



Centre for Energy and  
Environmental Markets

**UNSW**  
THE UNIVERSITY OF NEW SOUTH WALES  
SYDNEY • AUSTRALIA



# Energy Markets and Climate Change

IEST5011: Managing the Greenhouse, *July 2005*

Iain MacGill



## CEEM established ...

- *to formalise* growing interest + interactions between UNSW researchers in Engineering, Commerce + Economics... + more
- *through UNSW Centre* providing Australian research leadership in interdisciplinary design, analysis + performance monitoring of energy + environmental markets, associated policy frameworks
- *in the areas of*
  - Physical energy markets (with an initial focus on ancillary services, spot market + network services for electricity + gas)
  - Energy-related derivative markets (financial + environmental including interactions between derivative and physical markets)
  - Policy frameworks and instruments in energy and environment
  - Experimental market platforms and AI 'intelligent agent' techniques to aid in market design
  - Economic valuation methodologies



# Markets

- A **market** is a mechanism which allows people to trade, normally governed by the theory of supply and demand, so allocating resources through a price mechanism and bid and ask matching so that those willing to pay a price for something meet those willing to sell for it. *In some fields of study, a market is assumed to be only this mechanism. However that is an extreme ideological position ....* (Wikipedia.org)
- **In essence, one possible framework for decision-making**



# Decision making

- A **decision** is the commitment to irrevocably allocate valuable resources *with consequences*. **Decision making** is the cognitive process of selecting a course of action from among multiple alternatives. (Wikipedia.org)
- Decision-making framework
  - What decisions (*available choices*)
  - How are they taken (*process*)
  - Who takes them (*individuals, groups – always challenging*)
- Good decision making likely to require
  - Well informed decision makers
  - With a good process that includes all stakeholders
  - Autonomy for the decision maker (decision theirs to make)
  - ...but also accountability
- A continuum between centralised (government) and decentralised (commercial) frameworks



## Eg. Traditional electricity industry model: Vertically integrated *electricity supply utility*

- Britain, New Zealand, Australia, etc:
  - Statutory authority supervised by a Minister
  - Decision making political, “behind closed doors”:
    - Politicians negotiate tradeoffs
- USA:
  - Regulated private monopoly (in most cases)
  - Regulatory commission & formal public hearings
- Criticisms of traditional model:
  - Inefficient; stakeholder capture; risk averse



# Electricity industry restructuring objectives

- Improve economic efficiency by facilitating competition & new entry, which assumes:
  - Effective markets & sound legal & policy frameworks
- Enhance accountability to end-users & society through ‘customer choice’, which assumes:
  - End-users become active participants in the industry
  - End-users are independent agents who make “informed” decisions & efficiently manage the associated risks:
- Implement a market-based approach to social & environmental externalities:
  - Assumes political will to regulate non-monetary impacts
- Release government funds by asset sales:
  - Creates a moral hazard for politicians



# Terminology – its uses and abuses

- Is the Australian EI undergoing?
  - A           Market reform
  - B           Deregulation
  - C           Restructuring



## A – market reform?

- Governments – eg. Council of Aust. Govts.



- Regulators – eg. Aust. Competition + Consumer Commission





## B – Deregulation?



“The National Electricity Market (NEM) commenced operation on 13 December 1998, as part of the process of **deregulation** of the Australian power industry.”



### **Electricity competition and your business**

Deregulation of the energy industry will allow you to choose your electricity and natural gas retailer.



## C – Restructured is the safest choice

### ■ Reform?

**re·form** \_ P Pronunciation Key (r -fôr̩m )

v. **re·formed, re·form·ing, re·forms**

v. *tr.*

1. To improve by alteration, correction of error, or removal of defects; put into a better form or condition.

a. To abolish abuse or malpractice in: *reform the government.*

b. To put an end to (a wrong). See Synonyms at correct.

2. To cause (a person) to give up harmful or immoral practices; persuade to adopt a better way of life.

### ■ Deregulation?

- Changing regulatory roles yet is it realistic to assume energy markets won't always require government intervention?



# Why have government?

- A possible economist's (and Australian National Competition Policy) perspective
  - *For when the market does not provide efficient outcomes for society; ie. market failures*
    - Monopolies: The Failure of Competition
    - Public Goods
    - Incomplete markets
    - Information failures
    - The "Business Cycle
    - ***Externalities***
  - Energy markets seem to face all these *challenges*



# A government role in energy?

- Possible *energy* market failures:
  - Monopolies
    - *Generally concentrated supply-side*
  - Public Goods
    - *Essential services, contribution to growth*
  - Incomplete markets
    - *Electricity networks are shared - require high levels of coordination*
  - Information failures
    - *Under-utilised energy efficiency options*
  - The "Business Cycle"
    - *Capital intensive, long-lived investments*
  - **Externalities**
    - *Climate change, energy security, social impacts*



# How do governments act?

- To begin, through **Public Policies**
  - Pattern of government decisions and actions to solve public problems – serving the public interest  
Laws & Meyer(1999)



# Australian energy policy

- COAG has agreed to the following national energy policy objectives: (COAG ENERGY POLICY DETAILS: 8 JUNE 2001)
  - Encouraging efficient provision of reliable, competitively-priced energy services to Australians, underpinning wealth and job creation and improved quality of life, taking into account the needs of regional, rural and remote areas;
  - Encouraging responsible development of Australia's energy resources, technology and expertise, their efficient use by industries and households and their exploitation in export markets; and
  - **Mitigating local and global environmental impacts, notably greenhouse impacts, of energy production, transformation, supply and use.**



# How do governments act on policies?

- “Governments engage in three main activities:
  - they tax
  - they spend and
  - **they regulate.**

“Regulation is the least understood.. but... has a broader and more far-reaching impact on economic growth, development of the rule of law and govt effectiveness than do tax and fiscal policies.”

*(Scott Jacobs, OECD)*



# Energy market regulation

- Regulation to ensure imperfect market ‘means’ lead to desired societal ‘policy’ ends
  - *Energy* markets pose challenges
  - *Electricity* markets pose particular challenges
    - Shared nature of operation + hence decision making
  - *Externalities* pose particular challenges
    - Measurement, private cost – public benefit analysis
  - **Climate change** poses yet further challenges
    - Long time horizon of impacts and required actions
    - Only recent recognition that it’s a problem
    - The fundamental transformation of our fossil-fuel dependence that seems to be required (no easy technical ‘fix’)
  
- Energy markets are *designer* markets – design by govts.





# Market design for energy industry restructuring


- A transparent process that includes all stakeholders
- An appropriate balance and compatibility between:
  - Centralised decision-making - short term (engineering) to long term (policy)
  - Decentralised decision-making (commercial) - operation and investment
- Equal consideration for all system resources
  - Foster competition: don't favour incumbent technologies + participants against 'new entrants' - eg. Demand-side options, distributed generation
- Support appropriate innovation to meet emerging challenges + change
  - Focus on dynamic efficiency issues*
    - Technical or productive: reduce costs of production
    - Allocative: most appropriate choices b/n supply + demand options
    - **Dynamic:** support innovation + response to change
      - new technologies, social expectations, environmental impacts
- Careful consideration of interactions with other related markets
- Allocate costs + benefits to participants as appropriate to extent possible
  - Commercialise industry objectives – eg. internalise externalities



# Transparent process? eg. Ministerial Council on Energy program (12/03)

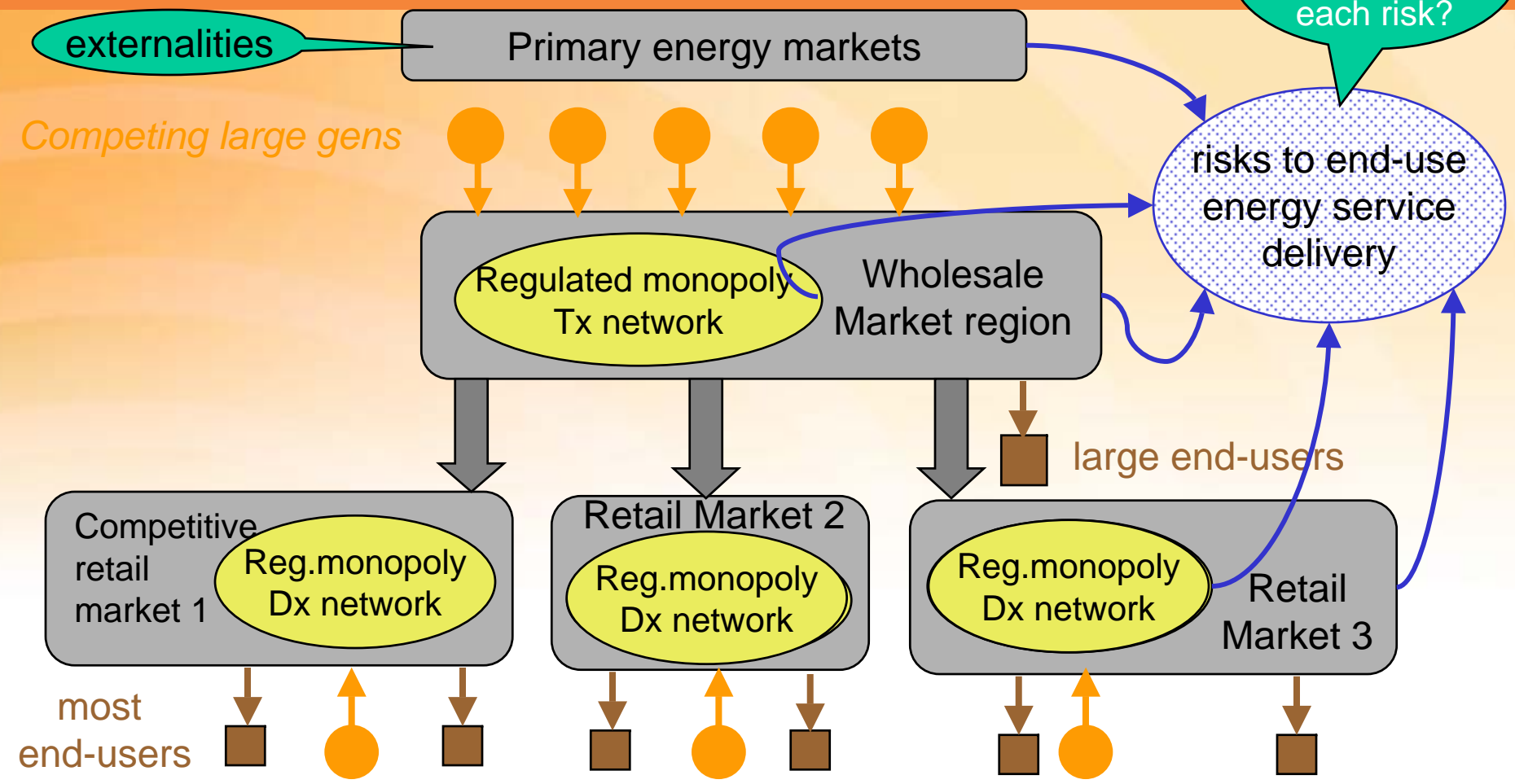
Projects	Qtr 4 / 2003	Qtr 1 / 2004	Qtr 2 / 2004	Qtr 3 / 2004	Qtr 4 / 2004	2005
<b>1. Governance &amp; Institutions [SA]</b>						
<i>Inter-Governmental Agreement</i>	MCE note framework	SCO draft IGA	MCE approve IGA	CoAG endorse IGA		
<i>National Legislation</i>	MCE consider legislative models	MCE finalise legislative framework. SCO develop draft bills	MCE approve bills. Bills introduced in parliaments	Legislation enacted		
<i>Establish AEMC &amp; AER</i>	SCO draft structure & operations paper	MCE endorse structure & operations paper	Commissioners selected	Operations commence		Transfer gas transmission*
<i>MOU between ACCC-AEMC-AER</i>	SCO draft framework	SCO develop MOU	MCE finalise negotiation & approve MOU	MOU implemented		
<i>NECA &amp; NGPAC Transition</i>	SCO draft transition paper	SCO endorse transition plan		NECA dissolved		NGPAC dissolved (subject to PC gas review)
<i>Subsume NEMMF into MCE</i>	SCO review NEMMF work program	NEMMF work program continues under SCO/MCE		NEMMF dissolved		
<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p>Denotes stakeholder consultation</p> <p>MCE denotes MCE decision point</p> </div>						
<b>2. Economic Regulation [Vic]</b>						
<i>Energy Access</i>		SCO draft issues paper on national approach	MCE endorse preferred approach	SCO develop national approach (subject to MCE decision and consideration of PC gas review)		MCE agree national structure
<i>Distribution &amp; Retail</i>	MCE agree policy & timing	SCO develop framework paper	MCE endorse framework paper	SCO develop detailed national structure		MCE agree national structure



Projects	Q4/03	Q1/04	Q2/04	Q3/04	Q4/04	2005
<b>3. Electricity Transmission [Qld]</b>						
<i>Transmission Regulatory Reform</i> 	MCE endorse policy framework	Commission study on regional boundaries. Commence agreed code changes	MCE consider boundary report. Remove market biases	Implement new regulatory test and transmission availability incentives	Implement new transmission pricing	
<i>National Transmission Planning</i>	NEMMCO commence scoping ANTS.	MCE finalise new planning process	First ANTS produced	Implement last resort power		
<b>4. User Participation [Tas]</b>						
<ul style="list-style-type: none"> <li>o Demand side response</li> <li>o Interval metering</li> <li>o Full Retail Contestability</li> </ul>	SCO develop issues paper	SCO prepare draft report	MCE approve user policy	Implementation commences		
				<p>Denotes stakeholder consultation</p> <p>MCE denotes MCE decision point</p>		
<b>5. Gas Market Development [NT]</b>						
<i>MCMPR Upstream Issues</i>	Advice requested from MCMPR	MCMPR review unproduced areas for 3 <sup>rd</sup> party access		MCE respond to MCMPR review		
<i>PC Gas Access Review</i>	PC issue draft report		PC issue final report	SCO draft response to report	MCE respond to PC review	
<b>6. Program Coordination [C'wlth]</b>						
<i>Market Consultation</i>	MCE endorse consultation plan	Market consultation (as above)	Consultation continues, as appropriate			

# Mix of centralised & decentralised decs.

Who is accountable for each risk?



- Typically, a competitive wholesale electricity market although including private and state-owned generators, regulated monopoly networks and a mix of competitive and regulated retail arrangements



# Centralised decision making – eg. planning

- Energy systems have important externalities:
  - Costs + benefits of activity that fall on parties other than those undertaking activity => don't *necessarily* influence decision making
  - Costs + benefits can be economic, environmental or social
  - Those effected by externalities are 'stakeholders' so projects have many: - project developers *but also* governments, other developers, local communities, the electricity industry, NGOs...
- Not independent projects:
  - Economies of scale in network connection
  - **Shared social & environmental impacts**



# Planning eg: A govt. role for wind farms

- Hard to internalise all externalities at project level
  - Many externalities depend on cumulative wind projects
  - Potential for poor outcomes + social discord
  - May be ‘internalised’ only after great expense + effort already undertaken
  - May engender generalised resistance to future projects

=> Govts required to provide appropriate frameworks

- externalities and stakeholders identified
- project developers + stakeholders can negotiate solutions



## Eg. Possible ways forward for wind planning

- Develop a comprehensive + coherent wind farm planning framework - federal, state, local:
  - Staged regional development process via stakeholder consultation:
    - Resource evaluation
    - Regional wind development & grid connection strategy with integrated forecasting processes
  - On-going monitoring & evaluation

- Opportunities to adapt other models –eg. mining

### **Queensland Coal Seam Gas Regime (2002)**

*"The regime provides greater certainty for explorers and developers to invest in coal seam gas projects as well as provide clear rules, rights and obligations for the coal and gas industries to work cooperatively in developing the resource."*

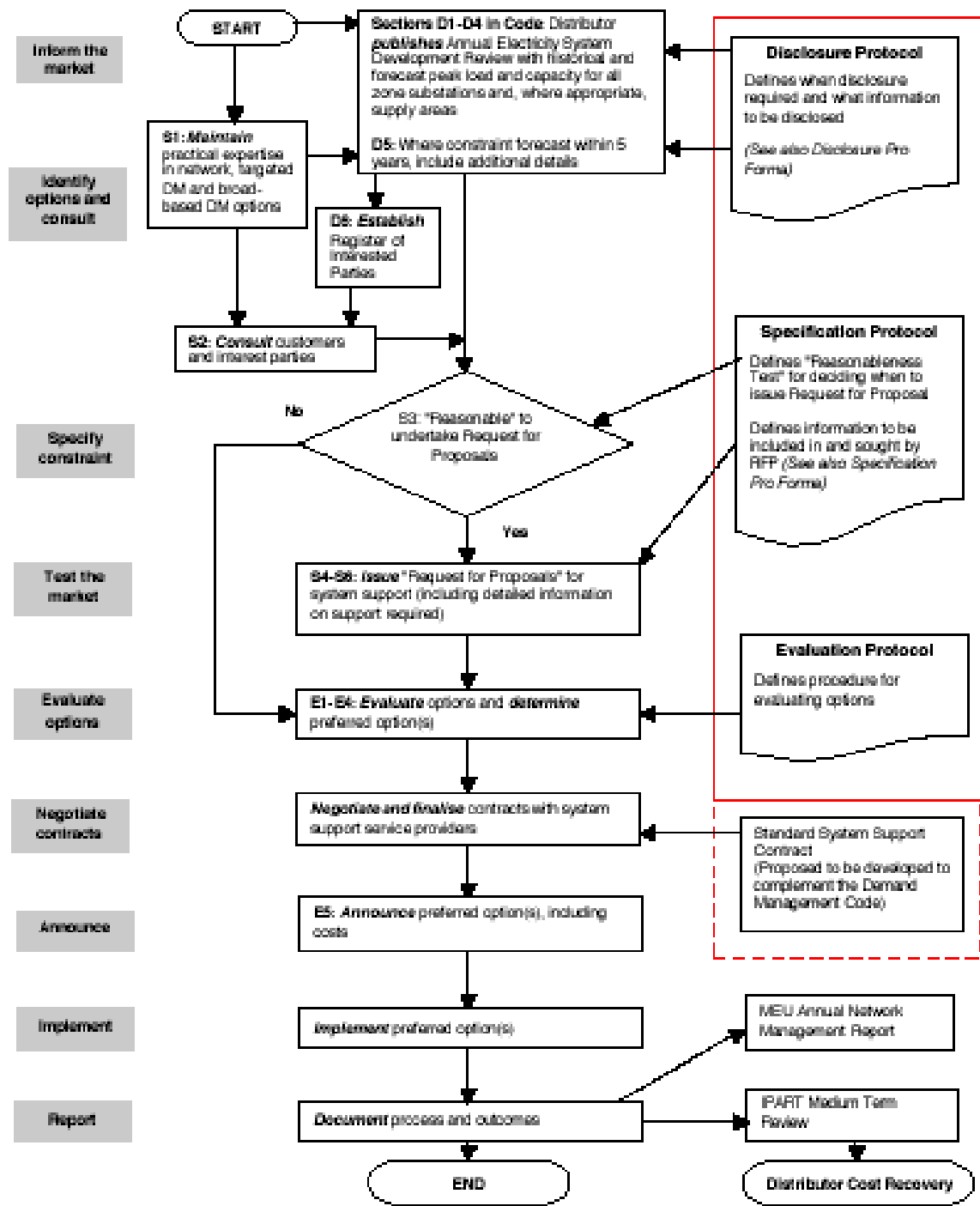




# Planning networks eg. NSW Demand Management Code of Practice for Distributors (May 2001)

An attempt to allow distributed resource options to compete with Dx augmentation....

but note the complexity of this process







# Equal consideration – National Electricity Code

- Objectives
  - Market should be competitive
  - Customers should be able to choose with which supplier they trade
  - Any person wishing to do so should be able to gain access to the interconnected T&D network
  - A person wishing to enter the market should not be treated more or less favourably than incumbents
  - A particular energy source or technology should not be treated more or less favourably than another energy source or technology
- However, hard to achieve in practice



## Equal consideration of resources: eg. wind power

- Wind an emerging technology + industry that
  - can help us meet emerging greenhouse + energy security challenges  
*a zero emissions, 'free', locally sourced energy resource*
  - has very different characteristics from conventional resources  
*the first really significant intermittent resource with variable, partially controllable and somewhat unpredictable output*
  - a 'new entrant' in electricity industries around the world
  - **Poses challenges to existing electricity industry operation + investment**
  - **Tests the adequacy of current EI market design**



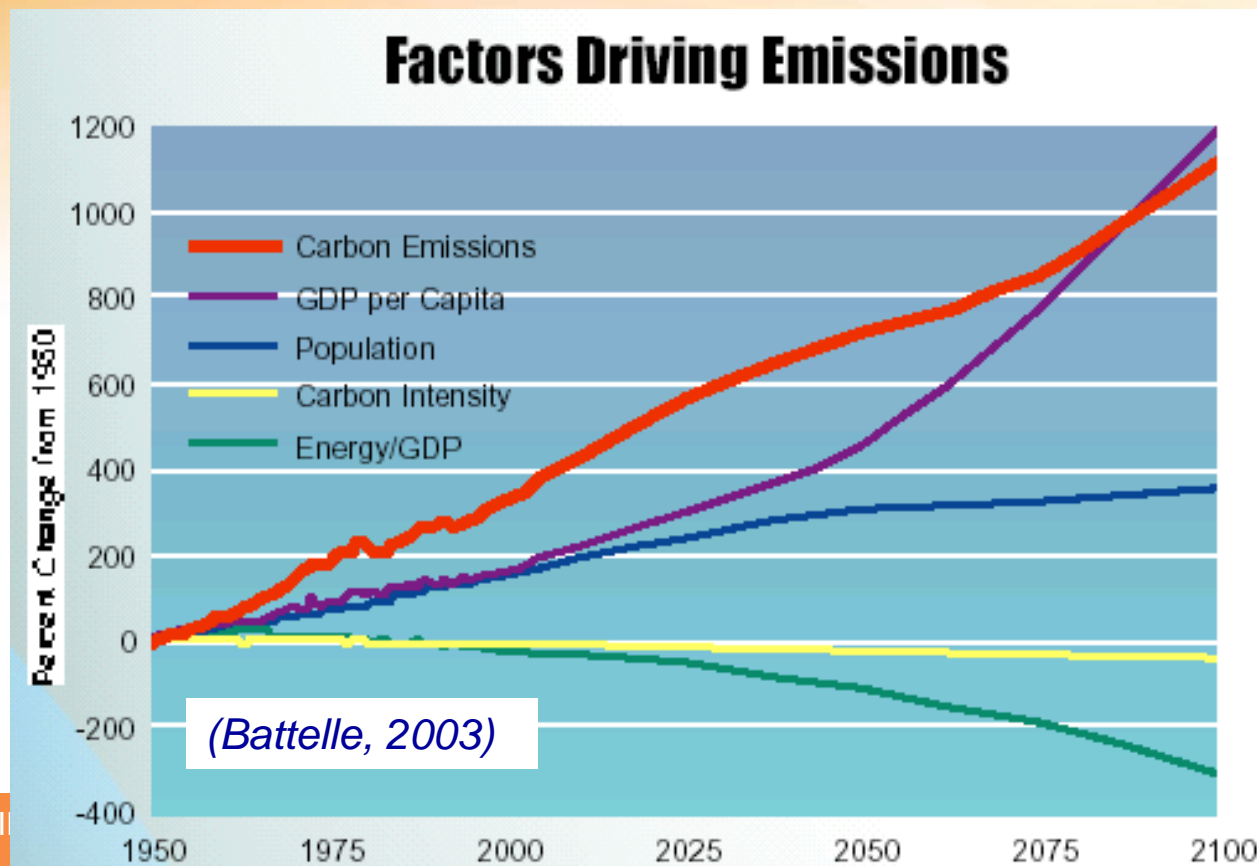
## Supporting innovation: eg. climate change technologies

- All technologies are energy technologies (end-use important too)
- Present technologies the major part of our climate problem
- Debatable whether current technological change helping or hindering

*(Convery et al., 2003)*

“Technology a more important determinant of future GHG emissions and possible climate change than all other driving forces put together” (IPCC)

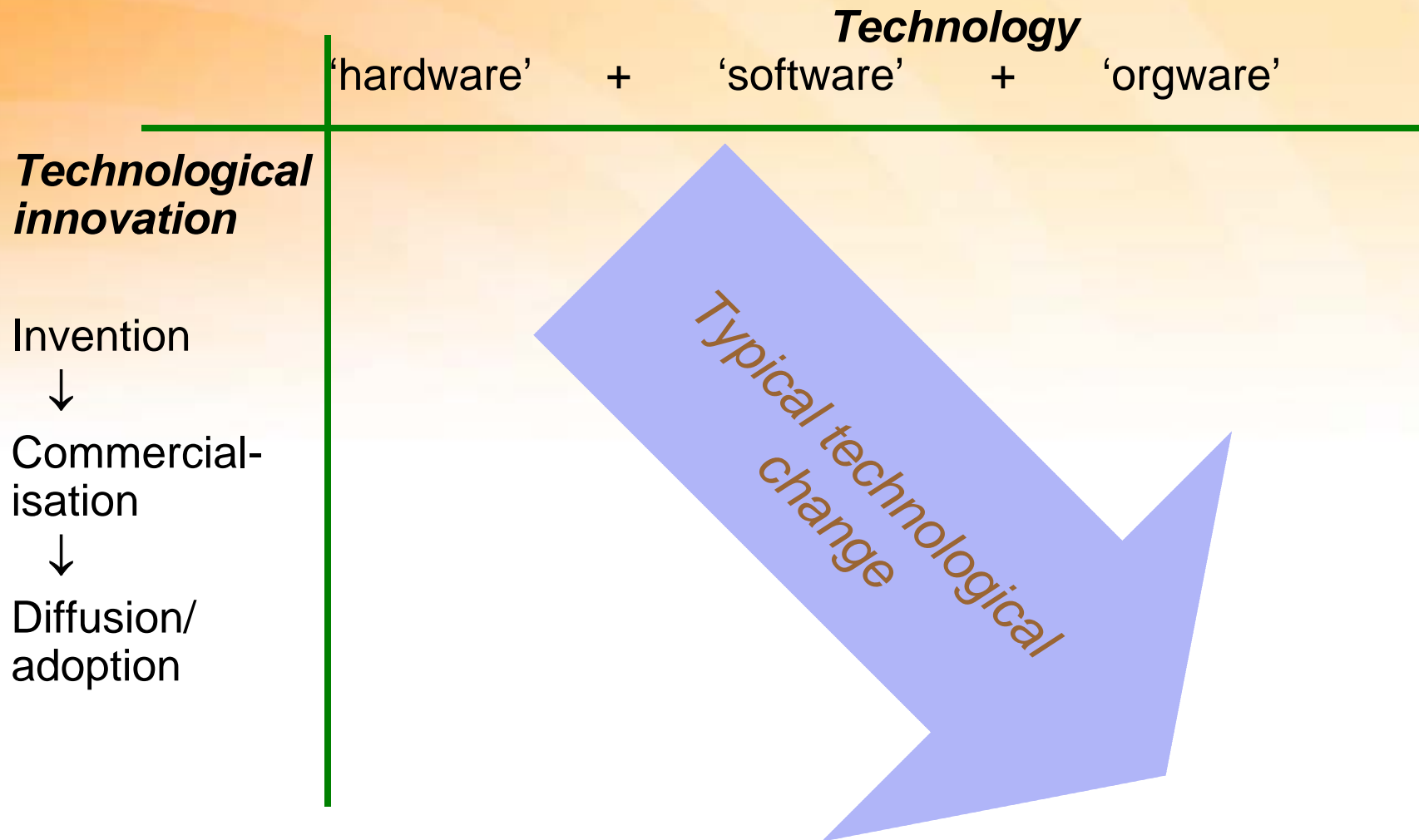
*=> Solving our climate problem requires we change present process of technological change, as well as the technologies themselves*





# Some dimensions of technological change

(IIASA)





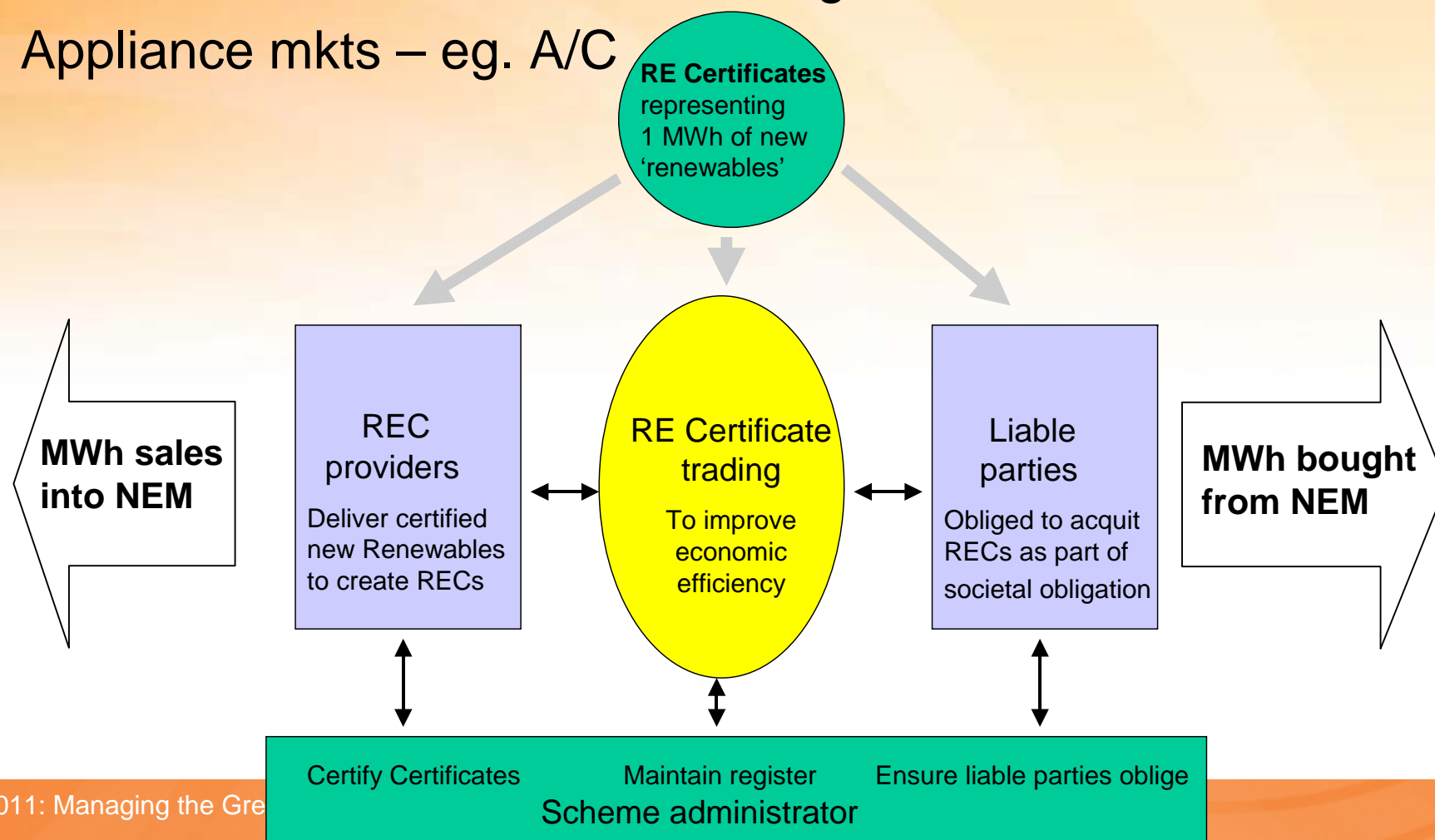
# The need for innovation policy

- Technological change is too important to leave to:
    - *Imperfect markets*: currently have severe climate *externality* failings, generally under-deliver R&D, more systemic problems too..
    - *Technology ‘champions’*: dangers of undue techno-optimism + unaccountable technical elites
  - Government policy roles in:
    - *Invention*: support R&D into promising socially beneficial yet unproven technologies
    - *Commercialisation*: support demonstration and initial deployment of promising, technically proven, technologies
    - *Diffusion/Adoption*: ensure markets reflect societal prefs
- => However, many challenges for policy makers...



## Interactions with related markets

- Primary energy markets – eg. coal, gas, oil
- Related environmental markets: eg. MRET
- Appliance mkts – eg. A/C





# Allocate costs + benefits appropriately

- Cost reflective tariffs
  - Eg. ensure people installing large air-conditioners don't impose associated costs such as network upgrades etc on other customers
- Commercialise externalities
  - Eg. price greenhouse emissions via emissions trading or carbon taxes
  - ***NEXT LECTURE***



## Getting it wrong? – the NEM & climate change

- Aust. National Electricity Code doesn't include specific environmental objectives
- However, expectation by some that Aust. Electricity Industry restructuring would help (14 MtCO<sub>2</sub> reduction from BAU in 2010):  
(Commonwealth Govt, *Climate Change: 2<sup>nd</sup> Communication to IPCC*, 1997)
  - Efficient competition in supply by cogen + renews
  - More sensible patterns of energy use through incentives for investment in EE
  - Greater penetration of natural gas





## What actually happened?

- Instead, now projected to increase 0.1MtCO<sub>2</sub> above BAU (CoAG, 2002)
  - Low cost of coal fired generation in Australia
  - Current failure to price greenhouse emissions
  - Excess electricity capacity that has depressed prices
  - Relatively immature and inflexible gas market
  - Reduced emphasis on EE from lower prices
  - Market design and regulation that favours incumbents (eg. advantages coal against new entrants like DG)
  - Supply-side orientation of reforms to date



## Summary - good design for energy industry restructuring

- A transparent process that includes all stakeholders
- An appropriate balance and compatibility between centralised and decentralised decision-making
- Don't favour incumbent technologies + participants against 'new entrants'
- Support appropriate innovation to meet emerging challenges + change: *Focus on dynamic efficiency issues*
- Careful consideration of interactions with other related mkts
- Allocate costs + benefits to participants as appropriate to extent possible including externalities



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Thankyou... and *questions*

*Many of our publications are available at:*

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