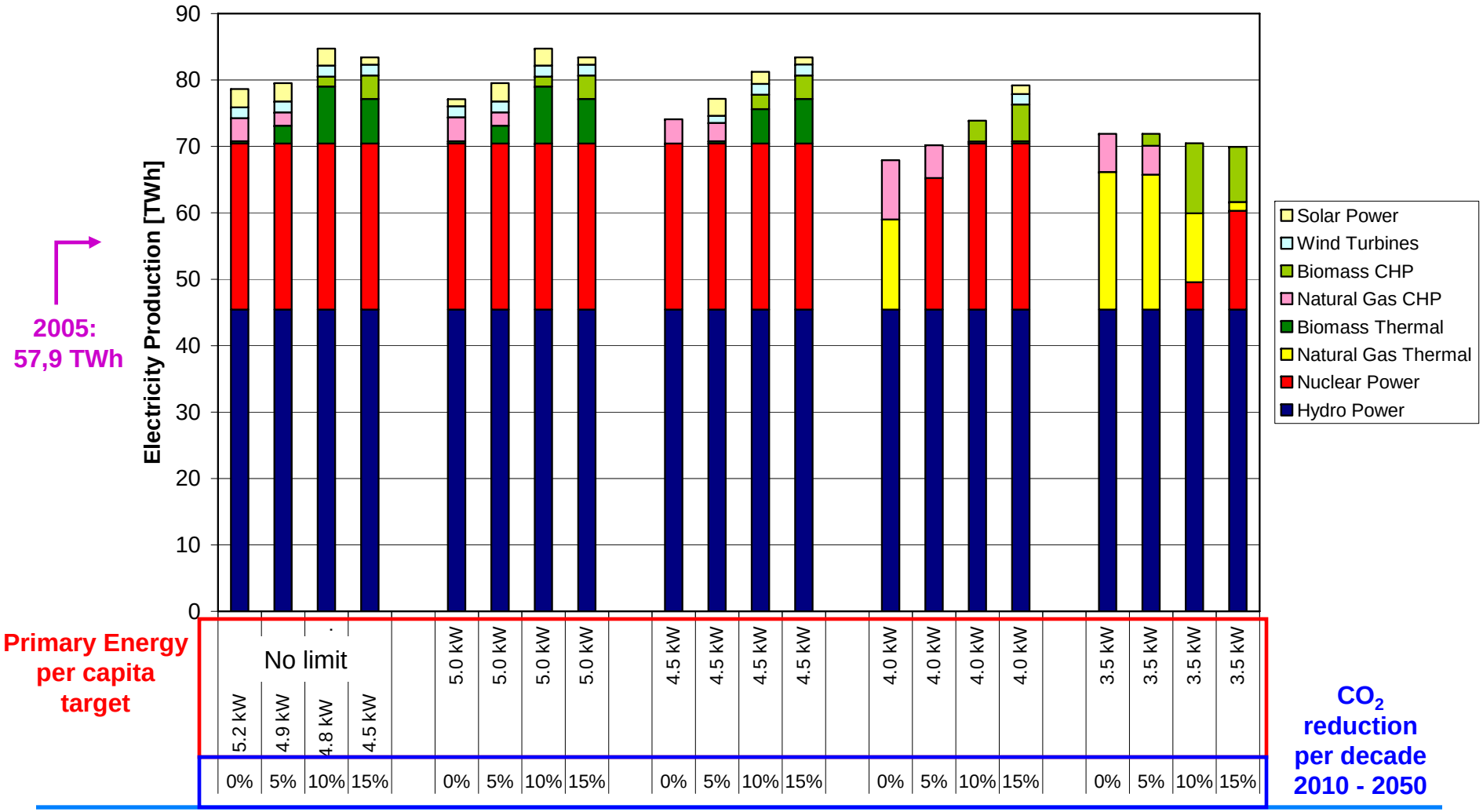
Primary energy per capita consumption (II)



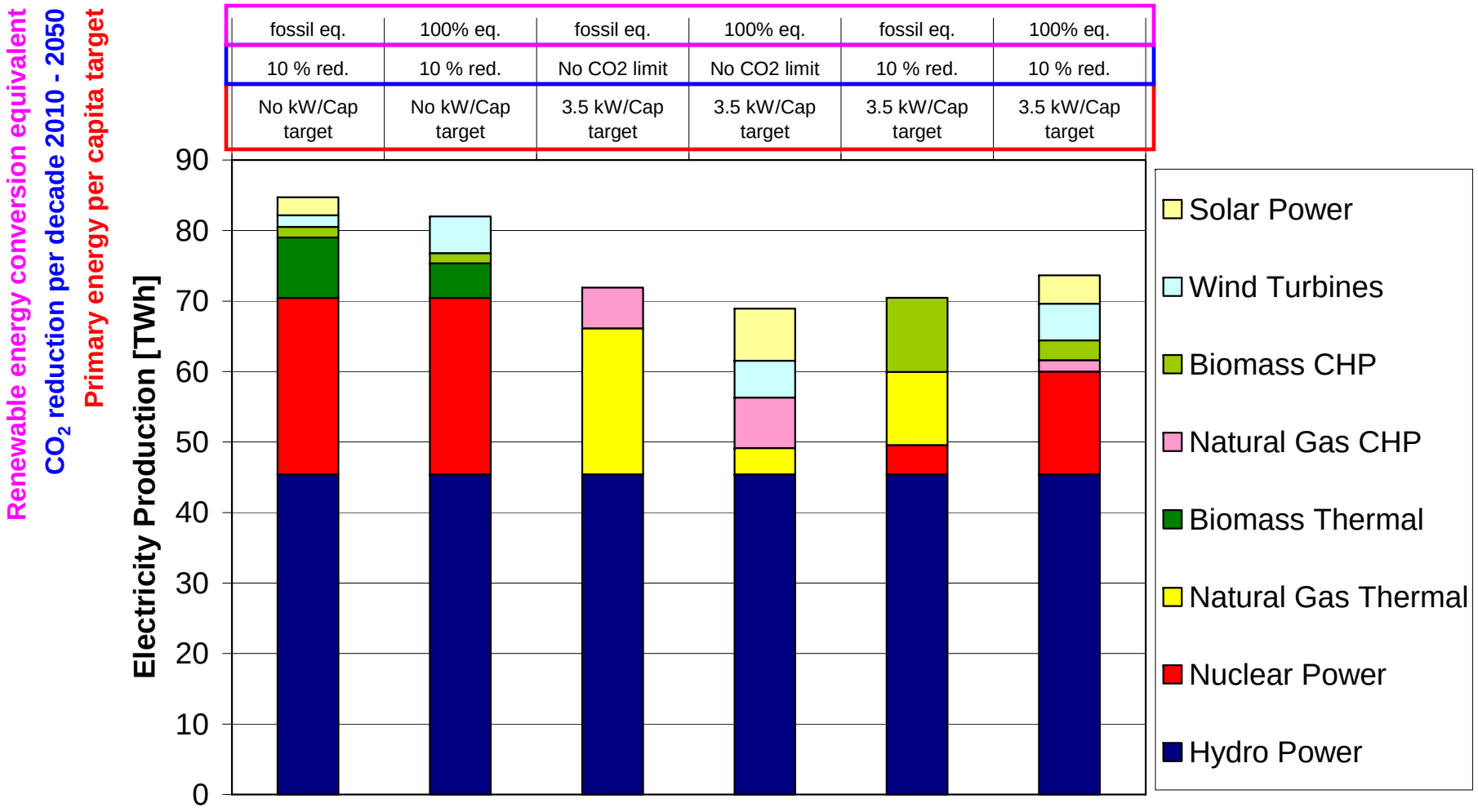
Primary energy per capita consumption (III) comparison with Elastic Demands (ED)



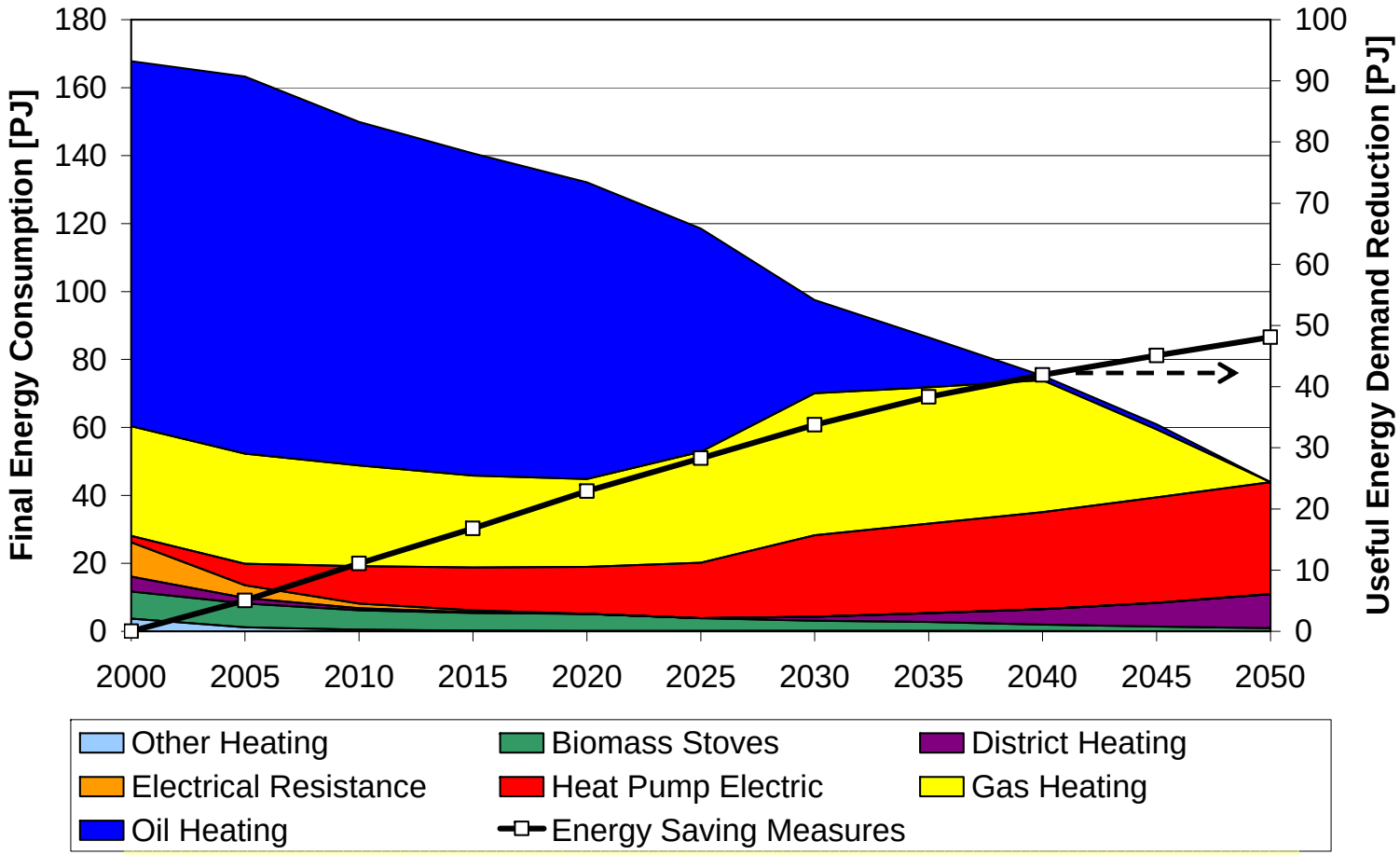
Electricity production



Electricity production: 100% equivalent



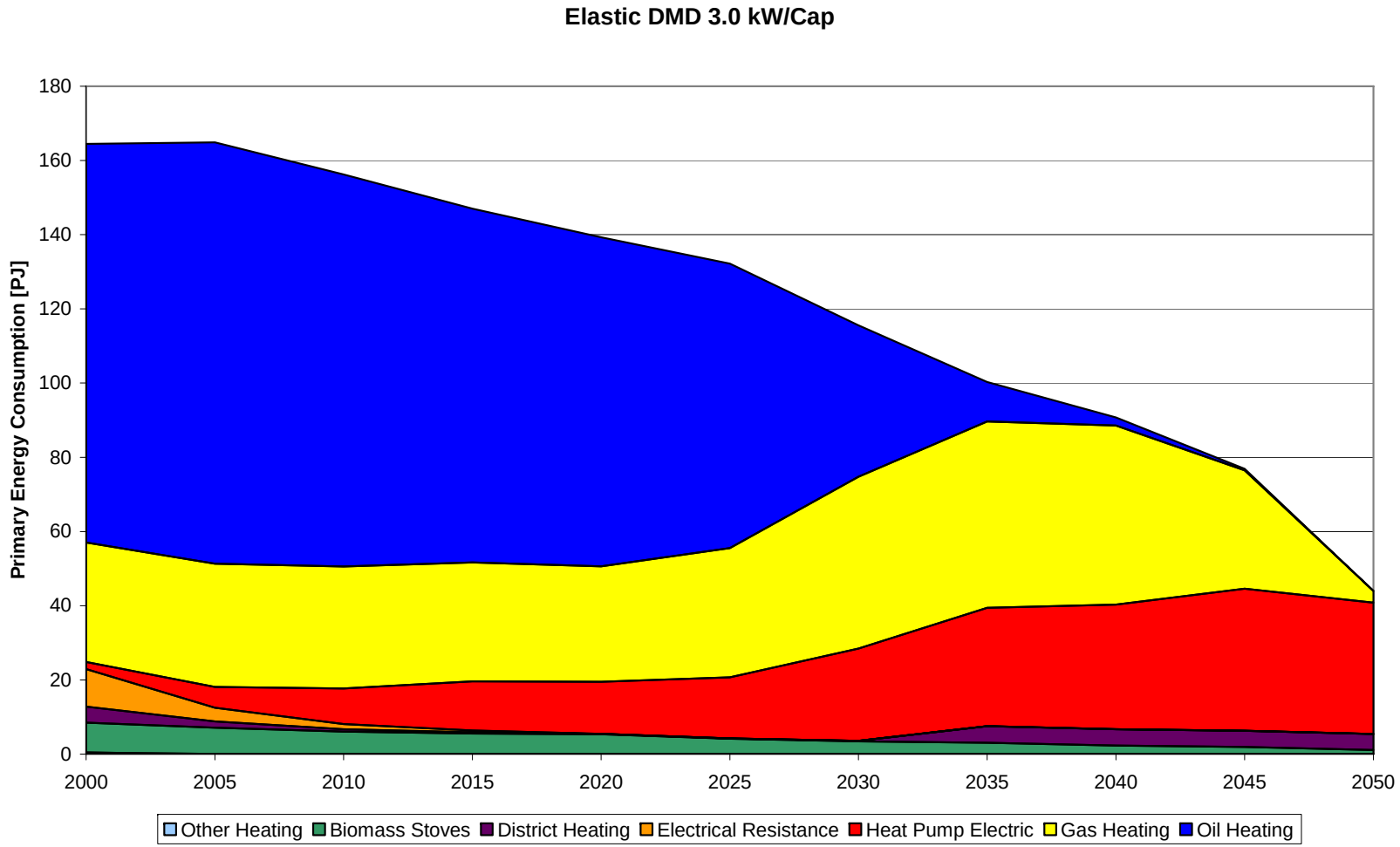
Residential heating: 3.5 kW/Cap



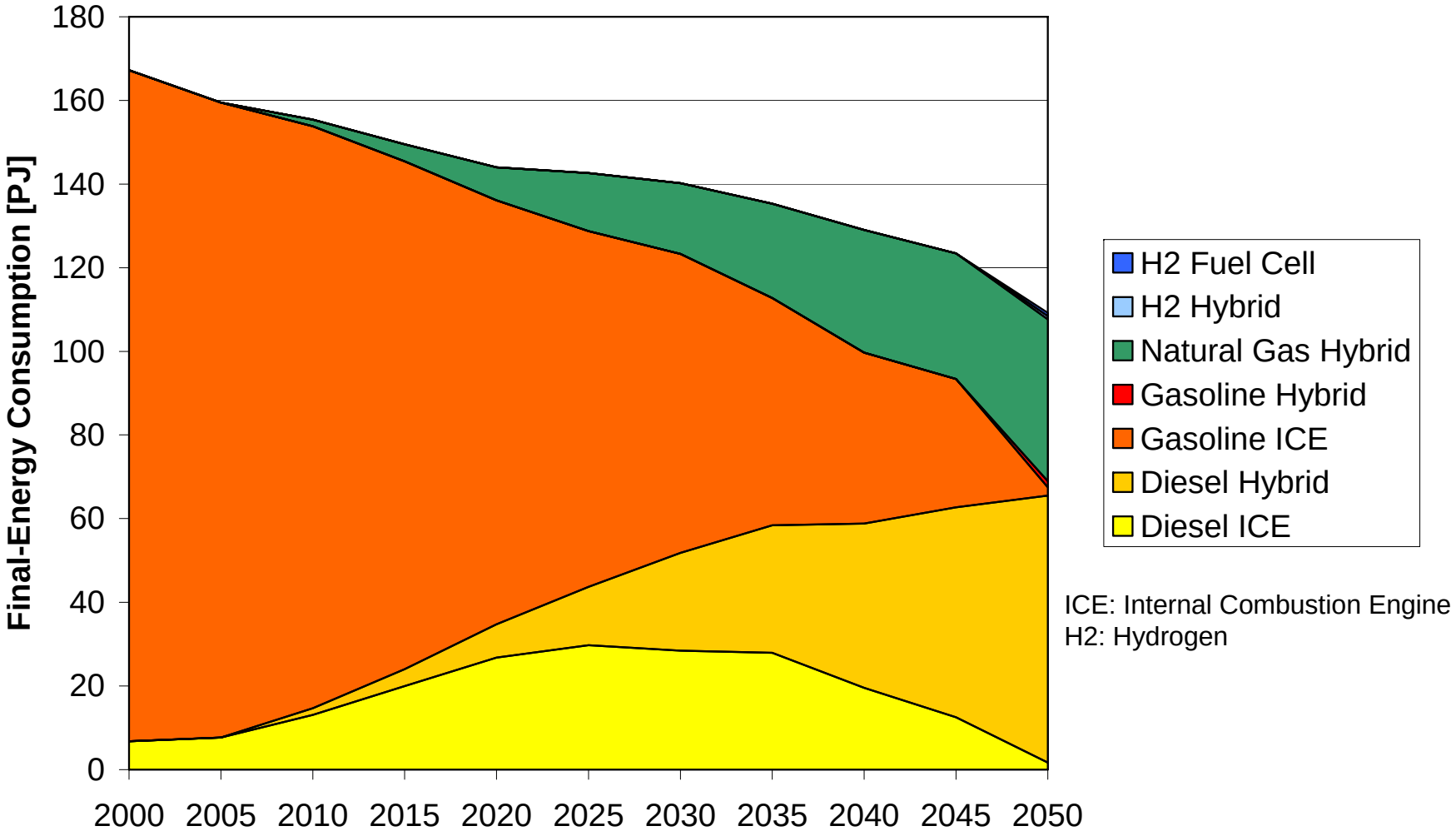
Useful Energy (Energy Demand) [TJ/a] =

Specific Room Heating Demand [MJ/m^2] * Energy Reference Floor Area [Mio. m^2]

Residential heating: 3.0 kW/Cap ED

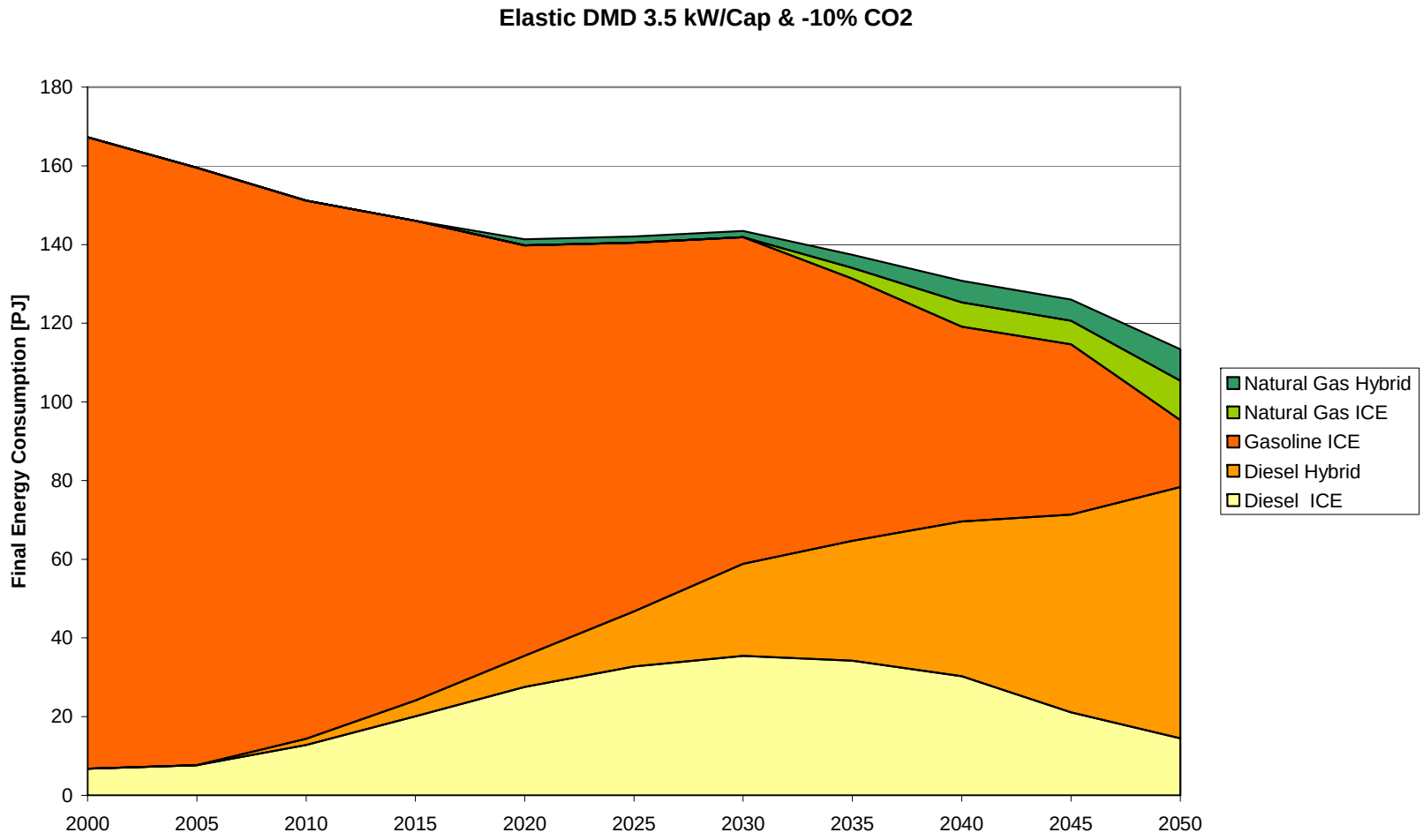


Passenger cars: 3.5 kW/Cap

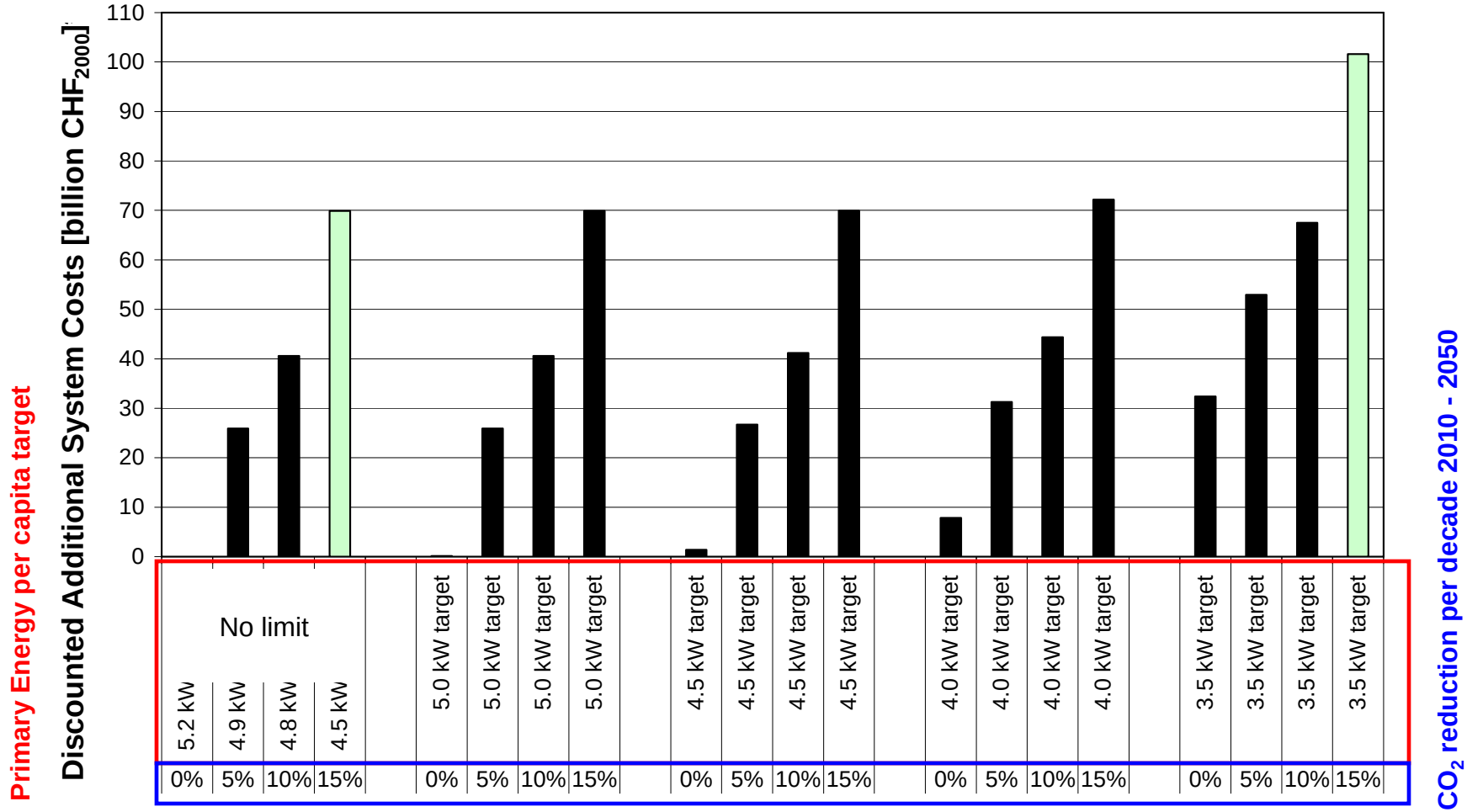


ICE: Internal Combustion Engine
H2: Hydrogen

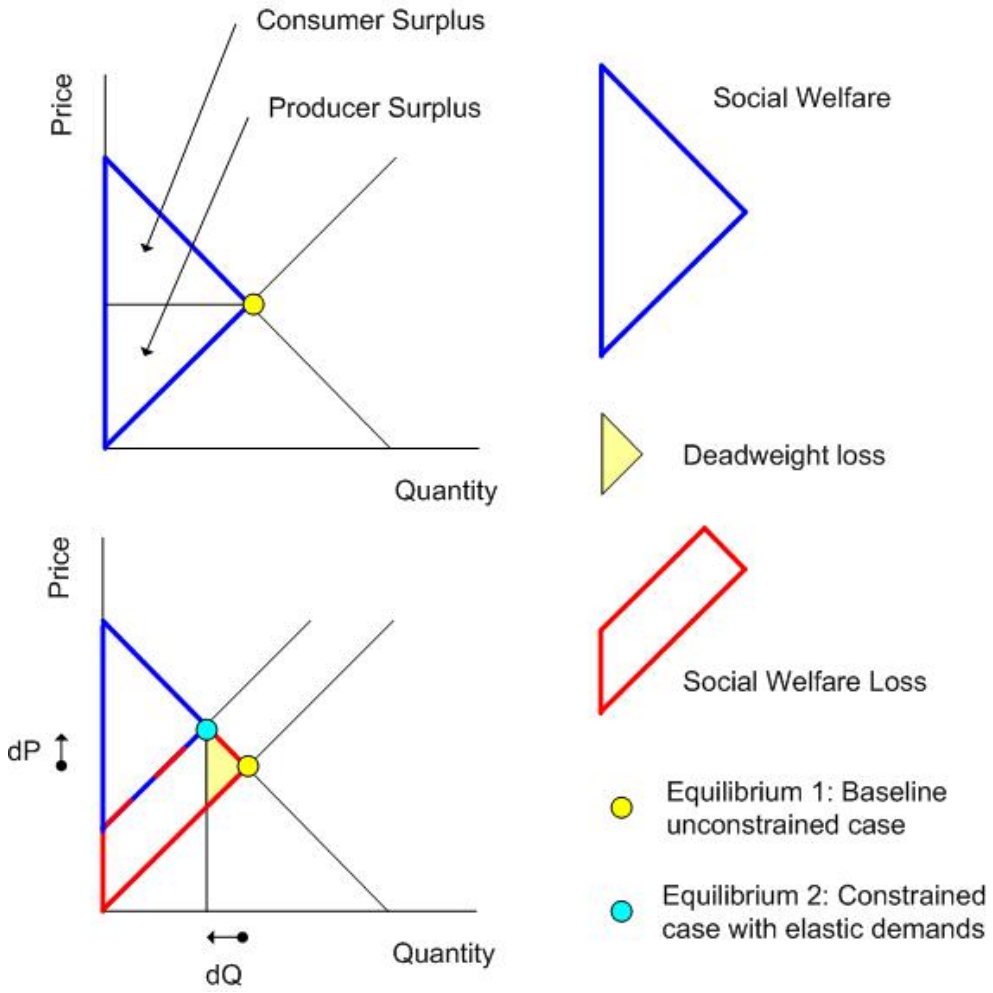
Passenger cars: 3.5 kW/Cap & -10% CO2 ED



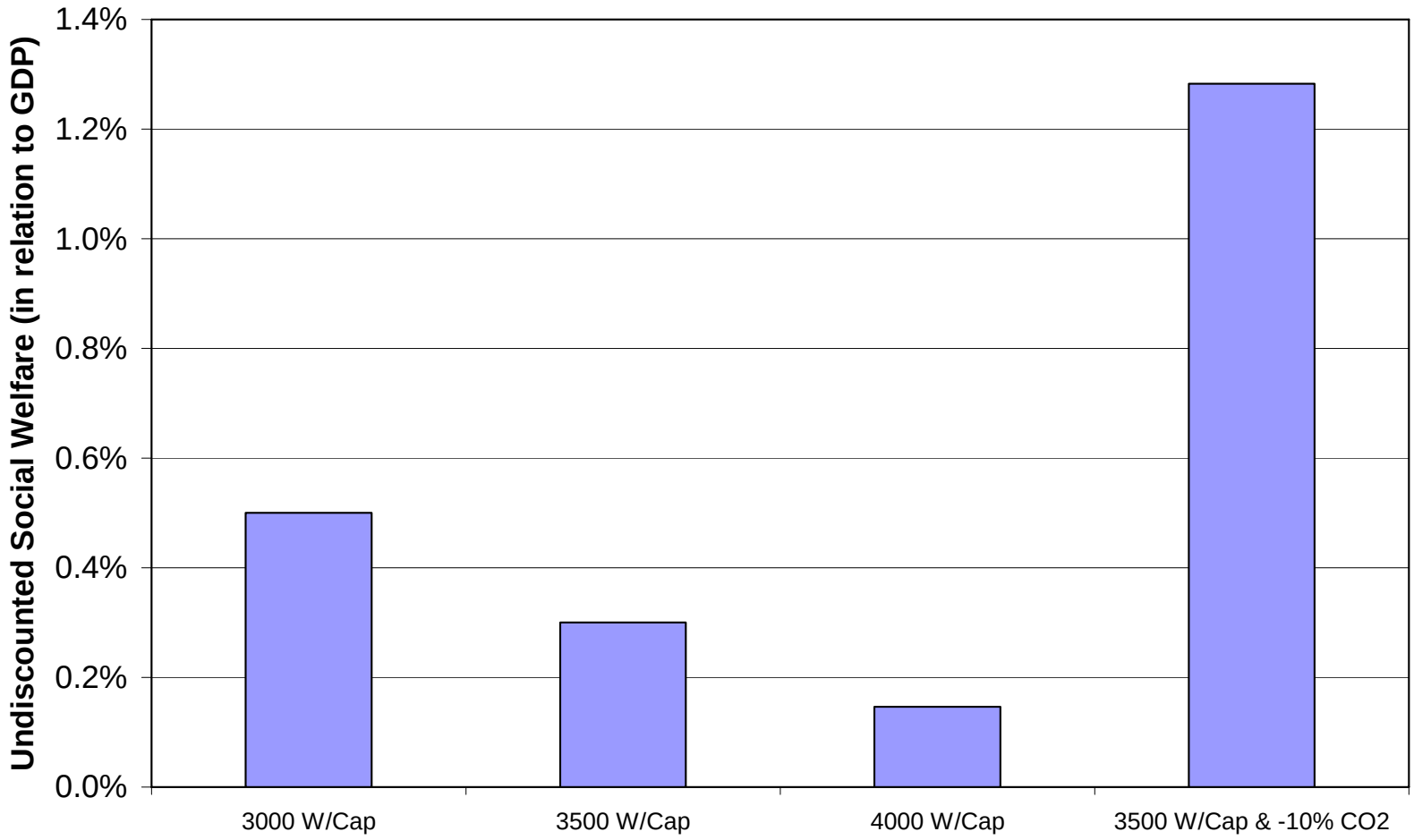
Total system costs



Deadweight and Social Welfare Loss



Social Welfare Loss per GDP



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Conclusions

- The primary energy per capita consumption target of 2000 Watts per capita should be seen as a **long-term goal**. During the first half of the century only intermediate steps towards the 2000-Watt society can be achieved.

- All primary energy per capita consumption targets until 2050 can reduce **CO_2 emissions to an equivalent of 5%** per decade at maximum. For significant CO_2-emission reductions, targets must be formulated explicitly.

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Conclusions (continued)

- This transformation is associated with **sizeable costs**. Following ambitious combined primary energy per capita and CO_2 targets is more expensive than following strict CO_2 reduction targets.

- To achieve already intermediate steps requires a **transformation of the energy use** as we know it today. The transformation can be identified especially in the residential and transportation sectors. The production of electricity will increase substantially.