Combining Climate Change and Security of Energy Supply: An Analysis with the ERIS Model

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Outline

- Security of energy supply and climate change
- The energy-system ERIS model
- Global oil resources
- Combining policies
- Some results
- Conclusions

Combining Security of Energy Supply and Climate Change Policies

- Climate change and energy supply disruptions are major risks linked to the energy system
- Both are important to long-term sustainability and are affected by technological change
- There may be synergies and trade-offs between pursuing GHG abatement and security of energy supply

Synergies and Trade-offs

- Synergies occur when actions are common to the two policy objectives
- Trade-offs occur when the best ways to achieve the two policy objectives separately are very different
- When synergies exist, the costs of combined policies may be lower than the summation of the costs of separate policies

The Energy-System ERIS Model

- ERIS (Energy Research and Investment Strategy), developed at PSI and IIASA
- “Bottom-up” energy-systems model with electric, non-electric and transport sectors
- Emissions and marginal abatement curves for CH_4,N_2O
- Clusters approach to endogenize technological learning
- Global, 11-region model (following MESSAGE model)
- Calibrated to year-2000 statistics

Resource Classification

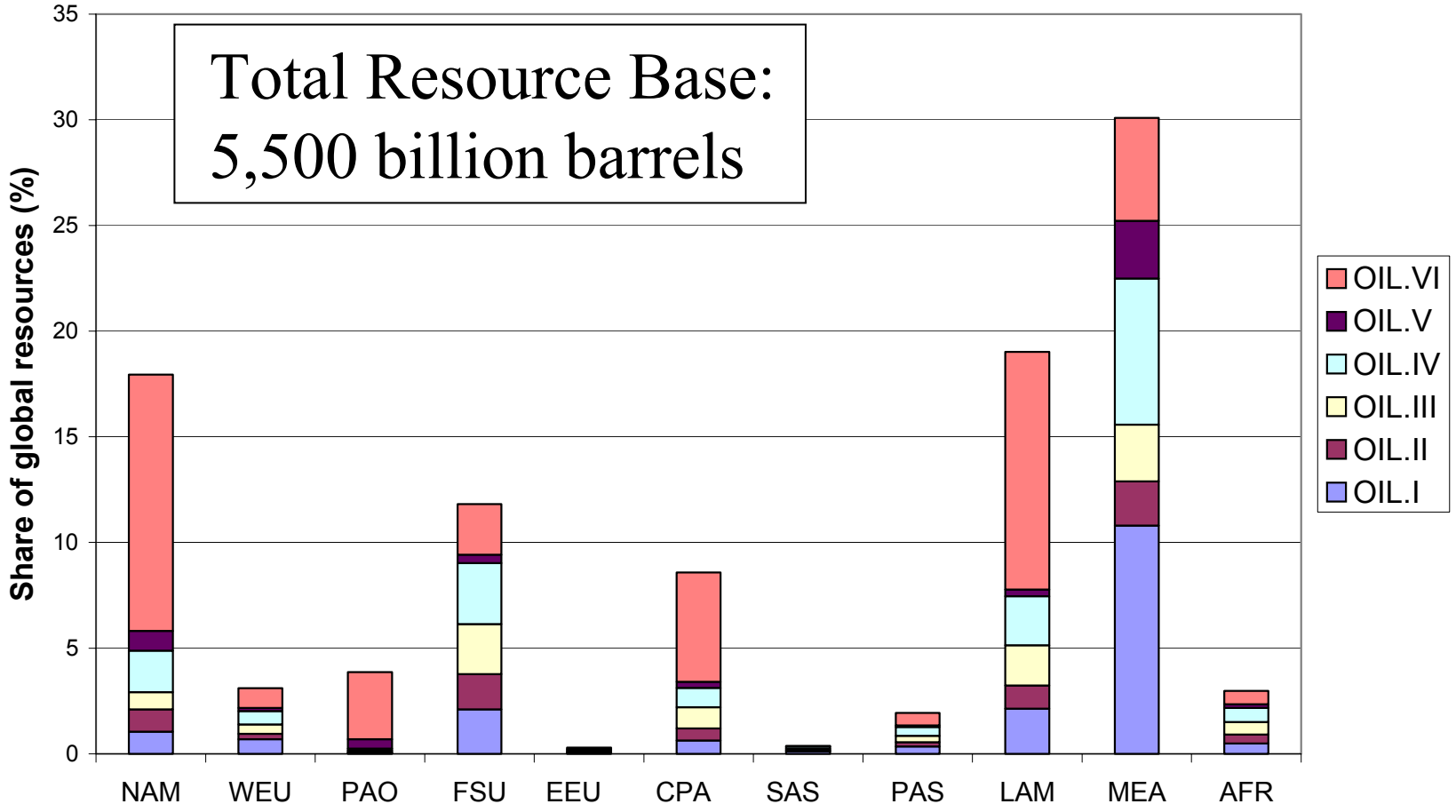
	Category	Description
Conventional	I	Proven reserves
	II	Estimated additional reserves
	III	Additional resources (50%)
	IV	Enhanced recovery
Unconventional	V	Proven reserves
	VI	Additional resources
		Other occurrences

- Oil shales, tarsands, heavy crudes

- Coal-seam methane, geopressured gas, tight formation, methane hydrates

Source: Rogner 1997, 2000

Global Oil Resources



Source: Rogner 1997, 2000

Resources to Consumption Ratio

- The number of years that domestic resources can support current domestic consumption
- Similar to R:P (Resources/Production), but incorporates physical import dependence

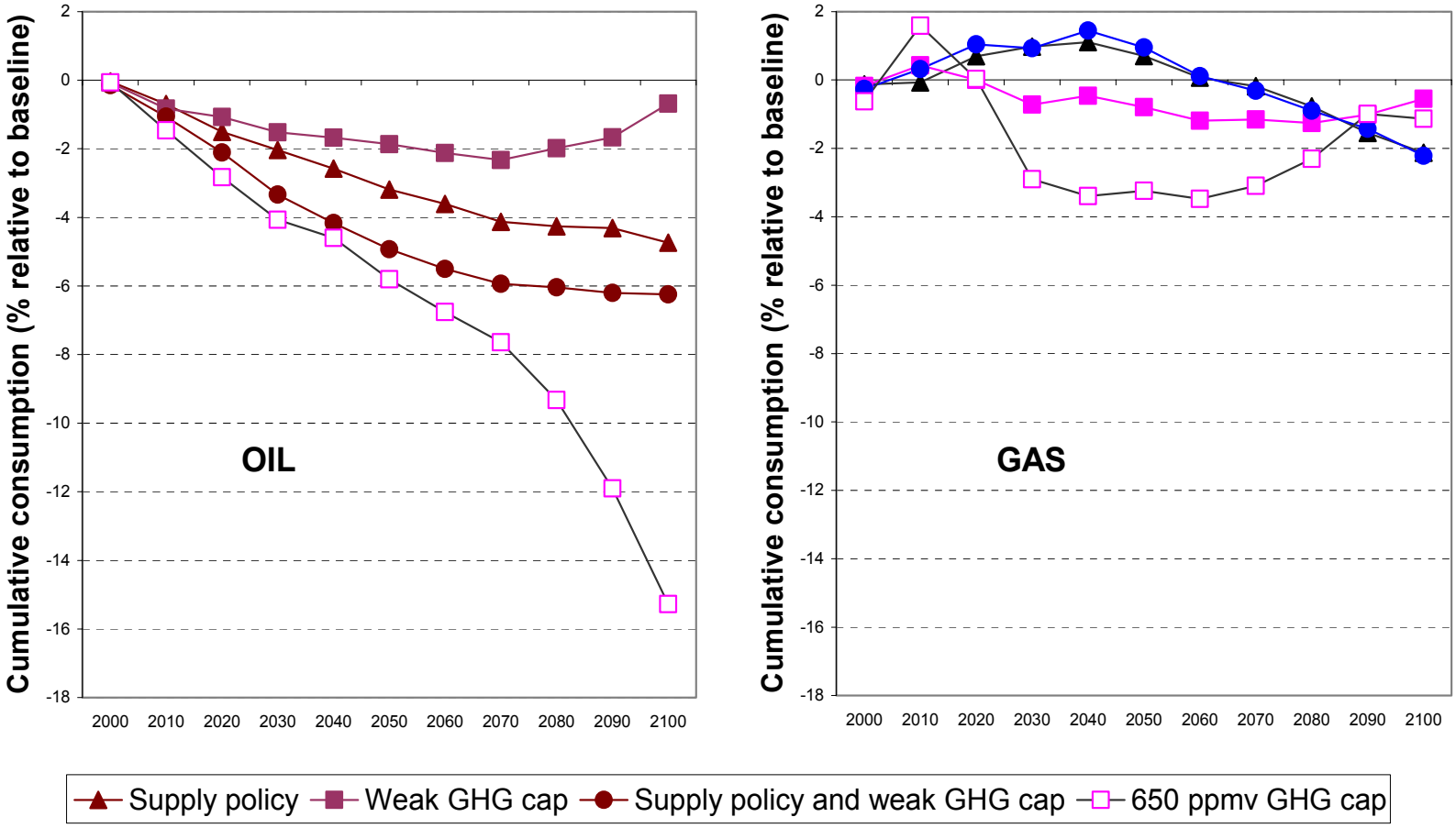
$$\frac{R}{C} = \frac{R}{P} \bullet \frac{P}{P + \text{Net imports}}$$

- Indicates long-term ability to maintain domestic supply when facing disruptions to energy availability

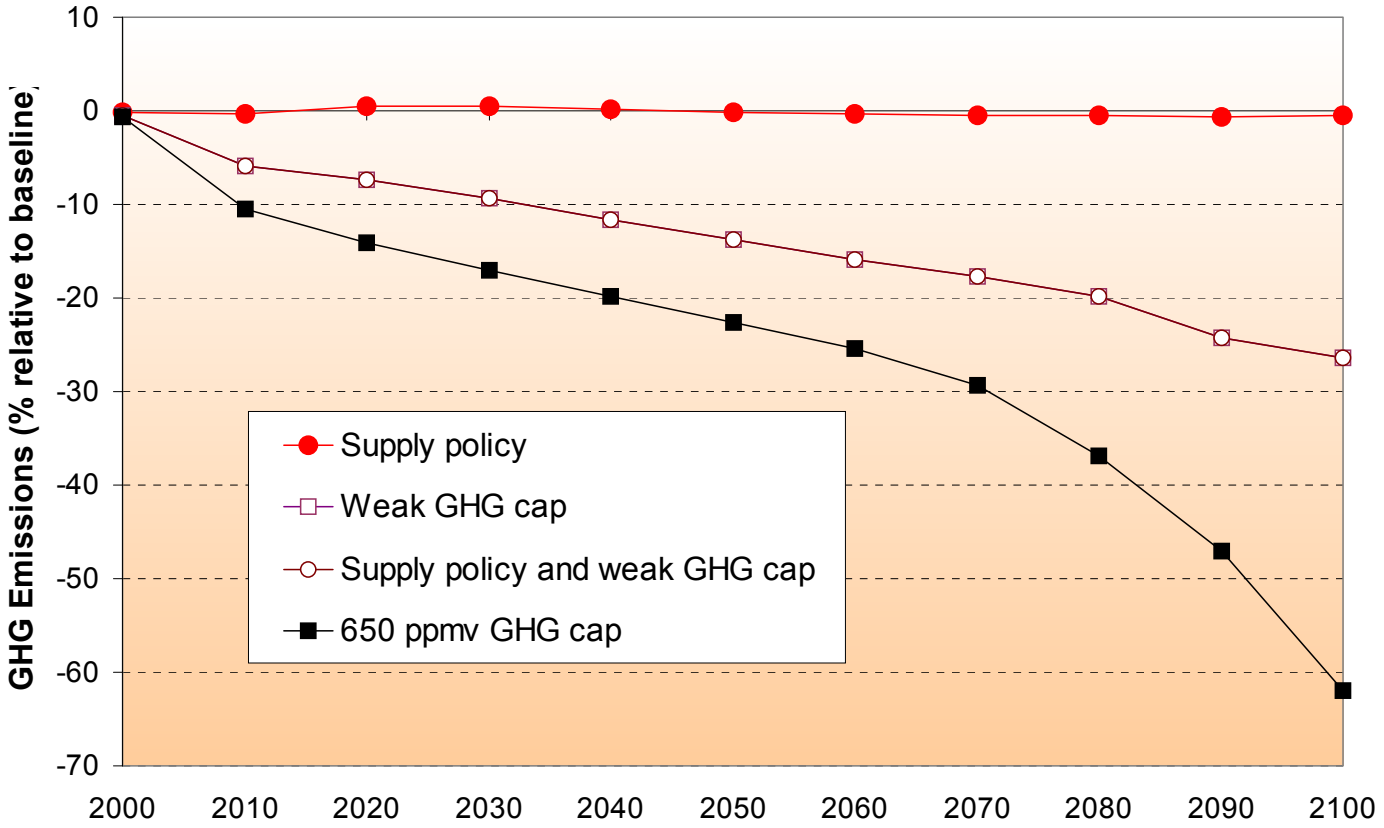
Security of Energy Supply and Climate Change Policies

- Security of energy supply policy (applied in NAM, WEU, EEU, PAO and CPA)
  - Maintain R:C ratio above 20 years
  - Maintain viable extraction industry
    - 25% of total supply obtained domestically until 2050
- Two climate change policies
  1. Weak – emissions trajectory ~ $75/t C-e
  2. Strong – 650 ppmv CO_2

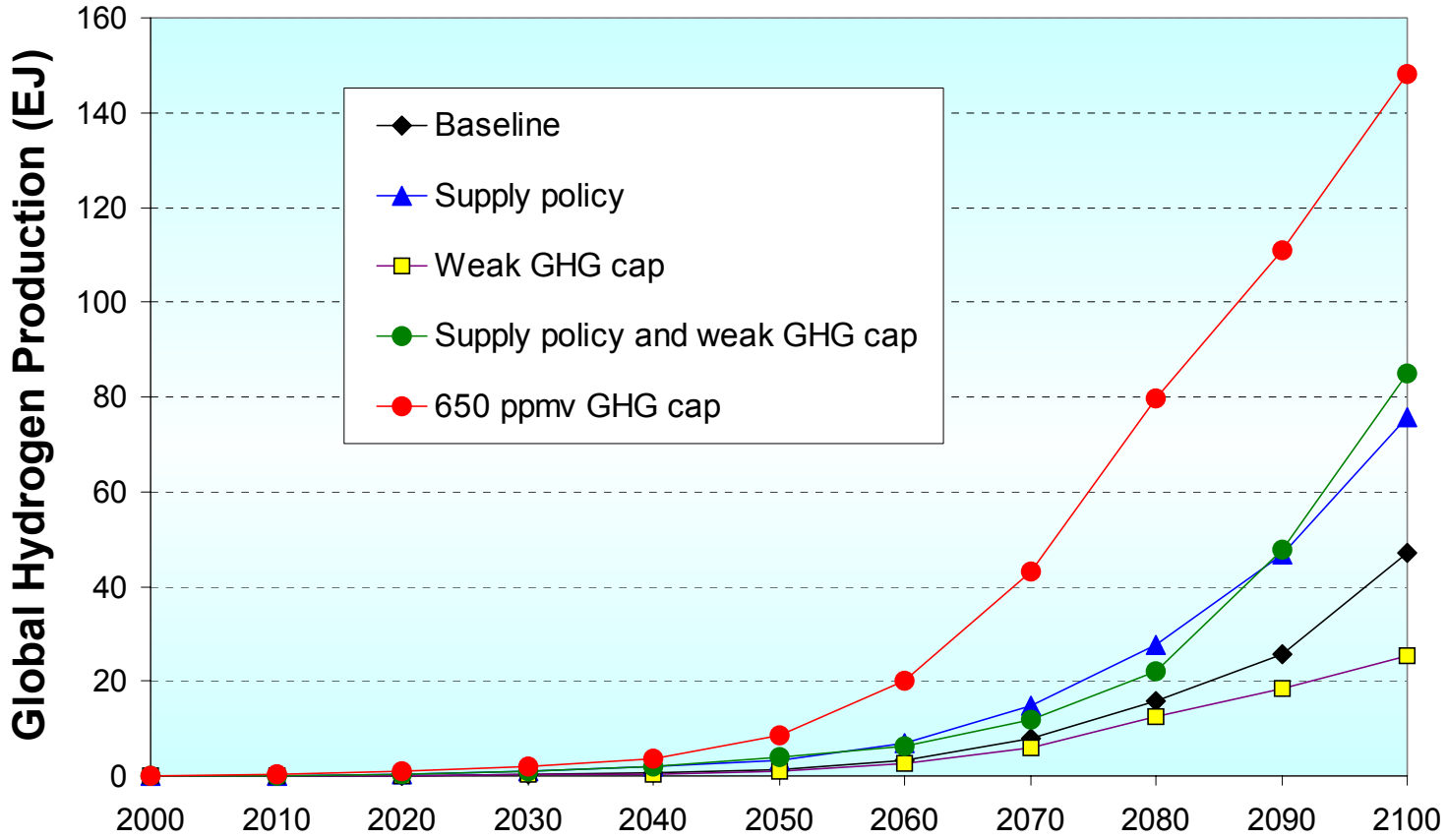
Impact on Oil and Gas Consumption



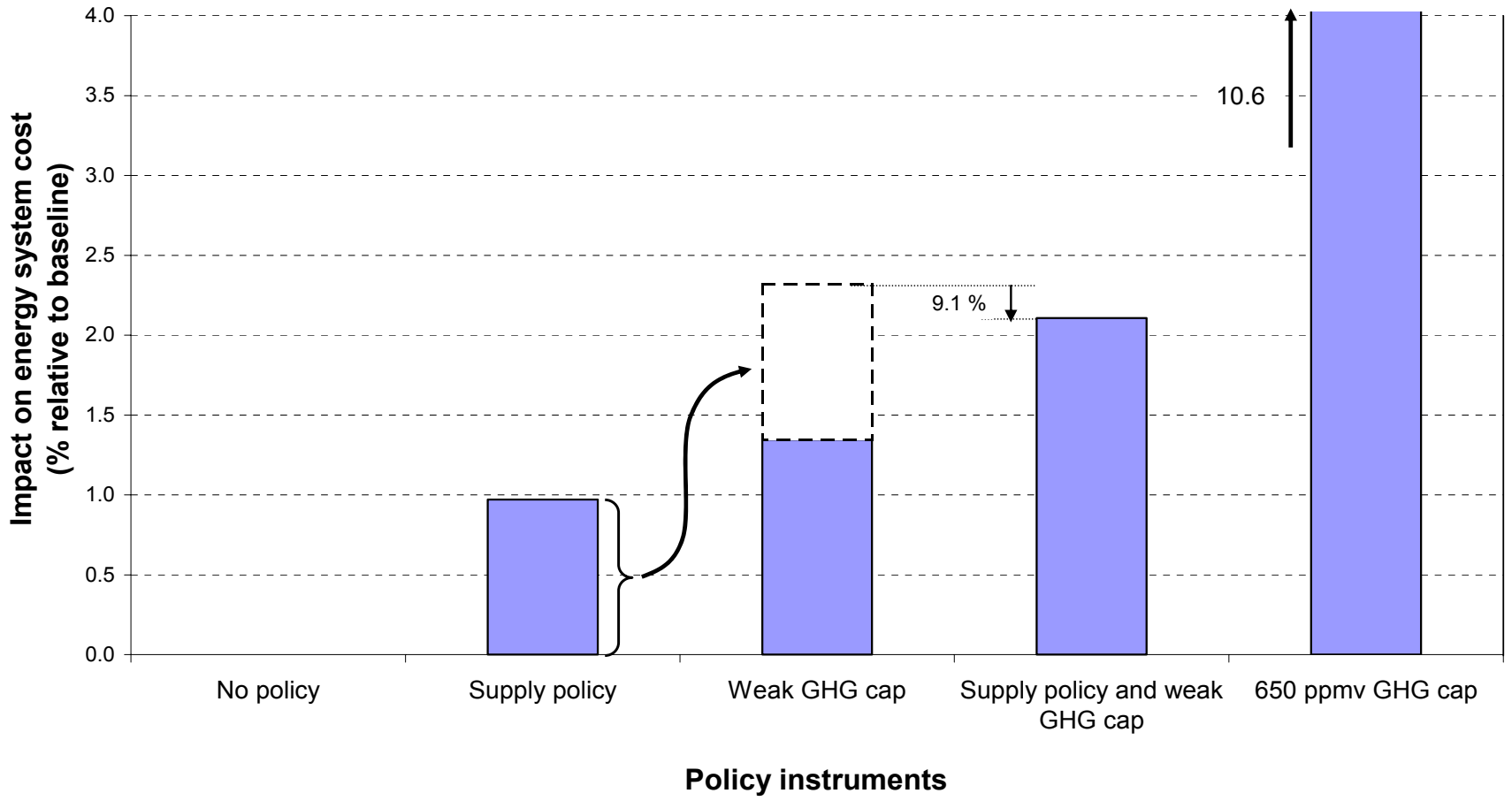
Impact of Policies on GHG Emissions
(relative to baseline)



Impact of Policies on Global H_2 Production



Policy Impact on Energy System Cost

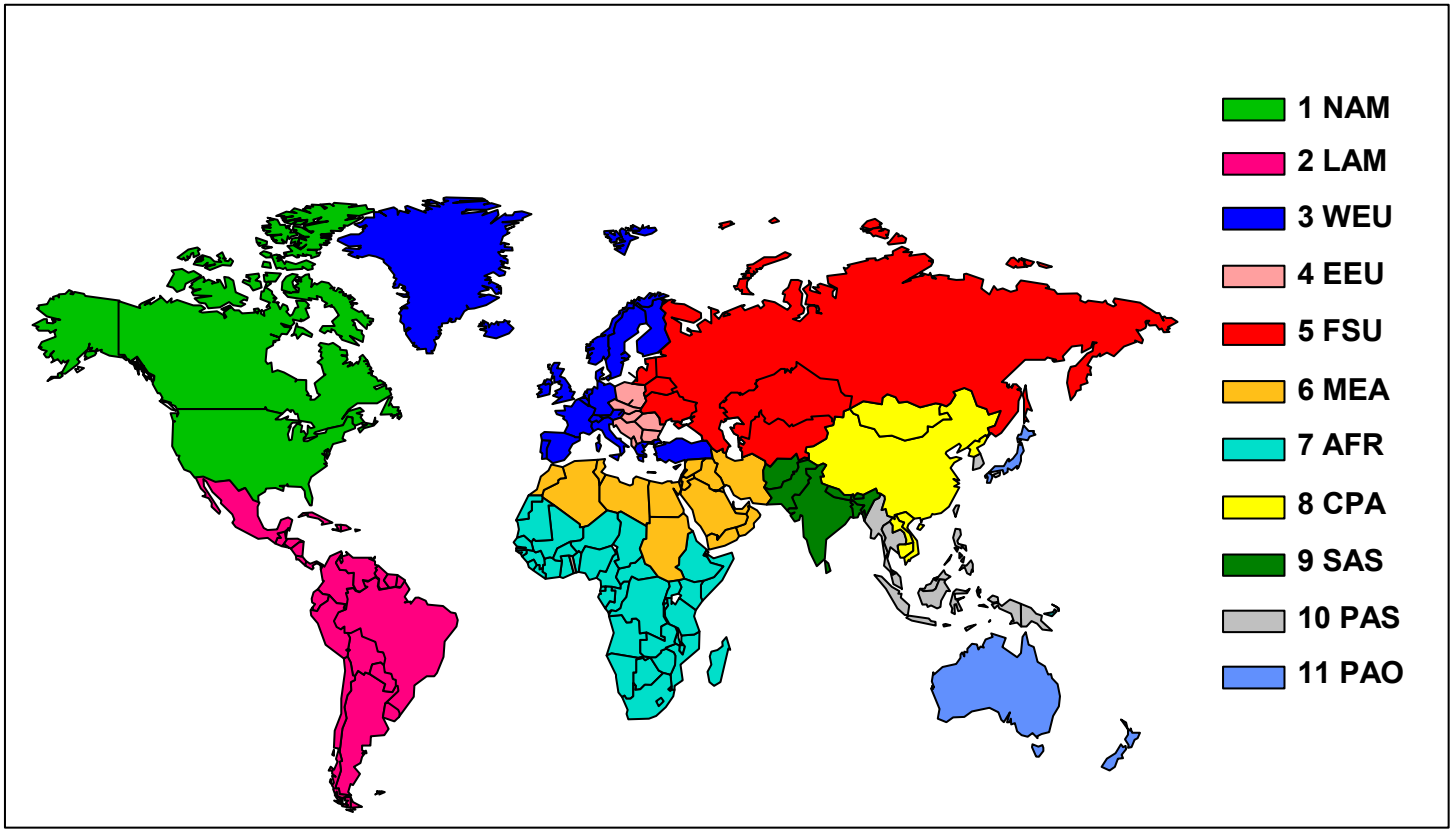


Conclusions

- There are synergies and trade-offs between climate change and security of energy supply
- They depend, among others, on the stringency of the climate policy.
- A strong climate policy could achieve security-of-supply objectives. Synergies with a less stringent climate policy are much weaker
- Supporting energy technologies that fulfill a policy objective in isolation could decrease flexibility to respond to other policy goals

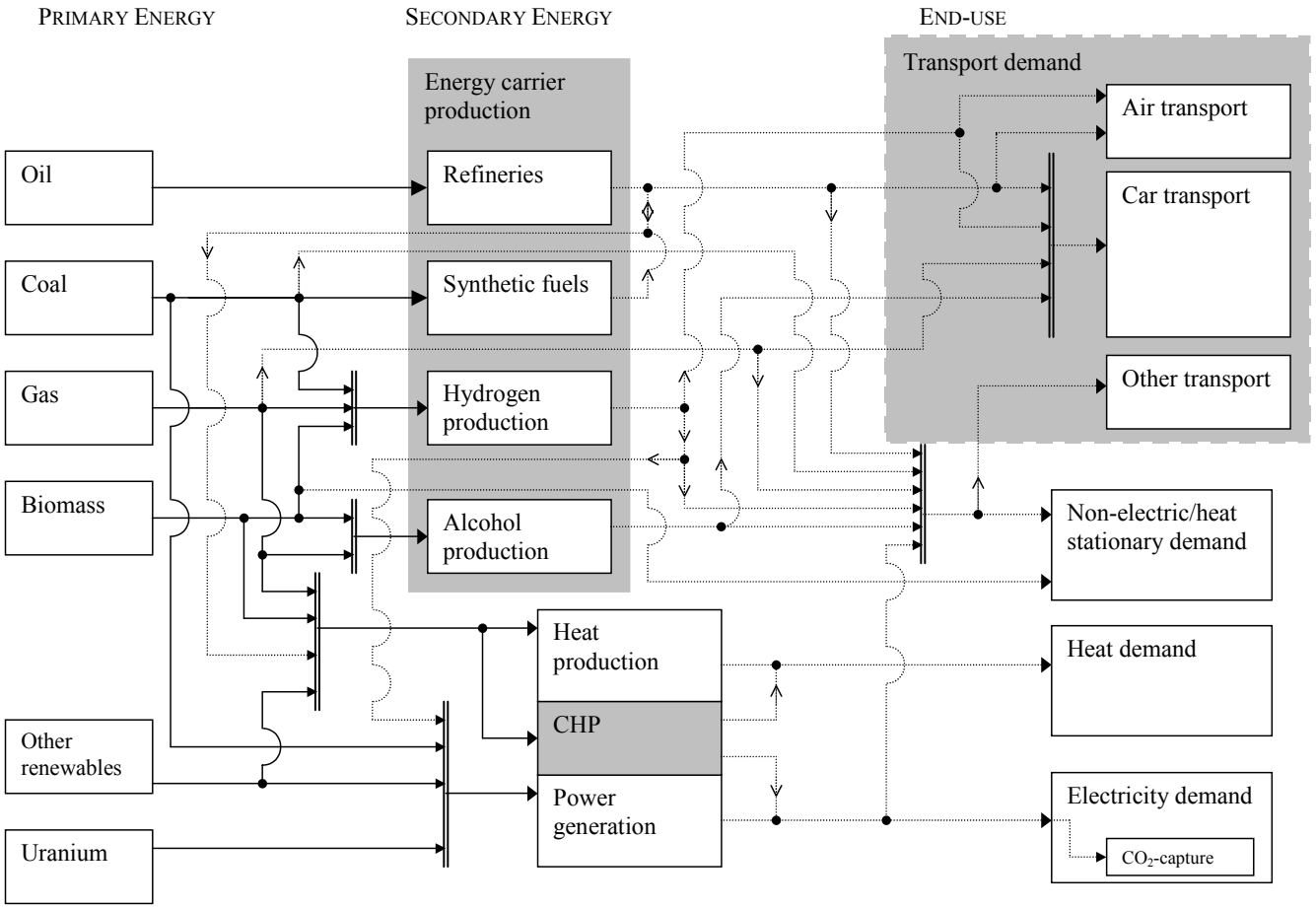
Support Slides

Eleven World Regions in the ERIS Model

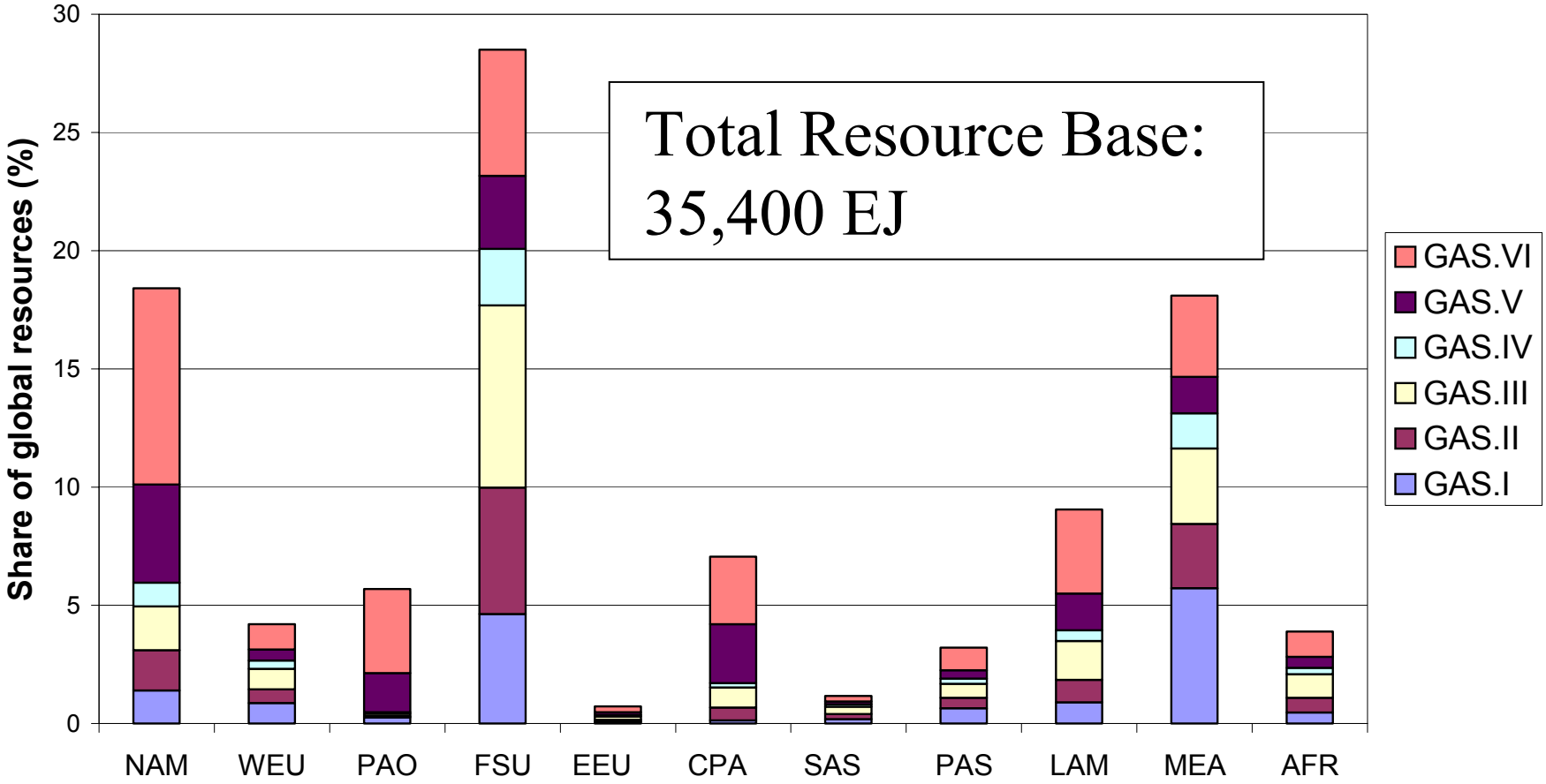


1 NAM North America
2 LAM Latin America & The Caribbean
3 WEU Western Europe
4 EEU Central & Eastern Europe
5 FSU Former Soviet Union
6 MEA Middle East & North Africa
7 AFR Sub-Saharan Africa
8 CPA Centrally Planned Asia & China
9 SAS South Asia
10 PAS Other Pacific Asia
11 PAO Pacific OECD

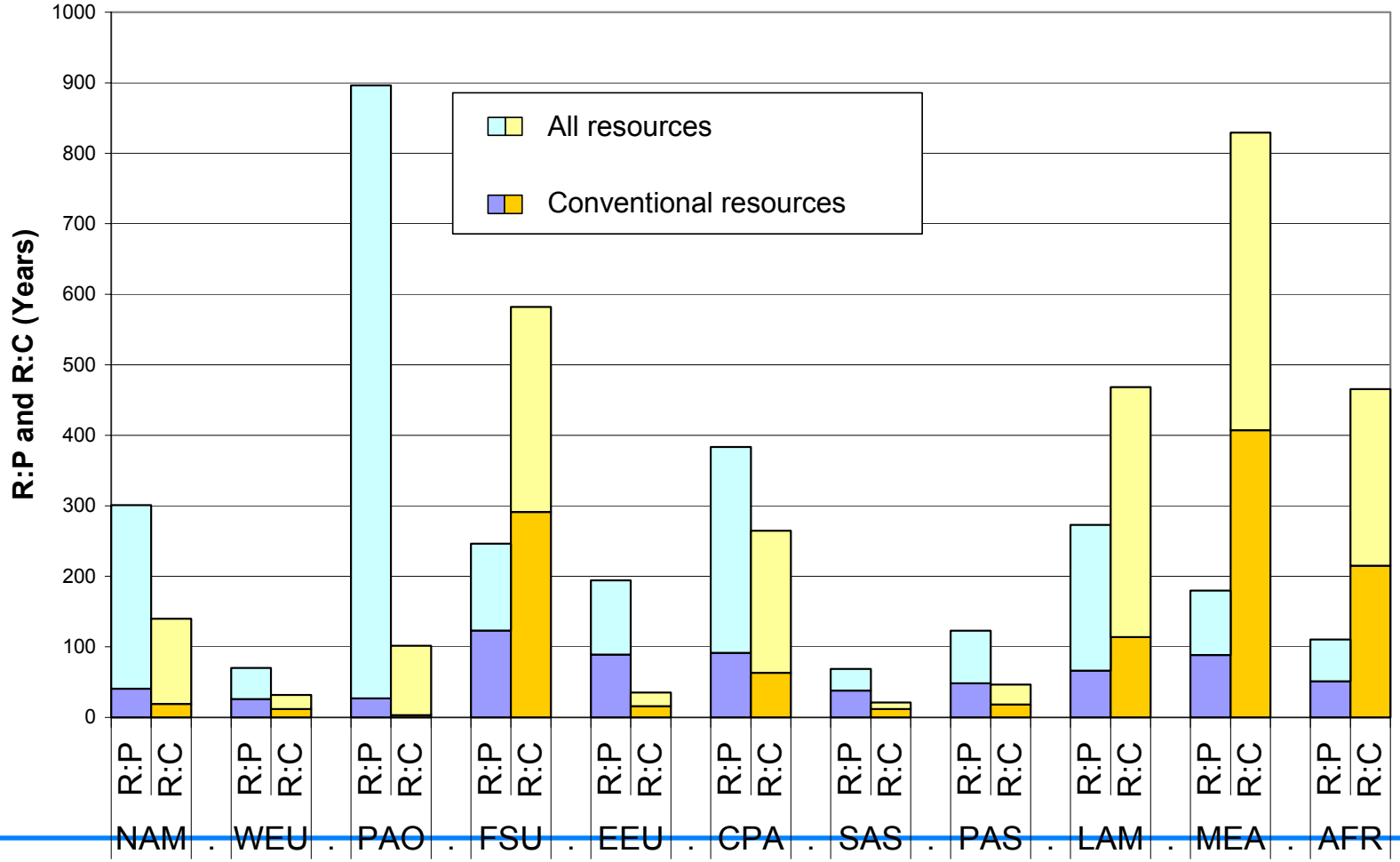
The ERIS Model: Reference Energy System



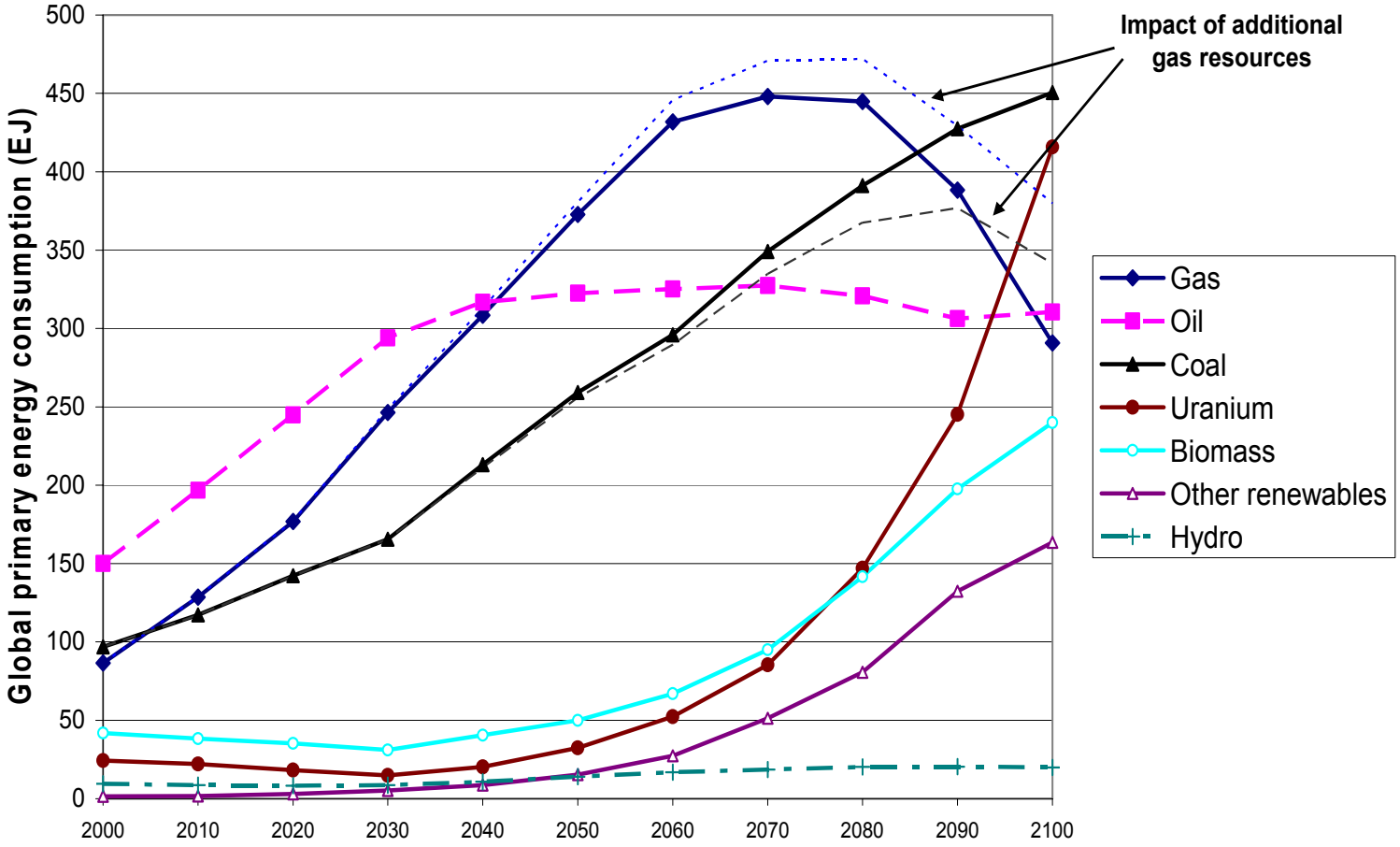
Global Gas Resources



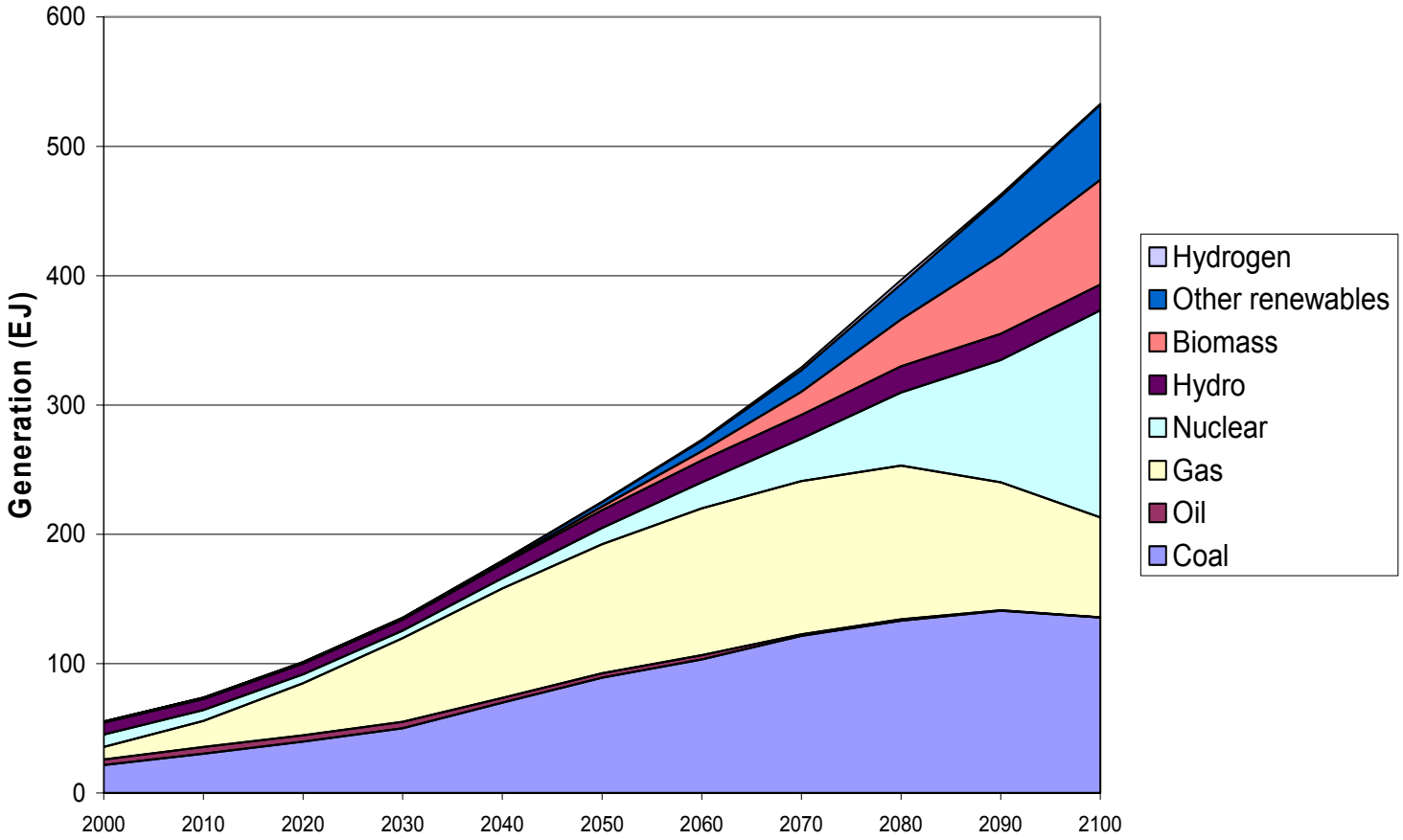
Some illustrative R:P and R:Cs for oil in 2000



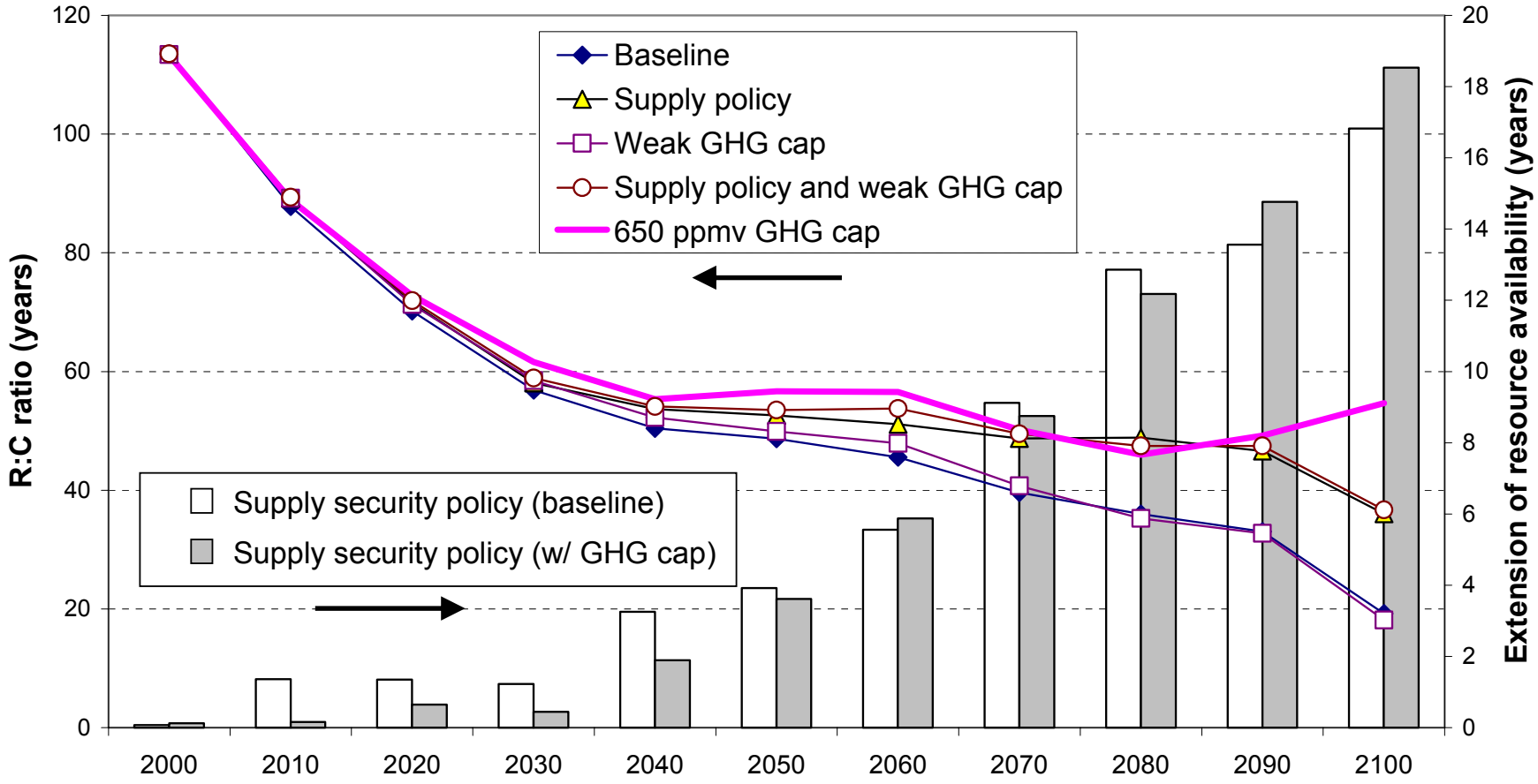
Primary Energy Consumption: Baseline



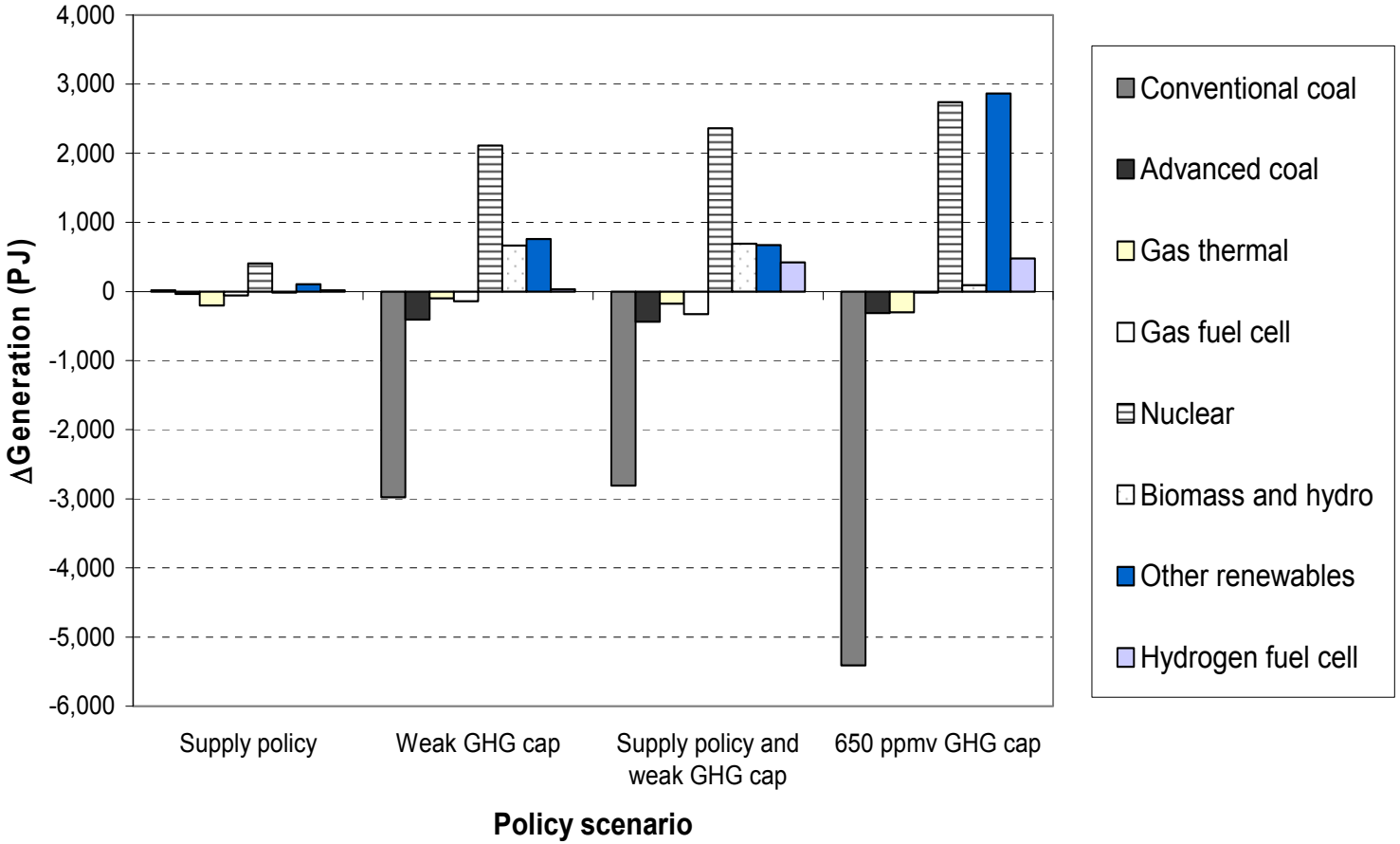
Global Electricity Generation: Baseline



R:C (Oil) for 5 Regions



Impact of Policies on Electricity Generation



Hydrogen Production

- Baseline: Mainly coal-based hydrogen
- Supply security: Increase, coal-based hydrogen
- Weak GHG target: Decrease, coal-based hydrogen is discouraged
- Combined supply security + weak GHG target: Increase, carbon-based hydrogen + CO_2 capture
- Strong GHG target: Shift towards carbon-free hydrogen and carbon-based hydrogen+CO_2 capture

Impact of Technology Policies