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# Assessing the technology and policy needs for grid connected renewable energy services

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# Talk outline

- Enhancing electricity industry sustainability
- The role of grid connected renewables
- Barriers to renewables
- What might be done

# Sustainability – what does it mean?

- The Brundtland definition (Our Common Future, 1987) *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*
- Key questions
  - Comparative or absolute concept? - are we aiming to *be* sustainable, or merely move *towards* it?
  - **How do we interpret + then turn into actions?**

# Modelling Sustainability

- Environmental (ecosystem) sustainability
- Economic (ability to progress) sustainability
- Institutional (social) sustainability
- Technical (physical) sustainability?

- Conceptualised by (some of) the business community as the *Triple Bottom Line*

# Sustainability indicators

## ABS (2002) *Measuring Australia's Progress*

| **Human capital** | **Natural capital** | **Produced + financial capital** | **Social capital** |
|---|---|---|---|
| Health | Biodiversity | National wealth | Crime |
| Education and training | Land (clearing and degradation) | National income | Social attachment |
| Work | Water | Economic disadvantage and inequality | |
| | Air quality | Housing | |
| | Greenhouse gases | | |

# Aust.'s EI + sustainability - policy

- COAG's agreed national energy policy objectives (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.

# Aust.'s EI + sustainability - legislation

## Renewable Energy (Electricity) Act 2000

The objects of this Act are:

(a) to encourage the additional generation of electricity from renewable sources; and

(b) to reduce emissions of greenhouse gases; and

(c) to ensure that renewable energy sources are ecologically sustainable.

# Aust.'s EI + sustainability - customers

Origin energy

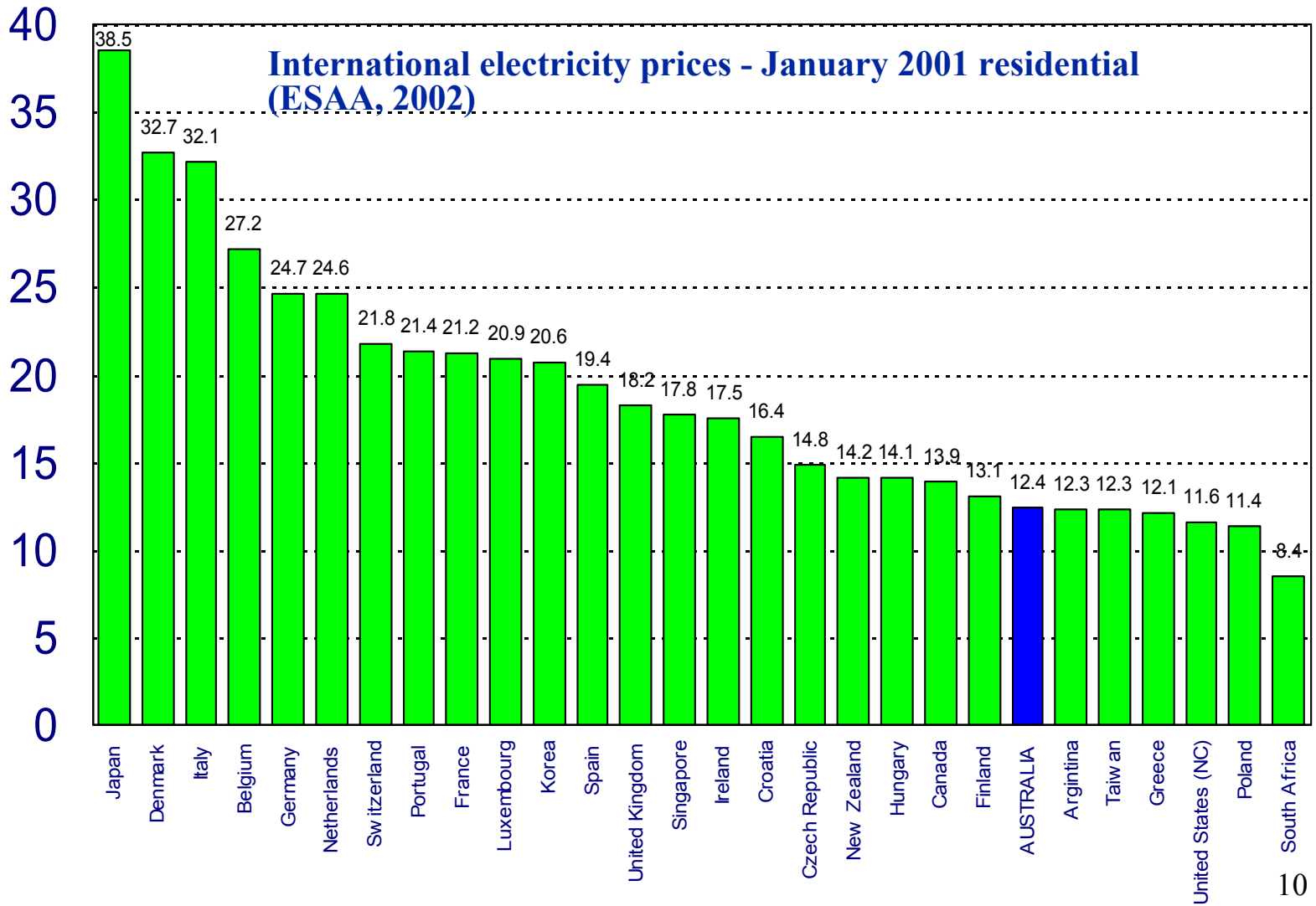
Managing
the environment
for sustainable growth
is a challenge for us all

Managing the environment for sustainable growth is a challenge for us all.
Origin Energy is committed to delivering innovative energy solutions for sustainable growth. As an energy producer, we work hard to ensure our operations are managed effectively to reduce our company's greenhouse gas emissions and to minimise the environmental impact of our customers' use of energy.

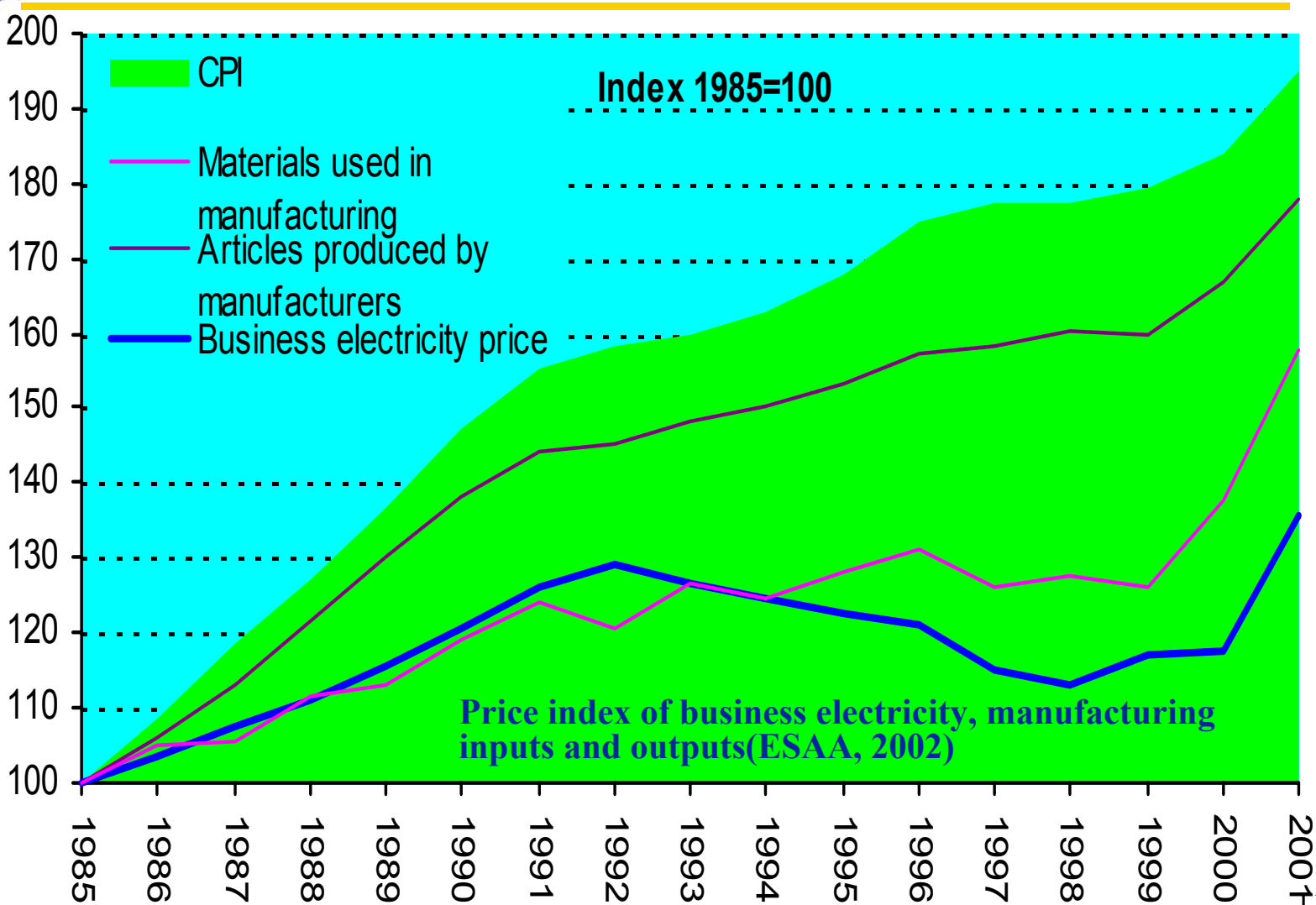
# EI + economic sustainability

- Electricity's role in *enabling* economic activity and growth
  - Cost of delivering *energy services* is key ($price/kWh X efficiency (kWh reqd to deliver)
- Economic sustainability's role in providing a surplus to permit pursuing other goals

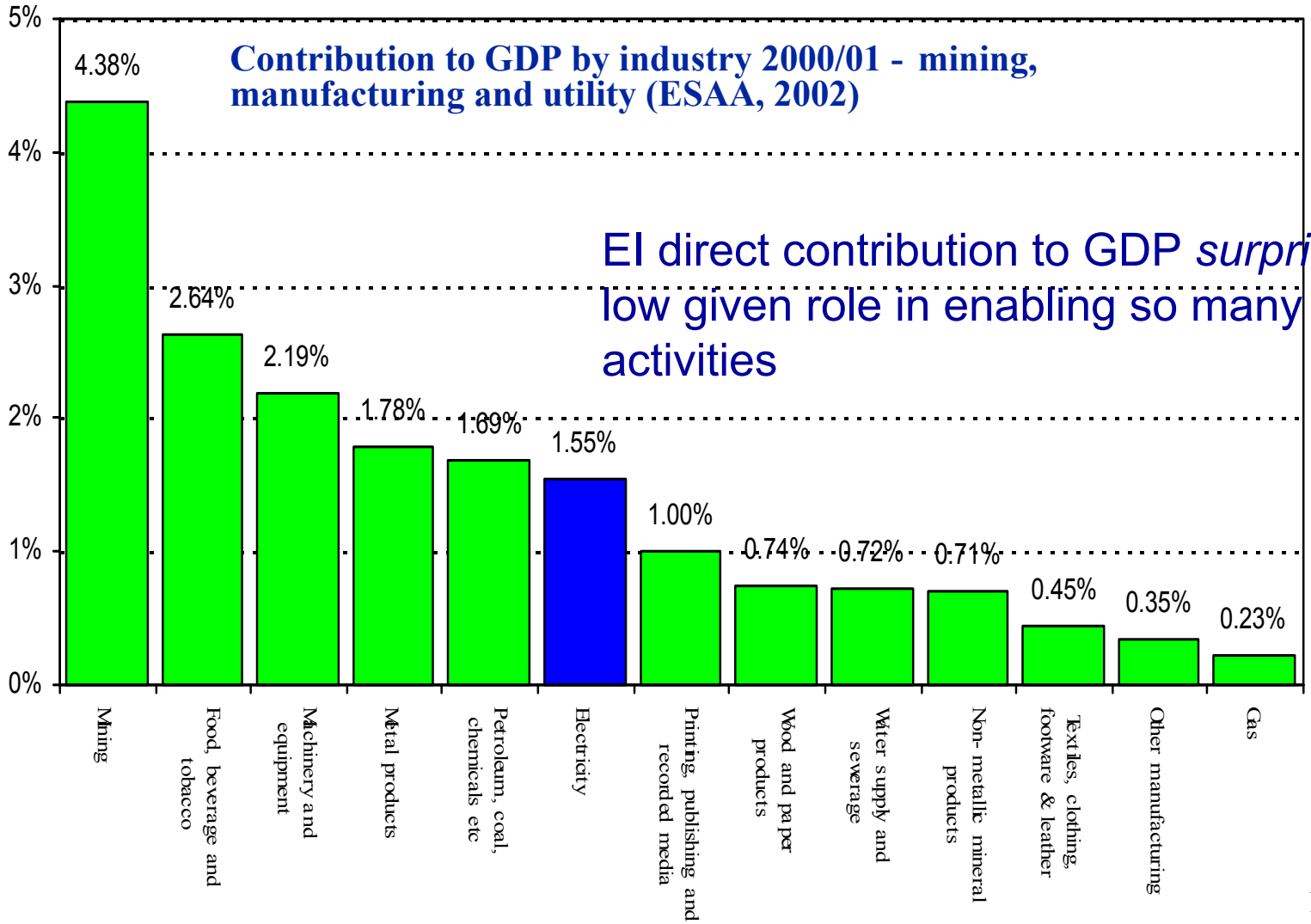
# EI economic sustainability - price



# EI economic sustainability - price



# EI economic sustainability - GDP




EI direct contribution to GDP *surprisingly* low given role in enabling so many other activities

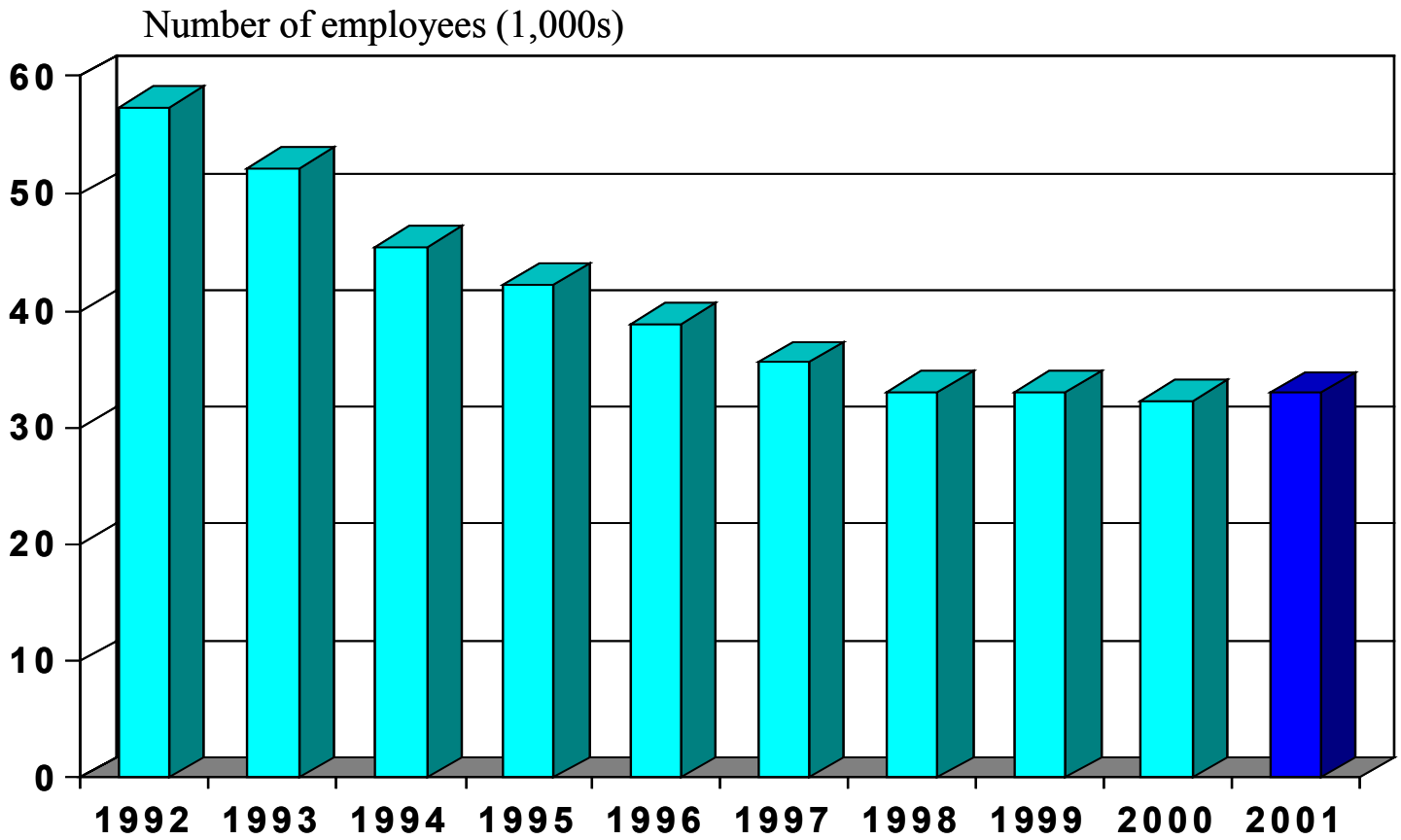
# EI + social sustainability

- Affordable energy services
  - 'Essential public good' + equity issues
- Community support
  - Certainly appreciate energy services

    *Australians consume av. 8kW per capita* (ABS, 2001)
  - Environmentally harmful generation?
- Jobs
- Regional development

# EI social sustainability - jobs

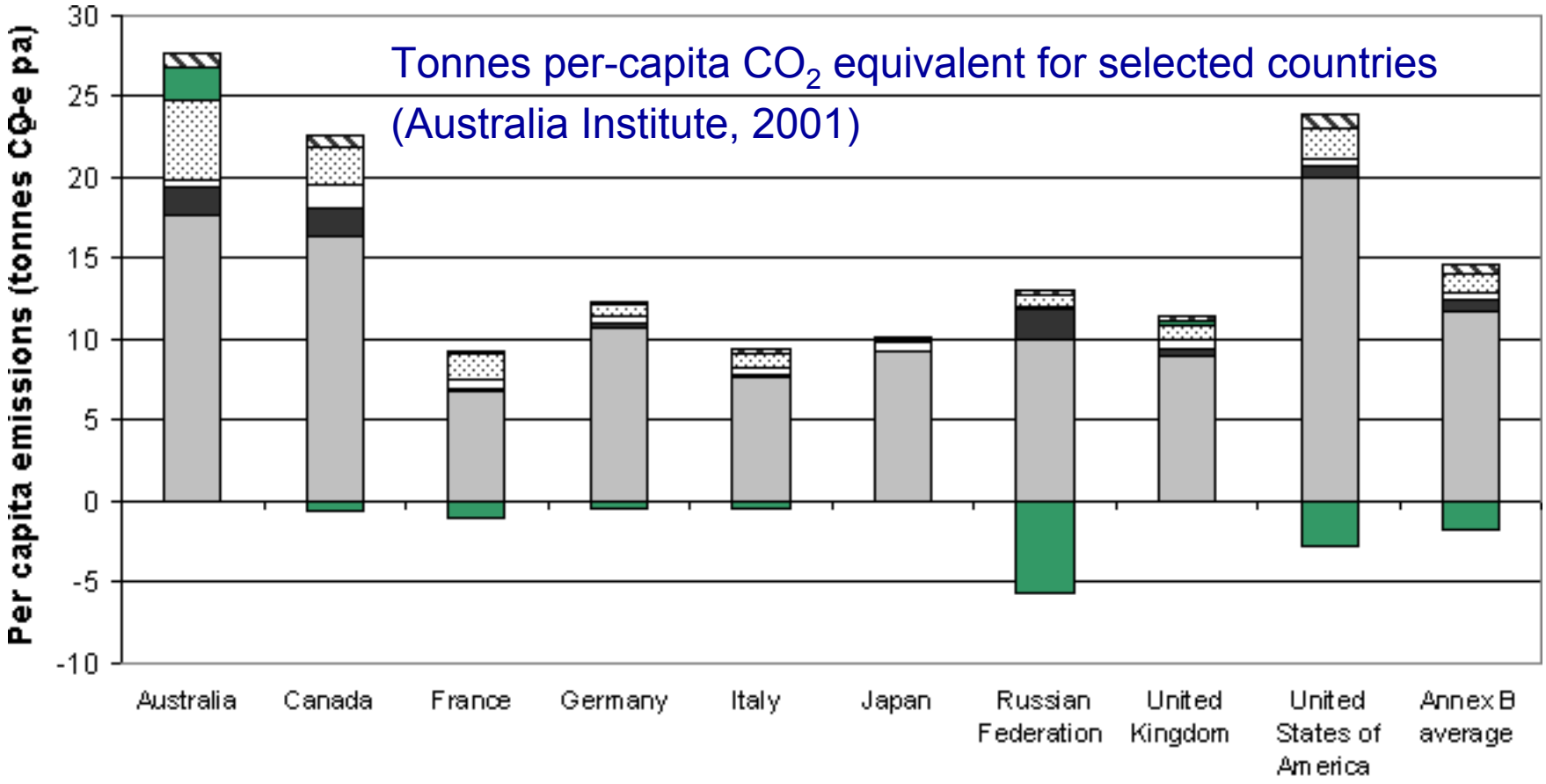
**Employment level in the electricity supply business (ESAA, 2002)**



# EI social sustainability - regional

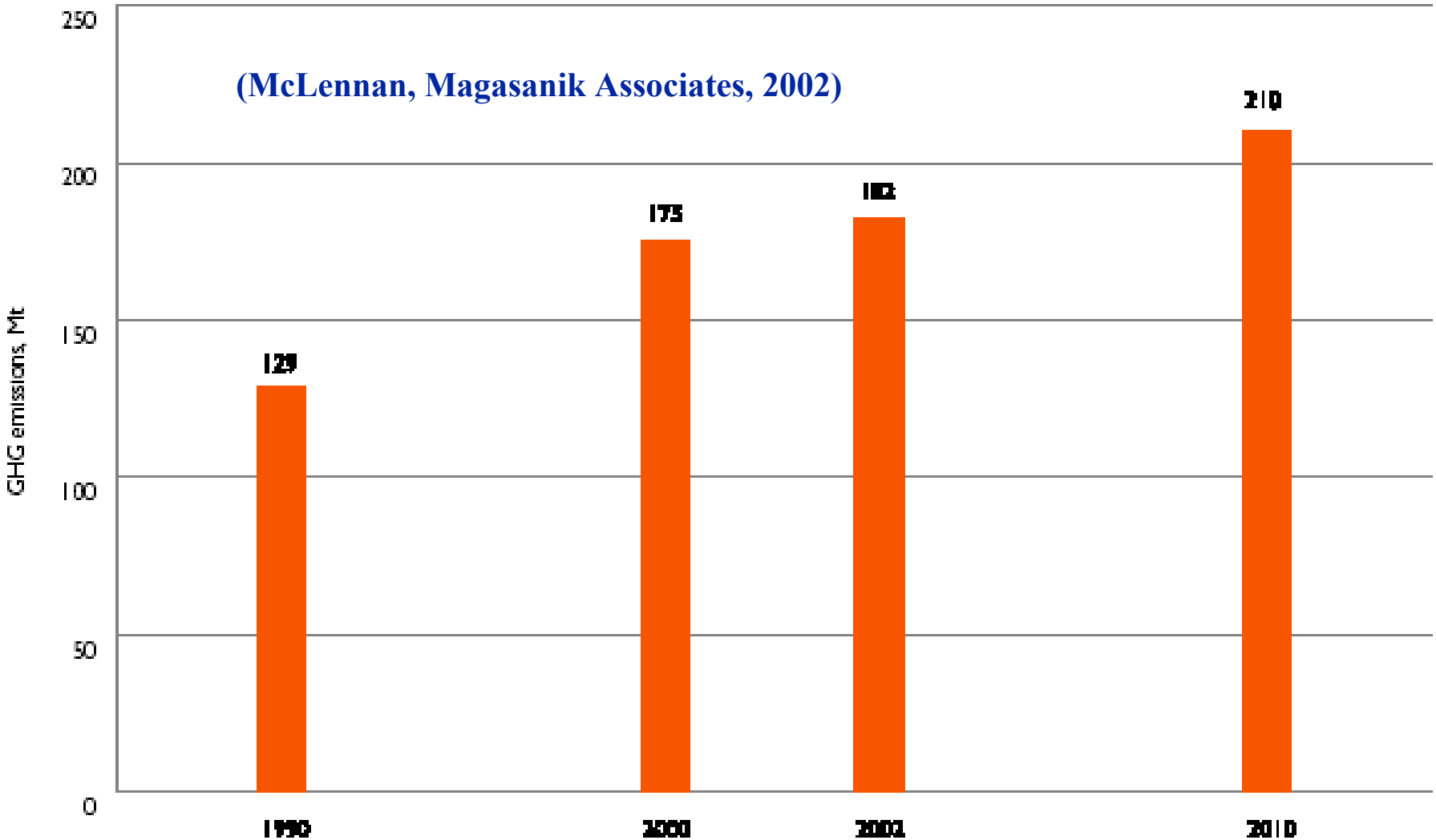
- *"It is evident that regional Australia has had an uneven experience of energy reform to date and, while some progress has been made, a significant number of issues remain to be resolved"*
  Parer (2002) *COAG Draft Report*

# EI environmental sustainability - CC



# EI environmental sustainability - GHGs

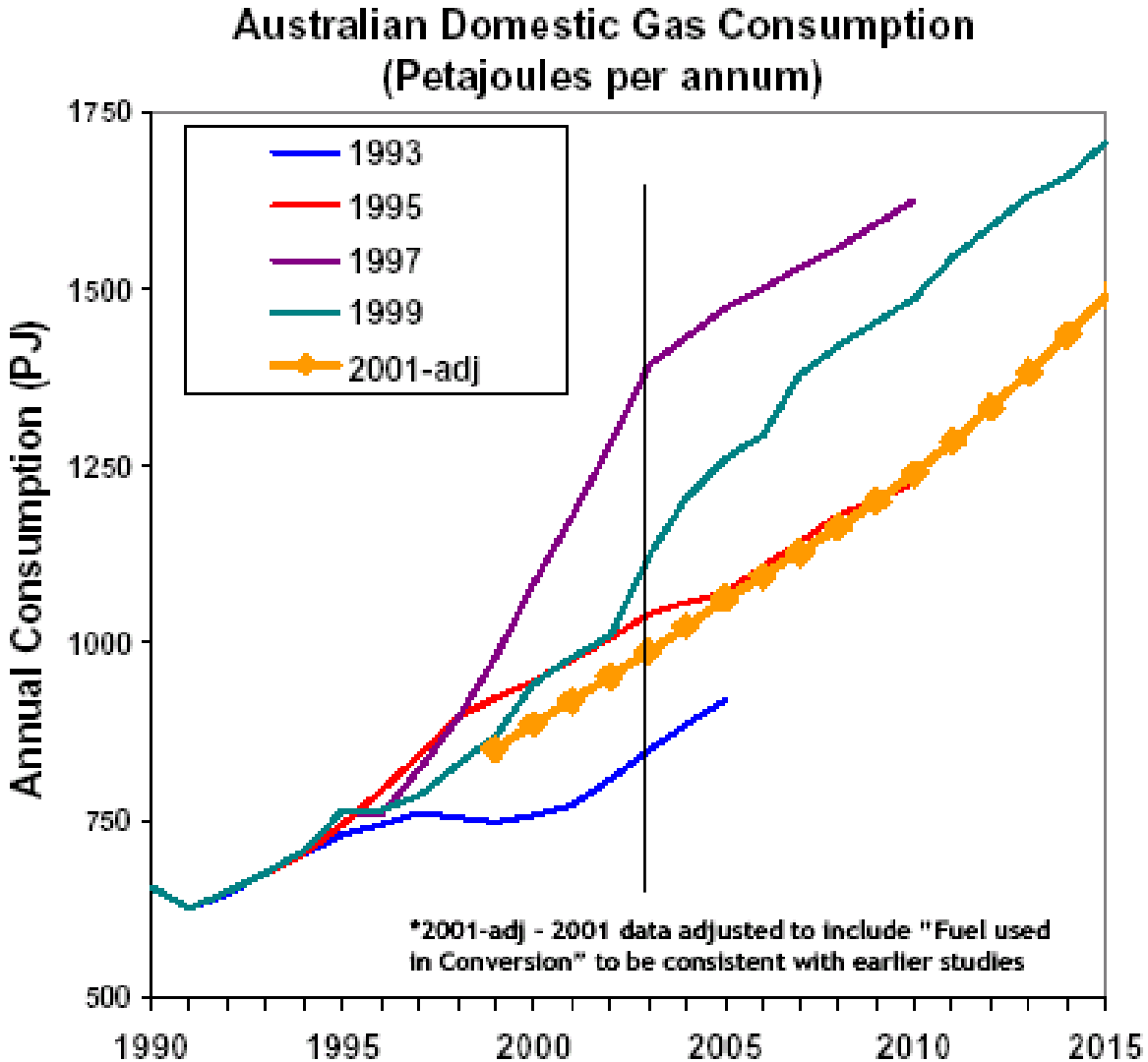
Figure 1: Greenhouse Gas Emissions from Electricity Generation 1990–2010



# Sustainability trends in the EI

- Projecting the future *can* be easy
- Forecasting the future requires judgement
- Getting it right is much harder yet
  - BAU assumption over longer term is questionable
  - Discontinuities: energy crisis, technological change, energy market reforms …

# The future – getting it wrong




**ABARE projections of future Australian gas consumption over the years 1993-2001**

**Origin (2002) *Eastern Australian energy needs: The impact of changes in the market on energy supply and demand***

# Energy + sustainability

- Energy services play a critical role in society
- Our present Electricity Industry has very high environmental externalities
  - Stationary energy sector contributes ~50% of Australia's GHG emissions, the electricity industry some 35% (excluding LUCF) (AGO, 2002)
- These externalities are unsustainable
  - BAU for Australian stationary sector suggests GHG emissions up 50% by 2020 (AGO, 2002)

# Energy, sustainability + transformation

- Required energy sector transformation is large
  - *"Over this century the world is going to have to reduce its global greenhouse gas emissions by some 50-60%"* Dr Kemp, Federal Environment Minister (The Age, 2002)
- Seeking most cost-effective *efficient* action over the longer term + for major transformation
- Types of efficiency
  - Productive: reduce costs of existing techs
  - Allocative: choice of best mix of existing techs
  - Dynamic: process of tech + organisational innovation responding to longer-term picture
- *Dynamic* is the critical efficiency for transformation

# Renewables + sustainability

- What role can renewables play in increasing the sustainability of the electricity industry?
- Are renewables even necessarily sustainable?

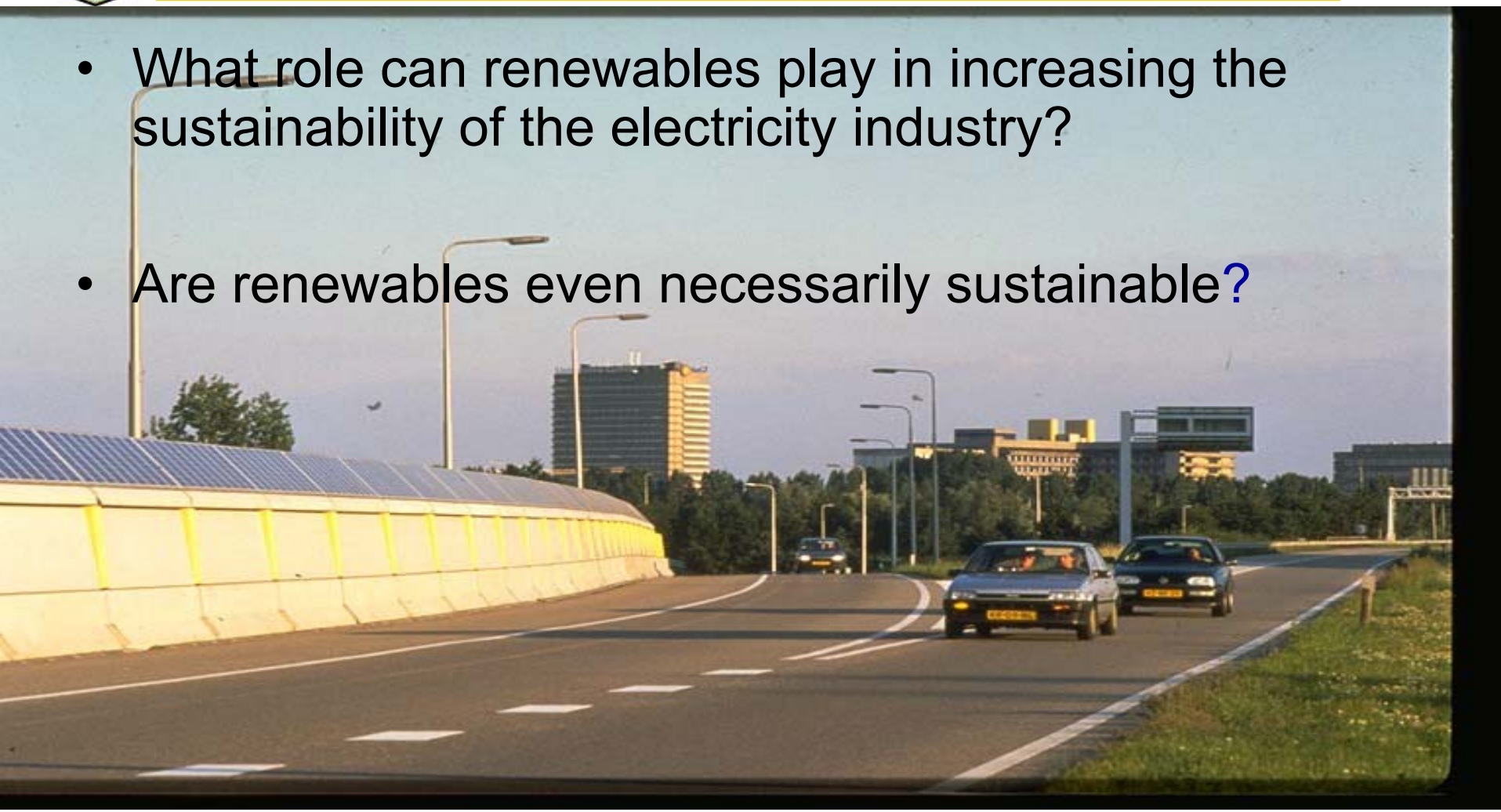
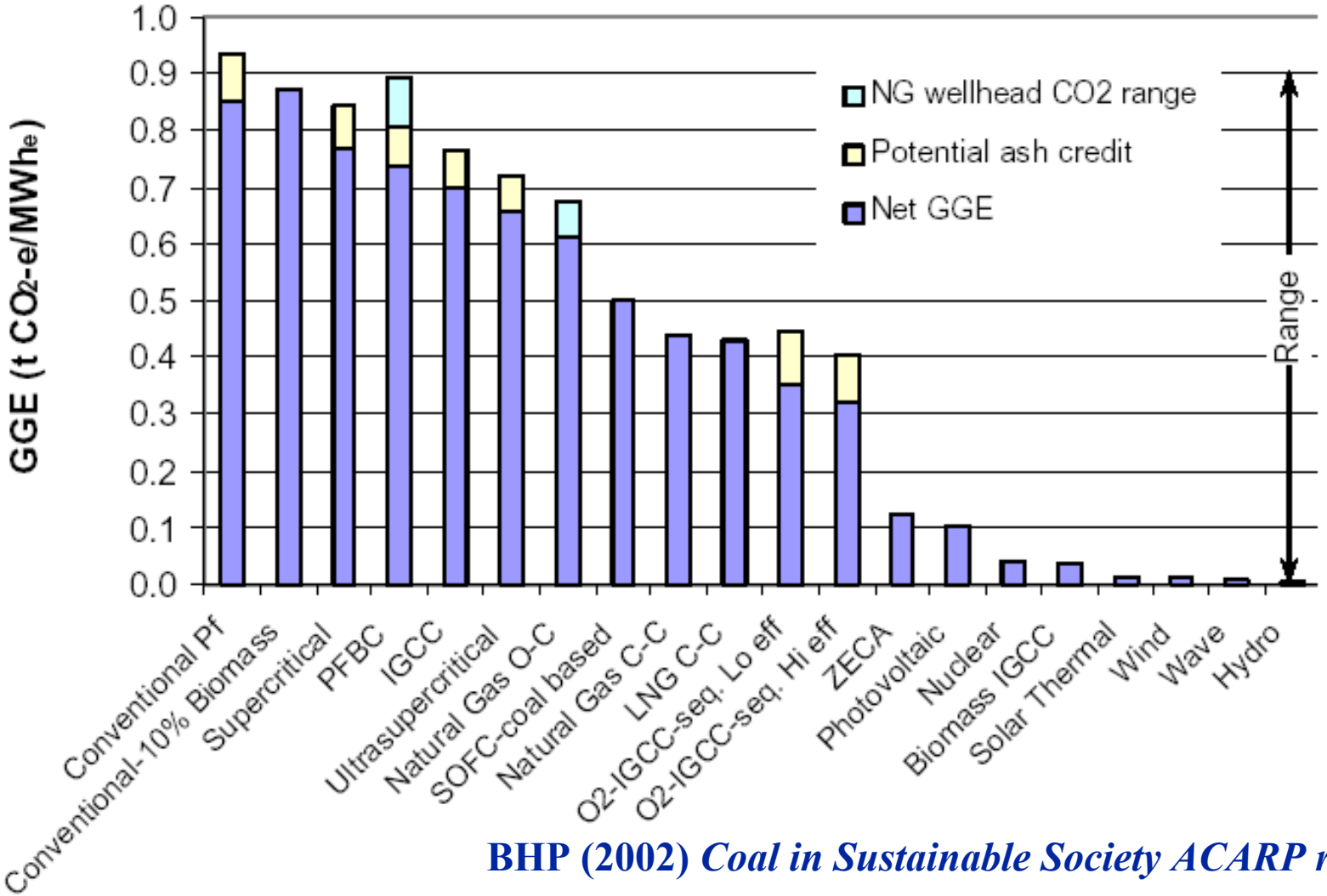


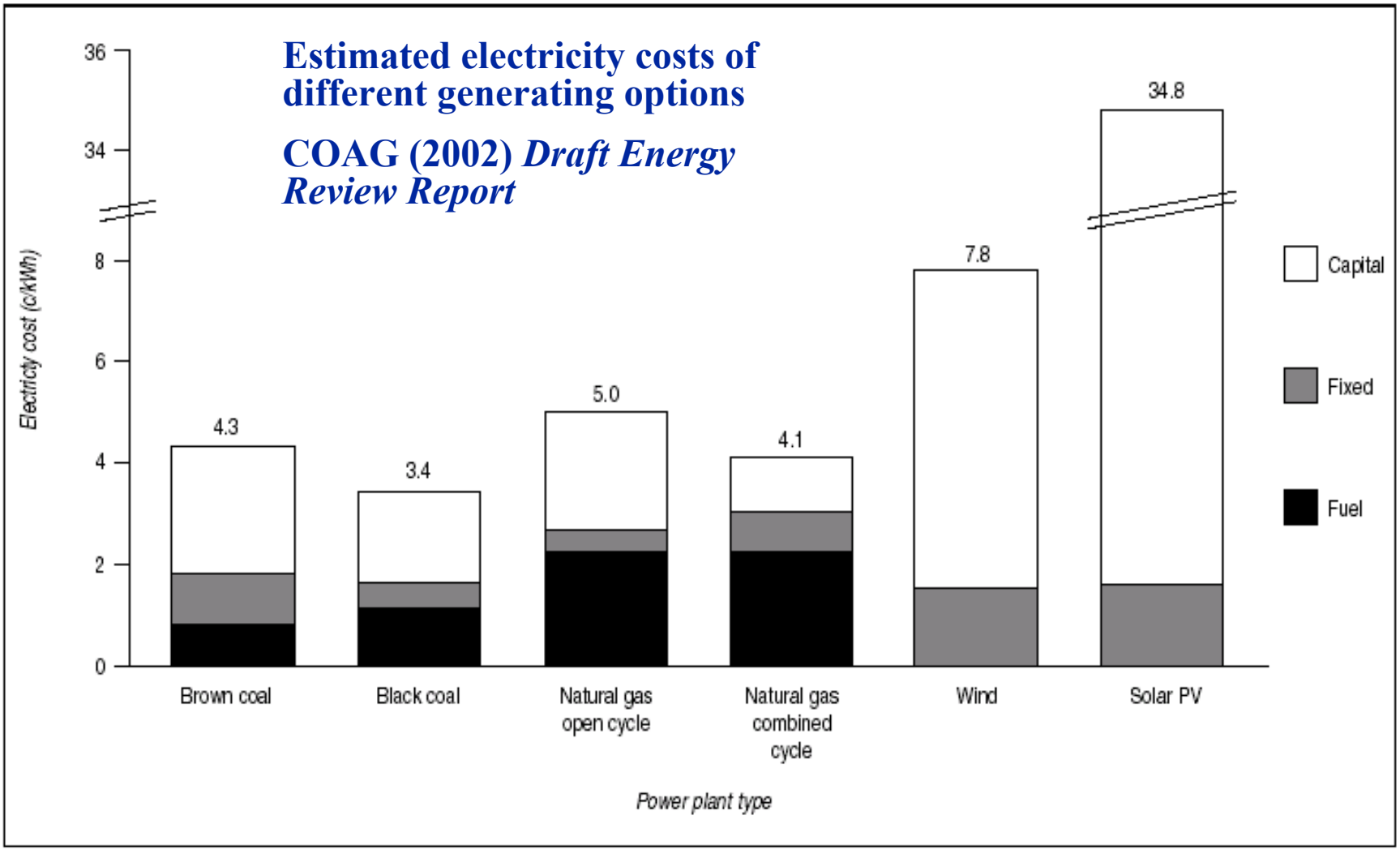
Photo courtesy NOVEM

# Renews + sustainability: environment




**BHP (2002)** ***Coal in Sustainable Society ACARP report.***

# Renews + sustainability: economics



# Renews + sustainability: economics

- Is there more to it?
  - Economic development
  - Employment
  - Falling costs of many renewables

- And mustn't forget
  - Subsidies to energy sector Reidy (2002) *Energy Policy*
  - Environmental externalities EU (2002) *ExternE Project*

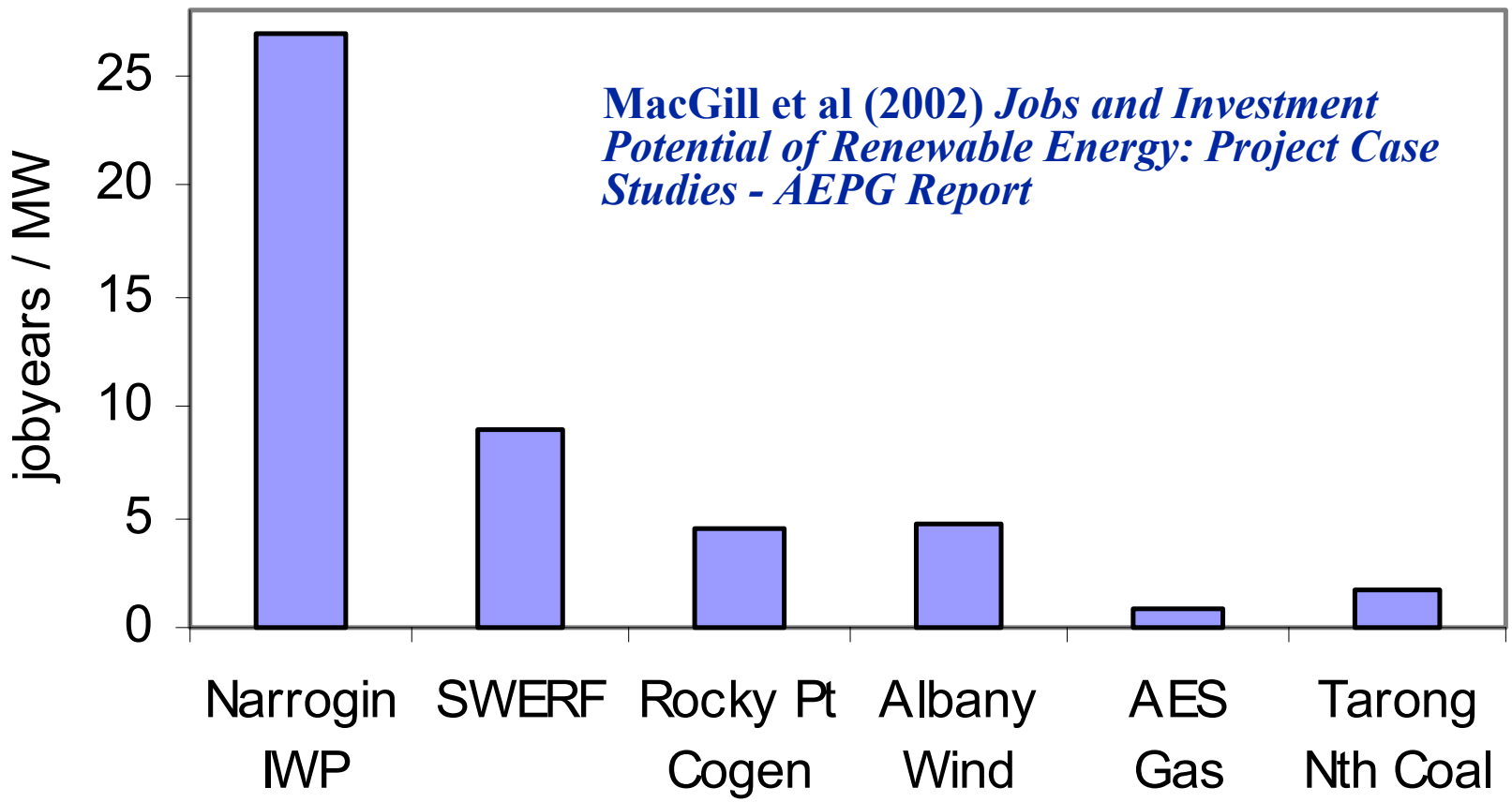
# Global energy technology markets

| Source | Average annual growth rate (%) over 1990-2000 |
|---|---|
| Wind power | 25 |
| Solar photovoltaics | 20 |
| Solar thermal (Europe) | 18 |
| Biomass | 3 |
| Natural gas | 1.6 |
| Coal | -1.0 |

**MacGill et al (2002)** ***Jobs and Investment Potential of Renewable Energy - AEPG Report***

- Renewables growth from a small base so far…
  - Oil was 2% of world energy supply in 1900

# Aust. M&C jobs for different energy projects



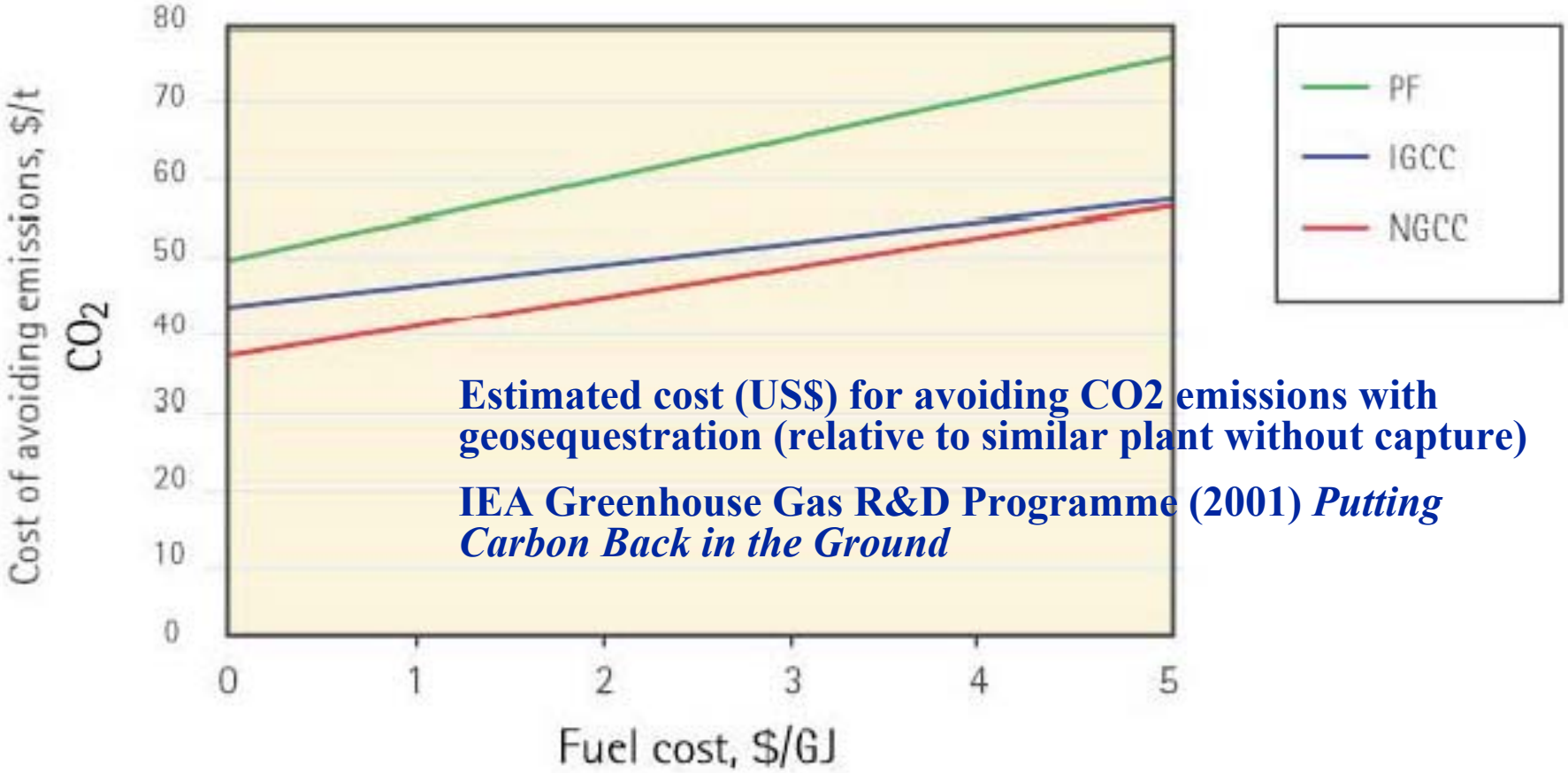
# Renews Industry Scenarios - Wind

- Investment + jobs for 1000MW, 3000MW + 5000MW scenarios of installed capacity in Australia by 2010
  MacGill et al (2002) *Australian Wind Industry Scenarios*

| Scenario | Total Cap. investment (A$m) | Total Aust. Component (A$m) | Aust. Manuf. & construction jobs (jobyears) | O&M expenditure (A$m) | Aust. O&M jobyears |
|---|---|---|---|---|---|
| *Low* | 1400 | 1000 | 4000 | 50 | 230 |
| *Medium* | 4000 | 3200 | 13000 | 160 | 840 |
| *High* | 6700 | 5400 | 22000 | 260 | 1400 |

# Zero-emissions coal?

- Shows promise – currently unproven + will cost




**Estimated cost (US$) for avoiding CO2 emissions with geosequestration (relative to similar plant without capture)**

**IEA Greenhouse Gas R&D Programme (2001) *Putting Carbon Back in the Ground***

# Renews + sustainability: Social

- Generally strong public support for renewables
- Regional development opportunities
  - "Regional Australia stands to benefit from a greater uptake of renewable generation technologies"
    COAG (2002) *Draft Energy Market Report*
- Some challenges …

# Possible sustainability tradeoffs

# Possible sustainability tradeoffs

# Are renewables sustainable?

- Australia's Federal Treasury view

  "Even though renewable energy is renewable, it does not necessarily mean it is environmentally benign. Like fossil fuels, renewable energy can also impose external costs on the community… the large-scale use of wind turbines may adversely affect landscapes, migrating bird species, and pristine wilderness areas. Additionally, it may result in noise and aesthetic pollution…"

  Treasury (2002) "Renewable energy – a clean alternative?" *Economic Roundup Spring 2002*

- => renewable technologies aren't inherently sustainable, but appropriate renewable energy systems can be


# Barriers to renewables

*G8 renewable energy taskforce final report, July 2001*

- Costs: not yet competitive with conv. alternatives
- Insufficient institutional infrastructure;
- Impediments to capital mobilisation
- Weak incentives and inconsistent policies

Where are the technical barriers?


# Technical barriers

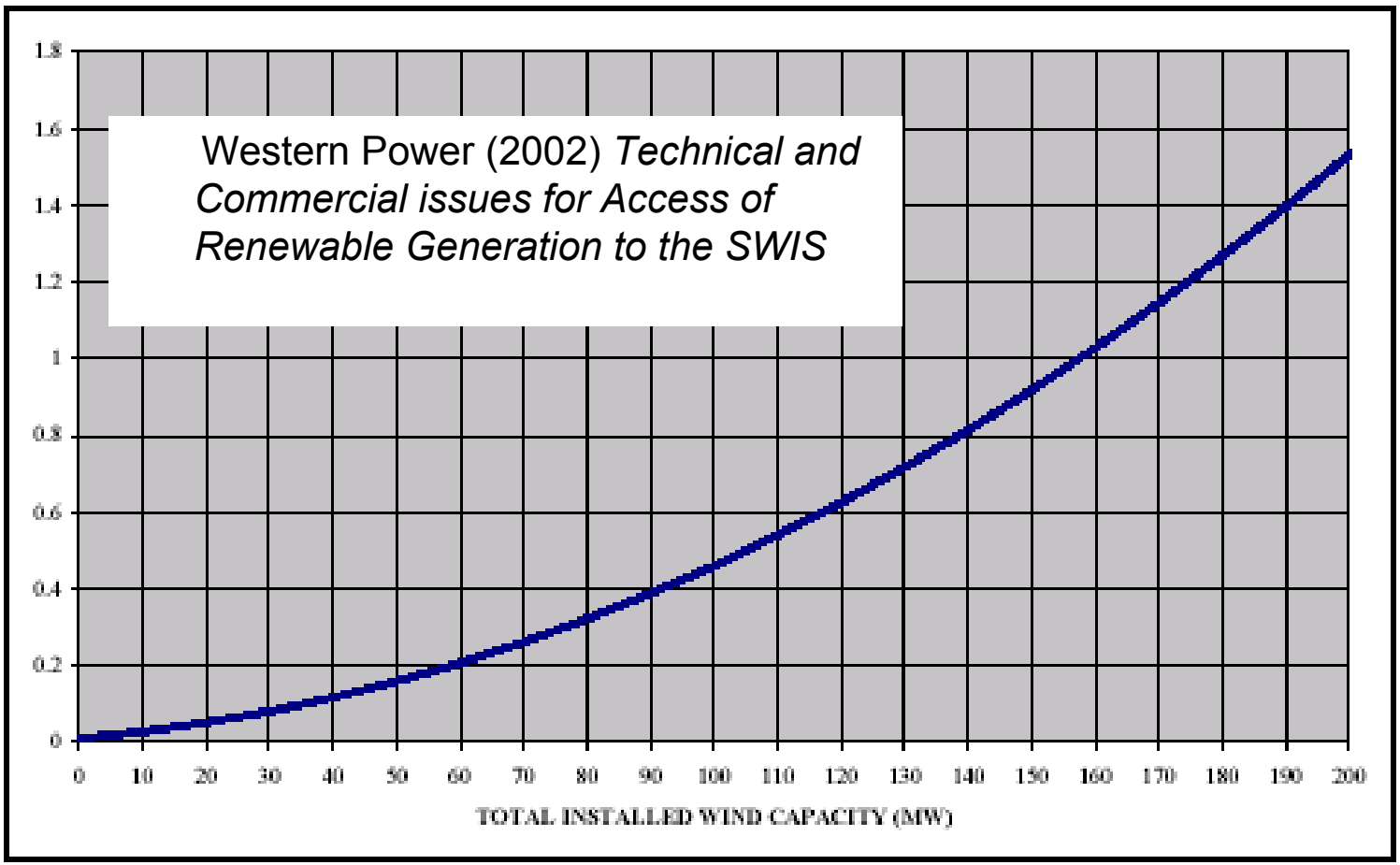
- Many renewables relatively 'technically' mature
- Technical Interconnection with the grid being standardised
  - AS4777 "**Grid connection of energy systems via inverters**" <30kW 3 ph or <10kW single phase
  - US IEEE P1547
    Draft Standard for Interconnecting Distributed Resources with Electric Power Systems
    Up to 10MVA – synchronous machines, induction generators, inverters

# Technical barriers – grid interactions

- Continuous, shared energy flow from generators to end-use equipment via network:
  - Instantaneously variable with time & location
    *Availability & quality can degrade rapidly*
  - Shared responsibility for availability & quality (ancillary services)
- Large stochastic generation raises technical / regulatory / institutional / economic / commercial issues wrt existing arrangements

# Eg. Adding wind to the SWIS

**Figure 1 – Suggested initial wind spinning reserve prices (cents/kWh of total wind energy generation)**




# Interconnection barriers - response

- Need proper counting of benefits + possible costs for different generation options
  - Particular challenge for distributed generation
- "..the energy market should not entrench the incumbent technologies"
  COAG (2002) *Draft Report*
- Costs of ancillary services should be "allocated to provide incentives to lower overall costs of the NEM"
  National Electricity Code
- SWIS example
  - Is problem variable wind, or inflexible coal fired plant?


# Institutional barriers

- Planning frameworks can be key
- Eg. Wind
  - Wind energy has important externalities:
  - Wind farms are not independent projects:
    - Economies of scale in network connection
    - Interference between shared wind resources
    - Shared social & environmental impacts
- Mixed federal, state & local government approvals process still lacks coherence

# Institutional barriers - response

- Develop a comprehensive wind farm planning framework: Outhred (2002) *Sustainability and renewables - wind*
  - Staged regional development process:
    - Resource evaluation; regional wind development & grid connection strategy; wind farm siting, forecasting
- Implement a consistent approach across Federal, state & local governments

- Note that other industries have a comprehensive planning framework, eg:
  - Strong, state-based planning framework for the minerals industry

# Example state based planning

Queensland Government
Natural Resources and Mines

- 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."*

# Policy barriers

*G8 renewable energy taskforce final report, July 2001*

- Weak incentives and inconsistent policies

- What to do? AEPG (2002) *Submission to COAG Draft Report*
  - Set objectives from sustainability rather than strict 'competition' framework

  => Environmental objectives need greater attention

  "Government policy makers anticipated that energy market reform… would lower the average GHG intensity of energy. Analysis now shoes that far from achieving a 14Mt reduction in 2010… energy market reform is now estimated to result in an increase of 0.1 Mt CO2-e by 2010"
  COAG (2002) Draft Energy Review Report

# Policy principles

- Goal
  - Determining best mix of 'least cost' measures to achieve climate protection objectives in context of concerted long-term action

  ⇒Large scale innovation + change required, not just cheapest available options now
- Principles for action
  - No universal policy, even emissions trading
    - "In addition to a national emissions trading system, there is likely to be a need for supplementary measures that address market impediments and aim to promote consistent incentives for abatement and innovation in those areas of the economy that an emissions trading system would have trouble reaching."

      AGO (2002) *Submission to COAG Energy Market Review*

  However, policies **do** need to be coordinated

# Policy principles (continued)

- Carbon price can be 'set' by policy design – targets + rules + accounting
  - Eg. NSW benchmark scheme first proposed to allow entire 1997+ gas-fired generation anywhere in NEM to *count* as NSW emissions reductions => carbon would be *cheap*
- Uncertainty + risk play an important role
  - There are risks in large investments in carbon-intensive generation - *real* advantages in smaller, low-emission options

# Policy principles (continued)

- Avoid stop-start policy changes that damage worthwhile progress
  - Renewables have a key role in longer-term climate change protection
  - MRET can play a major role in developing Australia's renewable energy industry + preparing Australia for longer-term transformation of the energy sector