

Alternative fuels and energy efficiency in transport

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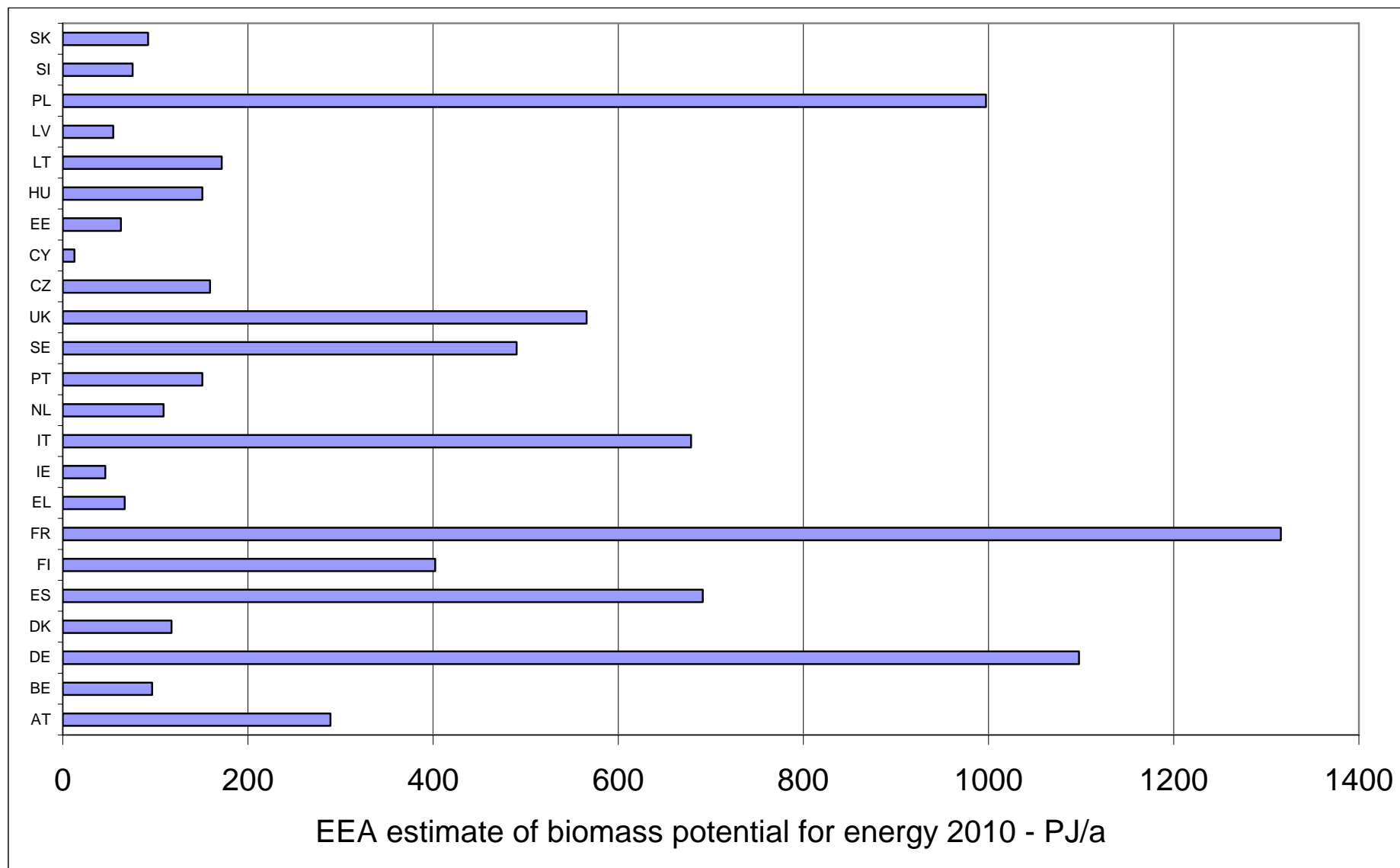
ISSUES COMPARING ENERGY CARRIERS

- renewable energy does not make energy efficiency superfluous
 - in practice always competition on land
- functional requirements
- costs - vehicle, infrastructure, fuel
- flexibility for energy resource
- demand for break with development of vehicles and infrastructure
- etc.

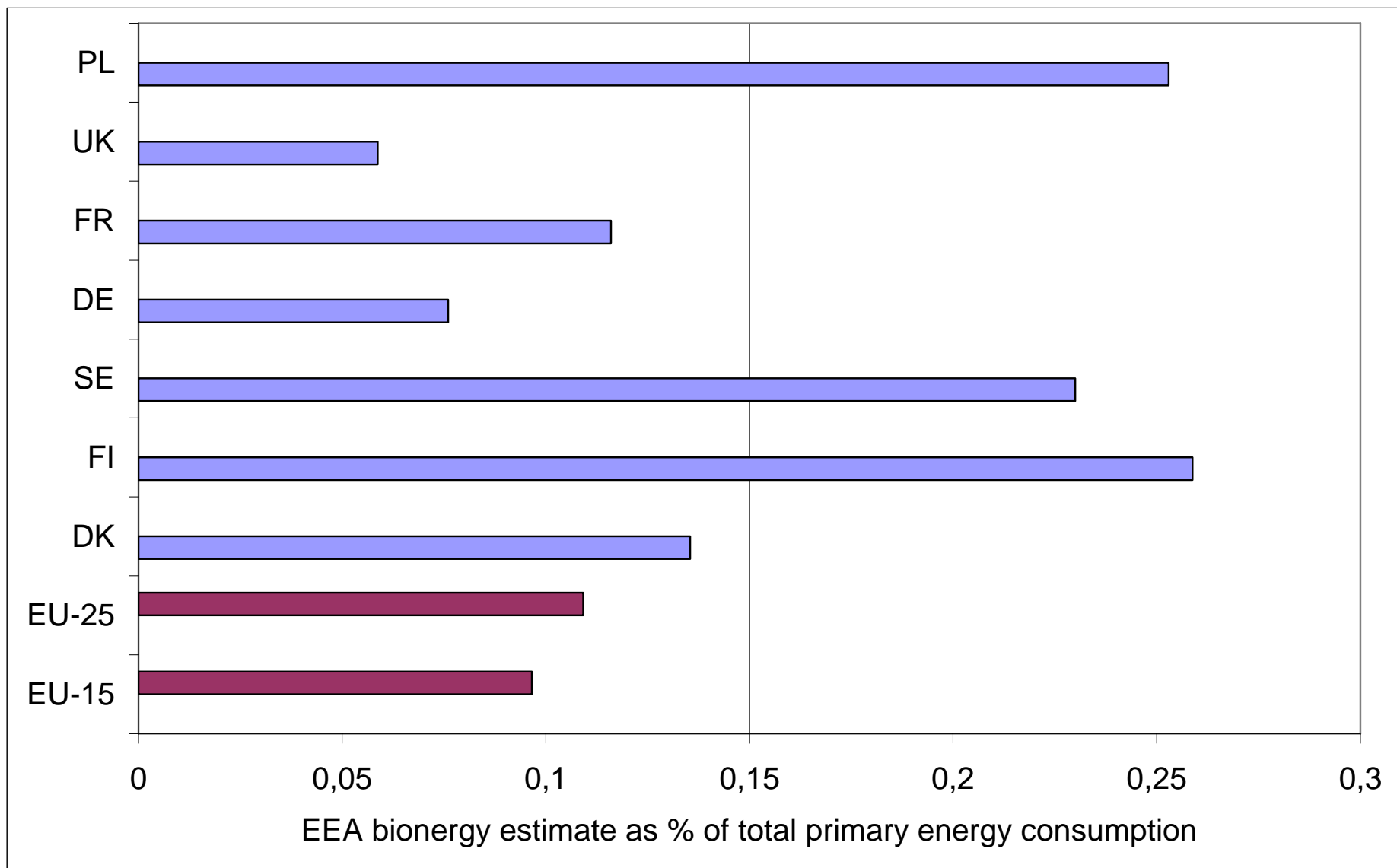
ENVIRONMENTAL BIOMASS POTENTIAL (EEA)

- "How much bioenergy can Europe produce without harming the environment?". EEA Report 7-2006 (www.eea.europa.eu)
- for 25 EU-members, EU-25 and EU-15
- 2010, 2020 and 2030
- environmental adapted: must not contribute negatively to the environmental load with respect to biodiversity, soil, water resource – or any other environmental considerations

ENVIRONMENTAL BIOMASS POTENTIAL (2010)



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BIOMASS AS ENERGY RESOURCE FOR TRANSPORT?

- bio-fuels, especially liquid, an easy solution - to a point
- very short time perspective, especially at low percentages
- do not require break with present fuel supply infrastructure
- inflexible concerning renewable energy source - in practice only biomass

LIMITATIONS OF BIO-FUELS

- direct competition (on land) with food and other applications
 - 1st generation bio-fuels
- is limited by the overall biomass frame
 - any generation
- "waste" is not necessarily waste
- well-to-wheel impacts: energy, CO₂, water etc.
- costs

OVERVIEW OF ELECTRICITY AND HYDROGEN

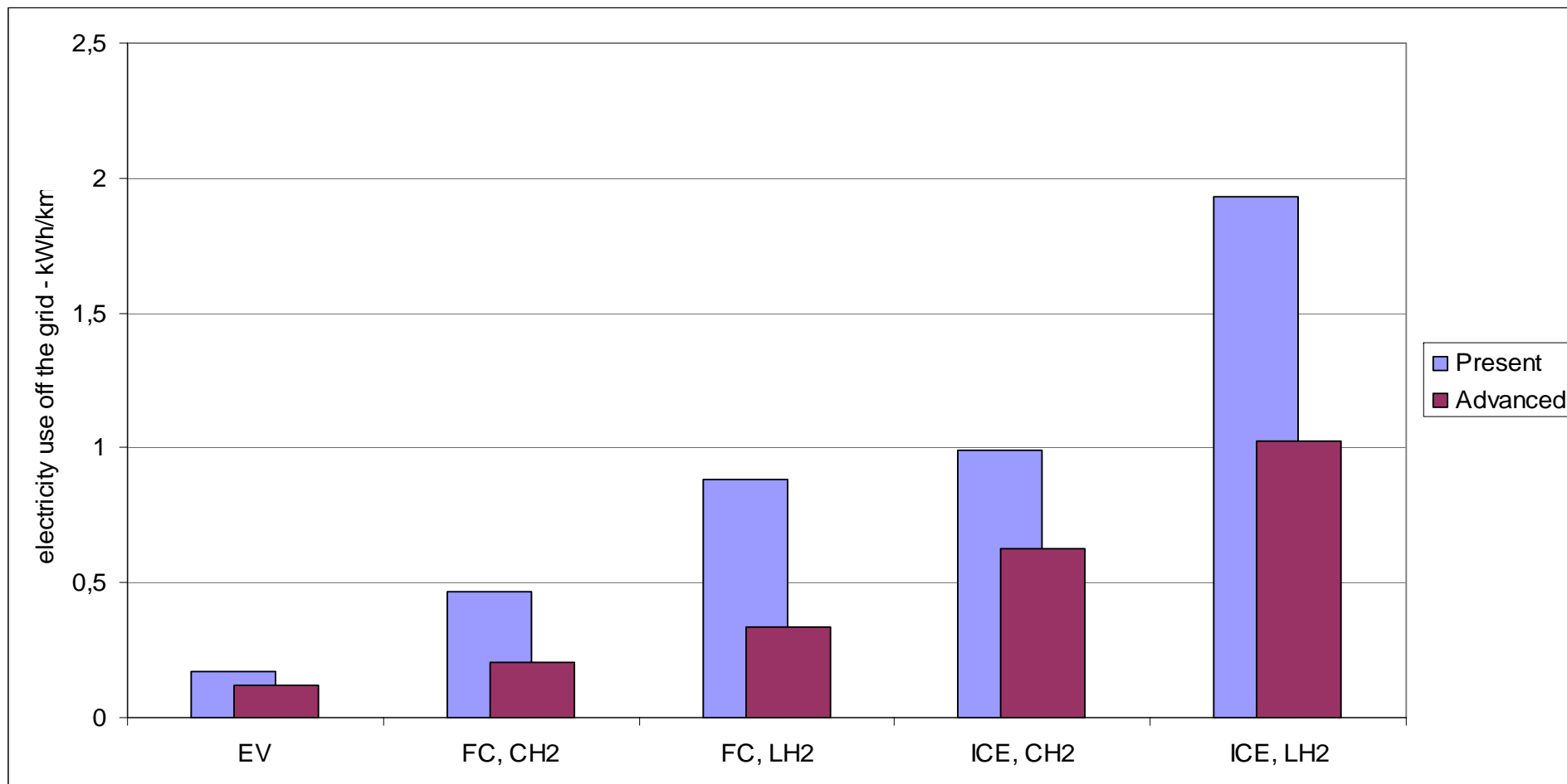
- require reack with the present development
- very long-term
- has potential to cover entire trasport sector demand
- extremely flexible - to both sustainable and unsustainable options

ELECTRICITY/ELECTRICITY IN TRANSPORT

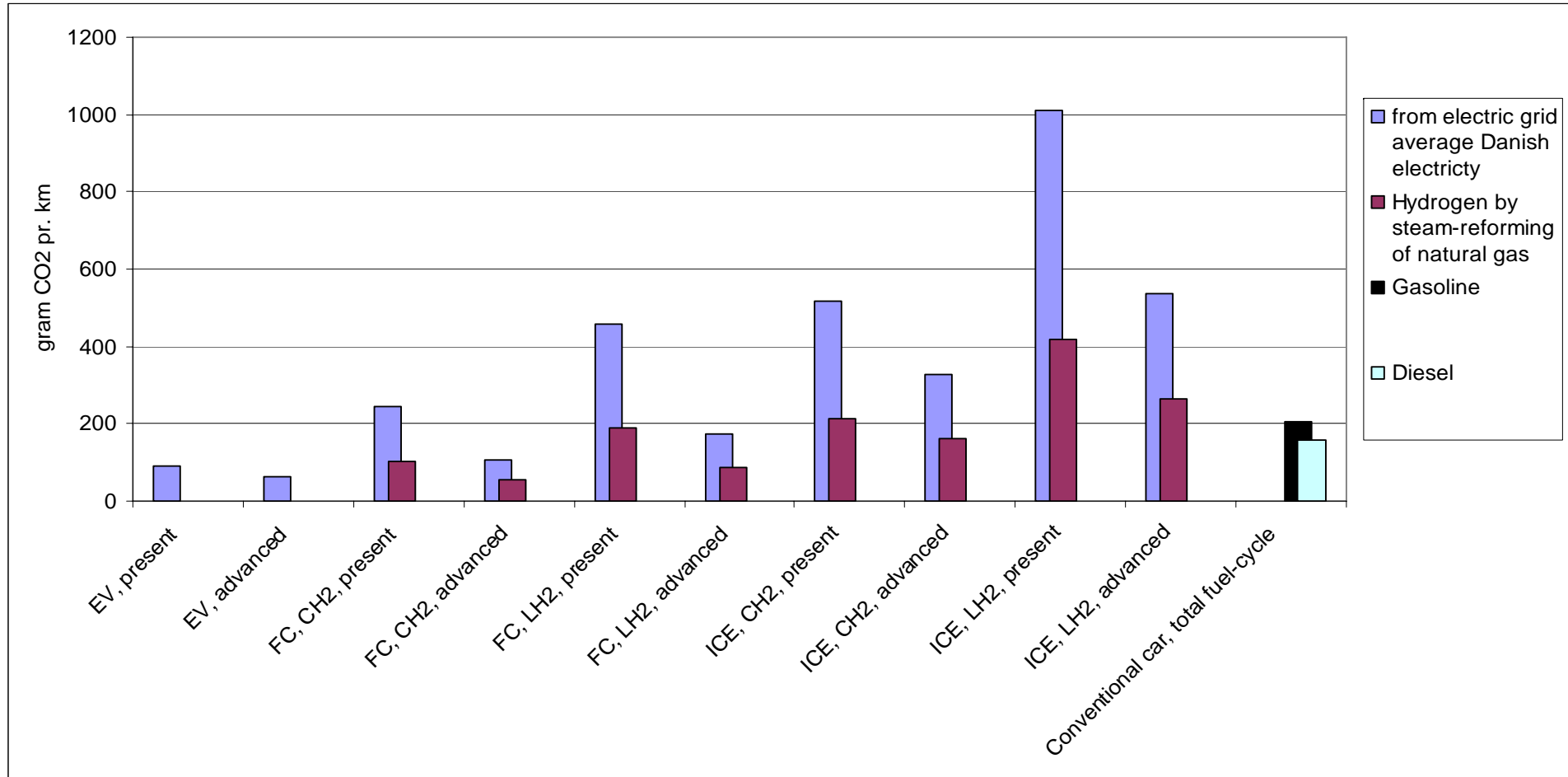
- electricity as energy carrier
 - electric vehicles
 - (plugin) hybrid electric vehicles
- hydrogen as energy carrier
 - e.g. generated by electrolysis
 - ICE or fuel cells/electric motors - maybe hybrid electric vehicles
 - onboard storage: CH_2 , MeH, LH_2 etc.
 - maybe liquids converted onboard: gasoline, methanol etc.

ELECTRIC PROPULSION - PLUG-IN OR ONBOARD
GENERATION OF ELECTRICITY

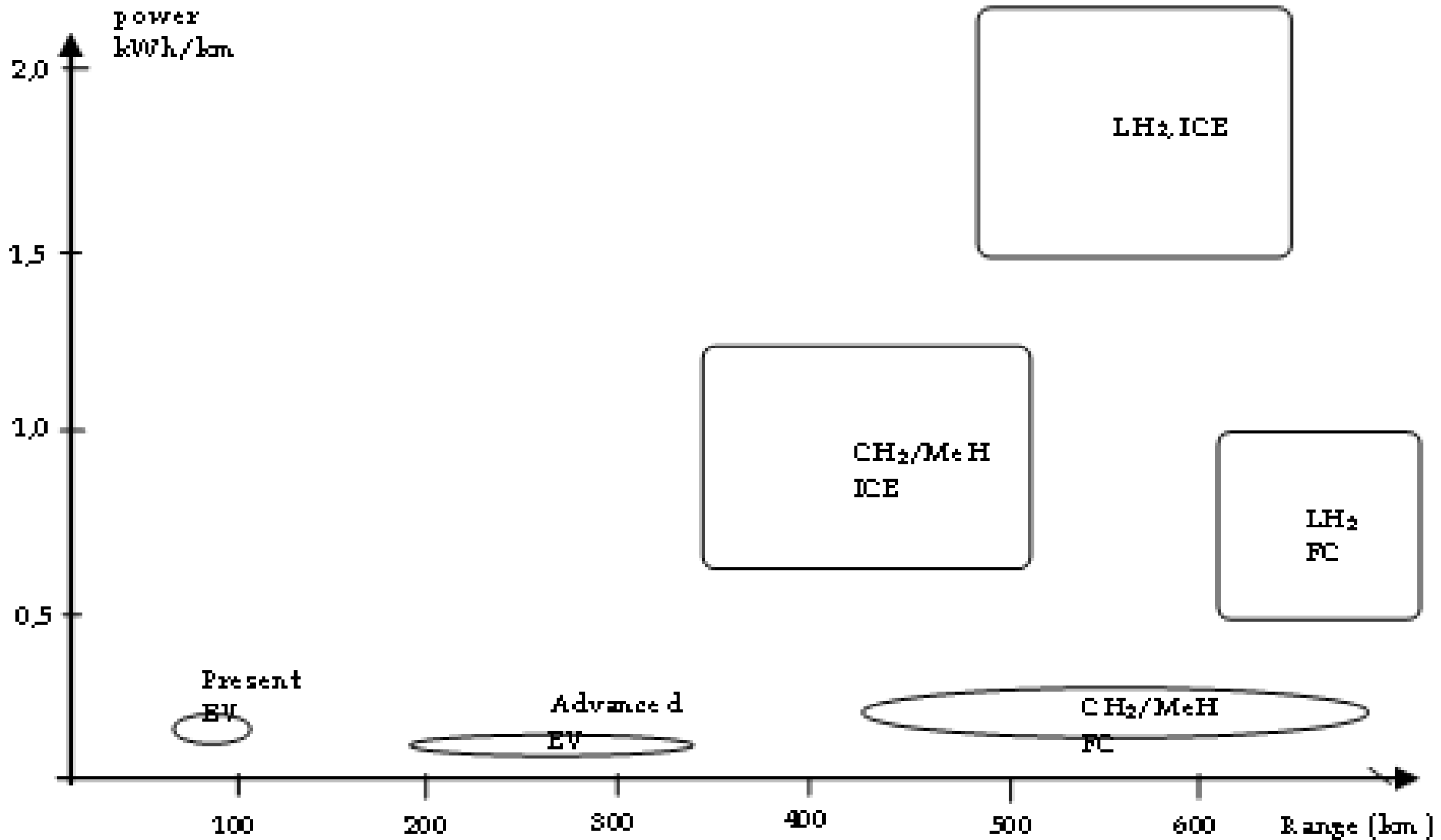
ELECTRICITY CONSUMPTION - KWH OFF THE GRID



ESTIMATED EMISSIONS - GRAM CO₂ PER KM



RANGE AND SPECIFIC ELECTRICITY



CO₂-NEUTRAL FUELS AND/OR ENERGY EFFICIENCY

- Californian ZEV-mandate in 1990
- technology push AND substantial cuts in emissions
- except for CO₂
- what about energy efficiency and CO₂?
- EU regulation of CO₂-emissions in motor vehicles

CONCLUSIONS

- quick, easy but partial (at best)
 - vs. long-term, troublesome but in potentially covering whole transport sector
- electricity/hydrogen offers no guarantee for sustainability
- biomass will remain a limited and problematic resource with many potential applications
- EVs generally have better energy efficiency than hydrogen - huge variations within each
- EVs require changes in perception of automobile
 - the issue must be addressed
- no completely clean or CO₂-neutral solutions in a foreseeable future
- no simple choices
- development depends on strong instruments