

Global Transformations and the Future of Mobility

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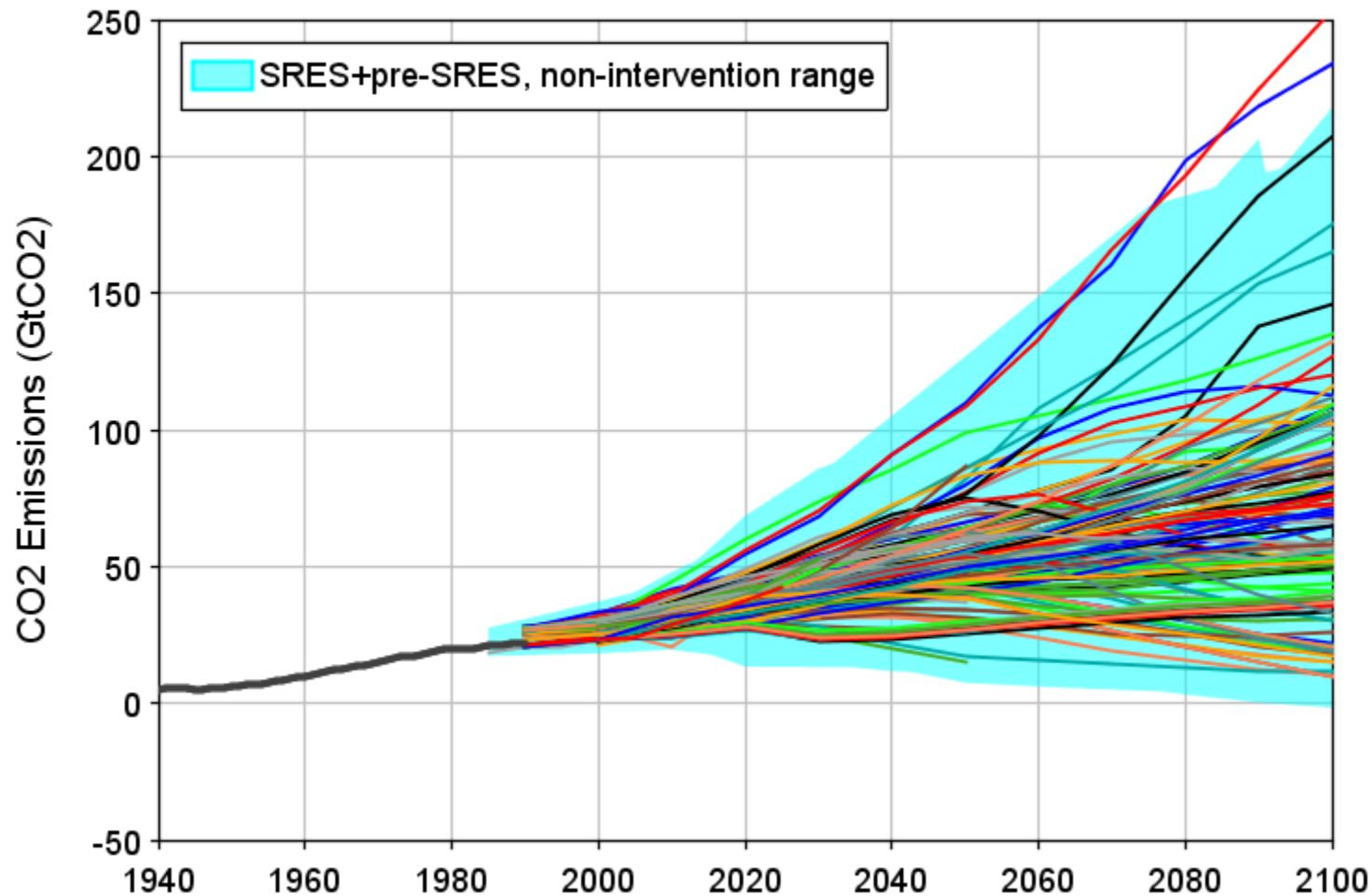
Technische Universität Wien



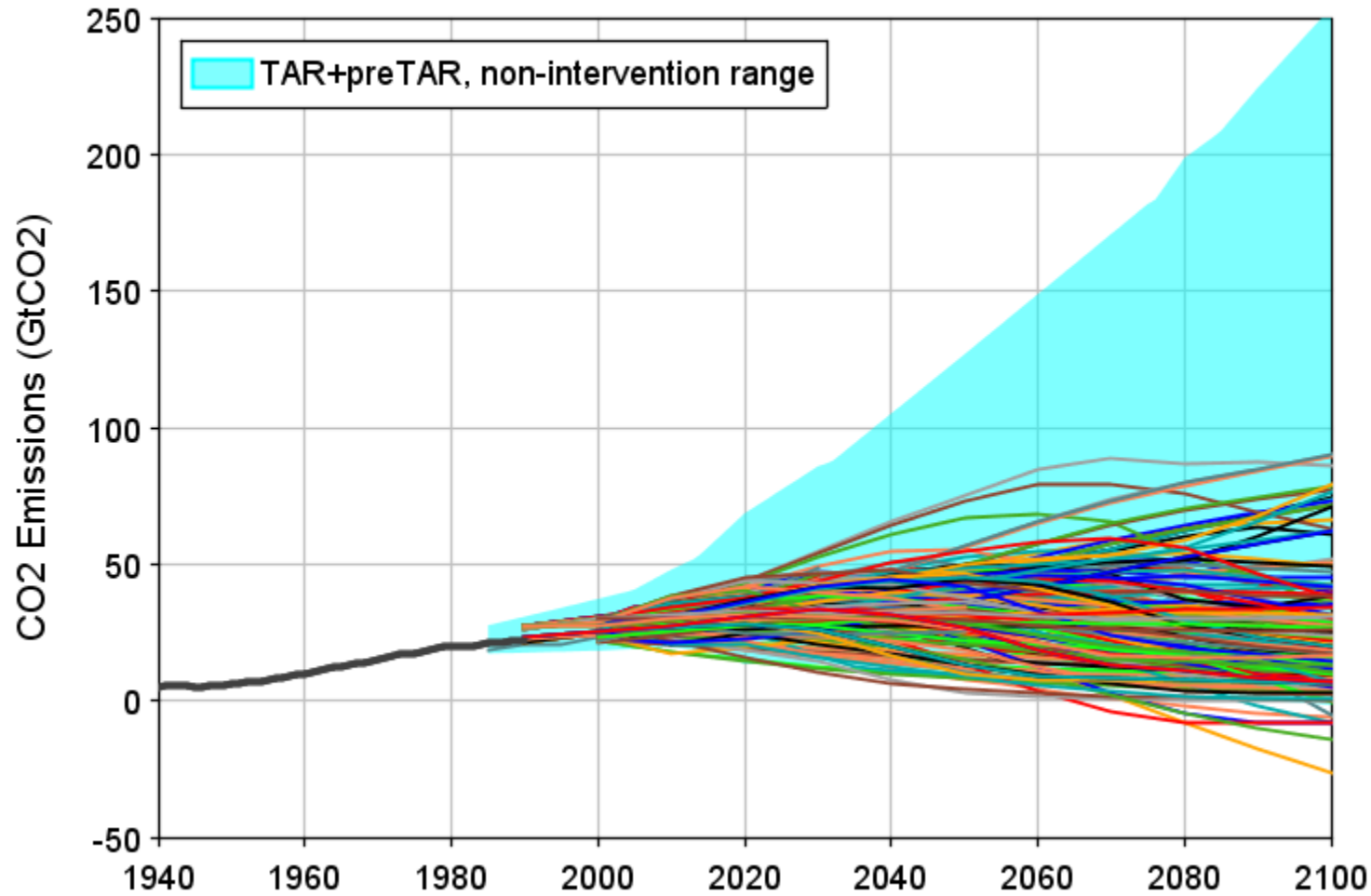
naki@iiasa.ac.at

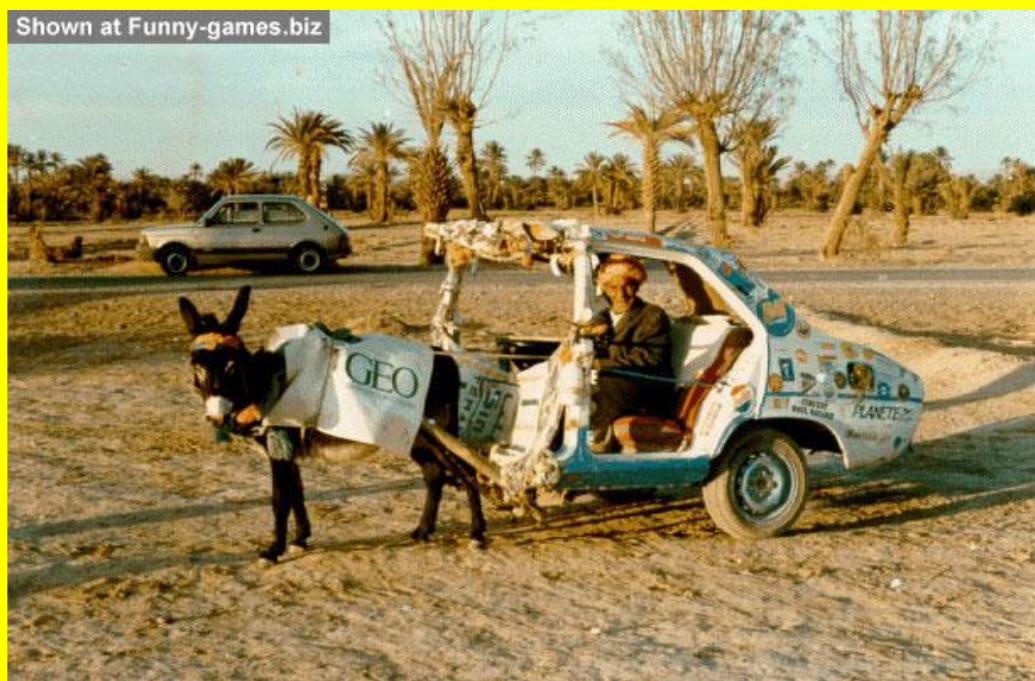
What Do Energy and GHG Scenarios Tell Us? 14th Biennial Conference on
Transportation and Energy, Asilomar Conference Grounds – 7 August 2013

Global CO2 Emissions

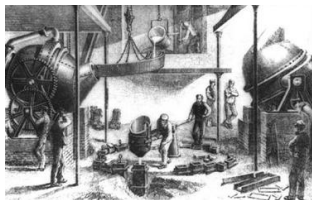


Global CO2 Emissions

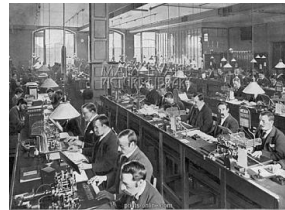
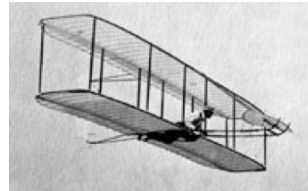




1850



1900



1950



2000

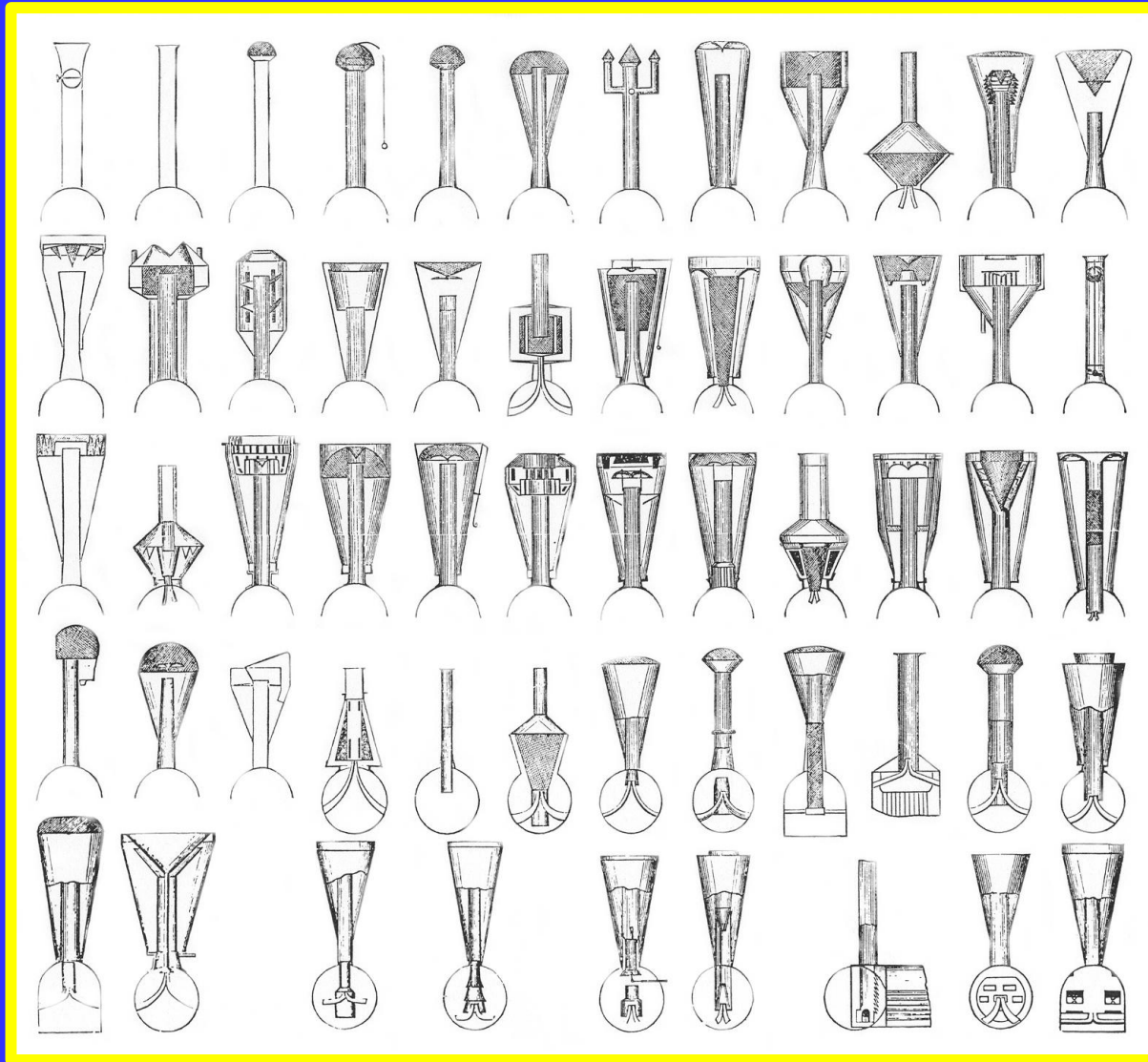


Technological Change: Dynamic, Cumulative, Systemic and Uncertain

- Incremental – gradual (continuous) and cumulative improvements
- Abrupt – radical, discontinuous and disruptive as “gales of creative destruction”

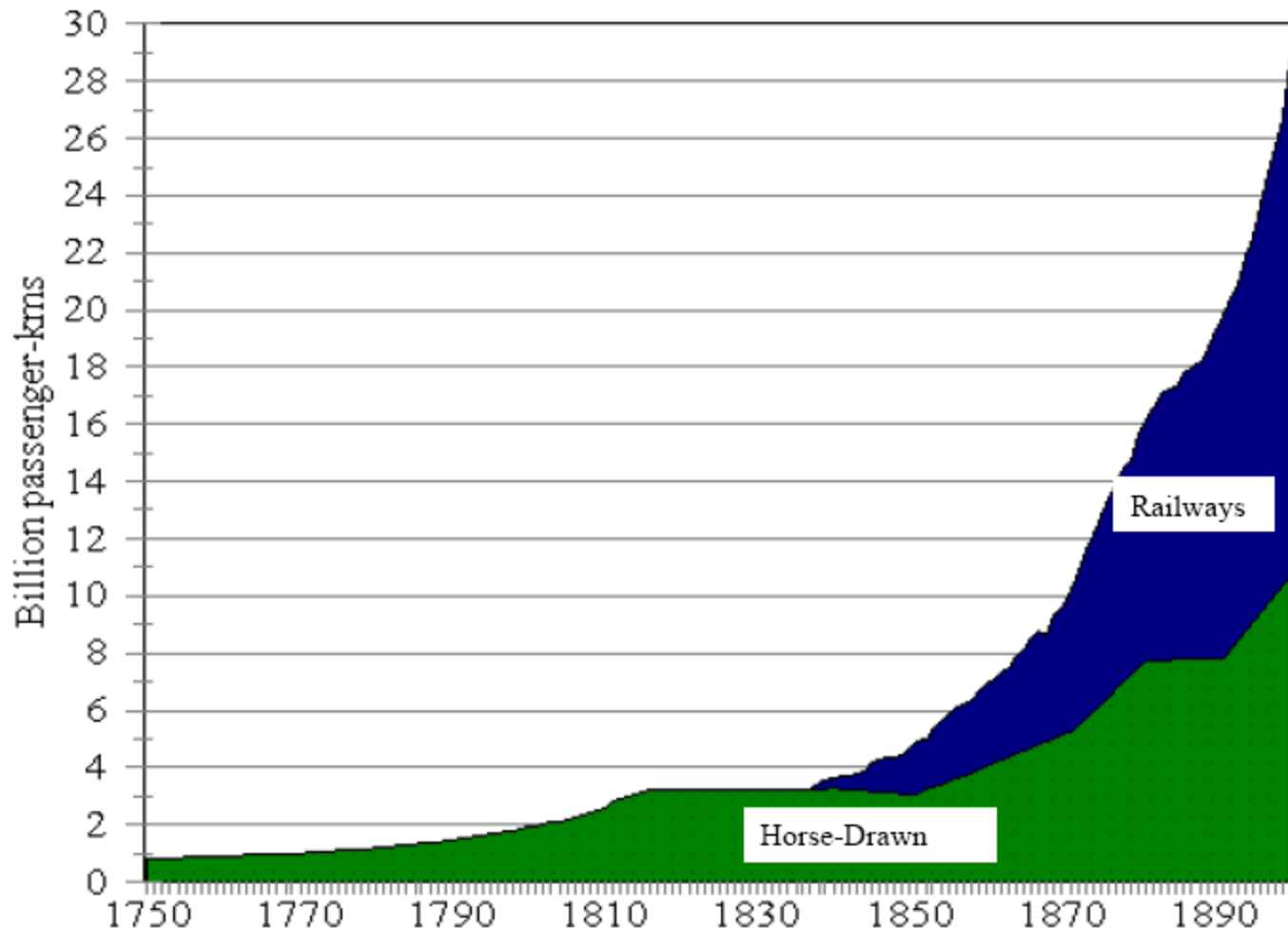
Technological Uncertainty

Patented but not adopted smoke-spark arrestors

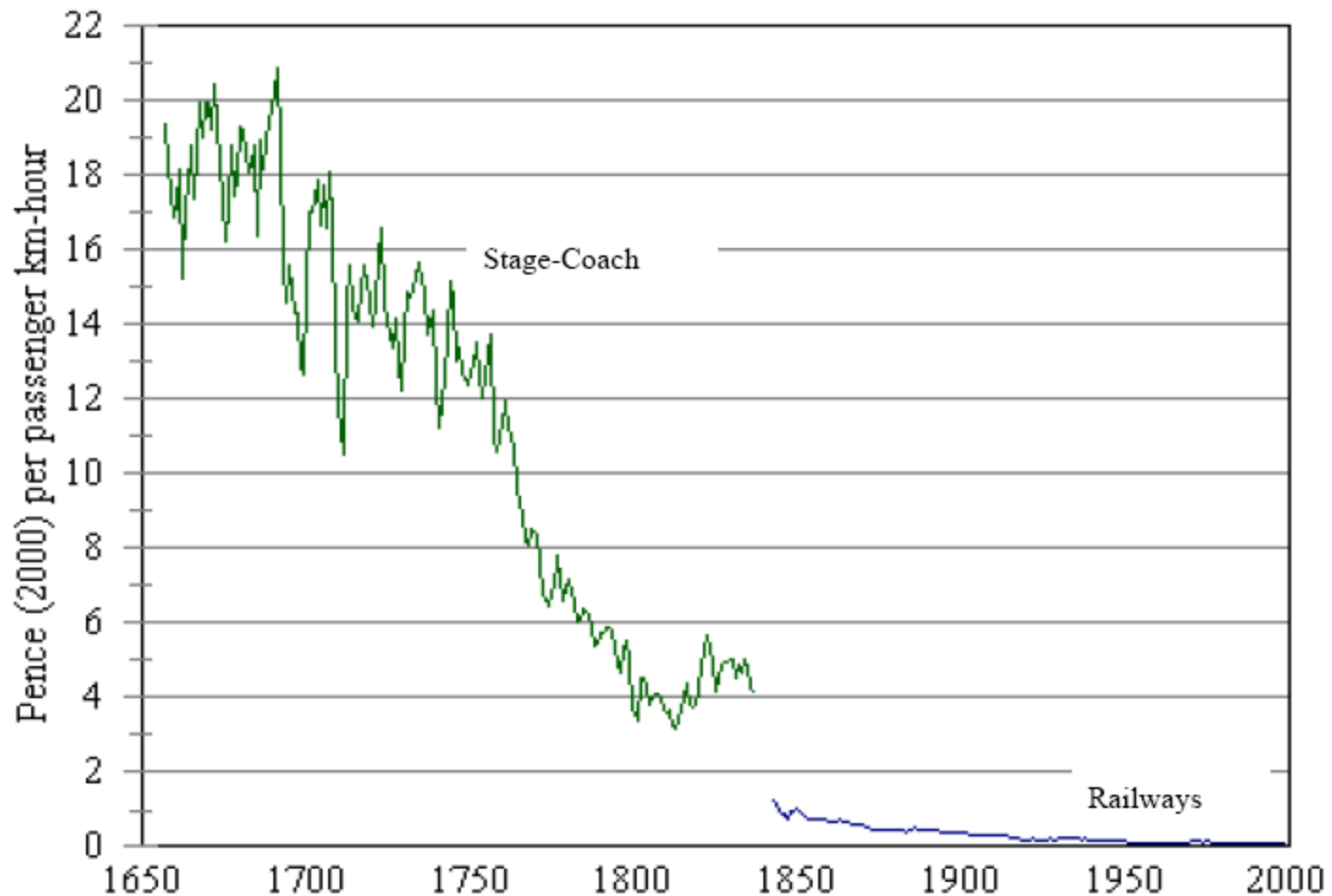


Source: J. White, *American Locomotives*, 1968.

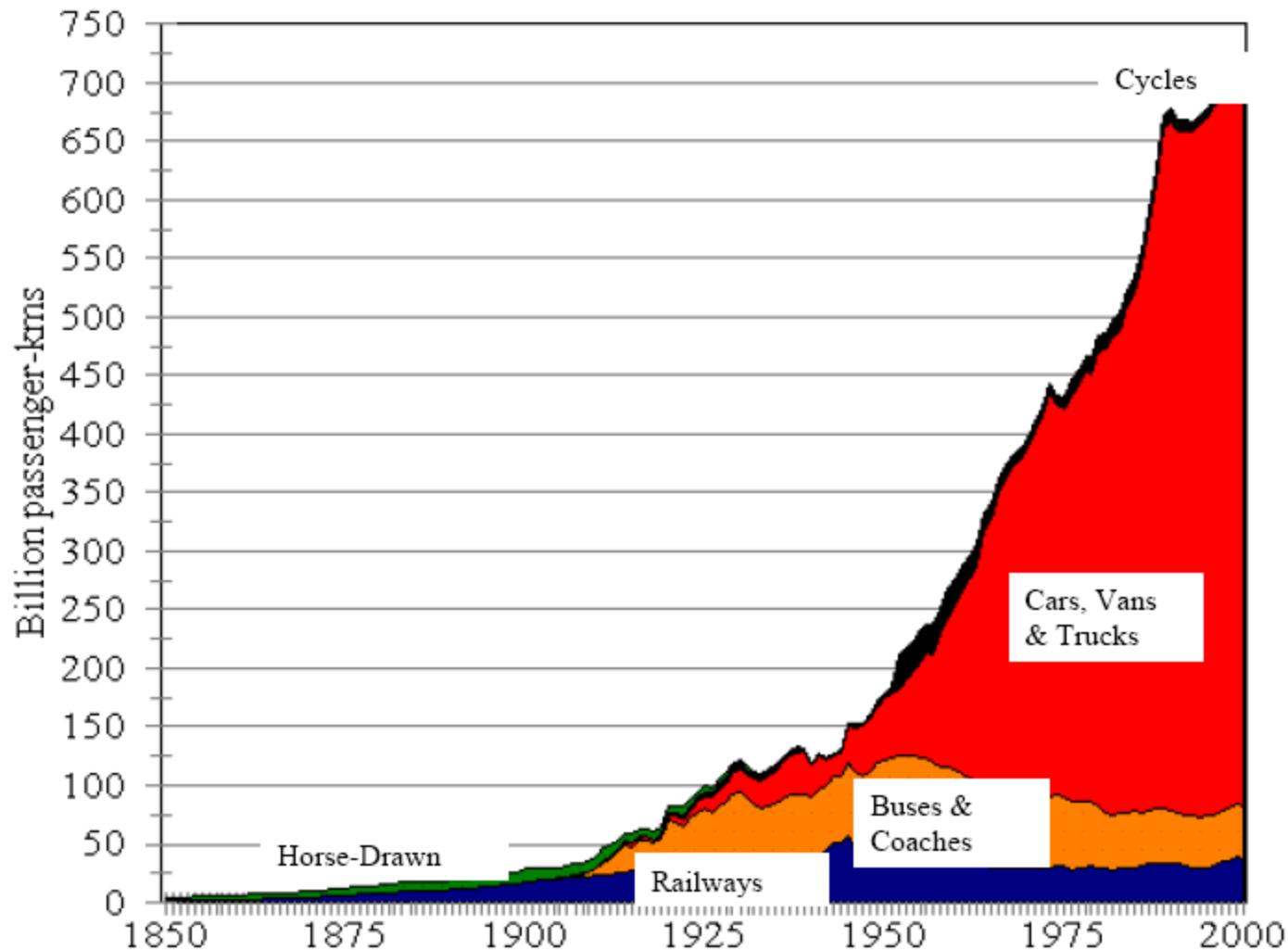
Use of Passenger Transport (per passenger-kilometer)



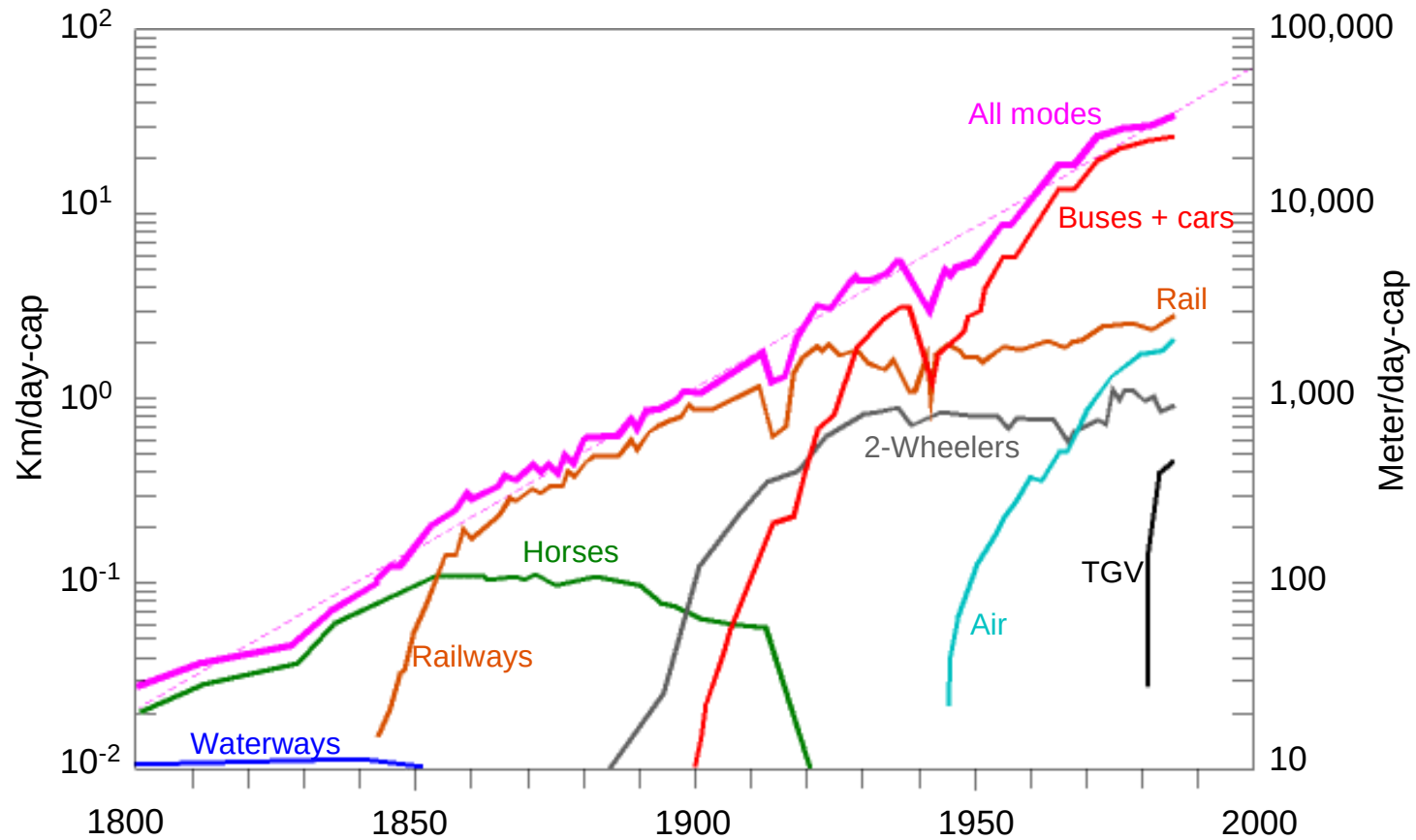
Price of Passenger Transport (per passenger-kilometer-hour)



Use of Passenger Transport (per passenger-kilometer)



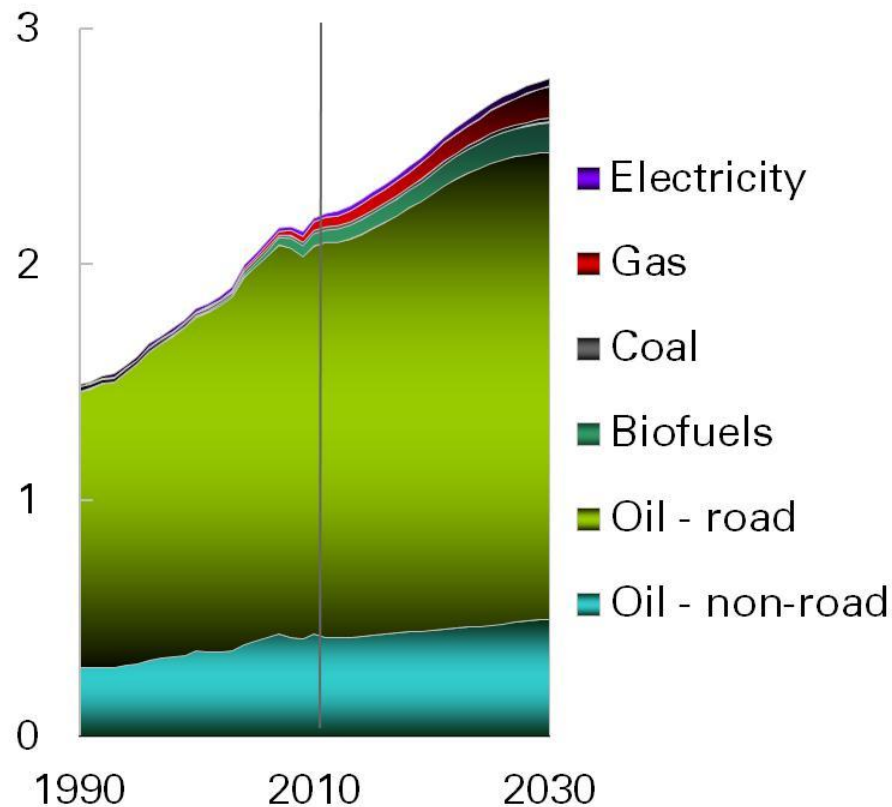
France - Growth in Motorized Mobility (pass-km per day per capita)



Global transport demand growth slows...

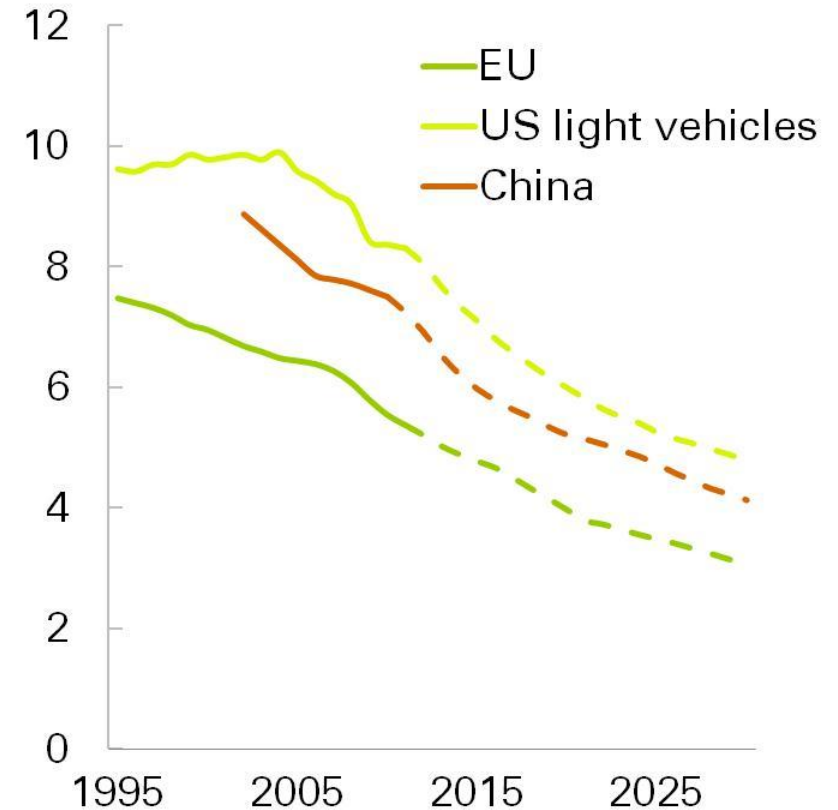
Transport demand by fuel

Billion toe



Fuel economy of new cars

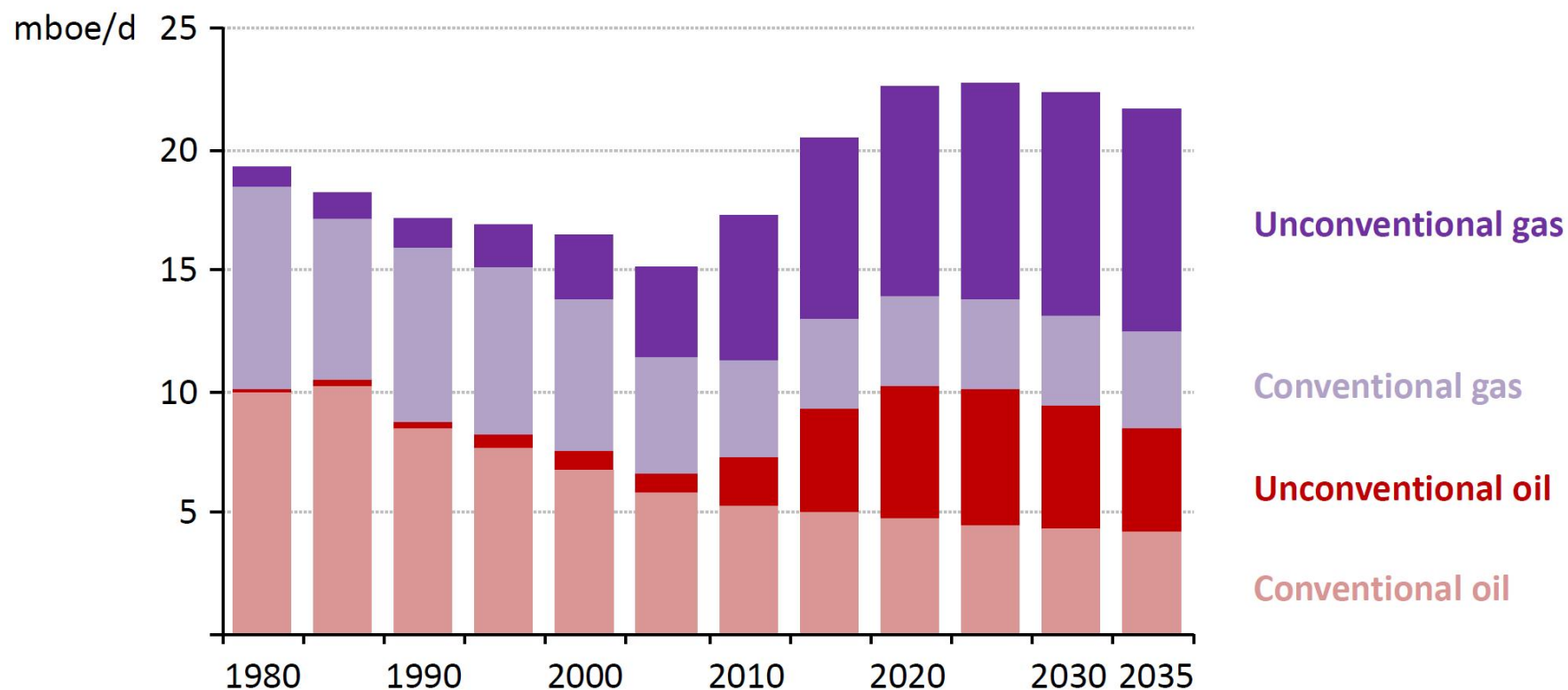
Litres per 100 km



A United States oil & gas transformation

WORLD
ENERGY
OUTLOOK
2012

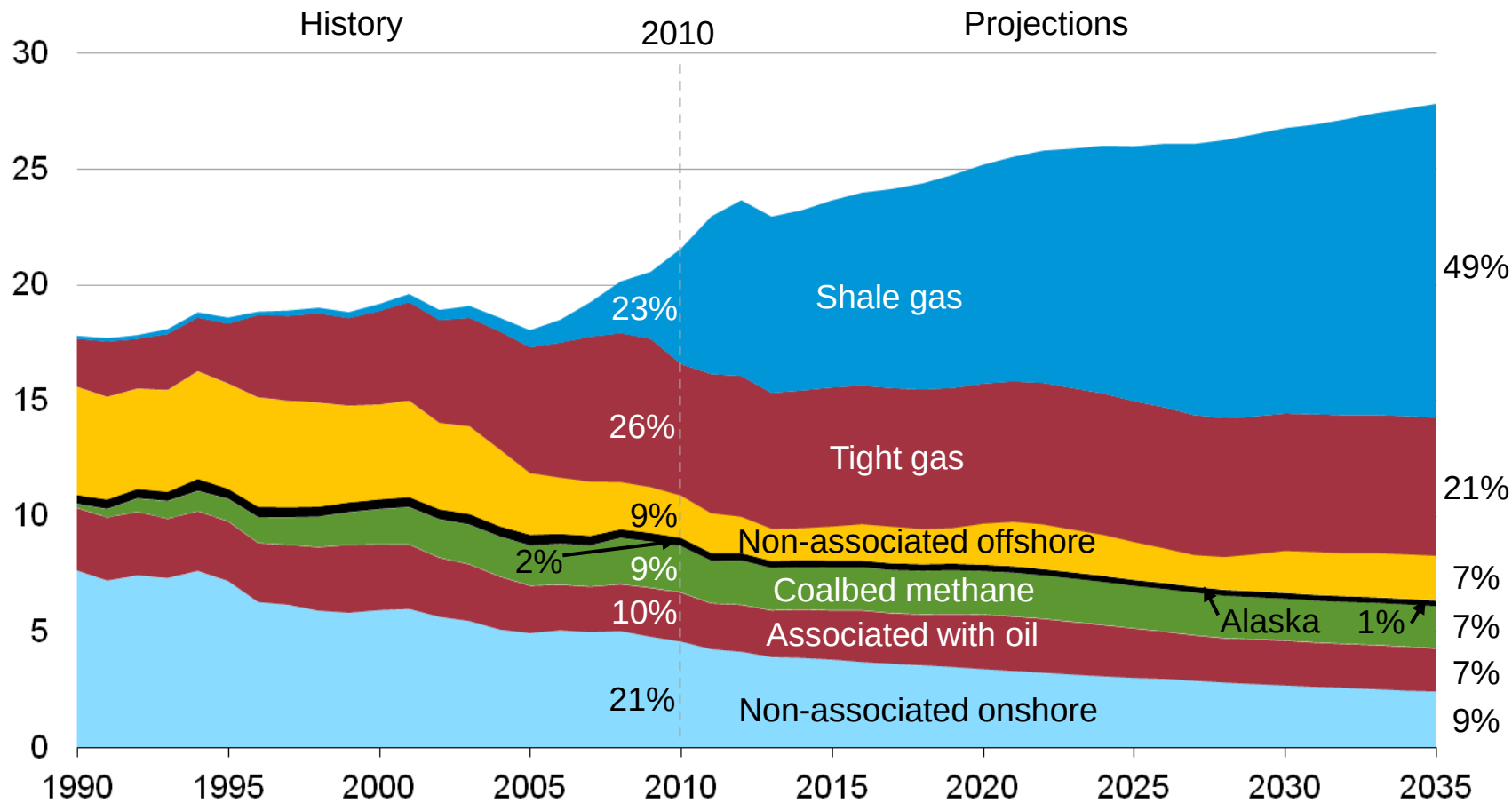
US oil and gas production



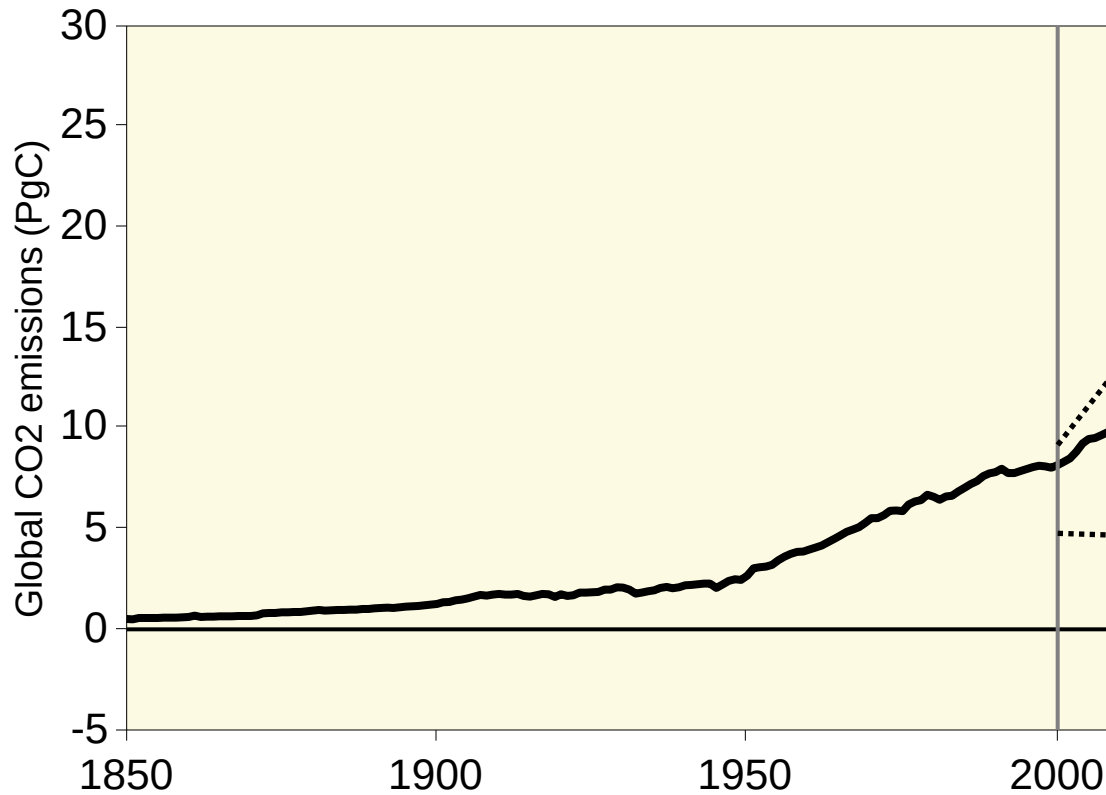
The surge in unconventional oil & gas production has implications well beyond the United States

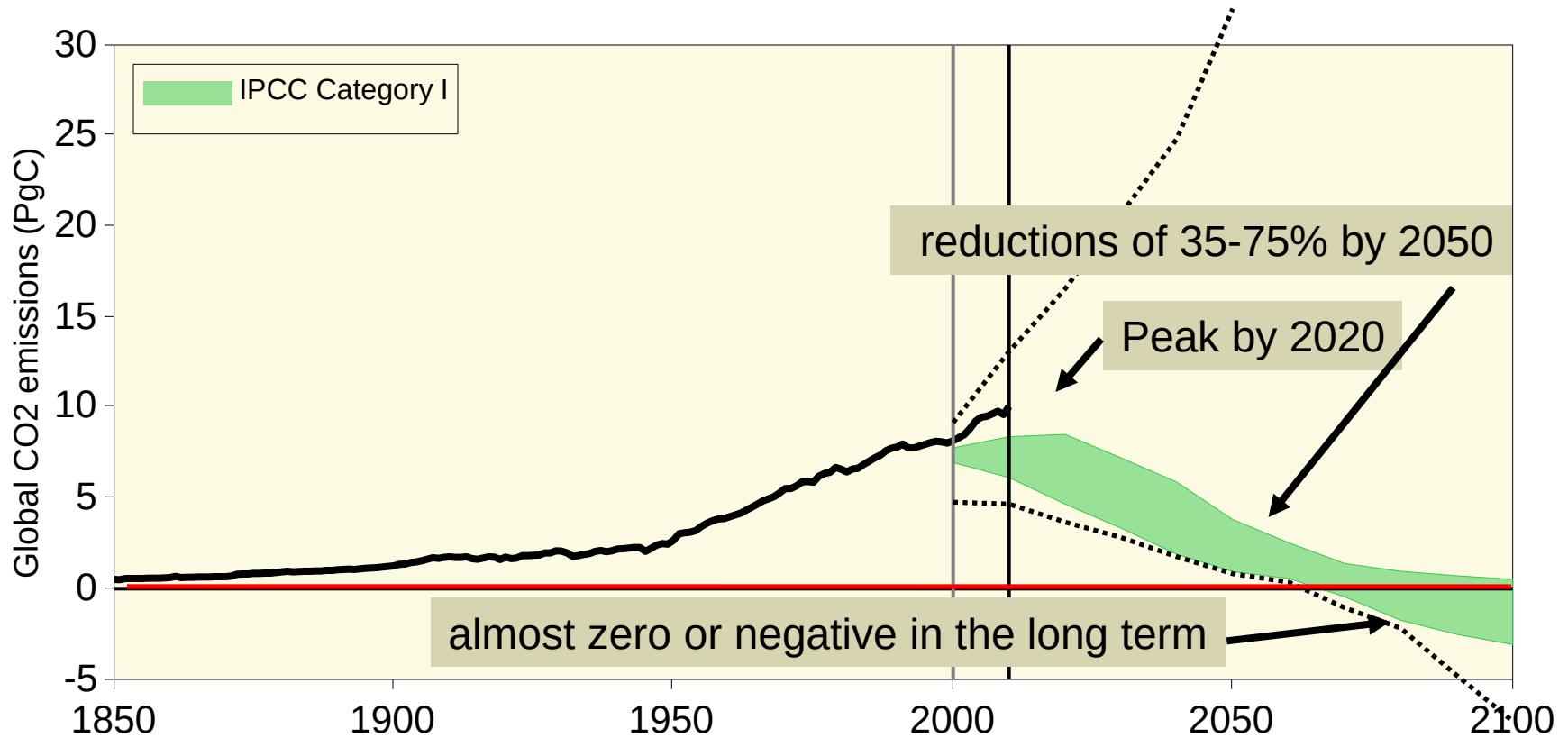
Shale gas offsets declines in other U.S. natural gas production sources

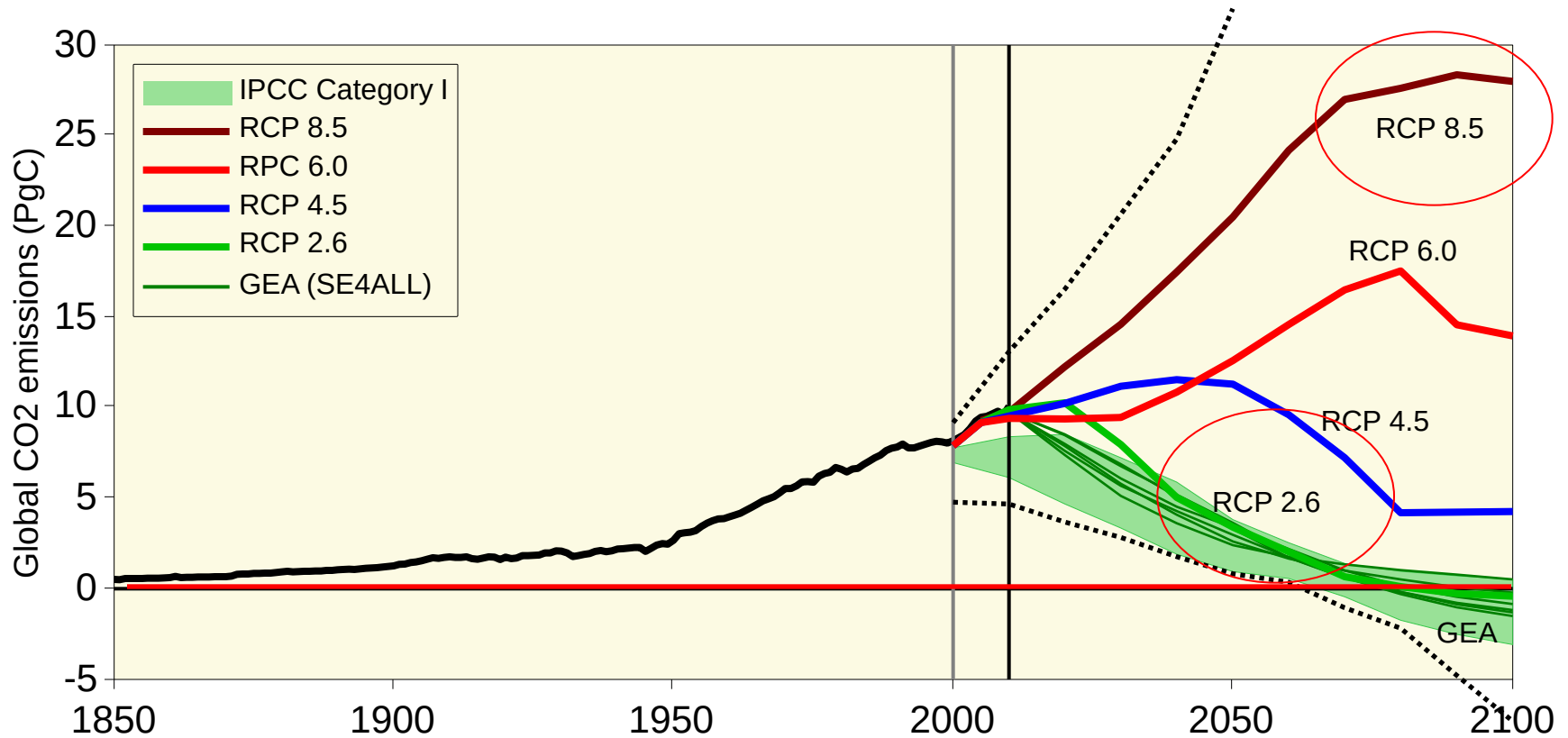
U.S. dry gas production
trillion cubic feet per year



Source: EIA, Annual Energy Outlook 2012 Early Release

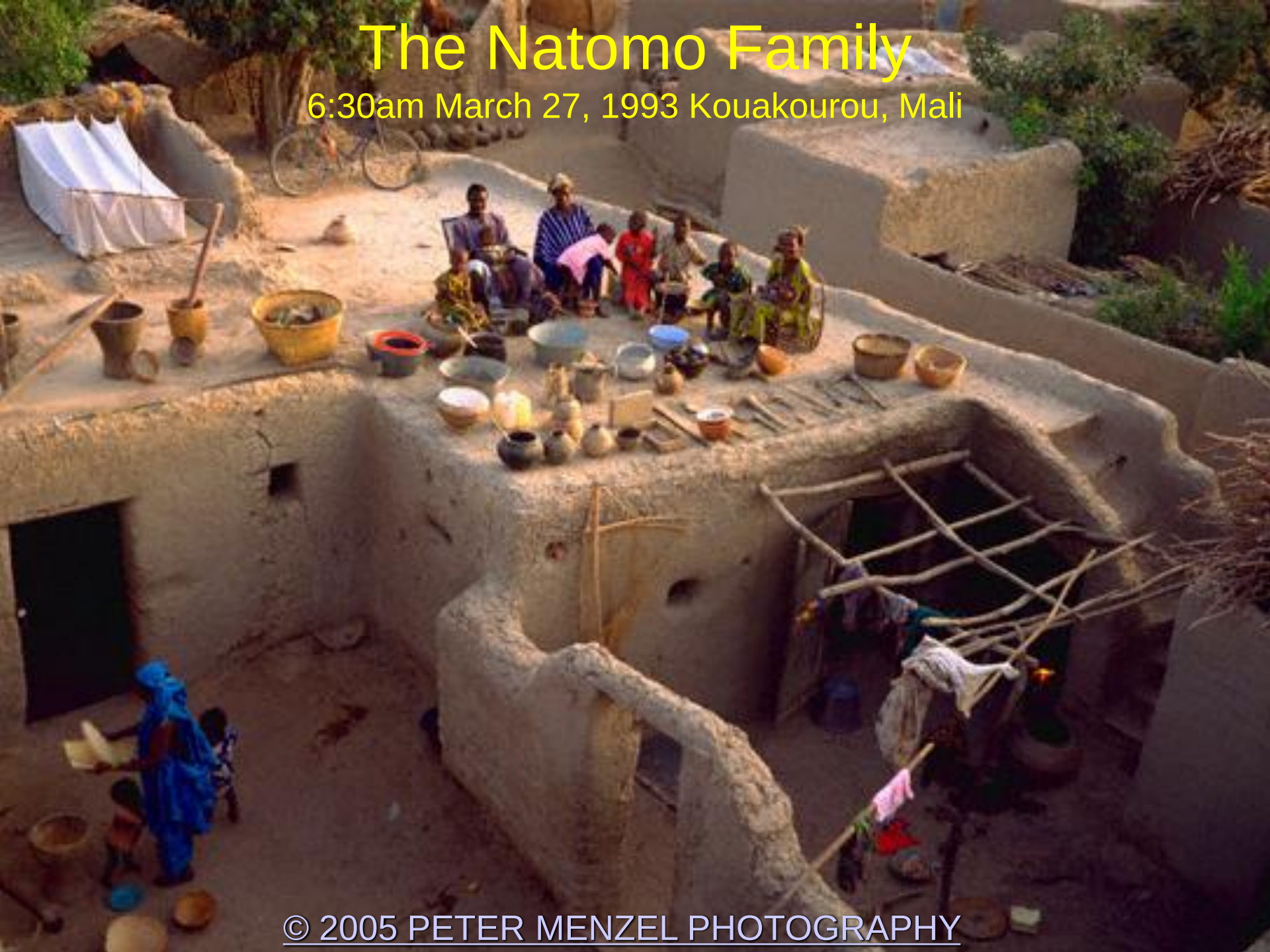






The Natomo Family

6:30am March 27, 1993 Kouakourou, Mali



The Kuenkaew Family

5:30pm, May 31, 1993 Ban Muang Wa, Thailand



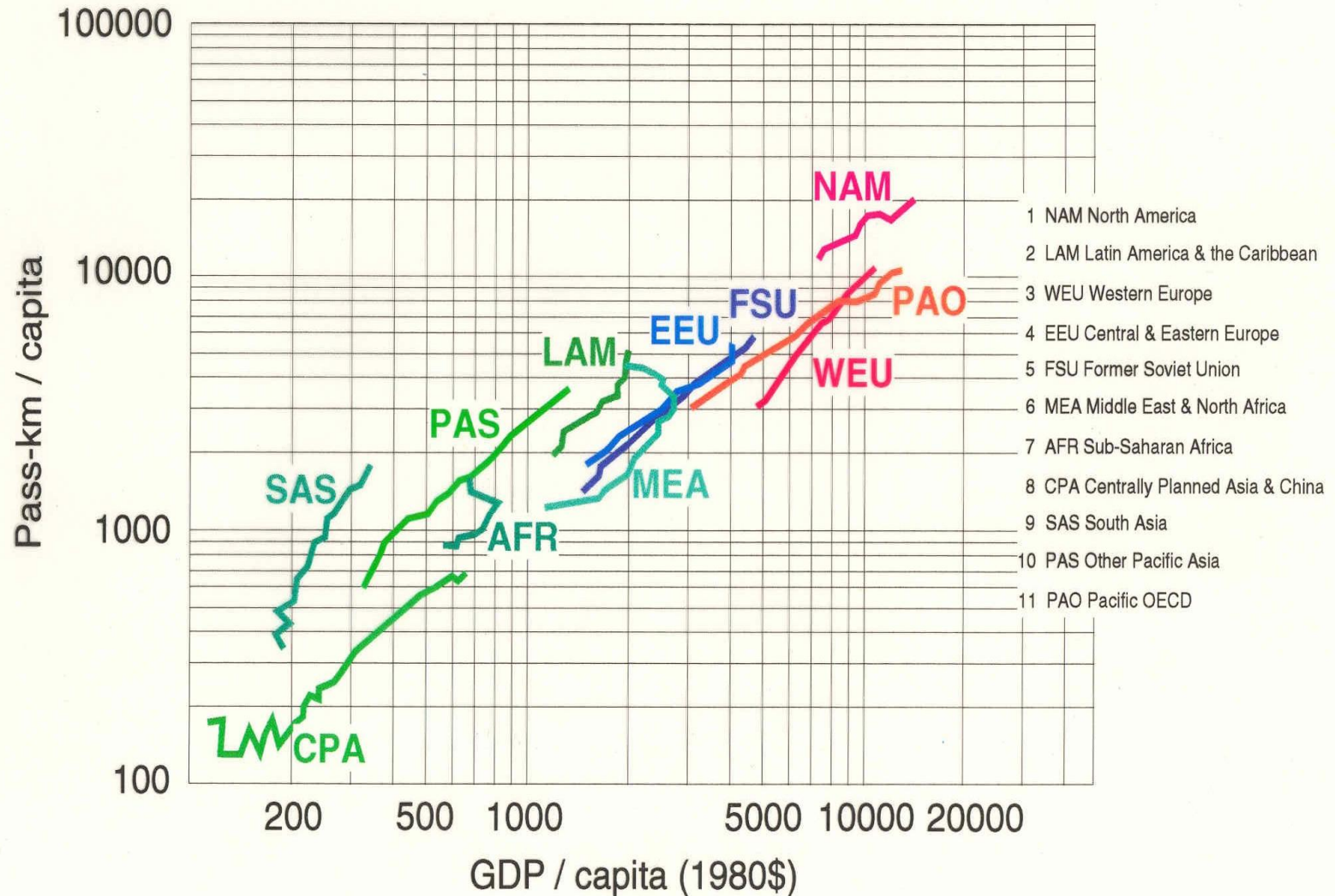
The Ukita Family

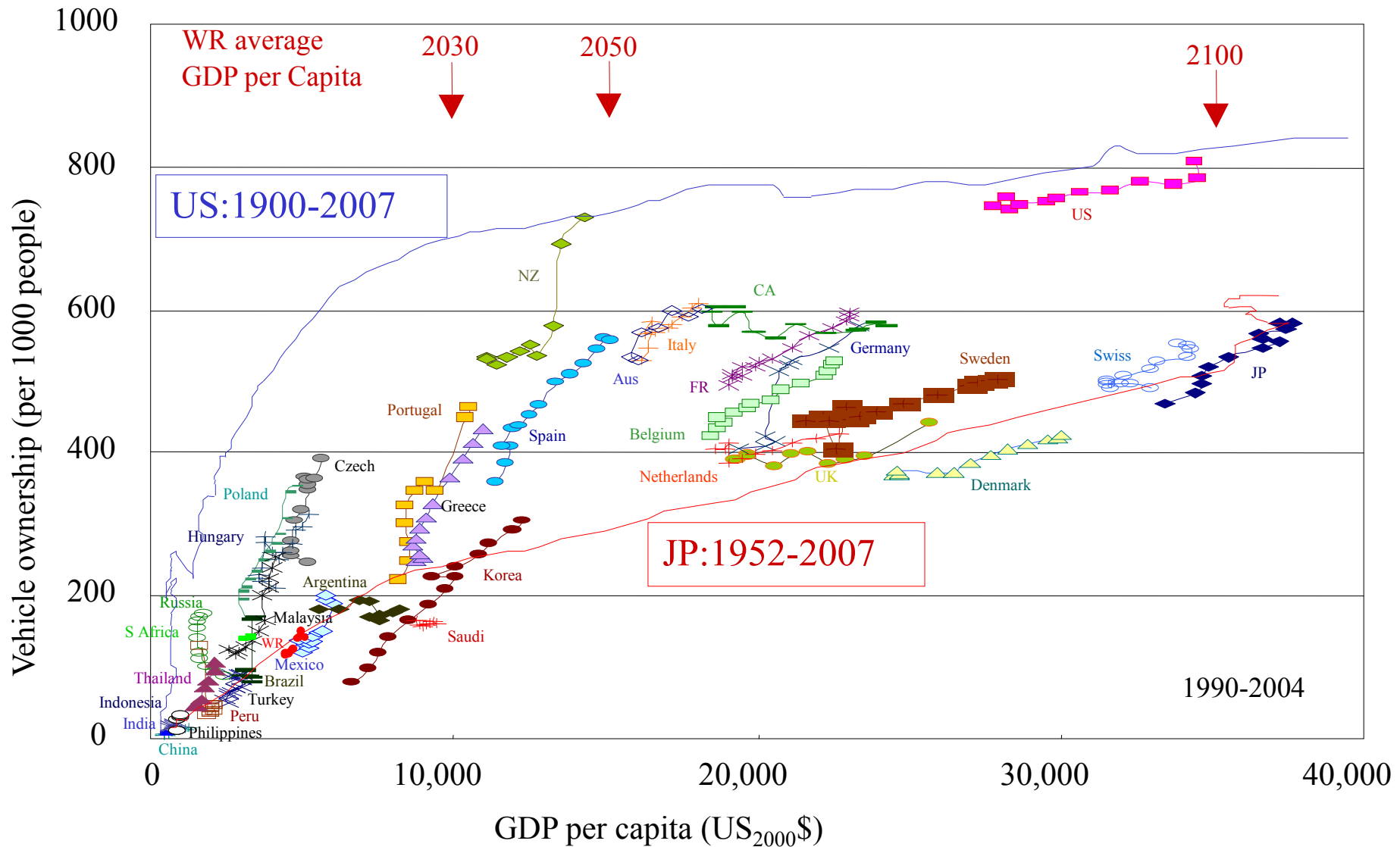
4:30pm December 16, 1992 Tokyo, Japan

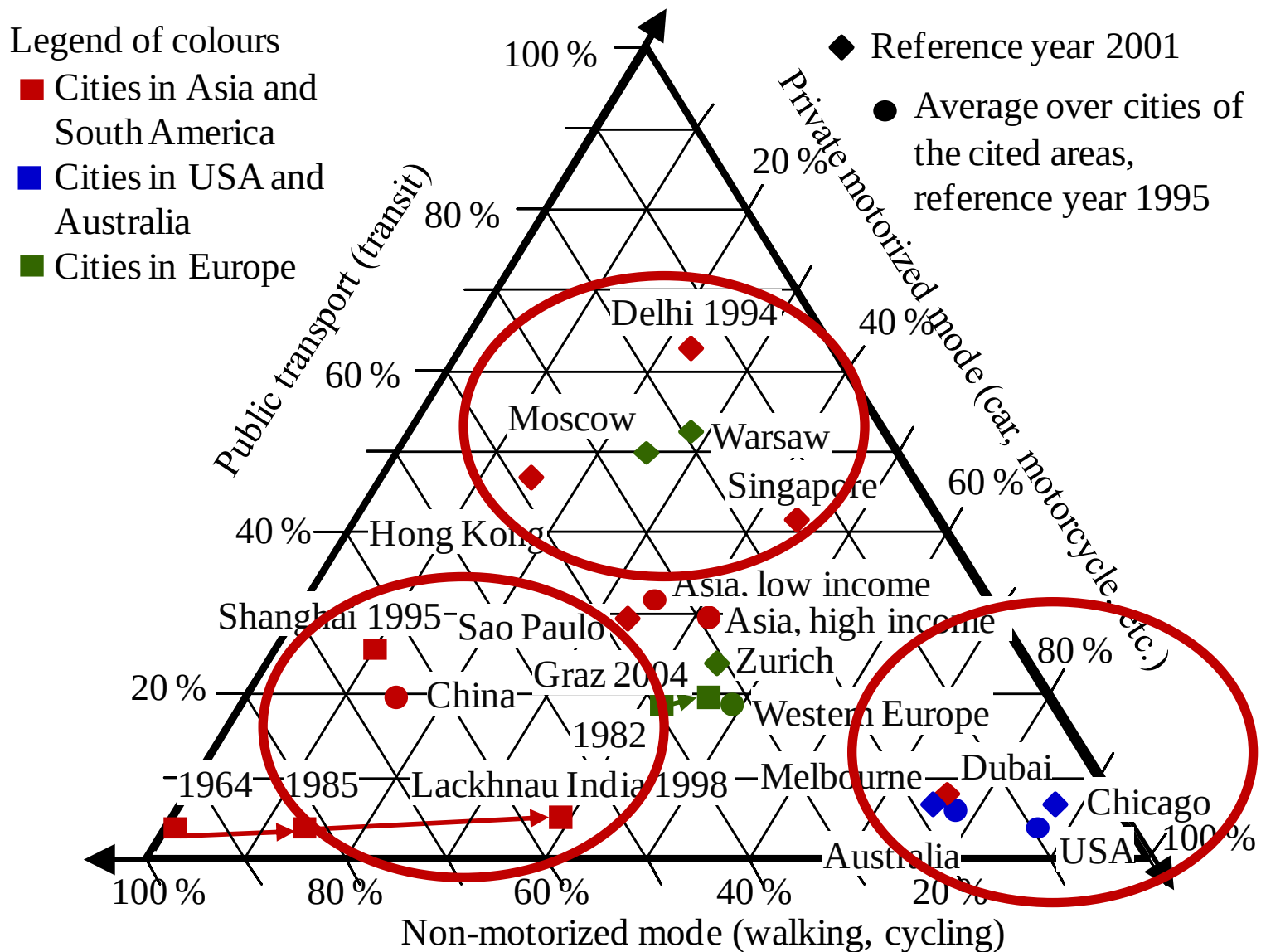


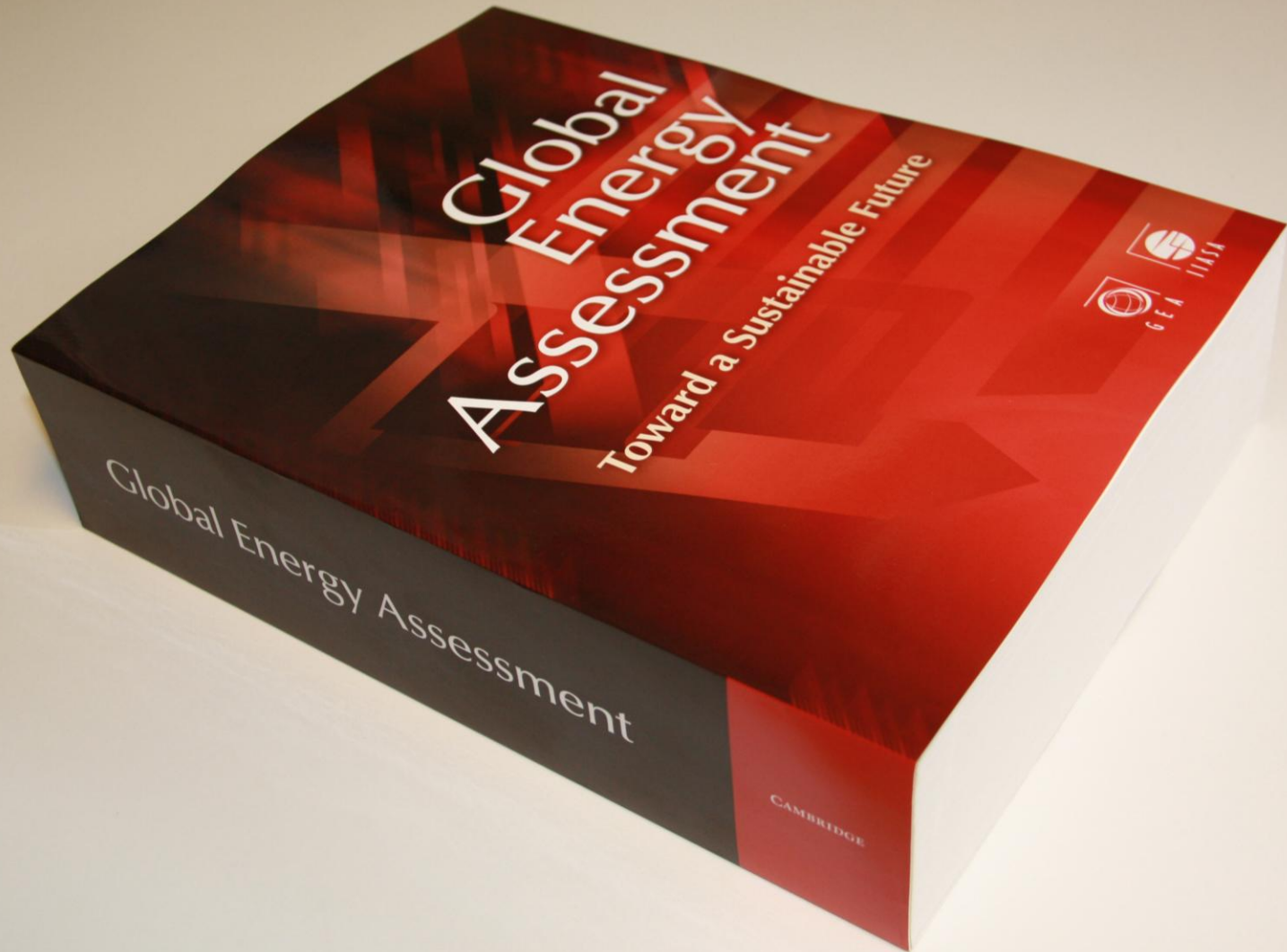
Motorized Mobility vs GDP/capita

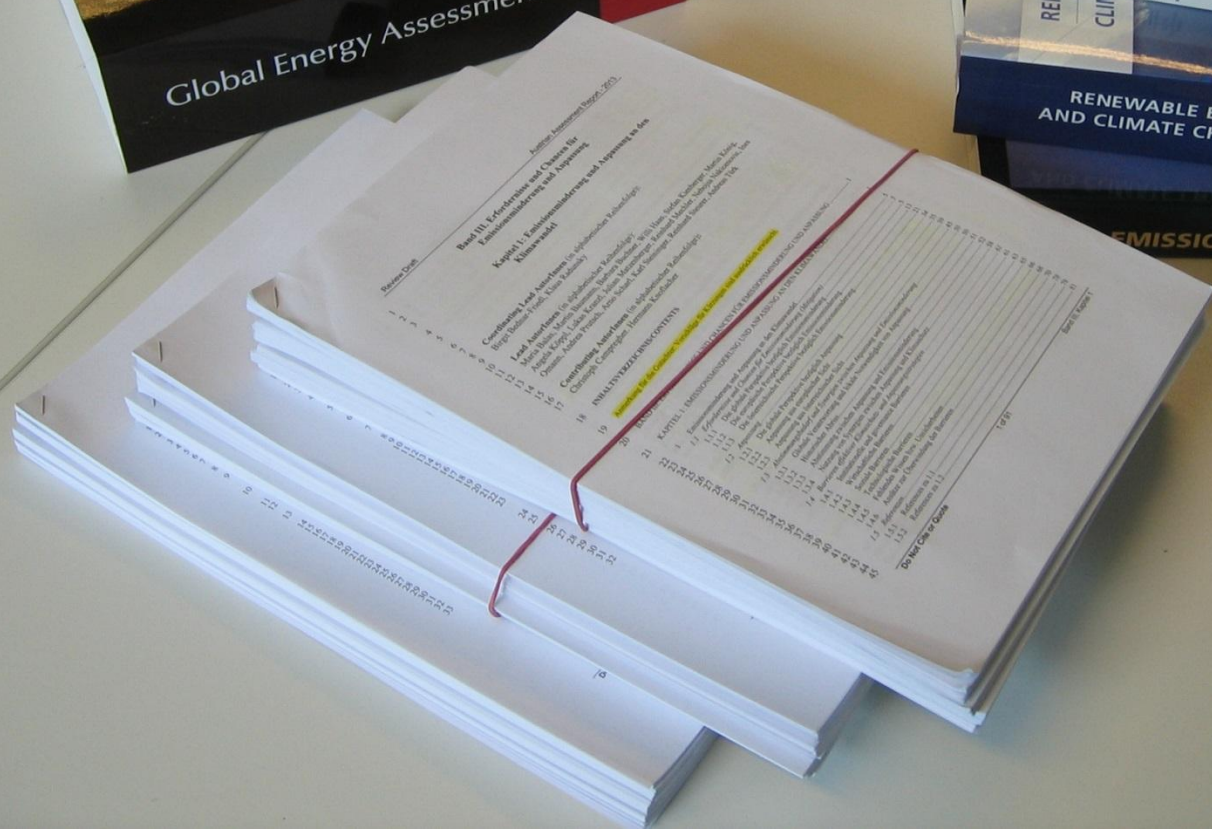
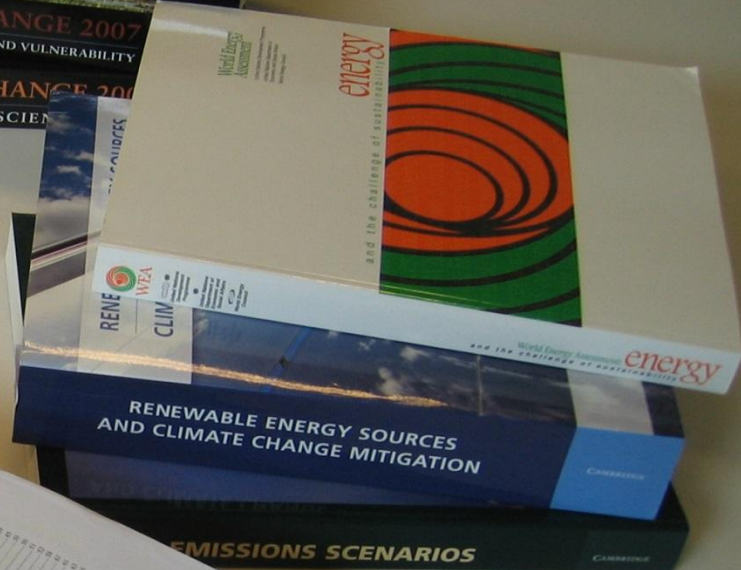
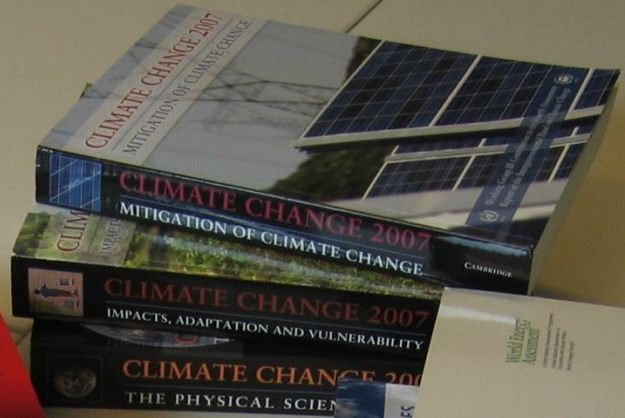
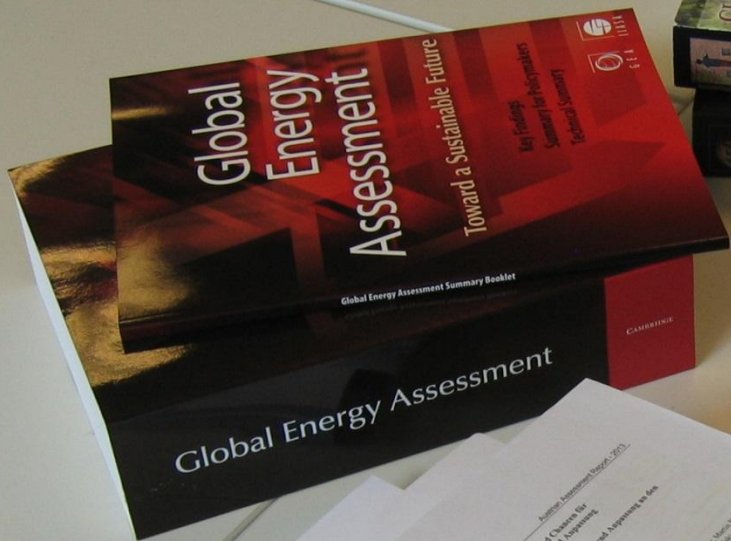
Based on Schafer & Victor, SciAmer. October 1997:56-59

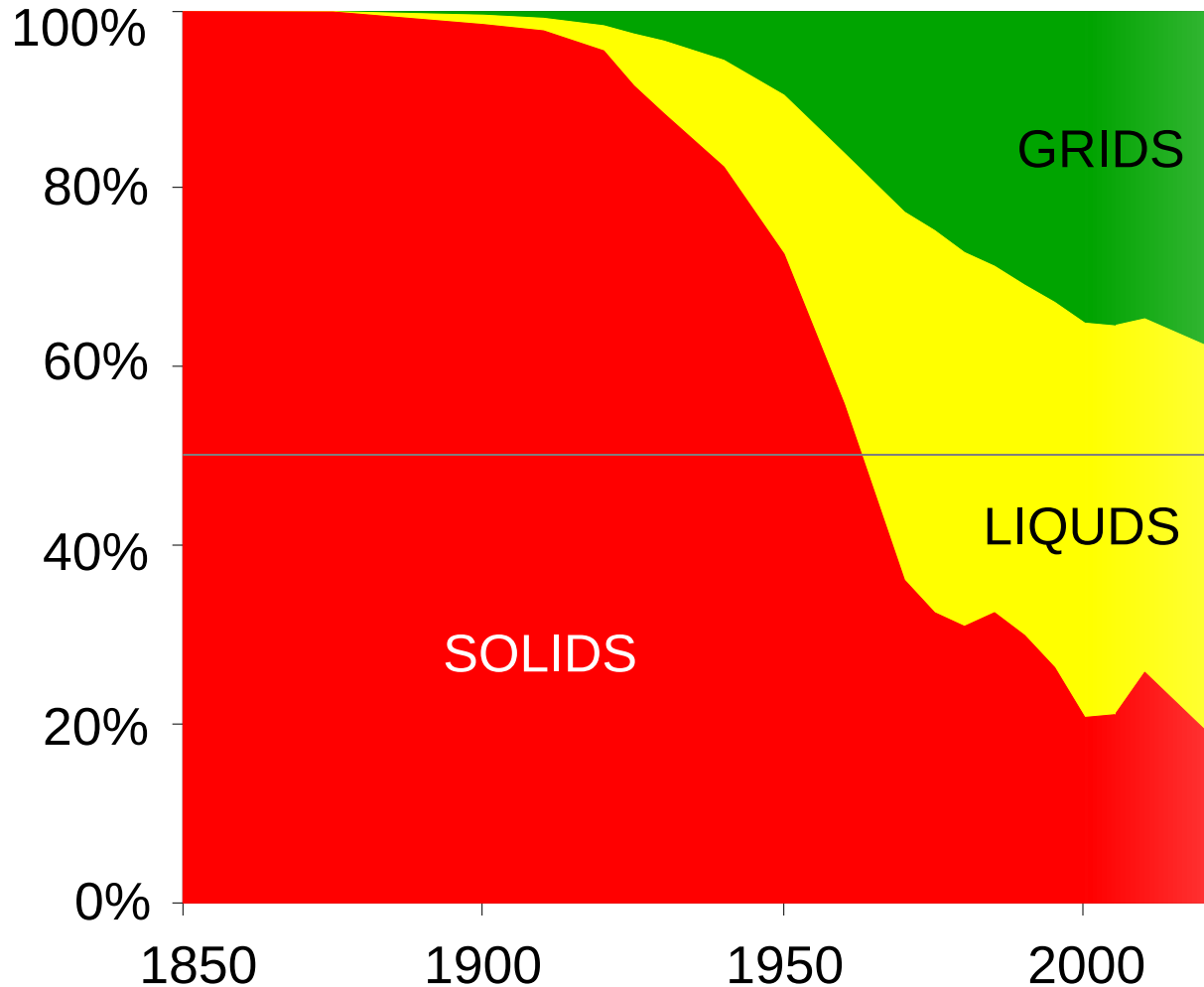
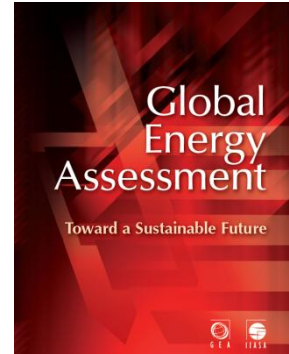




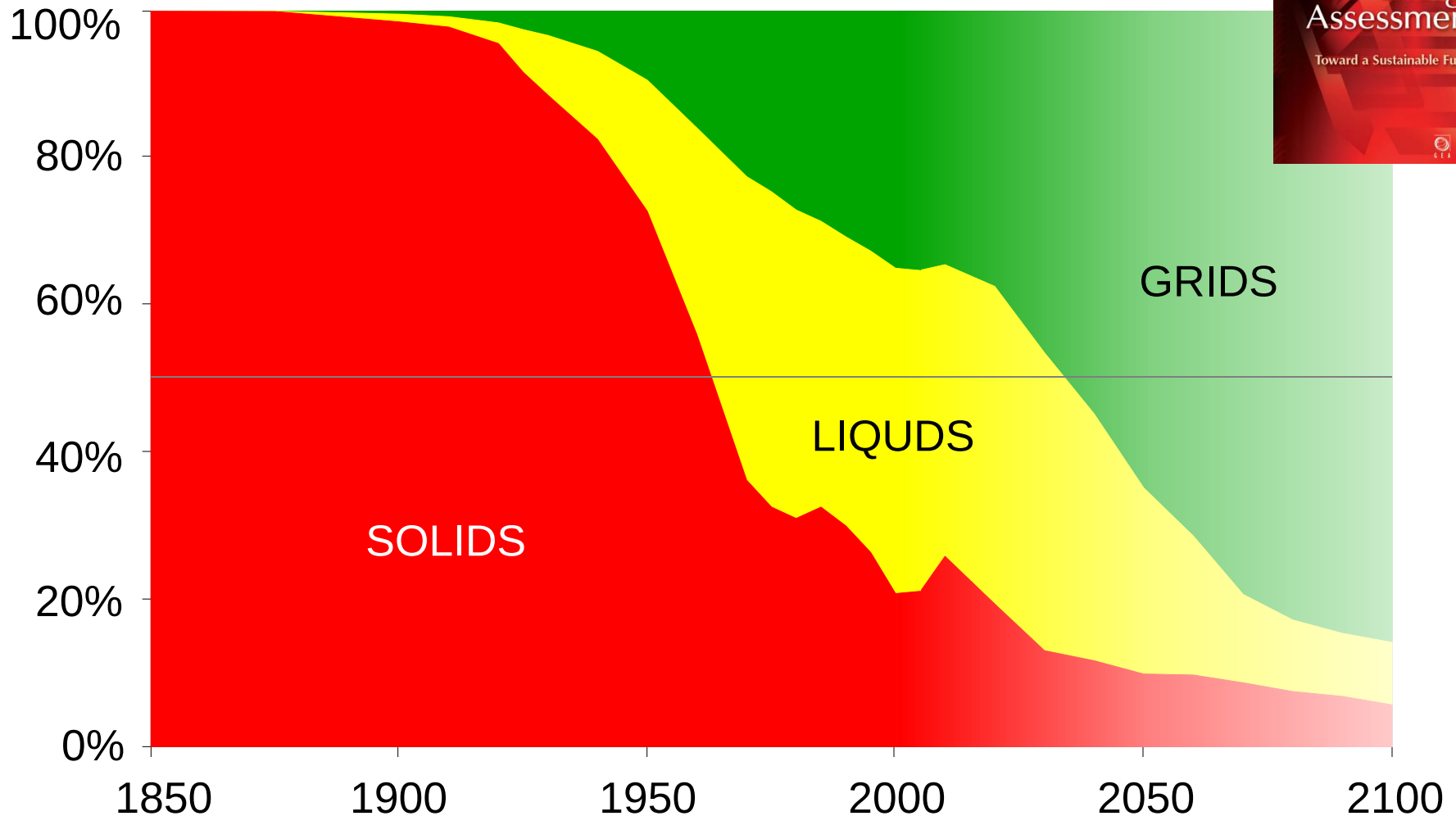
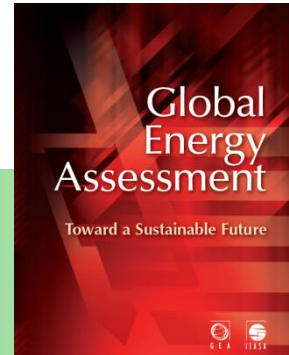


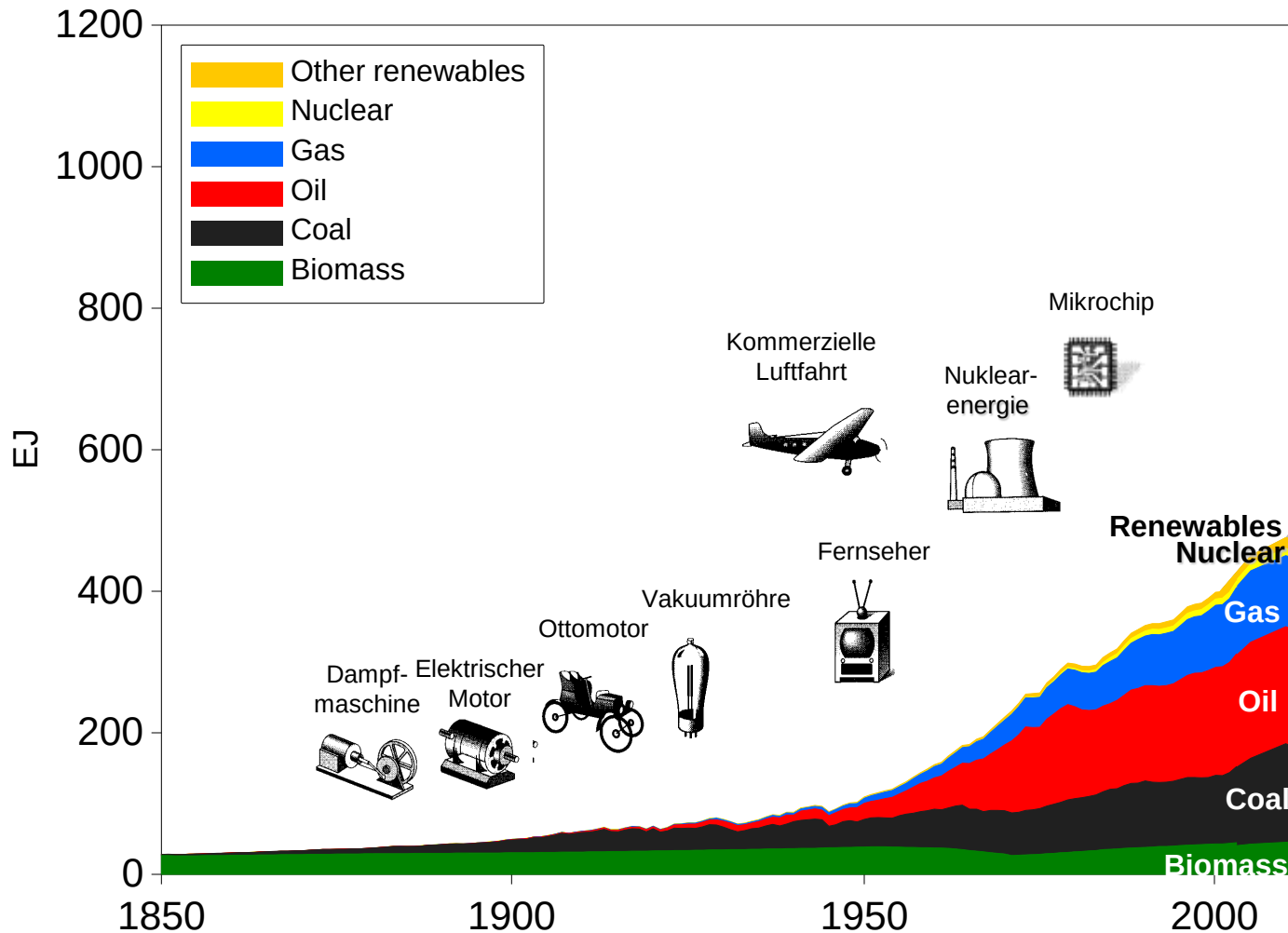
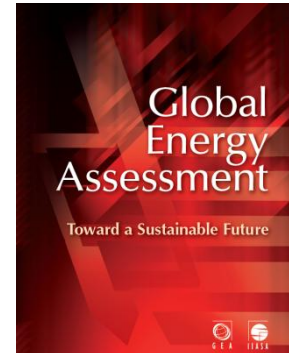






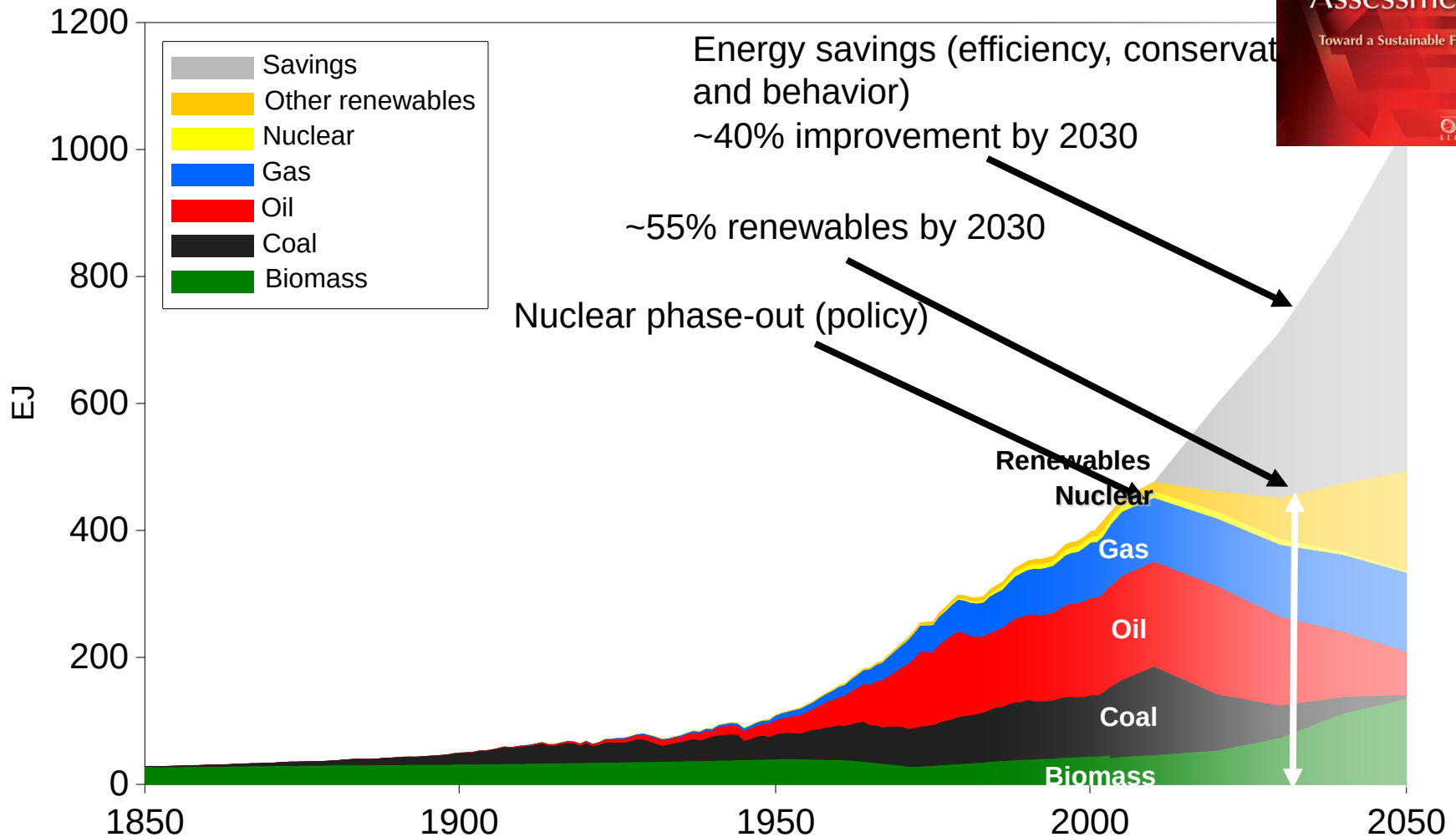
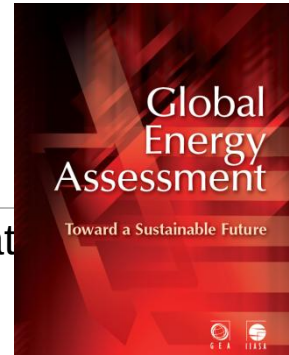
One of 41 GEA Pathways



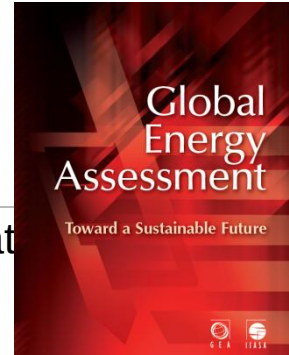
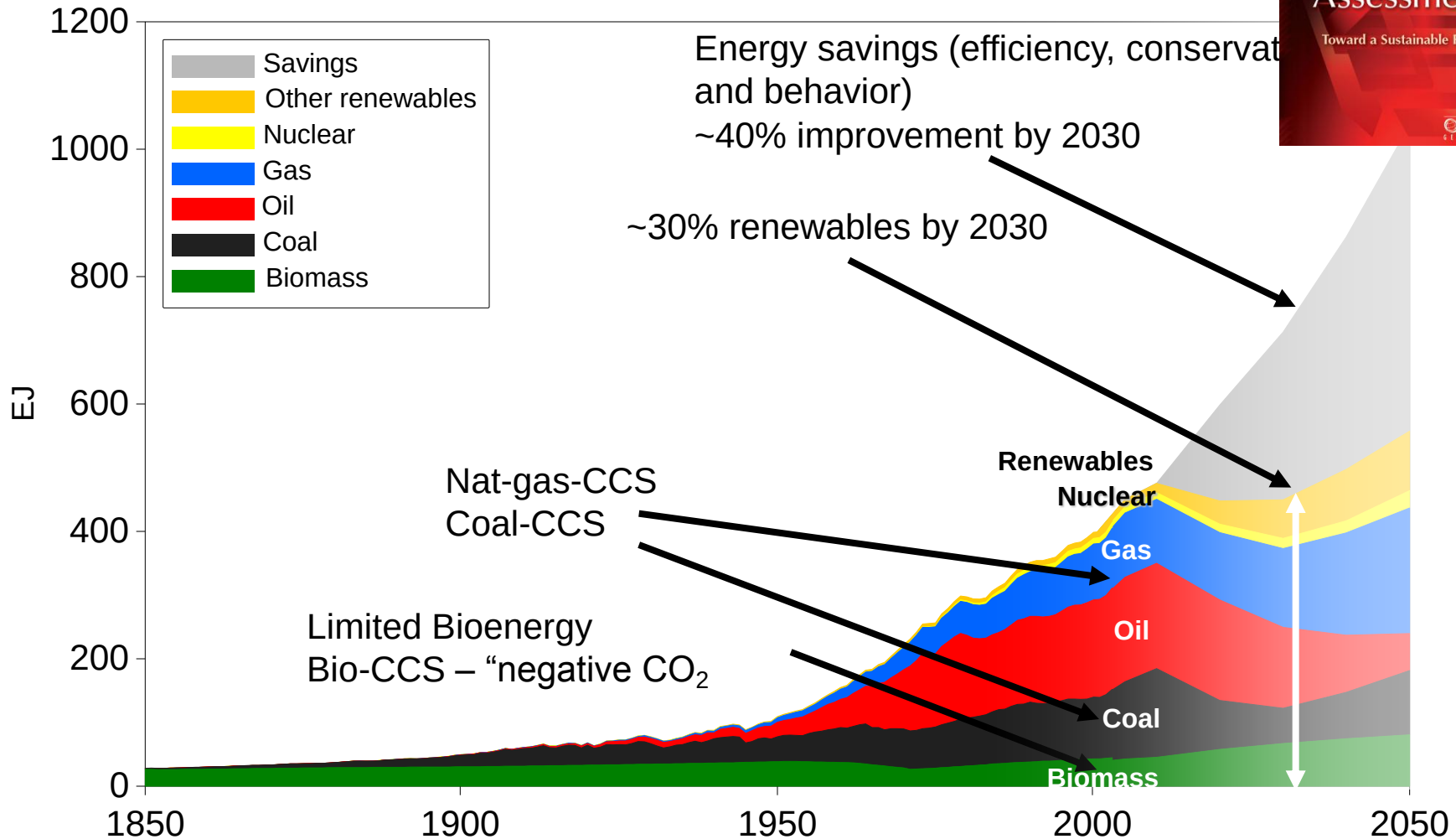


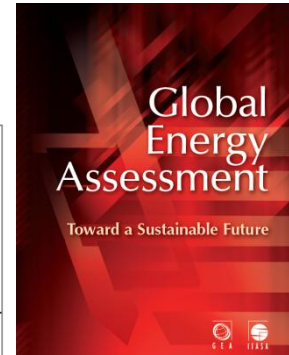
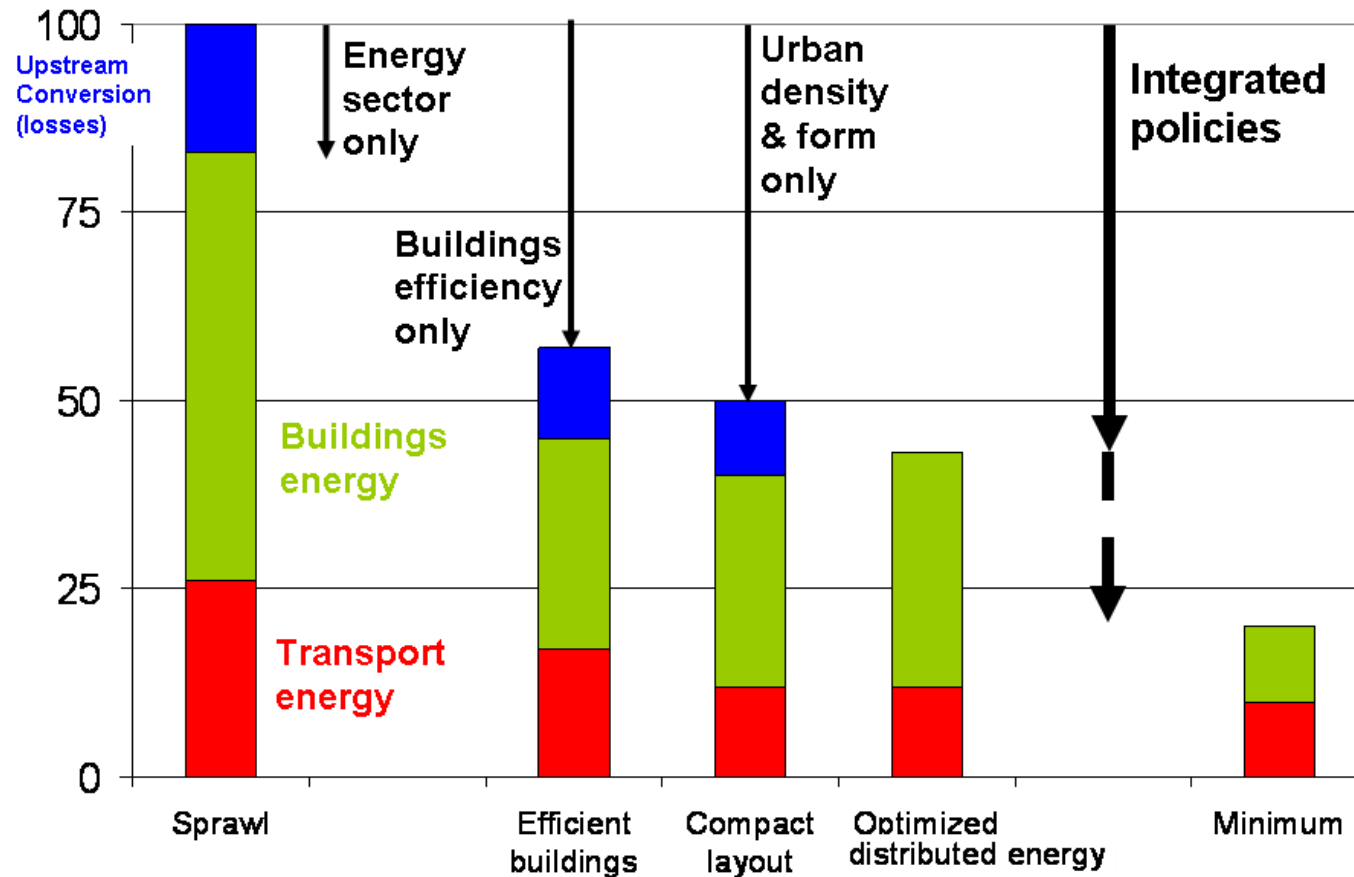
Global Primary Energy

no CCS, no Nuclear



lim. Bioenergy, lim. REN





Simulated energy use, urban settlement of 20,000, using the SimCity Model

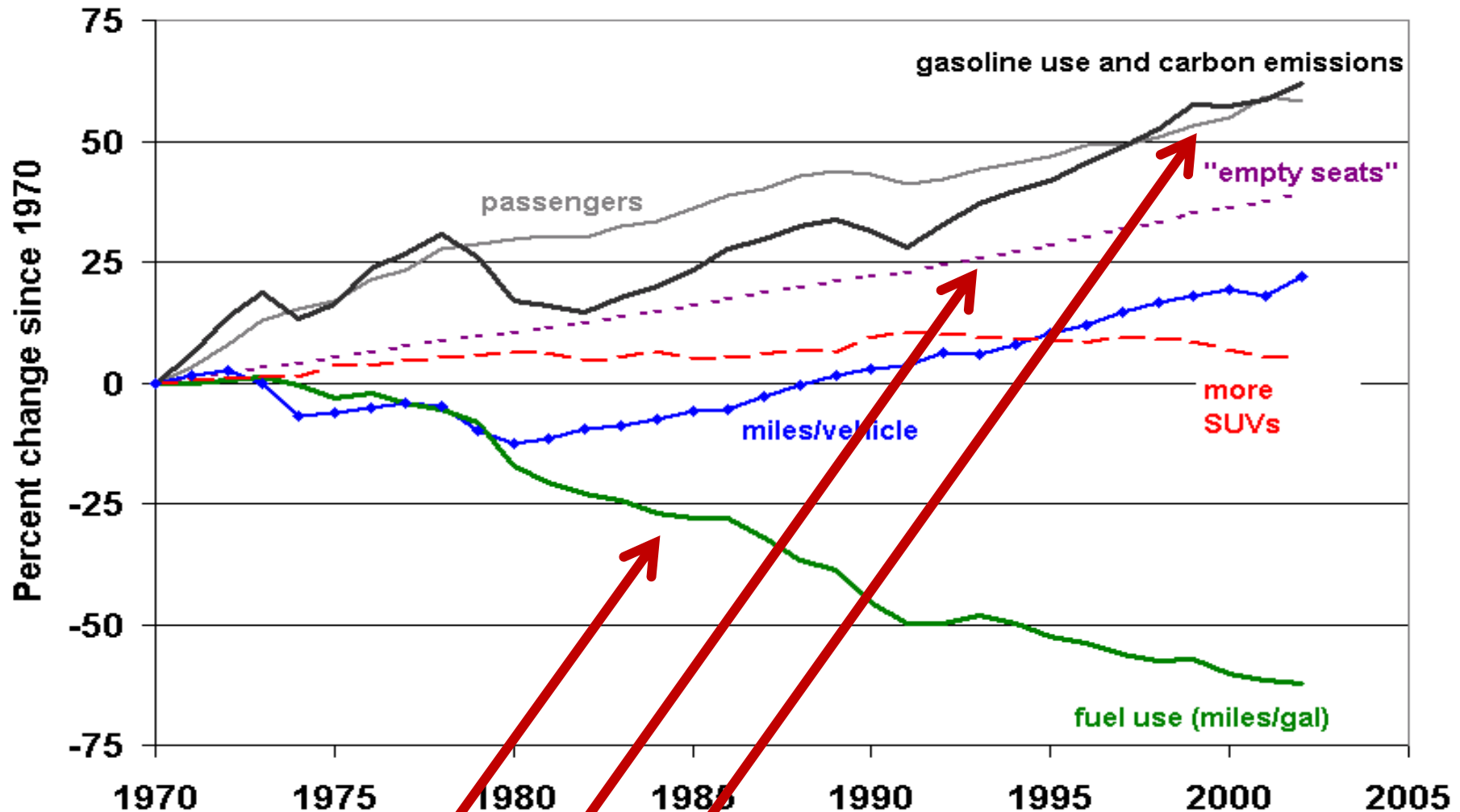
*Add as many mail coaches as you please,
you will never get a railroad by so doing*
Joseph A. Schumpeter

- New technological systems will not emerge by simply adding current and emerging technologies.
- A new paradigm is needed with convergence of innovative technologies.

Toyota – “I-Unit”



Emissions and Their Driving Forces





Area Occupied by Various Transport Modes

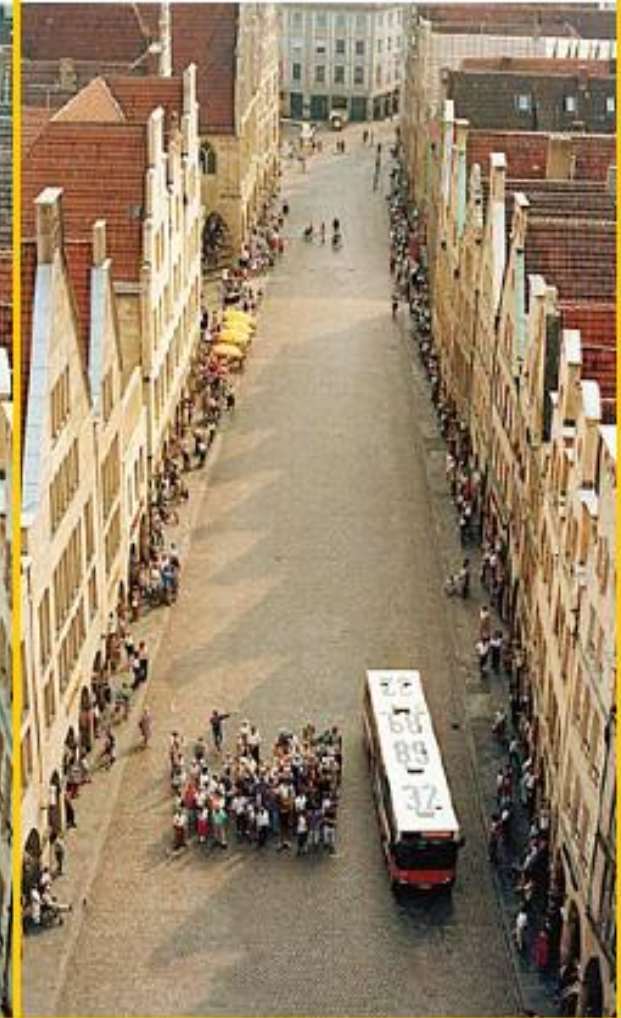
Automobile



Bicycle



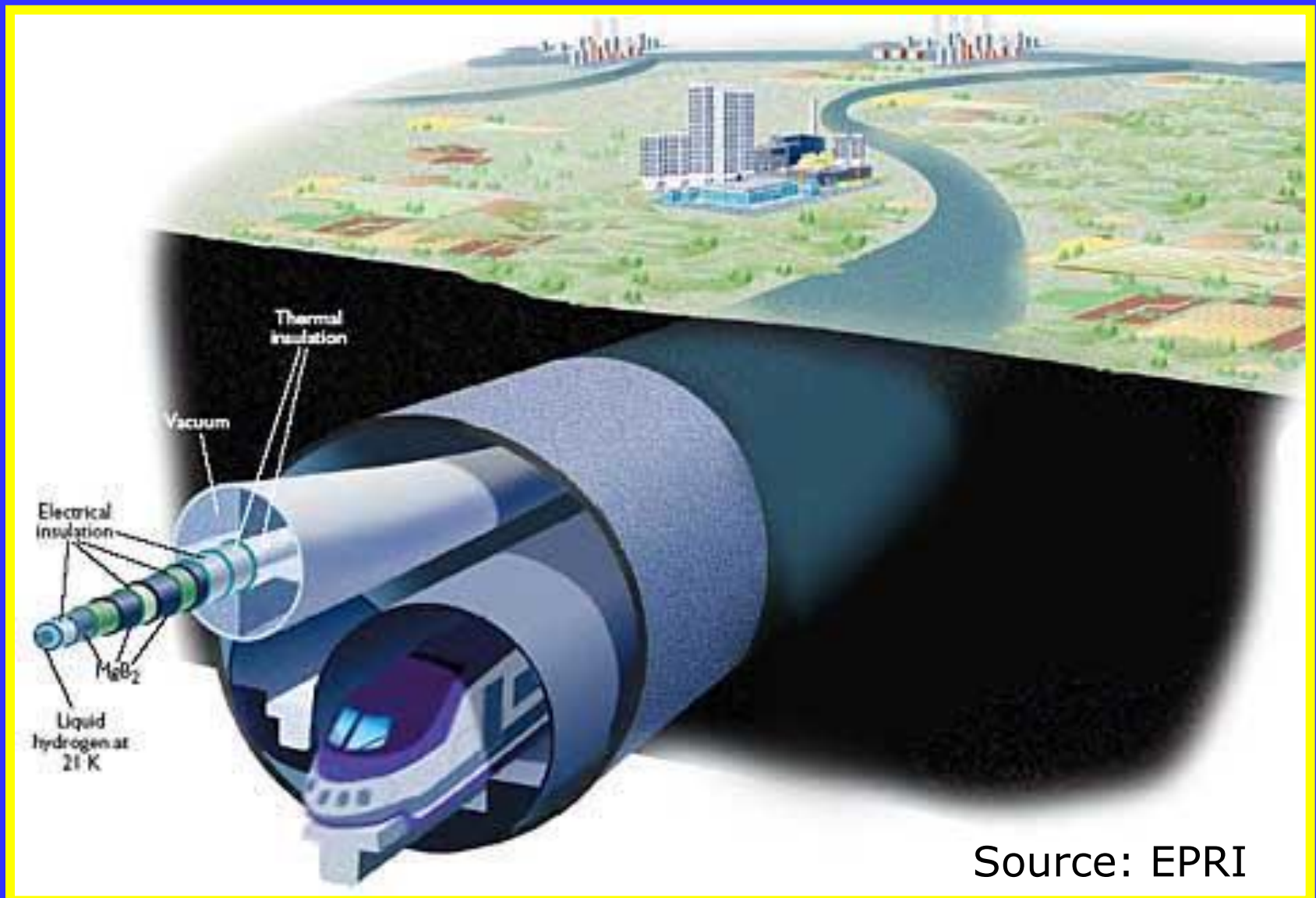
Bus



CITARO H₂ Fuel Cell Bus



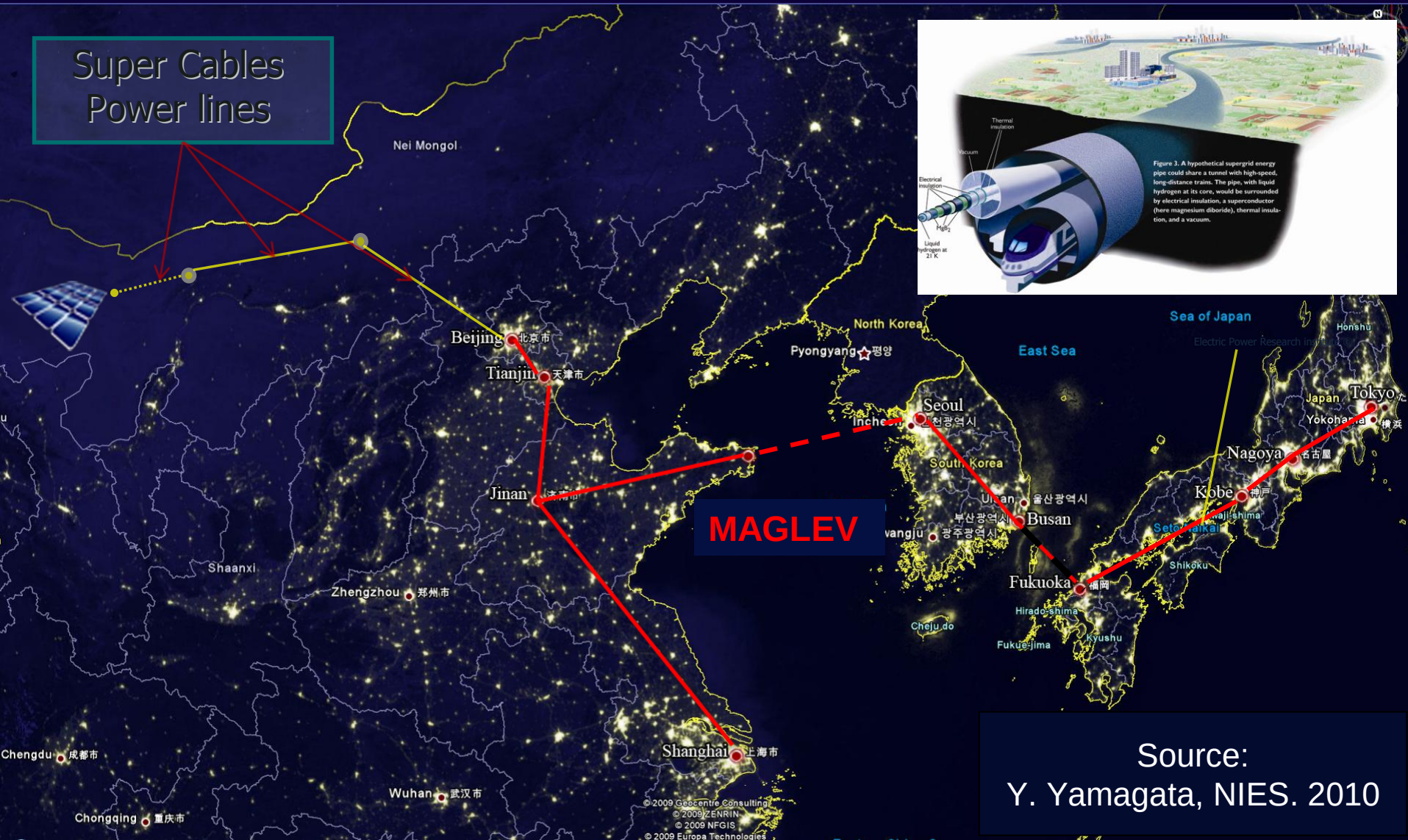
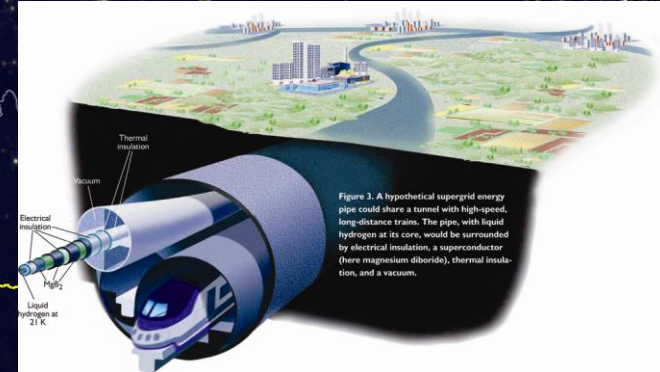
Energy SuperGrid and MagLev Trains



Source: EPRI

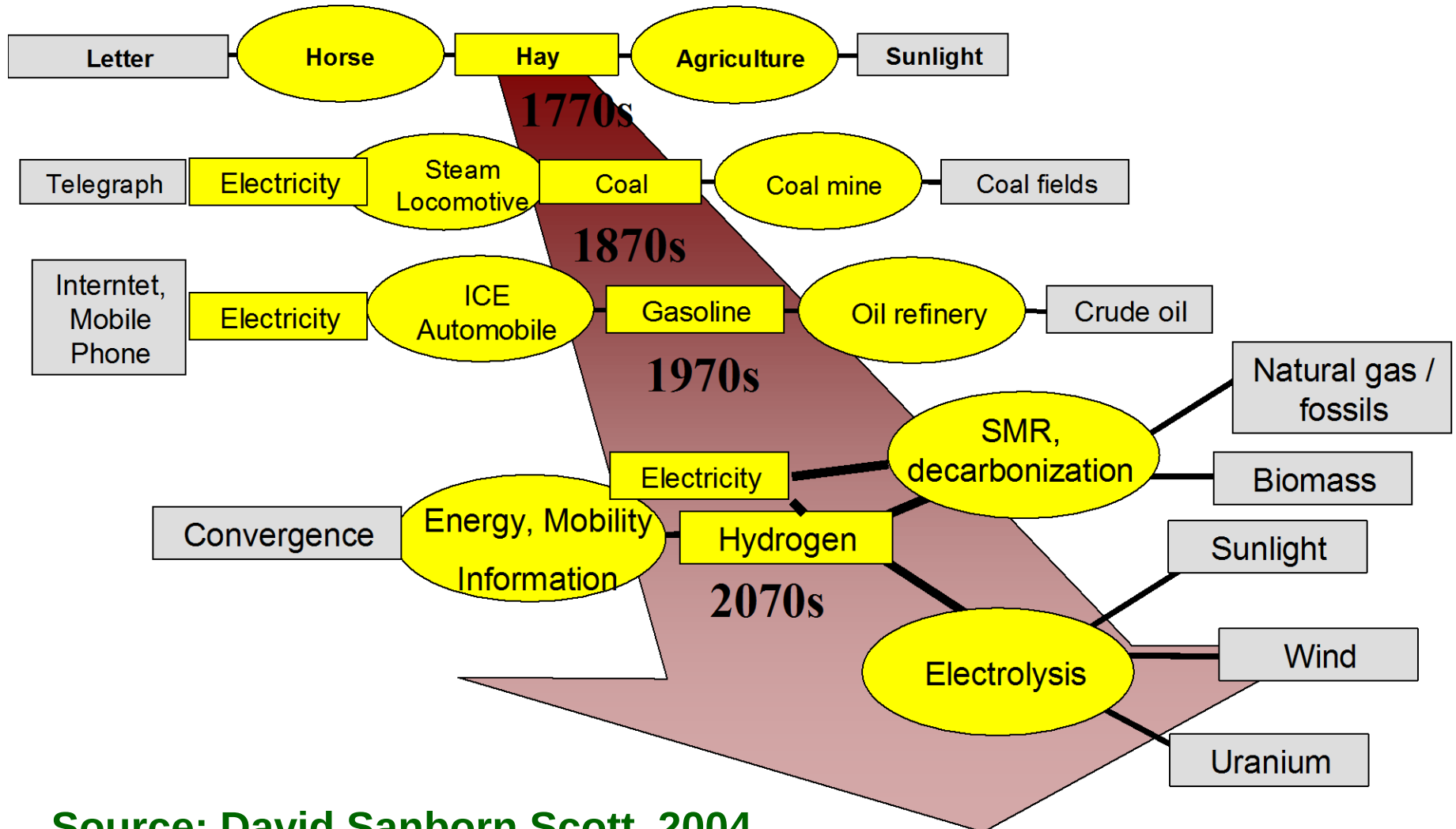
Potential Synergies between New Energy and Transport Infrastructures: Asian “Supergrid”

Super Cables
Power lines



Source:
Y. Yamagata, NIES. 2010

Mobility and Communication Through Time



Source: David Sanborn Scott, 2004

Vision of a Sailing Railway

Monorail using sails proposed by Henry R. Palmer in 1828

