

Uncertainty Analysis in IAMs

The Role of Technological Change

Nebojša Nakićenović

International Institute for Applied Systems Analysis 

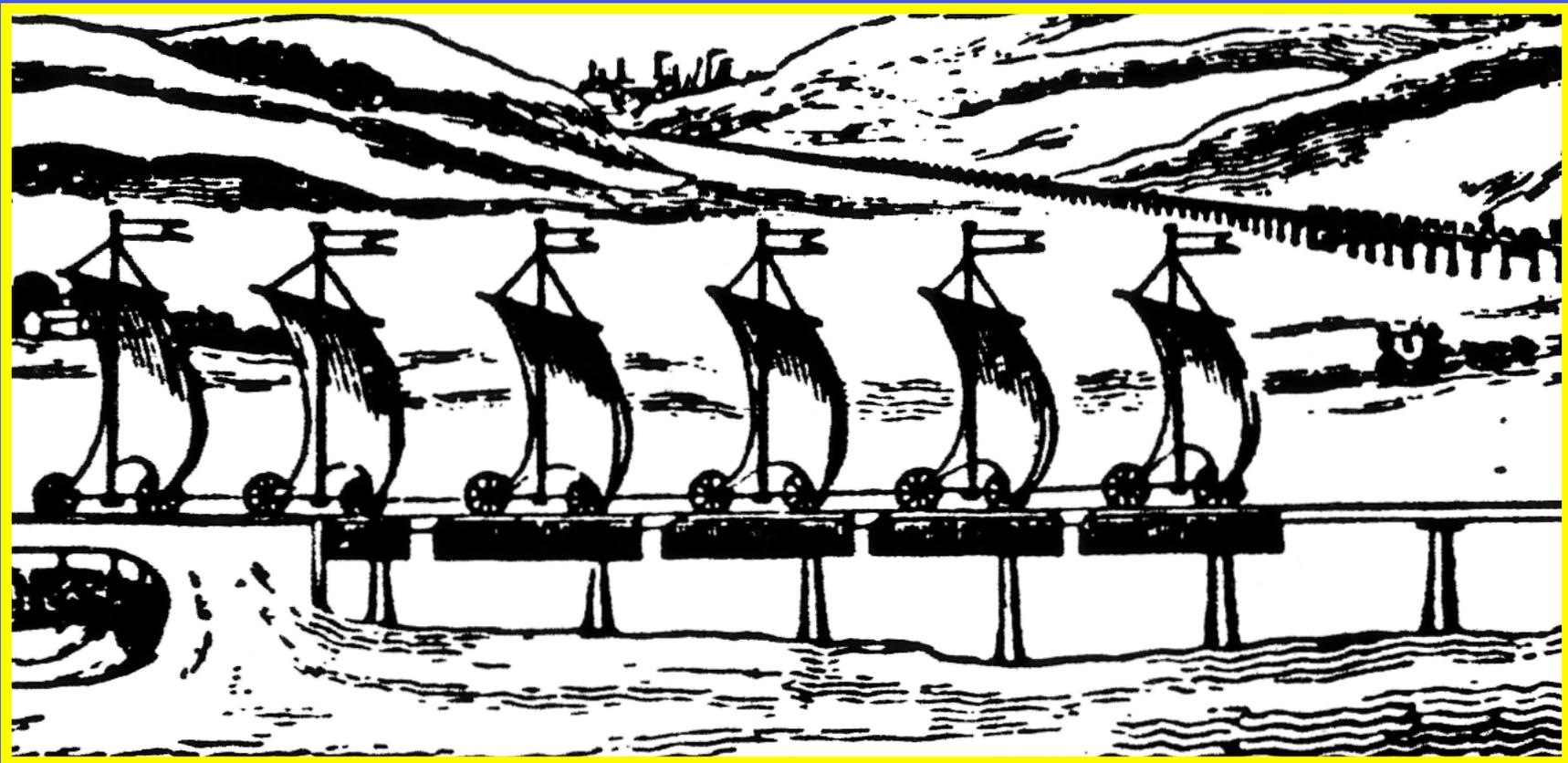
Technische Universität Wien 

naki@iiasa.ac.at

Uncertainty Analysis in IAMs, Snowmass – 1-2 August 2011

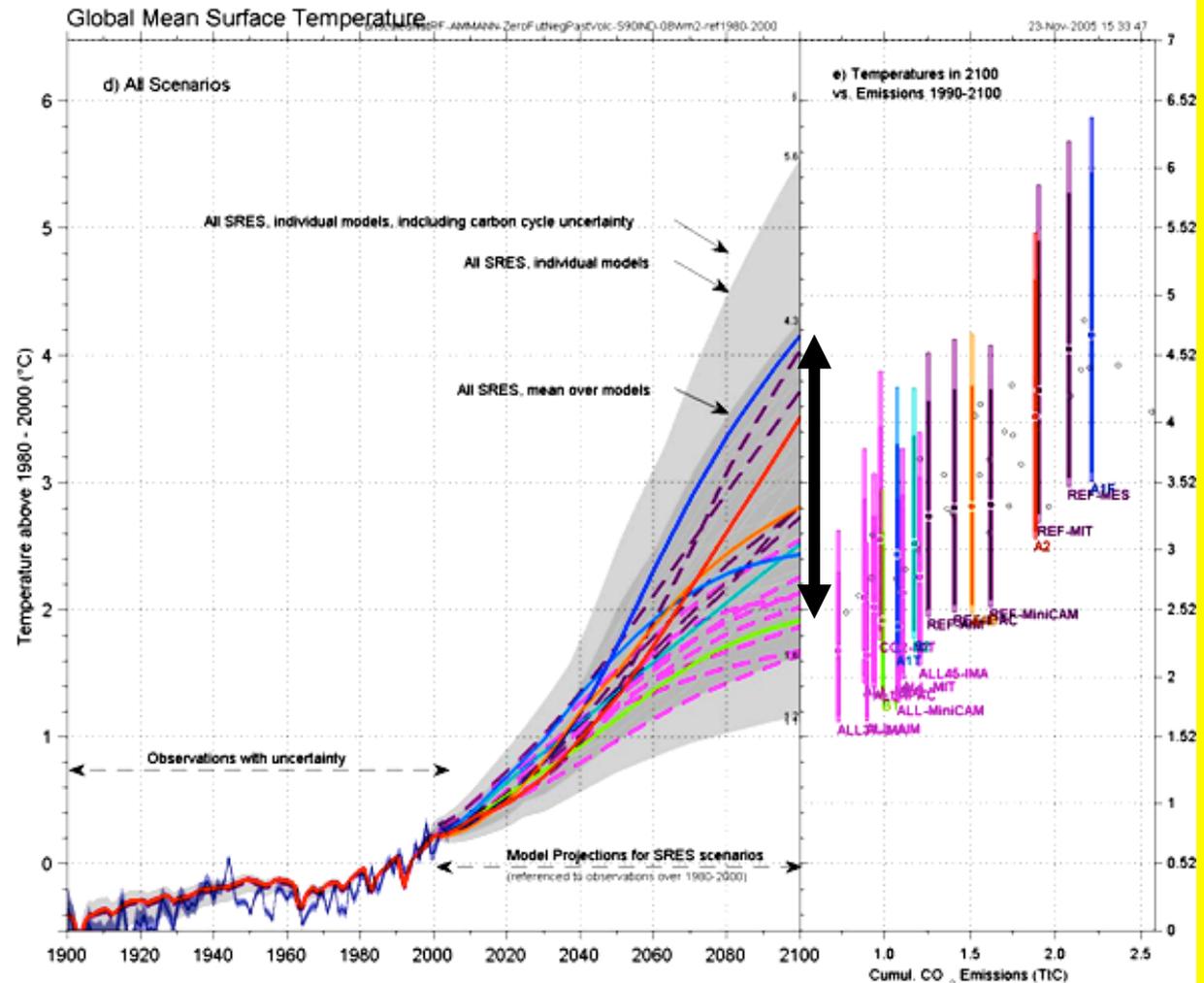
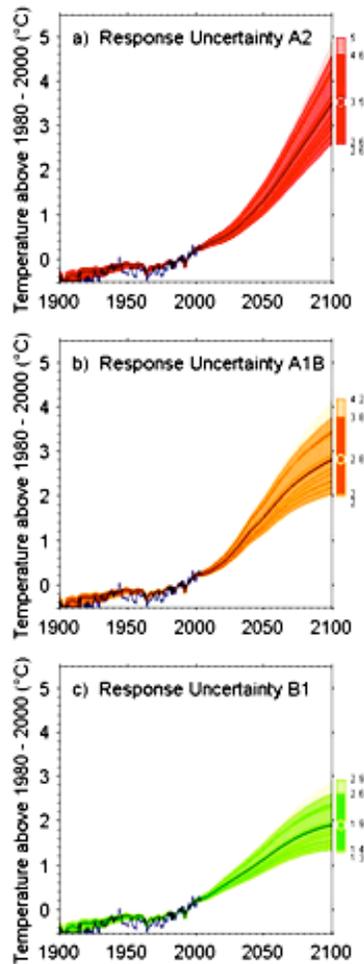
Vision of a Sailing Railway

Monorail using sails proposed by Henry R. Palmer in 1828



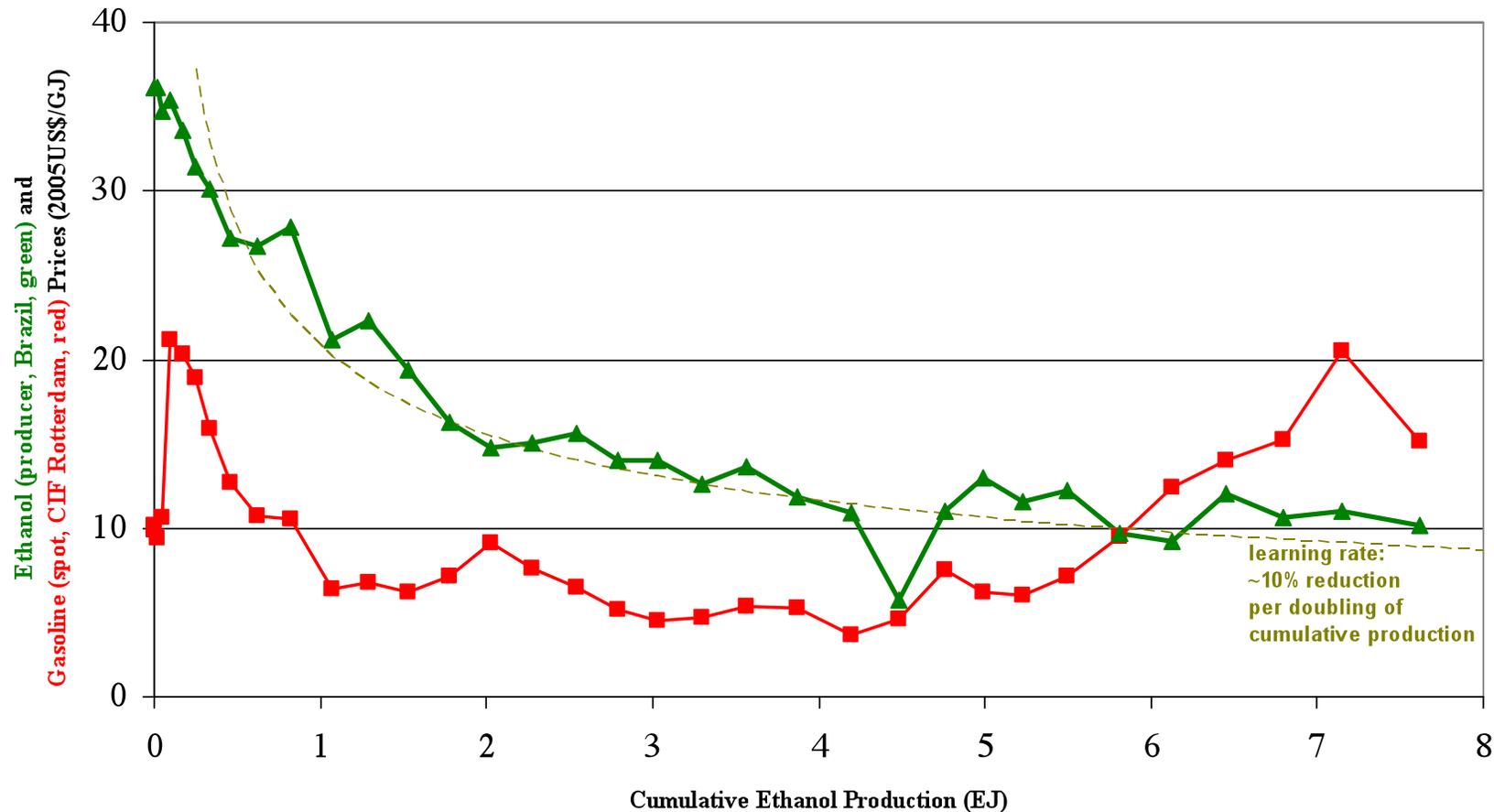
Global Mean Temperature Change

AR4 Illustrative Scenarios and Full Range



Uncertainty of Technological Change

- Future characteristics (e.g. costs) not a function of time, but dependent on intervening actions (R&D & investments)
- Improvements through accumulation of experience (learning + knowledge appreciation)
- Interactive rather than linear model:
Learning by doing **and** using;
supply push **and** demand pull

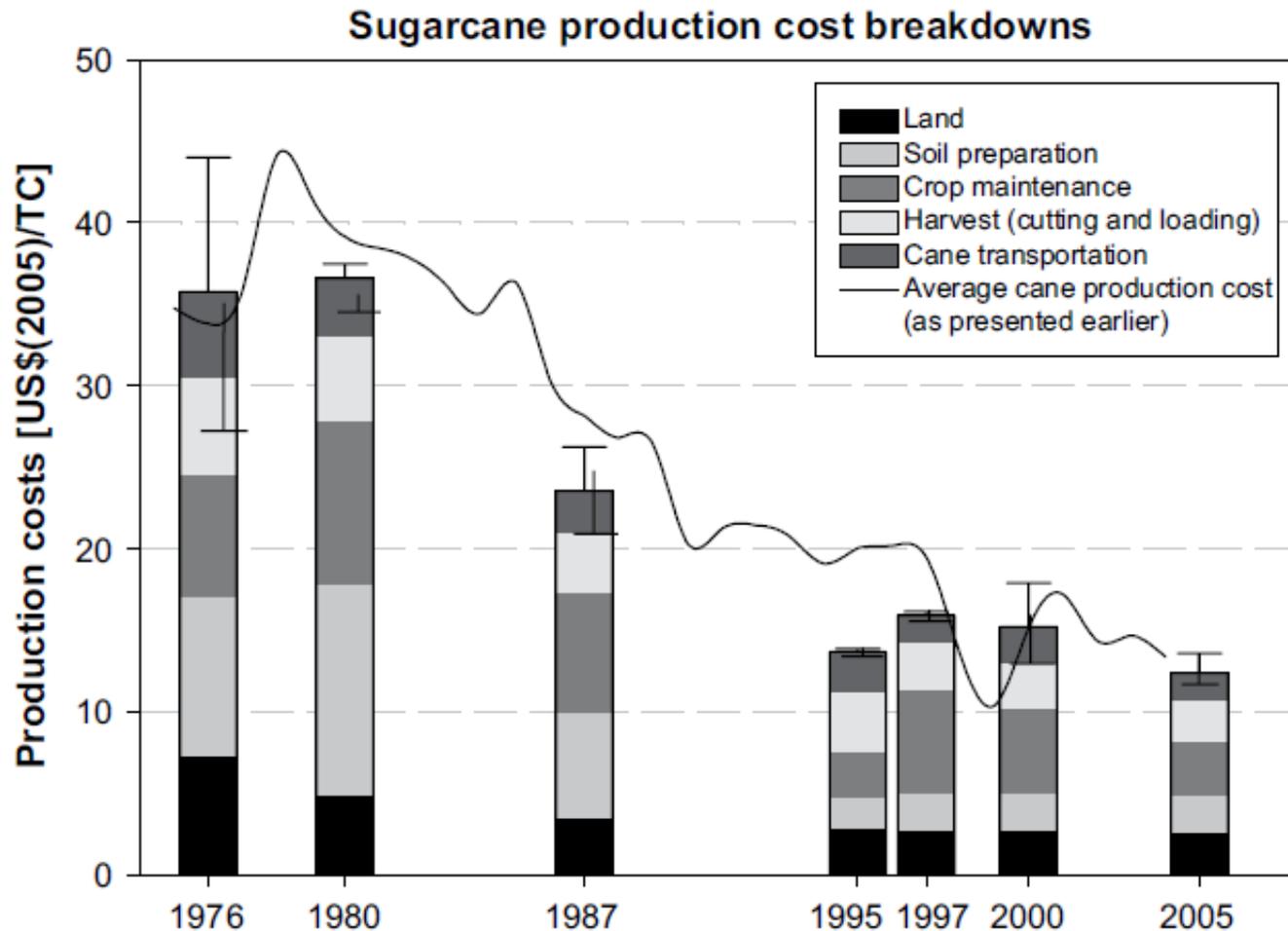


30 years to cost break even (2004); cumulative subsidies: ~50 Billion US\$2005

Source: Grübler (Goldemberg) 2011

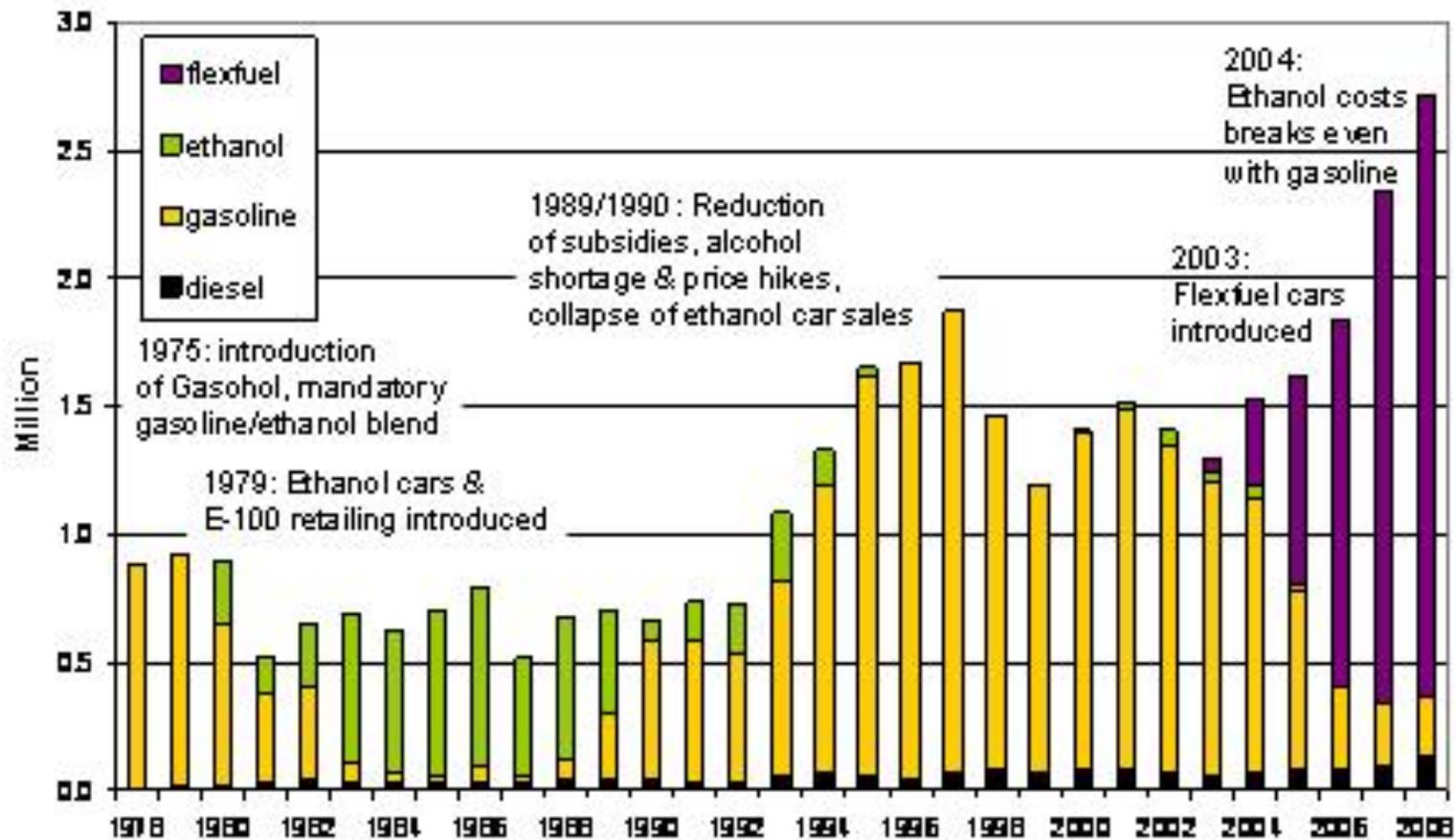
#5 2011

Brazilian Ethanol Cost Reductions



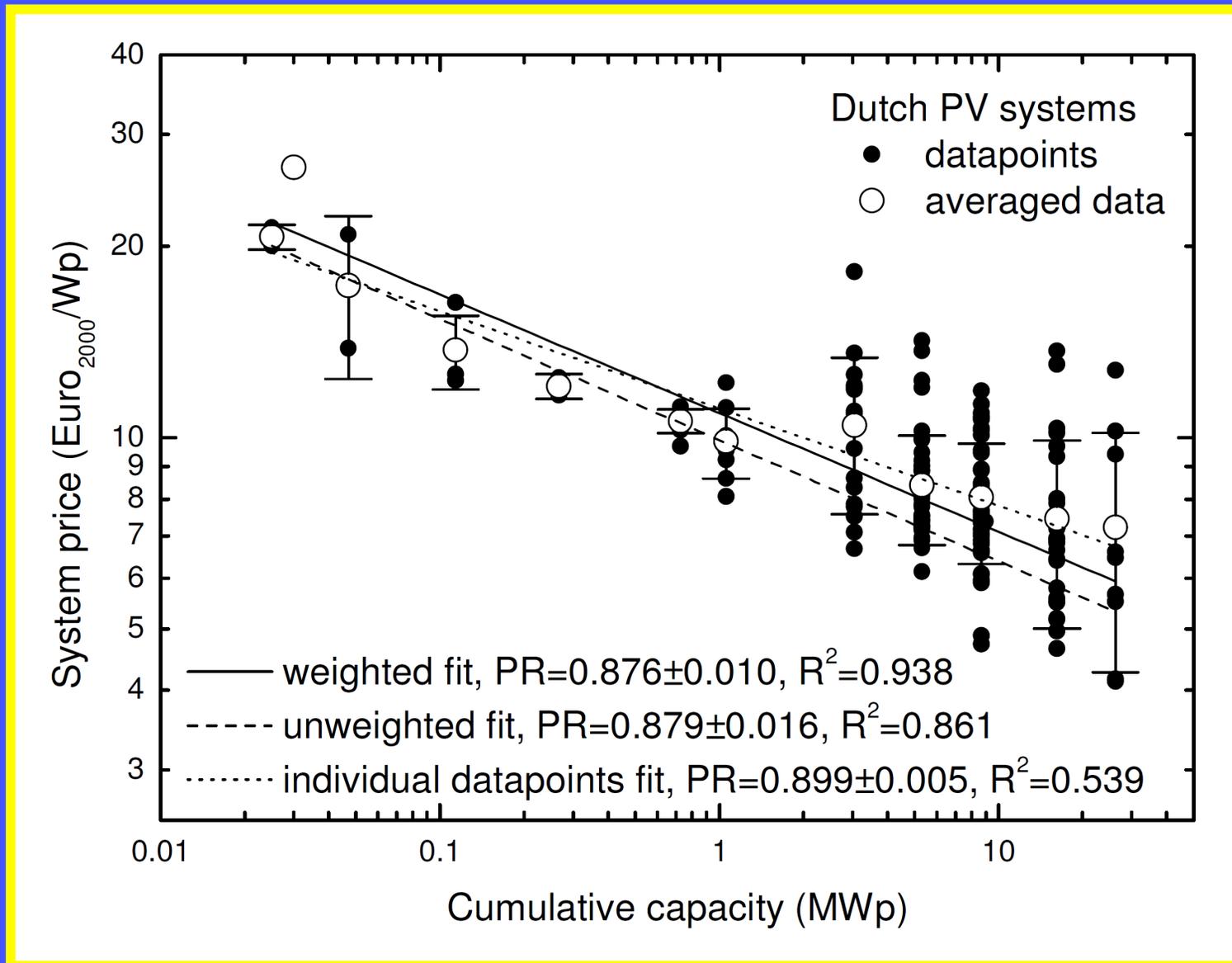
Source: Van den Wall Bake *et al.*, 2008

Vehicle Registrations in Brazil by Fuel Capability



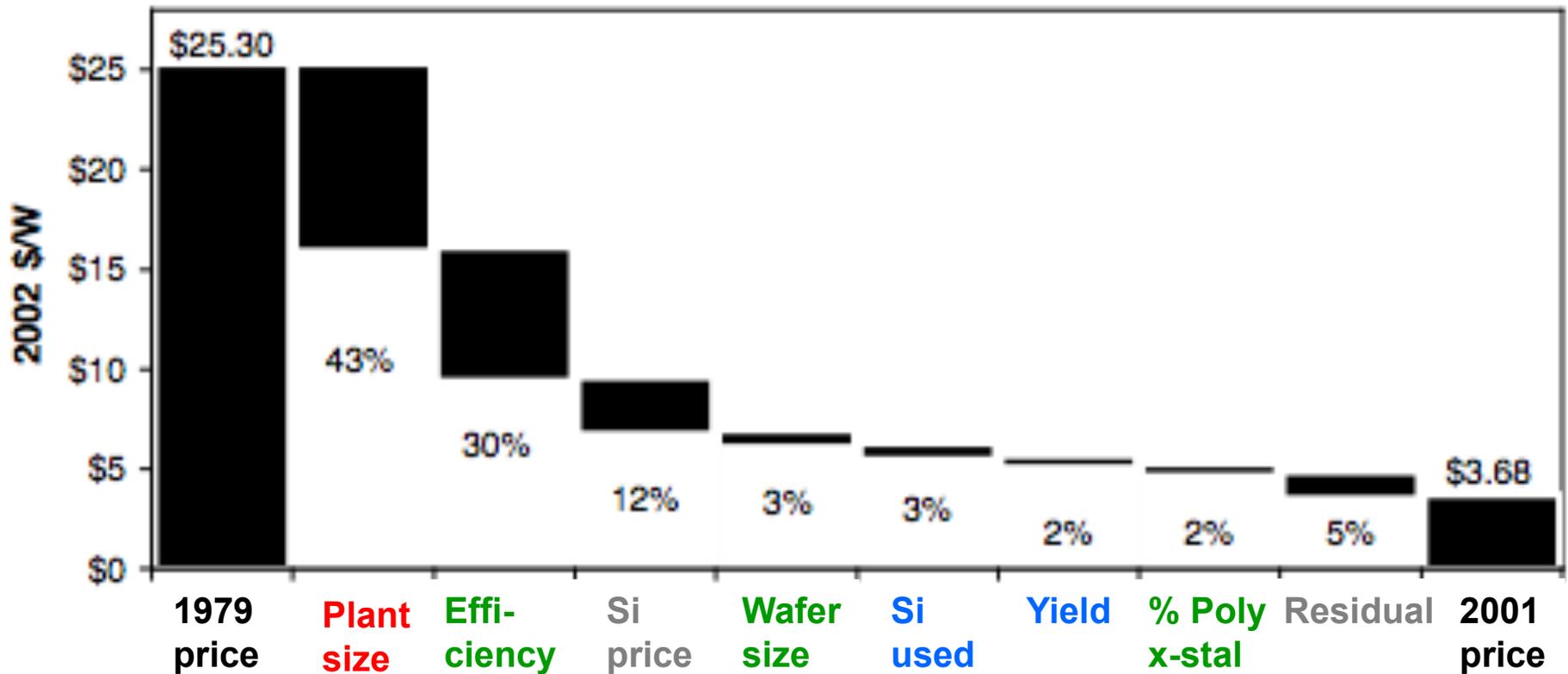
Source: GEA KM24 (forthcoming)
#7 2011

The Netherlands - PV Costs



Factors in US PV Cost Declines 1979-2001:

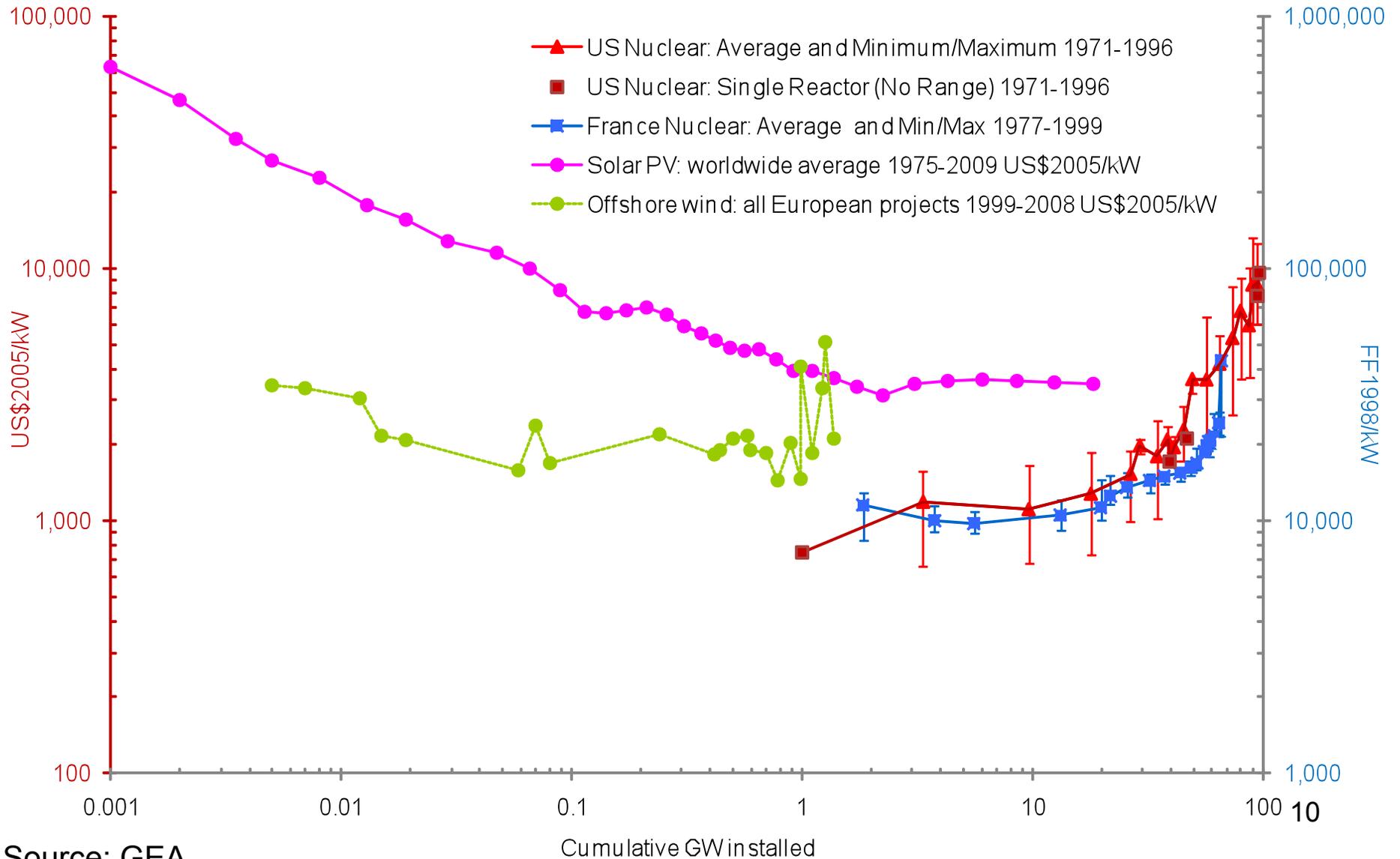
Economies of Scale (43%), R&D (35%), Learning by Doing (5%), Others (17%)



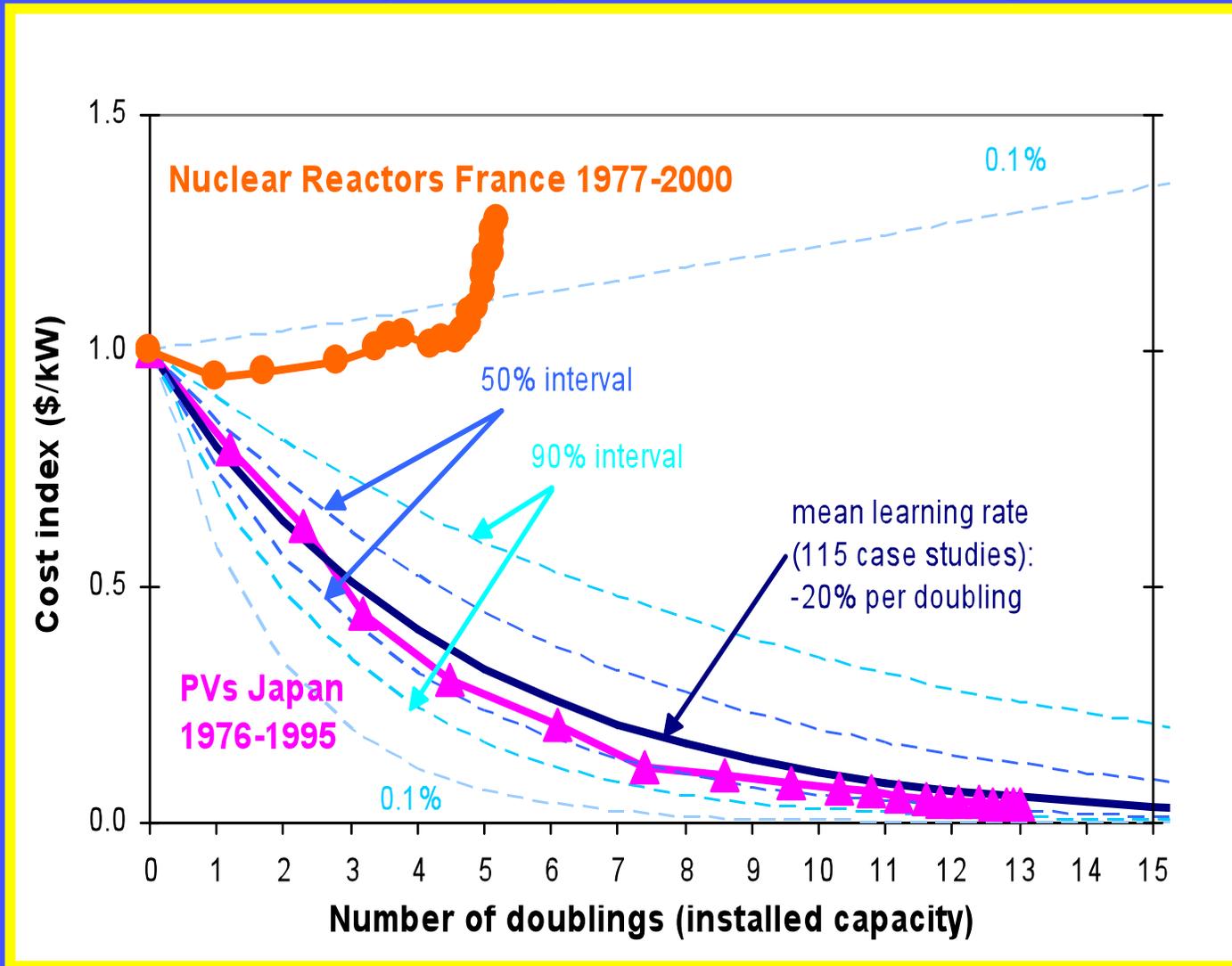
Source: Nemet, 2008

#9 2011

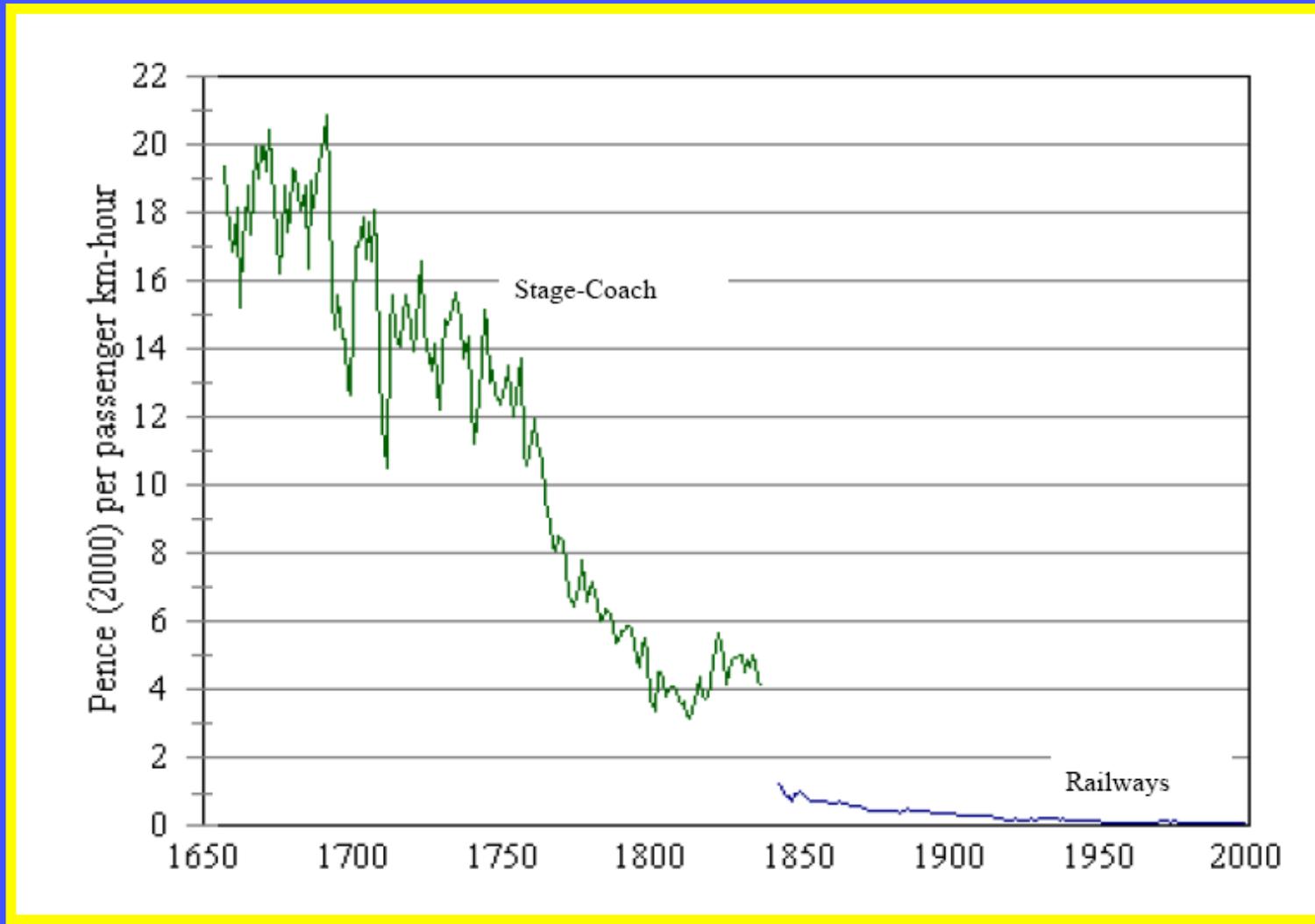
Photovoltaics, Offshore Wind and Nuclear



Technological Uncertainties: Learning rates (push) and market growth (pull)



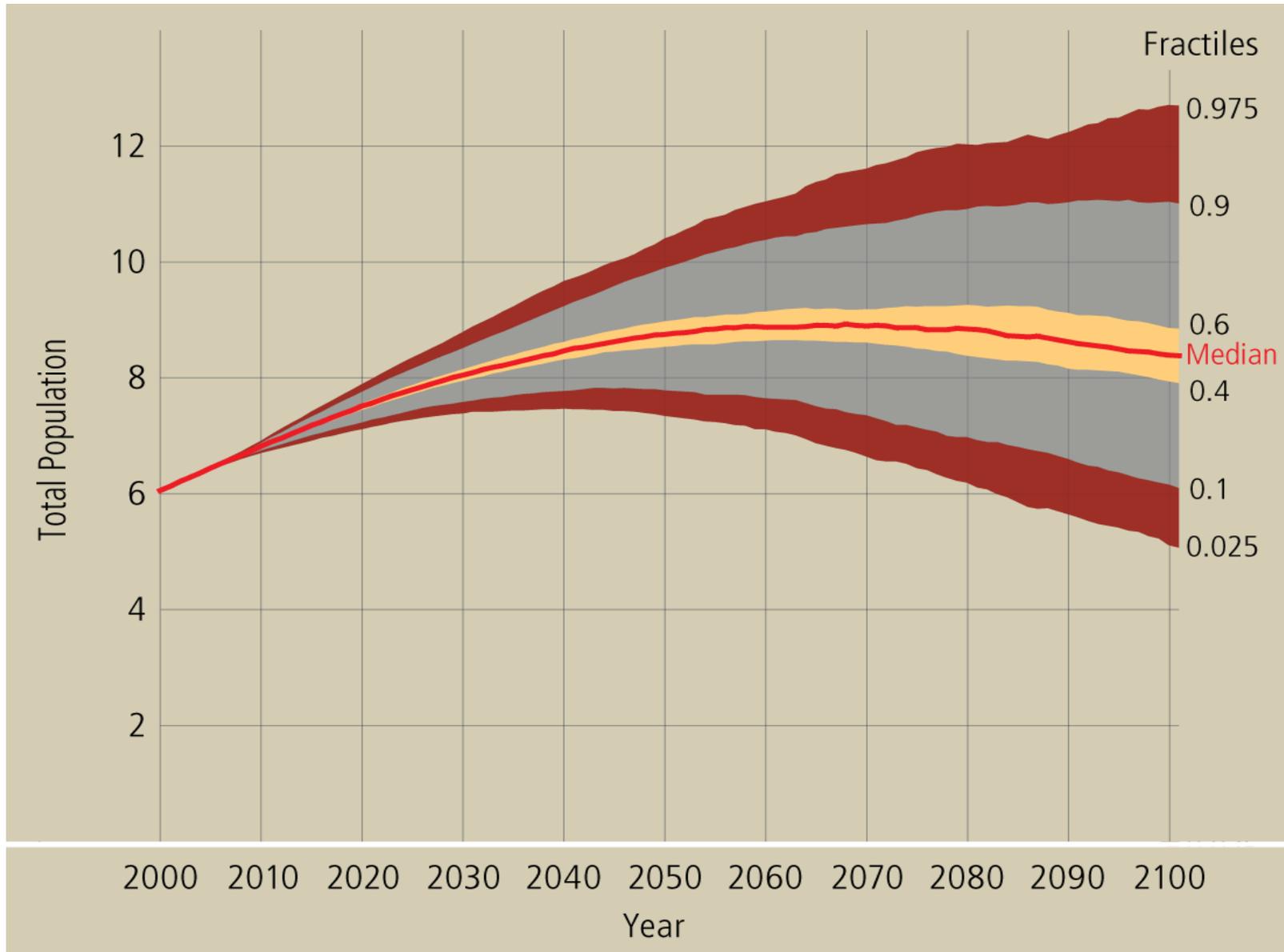
Price of Passenger Transport (per passenger-kilometer-hour)



A Place-Holder Proposal

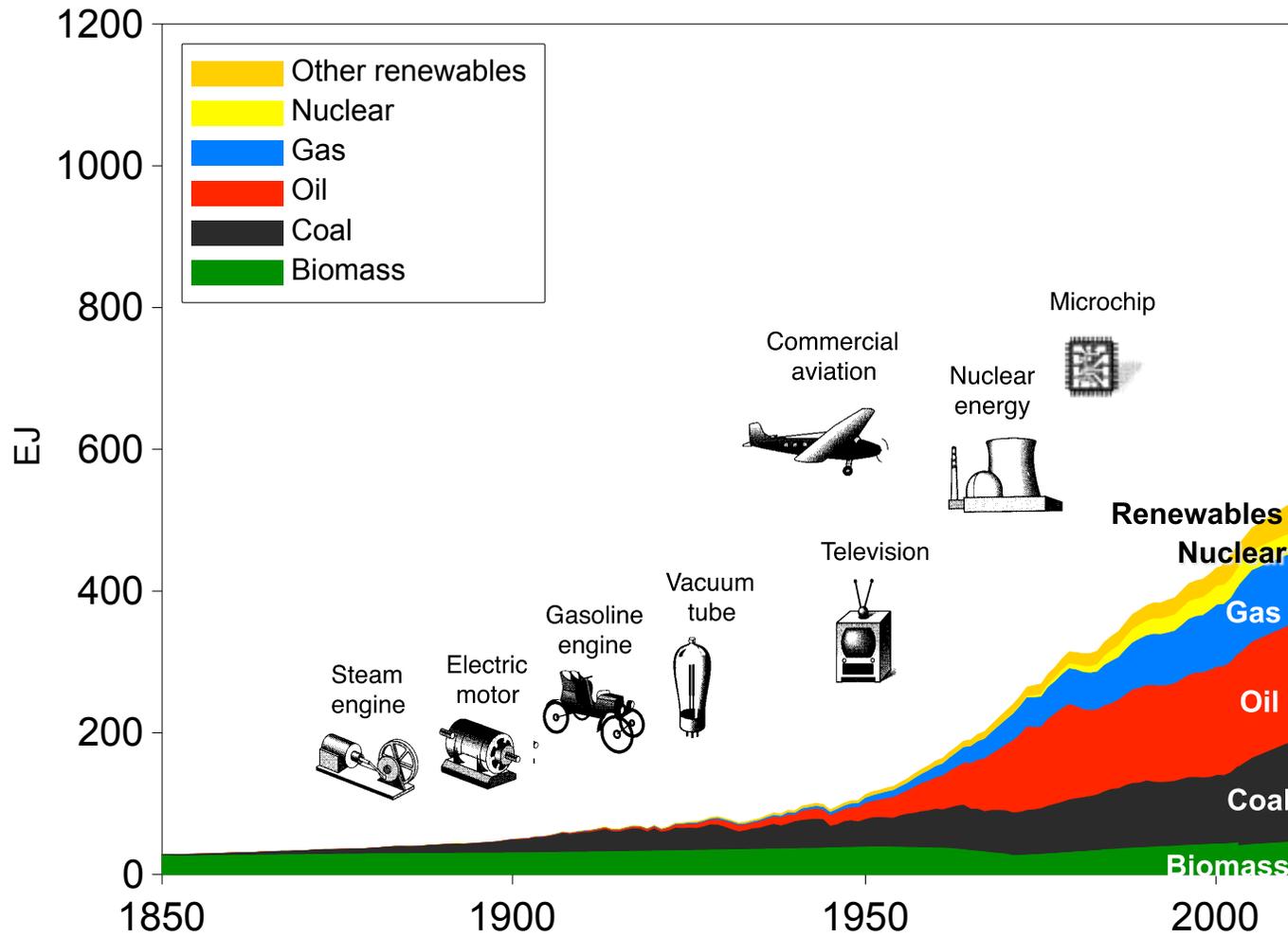
Intended for stimulating discussion about how technology comparison could be organized. It could be characterized as a “reduced-form” Monte-Carlo analysis:

1. “Modeler’s choice” scenarios and a shared policy scenario, e.g. stabilization of global mean temperature at 2°C above the pre-industrial (e.g. EMF 24). Policy assumptions could be uncertain.
2. Successively blocking one of mitigation options (bioenergy, CCS, nuclear, PV or Wind). More aggregated IAMs could simulate the same “ensemble” of scenarios by limiting low-carbon options (e.g. EMF 24). A partial “stress test”.
3. Correlations in the availability of technologies (possibly jointly with agreed assumptions about technological improvement rates), based on expert solicitation, literature review or on reference runs with stochastic uncertainty resolution.
4. Semi-stochastic “ensemble-like” runs with sampling from distributions with fat tails of model parameters, e.g. improvement rates of technologies, consisting of a limited number of shared and representative scenarios



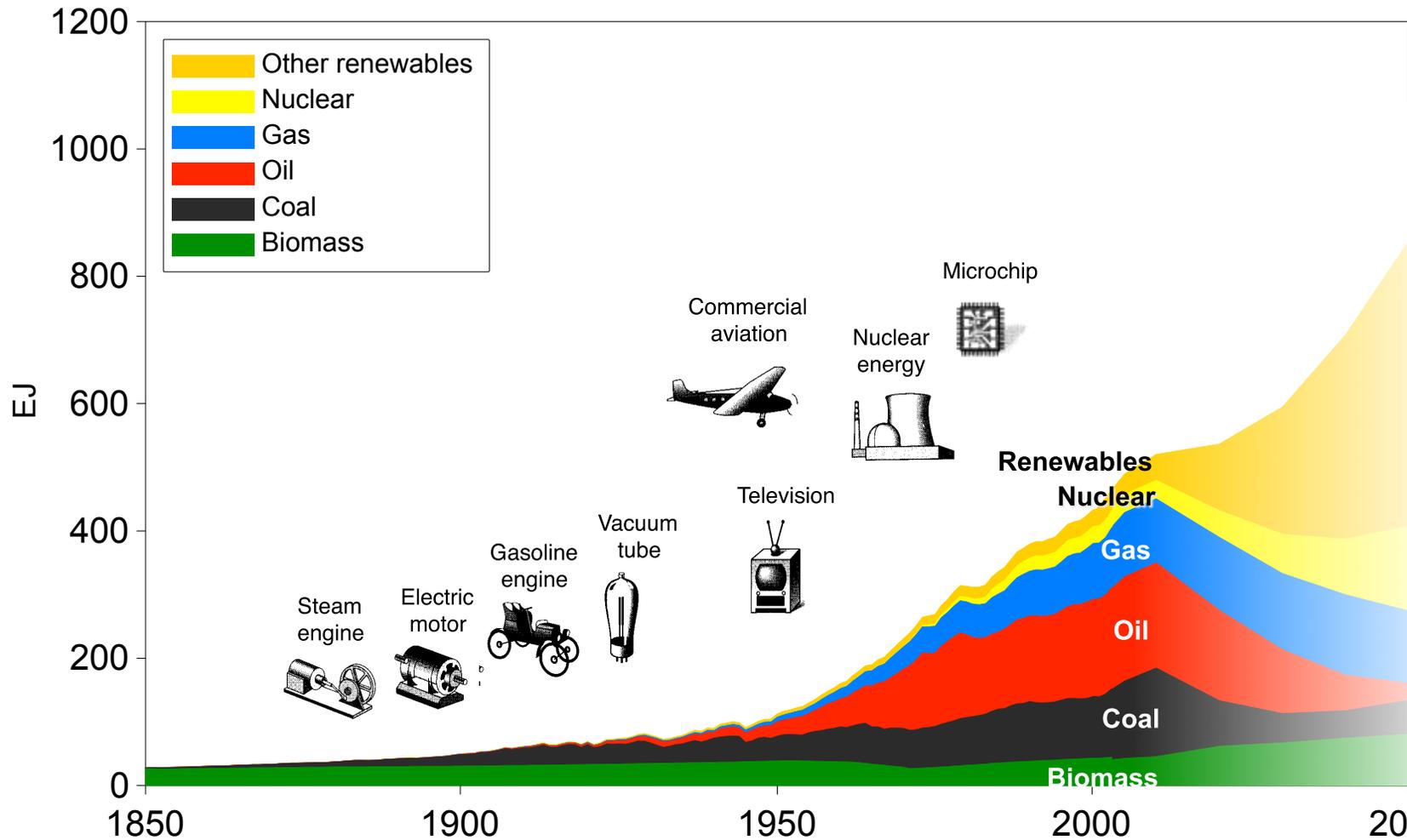
Source: IIASA

#14 2011



Global Primary Energy

Efficiency – High Nuclear

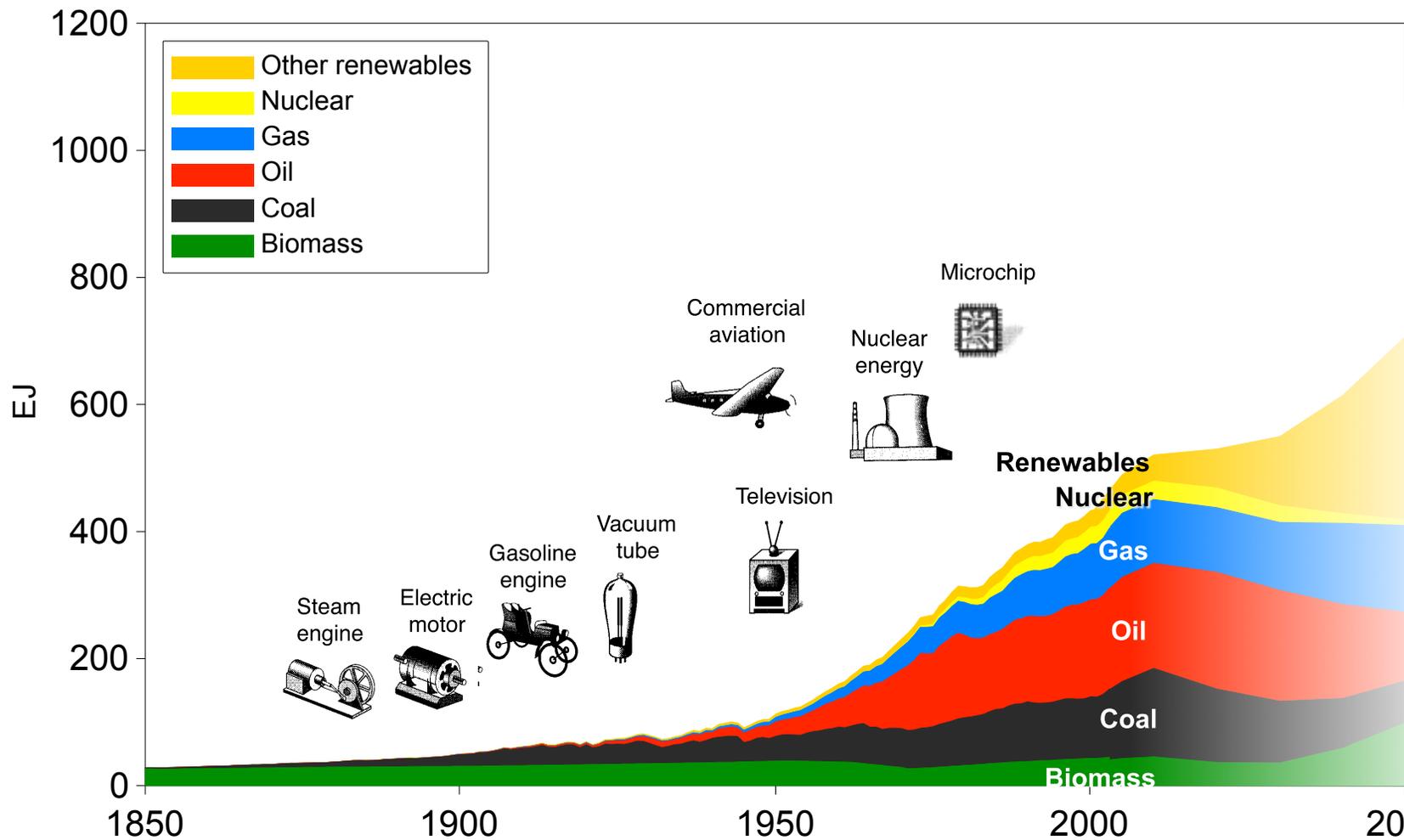


Source: GEA KM17 (in preparation)

#16 2011

Global Primary Energy

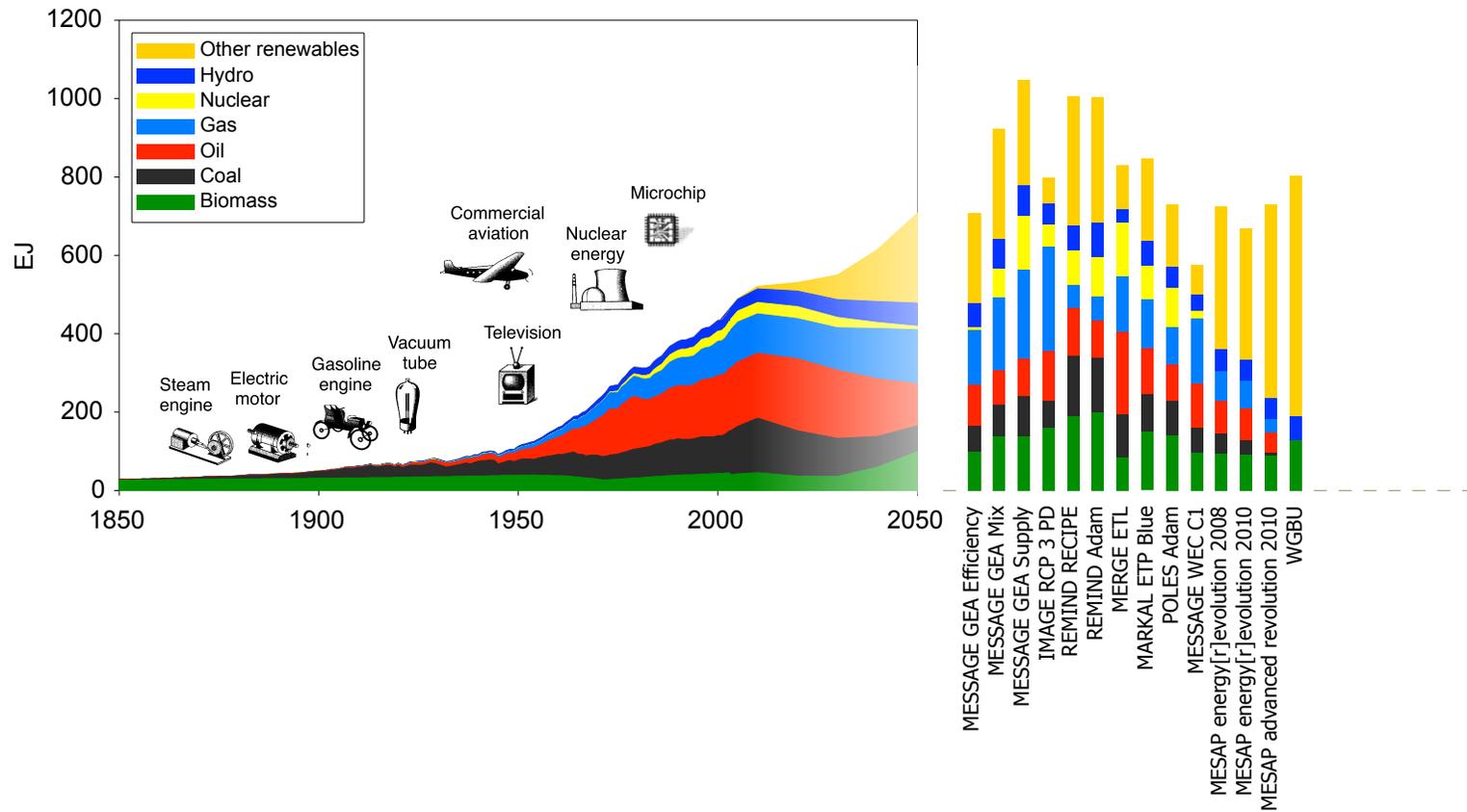
Efficiency – Low Nuclear



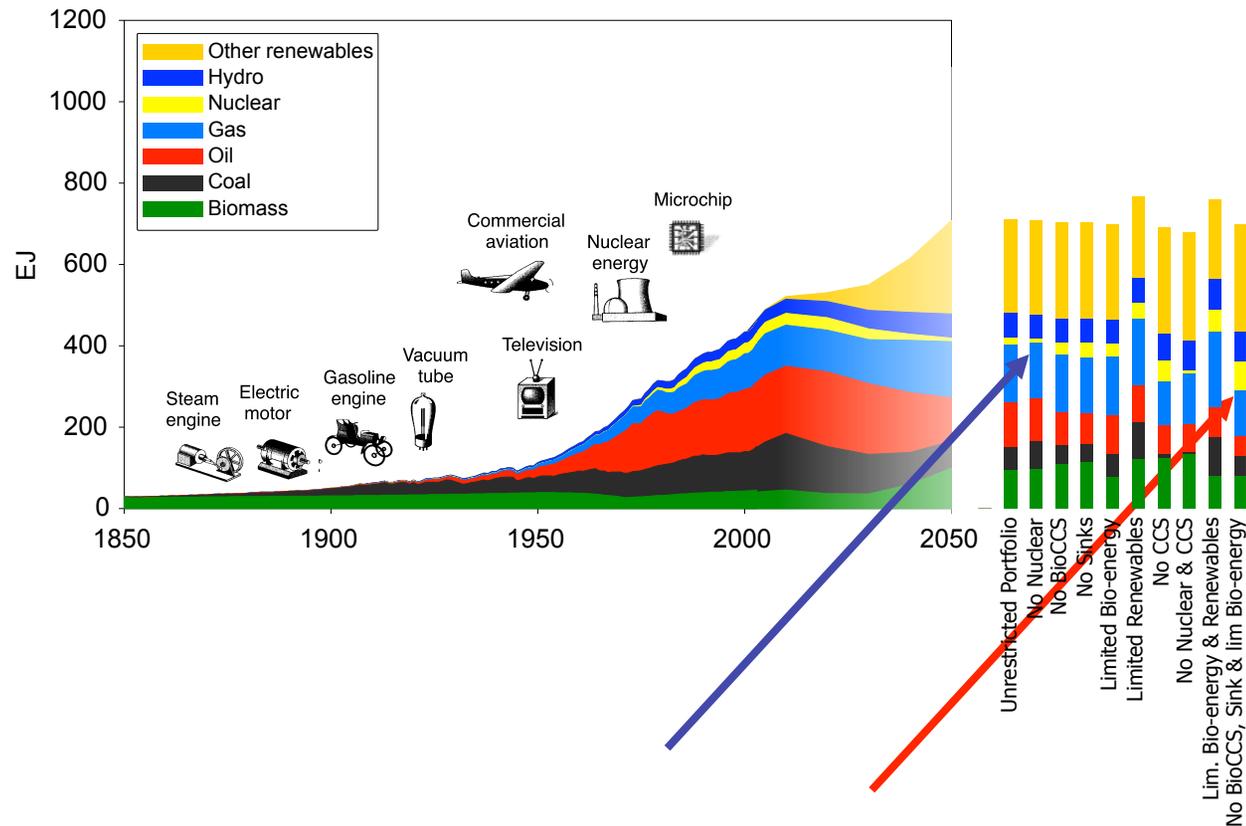
Source: GEA KM17 (in preparation)

#17 2011

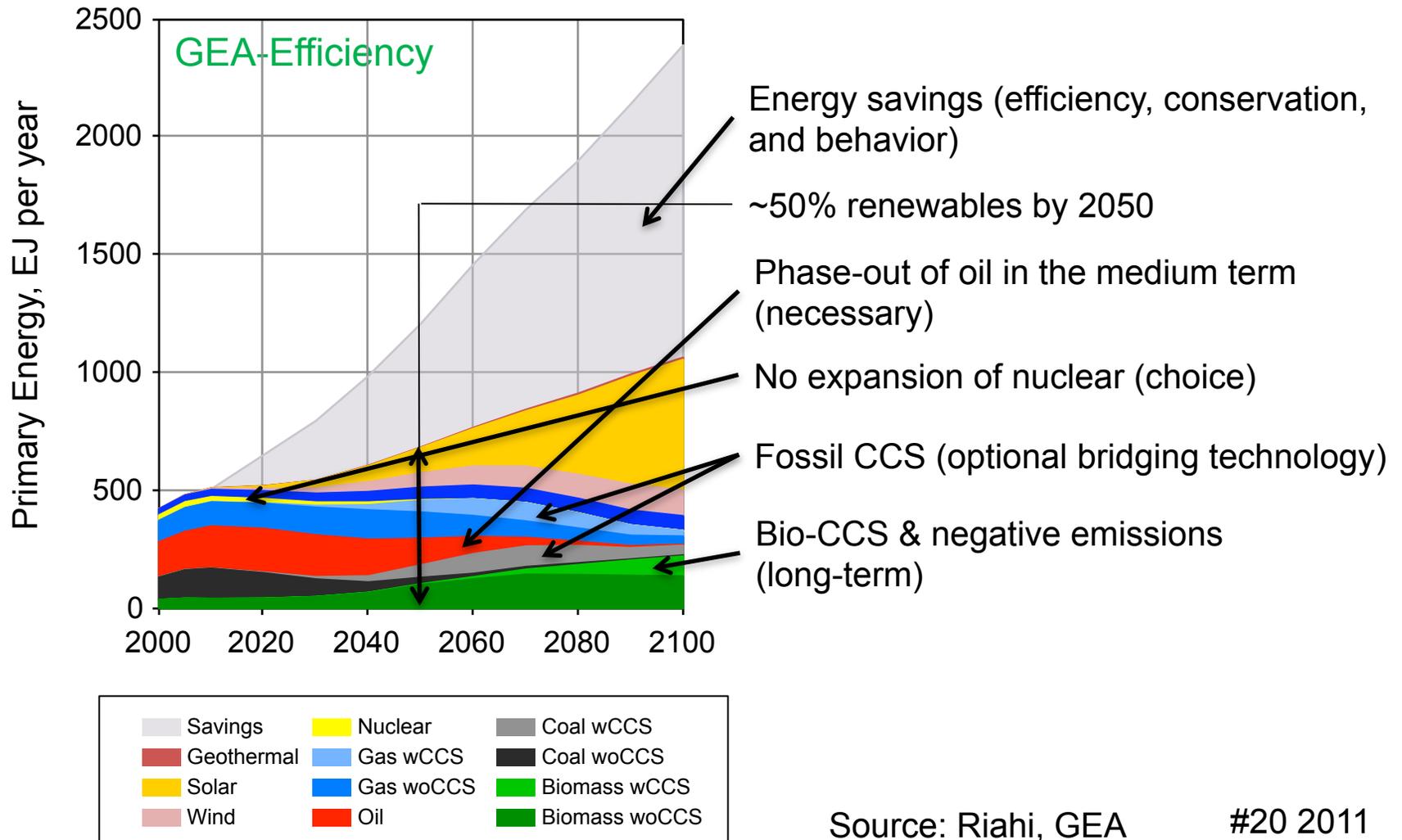
Efficiency



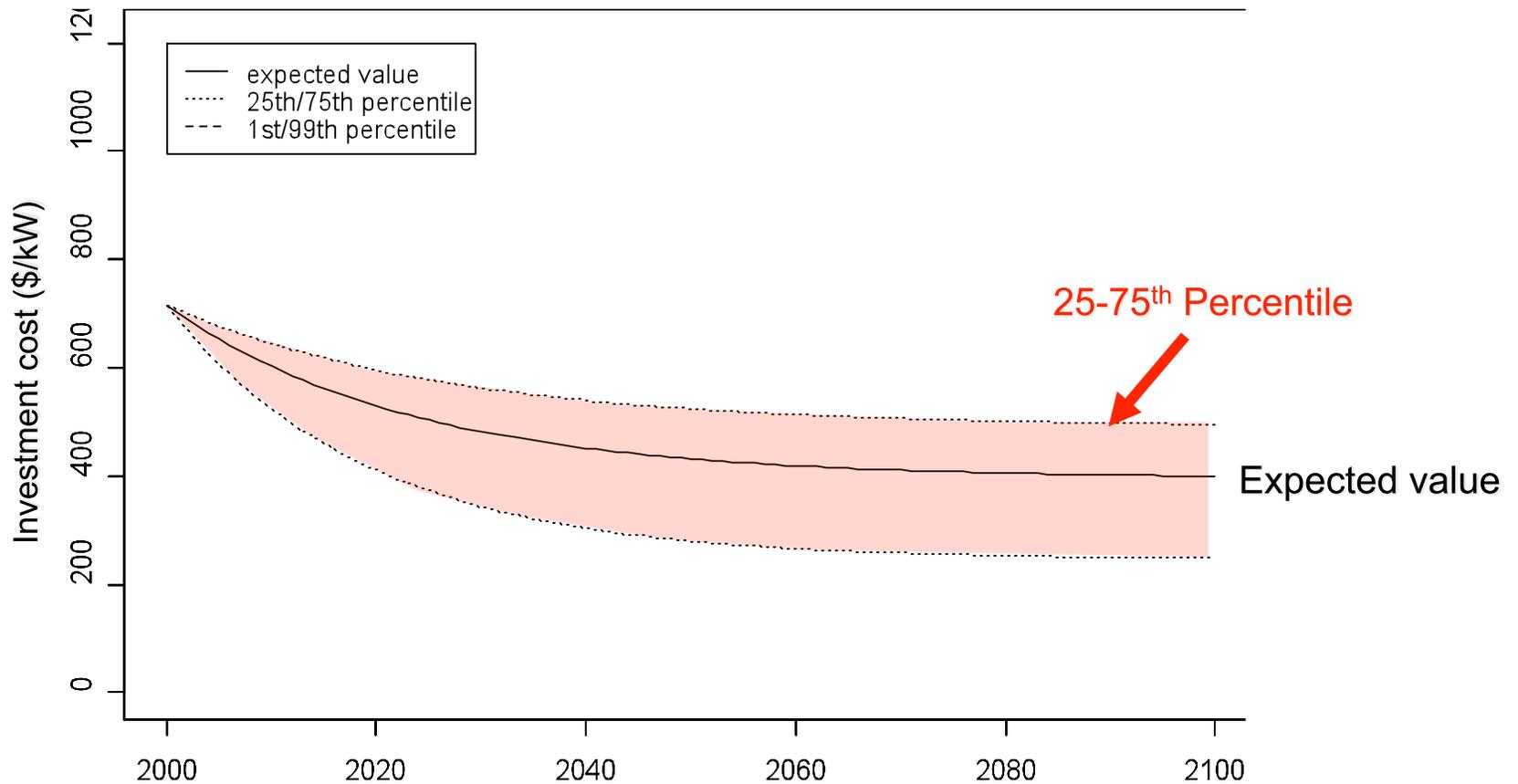
Efficiency



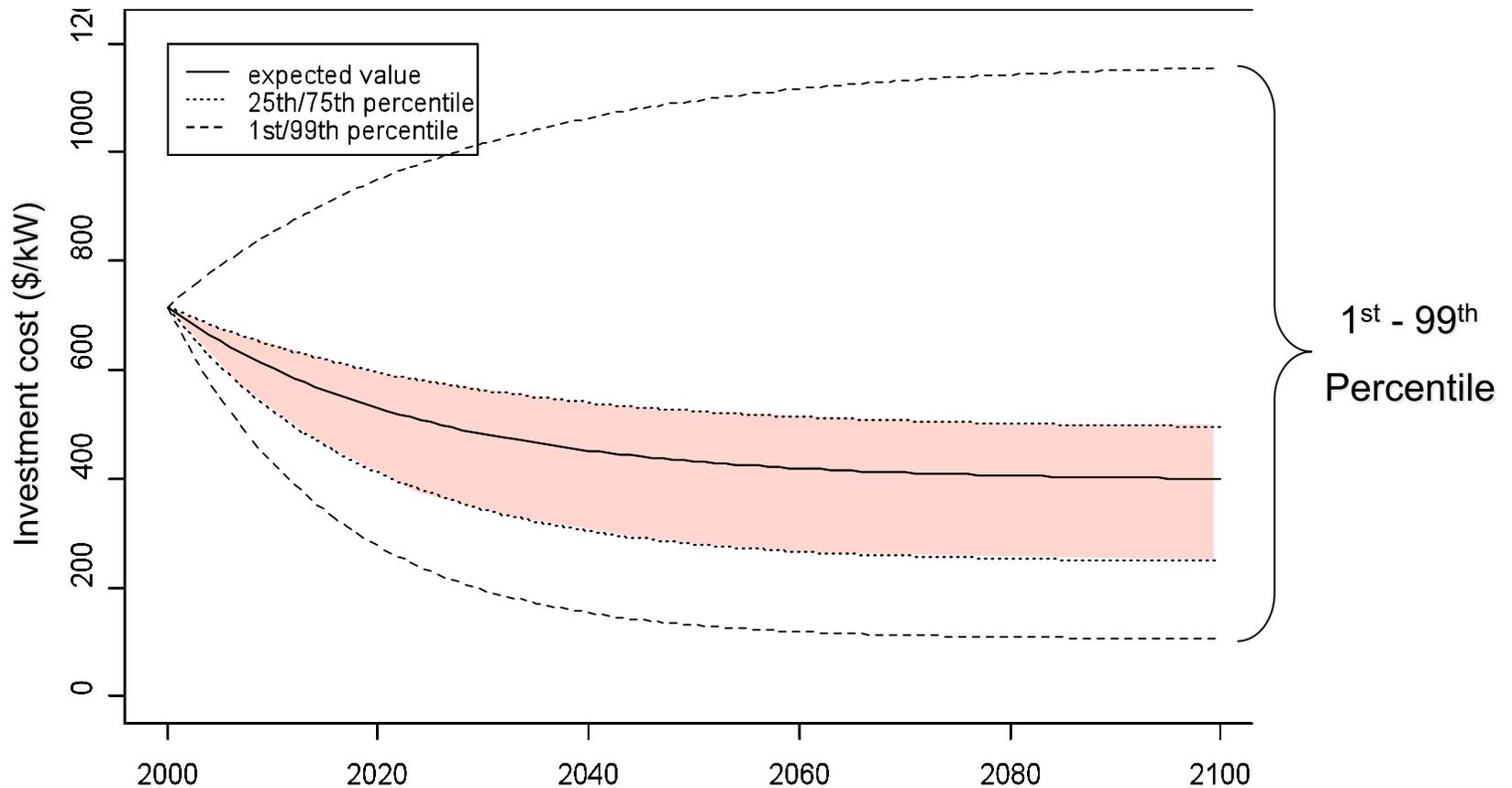
(= high flexibility for supply)



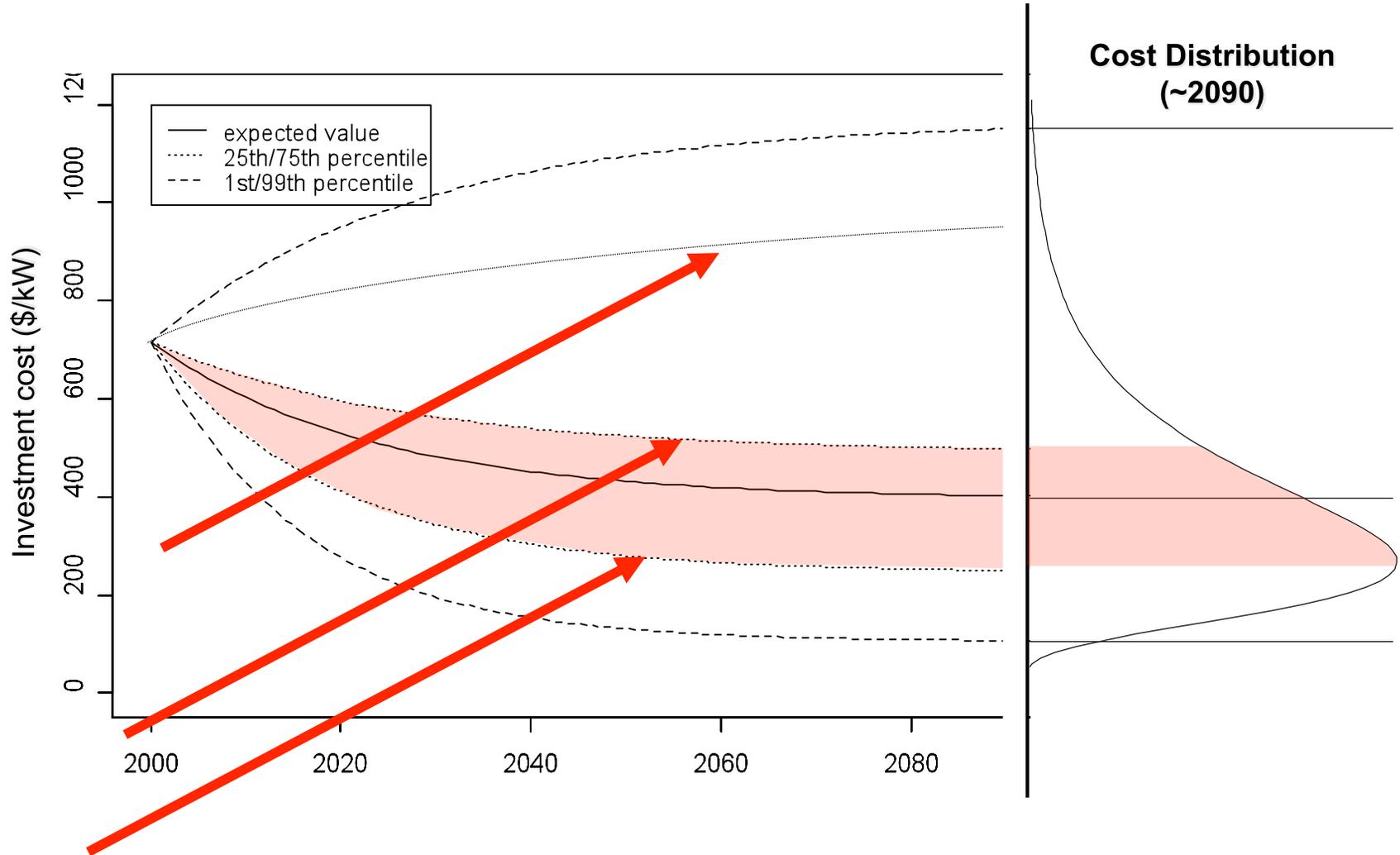
Cost Improvements over Time (NGCC)



(NGCC)

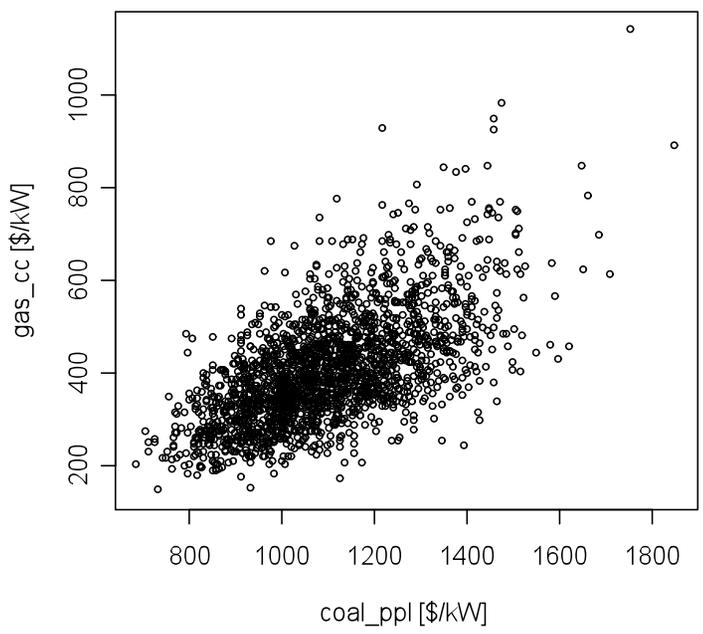


(NGCC)

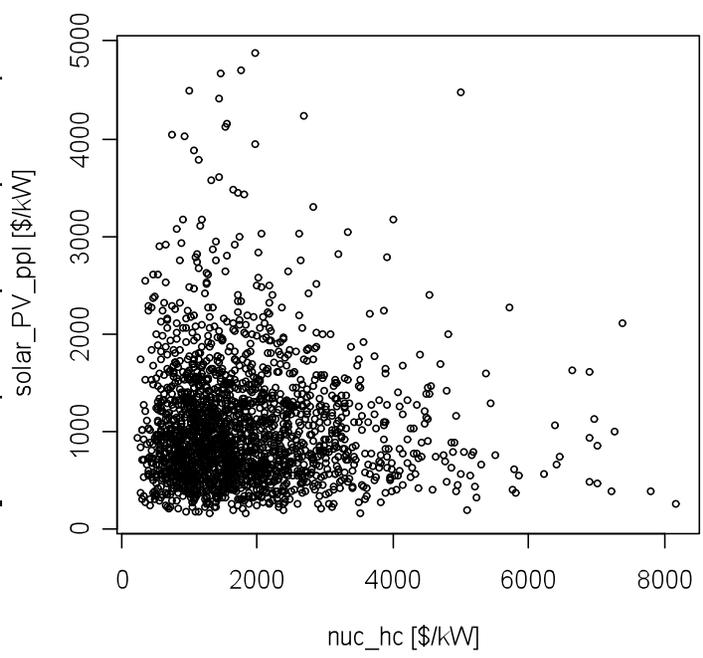


	Coal	Gas	Nuclear	Biomass	Hydro	Wind	Solar
Coal	1	0.63	0.05	0.57	0	0	0
Gas	0.63	1	0.05	0.57	0	0	0
Nuclear	0.05	0.05	1	0.57	0	0	0
Biomass	0.57	0.57	0.57	1	0	0	0
Hydro	0	0	0	0	1	0	0
Wind	0	0	0	0	0	1	0
Solar	0	0	0	0	0	0	1

cor=0.62



cor=-0.0295



0
0
0
0
0
1

- Hofburg (27-28 June 2012)
- IIASA (29 June)

www.iiasa.ac.at/conference2012




IIASA 40th Anniversary Conference
Hofburg Congress Center, Vienna
and IIASA, Laxenburg, Austria
27-29 June 2012

Home About Program Register Venue Sponsor Media Contact

LATEST NEWS
IIASA Announces Conference 2012
Conference Program Published
Full Registration Opening Soon

QUICK LINKS
Keep up to date
Tell a friend
Facebook Twitter LinkedIn
Green Conference

Take part in the conference to hear the latest thinking and research into how the world can respond to today's and tomorrow's global challenges

Conference Themes

- ▶ A World in Transformation - Expectations, Potential, Reality
- ▶ A World of Integrated Solutions - The Power of Systems Analysis
- ▶ Alternative Worlds - New Concepts and New Understanding

In cooperation with the Federal Ministry for European and International Affairs

BMW.F

International Institute for Applied Systems Analysis (IIASA) © 2011 | www.iiasa.ac.at



WORLDS WITHIN REACH
FROM SCIENCE TO POLICY

IIASA 40th Anniversary Conference
27-29 June 2012
Hofburg Congress Center, Vienna, Austria
and IIASA, Laxenburg, Austria
www.iiasa.ac.at/conference2012

International Institute for Applied Systems Analysis (IIASA)

In cooperation with the Federal Ministry for European and International Affairs

BMW.F