

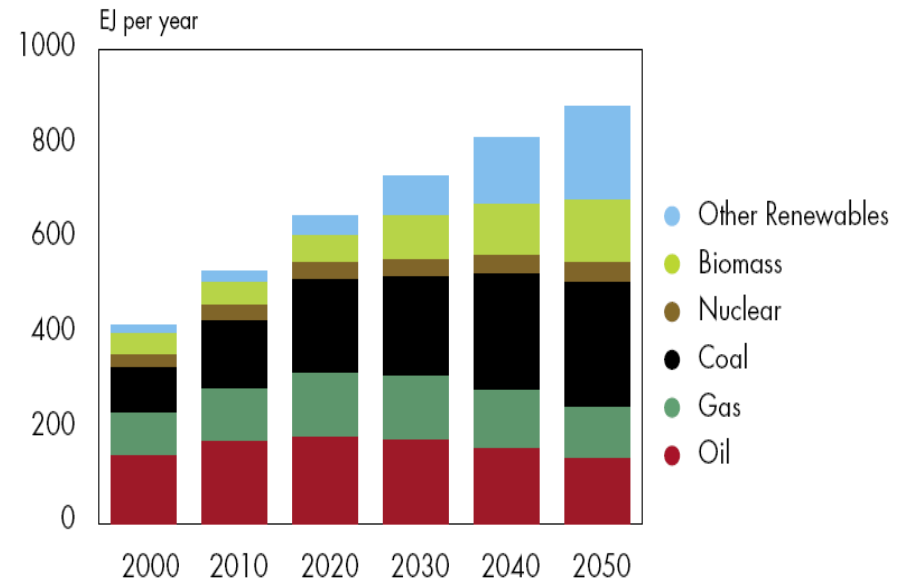
Prof. Armin Grunwald

Energy Futures: Projections,  
Analysis and Policy Conclusions

# Energy Futures are

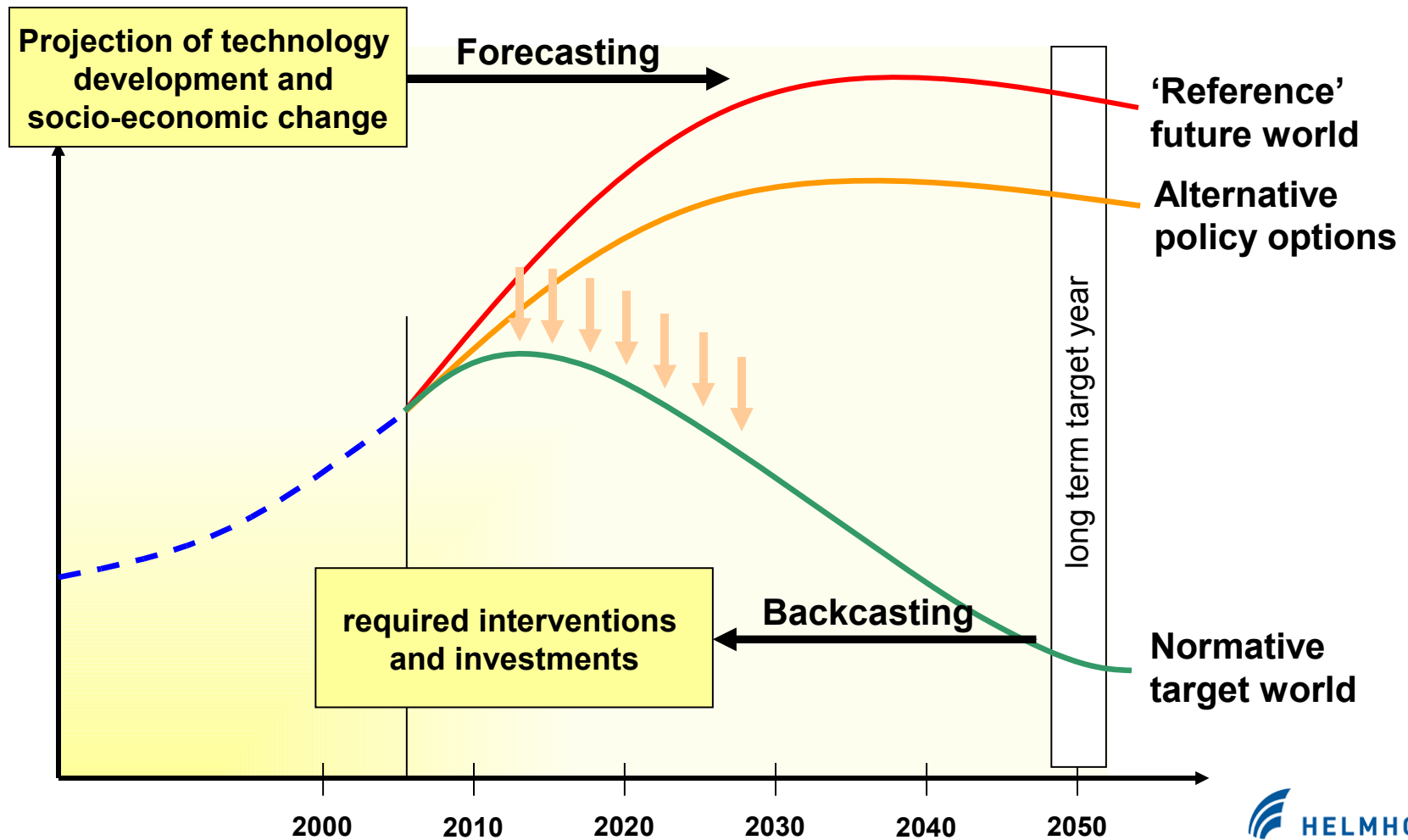
- scenarios including any energy issues (demand, supply, development of natural resources, development of technology etc.)
- roadmaps (innovation paths, technology routes etc.)
- foresight exercises including energy issues
- predictions and forecasts of future energy demand and supply
- predictions of future availability of resources (oil, uranium etc.)
- models of the availability of future technologies and of their economics
- .....

Primary energy by source



Biomass includes traditional renewables such as wood, dung, etc.

# Energy futures orientate energy policies and public debate

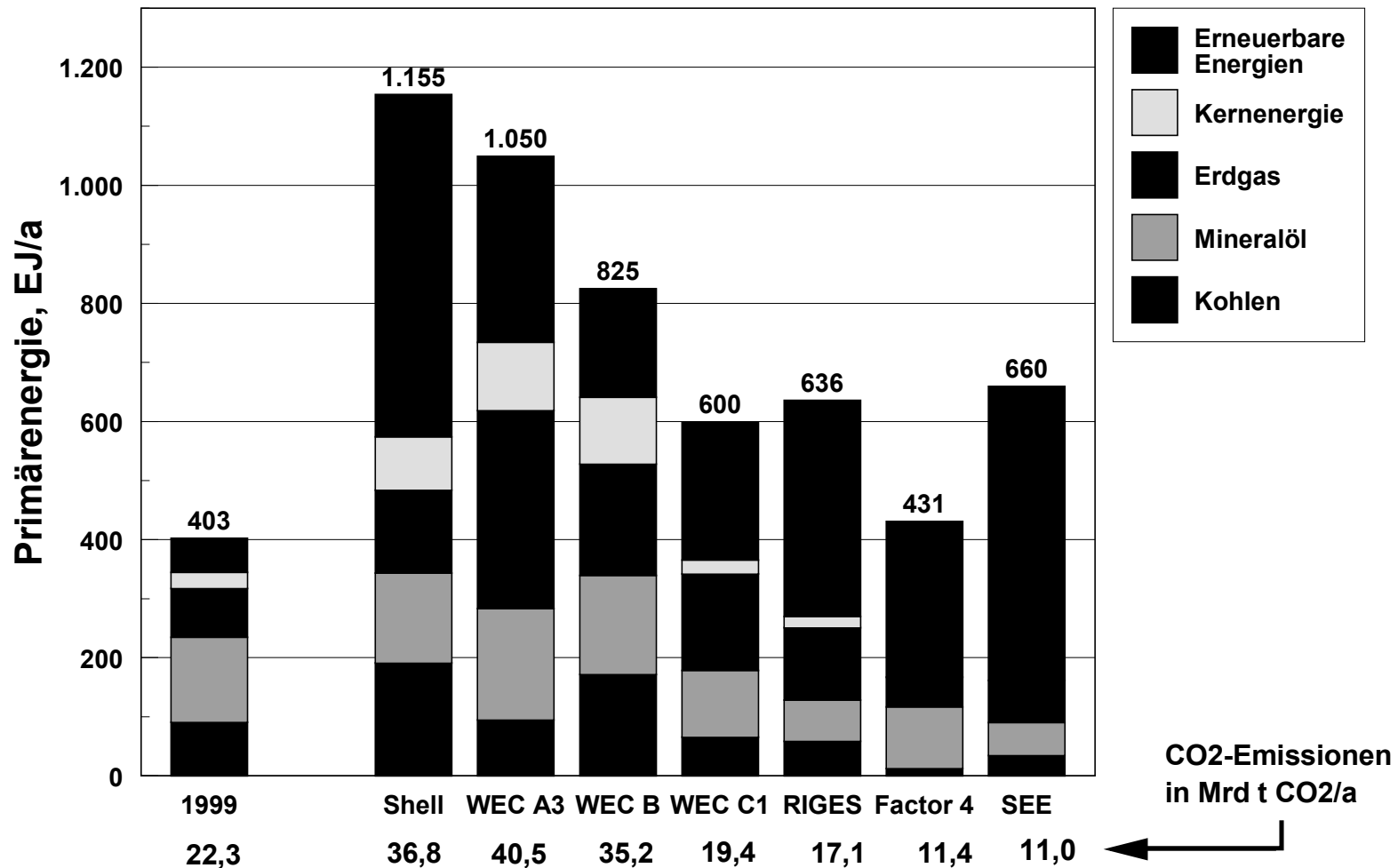


## But: Energy Futures

- are contested and controversial
- are diverging with regard to their messages for today's decisions
- include normative and value-loaden facets, might be regarded as ideologies, as mere strategical elements to gain advantages
- constructions, made of a lot of heterogenous ingredients
- include vast amounts of uncertainties or even non-knowledge, premises and presuppositions
- are difficult to assess with regard to their degree of „objectivity“

→ which future shall policy-makers trust?

# Example: futures of World energy demand 2050

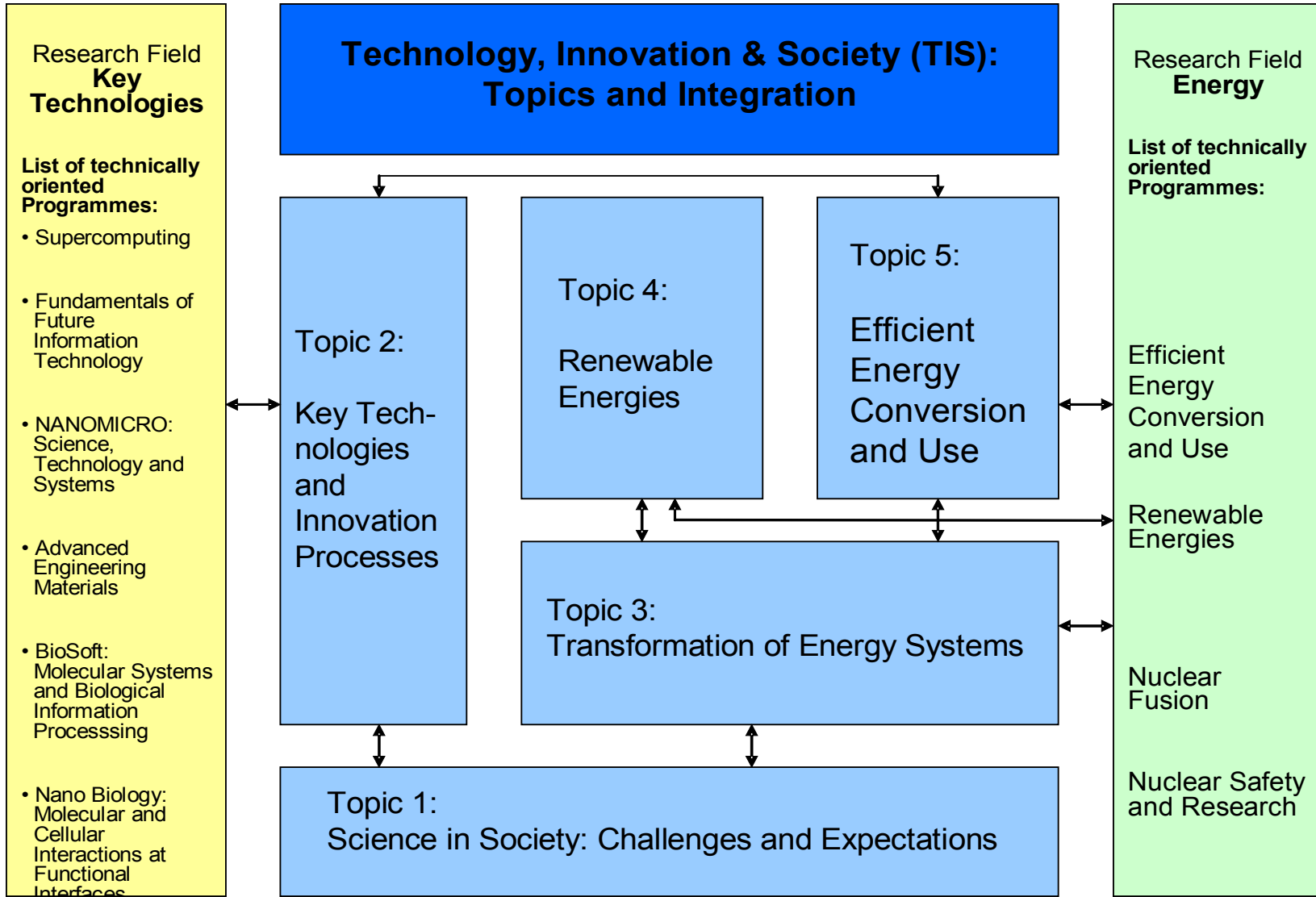


Aktuelle Szenarien des Weltenergieverbrauchs für das Jahr 2050 und Vergleich mit dem derzeitigen Verbrauch  
 Weltbevölkerung 2050: 9,5 Mrd. Menschen; Shell-Szenario „Nachhaltige Entwicklung“ (Shell 1995); WEC =  
 Diverse Szenarien der Weltenergiekonferenzen 1995 und 1998 (WEC 1995, 1998); RIGES = „Renewable Intensive  
 Global Energy Scenario“ (Johansson et.al. 1993); Faktor 4 = Szenario aus (Lovins, Hennicke 1999); SEE =  
 Szenario „Solar Energy Economy“ (Nitsch 1999)

# Challenges Ahead

- analysis of futures: criteria and better tools for assessing energy futures required
- synthesis of new energy: create more 'objective' futures (whatever this means)
- improve the relation between energy futures at the macro-level and detailed technological progress
- analyse the impacts of accelerating technology change on energy futures (in terms of European competitiveness, GHG emission reductions etc.)
- large infrastructures: transformation management needed based on 'sound' future prospects

# New Helmholtz Programme: „Technology, Innovation & Society“



# Summary

- the development of energy technologies is related with ,energy futures‘
- we often do not know much about the ,objectivity‘ of the futures
- policy-makers have to decide upon which futures they build their policies
- better assessment tools have to be developed
- we have relate better macro-level scenarios with technological progress



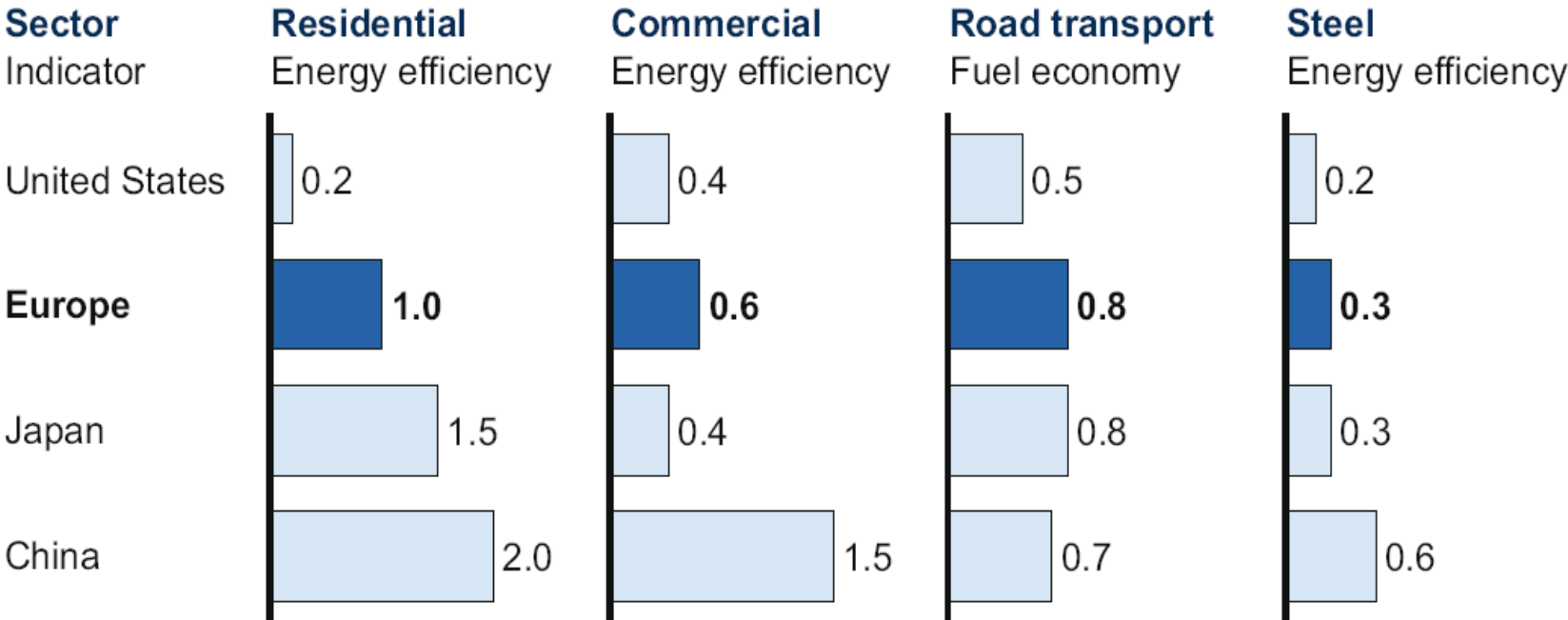
# THANK YOU !

Prof. Armin Grunwald

# SUBSTANTIAL EFFICIENCY IMPROVEMENTS WILL BE ACHIEVED ACROSS SECTORS IN EUROPE

Annual improvement of energy-efficiency indicators, 2003–2020

%

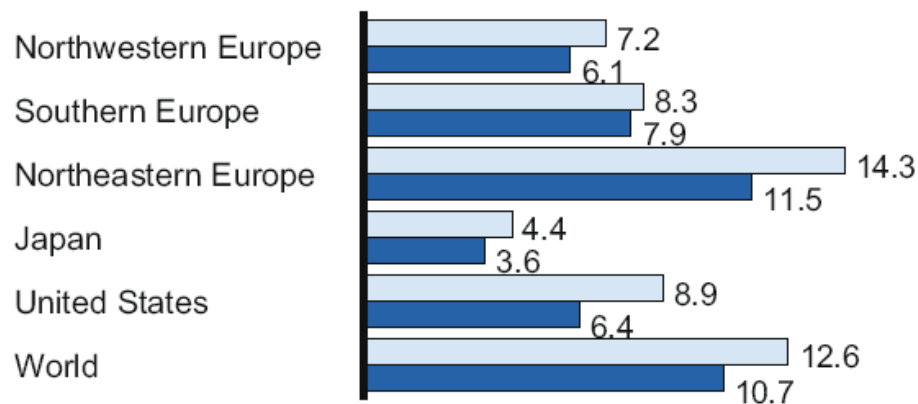


Source: EIA; Lawrence Berkeley National Laboratory China Energy Group; McKinsey Global Institute analysis

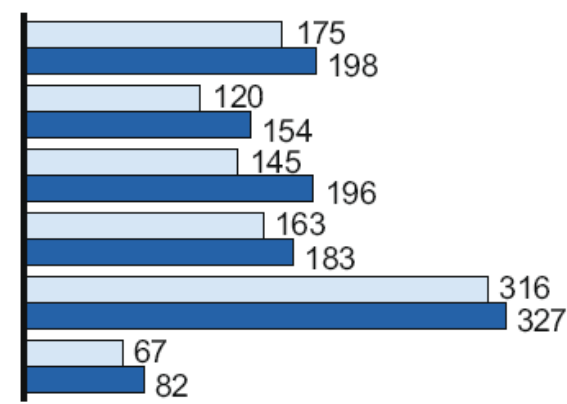
# PER CAPITA ENERGY DEMAND AND CO<sub>2</sub> EMISSIONS RISE ACROSS EUROPE'S REGIONS TO 2020

2003  
2020

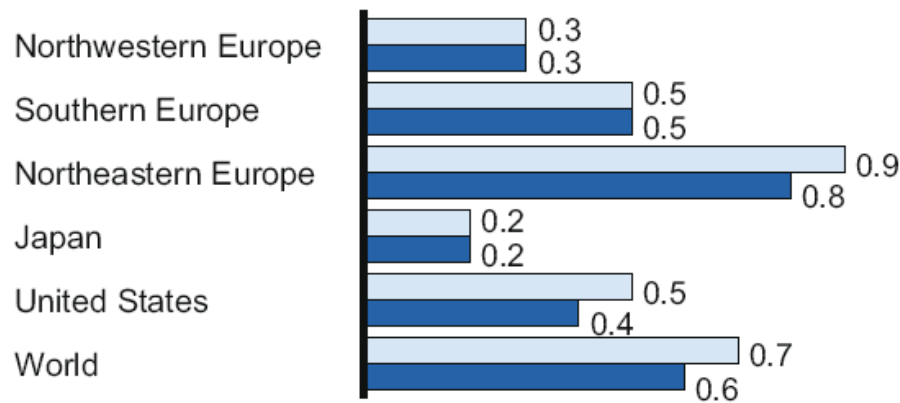
**Energy intensity**  
Thousand BTUs per real \$ of GDP



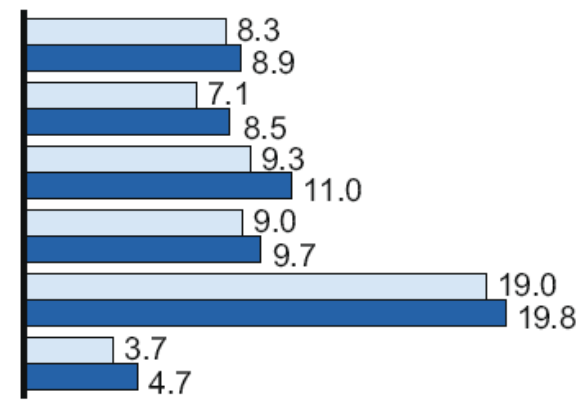
**Per capita energy demand**  
Million BTUs per capita



**CO<sub>2</sub> intensity**  
Kilogram per real \$ of GDP



**Per capita CO<sub>2</sub> emissions**  
Tonne per capita



Source: McKinsey Global Institute analysis

## Final energy consumption for transport

