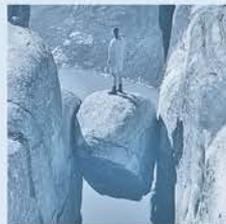


Reflections on Green Transition

Atle Midttun

Sept. 2014

Salzburg Energy Seminar



Optimism about mature economies



- Chris Huhne former Secretary of Energy UK (Liberal Party) (Guardian 25 August)
- We are growing richer while using less energy
- Many green thinkers suspicious of growth
- Today you can have both, no need for «green puritanism»

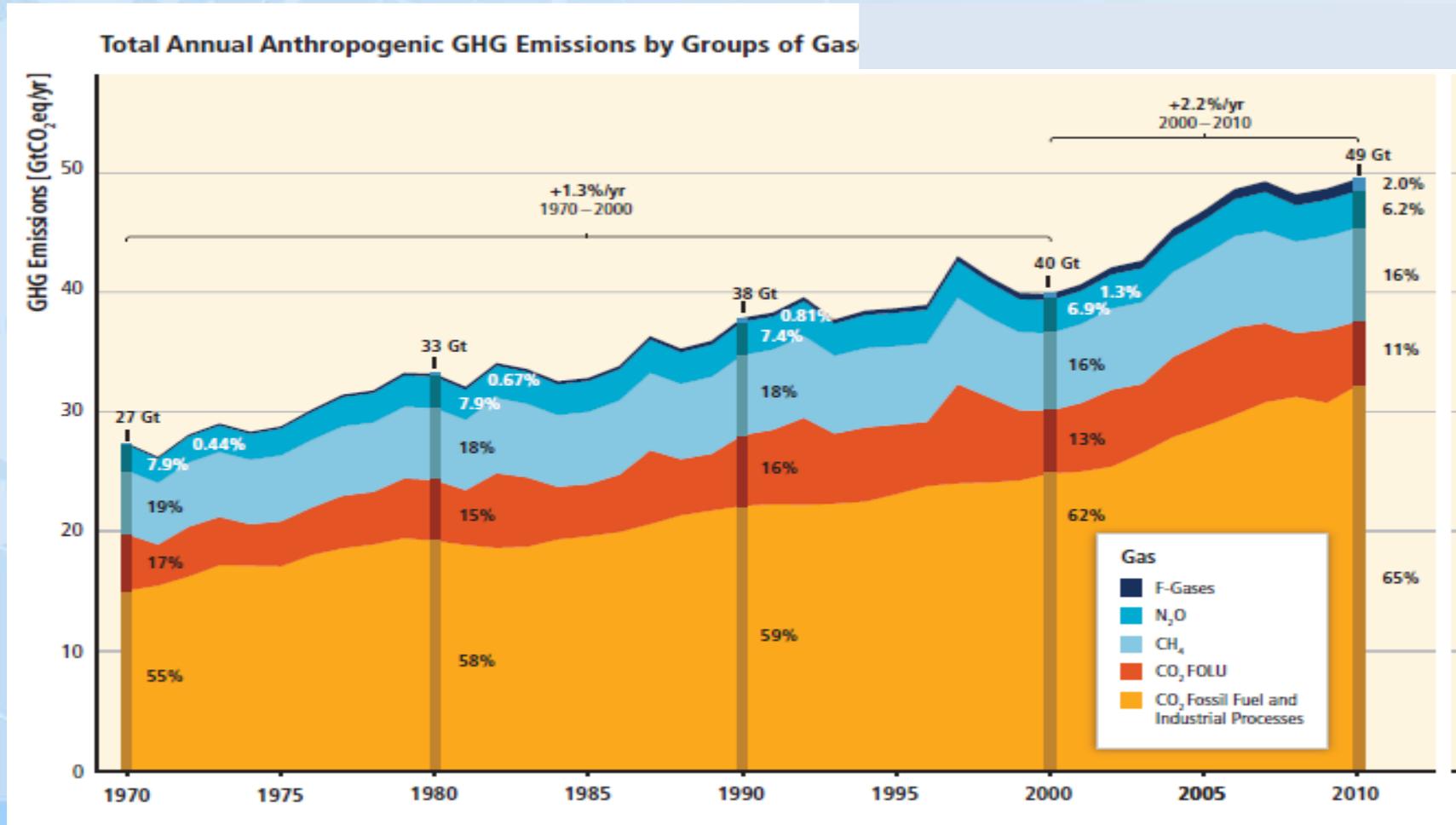
- Technology now allows us to increase growth and heighten living standards without increasing emissions.

- Cars are far more efficient
- We are taking the train more
- Lighting has increased tremendously in energy efficiency – LED light saves electricity by 93%

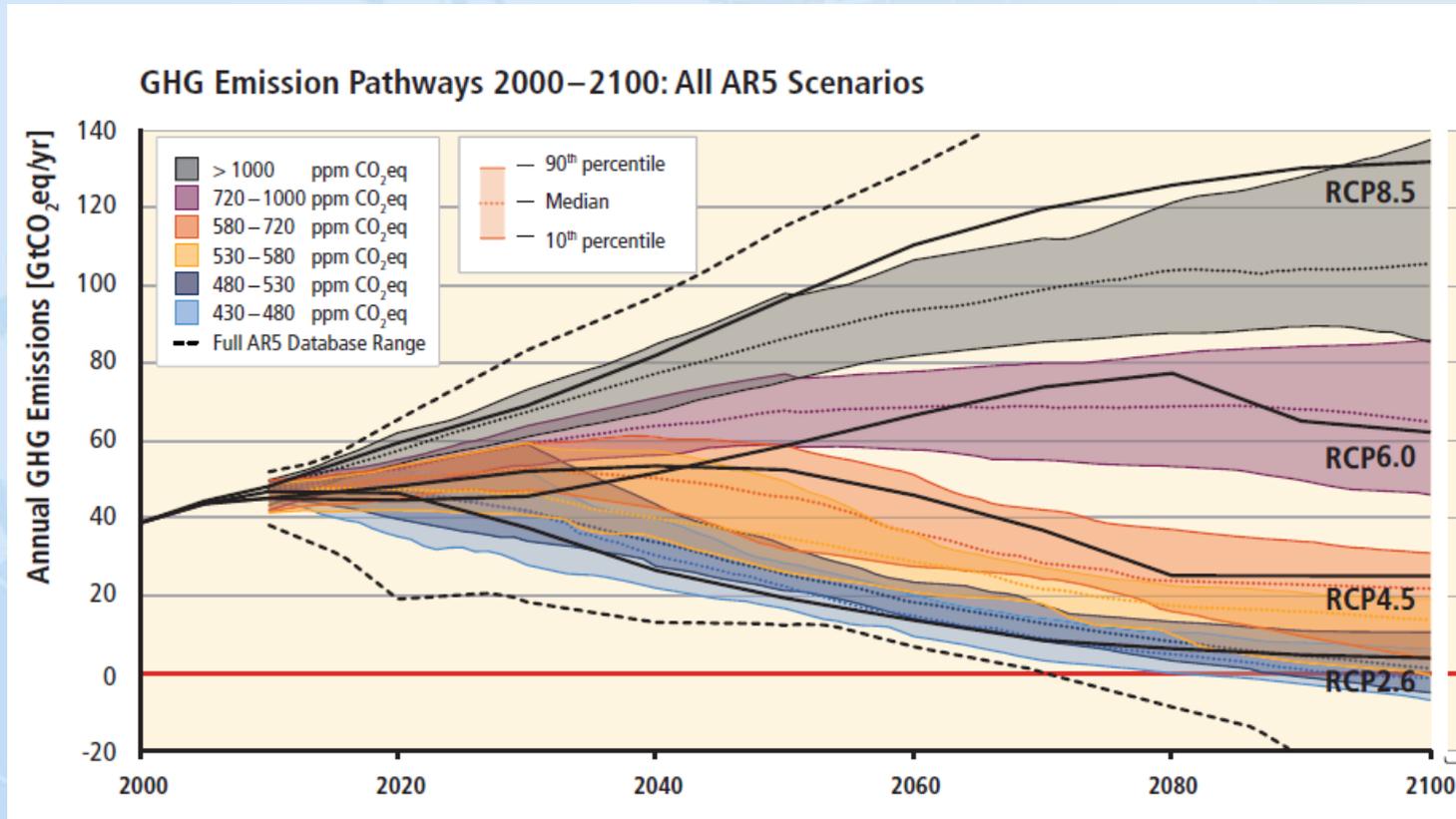
- Our living standards are rising, while our energy use is not.



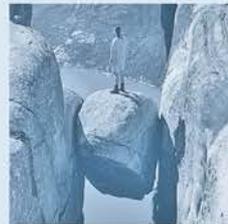
IPCC Pessimism



IPCC Pessimism ctd.

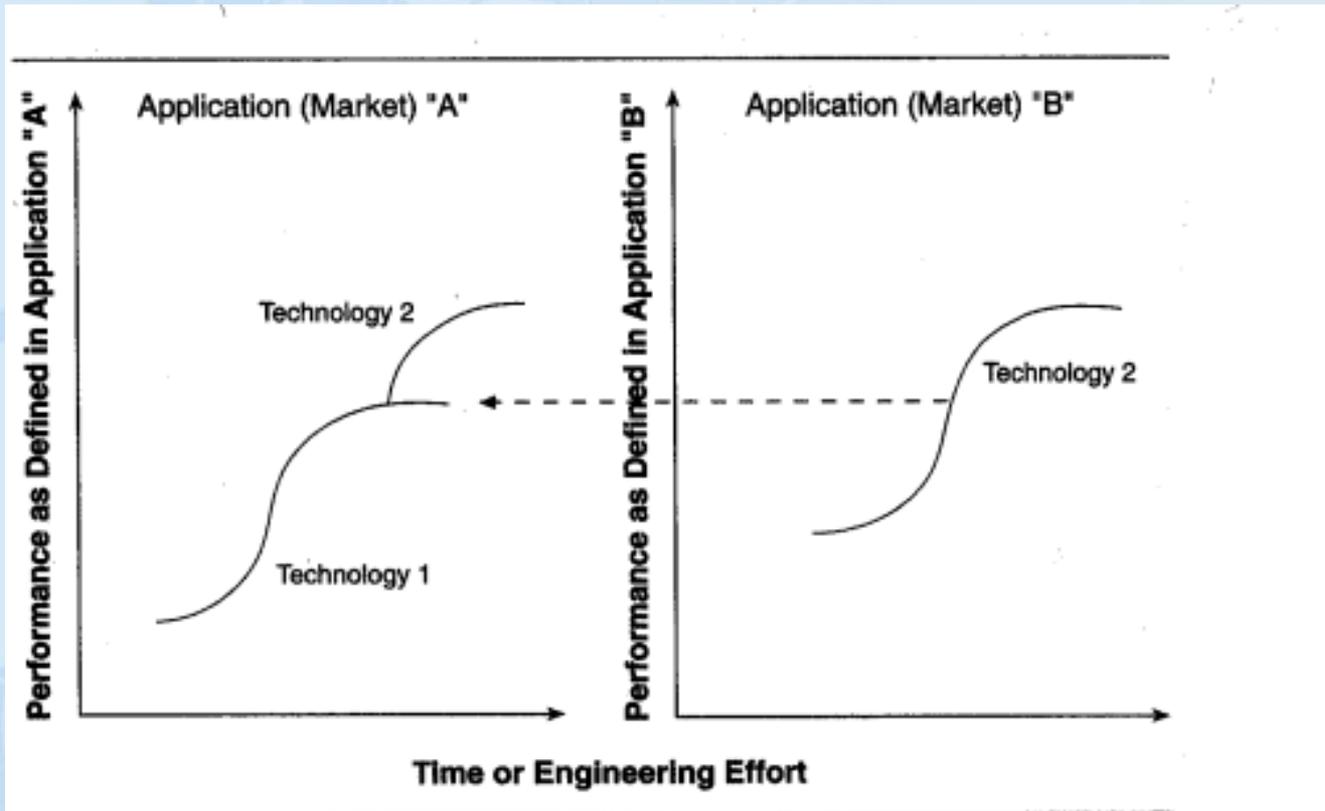


I Equilibrium versus Creative Destruction

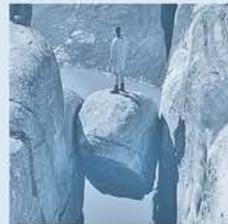


The challenge of Managing Disruptive Technologies

Clayton Christensen, 1992



Source: Clayton M. Christensen, "Exploring the Limits of the Technology S-Curve. Part I: Component Technologies," *Production and Operations Management* 1, no. 4 (Fall 1992): 361. Reprinted by permission.



Business Transformation

**How
Broad?**

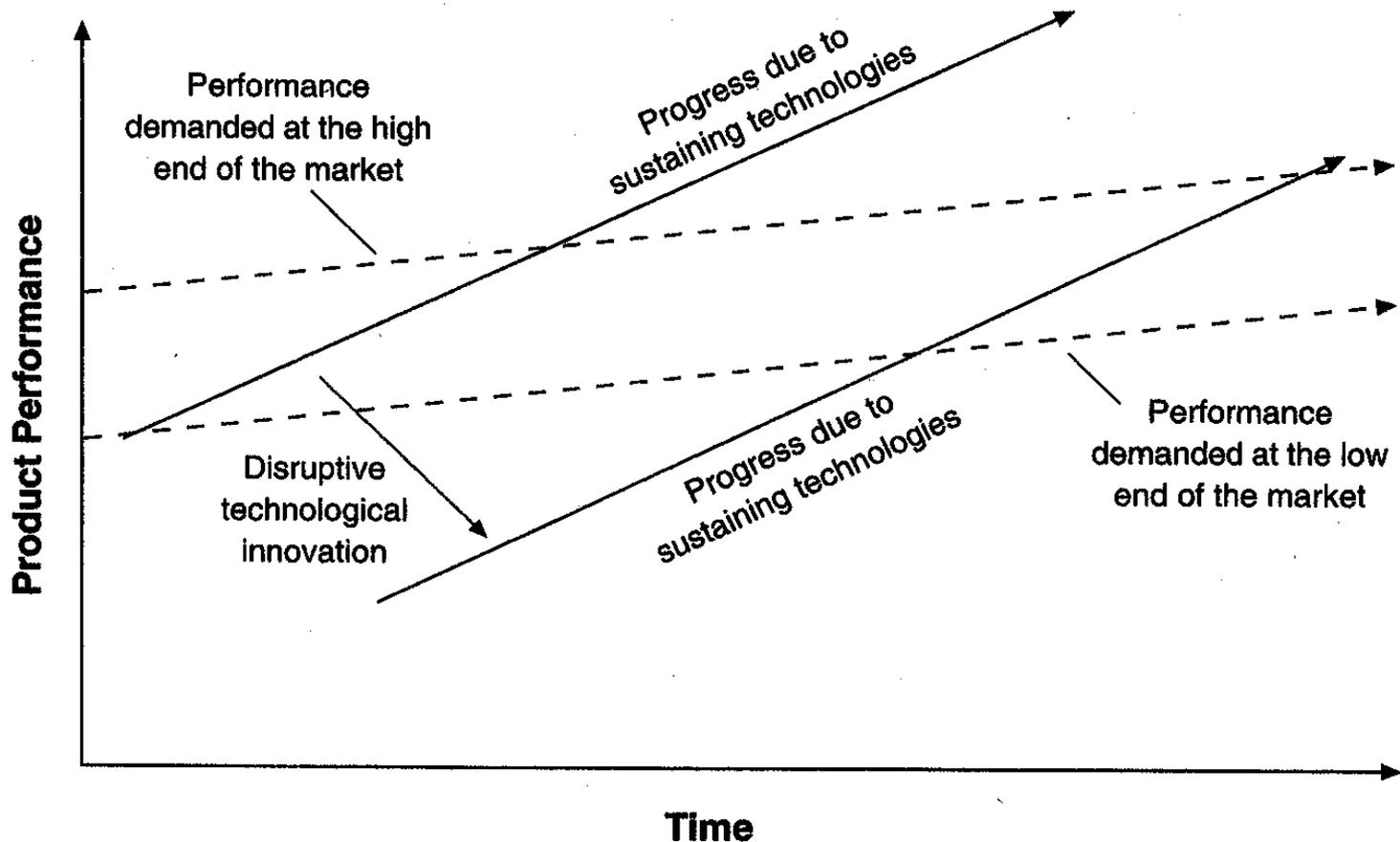
Industry	B2B and supply chain integration	Inventing new industry structures
Business	Re-engineering business processes	Creating entirely new business concepts
Product/ process	Refining product & processes	Reconfiguring Products & processes
	Incremental	Radical

How radical?

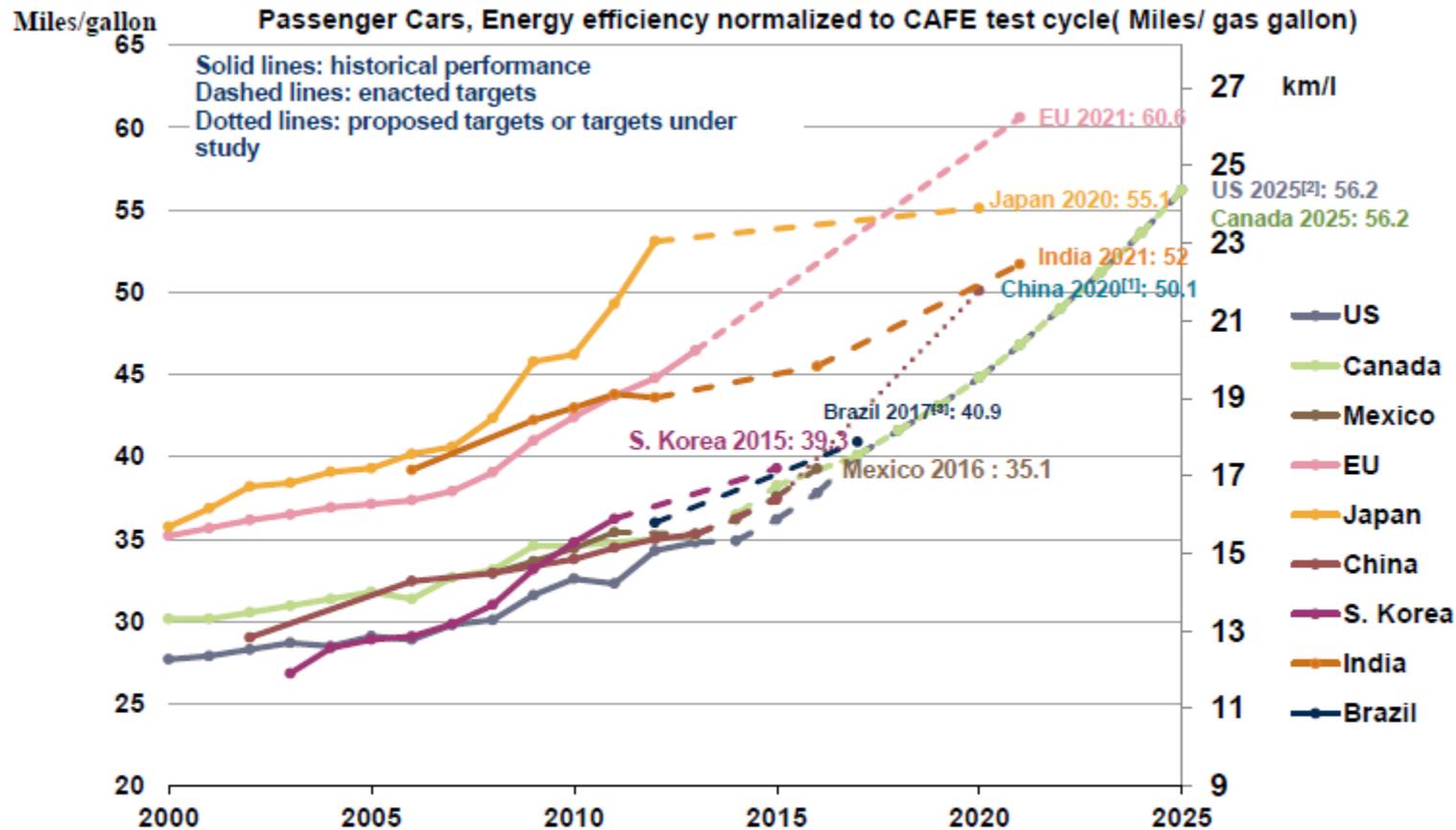


Sustaining (ST) versus disruptive technologies (DT)

Figure 1.1 The Impact of Sustaining and Disruptive Technological Change



Incremental innovation



[1] China's target reflects gasoline vehicles only. The target may be higher after new energy vehicles are considered.

[2] The U.S. standards are fuel economy standards set by NHTSA, which is slightly different from GHG standards due to A/C credits.

[3] Gasoline in Brazil contains 22% of ethanol (E22), all data in the chart have been converted to gasoline (E00) equivalent

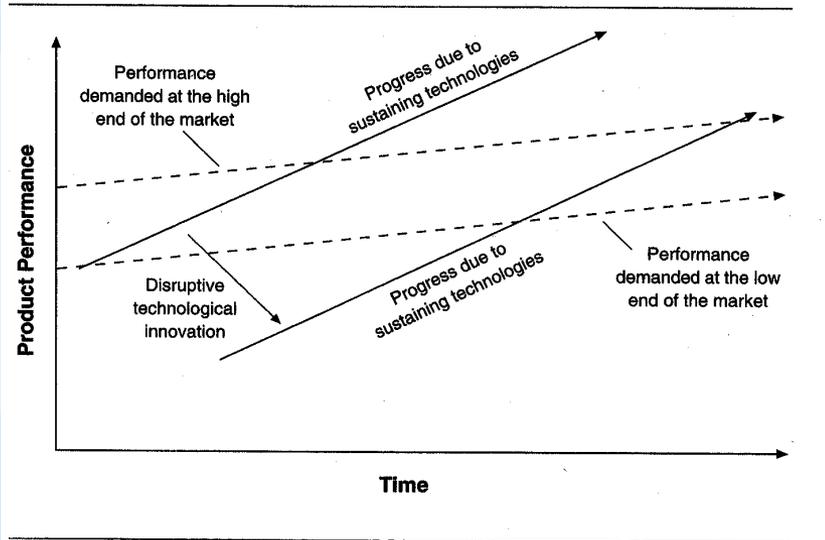
[4] Supporting data can be found at <http://www.theicct.org/info-tools/global-passenger-vehicle-standards>.

Figure 11: Passenger Cars, Energy efficiency normalized to CAFE test cycle¹⁵



Sustaining versus disruptive technologies

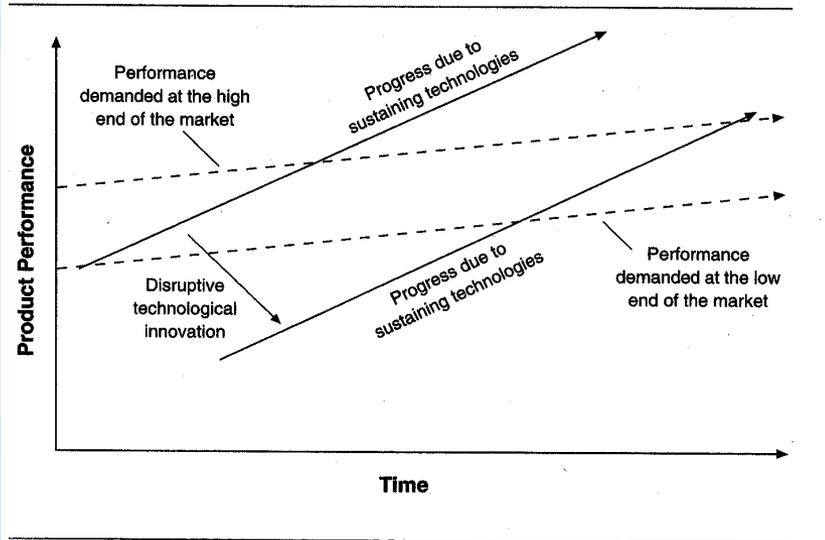
Figure 1.1 The Impact of Sustaining and Disruptive Technological Change



The Innovation may demand significant changes by not only the consumer, but also the infrastructure.

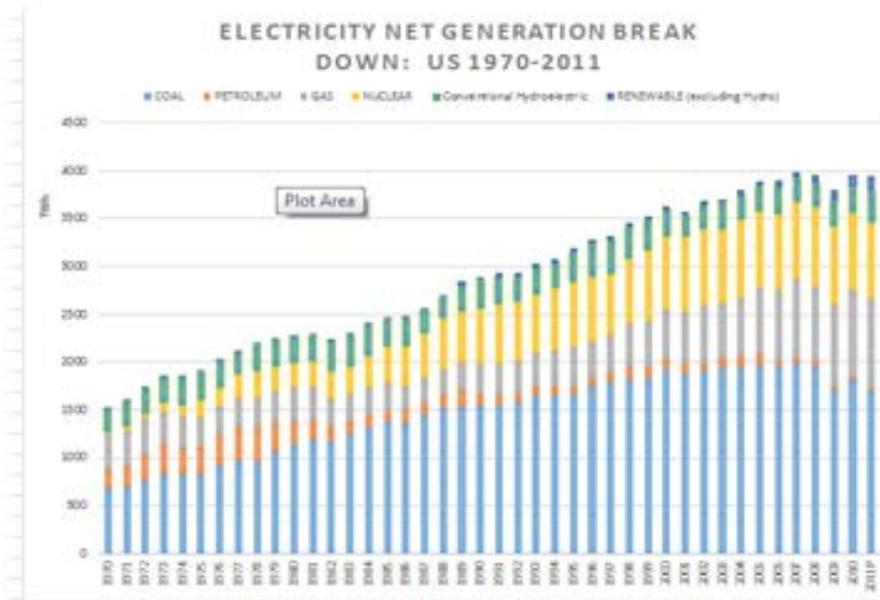
Sustaining versus disruptive technologies

Figure 1.1 The Impact of Sustaining and Disruptive Technological Change

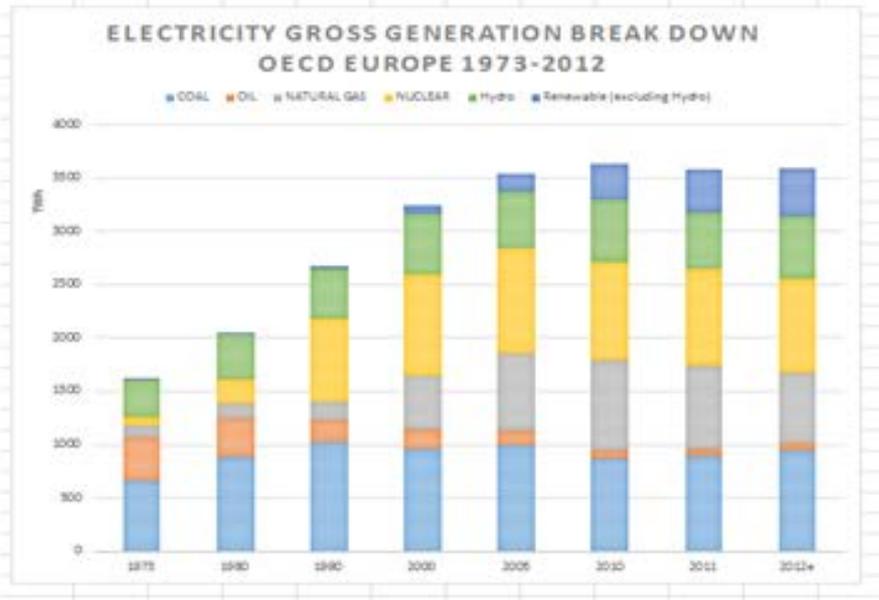


The Innovation may demand significant changes by not only the consumer, but also the infrastructure.

Stabilisation of electricity in mature economies



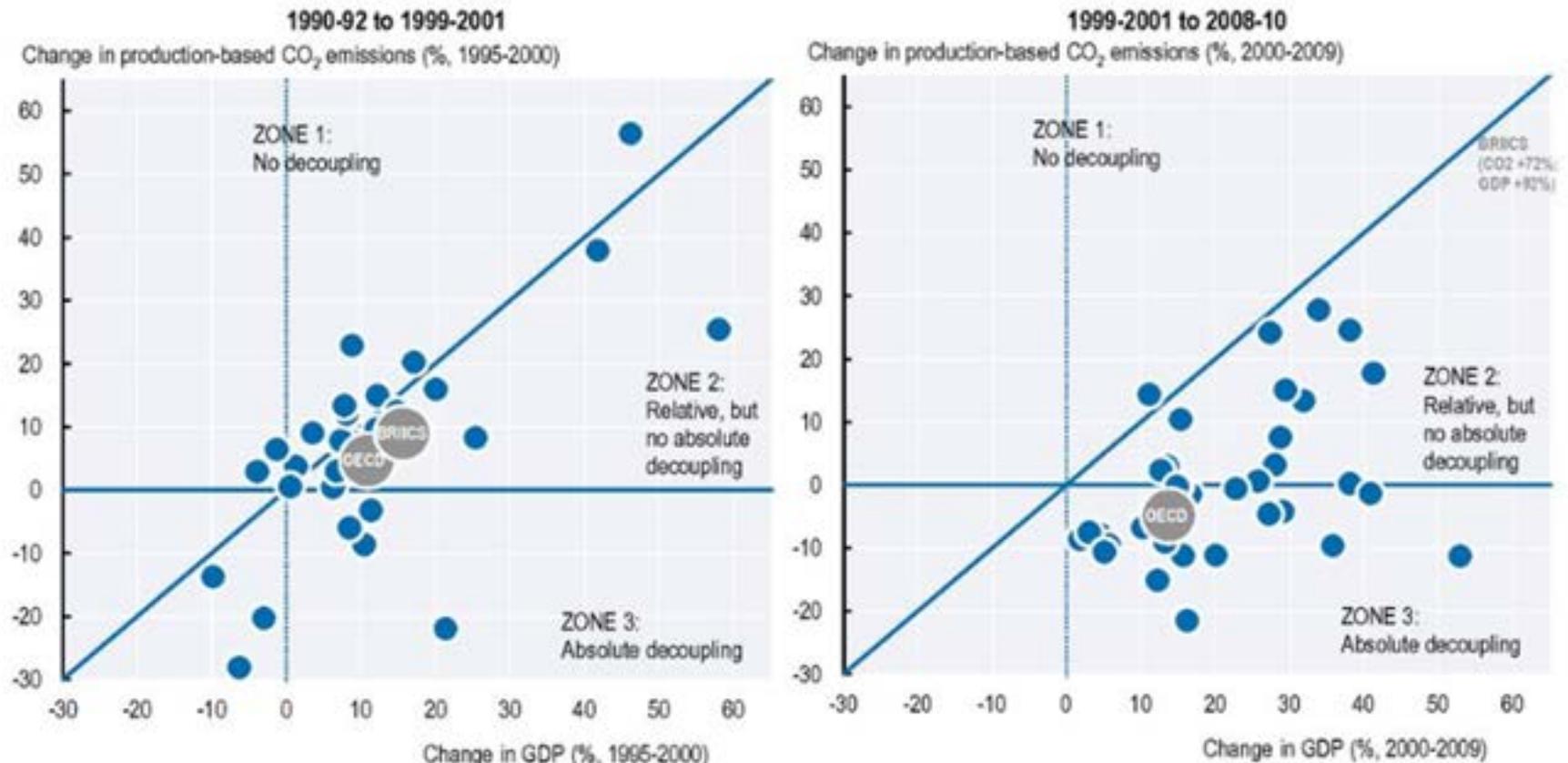
Source : EIA
Original Version at <http://www.eia.gov/totalenergy/data/annual/showtext.cfm?wptb0802b>



Source : IEA (2013), Electricity Information 2013, IEA, p IV59

Increased Carbon and Energy Productivity Production-Based

Figure 4.3. Decoupling trends: Production-based CO₂ emissions vs. GDP
OECD countries

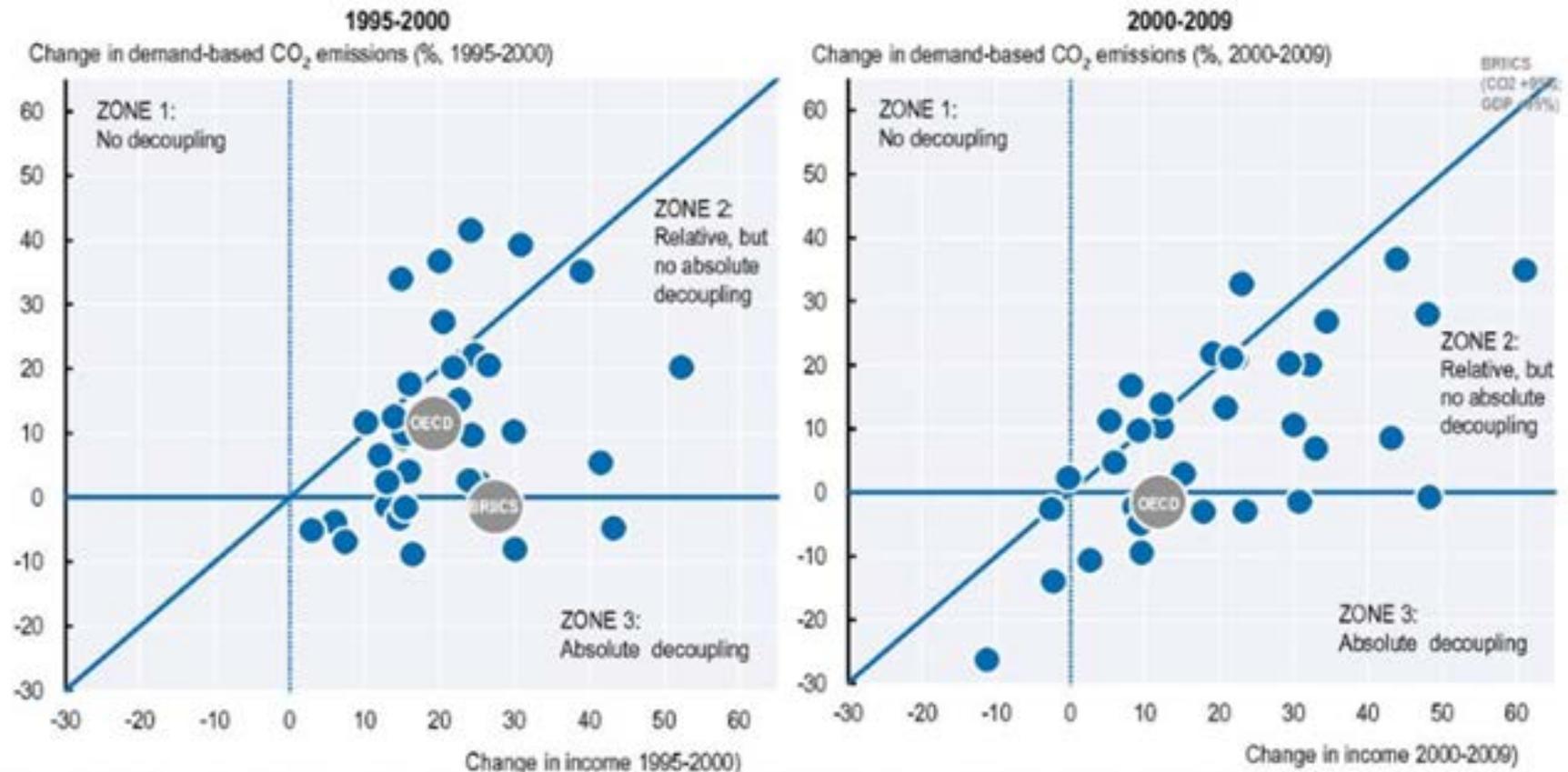


Source: IEA CO₂ emissions from fuel combustion statistics (database), OECD Economic Outlook: Statistics and Projections (database)

StatLink <http://dx.doi.org/10.1787/888932925198>

Carbon and Energy Productivity Demand-Based

Figure 4.4. Decoupling trends: Demand-based CO₂ emissions vs. income
OECD countries

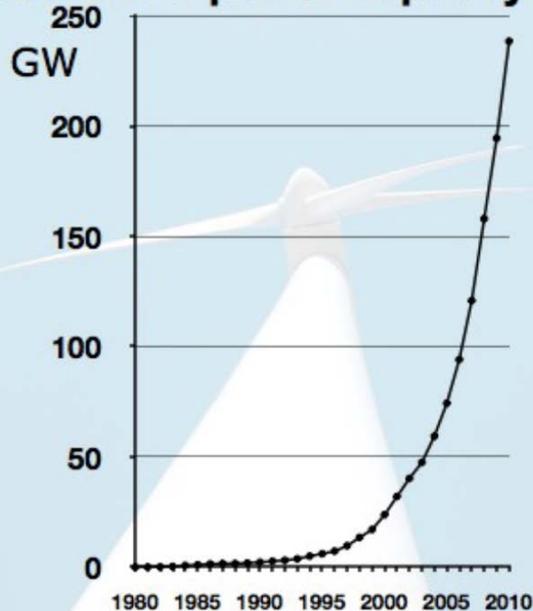


Source: OECD Carbon Dioxide Emissions Embodied in International Trade (database), OECD National Accounts Statistics (database); World Bank, World Development Indicators.

StatLink <http://dx.doi.org/10.1787/888932925217>

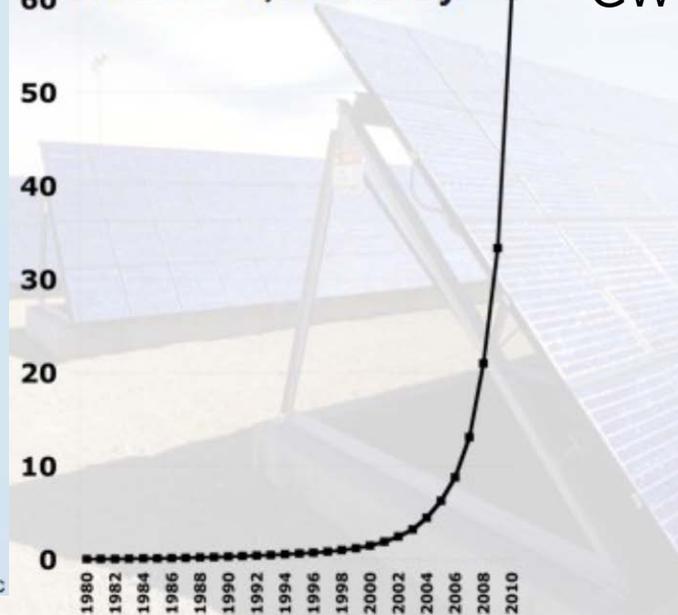
Takeoff for Green Energy

Global Wind power capacity 1980-2011



Data from GWEC

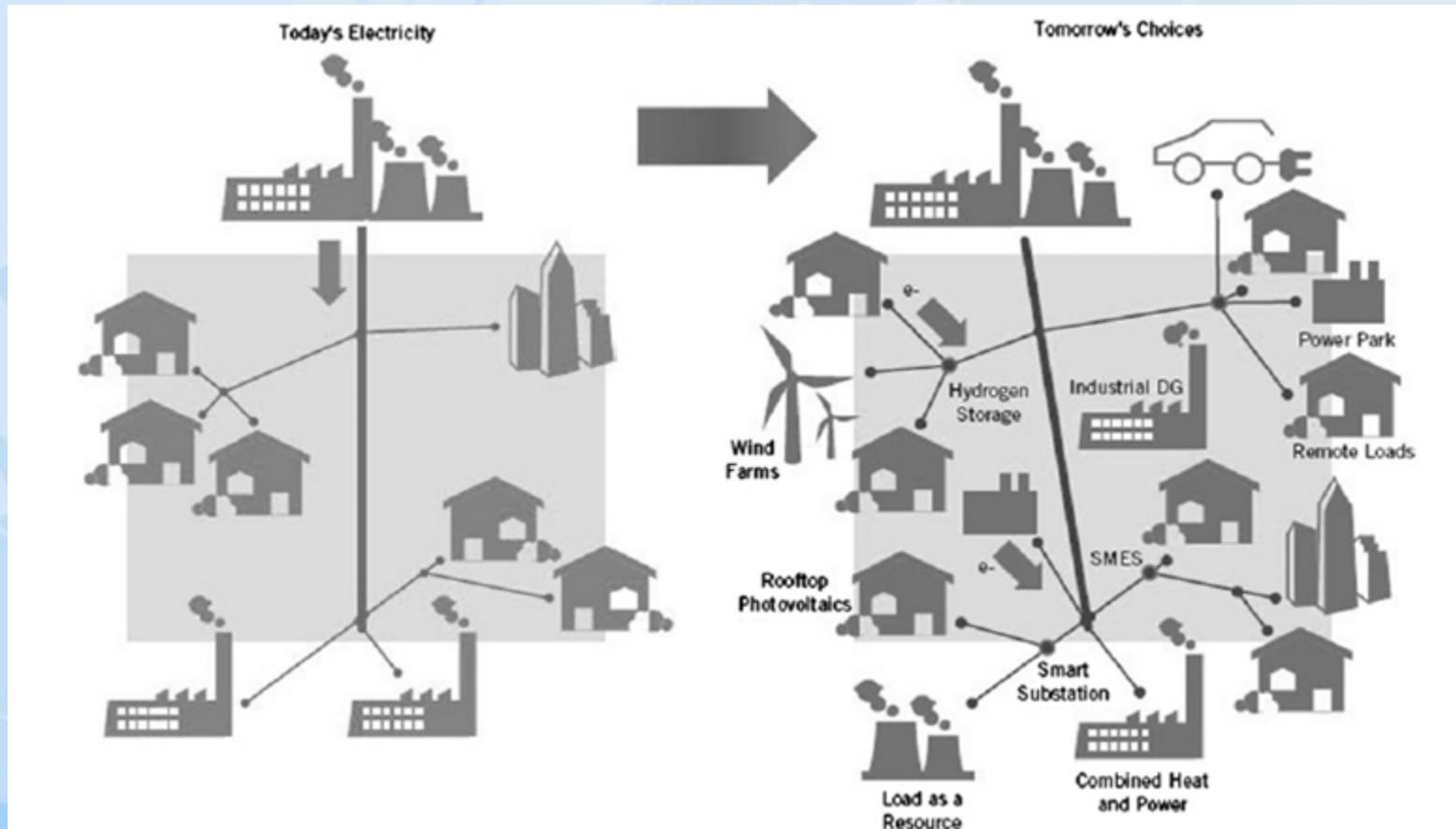
Solar PV, Globally GW



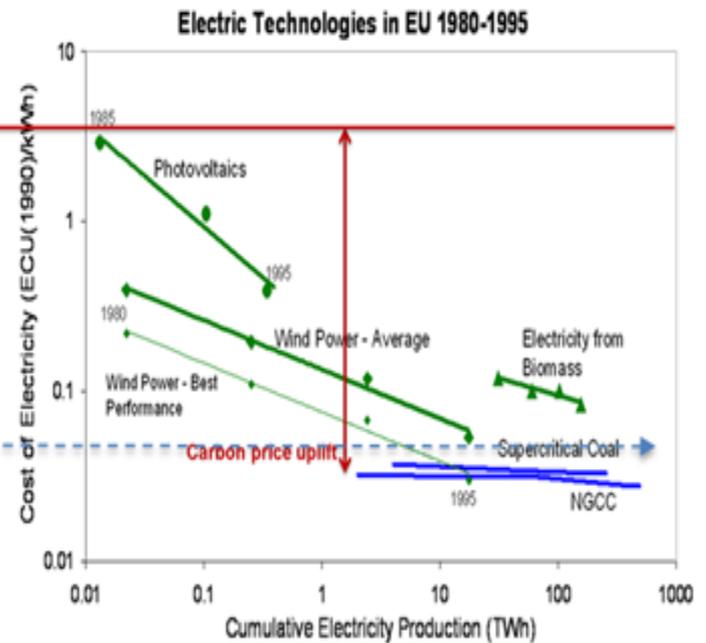
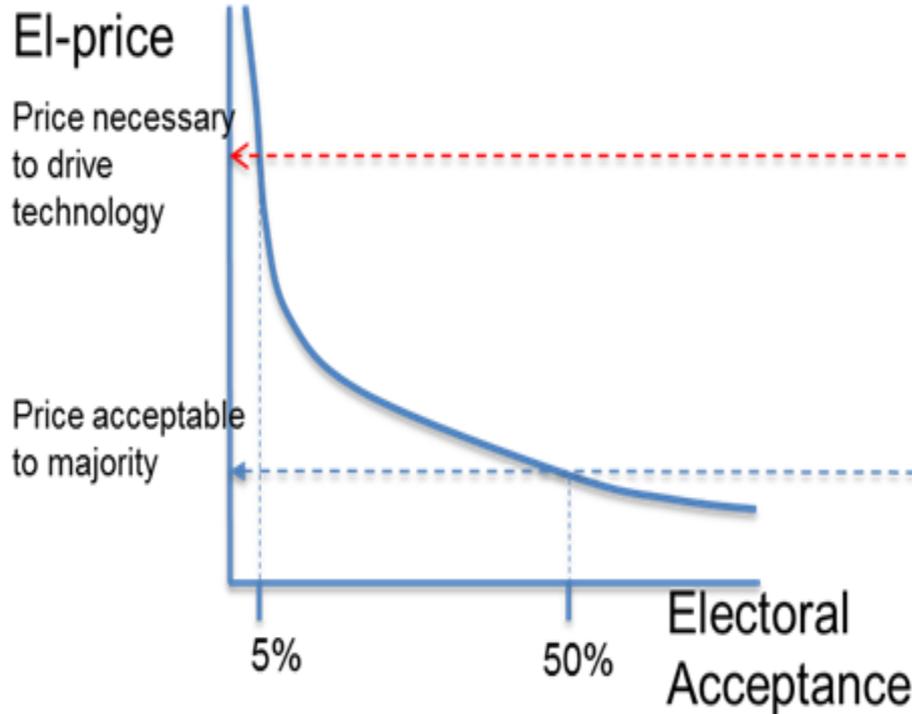
From Kåberger 2012

A Result of Policy and Technology Migration

Transformation of el-system



The Problem of Marginalism in Staging Transition



Sub-National Initiatives and Networks

benair of more than 40 C40 mayors to Dr. Joan Clos, Executive Director of UN-Habitat, urging the UN's Open Working Group on Sustainable Development Goals to include a specific urban goal.

The C40 Cities Climate Leadership Group (C40) is a network of the world's megacities committed to addressing climate change.

Acting both locally and collaboratively, C40 Cities are having a meaningful global impact in **reducing both greenhouse gas emissions and climate risks**. C40 brings together a unique set of assets and creates a shared sense of purpose. C40 offers cities an effective forum where they can collaborate, share knowledge and drive meaningful, measurable and sustainable action on climate change.

Explore an interactive list of the C40 Cities and our **Networks** and **Research** connecting them.

LATEST FROM OUR BLOG

September 01, 2014

C40 & Siemens Kick Off Voting for this Year's Citizen's Choice Award

Voting opens today for the Citizen's Choice Award, which will honor one of the 31 finalists of this year's C40 & Siemens City Climate Leadership Awards... chosen by you!

August 28, 2014



2014 – Copenhagen

Green Cities Fit for Life

POPULAR

Call for 2017 Applications now open!

or

Ljubljana wins 2016 European Green Capital Award
New video now available

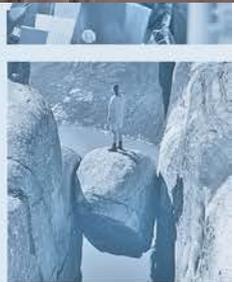
Latest news

GreenHopping – Changing the Future of Travel

2014 – Copenhagen

Climate neutral by 2025

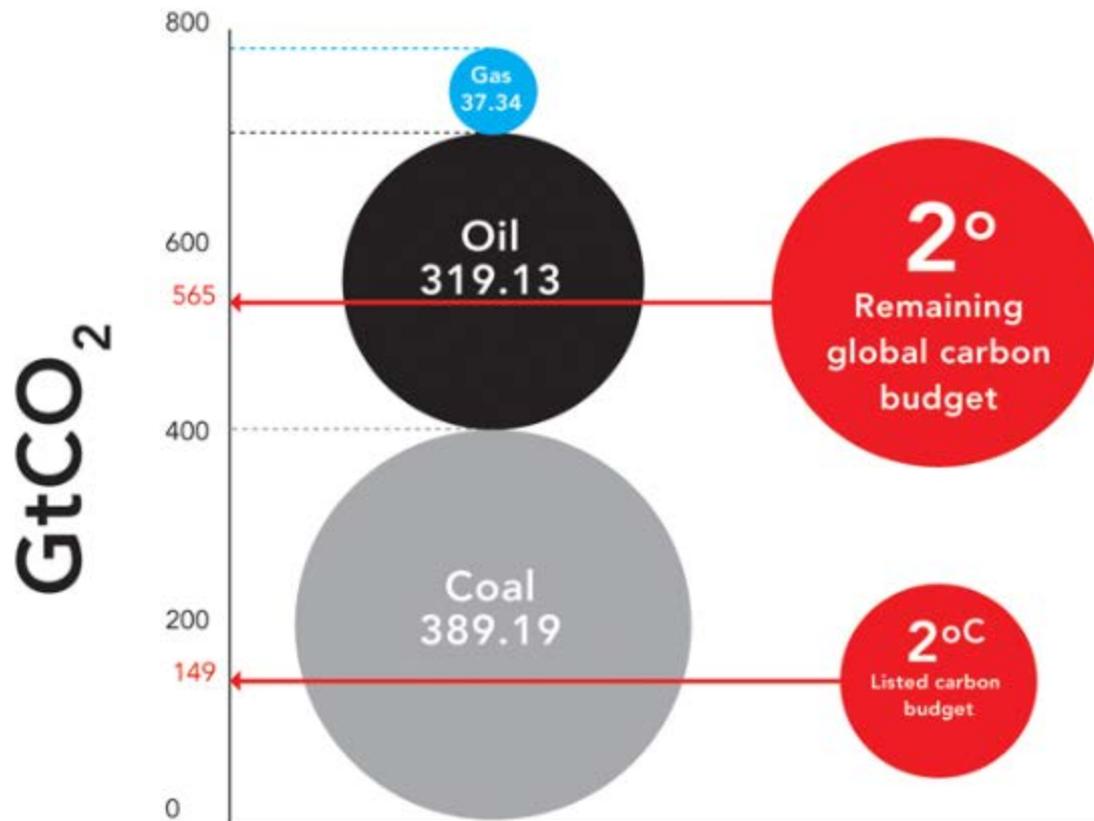
Mature, Catchup and Developing Economies



Responsible Finance

Carbon dioxide emissions potential of listed fossil fuel reserves

Fig.3



Mature Economies

Advantages

- Have technology competencies and resources to stage green transition.
- Have largely stopped expanding energy consumption due to high efficiency and saturated demand.

Disadvantages

- Large investments and sunk costs in the carbon economy
- Strong vested interests in carbon.
- Green growth become a zero sum game as it has to displace carbon in non-expanding energy sectors.



Catchup Economies

Advantages

- Are gaining technology competencies and resources to stage green transition.
- Green growth is part of a positive sum game where there is room for everything due to rapid expansion.
- Have a chance to implement latest technology when they start upgrading

Disadvantages

- Are committed to strong growth
- Have high demand expectations
- Growth is prioritised before anything else



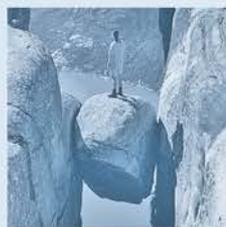
Developing Economies

Advantages

- Are at a low level of consumption, and have a long way to go
- Green growth could be part of a positive sum game where there is room for everything due to rapid expansion.
- Have a chance to implement latest technology or leapfrog when they start upgrading,

Disadvantages

- Are committed to strong growth
- Have high demand expectations
- Growth is prioritised before anything else
- Are probably hindered by developmental limitations
- Low technological competencies may limit opportunities
- Governance problems in weakly developed states

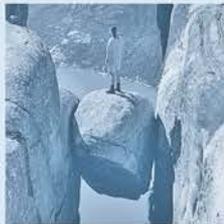


Infrastructural Hurdles in a Development context: African Automotive Sector

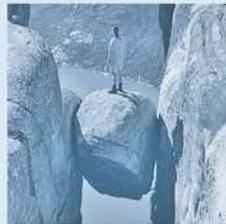
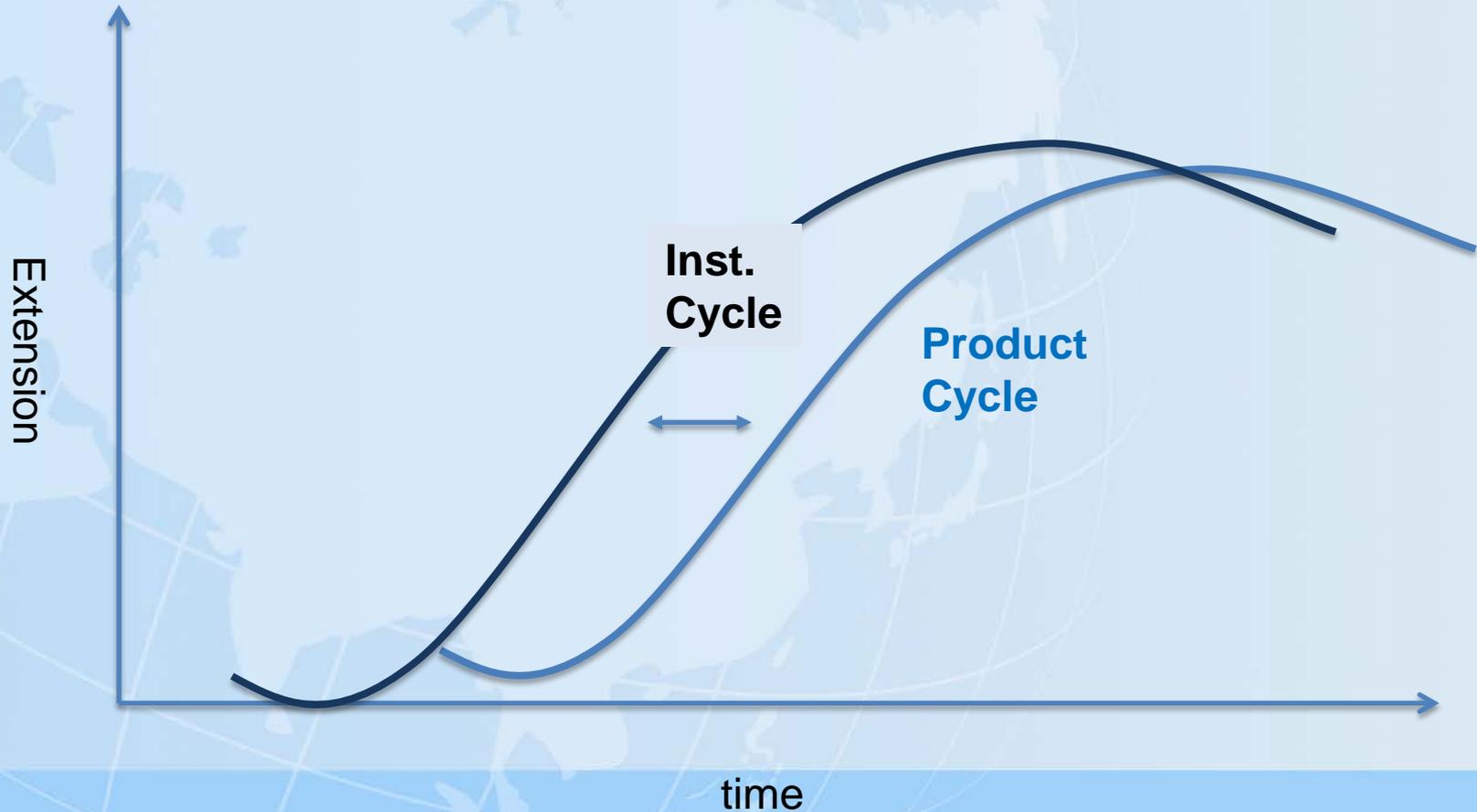
- Tough roads do not allow too advanced vehicles.
- Toyota Hillux – preferred vehicle comes in a rough version for African roads
- Oil refineries deliver qualities that do not allow most advanced engines
- Car mechanics not able to repair advanced electronics
- Change with emerging urban markets and middle class car use



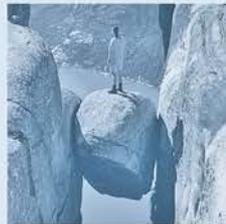
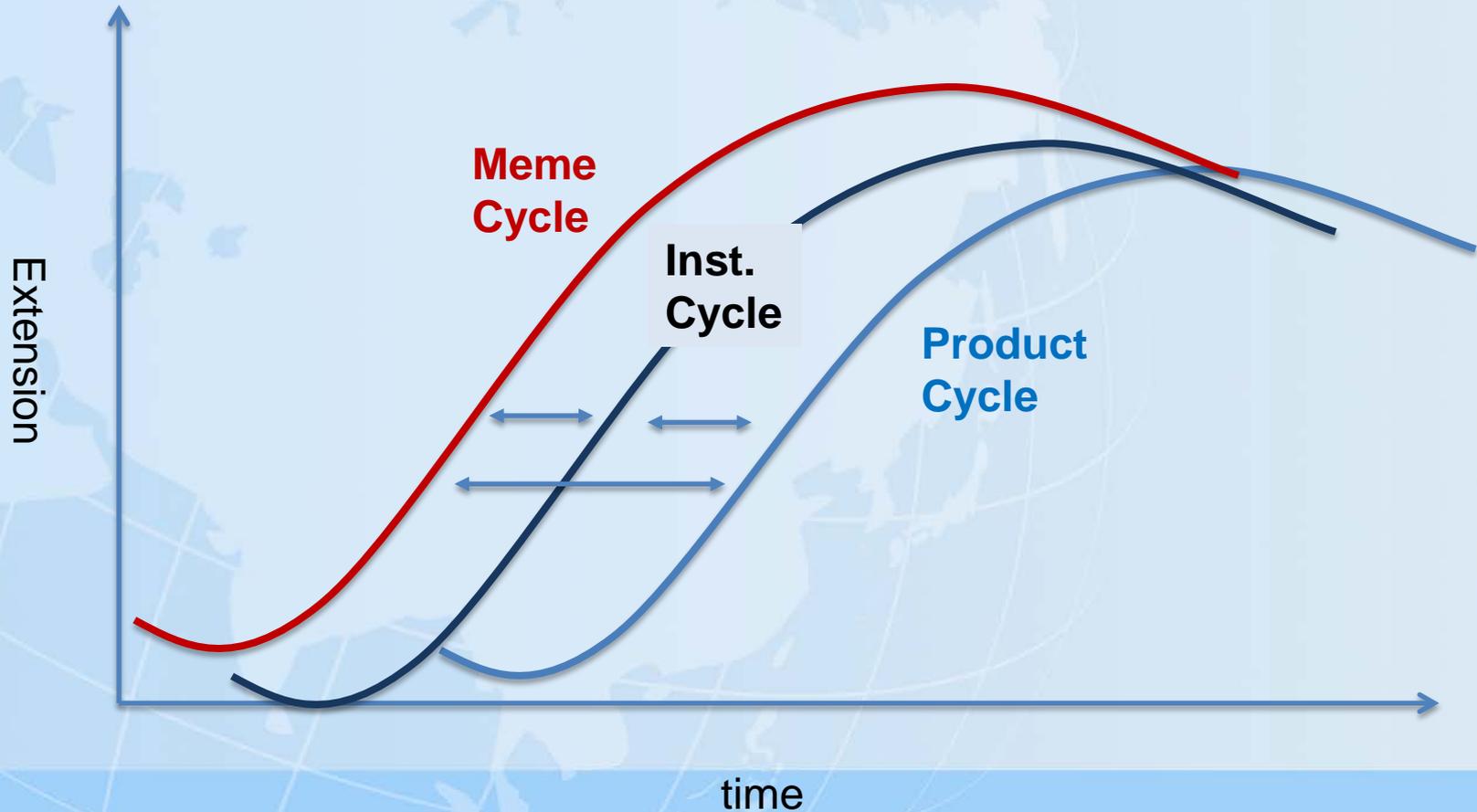
Product cycle



Institutional & Techno-Economic Dynamics



Cultural, Institutional & Techno-Economic Dynamics



European Climate Foundation's Roadmap 2050 Project

From Roadmaps To Reality is the latest step in the project

Phase

1

Roadmap 2050: a practical guide to a prosperous, low Carbon Europe

2010

EC Low-carbon 2050 Roadmap

Phase

2

Power Perspectives 2030: on the road to a decarbonised power sector

2011

EC Energy 2050 Roadmap

Phase

3

From Roadmaps to Reality

2013

Is the current framework adequate to drive the power sector transition?

Robust technical and economic basis

Green Roadmaps



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ENERGY

European Commission > Energy > Energy 2020 > Roadmap 2050

Initiatives

Roadmap 2050

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Energy Roadmap 2050

On 15 December 2011, the European Commission adopted the [Communication "Energy Roadmap 2050"](#). The EU is committed to reducing greenhouse gas emissions to 80-95% below 1990 levels by 2050 in the context of necessary reductions by developed countries as a group. In the **Energy Roadmap 2050** the Commission explores the challenges posed by delivering the EU's decarbonisation objective while at the same time ensuring **security of energy supply** and **competitiveness**. The Energy Roadmap 2050 is the basis for **developing a long-term European framework** together with all stakeholders.

[Video recording of the High-level Stakeholder Conference on the Energy Roadmap 2050 of 7 February 2012](#)

Facts & Figures

Policy initiative

Press room

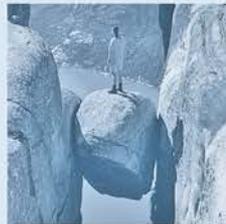
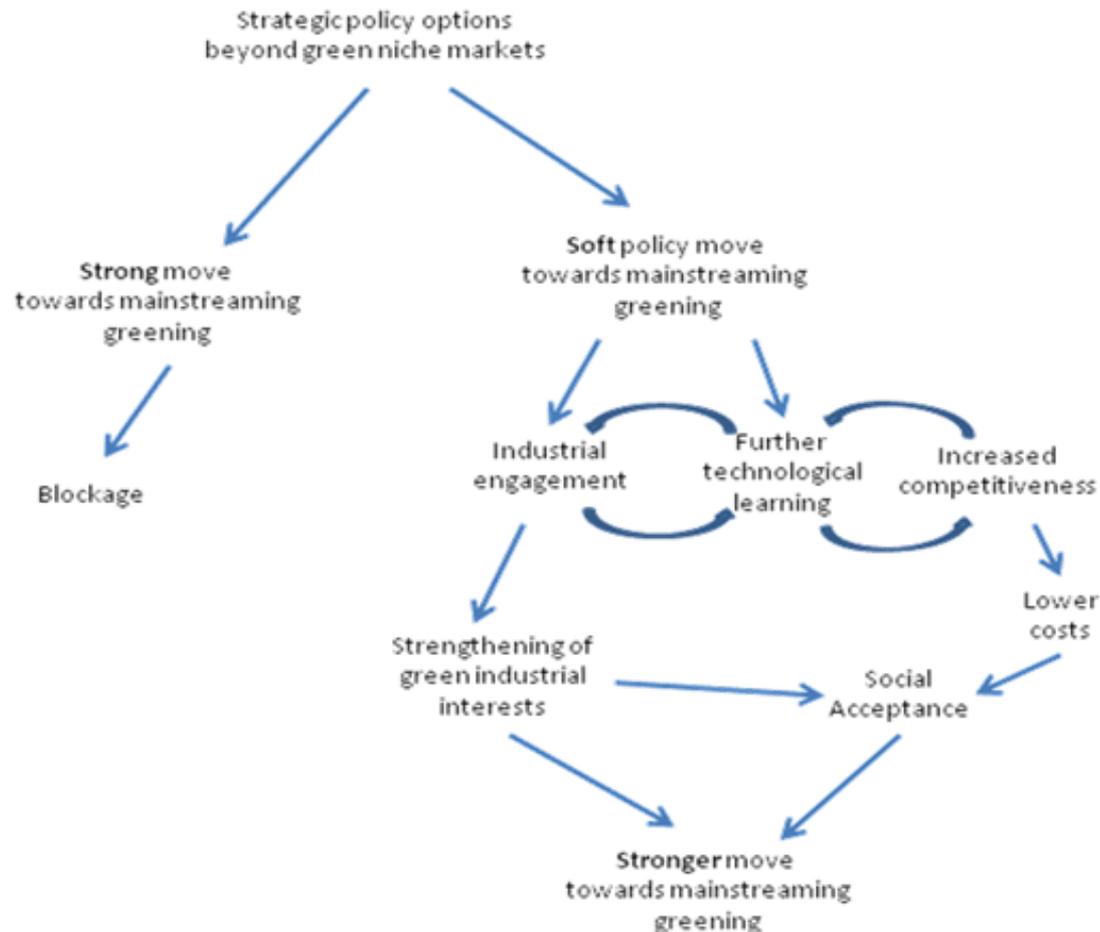
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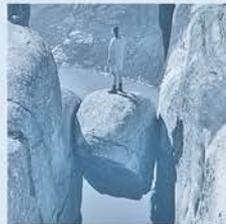
NORWEGIAN
BUSINESS SCHOOL

Transition by Sequential Triggering

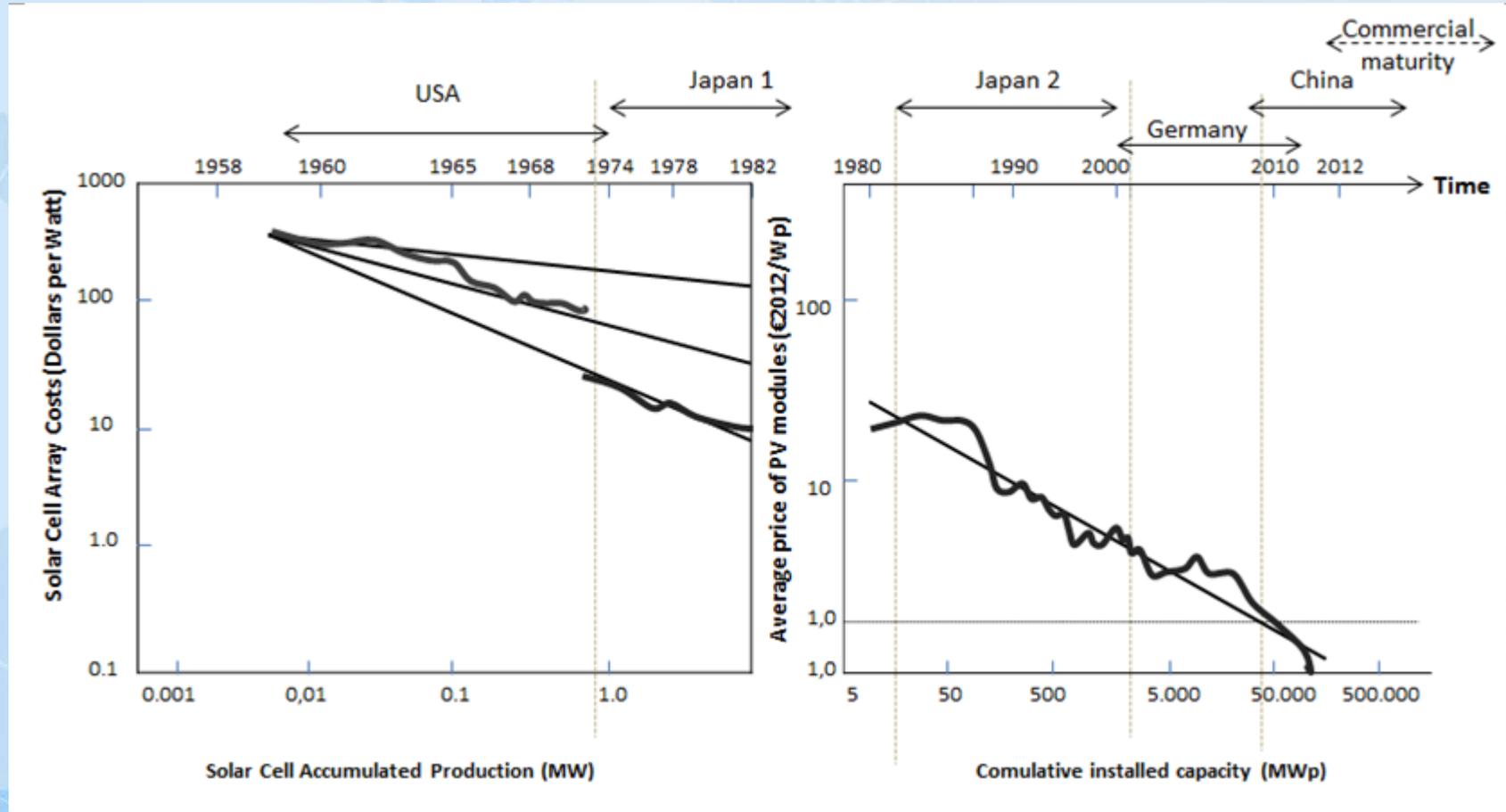
Figure 15: The Relay Model in Open Game Form



Migration of Technologies and Lead Markets



Global Innovatorium



Technological Innovation Perspective on Kondratieff waves

