Cost of Emission Reductions

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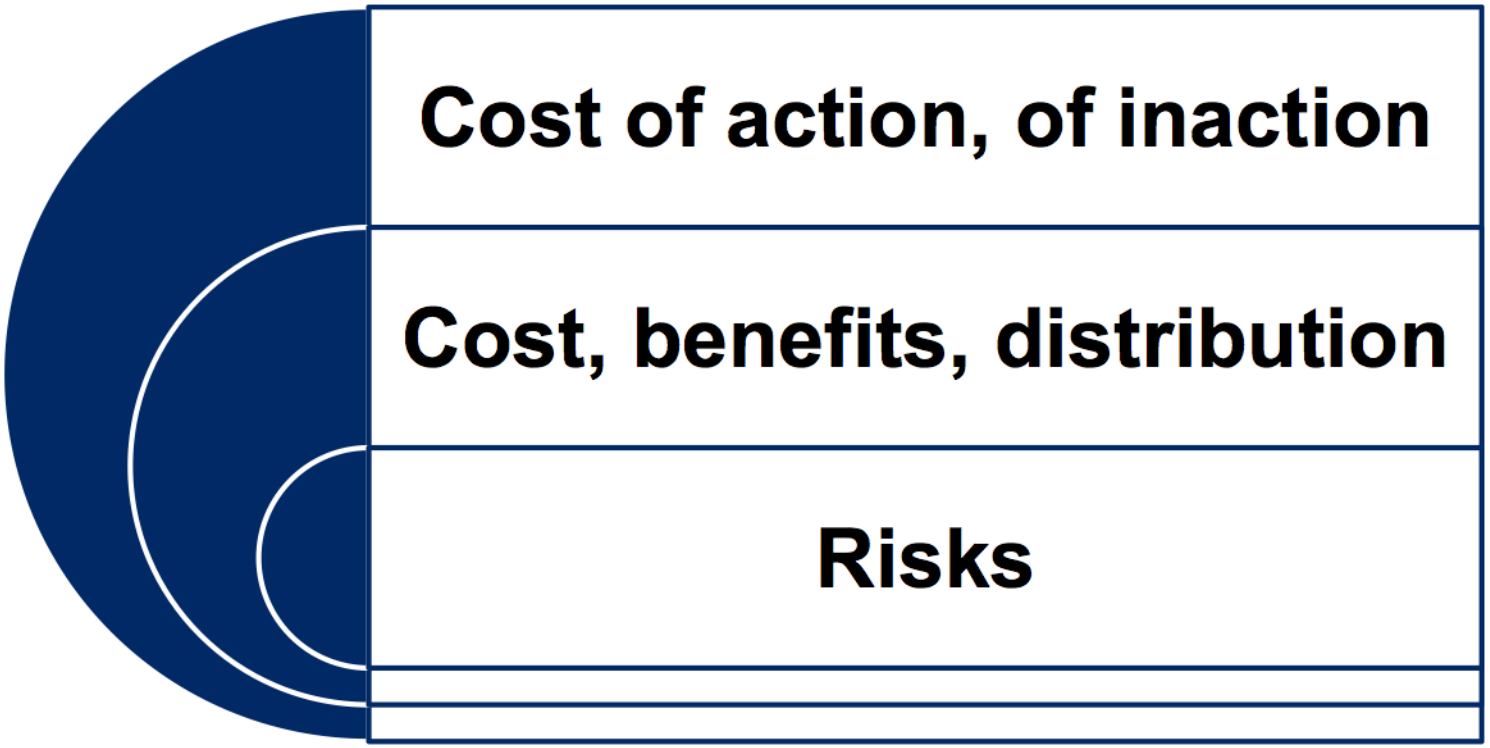
Cost and benefits



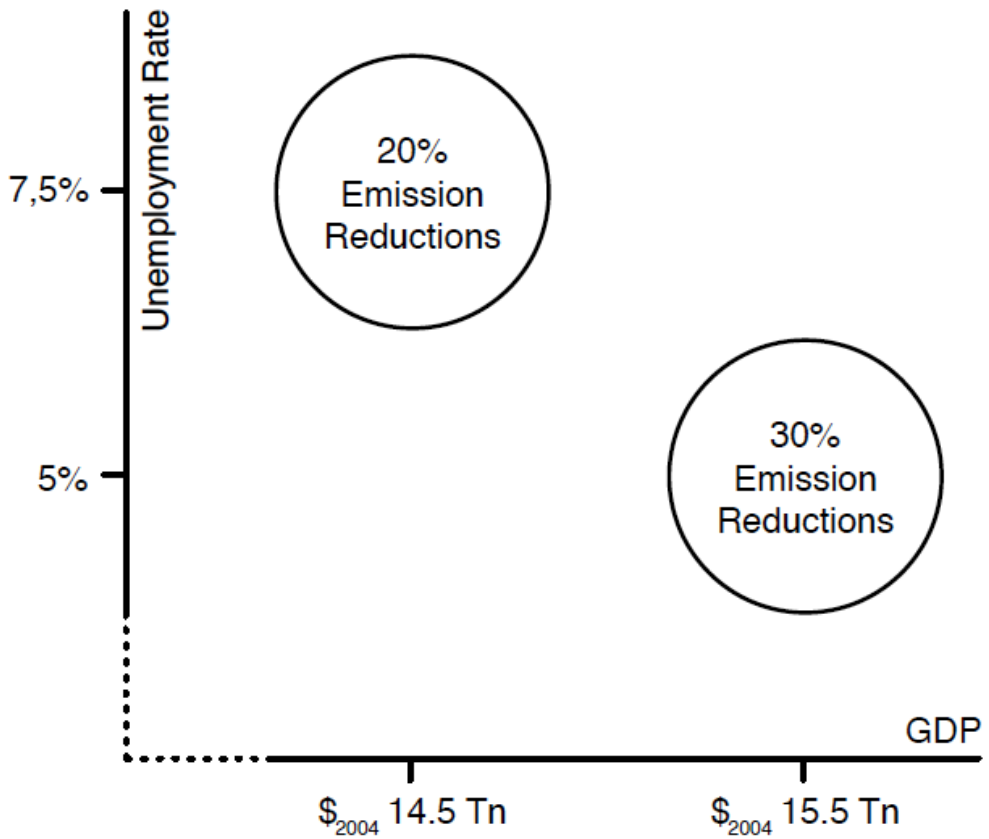
"Sustainable development: Development that our grandchildren would thank us for"

Cost perspectives

- **Static view:**
  - Loss of consumer and producer surplus
  - Better environmental quality
- **Dynamic view**
  - Induced innovation and investments
  - Sectoral change
- **Time horizon**
  - Growth effects are important → focus here

Optimistic view: Jaeger et al. (2011)

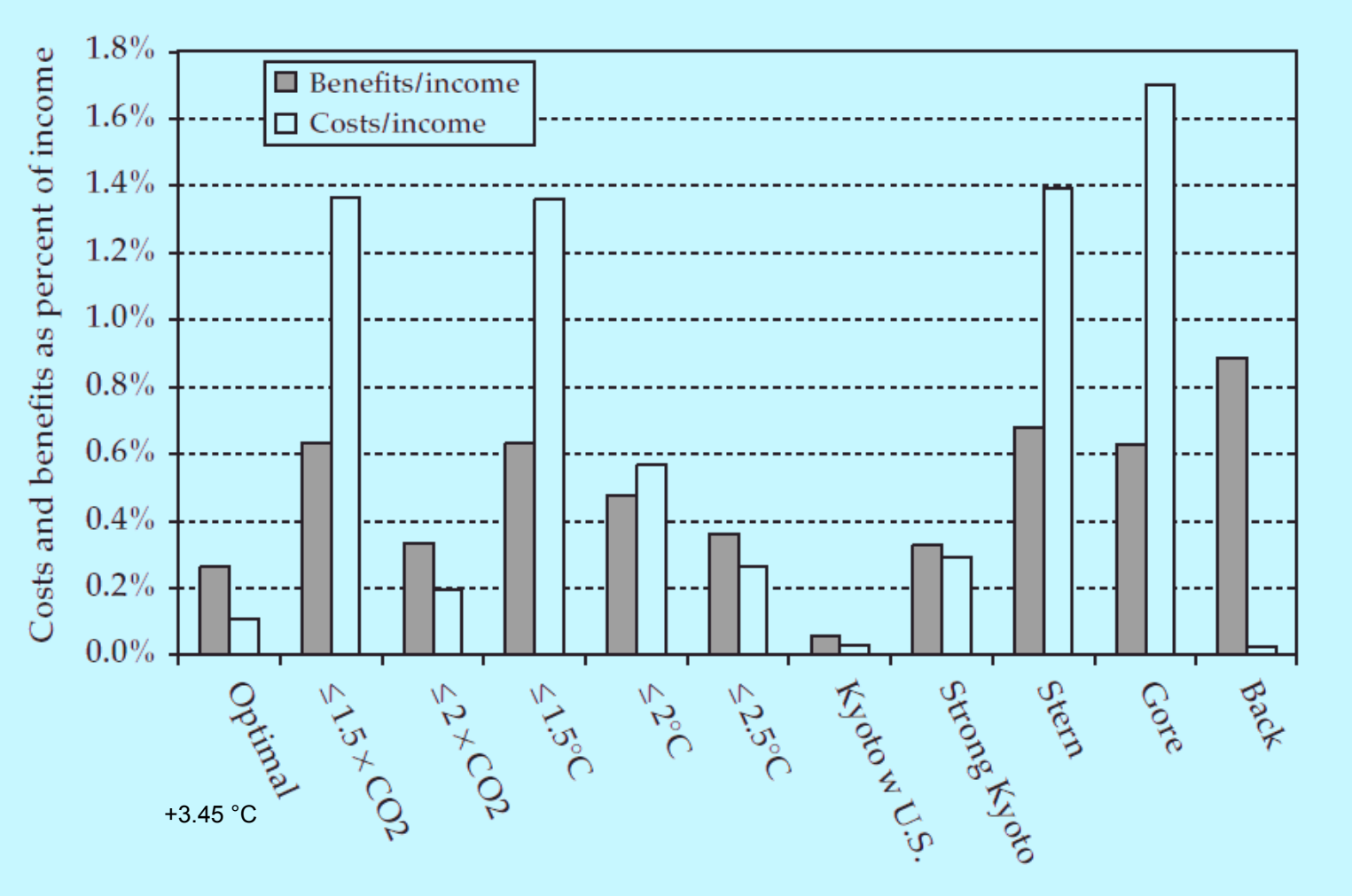
Figure 1: Two scenarios for Europe in 2020



Pessimistic view: Nordhaus (2008)

- "The ambitious programs embedded in the *Stern Review* and Gore policies are extremely expensive."
- "The inefficiency of these approaches is due to the fact that they involve emissions **reductions that are too sharp** and **too early in time** and therefore do not allow for intertemporal efficiency."

Nordhaus' Cost/benefit comparison



IPCC (2007)

Estimated costs for CO2-Stabilization in 2030 and 2050

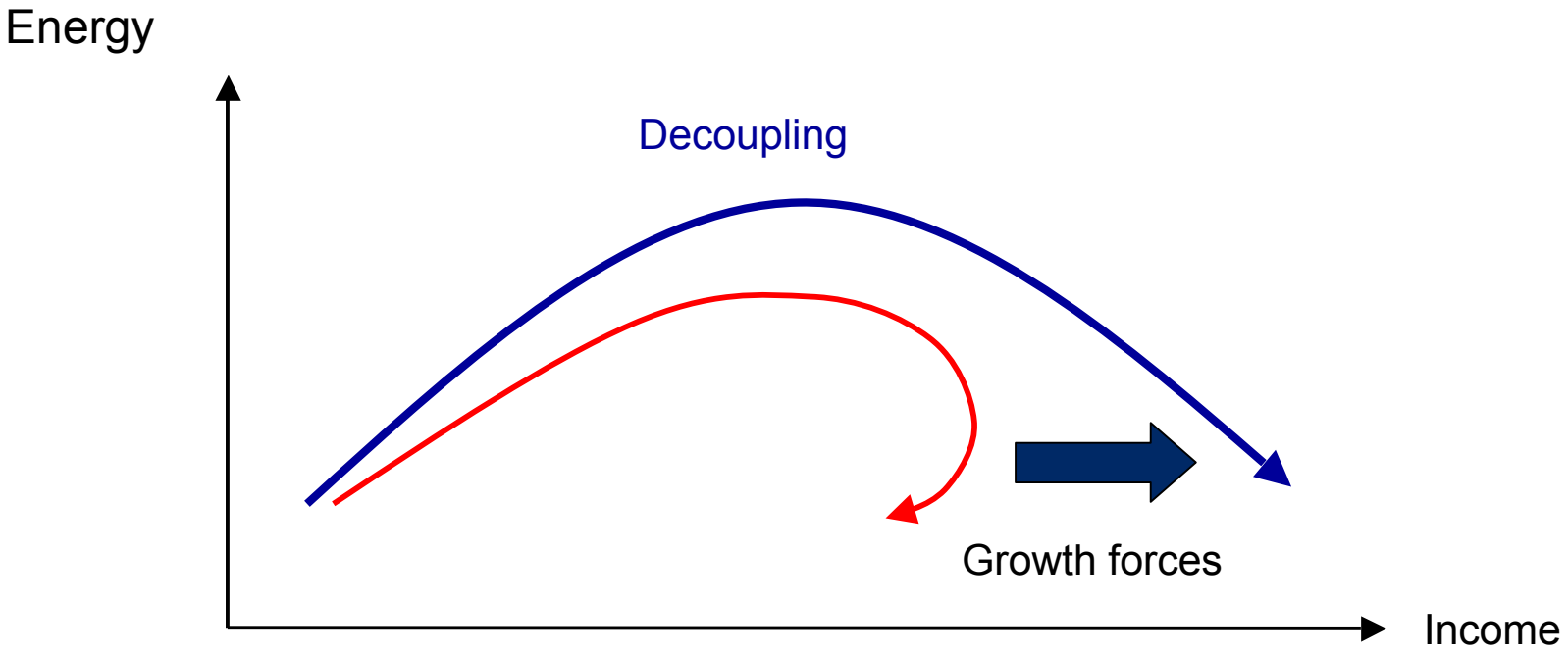
	Stabilization Level (ppm CO_2-Equivalent)	GDP Reduction (Median, %)	GDP Reduction (Spread, %)	GDP Annual Growth Reduction (%)
2030	590 – 710 535 – 590 445 – 535	0.2 0.6 not available	-0.6 – 1.2 0.2 – 2.5 < 3	< 0.06 < 0.1 < 0.12
2050	590 – 710 535 – 590 445 – 535	0.5 1.3 not available	-1 – 2 slightly negative – 4 < 5.5	< 0.05 < 0.1 < 0.12

Source: IPCC Fourth Assessment Report, WG III, 2007; Tables SPM.4 and SPM.6

Issues

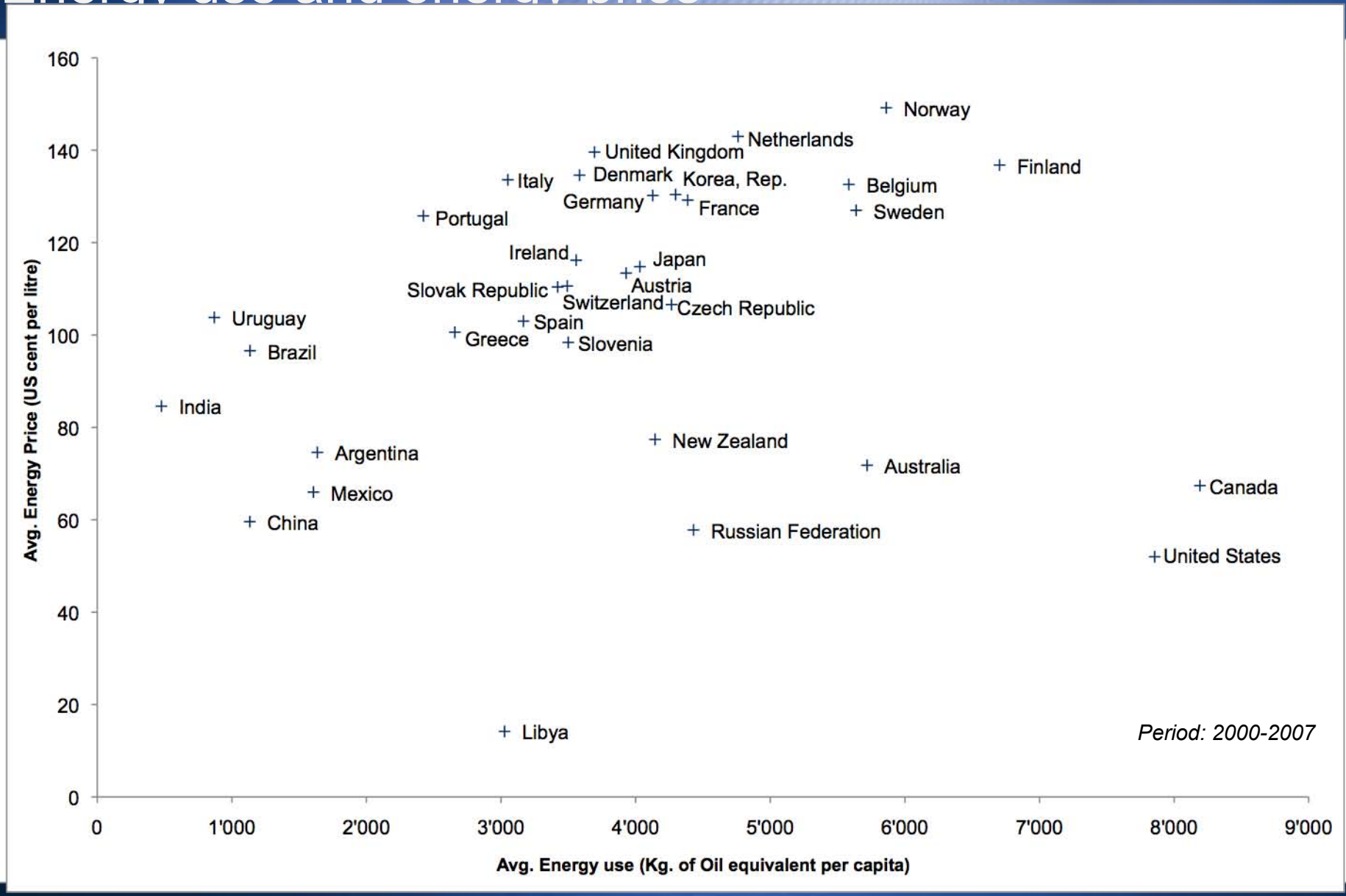
- **Energy and income**
  - Supply and / or demand
  - Energy «gaps»
  - Cross-country comparisons
- **Predictions of the CITE model**
  - Implementation of sharp carbon policies

Income

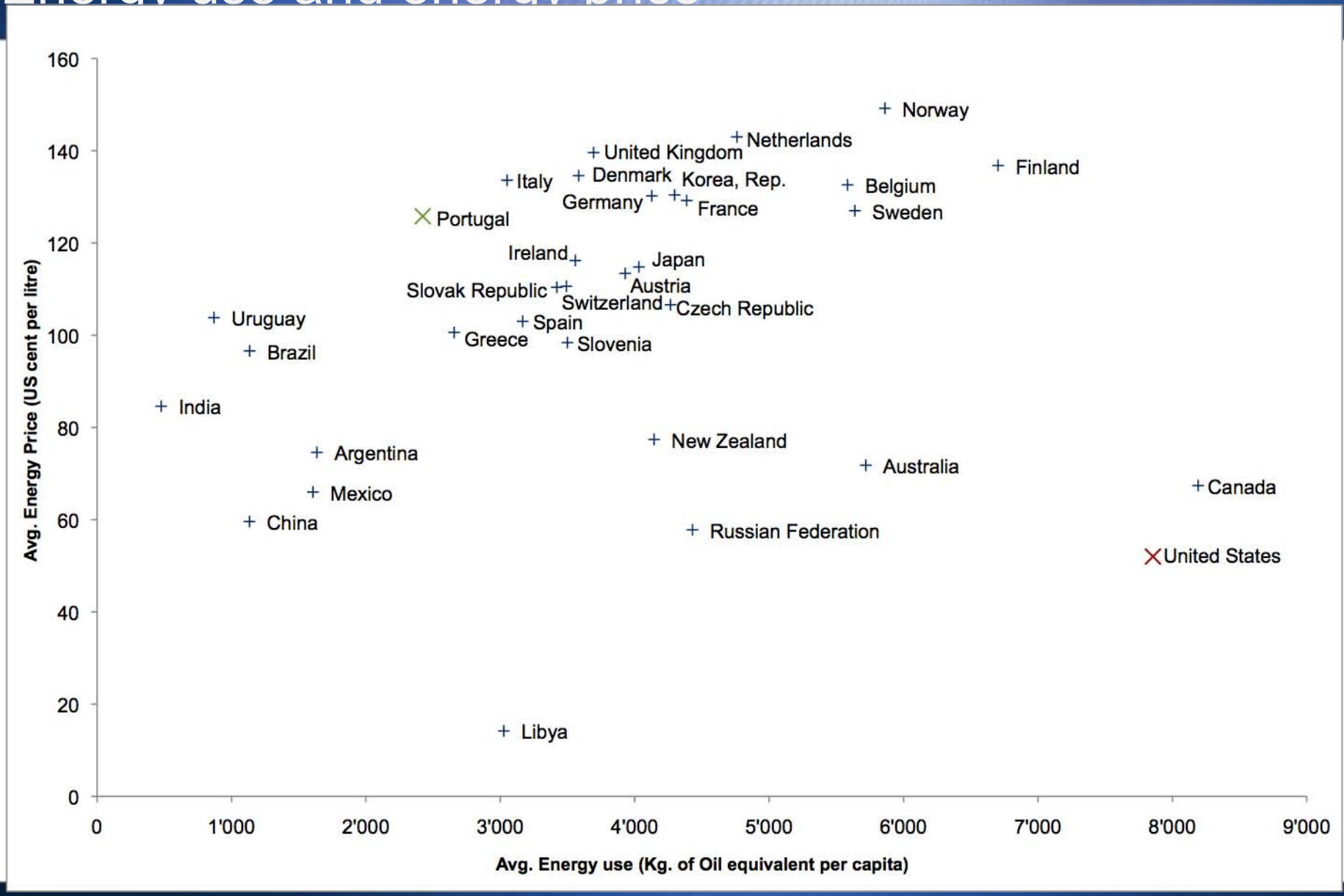


- **Energy markets and growth**

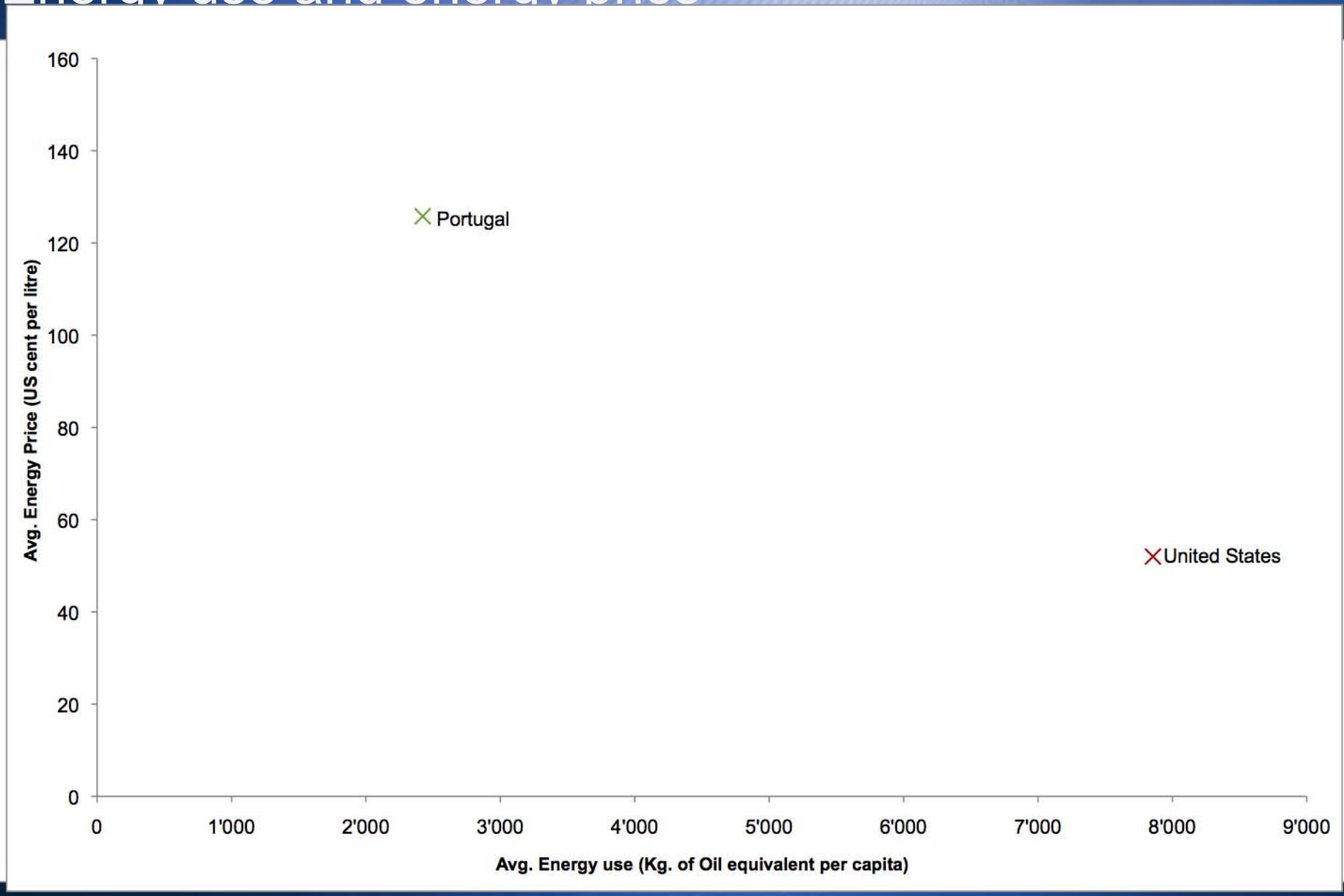
Energy use and energy price



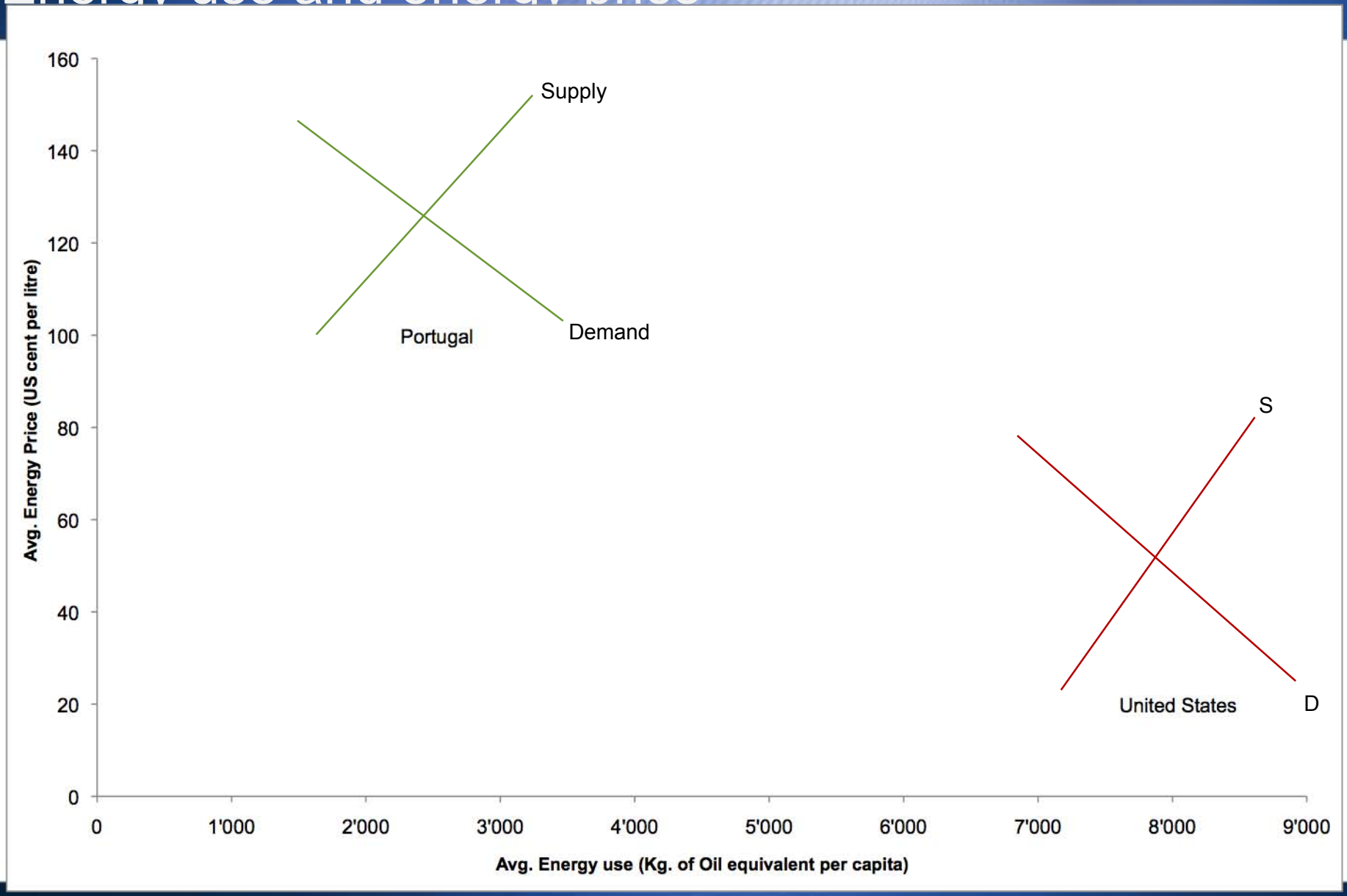
Energy use and energy price



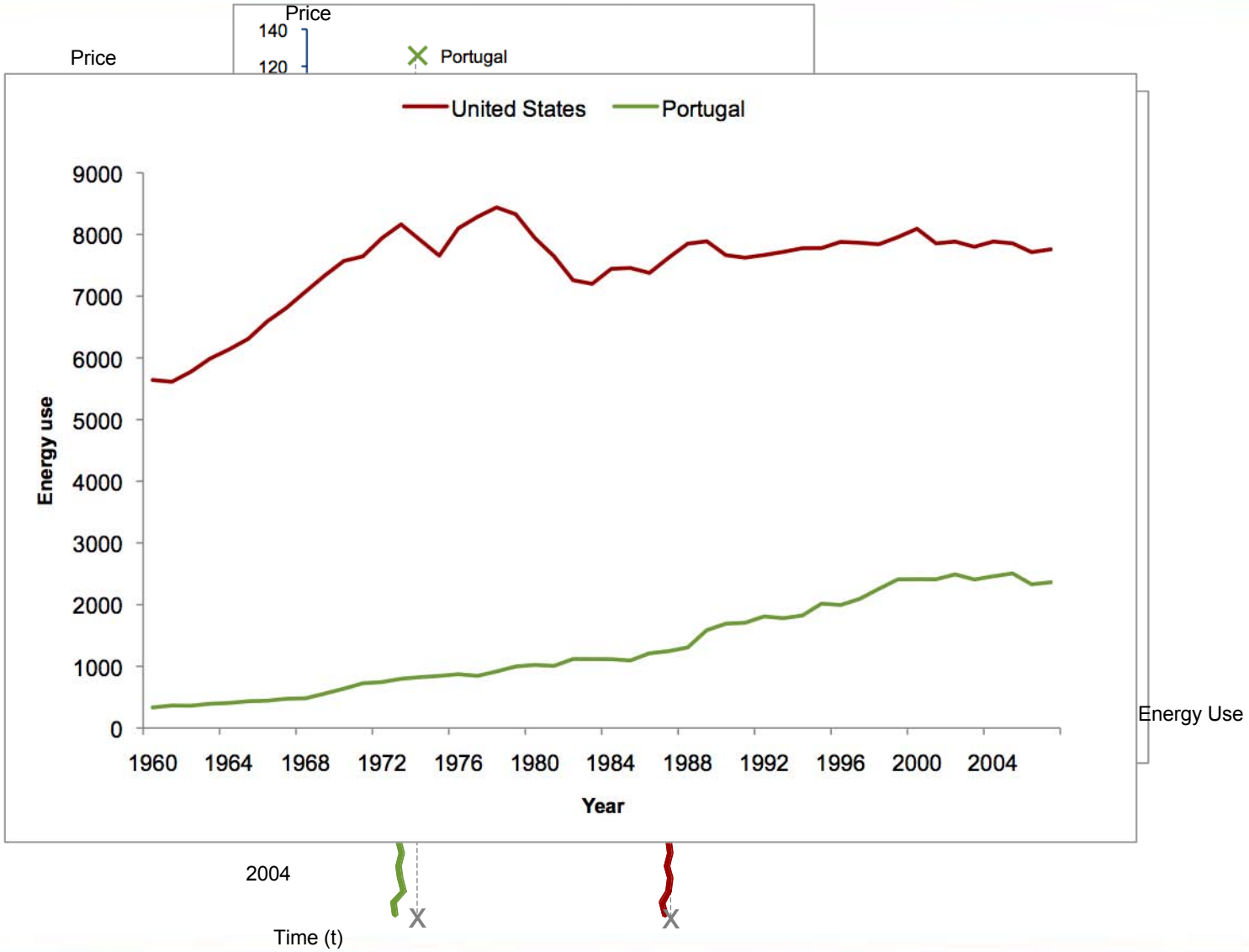
Energy use and energy price



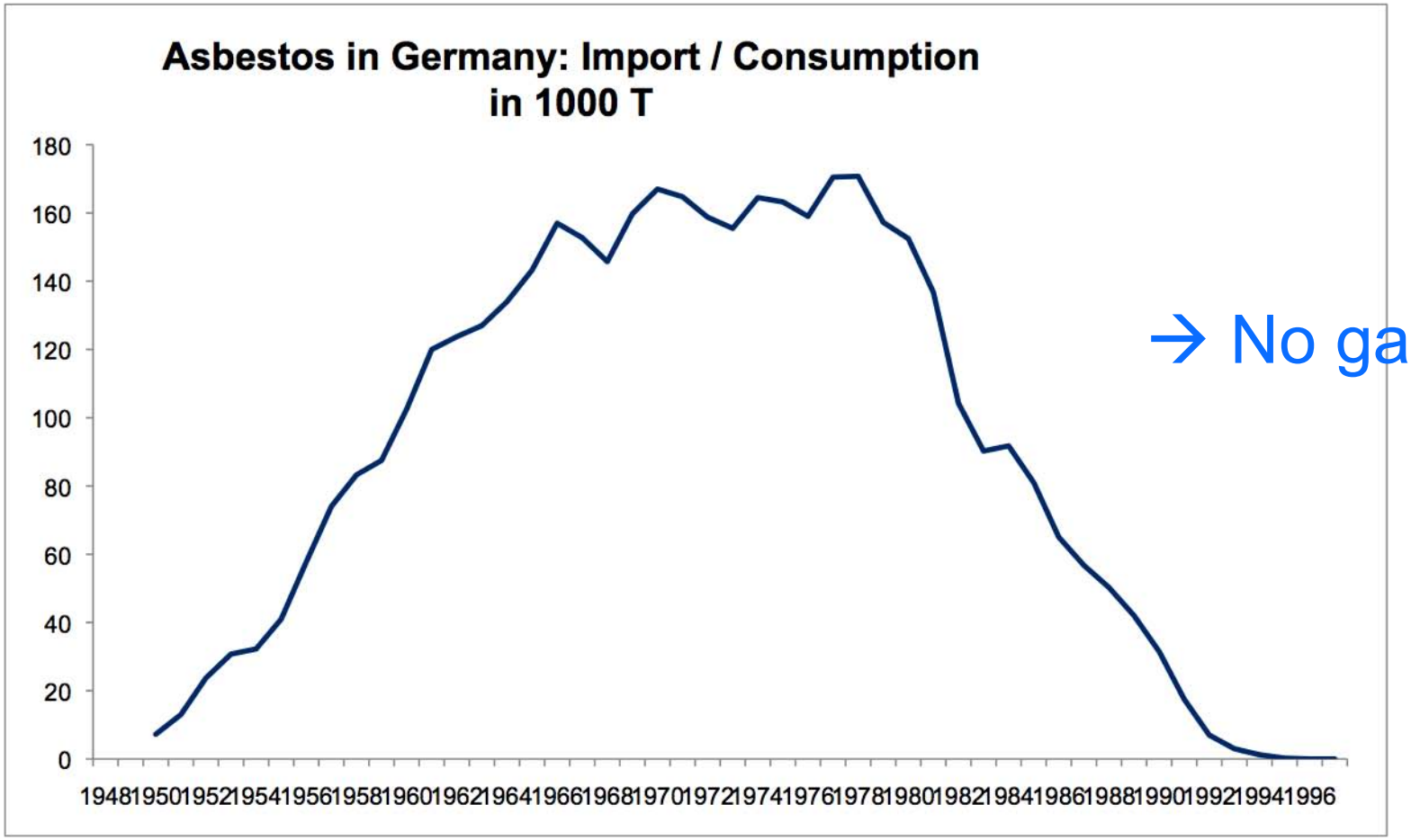
Energy use and energy price



Energy Path


Price
140
120
Portugal
United States
Portugal
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Energy use
1960
1964
1968
1972
1976
1980
1984
1988
1992
1996
2000
2004
Year
Energy Use
2004
Time (t)

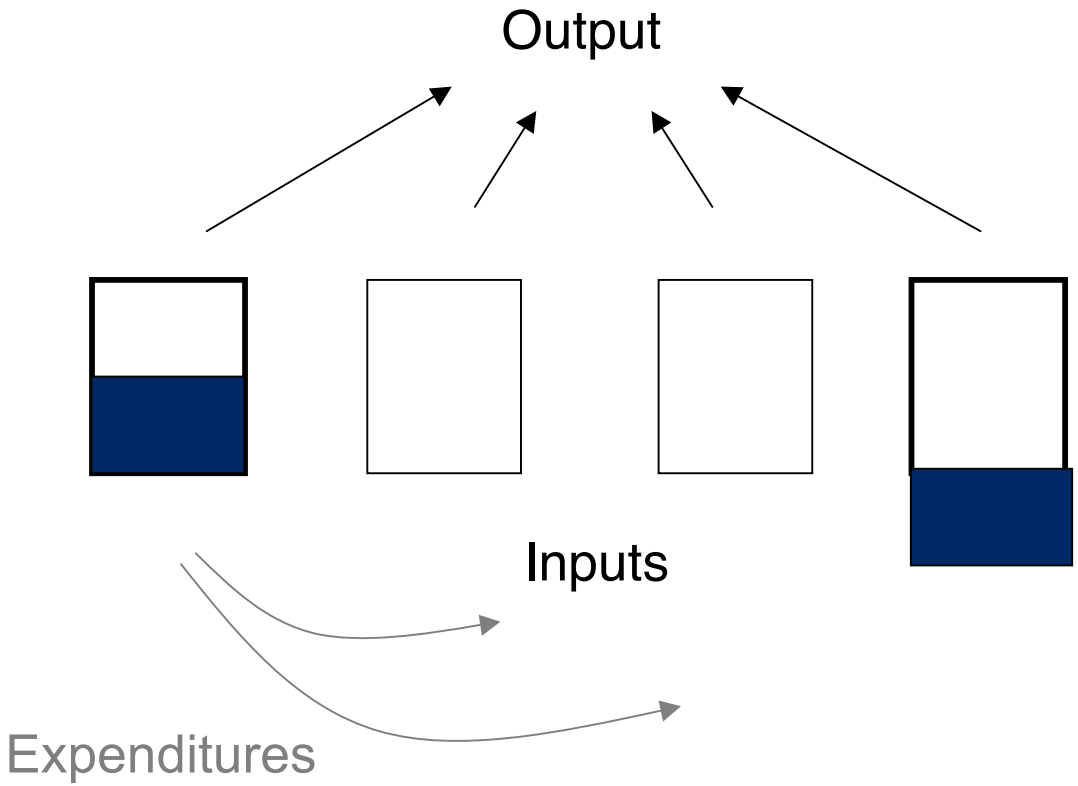
Analogy: Asbestos



→ No gaps

Source: HVBG/DGUV (2005)

Growth forces: More with less?



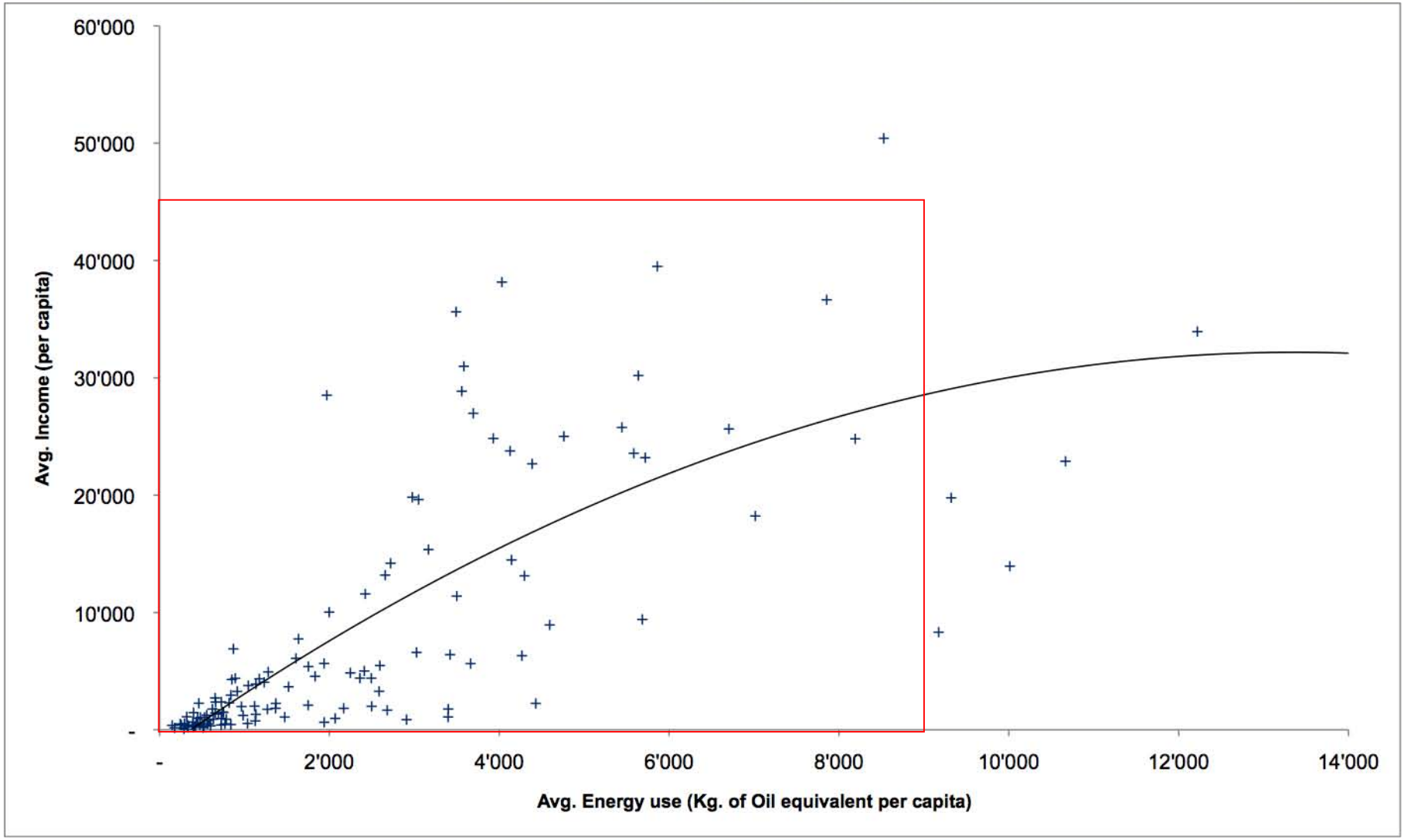
„Magic of the Marketplace“

Market economies are flexible in the long run

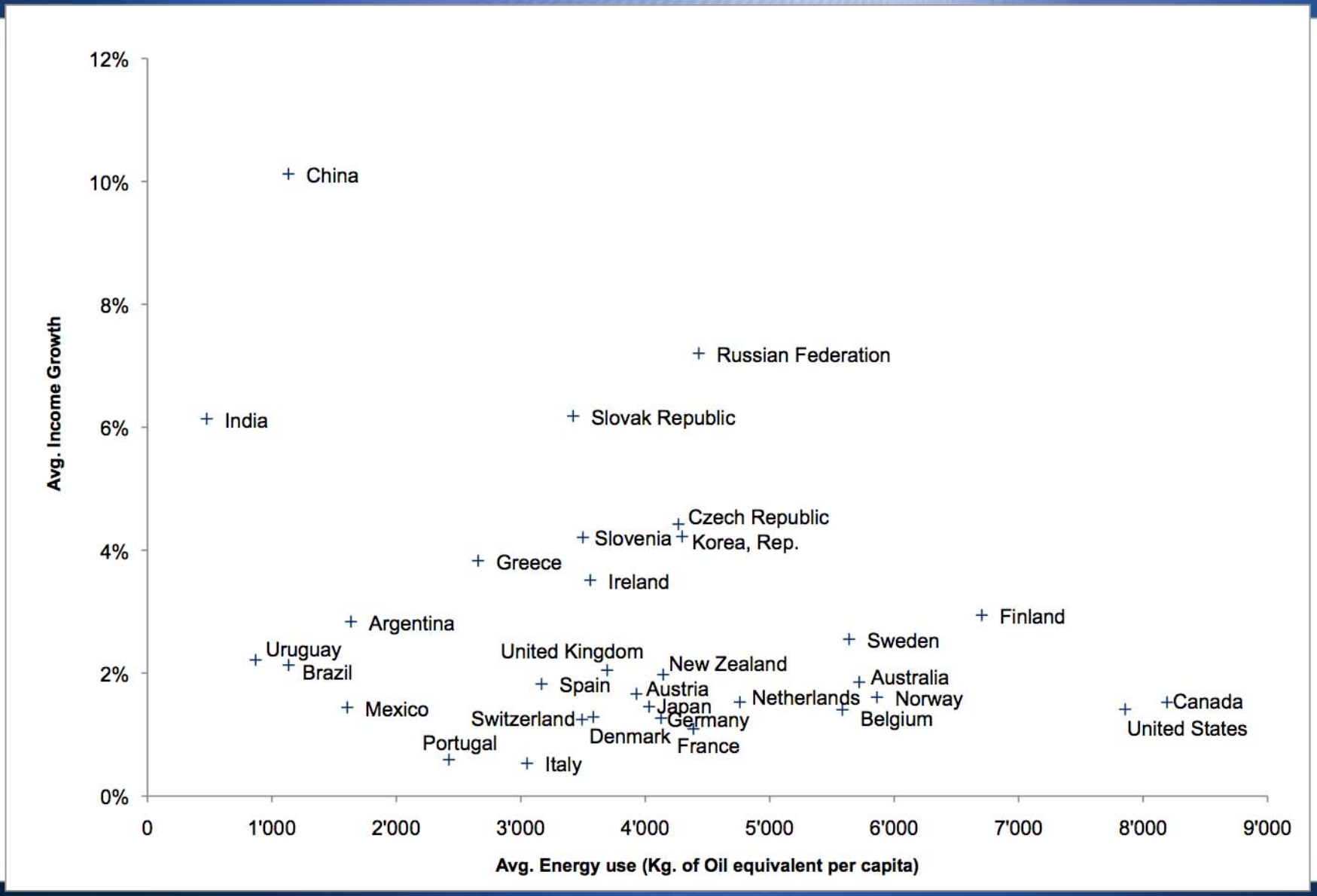
They can deal with limitations and restrictions

Induced innovation and investments

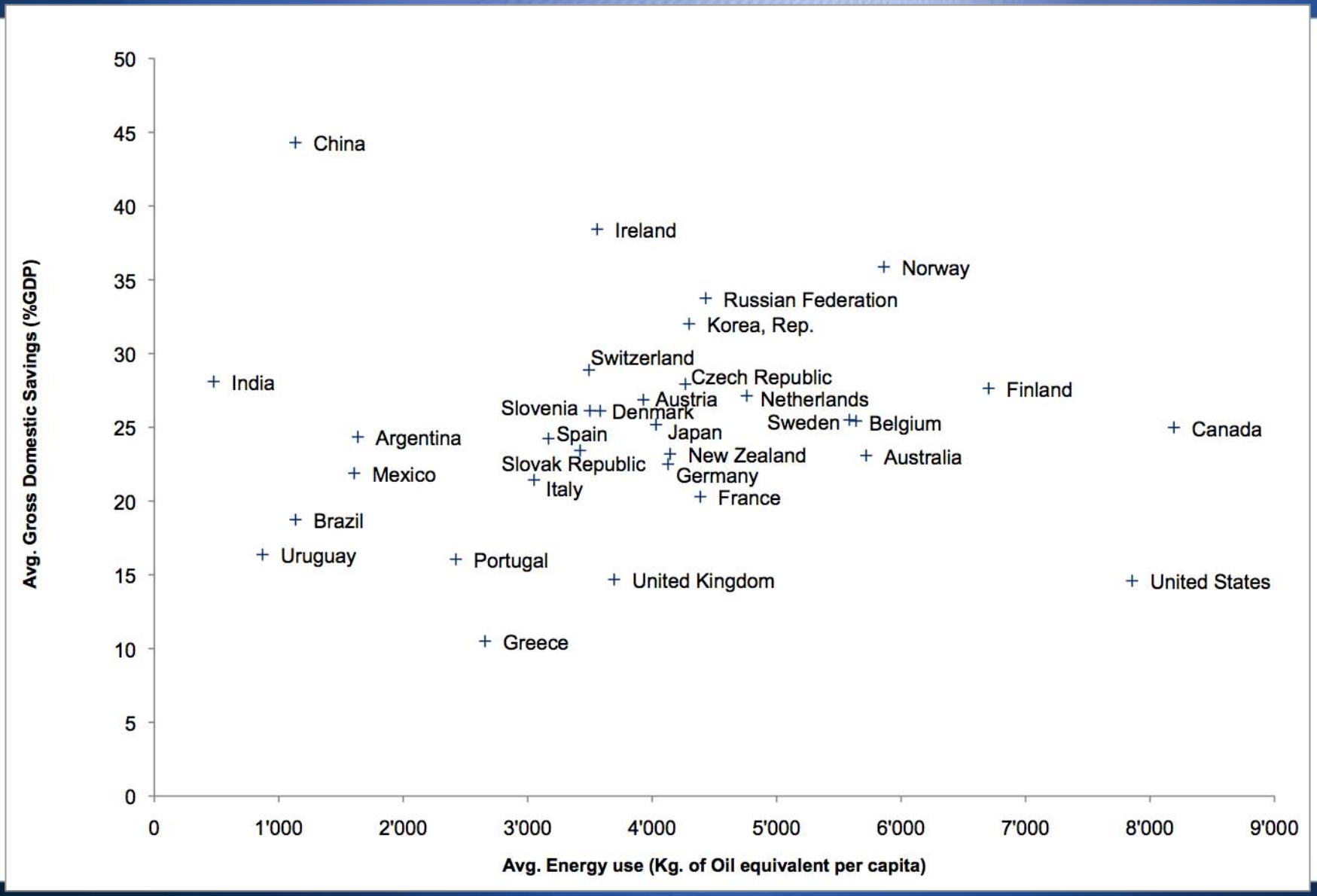
Energy use and income (avg. 2000-2007)



Energy use and income growth (2000-2007)



Energy use and investments (2000-2007)



2 Degrees Celsius Target

- **Reduction of CO_2 emissions**

  - 30 % by 2020 and

  - 80 % by 2050 (relative to 1990)

- **Example of Switzerland**

  • Instrument: Carbon tax

- **CITE Simulation Model (ETH)**

  • Endogenous growth due to endogenous innovation and investments

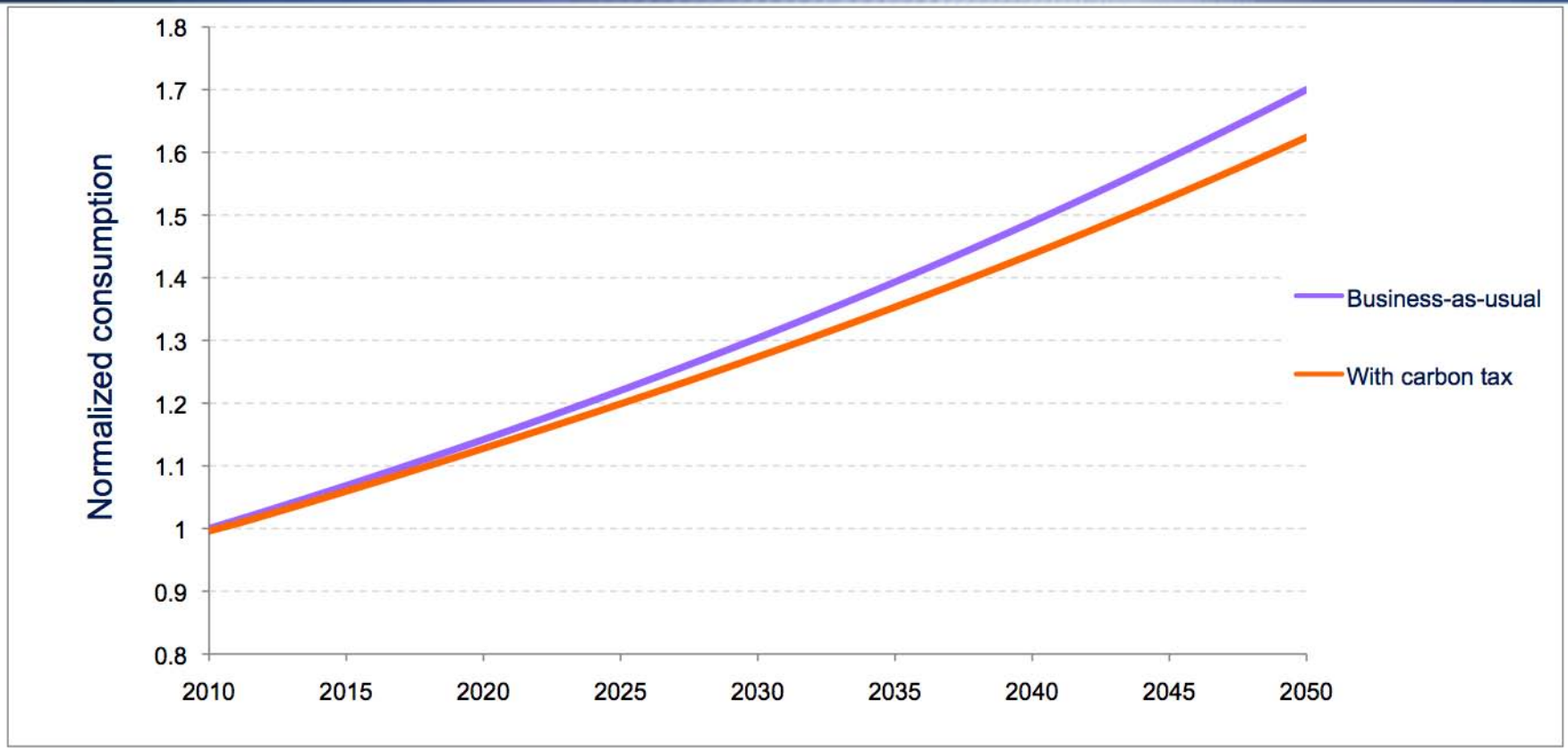
Sectors

12 production sectors (10 „regular“ sectors plus energy and oil)

Machinery industry (MCH)		Construction (CON)	
Chemical industry (CHM)		Transport (TRN)	
Insurances (INS)		Agriculture (AGR)	
Banking (BNK)		Other industries (OIN)	
Health (HEA)		Energy (EGY)	
Other services (OSE)		Oil (OIL)	

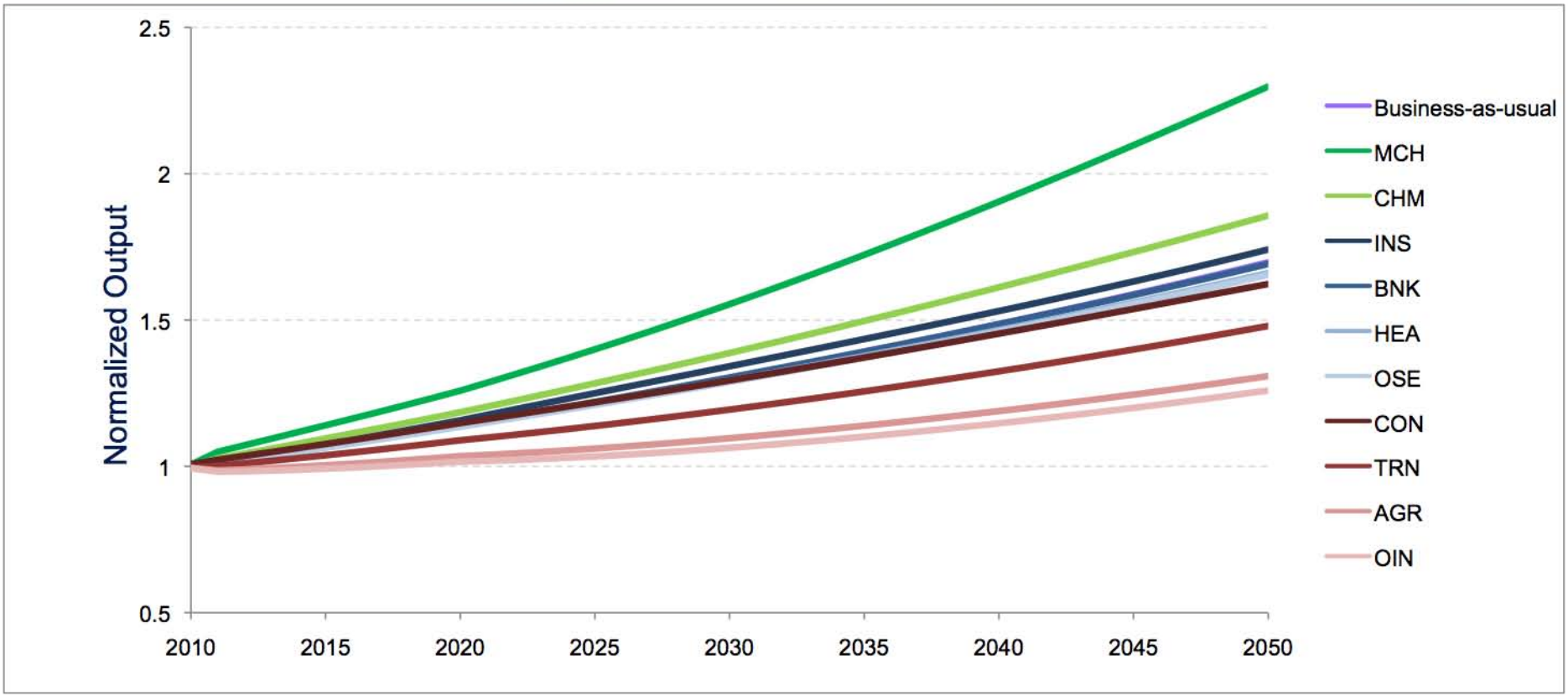
- «Other industries» includes heavy industries such as steel and cement
- «Other services» includes public sector, hotels etc.

Results: Consumption



- Effects on consumption are relatively moderate
- Consumption in 2050 lags about 3 years behind the «BAU»
- How relevant is BAU?

Results: Sectors



- Robust positive growth in all the sectors
- Policy leads to structural change

Conclusions

- **Knowledge, investments, and technologies** are decisive for decreasing the cost of emission reductions
- Adjustment to (much) lower energy use does not cause significant income losses, provided that prices guide the process **continuously**
- **Green sectors** will have higher growth
- Voluntary action of firms: highly welcome, but in the aggregate not strong enough; there remains a **role for active policies**
- «All we need now is the political will» (Paul Krugman, NYT)


Thank you!
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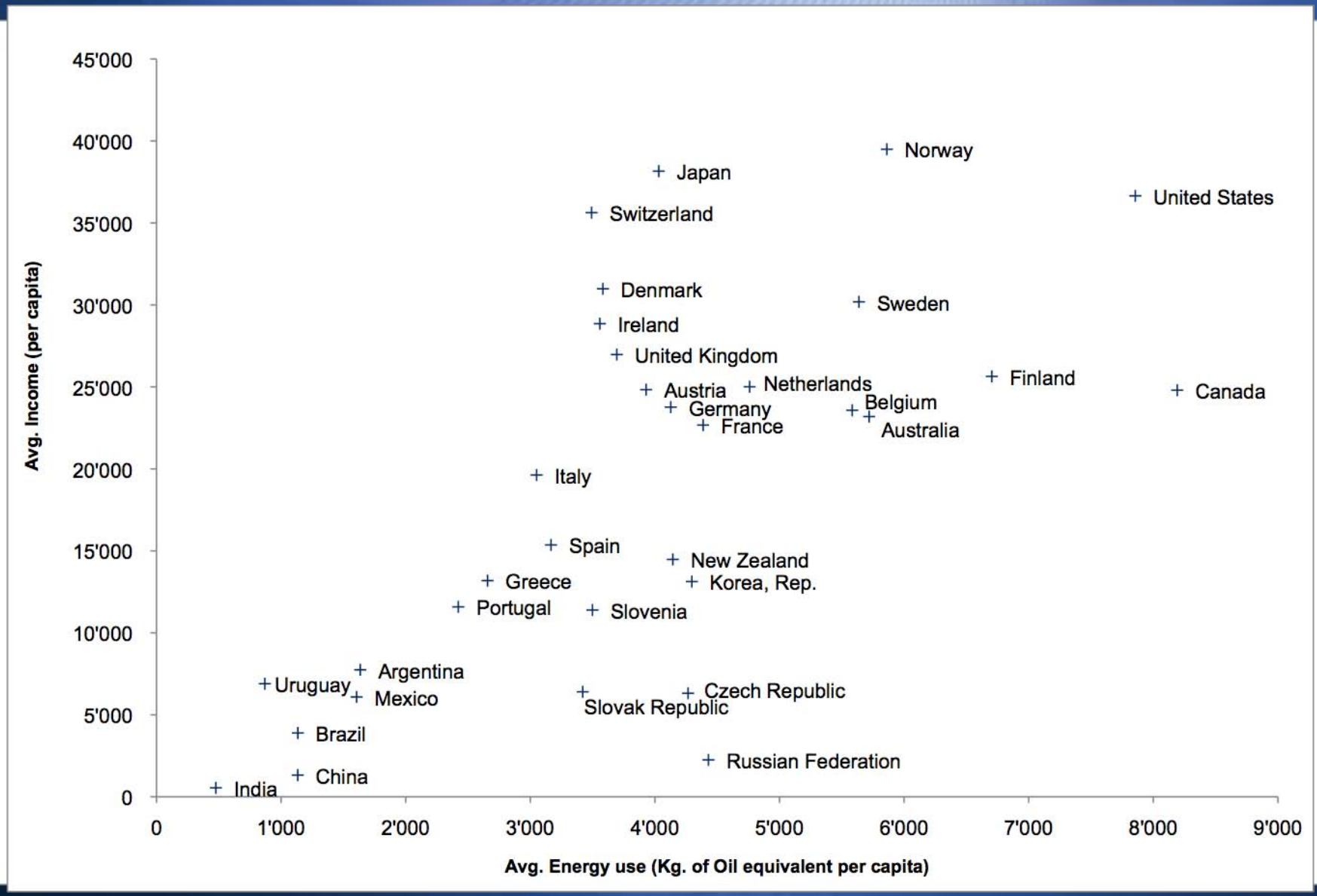
BACKUP: Nordhaus

Table 5-8. Projected Global Mean Temperature Change by Policy

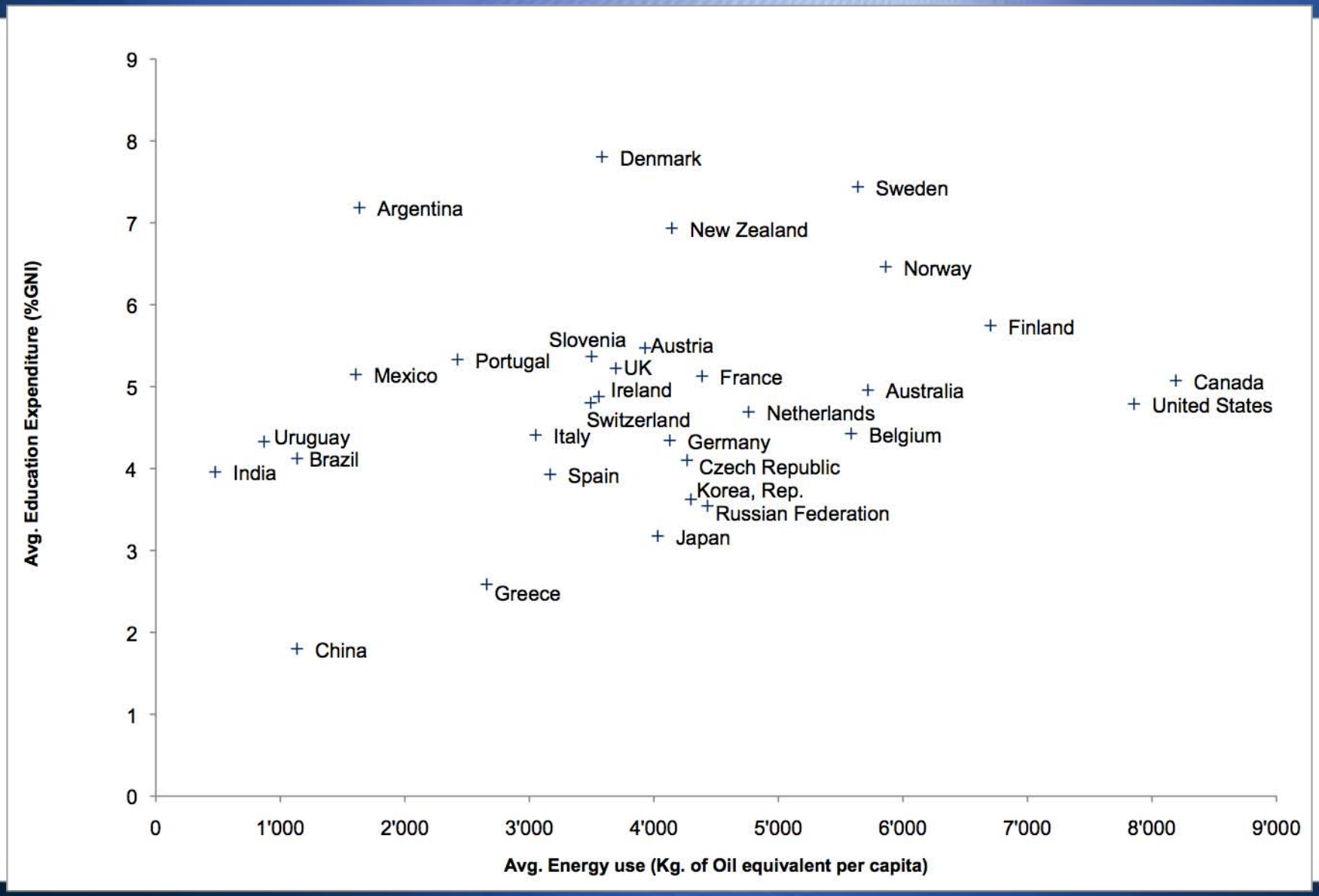
Policy	2005	2015	2025	2050	2100	2200
	(Temperature increase from 1900, degrees C)					
No controls						
250-year delay	0.73	0.96	1.20	1.82	3.06	5.30
50-year delay	0.73	0.96	1.20	1.81	2.72	3.52
Optimal	0.73	0.95	1.17	1.68	2.61	3.45
Concentration limits						
Limit to 1.5 × CO_2	0.73	0.94	1.10	1.36	1.61	1.78
Limit to 2 × CO_2	0.73	0.95	1.16	1.67	2.48	2.84
Limit to 2.5 × CO_2	0.73	0.95	1.17	1.68	2.61	3.45
Temperature limits						
Limit to 1.5°C	0.73	0.94	1.12	1.43	1.50	1.50
Limit to 2°C	0.73	0.95	1.15	1.61	2.00	2.00
Limit to 2.5°C	0.73	0.95	1.16	1.66	2.41	2.50
Limit to 3°C	0.73	0.95	1.17	1.68	2.57	2.99
Kyoto Protocol						
Kyoto with						
United States	0.73	0.96	1.18	1.76	2.94	5.23
Kyoto w/o						
United States	0.73	0.96	1.20	1.81	3.05	5.29
Strengthened	0.73	0.95	1.17	1.66	2.39	3.26
Stern Review						
discounting	0.73	0.89	1.03	1.31	1.52	1.27
Gore proposal	0.73	0.95	1.14	1.42	1.49	1.58
Low-cost backstop	0.73	0.80	0.84	0.86	0.90	0.83

Note: Increases are relative to the 1900 average.

Avg. energy use vs. Avg. Income (2000-2007)



Avg. energy use vs. Avg. Education Expenditure (2000-2007)



Avg. energy use vs. Avg. R&D Expenditure (2000-2007)