

Green growth and the transition to renewable energy: some economic questions

Mikael Skou Andersen, European Environment Agency

Challenge

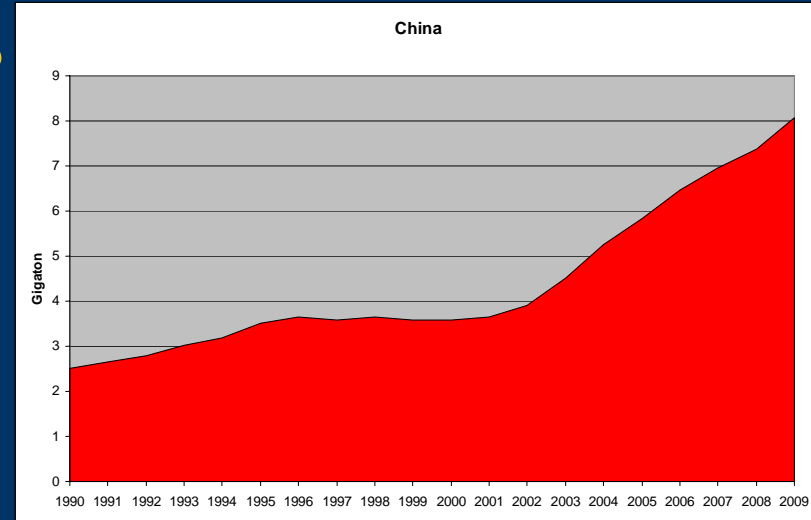
- **Impact (I) is a function of**
 - **Population (P)**
 - **x Affluence (A)**
 - **x Technology (T)**



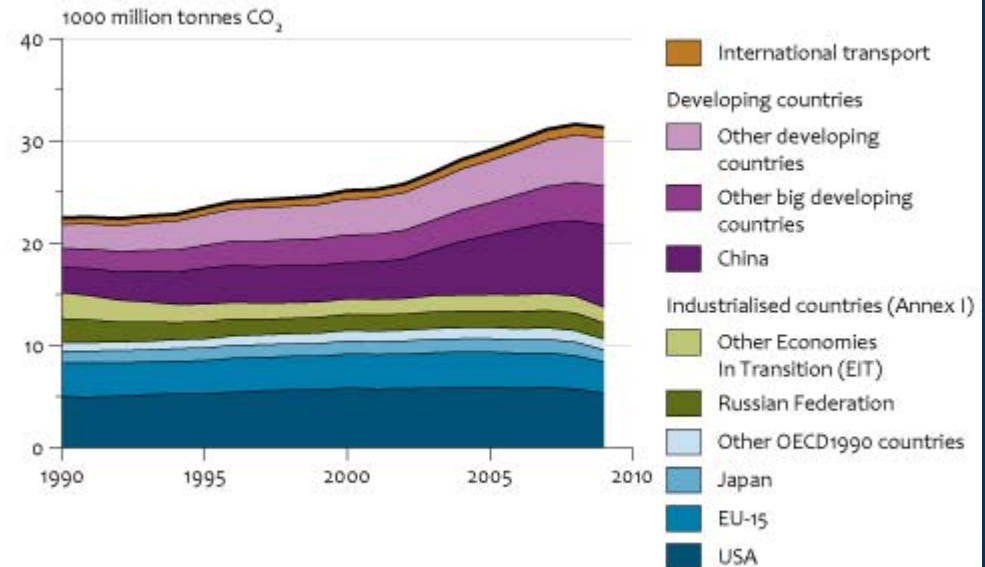
- **P increases globally with 50 pct. from 6 til 9 billion in 2050**
- **Asia: affluence projected to increase with a factor of 4 (2020)**
- **Need for factor 5-6 cleaner technology**

Global CO₂-emissions

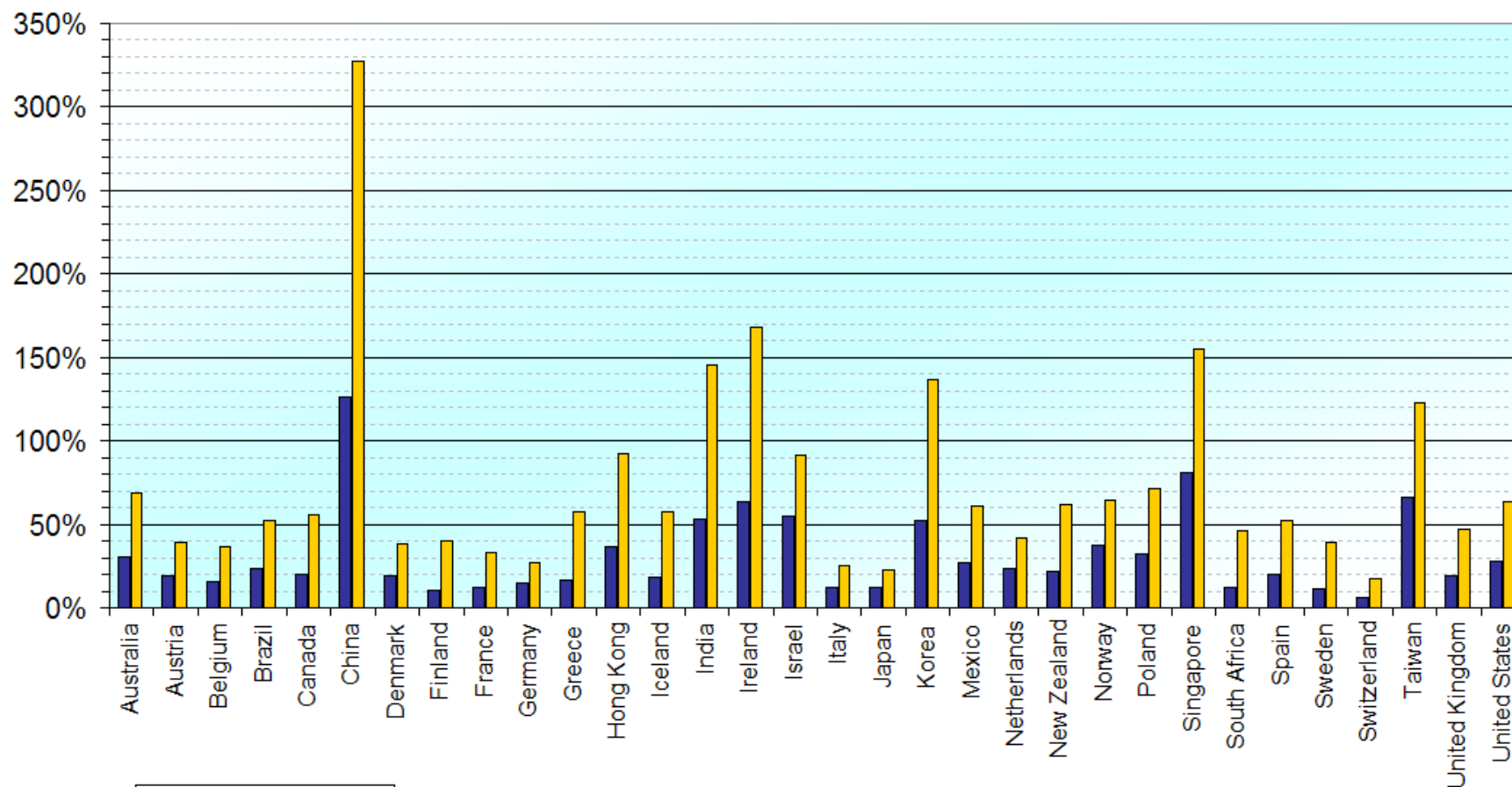
- USA: 17%
- China: 26%
- EU-15: 10%
- Russia: 5%
- Japan: 4%



Global CO₂ emissions from fuel use and cement production per region



GDP accumulated growth, in percent, constant prices

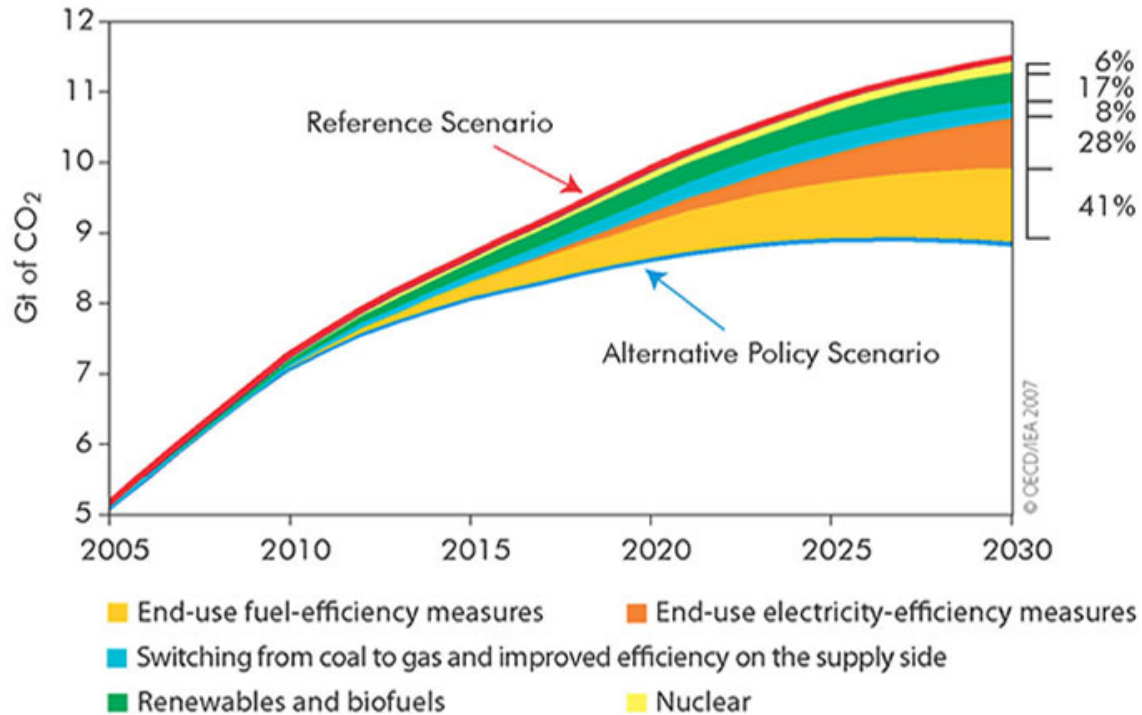


■ 1990-1998 ■ 1990-2006

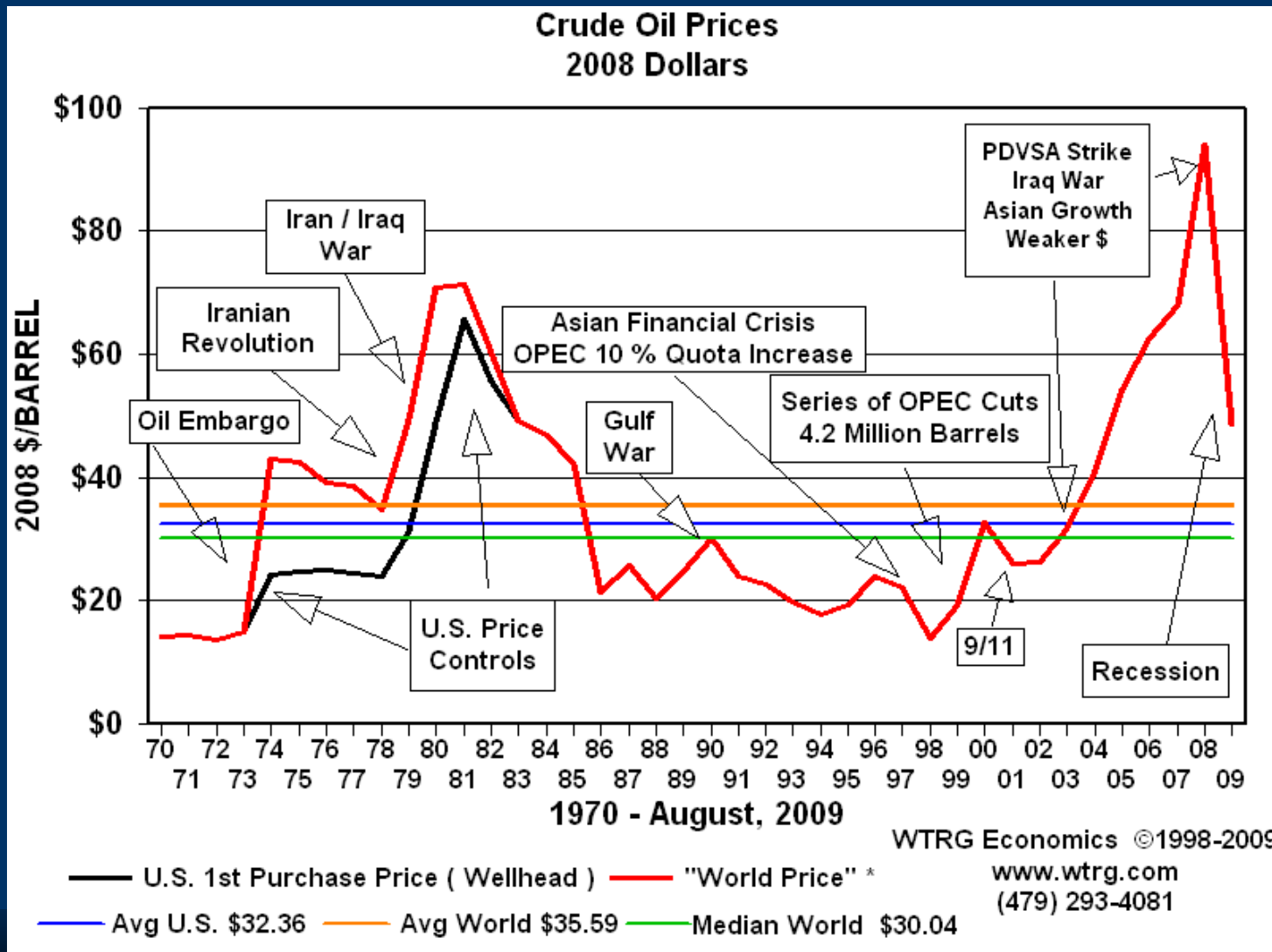
Source : IMF, World Economic Outlook Database, Avril 2005

World Energy Outlook 2007:

China's CO₂ Emissions in the Alternative Policy Scenario Compared with the Reference Scenario



Role of peaking oil prices ?

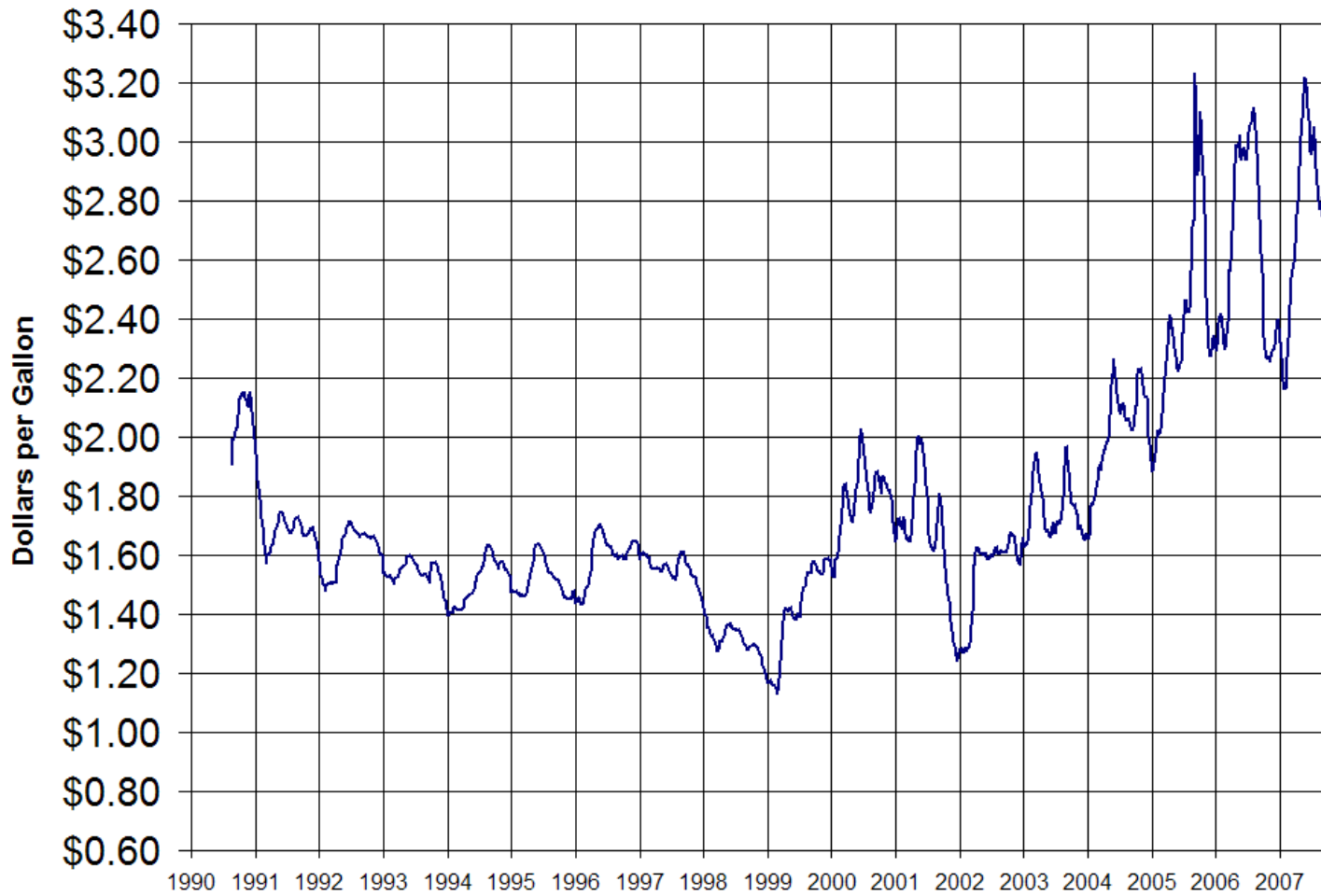


US subprime lending

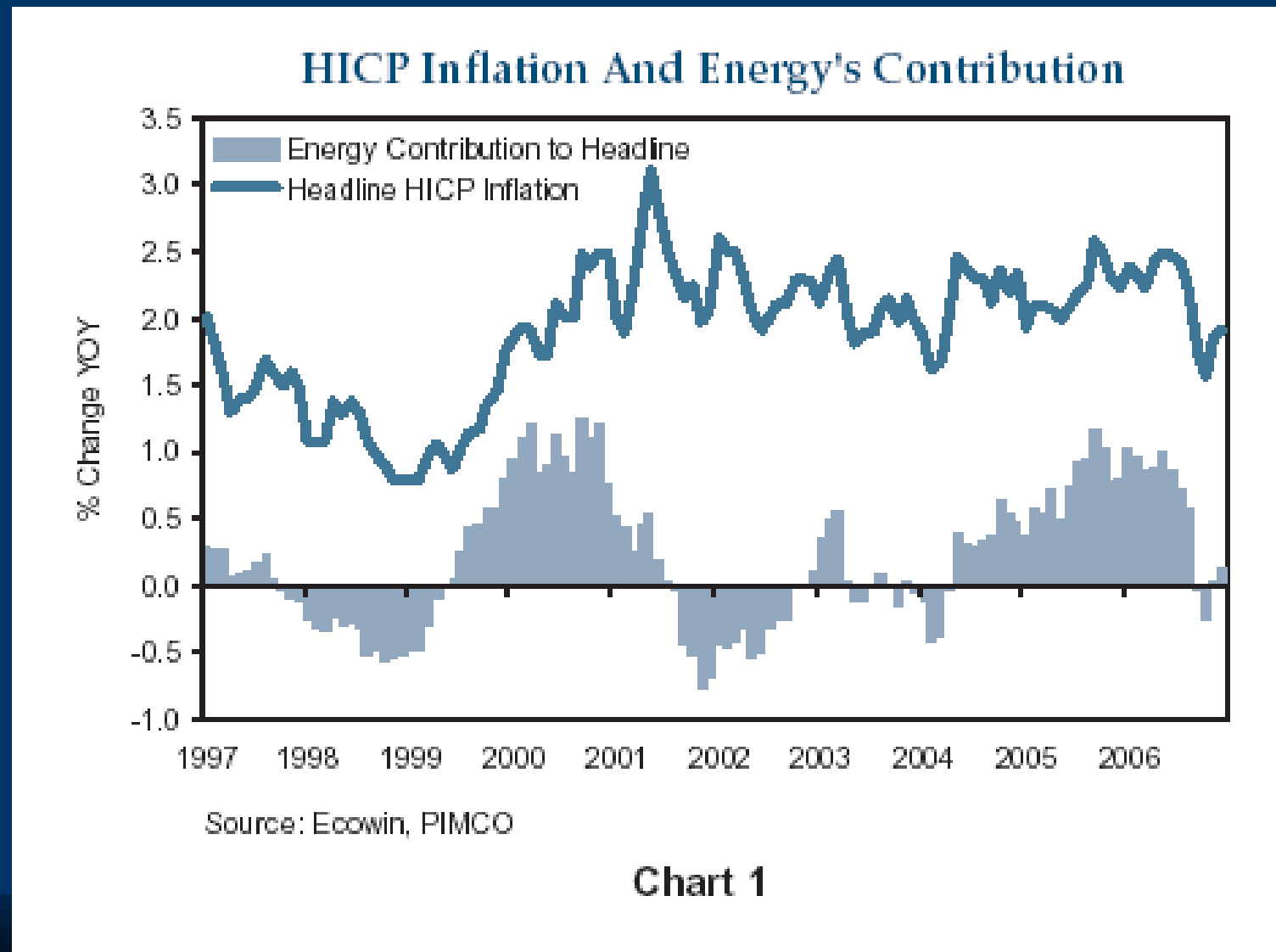
- Record-low interest rates had combined with ever-loosening lending standards to push real estate prices to record highs
- Subprime mortgage loans
 - Teasers: special low interest rates for first 1-2 years
 - ARM's: Adjustable-rate mortgages
 - resulting 'balloon payment' for lenders vulnerable to interest rate increases
- Mid-2006 inflation fears caused interest rate increase - and drop in home sales

U.S. Retail Gasoline Prices, 1990-2007

Regular Unleaded, Nationwide Average, Inflation-Adjusted (2007 Dollars)



EU: Energy prices and inflation



Euro-zone economic performance criteria

- Purpose: price stability
- Ratio of budget deficit to GDP $< 3\%$
- Ratio of gov. debt to GDP $< 60\%$
- Inflation $< 2\%$
 - actually $< +1,5\%$ of 3 best performing
 - currently: max. inflation is 1%

Challenge: improve resource productivity

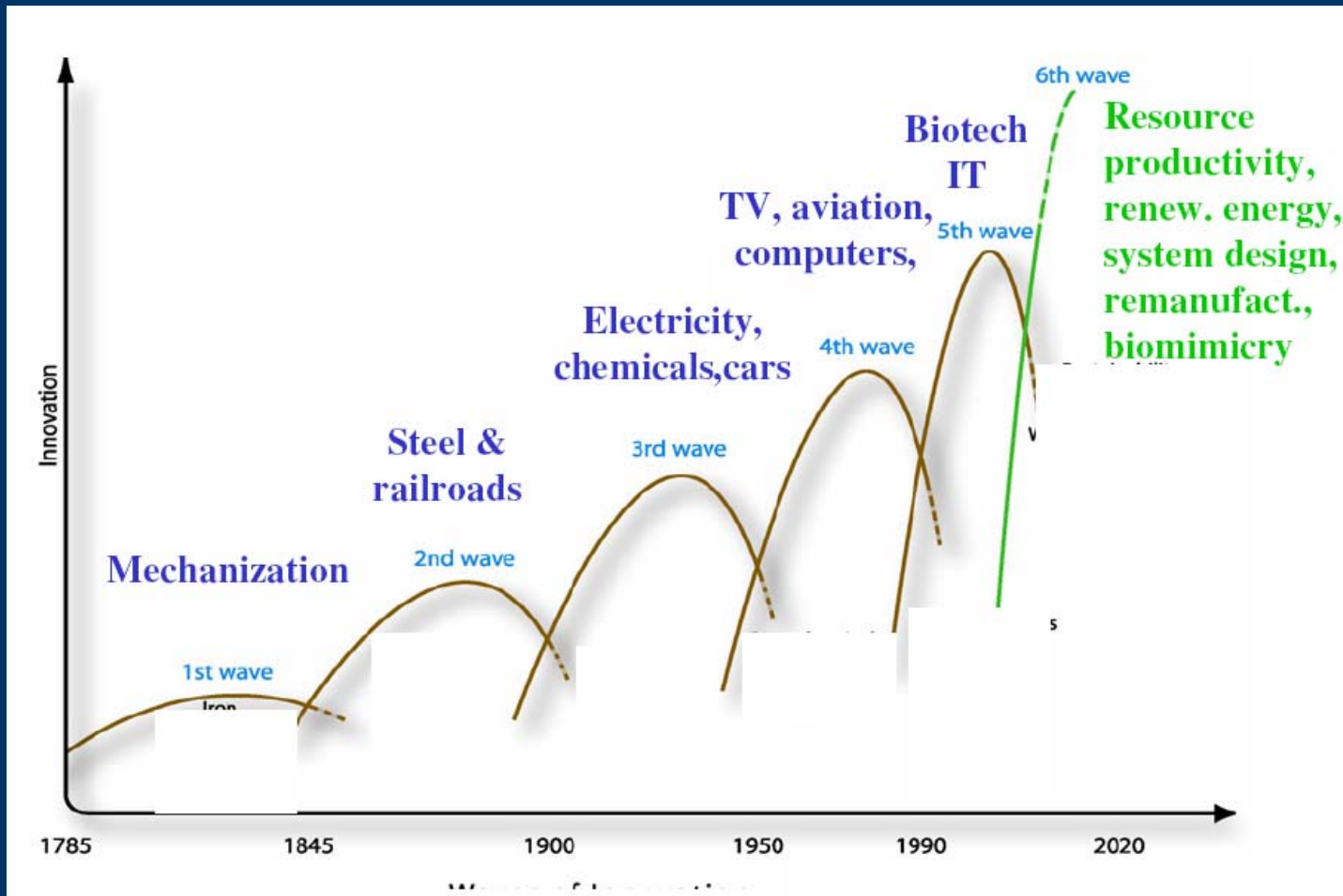
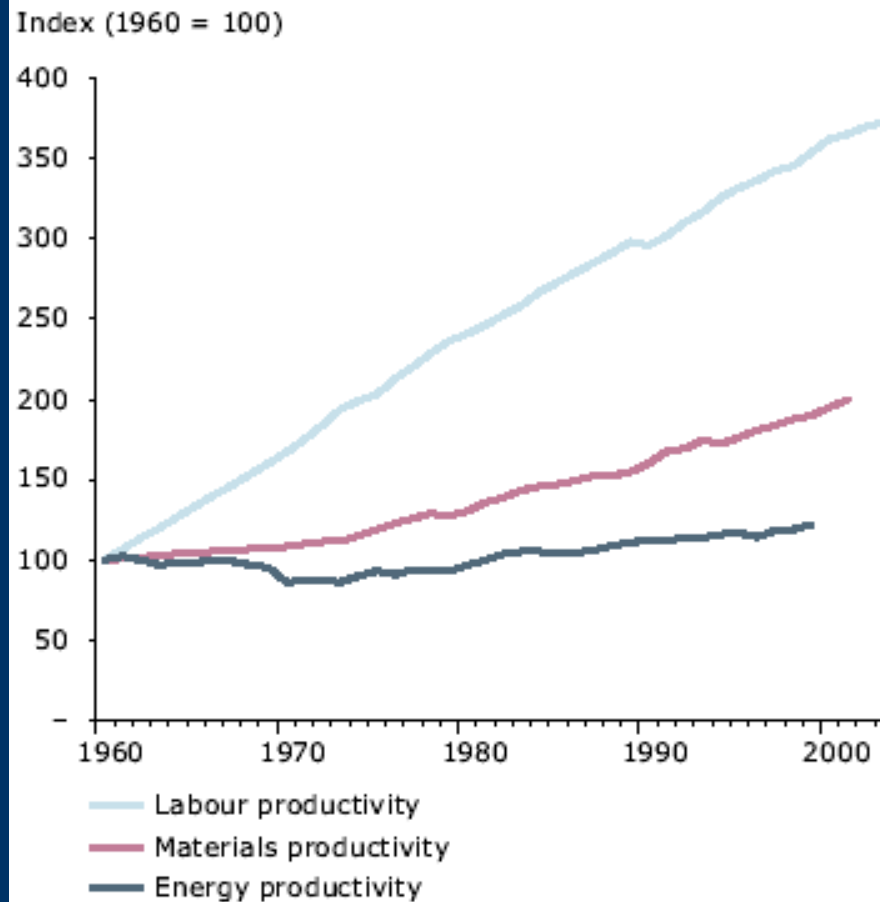
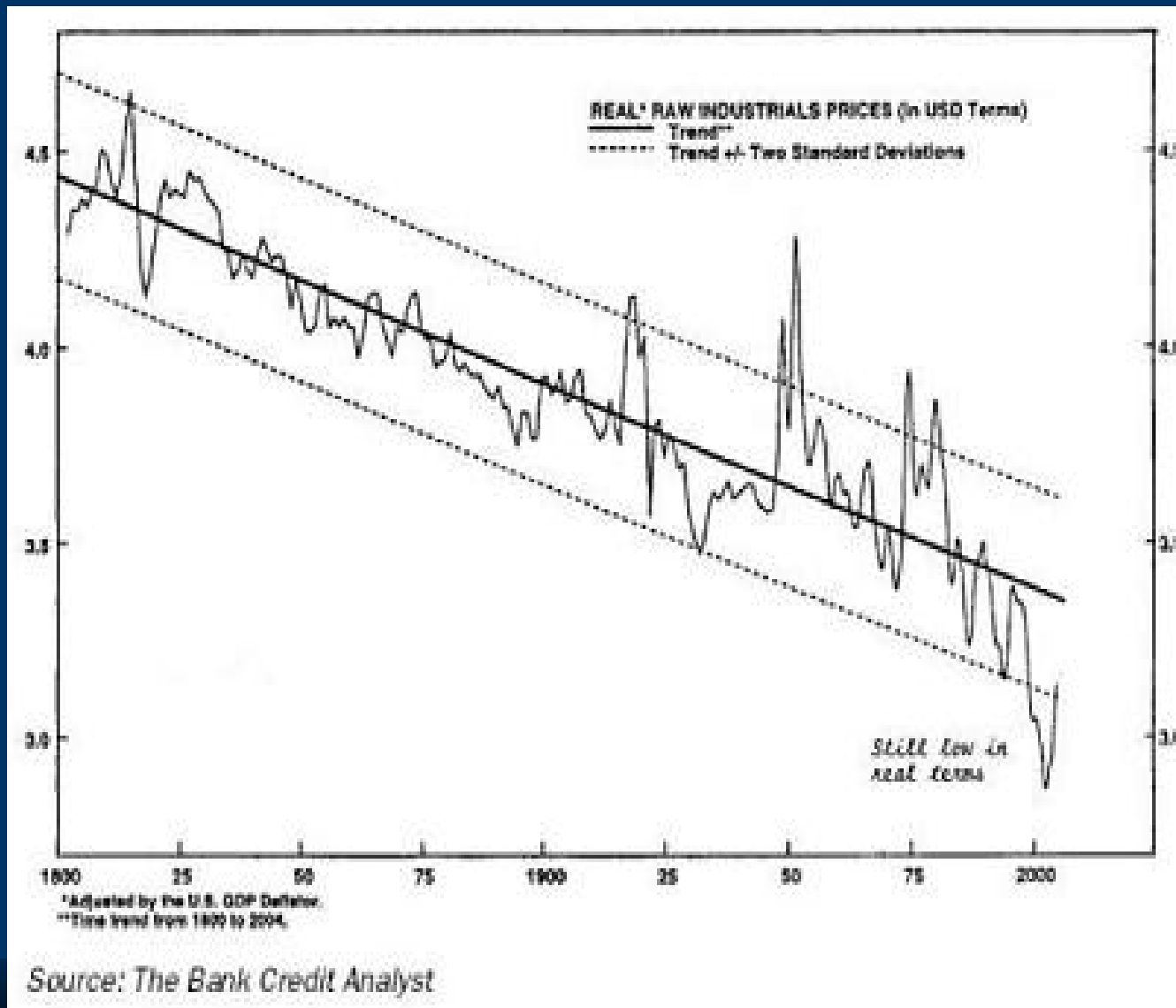


Figure 4.2 Labour productivity, material productivity, and energy productivity, EU-15, 1960–2002



Note: Labour productivity: GDP per annual working hours (1999 USD (converted at EKS PPPs) per hour); material productivity: GDP per domestic material consumption (DMC) (EUR per kg); energy productivity: GDP per total primary energy supply (TPES) (thousand 1995 USD per toe).

... declining raw material prices



Schumpeter's innovation theory

- **competitiveness is more than simple price competitiveness; to maintain and improve the real income of a country (OECD, 1992)**
- **to mobilise a technological advance and maintain it against 'waves of creative destruction'**
- **innovation is a creative process, driven by expectations, with uncertainty, requiring entrepreneurs with personal imagination**

Quality index for economic activities

Høj kvalitets aktiviteter
(Dynamisk ikke-fuldkommen konkurrence)

Karakteristika:

- stejle læringskurver
- høj vækst i output
- hurtig teknologisk udvikling
- højt F&U indhold
- learning-by-doing
- asymmetrisk information
- investeringer sker i store bidder og kan ikke opdeles
- højt lønniveau
- muligheder for storskalafordele
- høj industrikoncentration
- store barrierer for adgang
- mærkevarer
- standard antagelser fra neoklassisk økonomi irrelevante

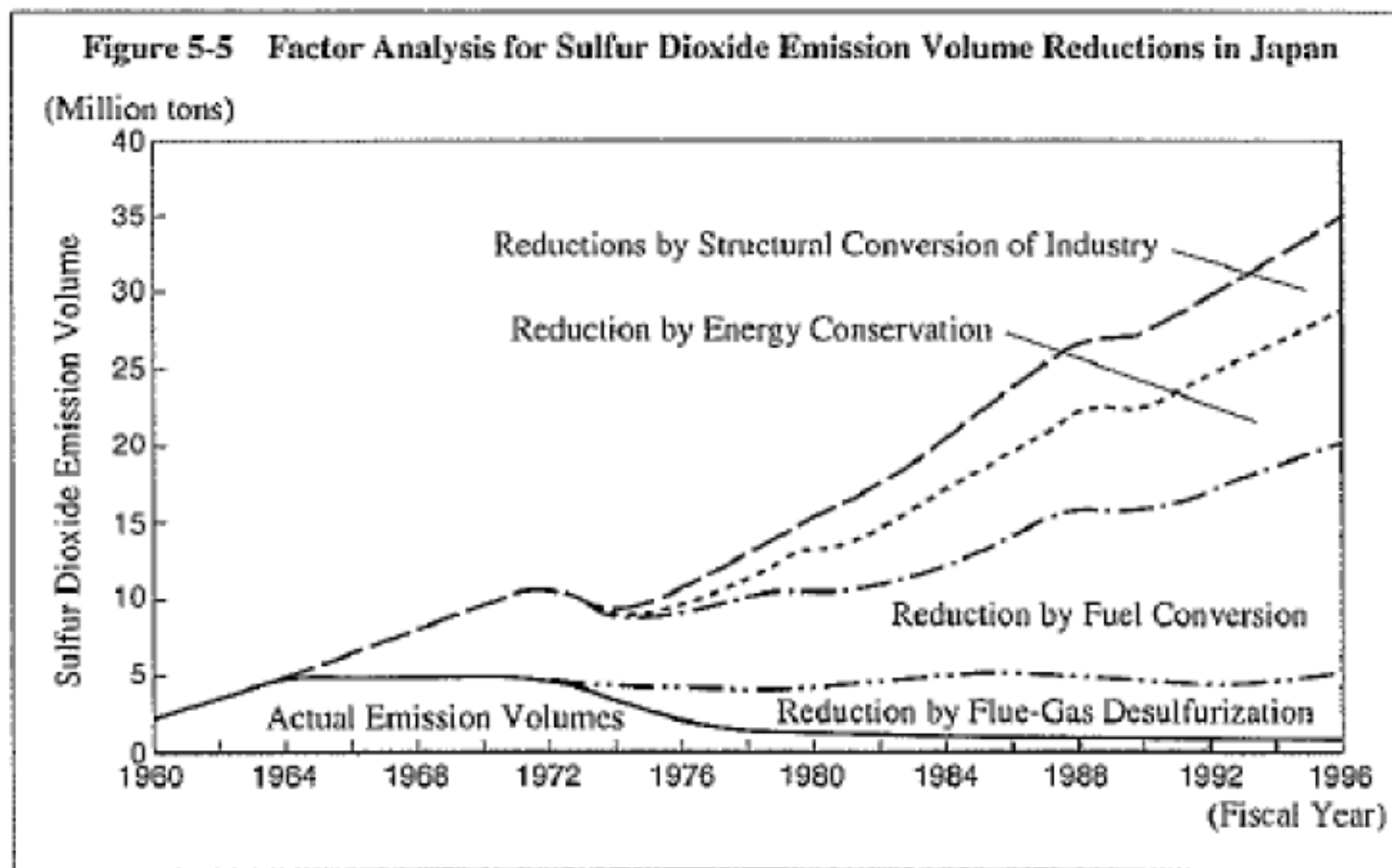
Lav kvalitets aktiviteter
(Fuldkommen konkurrence)

Karakteristika:

- flade læringskurver
- lav vækst i output
- små teknologiske fremskridt
- lavt F&U indhold
- lille individuel eller institutionel læring nødvendig
- fuldkommen information
- små, gradvise investeringer
- lavt lønniveau
- få storskalafordele
- fragmenteret industri
- nem adgang
- hyldevarer
- standard antagelser fra neoklassisk økonomi en rimelig tilnærmelse til realiteterne

Tabel 1: Kvalitetsindeks for økonomiske aktiviteter (jf. Reinert, 1995).

Japan in Schumpeters path: SO2



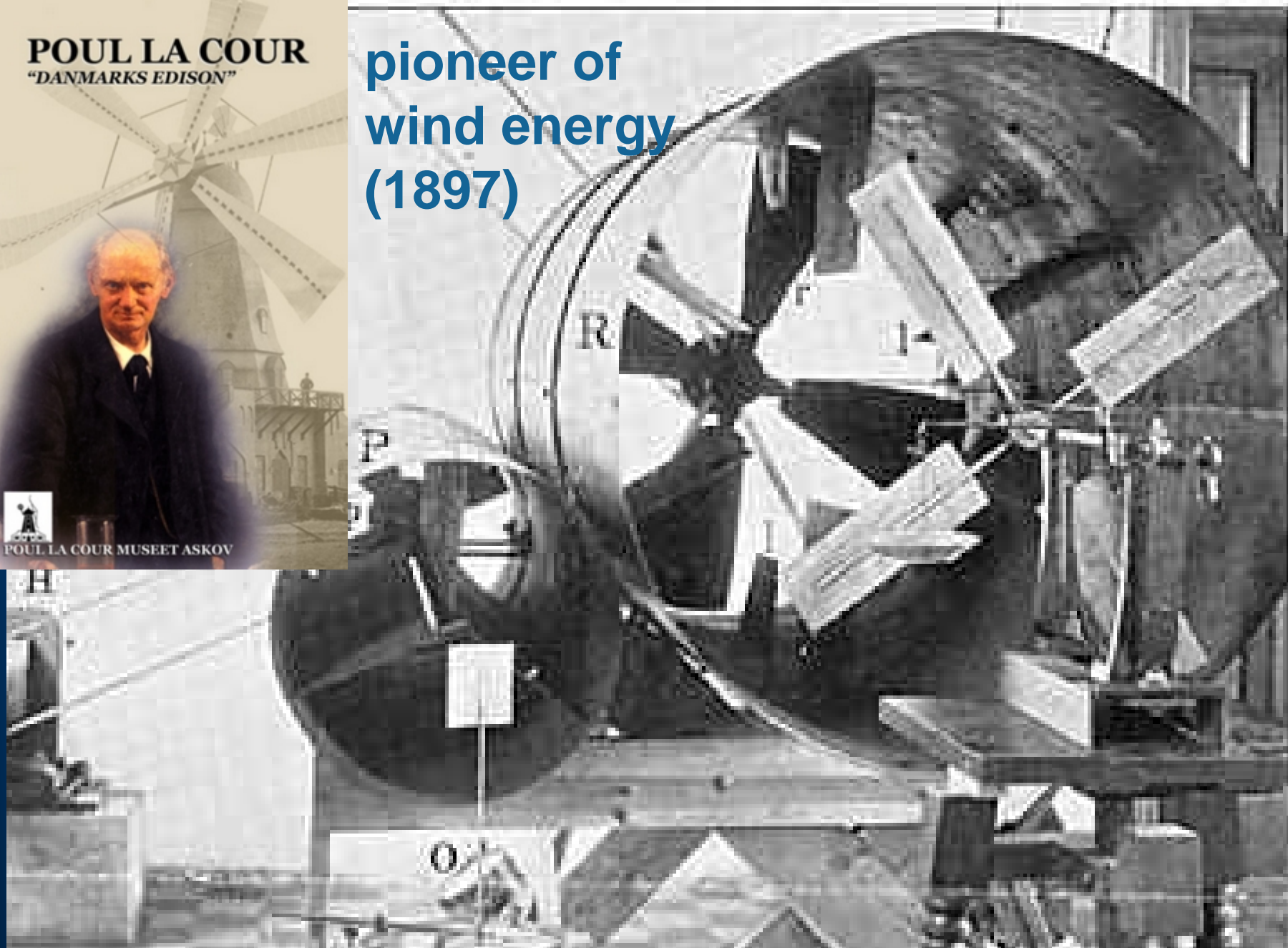
Figur 2. Dekomponering af SO₂-udledning i Japan 1960-1996 i forhold til business-as-usual.

POUL LA COUR
"DANMARKS EDISON"

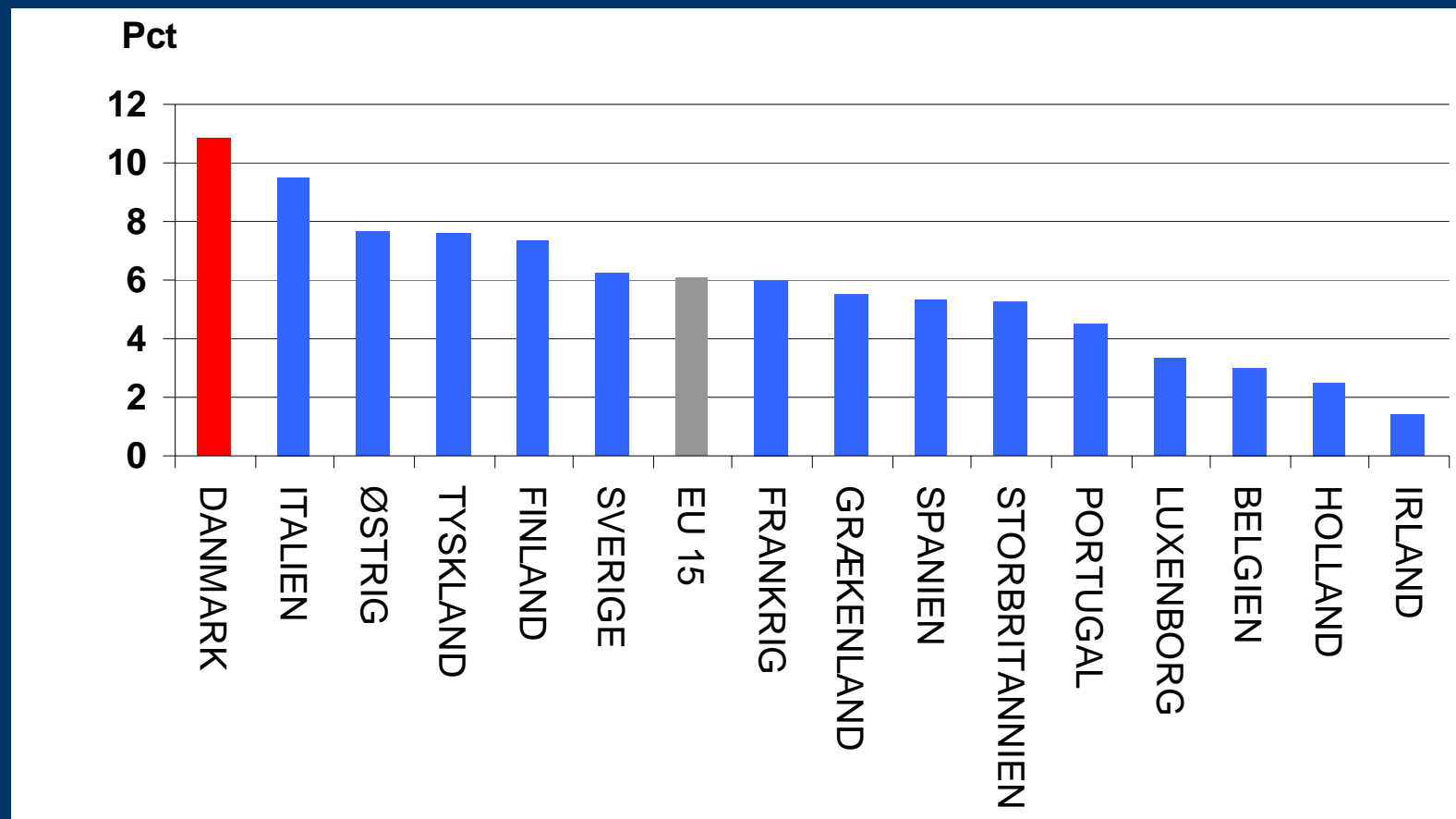


POUL LA COUR MUSEET ASKOV

**pioneer of
wind energy
(1897)**



Energy export in EU-15 (2008)



Eksporten af energi- og miljøteknologi, hvor vindmøller tegner sig for 2/3, toppede i 2008 med 64 mia. kr. og en vækst på 19 %. Sektoren vurderes at bestå af ca. 600 virksomheder med godt 95.000 ansatte. Eksporten af energi- og miljøteknologi udgjorde 11 % af den samlede danske vareeksport og er på 10 år steget 3,5 gang.

Energi og miljøsektoren rangordnet efter eksportværdi

Kilde: Danmarks Eksportråd, Udenrigsministeriet

Vindkraft 2/3

Resten (1/3):

Vandrensning

Forarbejdningsanlæg til biomasse og biogas

Kedler og brændere

Fjernvarmerør og kompensatorer

Pumper

Termiske solfangere

Isoleringsmaterialer

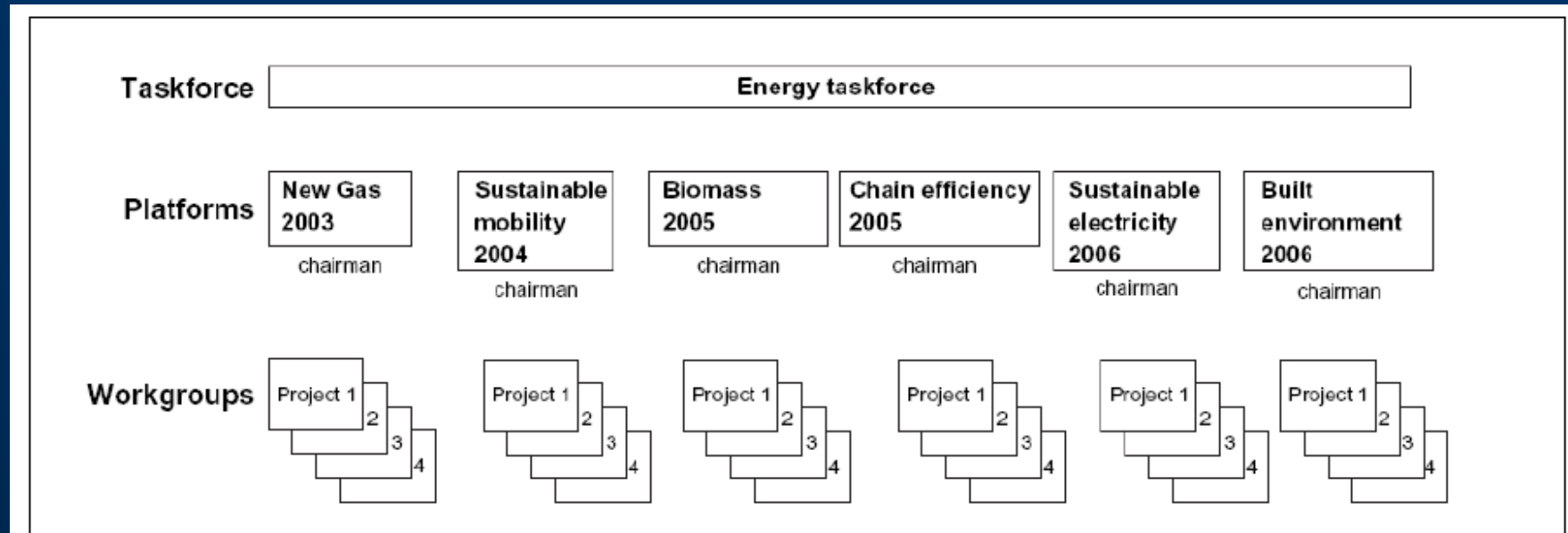
Affaldshåndteringssystemer

Olie og gas udstyr

Smart metering indenfor el og vand

Tabel 2. Energi- og miljøsektoren i Danmark.

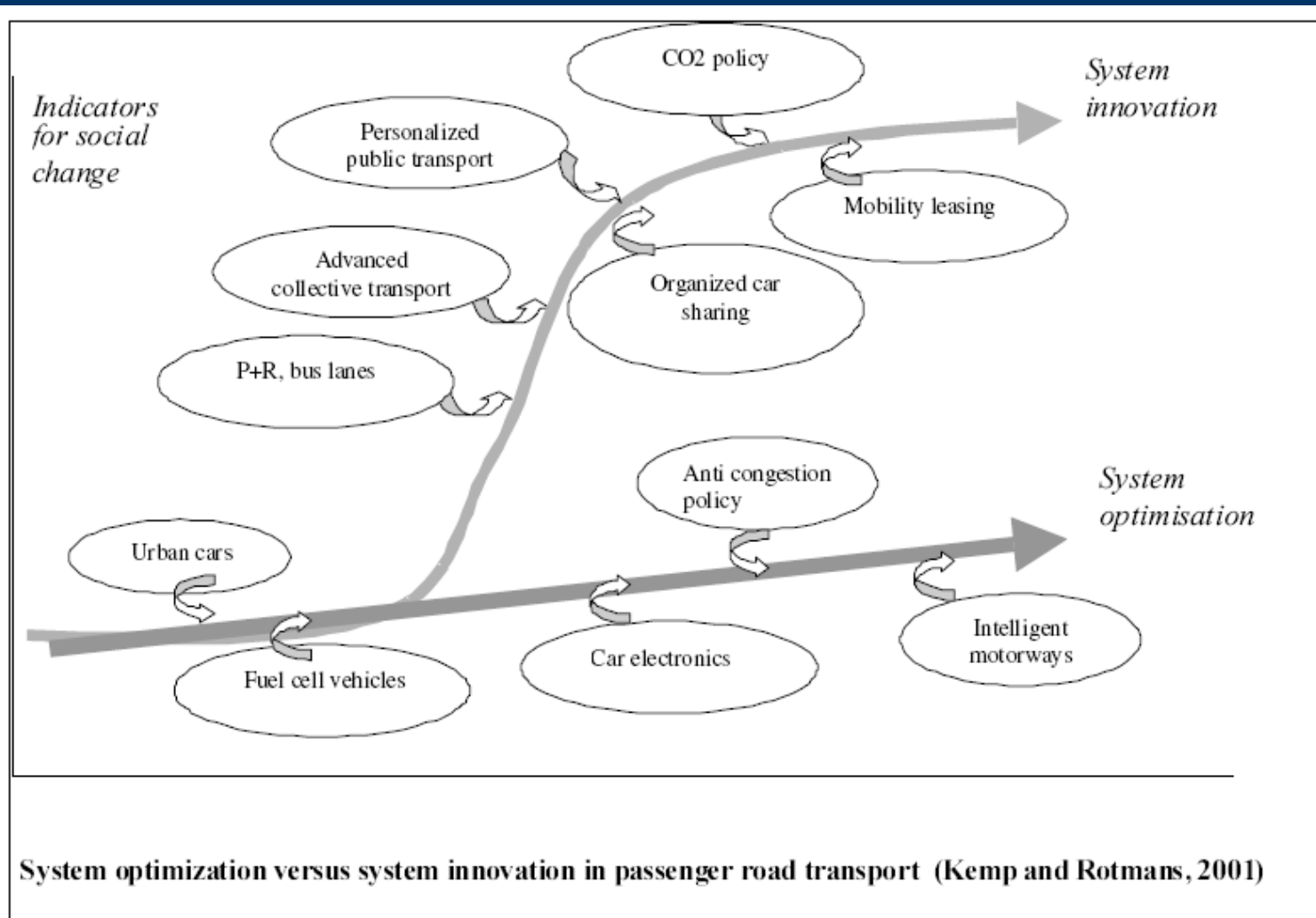
Dutch energy transition process



Figur 3. Teknologi-platforme i den Hollandske energi-transition.

Theme	Goal	Transition path
New gas	To become the most sustainable gas country in Europe	Decentralized electricity generation Energy efficient greenhouses Green gas hydrogen Clean fossil fuels
Sustainable mobility	Factor 2 reduction of GHG emissions for new vehicles in 2015 and factor 3 reduction for all vehicles in 2030	Hybrid propulsion Biofuels Hydrogen vehicles Intelligent transport systems
Green resources	Substitution of 30% of resources for energy by green resources by 2030	Biomass production in NL Chains for biomass import WISE Biomass co-production Synthetic Natural Gas Sustainable chemistry
Chain efficiency	20–30% extra improvement of product chains by 2030	Optimising the waste chain Precision farming Process intensification Multimodal transport Clearing house for bulk products Symbiosis (closing material loops) Micro cogeneration Energy efficient paper production
Sustainable electricity supply	To make electricity supply more sustainable	Renewable energy sources Decarbonisation and cogeneration Electric infrastructure Electricity use
Built environment	To accelerate energy improvement programmes and stimulate new innovations	Energy improvements in built environment Development and implementation of innovations Removal of institutional barriers

Tabel 7. Transitions-temaer i den Hollandske energitransition (Kemp et al., 2007).

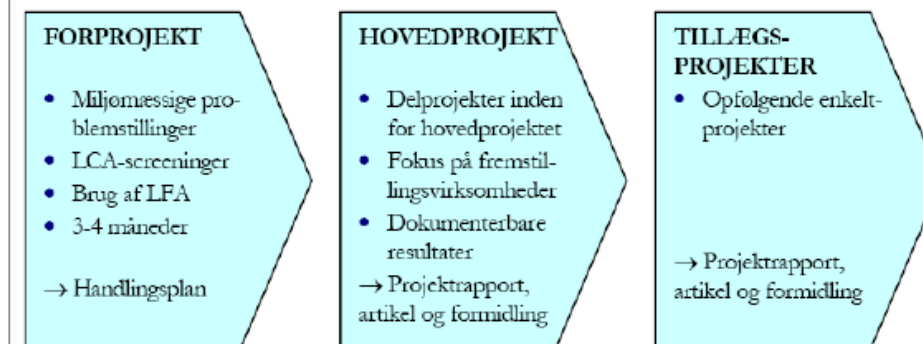


Figur 4: Systemoptimering versus systeminnovation i vejtransport.

Danish projects for green technology

	Antal projekter	Samlet Bevilling (mio. kr.)	Bevilling per år (mio. kr.)
Udviklingsprogram for renere teknologi 1987-1989	104	90	30
Handlingsprogram for renere teknologi 1990-1992	261	230	75
Handlingsprogram for renere teknologi 1993-1997	~437	380	75
Renere produkter 1999-2003	1.440	515	103
Miljøeffektiv teknologi 2007-2009	~175	120 ³	40
Miljøeffektiv teknologi 2010-2011		90	45

Tabel 3. Oversigt over dedikerede miljøteknologiske udviklingsprogrammer under Miljøministeriet.



Kilde: Oxford Research 2006

Tabel 5. Arbejdsgang i den brancheorienterede indsats.

South Korea: 5-yr plans for green growth

3. Establishment of Groundwork for Green Growth



Significance of 5-Year Implementation Plan

National Strategy and 5-year Plan



Significance of 5-year Plan

- 1 Mid-term action plan of National Strategy
Comprehensive consideration of sectoral plans
- 2 Re-creation of the success of
the past 5-year economic development plans
- 3 Investment planned for each year from 2009
to 2013 (resource allocation prioritized)
- 4 Sectoral policy goals
Specification of detailed projects

Contents and Implementation

- 3 major strategies, 10 policy directions, 50 key tasks, 187 major projects
- Investment of 107 tril won in 2009–2013 → production inducement of 182–206 tril won
- Annual planning and evaluation of implementation (central/local governments)

CARBON ENERGY TAXATION

OXFORD

Lessons from
Europe

EDITED BY
MIKAEL
SKOU
ANDERSEN
& PAUL EKINS

