Innovation, environmental policy and lock-in effects

Perspectives on the transition towards a greener economy

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Eco-innovation

- In Europe the term environmental technology is superseded by the broader concept of **eco-innovation** in recognition of the shifting attention to product change and changes in product chains.
- Eco-innovation is also the **stated aim of government**. It is part of the Sustainable development strategy and the economic growth strategy of the European Commission because of the assumption of offering a ‘double win’.

What is eco-innovation?

- Eco-innovation is a relative concept:
  - More environmentally benign than relevant alternatives
  - User perspective versus developer perspective
  - Innovative goods, services and systems are evolving
- It does not have to be environmentally motivated

3 definitions of eco-innovation

- “the production, application or exploitation of a good, service, production process, organisational structure, or management or business method that is **novel** to the firm or user and which **results**, throughout its life cycle, in a reduction of environmental risk, pollution and the negative impacts of resources use (including energy use) **compared to relevant alternatives”** (MEI project)

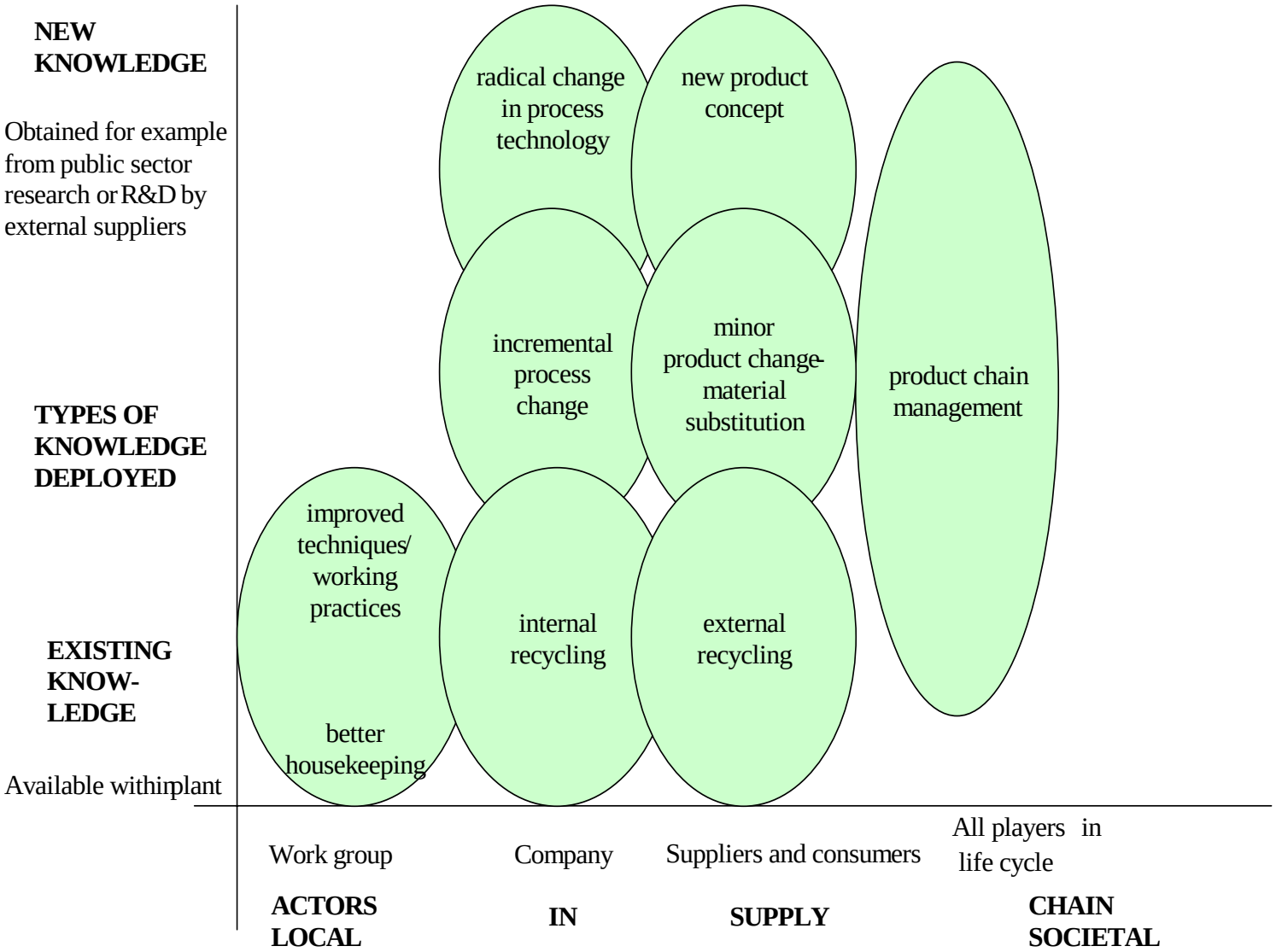
- “the creation of novel and competitively priced goods, processes, systems, services, and procedures that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimal use of natural **resources** (materials including energy and surface area) per unit of output, and a minimal release of toxic resources” (Technopolis)

- “a change in economic activities that improves **both** the economic performance and the environmental performance” (ECO-DRIVE project).

- The concept of eco-innovation has been wrongly restricted in policy debates to (technological) innovation in the environmental goods and services sector;
- Eco-innovation can and does occur in all economic sectors but the current set of indicators and data prevents a full and proper analysis of the phenomenon;

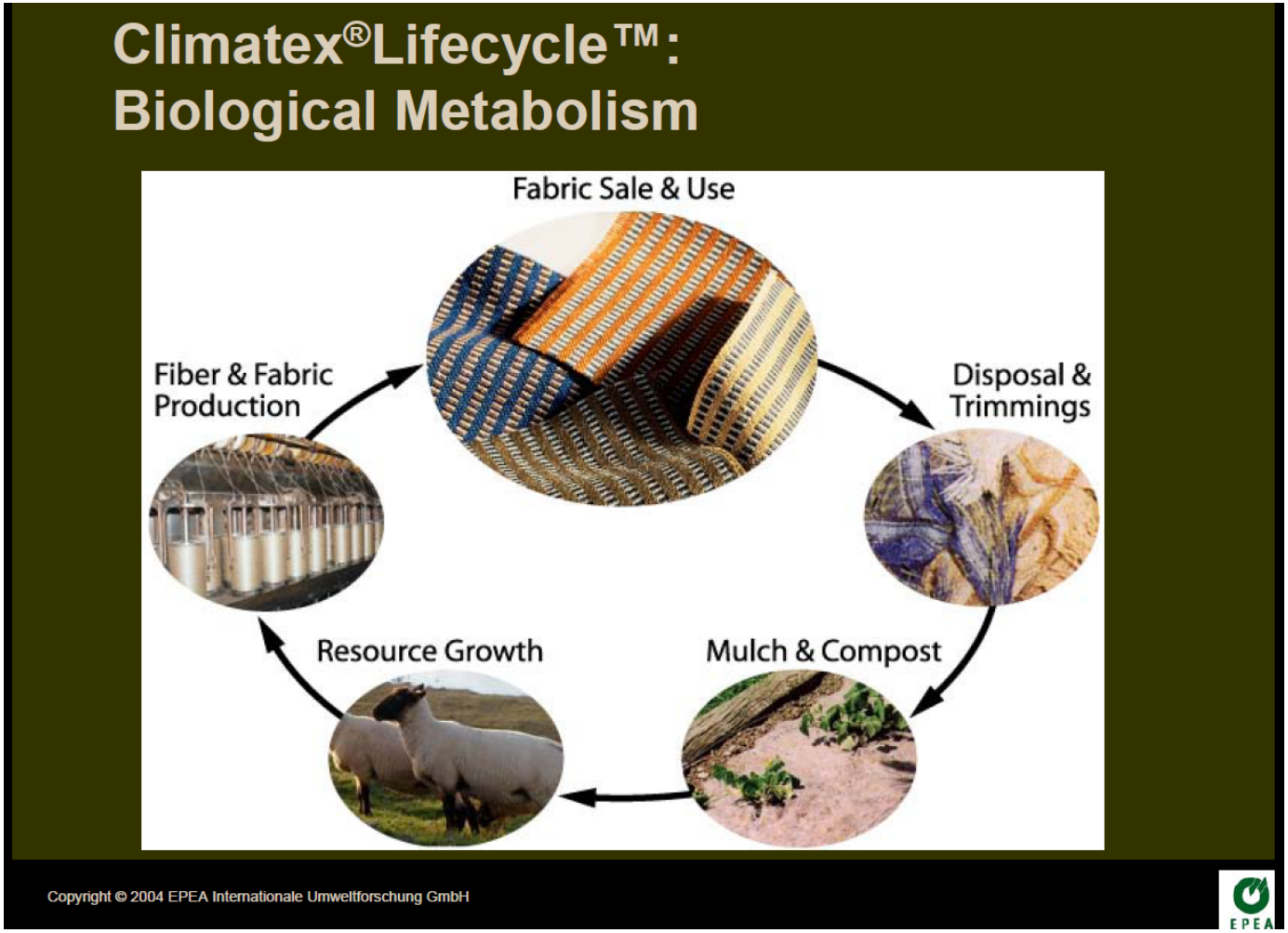
  (Reid and Miedzinski, 2008)

Type of eco-innovation	Pulled/pushed by
A. Environmental technologies	
Pollution control technologies	Environmental regulation
Cleaning-up technologies	Soil remediation programmes
Waste management systems	Resource prices, waste management requirements, EPR
Cleaner process technologies	Cost minimisation
Environmental monitoring and instrumentation	Environmental regulations and EMAS
Noise and vibration control	Noise regulations
Water supply	Water supply programmes of water boards
Green energy technologies	Environmental regulations, subsidies, taxes, ETS
B. Organisational innovations for the environment	Regulations (directly or indirectly), management demand
C. Product changes	Regulations, green demand, competition
D. Green system innovations (industrial ecology, smart grids, V2G)	GPT pushed by science, niche applications, visions, …

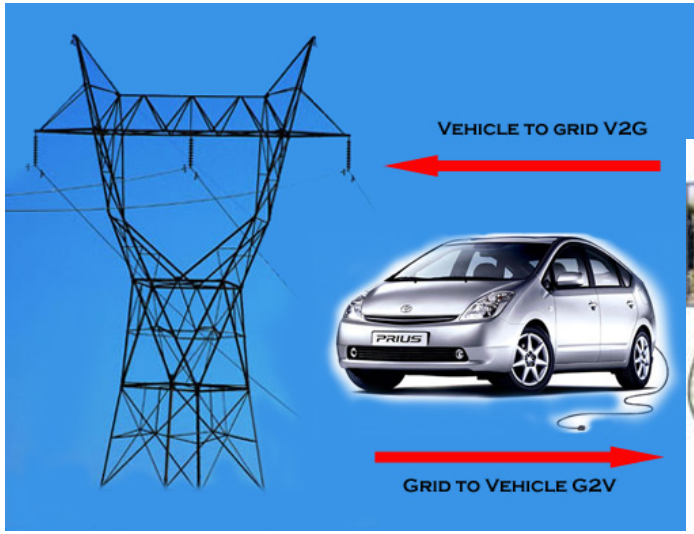


Source: Clayton, Anthony, Graham Spinardi and Robin Williams (1999), Policies for Cleaner Technology . A New Agenda for Government and Industry. Earthscan Publications Ltd ., London, p.273

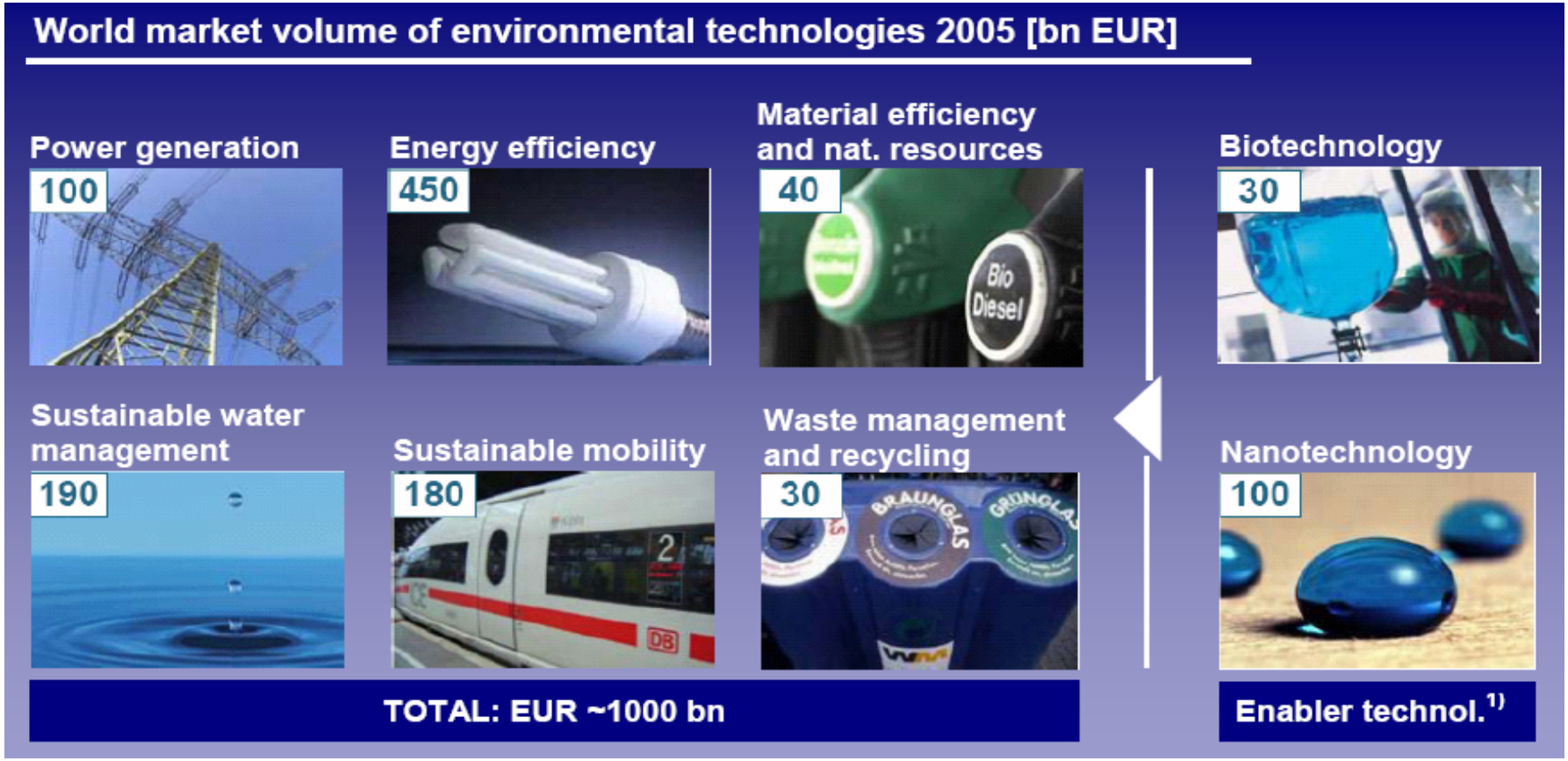
Cradle to cradle (C2C)



Vehicle to Grid (V2G)

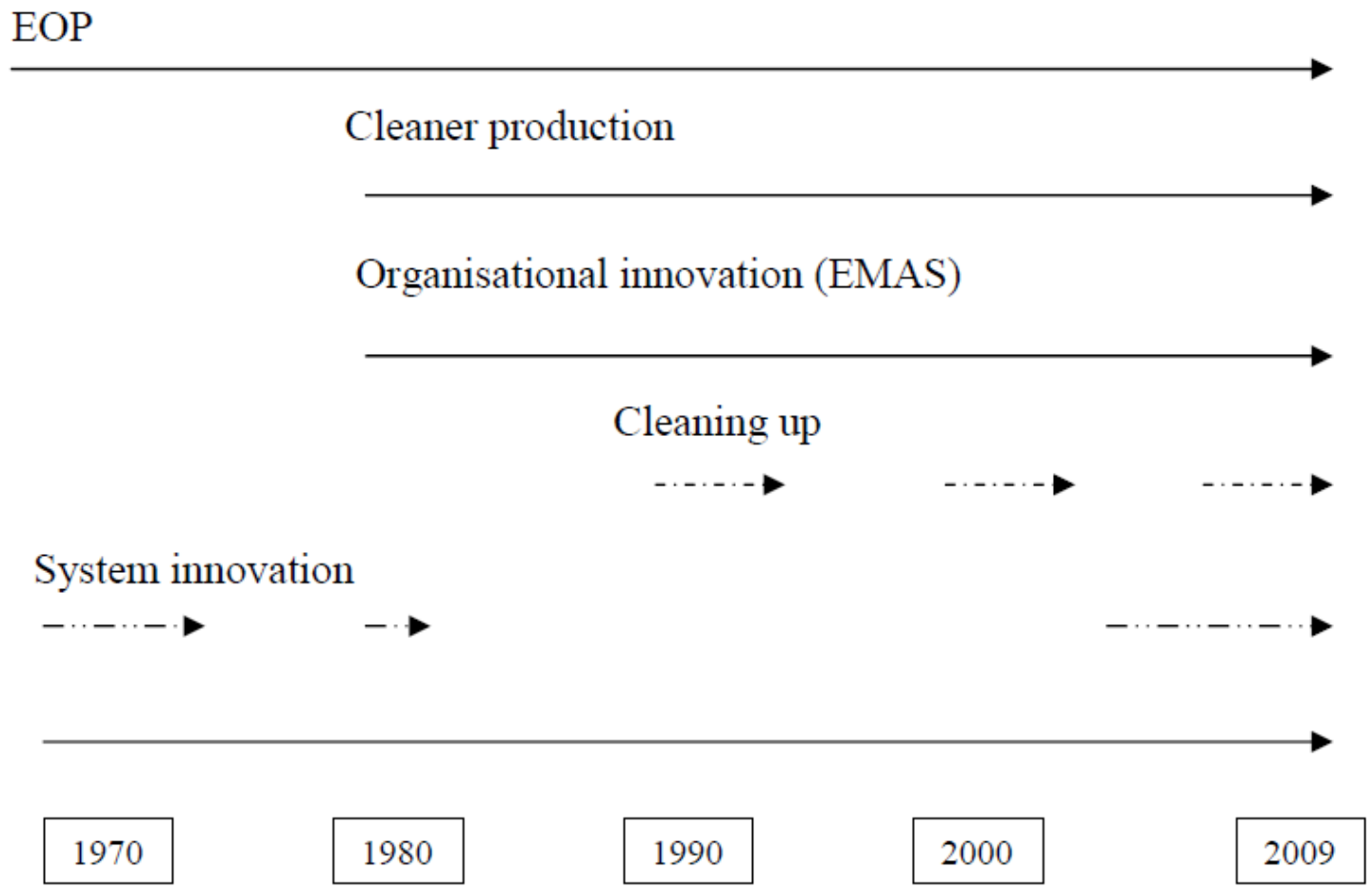


A market estimate



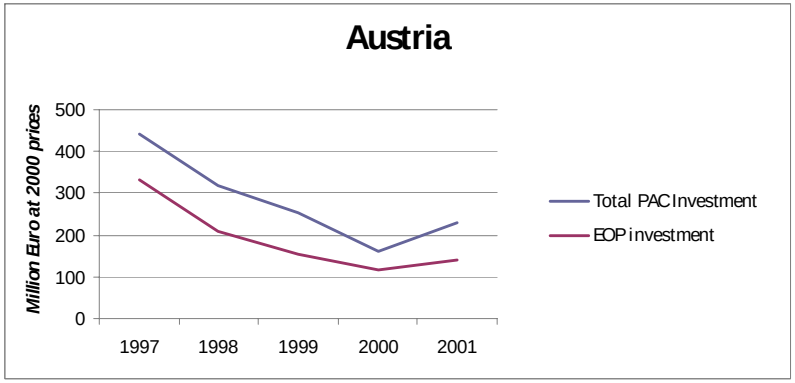
Source: *Market studies, expert interviews, Roland Berger Strategy Consultants, 2006*

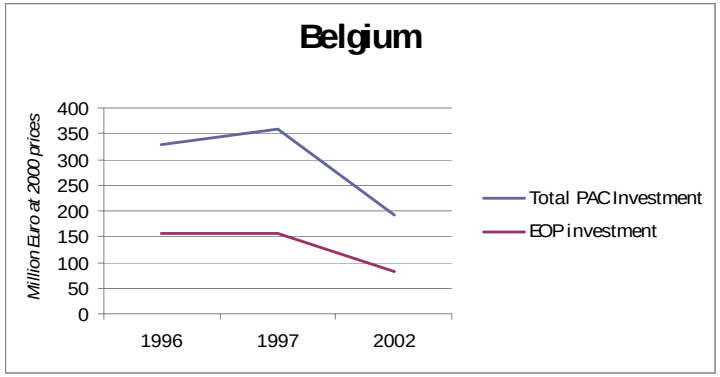
The eco-innovation time line

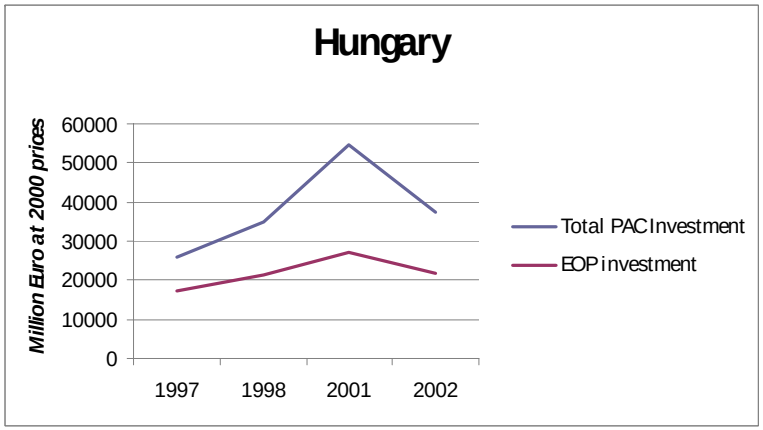


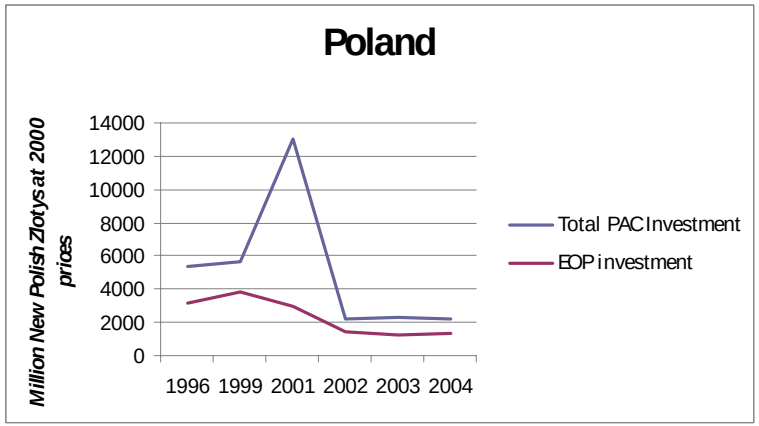
Investments in pollution abatement expenditure (Total vs. EOP)

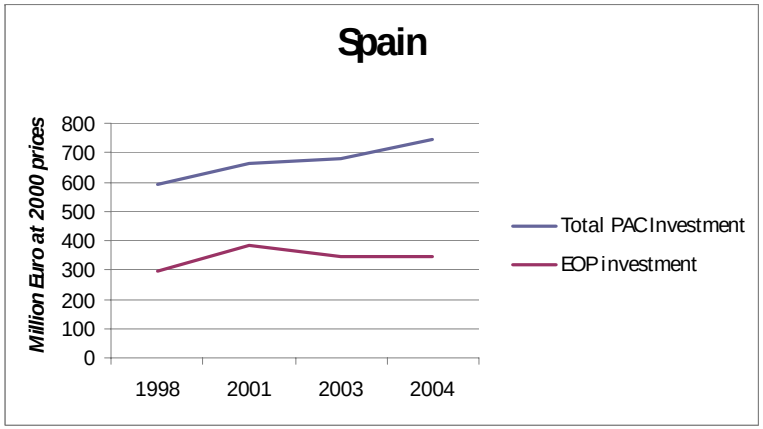
Source: OECD

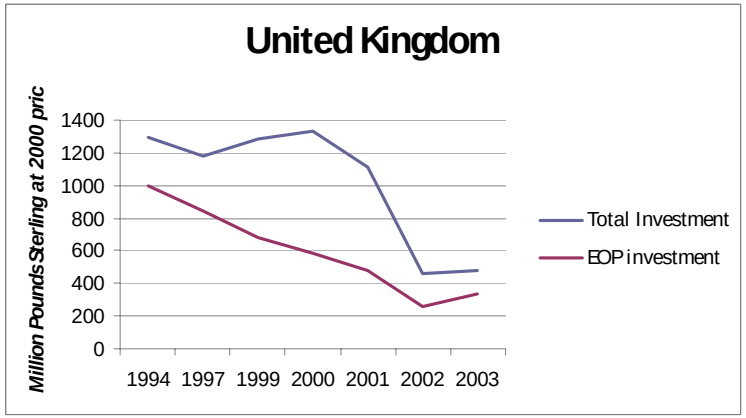




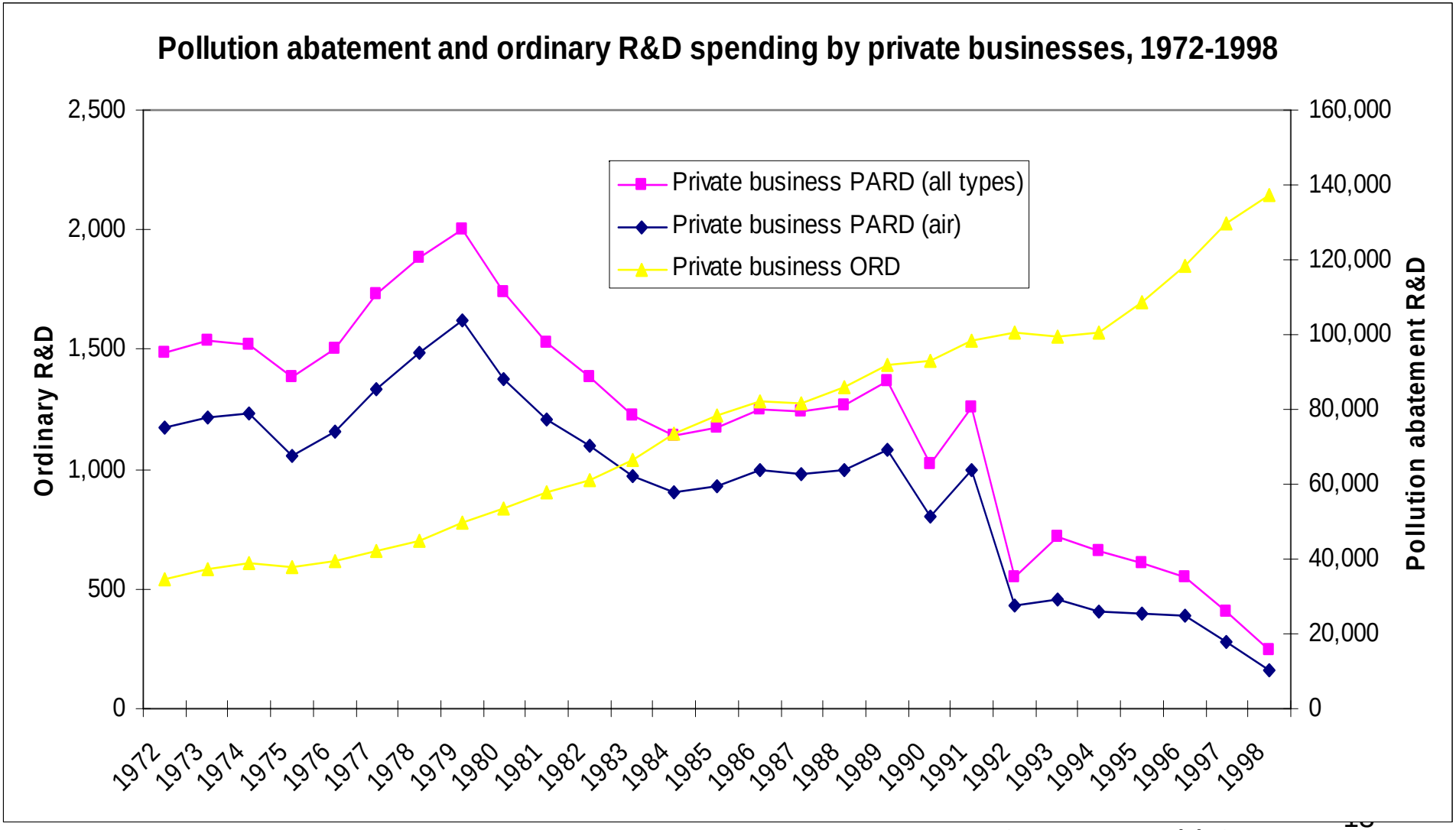








Pollution abatement R&D shows a countervailing trend in the US



Source: David Grover

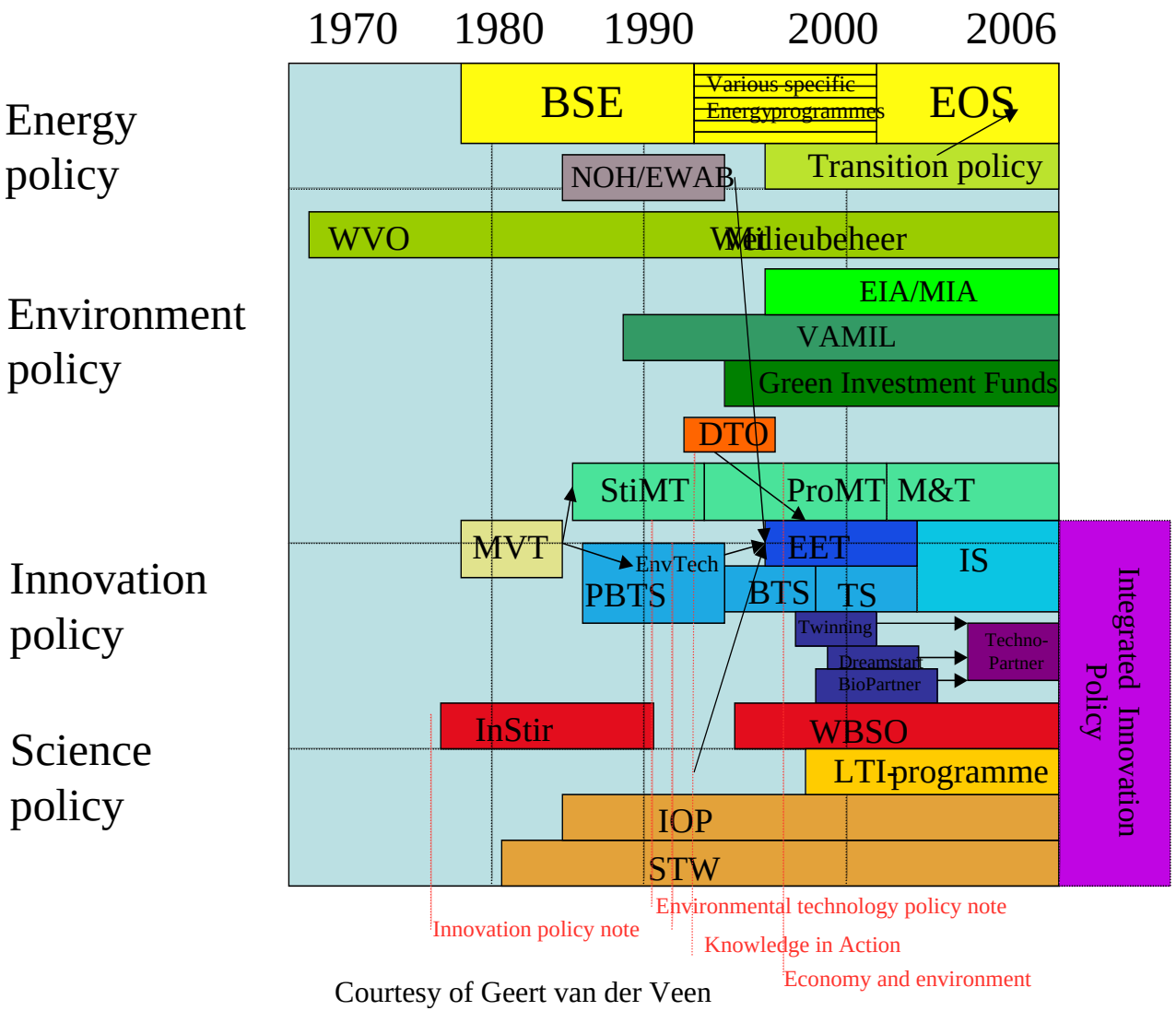
Countries have **multiple policies** for innovation:

- Support of R&D
- Knowledge transfer
- Investment support
- Green taxes
- Science and technology programmes
- Skills and educational policies
- Competition policy
- Regulations to diffuse environmental technologies
- ..

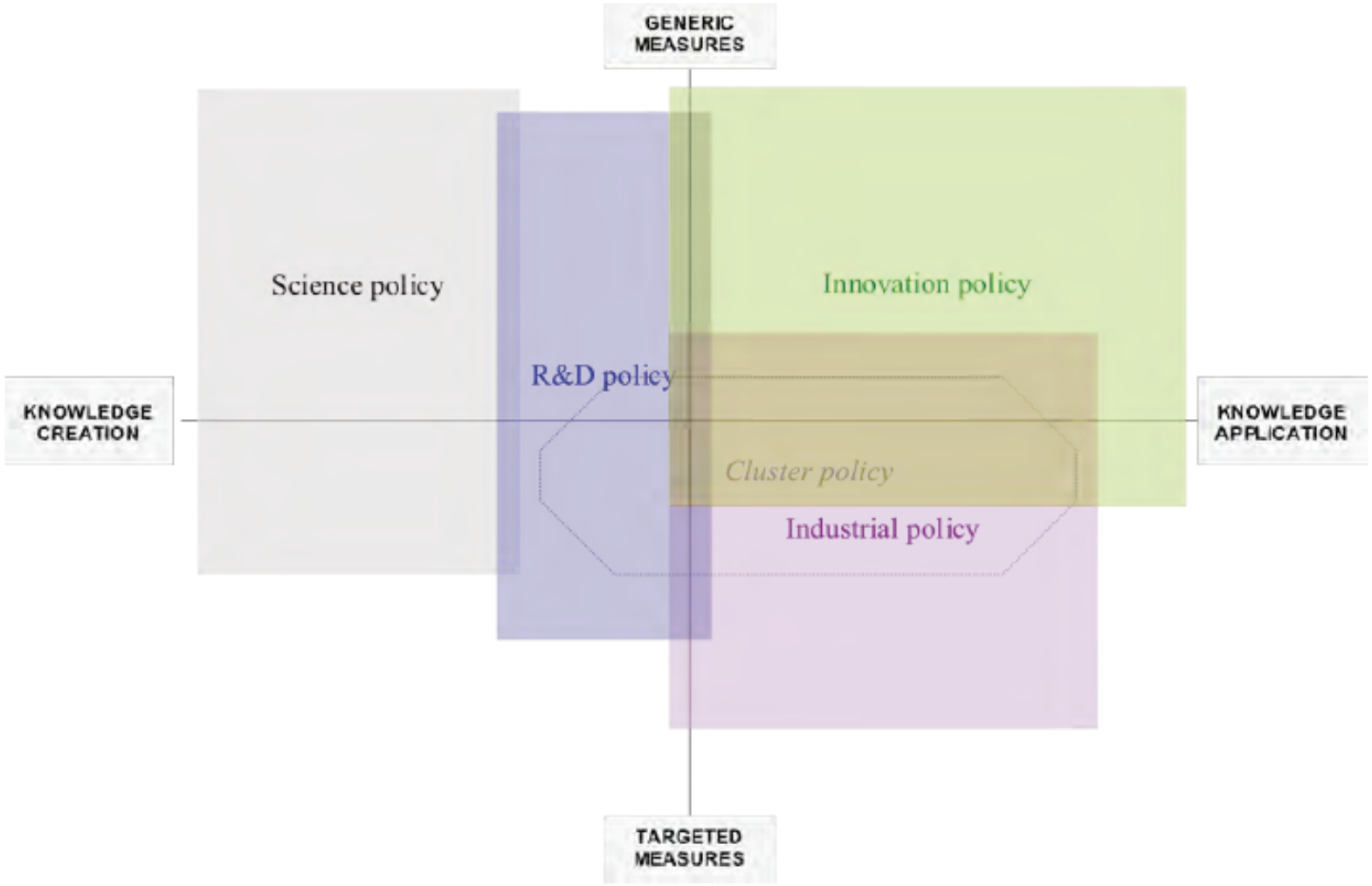
Exhibit 30. Examples of typical eco-innovation measures

Type	Examples of measures	Policy fields
Market-oriented instruments	• fiscal measures (e.g. energy tax, emissions tax, tax reductions, investment tax credits, VAT) • emissions trading schemes	• fiscal policy • trade policy
Public procurement	• green public procurement	• relevant for all policy fields with the public procurement capacity (notably transport policy, • construction and housing policy, defence policy)
Regulatory and normative frameworks	• energy (de)regulation • standards and norms (including technology regulations, quota-based schemes, energy saving requirements) • permits and bans • land use regulations • environmental management systems • eco-labels and other soft standardisation instruments (including voluntary agreements)	• environmental policy • industrial policy • energy policy • trade policy • local development policy
Support for innovation activity	• financial schemes (loans and credits) • subsidies (e.g. renewable energy infrastructure subsisdies) • venture capital funds • business incubation programmes • targeted R&D and technology programmes • targeted business advisory services • eco-cluster policies (cluster involved in eco-innovation development and support for eco-innovative solutions in existing clusters e.g. advanced on-site industrial ecology solutions)	• economic policy • energy policy • innovation policy • entrepreneurship policy • research policy • regional policy
Capacity building and demonstration measures	• professional training (eco-efficiency capacity building for enterprises) • changes in educational programmes	• education and training policy •
Strategic planning and foresight	• green foresight • strategic spatial planning	• foresight is relevant for all policy fields

Government policy and sustainable innovation in the Netherlands

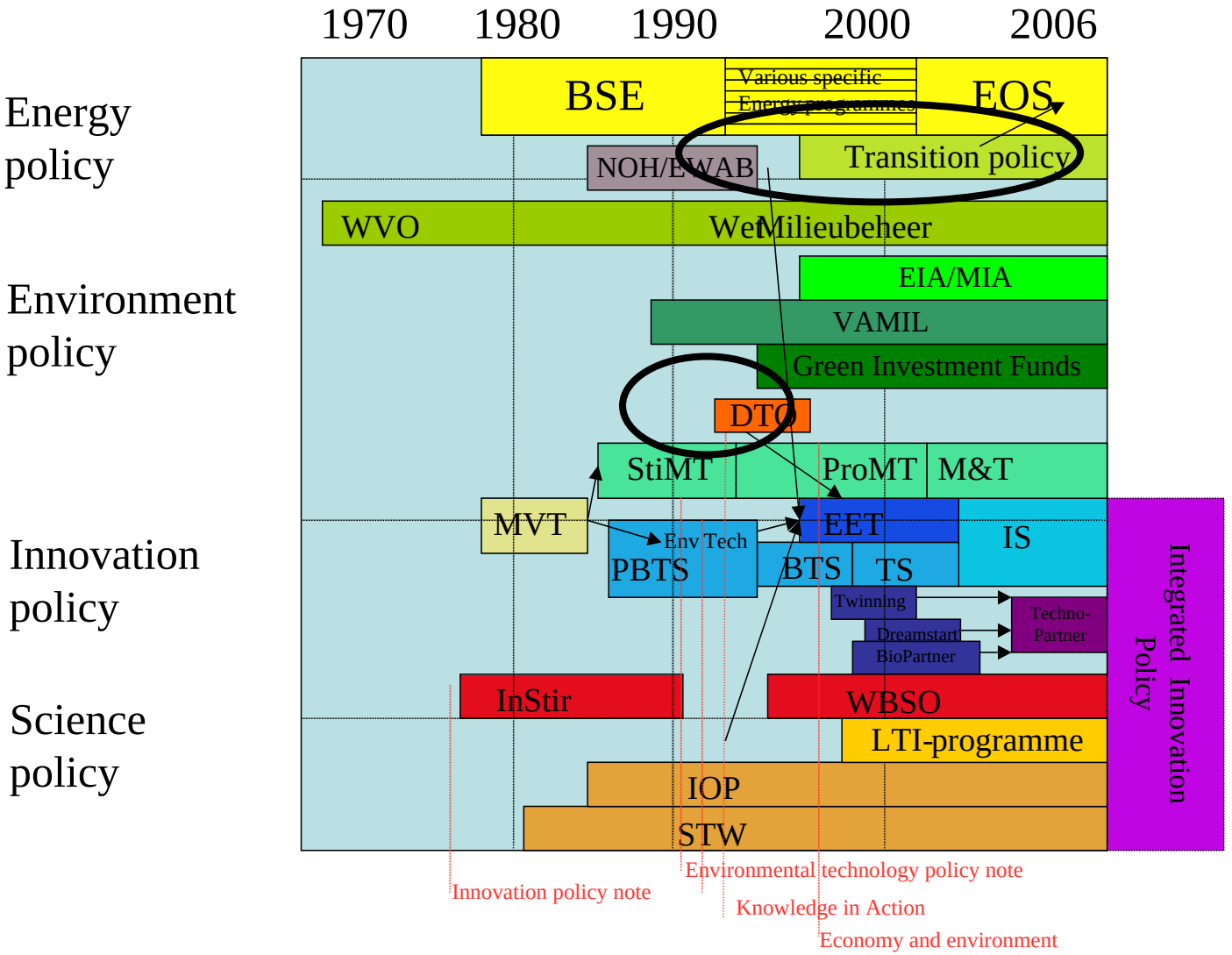


Courtesy of Geert van der Veen



Source: Reid and Miedzinski (2008)

Long term programming

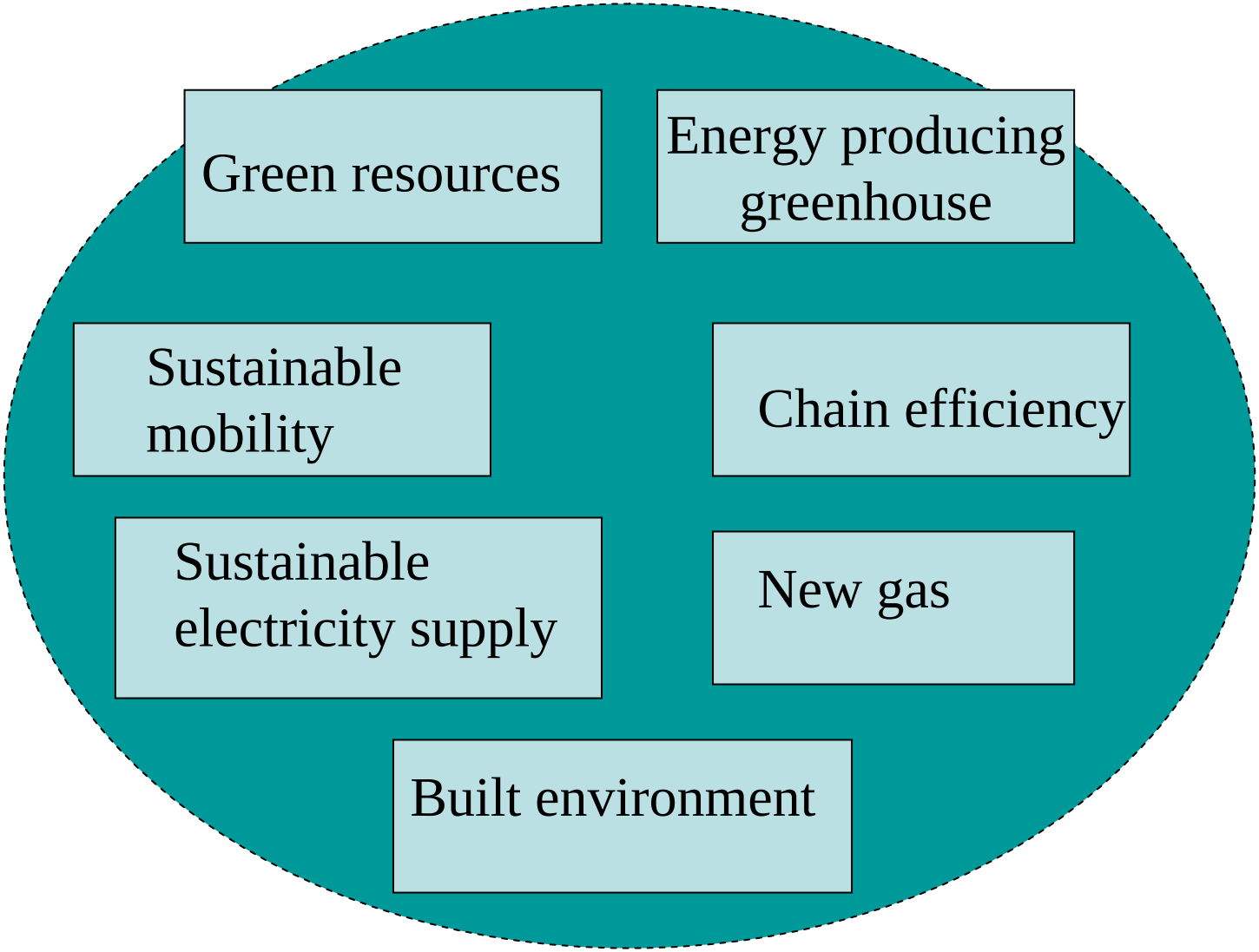


Courtesy of Geert van der Veen

The Dutch transition approach for energy

- Goals
  - -50% CO2 in 2050 in a growing economy
  - An increase in the rate of energy saving to 1.5- 2% a year
  - The energy system getting progressively more sustainable
  - The creation of new business
- Means
  - Government process manager; interdepartmental directorate
  - 7 transition platforms
  - 35 transition paths
  - (Specific subsidy scheme to support) Experiments
  - Challengers helpdesk

Official transition platforms



Selected transition paths

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
		Built environment
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	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

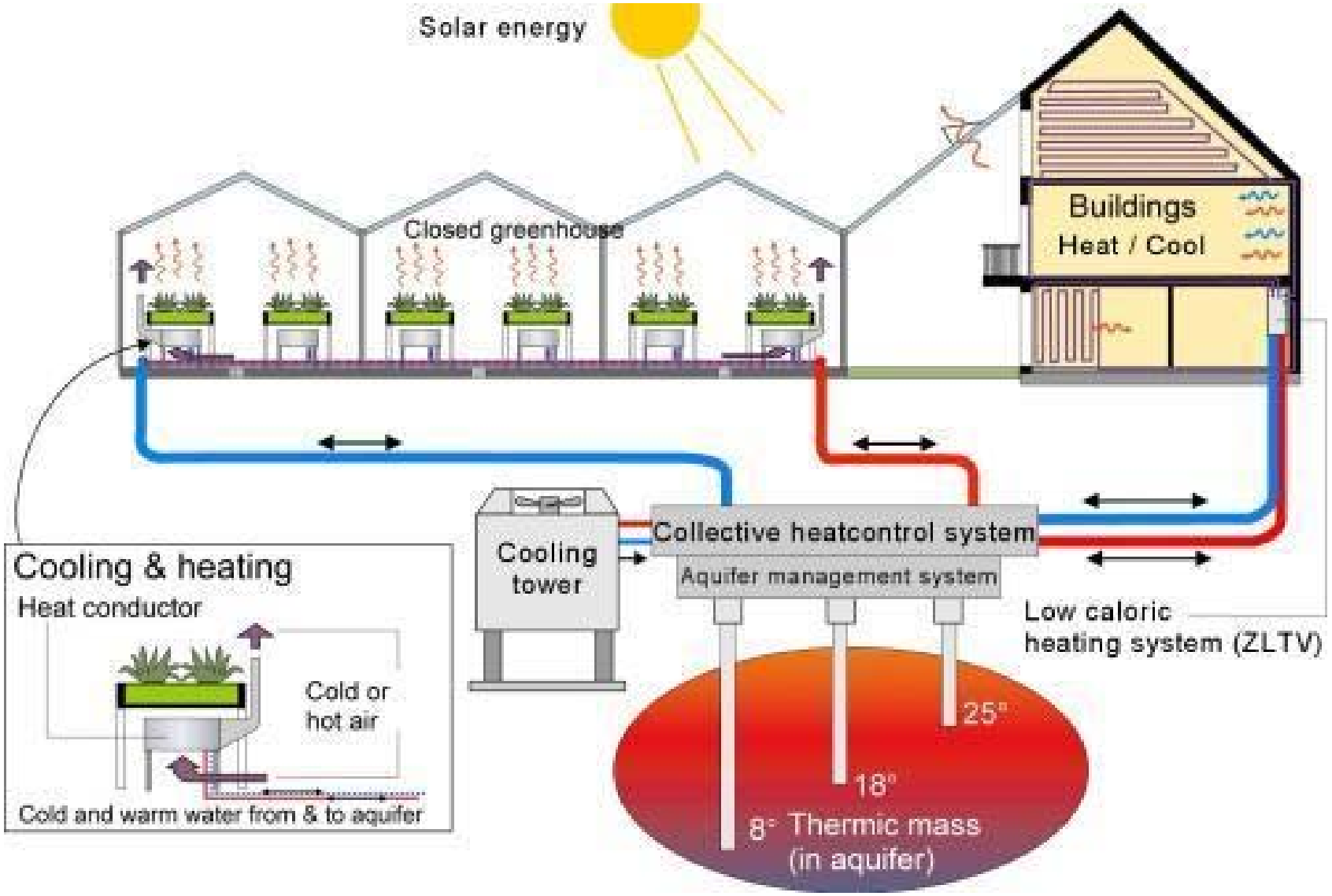
Platform new gas

- One of 7 platforms
- Goal: to become the most sustainable gas country in the world
- 4 transition paths:
  - Decentralized electricity production (micro cogeneration)
  - Energy efficient greenhouse
  - Green gas hydrogen
  - Clean fossil fuels

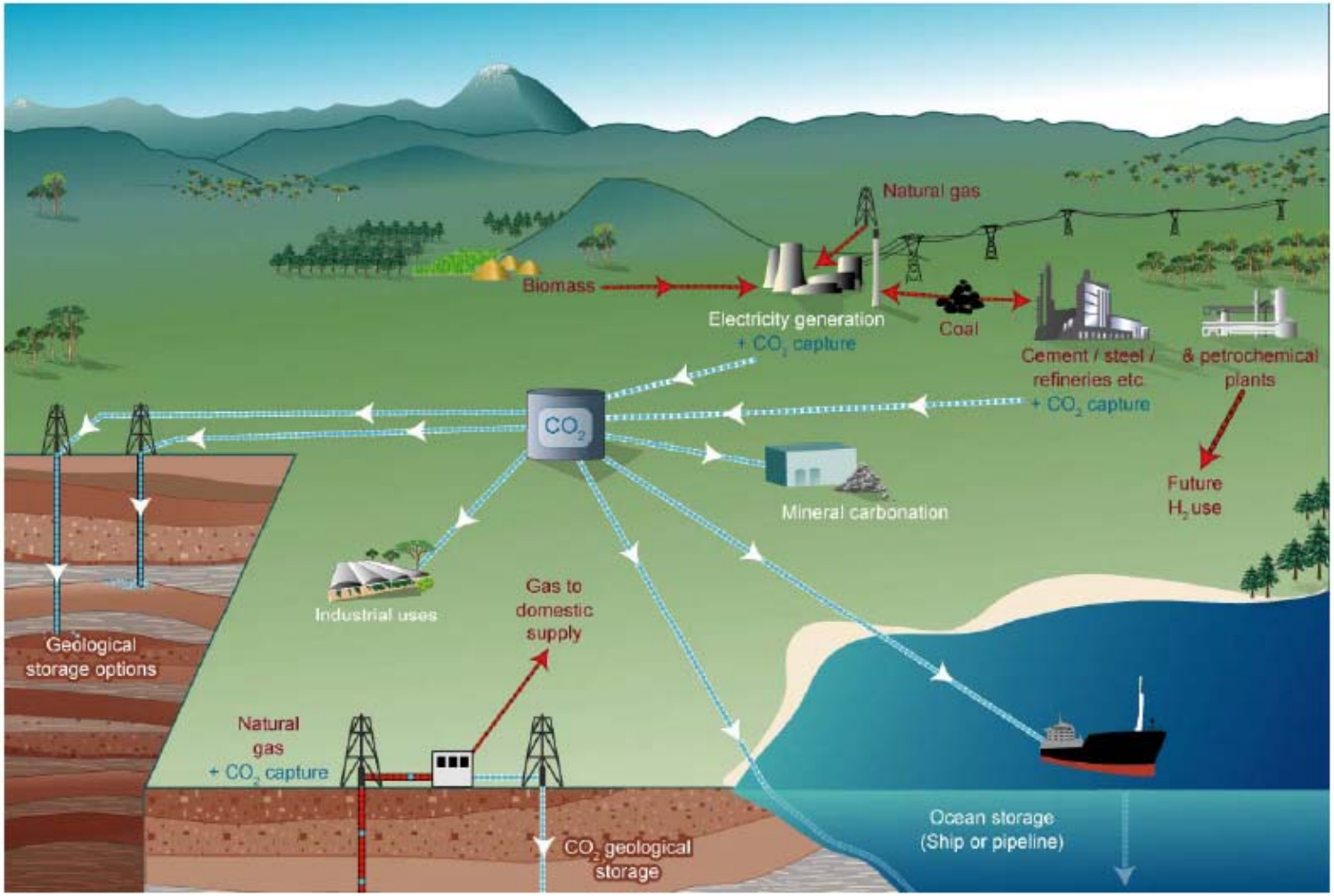
Bottom-up elements

- Business alliances (sometimes with NGO's)
- Transition-experiments
- Identification of barriers / opportunities *informing* private action and policy

Energy producing greenhouse



Carbon capture and storage



The philosophy behind TM:

Perspektivischer Inkrementalismus

(a guided form of evolutionary change)

- The use of **multiple visions** (because visions create better world together rather than apart)
- The use of experimental learning
- Adaptive portfolios
- Policy oriented towards transitions
- Government as a **facilitator** of change and partner of business

The role for science and research

- **Creating** technological innovations
- **Sustainability assessment** of innovations and alternative systems
- Foresight analysis
- **Evaluating the science and research system**: is it contributing to system improvement or system innovation?
- Study the **politics** of sustainable innovation

Evaluating the science and research system (suggestion of Andy Stirling)

How much money is spend is for technical research of which the sustainability is

- **Highly** contested (biofuels, nuclear, CCS, pesticides, etc.)
- **Weakly** contested (automotive batteries, fuel cells, ..)
- **Not** contested (solar PV, CSP, ..)

3 types of lock-in

- **Sectors** are locked into particular technologies, which lead companies to focus their attention to (non-disruptive) incremental innovation
- **Policy** is locked into fragmented approaches which somehow have to be aligned to SD goals
- **Societies** are locked into energy sources and combustion technologies, patterns of consumption that are material intensive and produce large amounts greenhouse gasses (Carbon lock-in)

A re-evaluation of picking winners policies

- Picking winners processes are useful for discussing pros and cons of technology options
- Which should not be used to make technology choices in a centralised manner but should help to guide research into directions where improvement is needed for reasons of sustainability (→ like safer forms of nuclear energy)
- With clear rules for deciding on portfolios and support which is provisional and adaptive

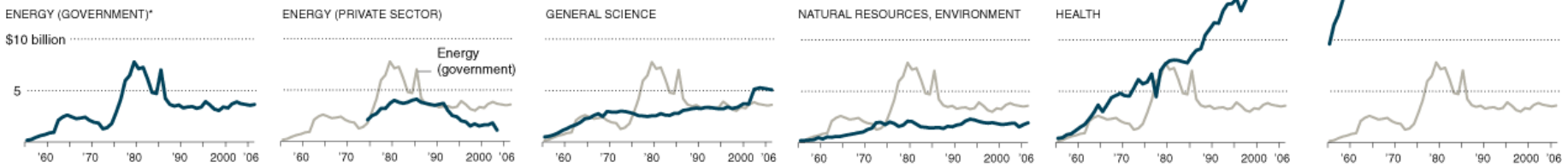
- System innovation presents a difficult issue for policy as it involves substantive risky investments, conflicts between emergent and incumbent actors and reconfiguring the traditional sectoral and policy boundaries (Steward, 2008)
- At present neither innovation policy nor sustainability policy are configured to allow a serious pursuit of transformative innovation

- President Obama has called for support for transformation technologies

Declining Investment in Energy R.&D.

Spending for energy research and development peaked during the oil crisis and has since fallen while spending in most other sectors continues to grow.

Research and development spending by function, in 2006 dollars



Sources: American Association for the Advancement of Science; Dan Kammen, University of California at Berkeley

*Data after 1998 adjusts for U.S. accounting changes.

David Constantine/The New York Times