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Technology, Human Society & Environment: Current State of Play

Part 1. Sustainability, Technology Diffusion, Civic Network & Social Field
Part 2. Current State of Play, Where to from Here?

Sustainable Energy Discussion Group, May 7th 2010

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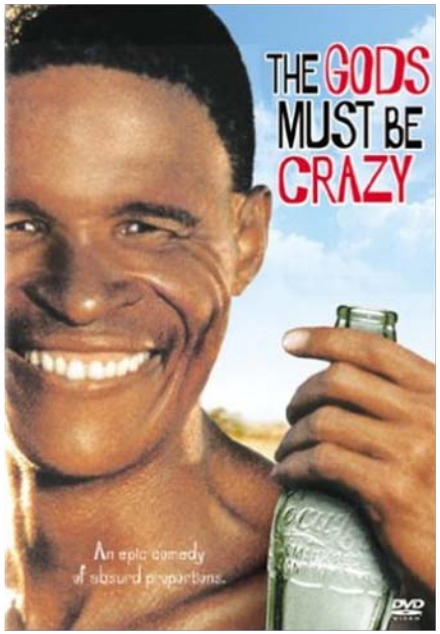
http://www.ceem.unsw.edu.au/content/RenewableEnergyinIndonesia.cfm?ss=1

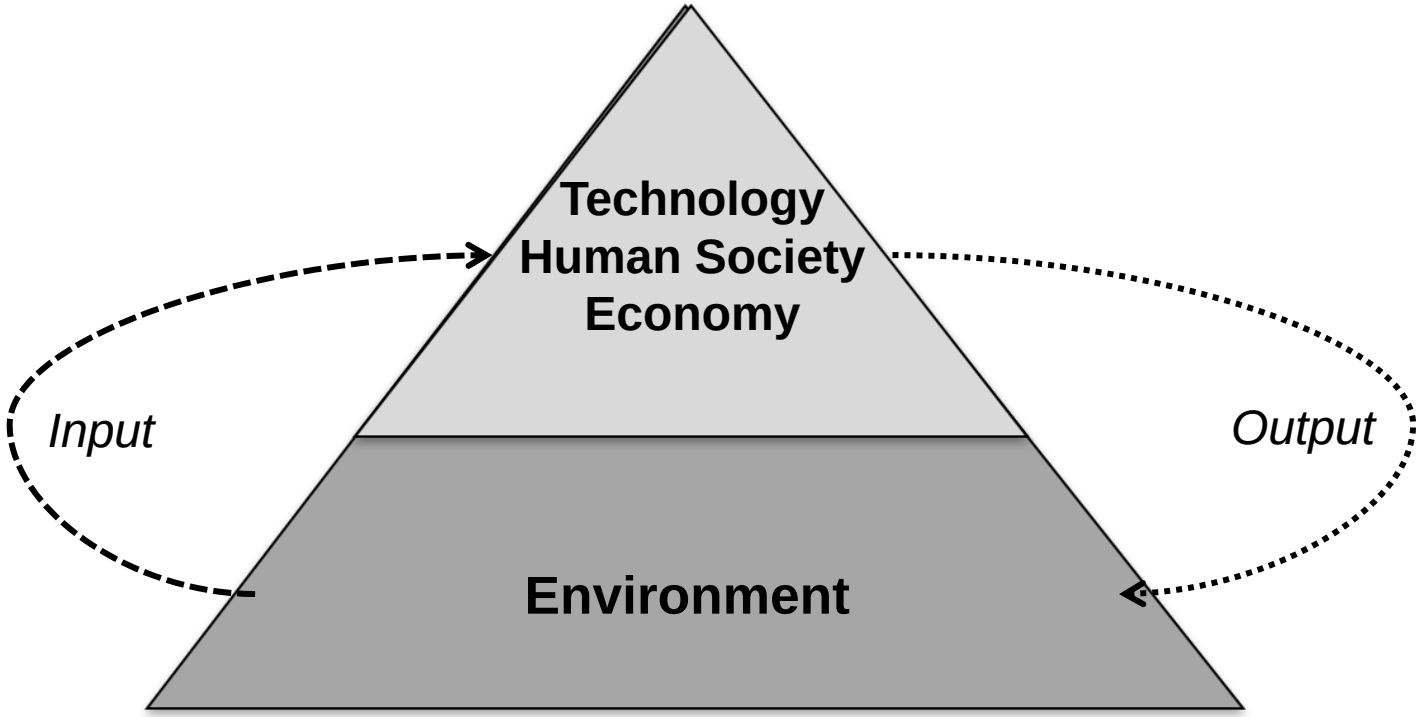
Technology, Human Society & Environment

- The use of tools started prior to the emergence of humans
- Tools are used to define human Ages (Stone, Iron, Agricultural, Industrial, Information): Fire, Wheel, Satellite, IT, Clean Technology, Nano, Geoengineering, CDM, REDD, ETS, ...
- Human society has evolved from a simple local tribal structure to a complex global community that is constantly innovating
- Technology can be useful, but can also be problematic. How to make sense out of all this? Impact of innovation on the society, economy and the environment (and vice versa)?
- Discussion: Technology as Hardware, Software & Orgware, Acculturation (Diffusion of Innovation), Innovation & Society (Social System, Civic Network, Social Field)



Mera Hertel 2005; NYU undated; Andrews 2009

Technology, Society, Economy & Environment

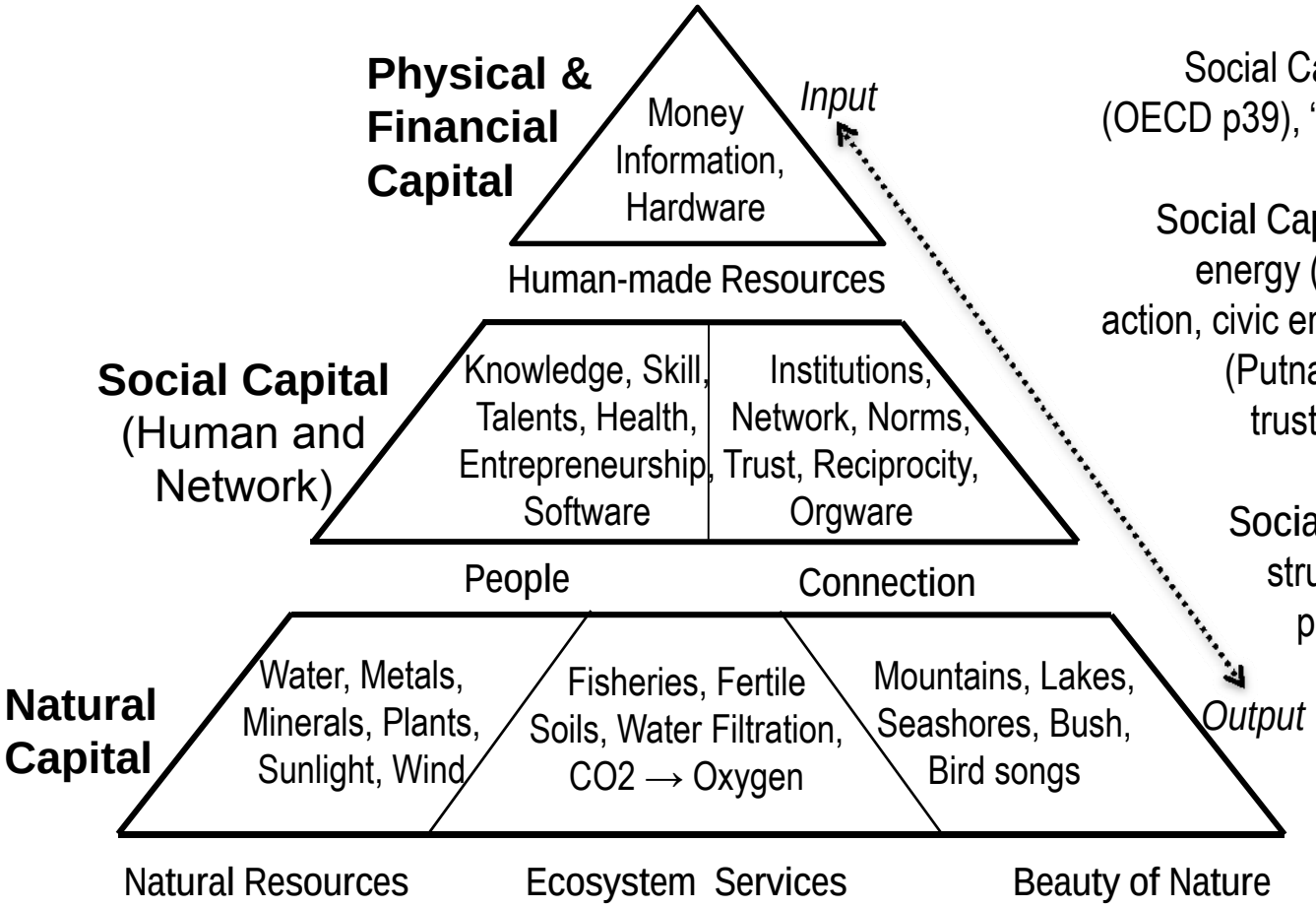


TSE Pyramid: Our existence is dependent upon the services provided by nature

Sustainability is about maintaining long-term and continued healthy balance between technology, human society, economy & the environment

Enlarging the scope of human activity (technology, society, economy) may compromise the environment's ability to support human activity

Community Resources: Physical, Social & Natural Capitals



Reproduced from Hart 1998, with some modifications.

Social Capital "resides in social relationship" (OECD p39), "network has value" (Putnam 2000).

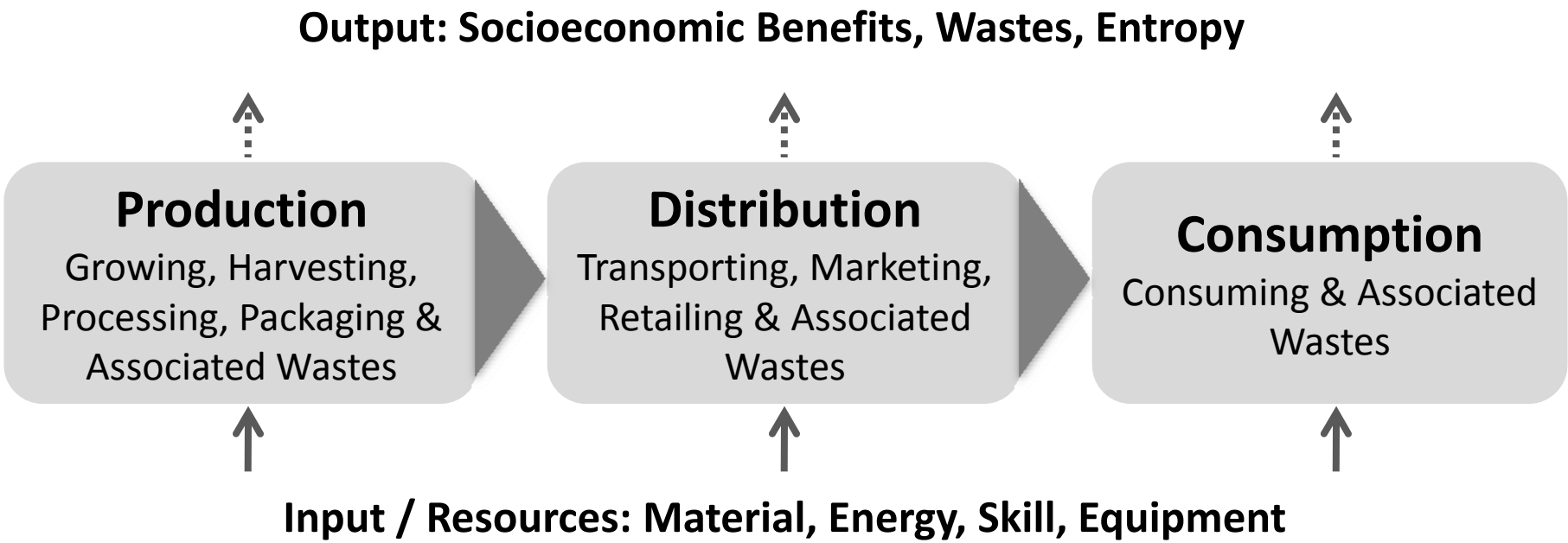
Social Capital elements: Membership, social energy (Bourdieu 1986); network, collective action, civic engagement, norms, trust, reciprocity (Putnam 2000); obligations, expectations, trustworthiness (Coleman 1988), ethics.

Social Capital nature: Bonding/bridging. structural/cognitive; inclusive/exclusive positive/negative; resource/outcome.

SC of Timothy McVeigh, 9/11, Bali Bombing: Network of a social group bound by norms, trust, expectations & obligations that "enable (them) to do what (they) could not have done alone" (Putnam 2000, p21).

Social Capital: Dynamic resources in both structural (institutions, network) & cognitive (norms, trust, reciprocity) terms which, subject to the ways in which they are used, may cause social capital to increase, decrease or remain constant overtime (Retnanestri 2007, p68).

Example: Food (Energy) Chain



Our existence is dependent upon the services provided by nature

Entropy: Degraded matter or energy

Technology: Hardware – Software – Orgware Compound

(Retnanestri 2007)

Wilkins 2002 (in Retnanestri 2007 p54)**, IIASA 2006:**

- Hardware: Equipment, artefacts
- Software: Knowledge required to manufacture, install, operate & maintain the equipment
- Orgware: Institutional framework & rules in which the hardware & software can function

Cultural Capital (Bourdieu 1986), viewing technology as cultural goods:

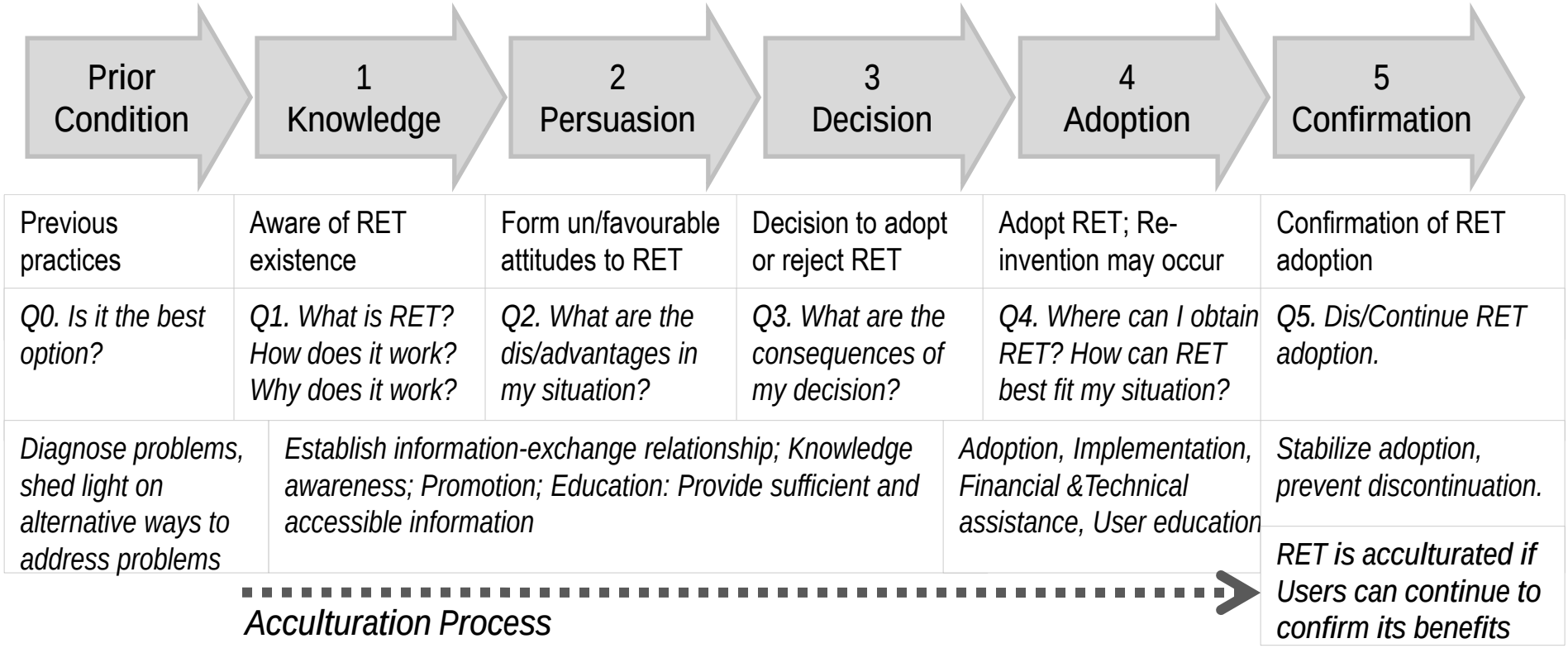
- Objectified Cultural Capital: "realization of theories" eg pictures, equipment, machines (*physical capital, hardware*); One only needs access to economic capital to possess it
- Embodied Cultural Capital: "long-lasting dispositions of mind and body" the acquisition of which requires "time and effort" (*human capital, knowledge, software*)
- Institutionalized Cultural Capital: educational qualifications to acquire embodied cultural capital *(part of orgware in which skill and knowledge can be acquired if access is available)*

Diffusion of Innovation: Acculturation Process

- **Innovation:** “An idea, practice or object that is perceived as new” by its adopters (Rogers 2003 Retnanestri 2007 p56)
- **Acculturation:** ”A merging of cultures as a result of prolonged contact” www.merriam-webster.com
- **Diffusion of Innovations:** “The process in which an innovation is communicated through certain channels over time among the members of a social system” Rogers (1995, 2003).
- **Diffusion** is “a kind of social change: the process by which alteration occurs in the structure or function of a social system” (Rogers 2003 Retnanestri 2007 p56)
- **Innovation Decision Process** (Rogers 2003 pp 168-179): Knowledge, Persuasion, Decision, Implementation/Adoption, Confirmation
- Labelled here as the KPDAC Continuum to understand the stages in innovation acculturation process

Exp: The KPDAC Continuum & Acculturation Process of RET

Developed and modified from the Rogers (2003)'s concept of innovation decision stages (Retnanestri 2007)



The KPDAC continuum:

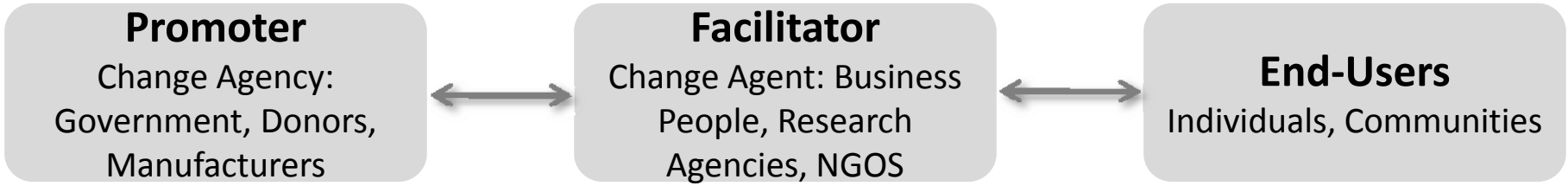
- Interweaving of hardware-software-orgware that explains the what, why, who, how involved in the RET acculturation process, as well as its success or failure
- This continuum may be cyclic

DOI & Social System

Diffusion of Innovations: "The process in which an innovation is communicated through certain channels over time among the members of a social system" Rogers (1995, 2003).

Social System: "A set of interrelated units that are engaged in joint problem solving to accomplish a common goal" (Rogers 2003, p23).

RET Delivery Social System *(Indonesian RE case studies, Retnanestri 2007)*



Social System of food, energy or other products, utilities or services

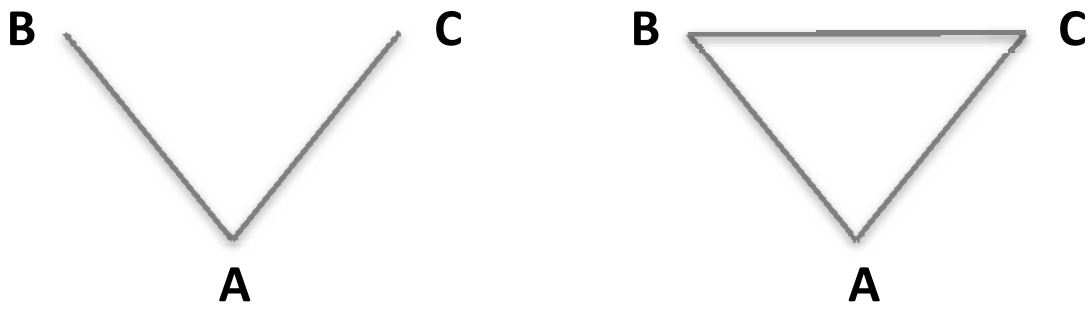
(Example: March 2010 Cornell Workshop – Exploring Linkages between Sustainability of Smallholder Food Value Chains and Poverty Alleviation in Low Income Countries)

Countries, social system within universities, communities , your group, etc

Civic Network & Social Field / Social Arena

- **Civic Network** is characterized by consensus, active involvement of well-informed and capable participants, and good governance based on trust, norms and obligations among its members
- **Some conditions for active participation**:
  - Ability to participate
  - Structure of social system that allows participation (rules, norms, relationship)
- Bourdieu 1986, Coleman 1988: Individual actor mobilizes social relationship to advance their interests and will continue to do so if the relationship continues to provide benefits
- Members of social system can be **heterophilous** (Rogers 2000): Different position, interests and capacity (financial, technical, social, institutional) → uneven distribution of capacity, authority
- Social system may turn into a **field of social** struggle (Bourdieu 1986) between conflicting interests and or actors, noting that actors' "principle of action" is based on "maximizing utility" (Coleman 1988) → battleground of differing interests → "seedbed of social conflict" (Siisianien 2000)

Norms & Closure of a Structure



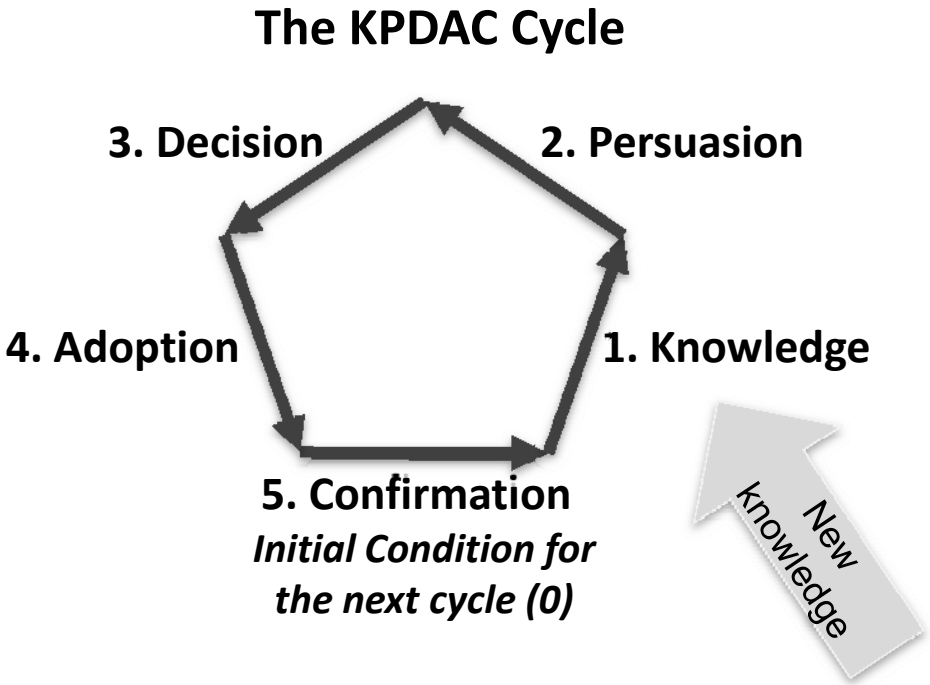
Network 1) without "closure" and 2) with "closure"

(Reproduced from Coleman 1988 with slight modification)

- Agreed norms limit negative external effects & encourage positive ones (Coleman 1998). Norms can or cannot exist depending on the "closure" of the social structure: *In an open structure A may impose externalities upon B or C or both without B & C being able to sanction A (unless sufficiently harmed & powerful to take sole action against A). In a close structure, B & C can combine to provide collection sanction to A or reward the other for sanctioning A*
- Copenhagen, RET Delivery, REDD, CDM, ETS, CCS, Fair trade, Wall-mart:
  - A civic network (Putnam) or a (un-civic) social field (Bourdieu)?
  - Social Capital: Bonding or Linking? Exclusive or Inclusive? Positive or Negative?

Summary: Innovation, Sustainability

Change from Old to New Practices	
Smoking	Not smoking?
No electricity; Conventional electricity	RET? Energy efficiency? Smart, Intelligent Grid?
Climate-changing practices	ETS? CDM? REDD? CCS? Sulphur injection? GM food? Organic food? Frugality?



1. **Acculturation process**: Hardware – Software – Orgware: What, why, who, how at each stage of the KPDAC continuum
   - *Institutional*: Stakeholders, network, objectives, roles, norms, strategy, policy
   - *Financial*: Cost, benefit, funding scheme
   - *Technological*: Hardware, software, innovation scheme/design
   - *Social: Socioeconomic benefits/ issues*
   - *Ecological: Ecological benefits/ issues*
2. **Civic network** (active participation, capacity to participate, norms, trust, governance, closure of structure) or **Social field** (battleground of differing interests)?
3. **Sustainability:** Sustainable? TSE impact? (technology on society, societal needs on technological development, environment?)
4. Is that innovation useful? Is it or is it just a coke bottle thrown at the society?

Current state of play: civic network or social field?

http://commons.wikimedia.org/wiki/File:HomelessParis_7032101.jpg

Sustainability – definition & issues

- Many definitions – here we will say:
  - Sustainable societies do not violate critical social, economic, environmental or technical constraints
  - A total society's impact in a particular category (e.g. CO_2, resource depletion, etc.):

    = population x (average per-capita impact)
- Threats to sustainability arise from:
  - Growth in population and/or per-capita use
    - Exponential growth in either is unsustainable:

Exp growth rate (%/year)	1	2	3	5	10
Doubling time (approx. years)	70	35	25	14	7

Earth's Carrying Capacity:

If we had more planets… (WWI, 12 January 2010)

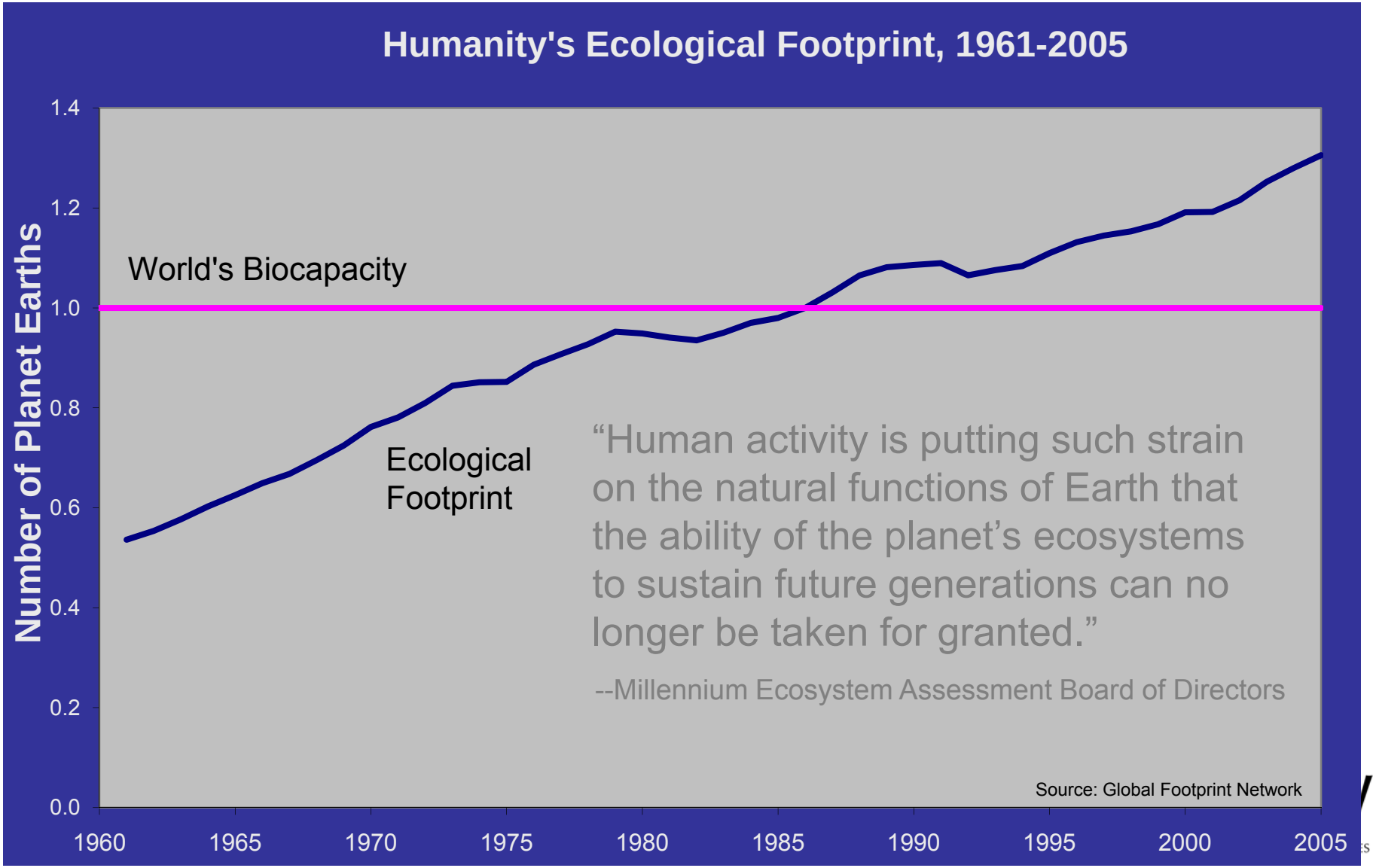
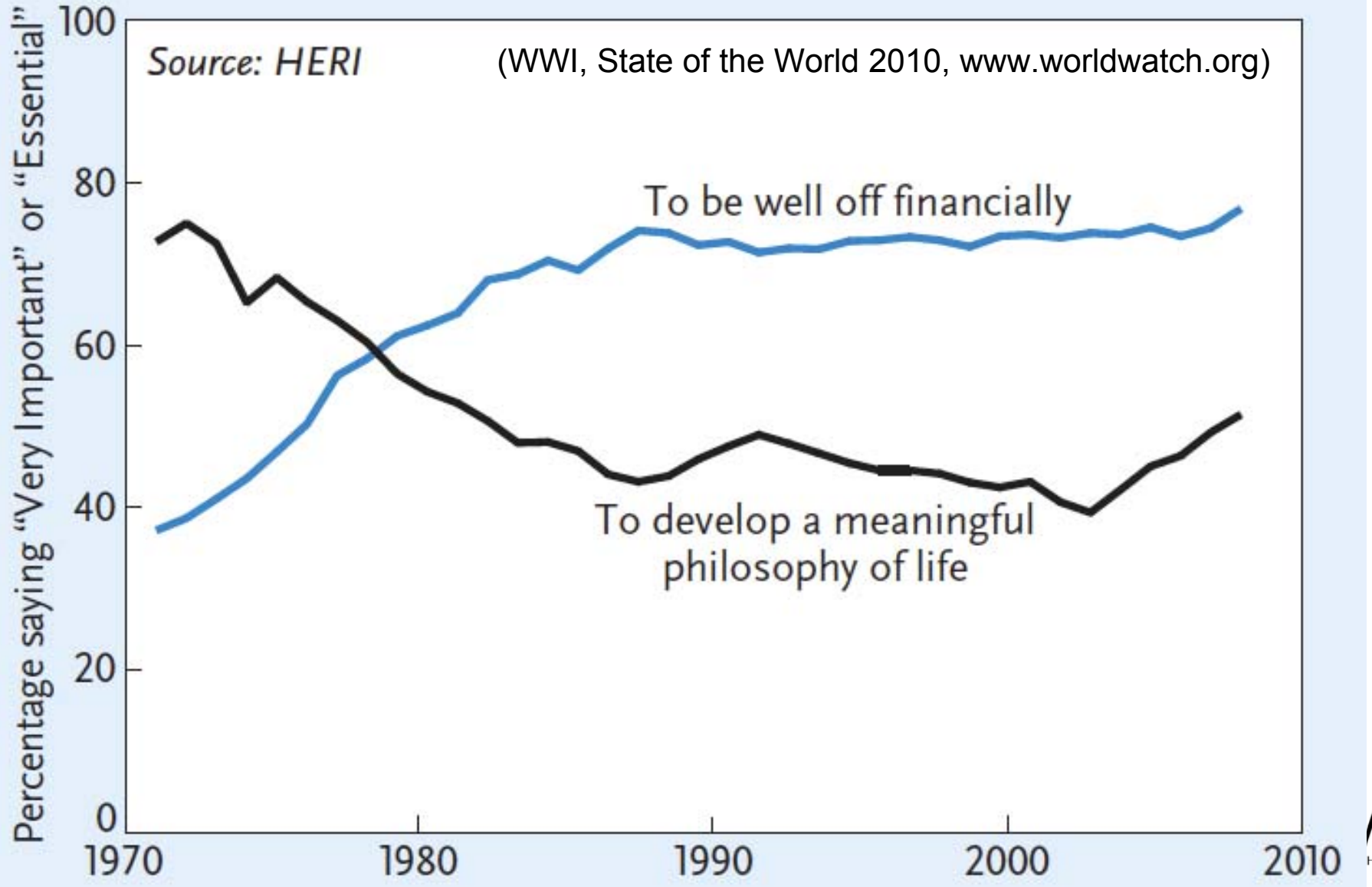


Figure 2. Aspirations of First-Year College Students in the United States, 1971–2008



Siemens perspective on global challenges (Sept 08)

Demographic Dynamics

- **Population growth:** 7.5 bill. in 2020 (+1.1 bill.)
- **Power consumption:** +5.2% p.a. in emerging regions versus 1.4% in developed world
- **Urbanization & megacities (>10 million):** 22 megacities by 2015

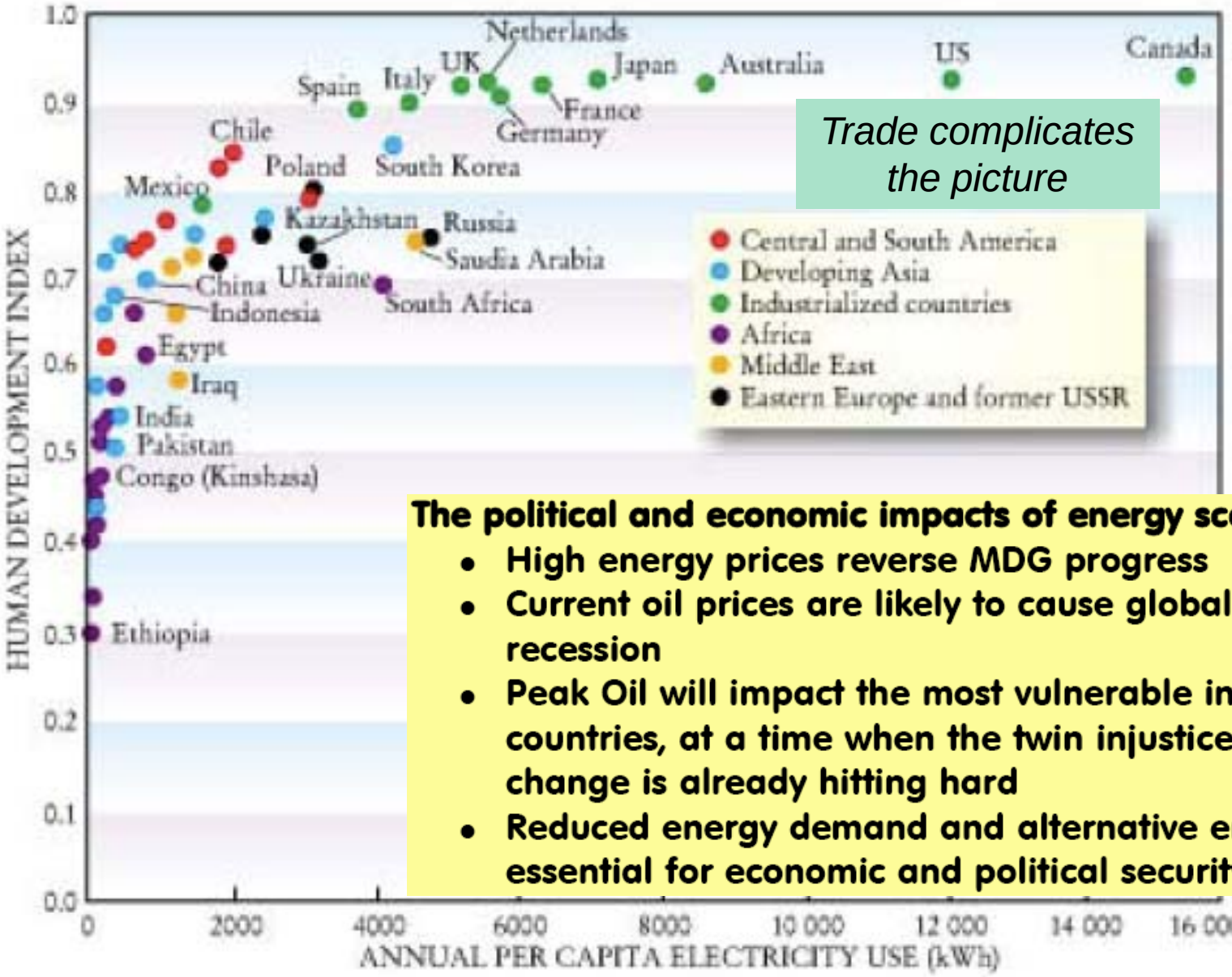
Resource Scarcity

- **Geopolitics:** 70% of world's oil and gas reserves concentrated only in a few countries
- **Fuel diversification:** Steadily rising oil prices accelerate the shift to a broader fuel mix

Environmental Focus

- **Climate change:** Global warming is a fact and poses a threat to mankind and the biosphere
- **Air pollution:** Air pollution has intensified worldwide

Sources: UN; IEA; BP; BGR; Siemens; figures based on year 2006



Trade complicates the picture

"The impact of Peak Oil on International Development" (RESET, 2008)

The political and economic impacts of energy scarcity

- **High energy prices reverse MDG progress**
- **Current oil prices are likely to cause global economic recession**
- **Peak Oil will impact the most vulnerable in developing countries, at a time when the twin injustice of climate change is already hitting hard**
- **Reduced energy demand and alternative energy sources are essential for economic and political security**

Figure 3. Paternak, Global Energy Futures and Human Development: A Framework for Analysis, Lawrence Livermore National Laboratory rep no: UCRL - ID- 140773, October 2000. *Provided by:* Practical Action

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Quotations from Australian Defence White Paper, 2009

- Beyond our region, Australia cannot be secure in an insecure world. We have a strategic interest in preserving an international order that restrains aggression by states against each other, and can effectively manage other risks and threats, such as the proliferation of WMD, terrorism, state fragility and failure, intra-state conflict, and the security impacts of climate change and resource scarcity. (p 12)
- In the past decade we have also become increasingly more conscious of the potential security impacts of changing climate patterns, resource and energy scarcity, and persistent patterns of poverty and poor governance in many parts of the world (p 16)
- Changing climate patterns, combined with booming population growth, will sharpen competition for scarce food, water and energy resources in many parts of the world (p 31)
- It may be that the new potential sources of conflict related to our planet's changing climate, or resource scarcity, give rise to very old forms of confrontation and war, such as clashes between states over resources (p 40)

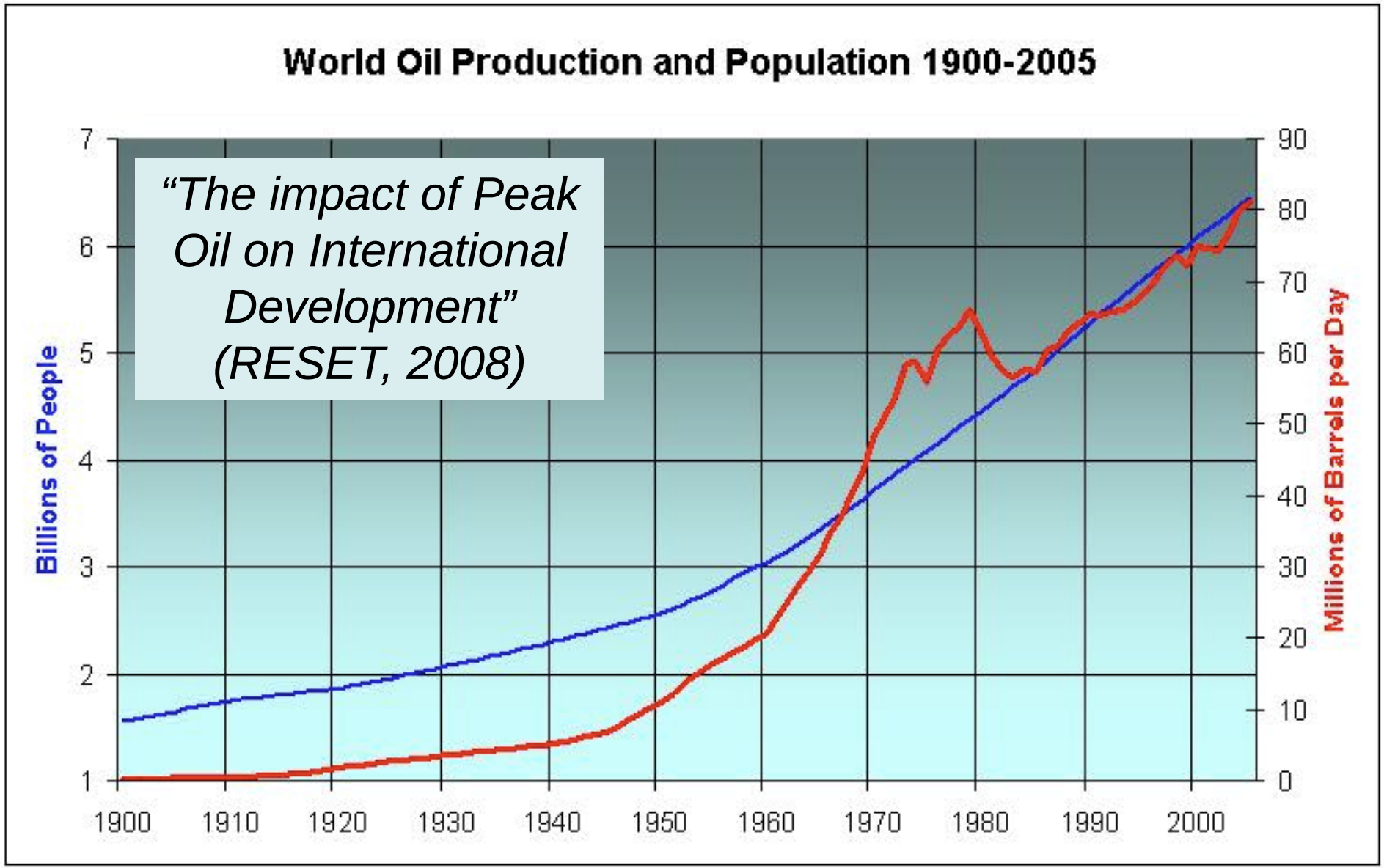
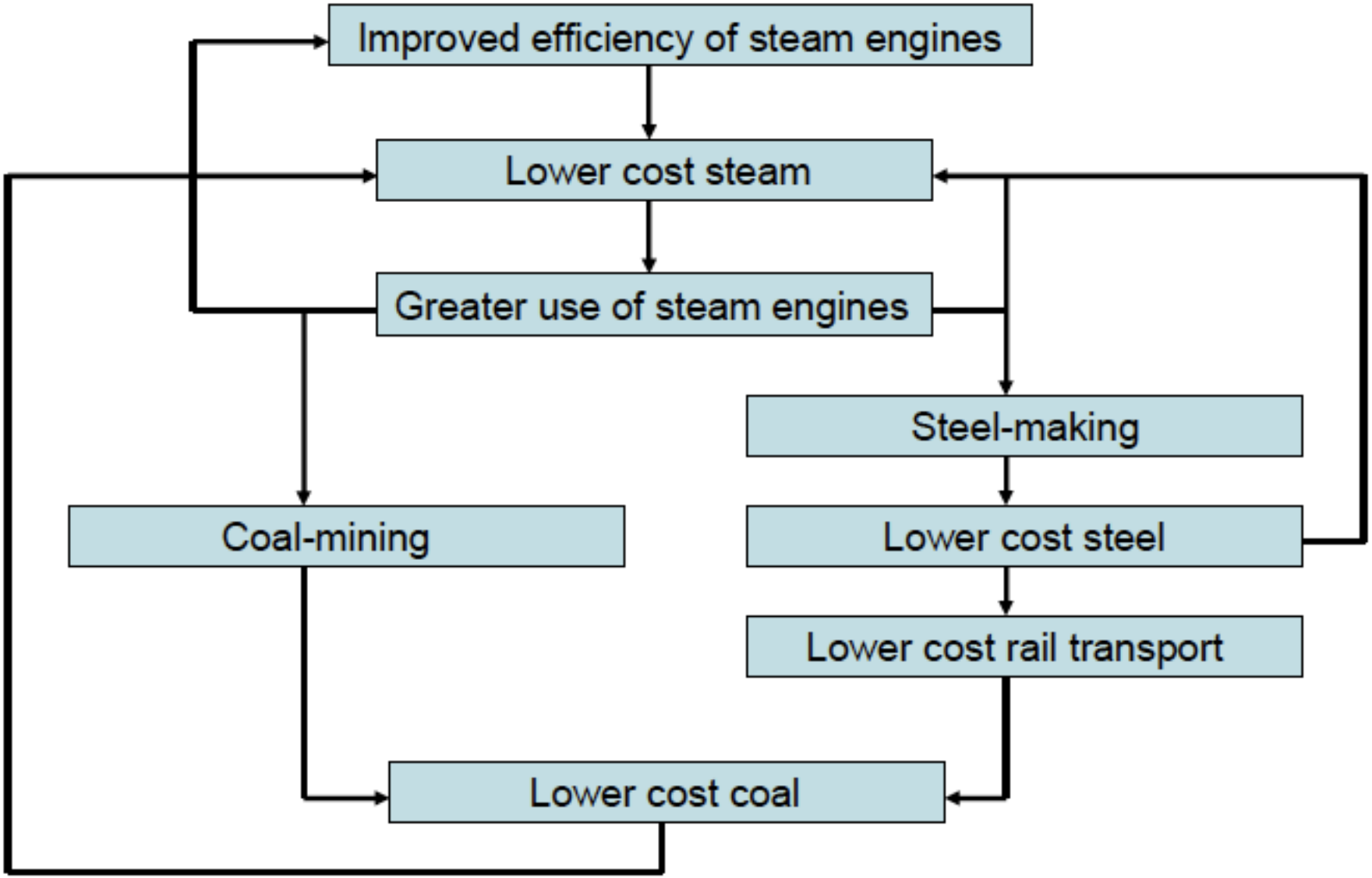


Fig. 1: World Population and Oil Production
(Source: Chefurka, P. *World Energy and Population Trends to 2100*)

Positive feedbacks in the industrial revolution

(Sorell, Energy, Growth & Sustainability, 2010)



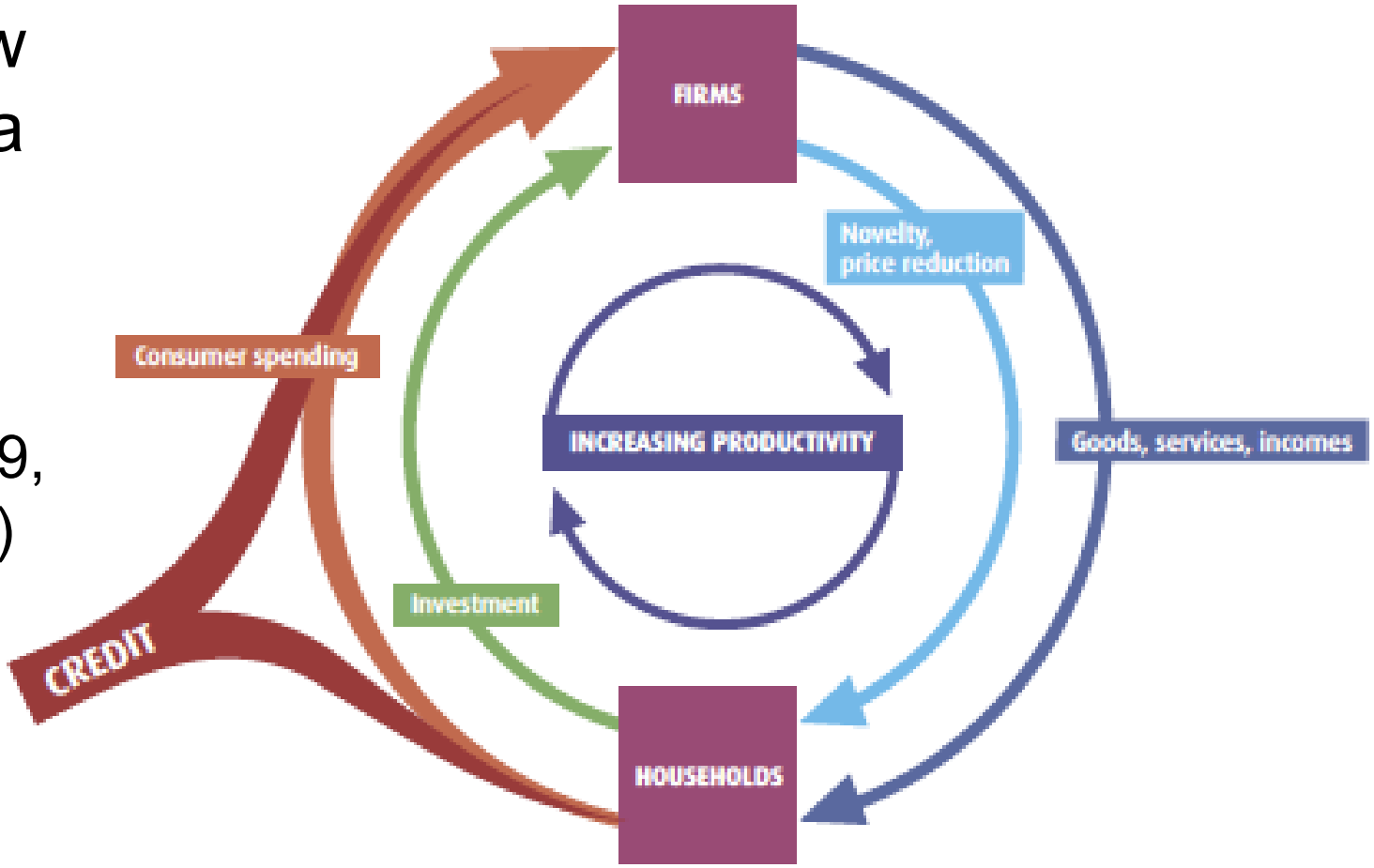
Sorell, Energy, Growth & Sustainability, 2010

Table 1 Orthodox and ecological perspectives on energy, productivity and economic growth

	Orthodox view	Ecological view
Main source of productivity improvements	Exogenous or endogenous technical change	Increasing availability of high-quality energy, both directly and embodied in capital equipment and technology
Marginal productivity of energy inputs	Proportional to share of energy in the value of output	Greater than the share of energy in the value of output
Input substitution in production	Scope for substitution indicated by substitution elasticities estimated at the sector level	Scope for substitution overestimated by substitution elasticities estimated at the sector level, since these neglect embodied energy
Decoupling of energy consumption from GDP	Decoupling has already occurred in OECD economies and there is considerable scope for further decoupling	Conventional measures of energy inputs overstate the amount of decoupling. A strong link exists between *quality adjusted* energy use and economic output and will continue to exist, both temporally and cross-sectionally.
Economy-wide rebound effect	Likely to be small	Likely to be large

Source: Cleveland, *et al*.(1984); Ayres and Warr (2005)

Circular flow of funds in a private enterprise economy (Jackson, 2009, Sorrell, 2010)



- Investment by firms increases the quantity or quality of goods/services they can supply
- If they have money, consumers will buy more goods/services or pay more for higher quality
- Firms can then employ more workers or pay existing workers more
- Households can then earn more and can thus buy/pay more but only after a lag
- Credit (debt) is used to bridge the inter-temporal gap
- If creditors want interest on the money they lent, money supply must increase
- The real economy must expand with money supply to maintain a one-to-one relationship
- The real economy can't continue to expand if physical constraints bind

Niall Ferguson, *Complexity & Collapse,* Foreign Affairs, April 2010

Over the last three years, the complex system of the global economy flipped from boom to bust -- all because a bunch of Americans started to default on their subprime mortgages, thereby blowing huge holes in the business models of thousands of highly leveraged financial institutions. The next phase of the current crisis may begin when the public begins to reassess the credibility of the monetary and fiscal measures that the Obama administration has taken in response. Neither interest rates at zero nor fiscal stimulus can achieve a sustainable recovery if people in the United States and abroad collectively decide, overnight, that such measures will lead to much higher inflation rates or outright default. As Thomas Sargent, an economist who pioneered the idea of rational expectations, demonstrated more than 20 years ago, such decisions are self-fulfilling: it is not the base supply of money that determines inflation but the velocity of its circulation, which in turn is a function of expectations. In the same way, it is not the debt-to-GDP ratio that determines government solvency but the interest rate that investors demand. Bond yields can shoot up if expectations change about future government solvency, intensifying an already bad fiscal crisis by driving up the cost of interest payments on new debt. Just ask Greece -- it happened there at the end of last year, plunging the country into fiscal and political crisis.

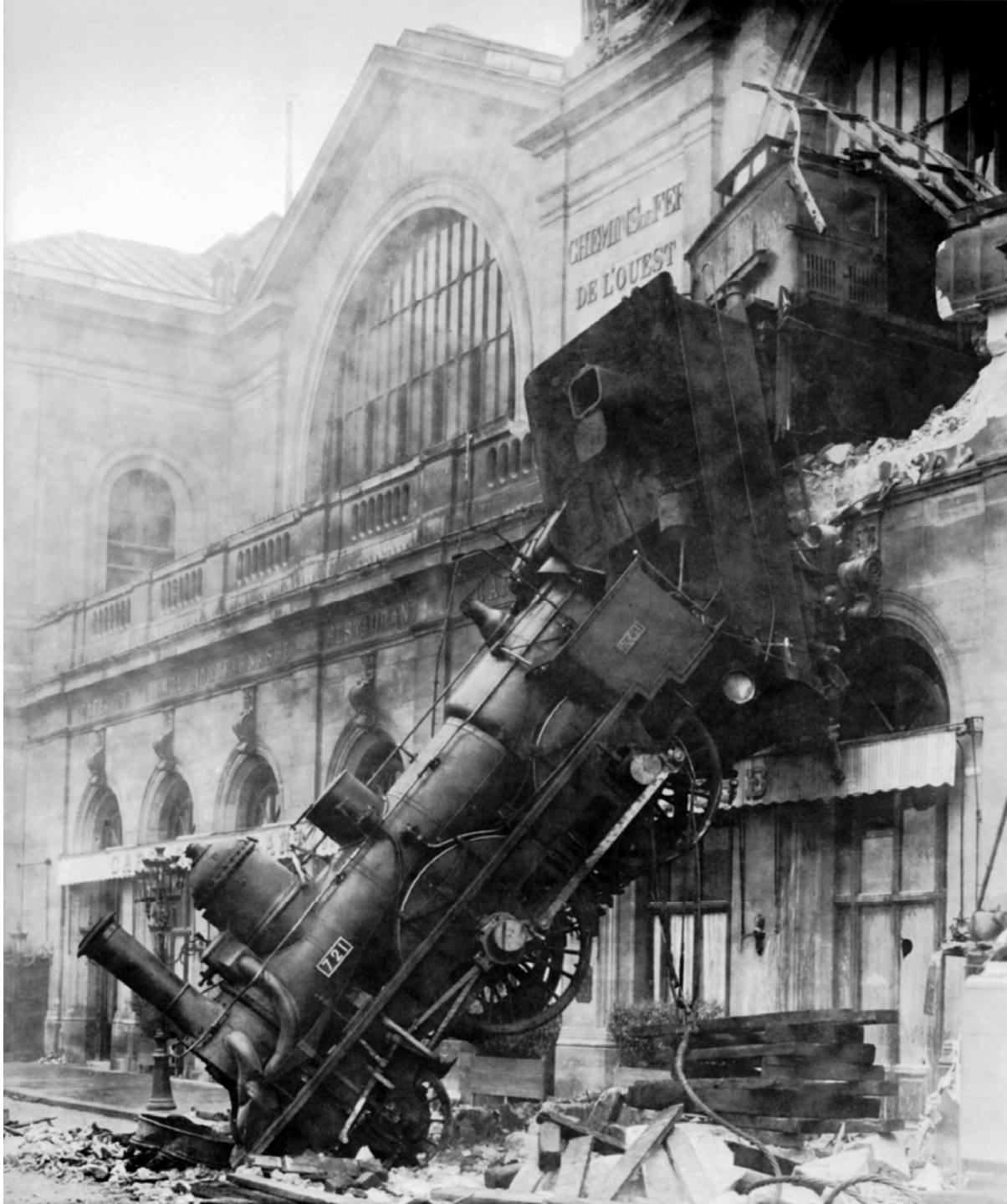
Niall Ferguson, *Complexity & Collapse,* Foreign Affairs, April 2010

The sun set on the British Empire almost as suddenly. In February 1945, Prime Minister Winston Churchill was at Yalta, dividing up the world with U.S. President Franklin Roosevelt and Soviet Premier Joseph Stalin. As World War II was ending, he was swept from office in the July 1945 general election. Within a decade, the United Kingdom had conceded independence to Bangladesh, Bhutan, Burma, Egypt, Eritrea, India, Iran, Israel, Jordan, Libya, Madagascar, Pakistan, and Sri Lanka. The Suez crisis in 1956 proved that the United Kingdom could not act in defiance of the United States in the Middle East, setting the seal on the end of empire. Although it took until the 1960s for independence to reach sub-Saharan Africa and the remnants of colonial rule east of the Suez, the United Kingdom's age of hegemony was effectively over less than a dozen years after its victories over Germany and Japan.

“A defective brake or a sleeping driver can be all it takes to go over the edge of chaos” (Niall Ferguson, 2010)

Train wreck at Montparnasse, Paris, 1895

(photo: http://en.wikipedia.org/wiki/File:Train_wreck_at_Montparnasse_1895.jpg)



World's People's Conference on Climate Change & the Rights of Mother Earth, April 2010: People's Agreement

We confront the terminal crisis of a civilizing model that is patriarchal and based on the submission and destruction of human beings and nature that accelerated since the industrial revolution.

The capitalist system has imposed on us a logic of competition, progress and limitless growth. This regime of production and consumption seeks profit without limits, separating human beings from nature and imposing a logic of domination upon nature, transforming everything into commodities: water, earth, the human genome, ancestral cultures, biodiversity, justice, ethics, the rights of peoples, and life itself.

Under capitalism, Mother Earth is converted into a source of raw materials, and human beings into consumers and a means of production, into people that are seen as valuable only for what they own, and not for what they are.

World's People's Conference on Climate Change & the Rights of Mother Earth, April 2010: People's Agreement

It is imperative that we forge a new system that restores harmony with nature and among human beings. And in order for there to be balance with nature, there must first be equity among human beings. We propose to the peoples of the world the recovery, revalorization, and strengthening of the knowledge, wisdom, and ancestral practices of Indigenous Peoples, which are affirmed in the thought and practices of "Living Well," recognizing Mother Earth as a living being with which we have an indivisible, interdependent, complementary and spiritual relationship. To face climate change, we must recognize Mother Earth as the source of life and forge a new system based on the principles of:

- harmony and balance among all and with all things;
- complementarity, solidarity, and equality;
- collective well-being and the satisfaction of the basic necessities of all;
- people in harmony with nature;
- recognition of human beings for what they are, not what they own;
- elimination of all forms of colonialism, imperialism and interventionism;
- peace among the peoples and with Mother Earth;

The Garnaut Climate Change Review, 2008, Ch 1, p3 & p5

"Economic development over the past two centuries has taken most of humanity—but certainly not all—from lives that were insecure, ignorant and short, to personal health and security, material comfort and knowledge unknown to the elites of the wealthiest and most powerful societies in earlier times."

"It is clear from the present state of knowledge—as it was not to earlier generations—that it would be possible for humanity to break the link between economic growth and combustion of fossil fuels. This would make it possible for the world economy to adjust to the approach of economically relevant limits to fossil fuel availability, without bringing the increase in human consumption of goods and services to an end."

The Garnaut Climate Change Review, 2008, Ch 1, p 4

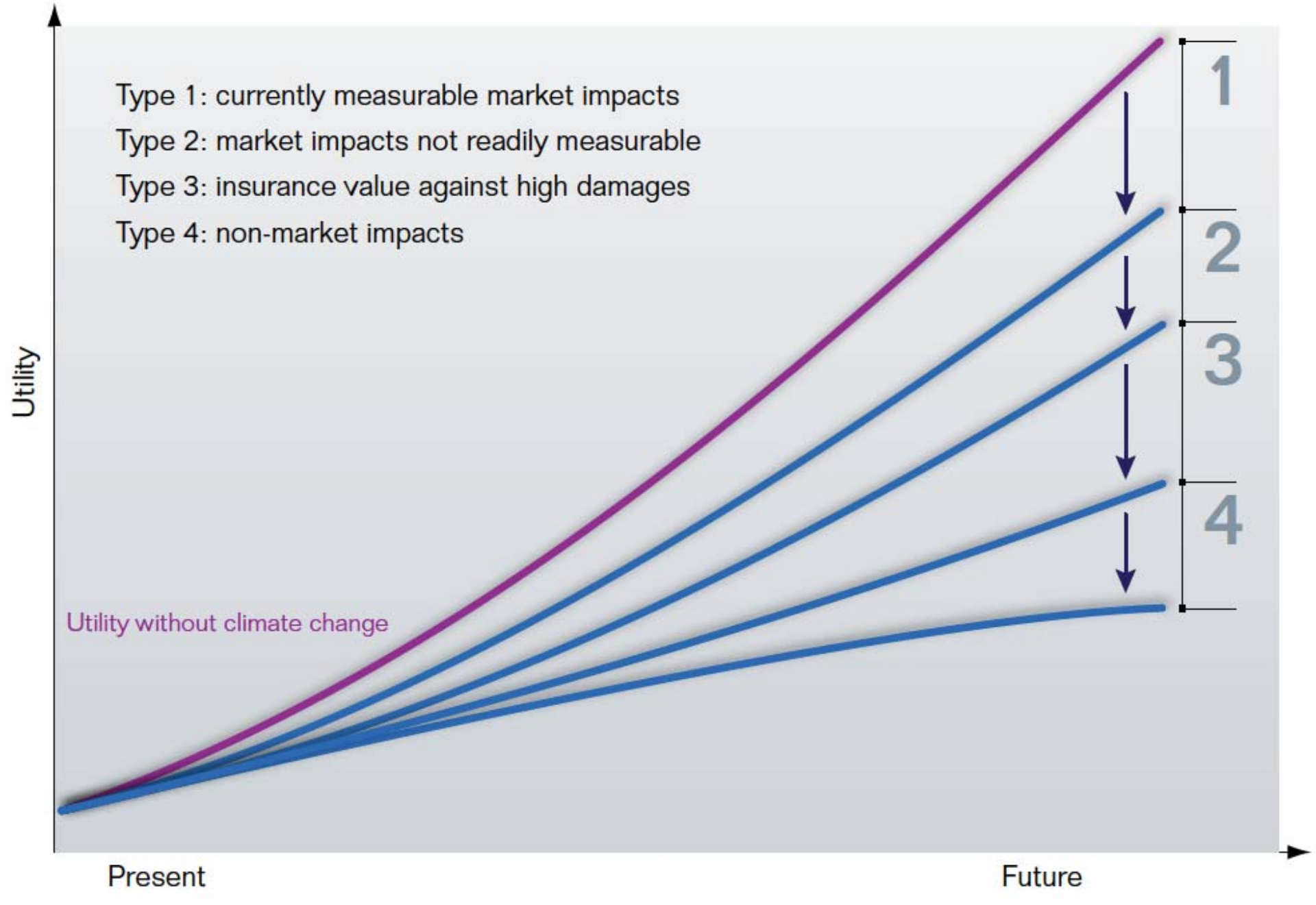
"A new era began in the fourth quarter of the last century, with the rapid extension of the beneficent processes of modern economic development into the heartland of the populous countries of Asia, including China, India and Indonesia. From this has emerged what can be described as the Platinum Age of global economic growth in the early 21st century (Garnaut & Huang 2007). Incomes are growing rapidly in a large proportion of the developing world. In the absence of a major dislocation of established trends, this is likely to continue for a considerable period. There will be a greater absolute increase in annual human output and consumption in the first two decades of the 21st century than was generated in the whole previous history of our species. Similarly strong growth in output can be expected in the next following decade to 2030."

The Garnaut Climate Change Review, 2008, Ch 1, p 6

"A dramatic transformation in humanity's use of fossil-fuel-based energy would be necessary sooner or later to sustain and to extend modern standards of living. It will be required sooner if the world is to hold the risks of climate change to acceptable levels. The costs incurred in making an early adjustment will bring forward, and reduce for future times, the costs of the inevitable adjustment away from fossil fuels. How much sooner and at what extra cost are central questions before the Review.

The costs of mitigation depend on the extent to which, and the time over which, reductions in emissions are achieved. Costs depend on the efficiency of the chosen policy instruments. There are cost advantages in having a single price on emissions as the main instrument of policy, supported by measures to correct market failures in utilisation of the commercial opportunities created by the price on emissions"

Garnaut Report, Figure 1.3



(Grattan Institute, April 2010)

Overview

Like much of the world, Australia has debated putting a price on carbon emissions (a "carbon price") with an emissions trading scheme or tax. These aim to induce structural change in the economy that will reduce greenhouse gas emissions.

The Australian debate has been dominated by concerns that Australia might lose industry and jobs offshore if it has a carbon price when competitor countries do not. If Australian production moves to countries with *higher* emissions (carbon leakage), this would defeat the purpose of carbon pricing. To protect industry from such an event, government plans to provide some industries with free carbon permits.

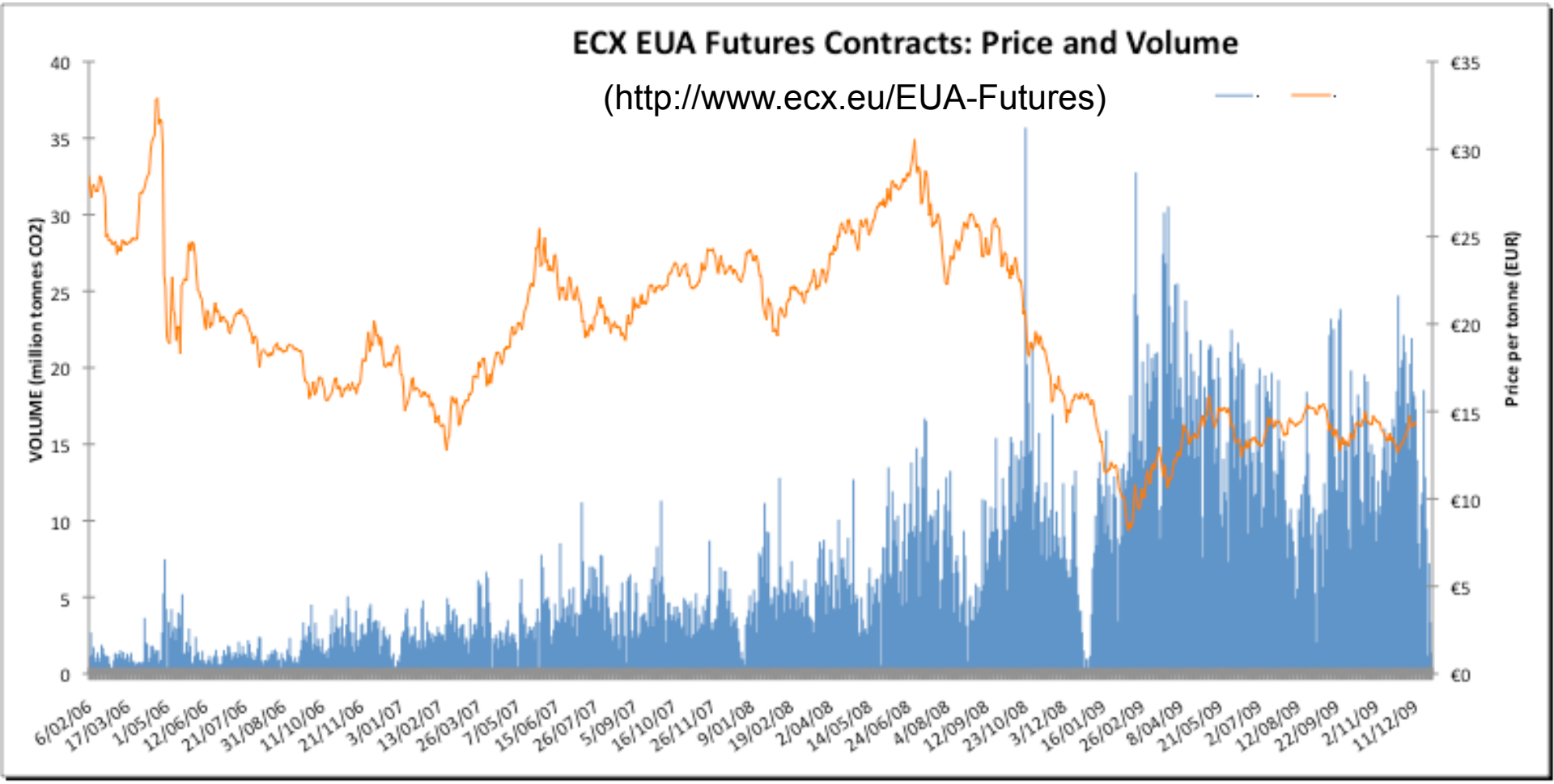
We find that **much of the protection proposed for the major emissions-intensive industries is unnecessary or poorly targeted**. It would delay the structural adjustment required to move to a lower carbon economy.

- Several industries, such as **alumina refining, LNG production and most coal mining**, will be less profitable, but still internationally competitive. Shielding these industries imposes large costs on the rest of the community and can discourage the economy from efficiently adjusting to produce less carbon. "Compensating" these producers is contrary to general principles that industry is not compensated for changes to environmental or health and safety regulation.
- Free permits or other assistance would be justified for **steel and cement**. A carbon price could force these industries offshore to locations that would not have substantially lower greenhouse emissions. Intervention to prevent such perverse outcomes is appropriate. However, there should be ongoing monitoring of the type and level of assistance required by an independent body such as the Productivity Commission.
- Australia should provide targeted assistance to the individual workers and communities reliant on industries such as **aluminium, and oil refining.** These industries may well be forced offshore by carbon pricing, but they are likely to move to locations where they will emit substantially less greenhouse gases. The very purpose of carbon pricing is to promote this result. Assistance should be provided to the workers and communities affected to enable them to adjust successfully to an economy with carbon emission constraints.

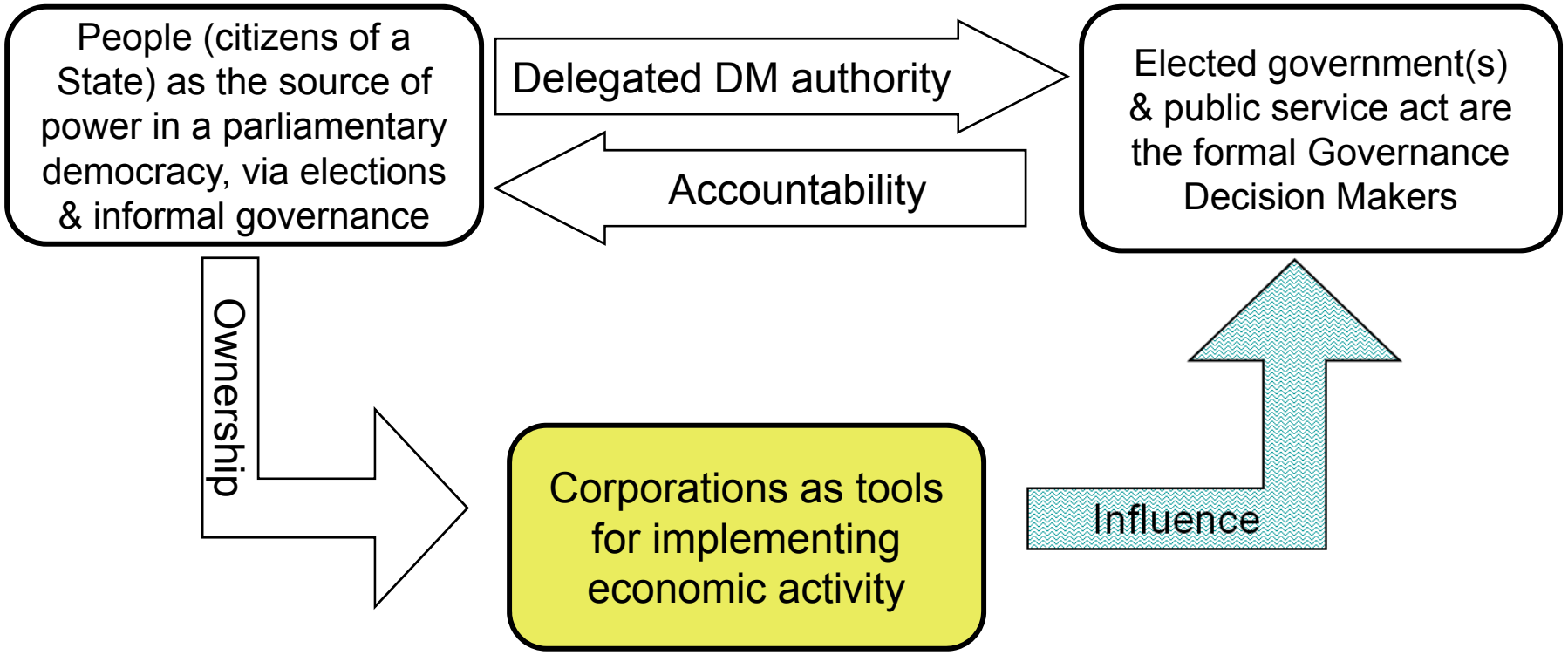
For the **bulk** of the economy a carbon price would have only **minor impacts on costs and competitiveness** - smaller than other factors such as exchange rates, labour market costs, and fuel prices. Compared to other economic reforms, such as reduction in tariff protection over the 1980s and 1990s, a carbon price requires relatively little structural adjustment.

Consequently, we find that concerns about industry competitiveness are misplaced, and **no reason to delay introducing a carbon price**. The adjustments for emissions-intensive industries are manageable and inevitable if we are ultimately to constrain carbon emissions. Australia would be better to start restructuring its economy for the inevitable rather than persisting with an economy not structured for a carbon-constrained future.

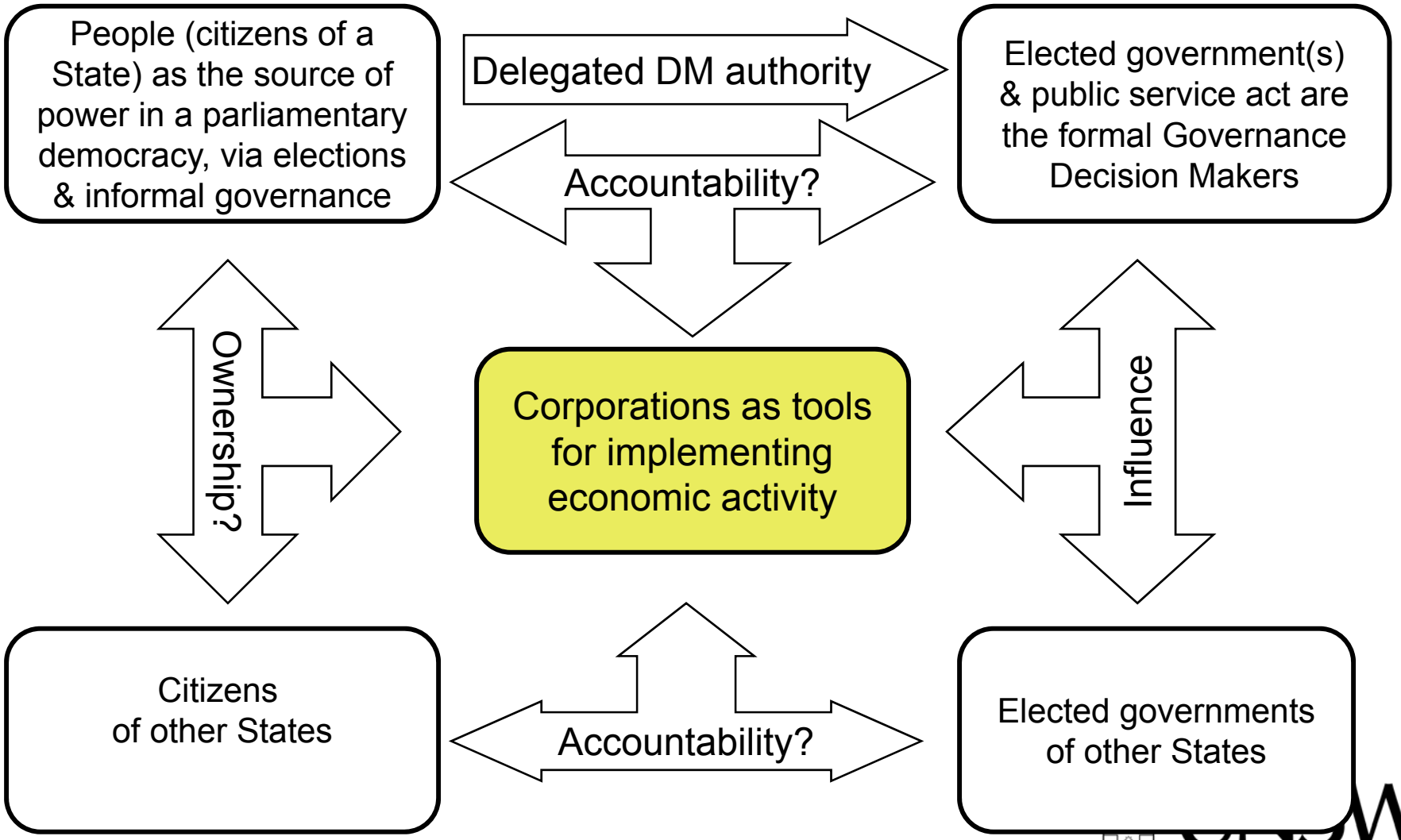
Emission trading – EUA futures contract prices, 2006-2009



Governance in an isolated, “pure” parliamentary democracy has the potential for closure to form a civic network



Governance in a global context: unlikely that there will be closure to form a civic network

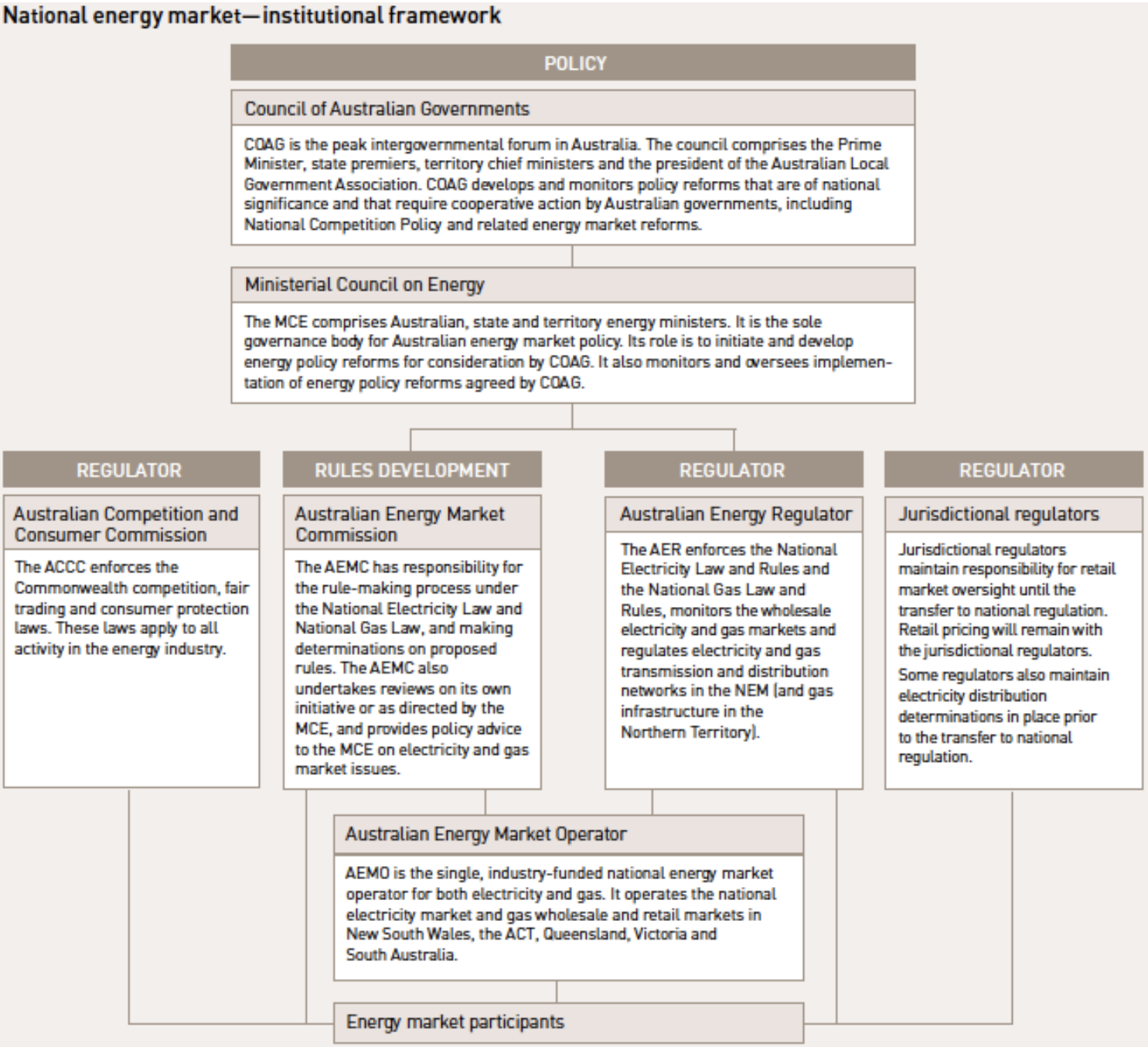


Decision-making framework for a competitive electricity industry

Governance regime	▪ Formal institutions, legislation & policies ▪ *Informal social context including politics*
Security regime	▪ Responsible for core integrity on local or industry-wide basis, with power to override
Technical regime	▪ To allow connected industry components to function as industry-wide machine
Commercial regime	▪ To coordinate decentralised decision-making according to commercial criteria ▪ Includes formally designed markets

Governance regime for the Australian stationary energy sector (AER, 2009)

Consistent governance for electricity & gas



Dr. Maria Retnanestri

Dr. Maria Retnanestri completed her undergraduate degree in Electrical Engineering at STTNAS Jogjakarta, Indonesia in 1991. Maria was awarded her Master of Engineering Science (MEngSc) and PhD degrees at the School of Electrical Engineering & Telecommunications, the University of New South Wales (UNSW), Sydney, Australia, in October 1999 and November 2007 respectively.

In her PhD research, Maria Retnanestri developed the I3A (Implementation, Accessibility, Availability and Acceptability) Framework to investigate overall sustainability of renewable energy projects, considering their institutional, financial, technological, social and ecological sustainability dimensions.

Currently she is on leave from STTNAS Jogjakarta College as a Postdoctoral Research Associate at UNSW funded by an Australian Development Research Award (ADRA) 2007 to identify ways to overcome barriers to renewable energy for sustainable development in developing countries.

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Hugh retired in 2007 after a 35-year career at UNSW, most recently as Presiding Director, Centre for Energy and Environmental Markets and Head, Electrical Energy Research Group, School of Electrical Engineering and Telecommunications.

During his career, Hugh has been a Fulbright Senior Fellow at the University of California Berkeley, a Board Member of the Australian Cooperative Research Centre for Renewable Energy, an Associate Director of UNSW's Centre for Photovoltaic Devices and Systems, a Member of CSIRO's Energy Flagship Advisory Committee, a Member of the National Electricity Tribunal and a Member of the New South Wales Licence Compliance Advisory Board.

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