How might a future global sustainable transport system look?

A long-term scenario of sustainable technology deployment

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International Energy Workshop, Paris
30 June – 2 July, 2008

Outline

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Methodology: modelling a scenario of sustainable energy and transport

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Summary of key finds and conclusions

Background and policy context

Transport represents a major threat to long-term sustainable development, given:

- High dependence on oil; and
- Future economic development, demand for mobility,

creating challenges in terms of :

- Security of energy supply
- Greenhouse gas emissions and climate change
- Others: congestion, local/regional pollution

What are the features of possible pathways to a sustainable transport system?

- What technologies, fuels and complementary developments might be necessary?

Approach

Construct and analyse a global automobile transport scenario for the 21st century, encompassing sustainability objectives:

economic growth, mobility, climate change, energy security

Explore:

- key transport technology developments;
- fuel supply requirements; and
- broader energy system developments

compatible with long-term sustainable development

Identify possible policy initiatives necessary to support sustainable development in the energy-transport sector

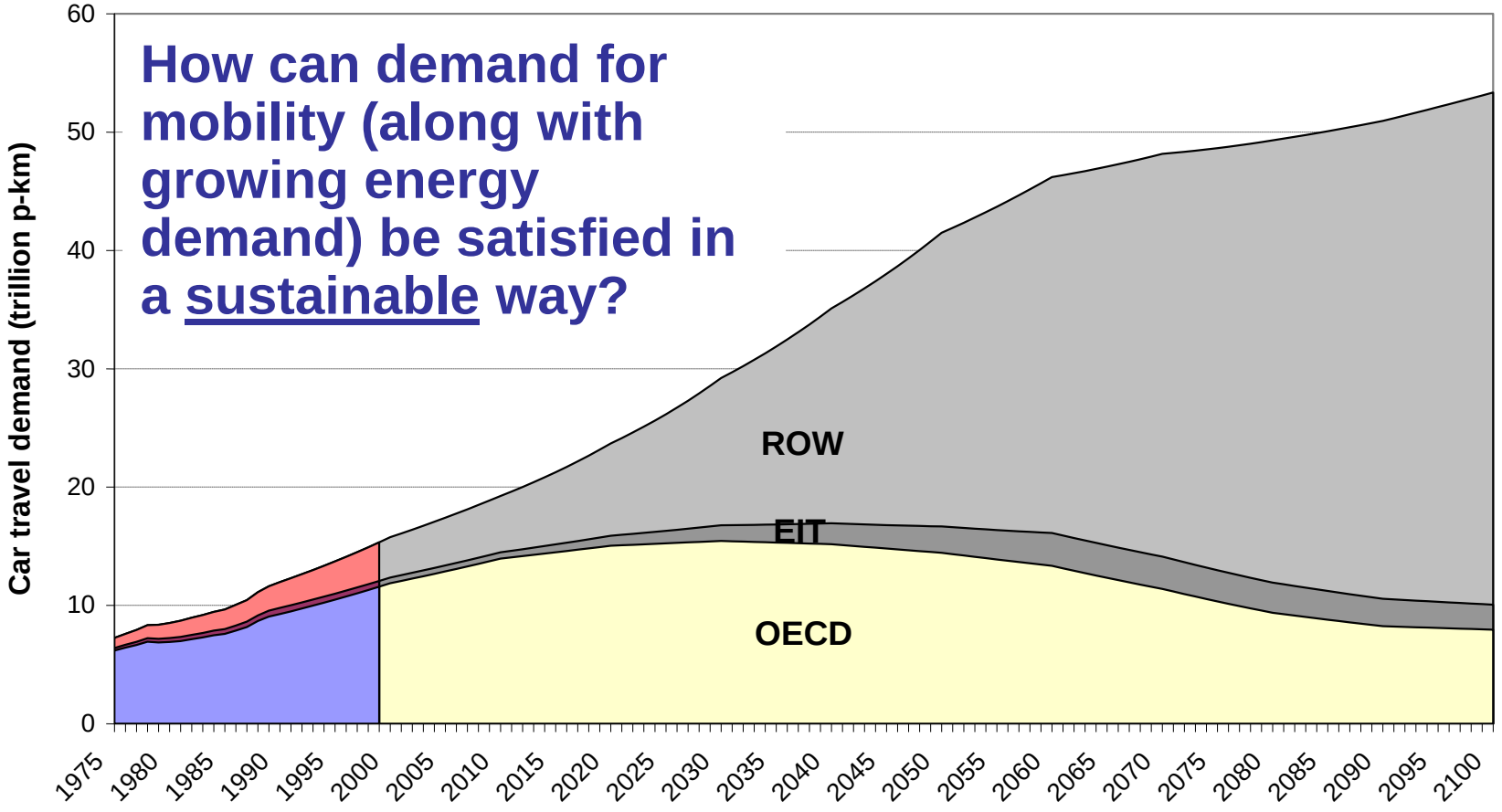
Starting point: IPCC SRES* B2 scenario of economic growth and equity

	Global population in 2100 (billions)	Av. annual income growth (%)	Average global income in 2100 (1990US$,000s)	Inequality in 2100 (Richest: Poorest)	Av. global energy intensity (MJ/$)
A1	7.2	2.7	74.9	1.8	4.2
A2	15.1	1.3	16.1	7.5	7.1
B1	7.2	2.2	46.6	2.2	1.6
B2	10.4	1.6	22.0	3.8	5.8

Long-term growth and improving equity

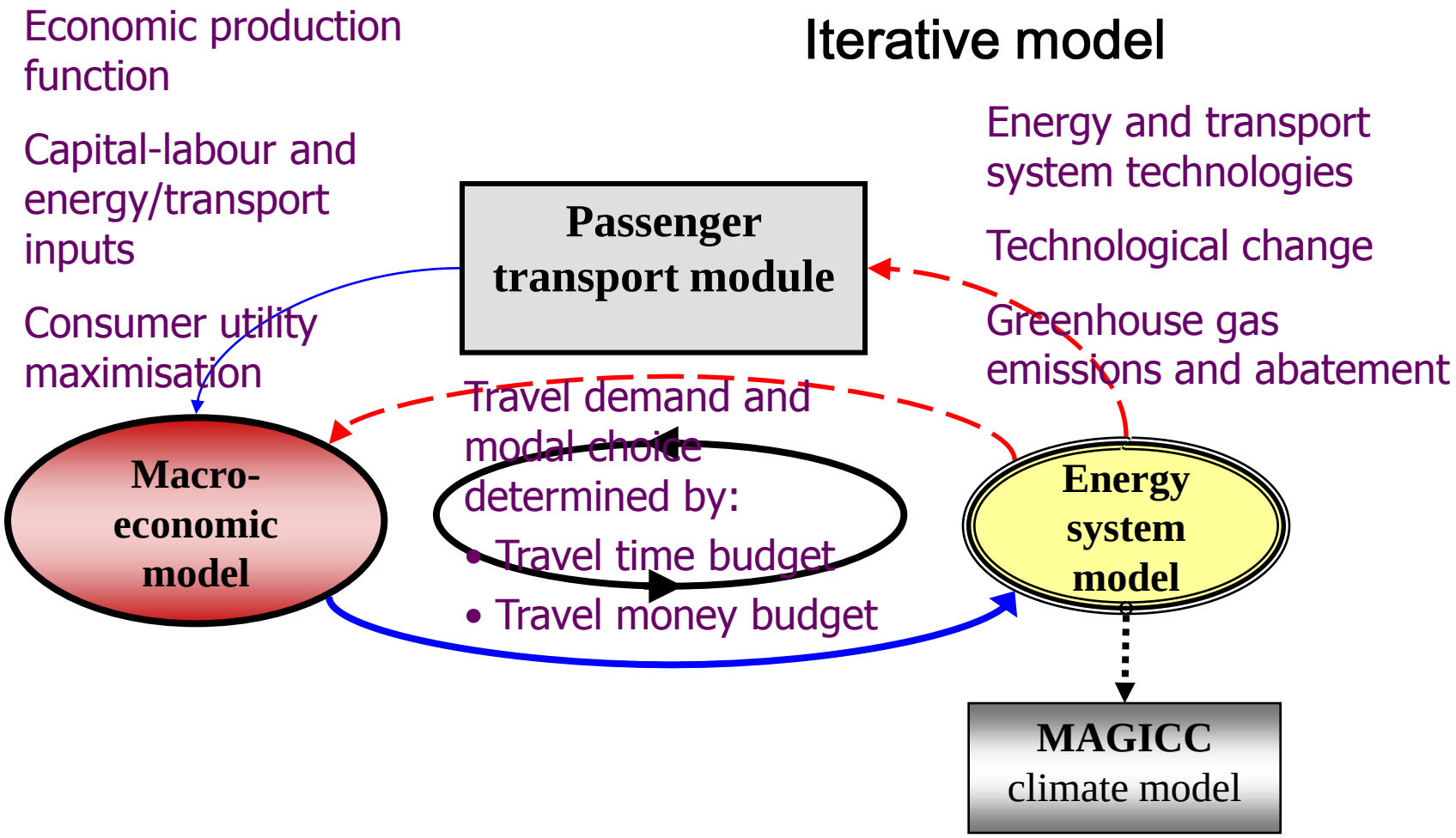
*Special Report on Emissions Scenarios (Nakicenovic 2000); Source: Kram *et al.* 2000; Nakicenovic 2000, Figure 4-5

Global mobility: future car travel demand



Methodology: modelling a scenario of sustainable energy and transport

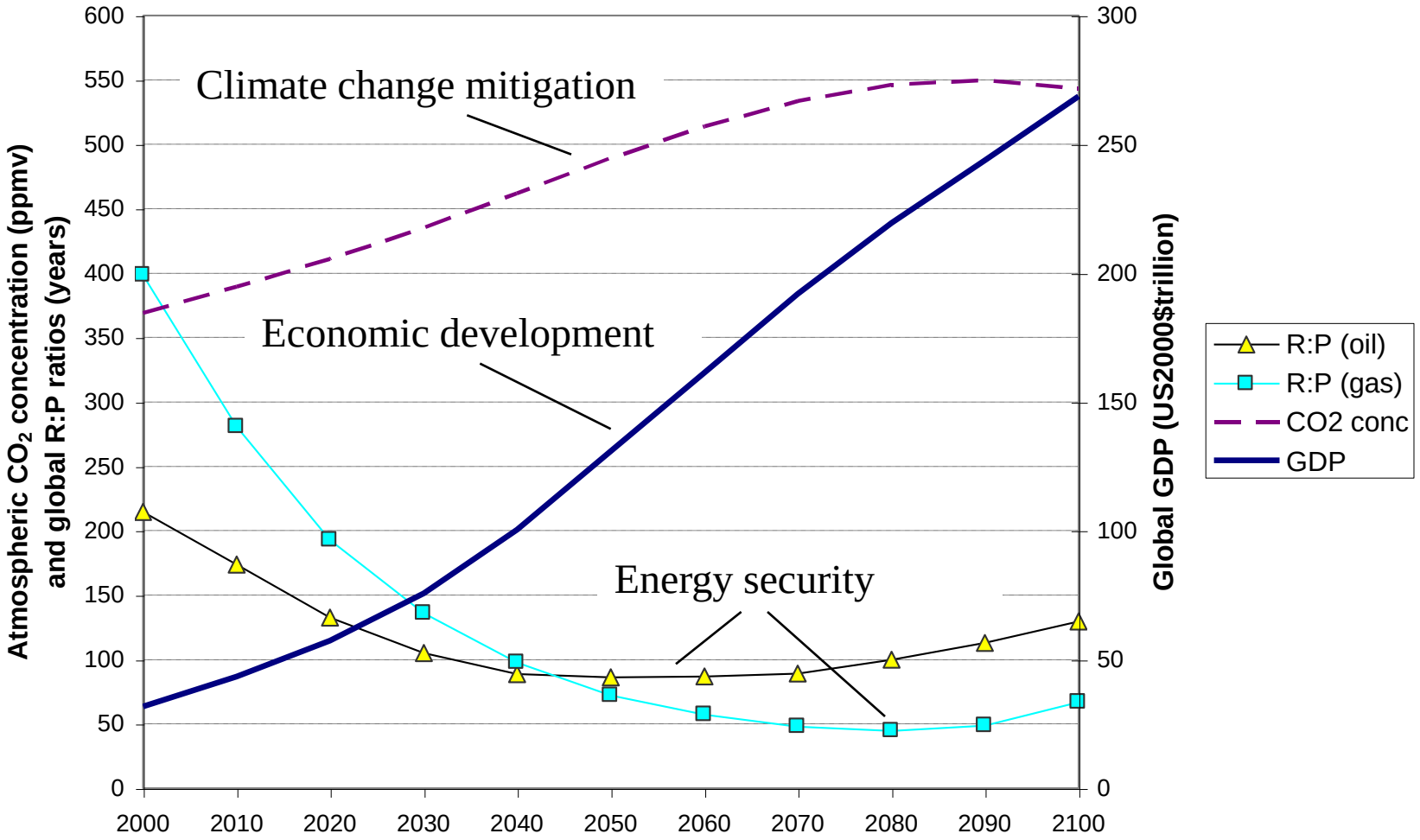
Overall ECLIPSE framework



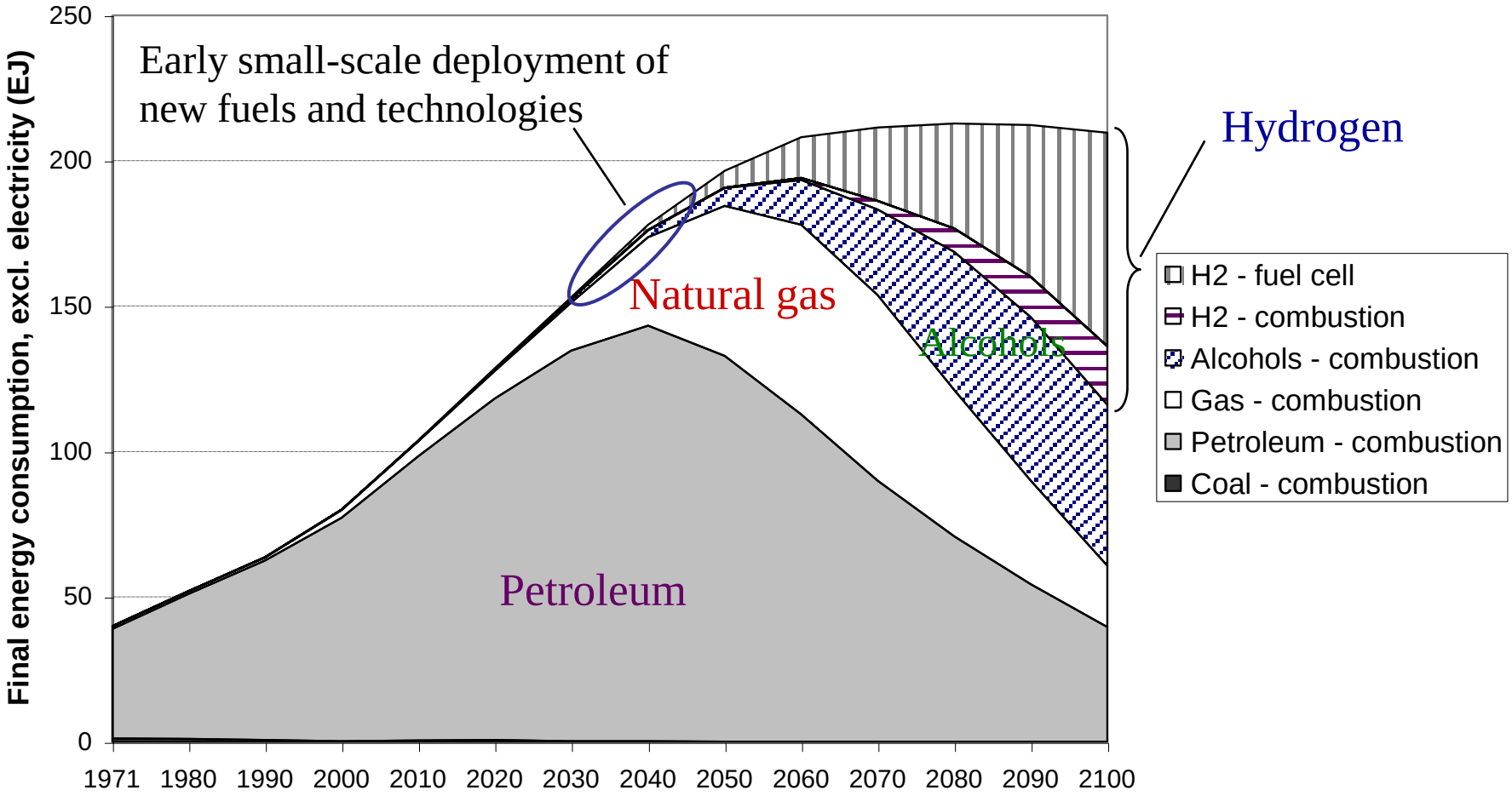
Scenario modelling results

What might a sustainable transport and energy system look like?

Key indicators of sustainable development

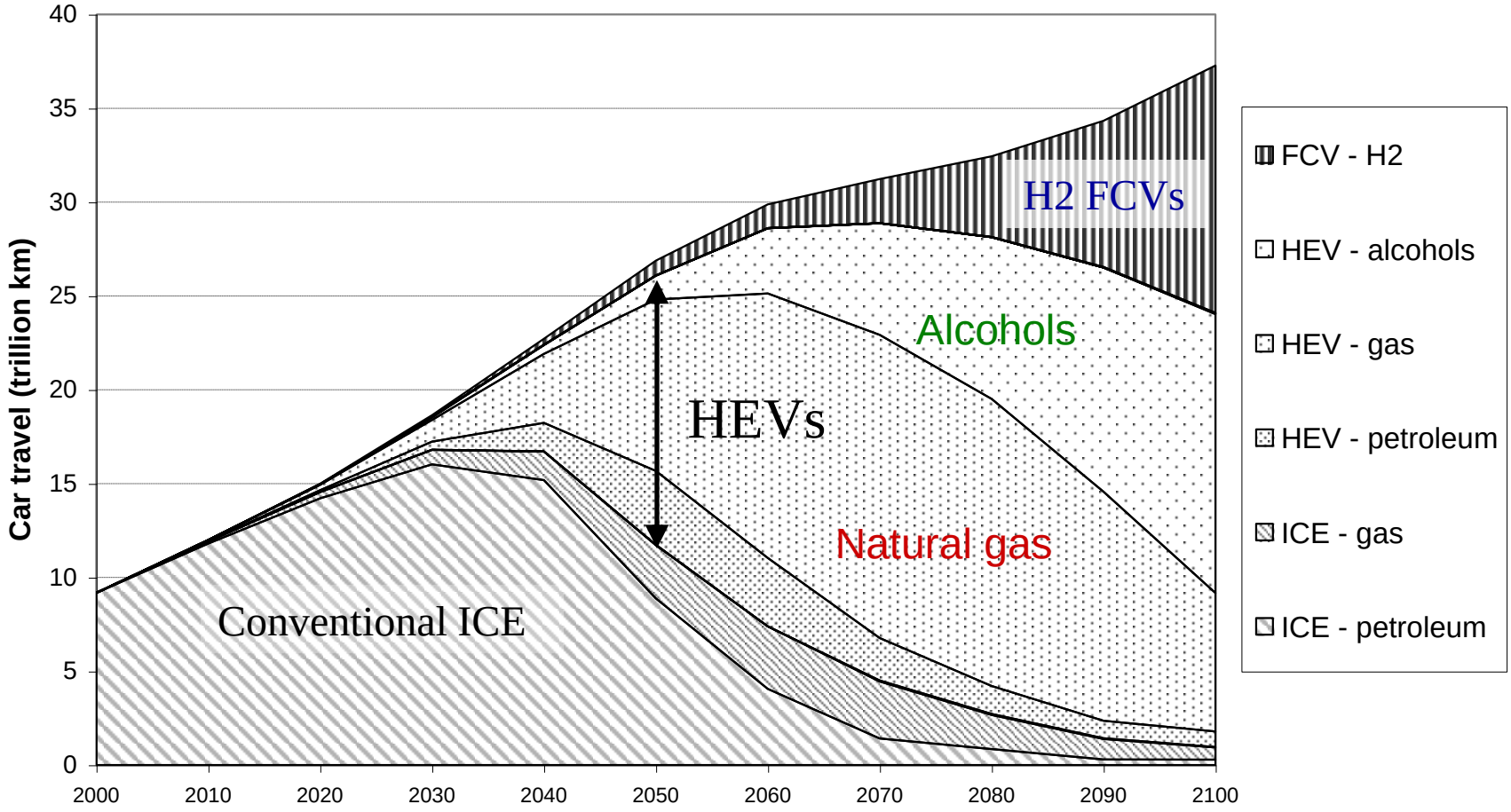


Transport sector: sustainable energy demand



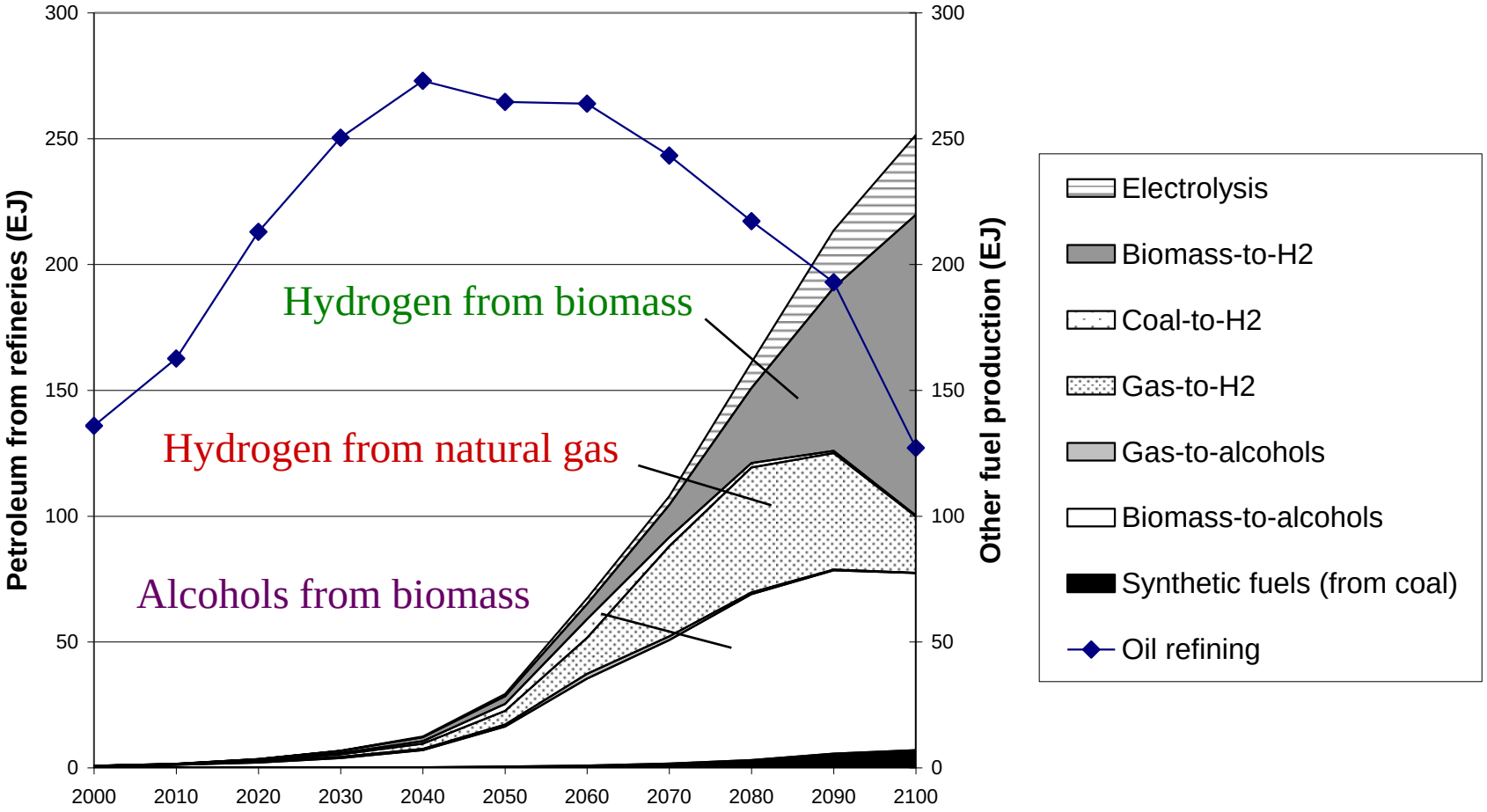
Historical statistics from IEA 2003a,b

Example: automobile transport and sustainable development



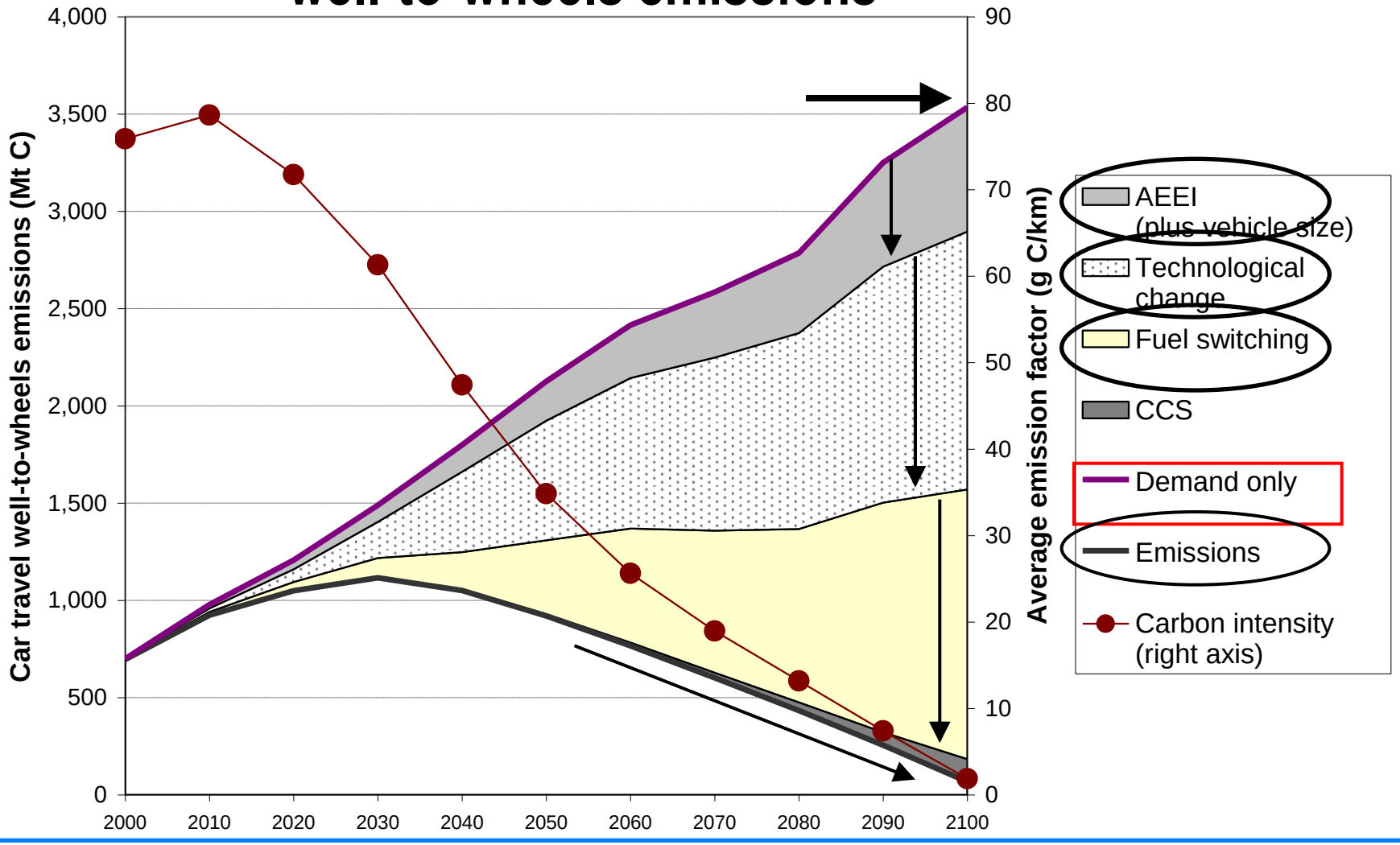
ICE – conventional internal combustion engine vehicle; HEV – hybrid ICE-electric vehicle; and FCV – hybrid fuel cell-electric vehicle.

Transport sustainability and fuel production



Automobile transport and GHG emissions:

well-to-wheels emissions



Summary: sustainable transport

Technology deployment

- Hybrids may be a long-term transition tech
  - Technology is already in early diffusion phase
    - Incentives, regulations, procurement programs
- Fuel cells longer term option
  - Initially more attractive in non-automobile transport
  - Still technical challenges
    - R&D support, niche applications

Summary: transport fuel production

Shift from petroleum → natural gas → alcohols → hydrogen

- Infrastructure requirements
- Sustainable mobilisation of biomass feedstock
- Both requiring major investment, and co-ordination activities
  - Potentially important public-private cooperation
  - Major challenge in developing countries, but opportunity to leap-frog – e.g. ethanol in Brazil

Conclusions

It is possible to envisage a sustainable transport and energy system encompassing simultaneously multiple objectives, including:

- restricting CO_2 emissions (and almost eliminating them from transport);
- maintaining resources:production ratios for oil and gas; and
- satisfying a rapidly growing global demand for transport and energy

The scenario presented here illustrates the kind of technology pathways along which a sustainable transport system may emerge

- begins to lay out a technological and infrastructure roadmap illustrating one pathway.

Conclusions

Critical roles in transport are identified for:

- hybrid-electric and fuel cell technologies
- alcohol and hydrogen fuels synthesised from biomass

all of which may be potential candidates for strategic public support and coordination of private investment, but face major challenges.

A major transformation is required to achieve SD

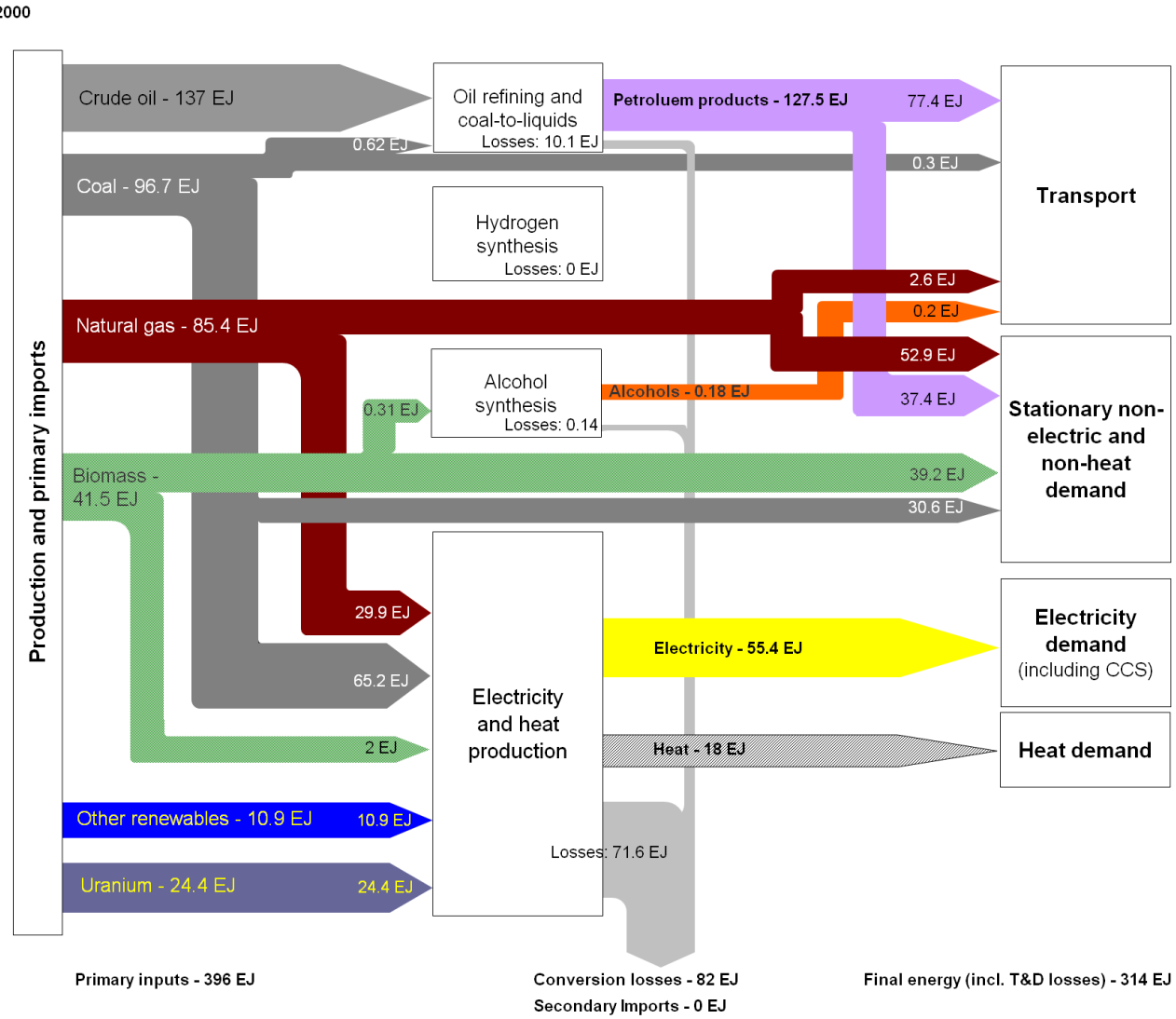
Early deployment of new technologies is important, given the slow pace of energy and transport infrastructure development

- Hence, early and consistent actions (and incentives) are necessary to achieve sustainable mobility.

Thank you

Support slides

Global energy system in 2000



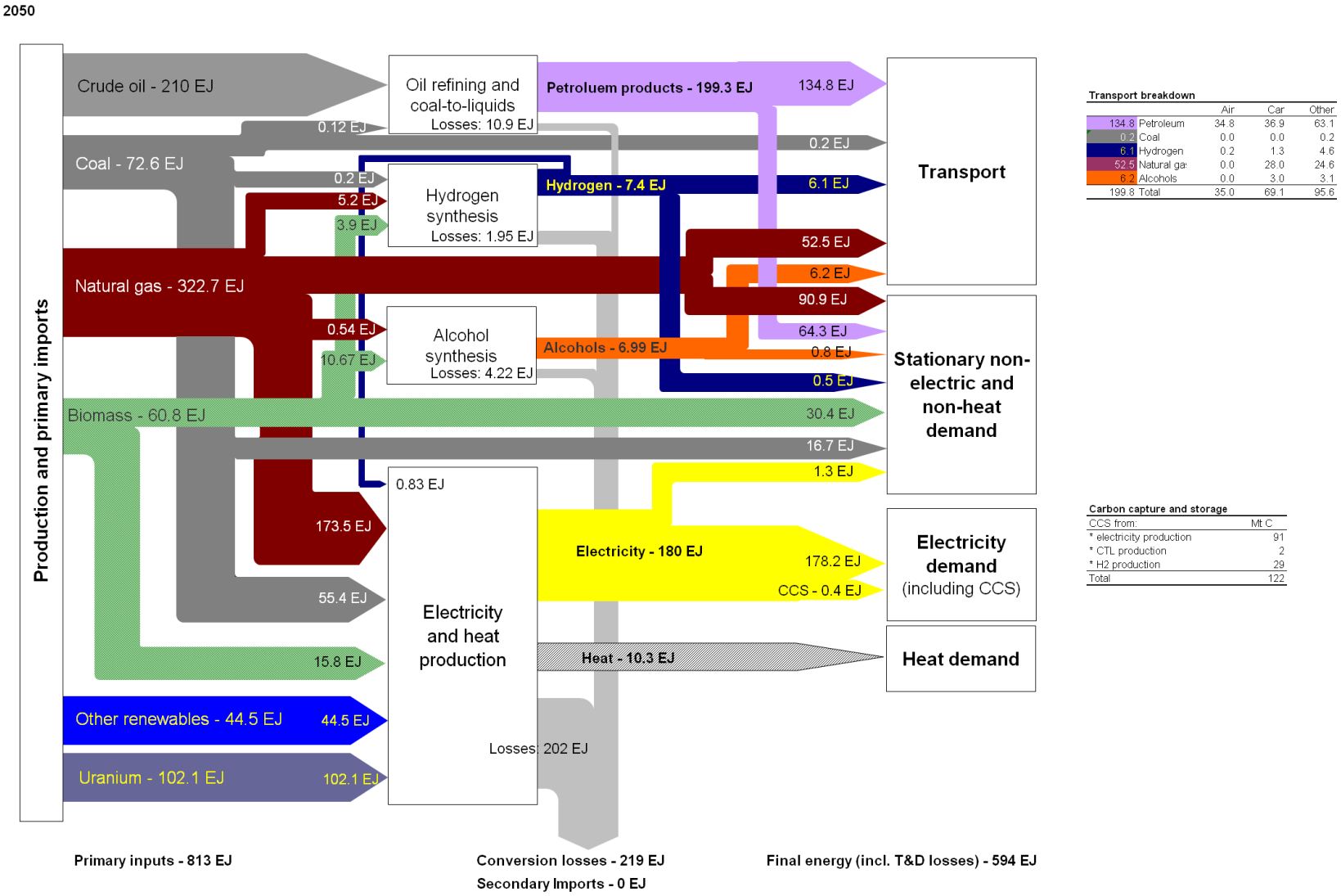
Transport breakdown

		Air	Car	Other
77.4	Petroleum	9.3	31.5	36.6
0.3	Coal	0.0	0.0	0.3
0	Hydrogen	0.0	0.0	0.0
2.6	Natural ga:	0.0	0.0	2.6
0.2	Alcohols	0.0	0.0	0.2
80.5	Total	9.3	31.5	39.7

Carbon capture and storage

CCS from:	Mt C
* electricity production	0
* CTL production	0
* H2 production	0
Total	0

Global energy system in 2050



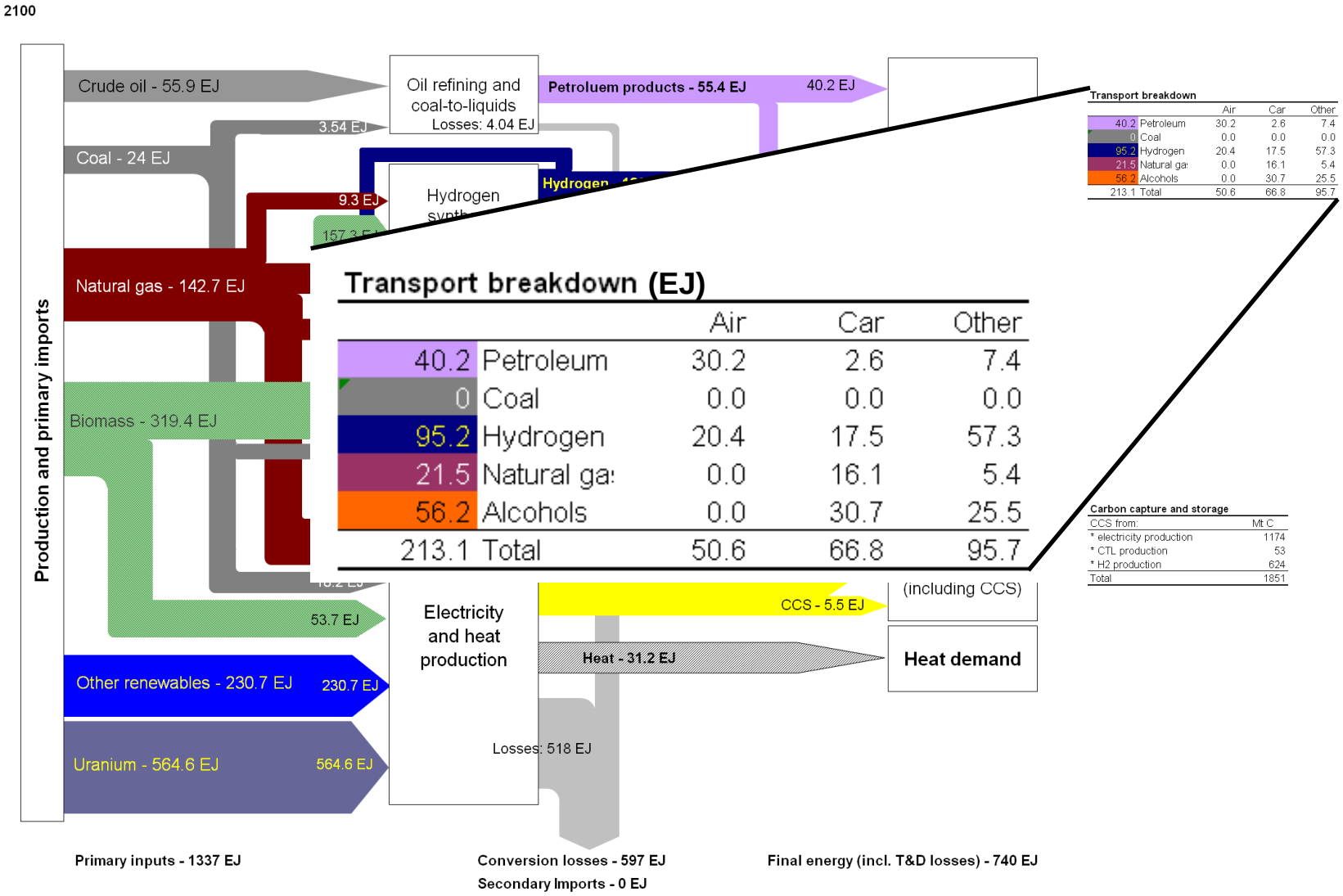
Transport breakdown

		Air	Car	Other
134.8	Petroleum	34.8	36.9	63.1
0.2	Coal	0.0	0.0	0.2
6.1	Hydrogen	0.2	1.3	4.6
52.5	Natural ga:	0.0	28.0	24.6
6.2	Alcohols	0.0	3.0	3.1
199.8	Total	35.0	69.1	95.6

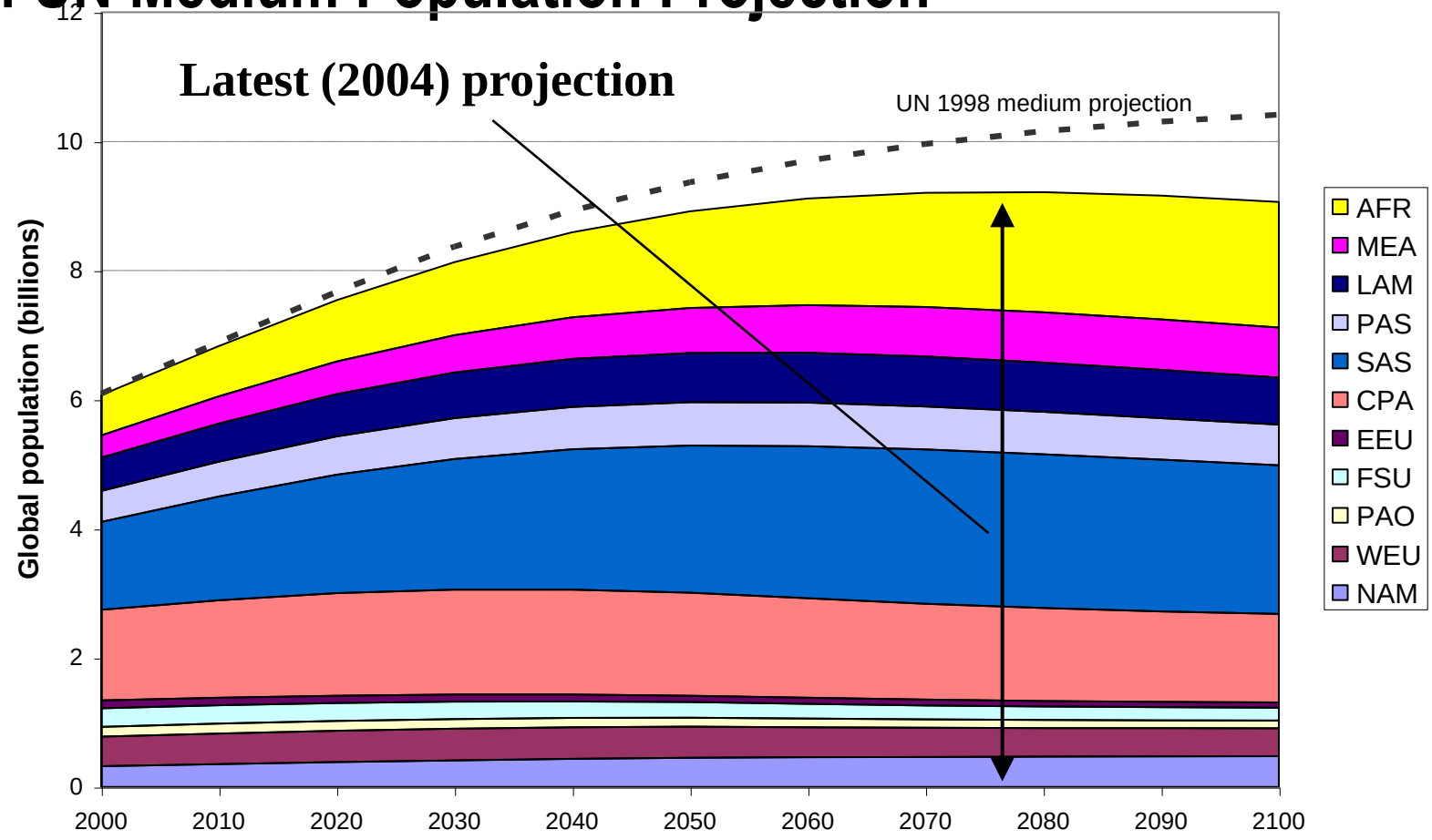
Carbon capture and storage

CCS from:	Mt C
* electricity production	91
* CTL production	2
* H2 production	29
Total	122

Global energy system in 2100

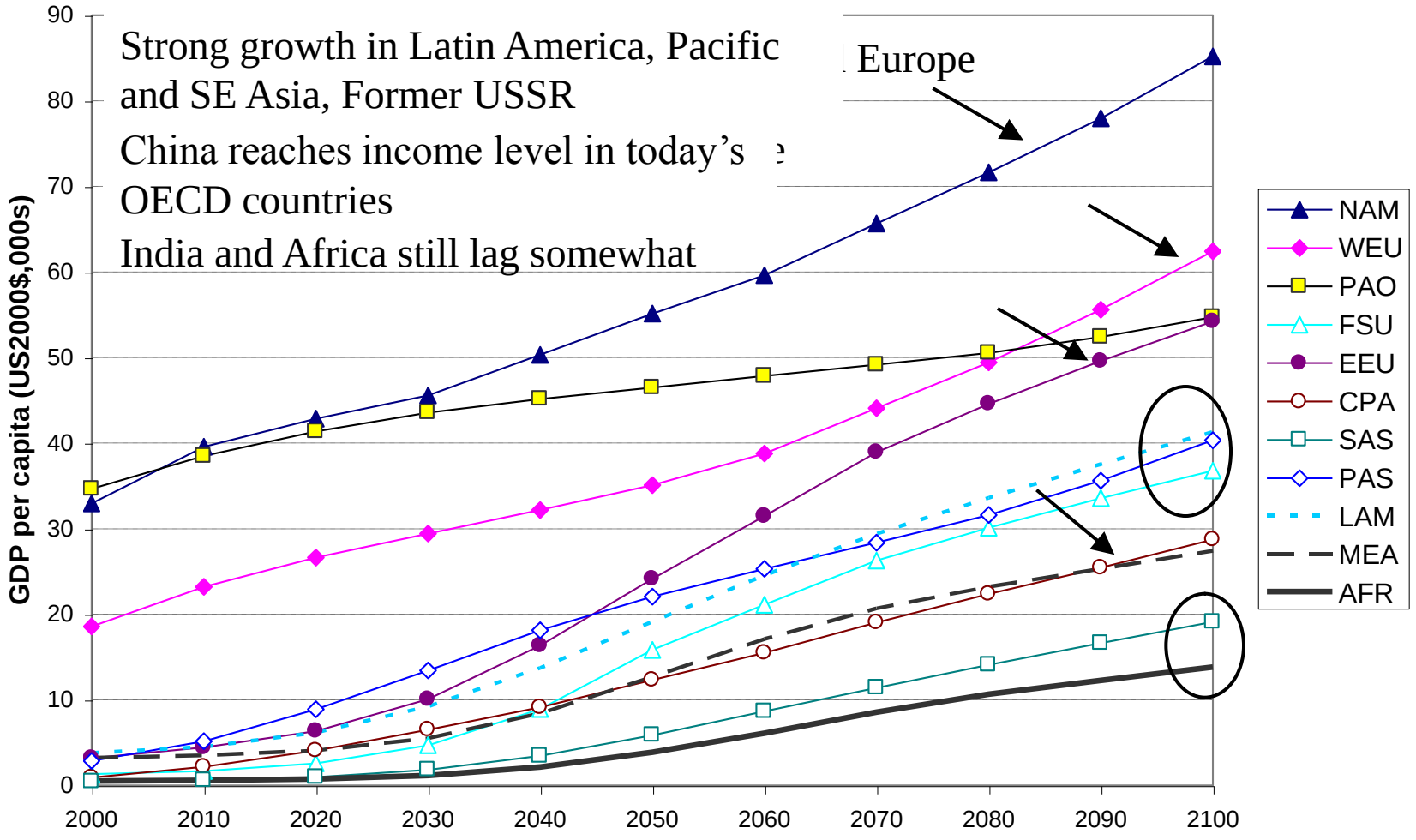


B2: UN Medium Population Projection



Source: UN 2004
NAM: North America, WEU: Western Europe and Turkey, PAO: Pacific OECD, FSU: Former Soviet Union, EEU: Eastern and Central Europe, CPA: Centrally Planned Asia, SAS: South Asia, PAS: Pacific and Other Asia, LAM: Latin America, MEA: Middle East and North Africa, AFR: Sub-Saharan Africa

B2: Per capita income growth



Source: derived from Nakicenovic 2000; Riahi 2005; Miketa 2004.

SD: provision of global mobility

One further drawback is that B2 assumes:

- "[u]rban and transport infrastructure is a particular focus of community innovation, contributing to a low level of car dependence and less urban sprawl" (Section 4.3.4 in Nakicenovic 2000)

Inconsistent with other aspects of B2:

- Gradual changes in demographics, geopolitics, productivity, technology and other characteristics
  - Systems with high inertia, such as transport are unlikely to be amenable to more rapid changes