Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

DE policy and regulatory requirements

The Role of PV in Smart Grids: Integration of Renewable Energy Systems and Distributed Energy in Electricity Grids Opportunities and Issues for PV

Sydney, 24 November 2008

Dr Iain MacGill, Joint Director - CEEM

CEEM established …

- *to provide a formal interdisciplinary framework* for joint work between UNSW researchers in Engineering, Business, Social Sciences, Environmental Sciences…
- *through UNSW Centre* providing Australian research leadership in interdisciplinary design, analysis + performance monitoring of energy + environmental markets, associated policy frameworks
- *in the areas* of
  - Energy markets
    - spot, ancillary services and derivative markets, **retail markets**
    - *Primary focus on the Australian NEM*
  - Energy related environmental markets
    - Eg. National Emissions Trading, MRET, Energy Efficiency Certificate Trading, Renewable energy support…
  - Broader policy frameworks and instruments to achieve desired societal energy and environmental outcomes

More information at www.ceem.unsw.edu.au

Decision-making in the electricity industry:

… as a centralised engineering optimisation problem

- Given:
  - An inventory of all existing & potential future generation, network & demand-side electrical equipment:
  - All their technical parameters, operating constraints, operating & capital costs, and derived 'energy service' benefits of demand
  - All externality costs and benefits associated with operation and investment of all these options
  - Uncertainties in all of the above – most of these without understood probabilities
  - … and the ability to control all generation, network & end-use equipment
- Calculate a strategy to maximise overall societal benefit:
  - Solve a stochastic non-linear dynamic optimisation problem for operating & investment decisions in generation, network and demand side equipment accounting for the special characteristics of electricity and electrical networks

Decision-making in the electricity industry:

… as decentralised commercial optimisation problem

- Given industry 'market' participants who in aggregate know:
  - all existing & potential future generation, network & demand-side electrical equipment:
  - All their technical parameters, operating constraints, operating & capital costs, and derived 'energy service' benefits of demand
  - All externality costs and benefits associated with operation and investment of all these options
  - Uncertainties in all of the above – most of these without understood probabilities
  - … and who have the ability to control their own generation, network & end-use equipment
- Establish markets that maximise overall societal benefit:
  - Spot and future prices for markets in energy and ancillary services and externalities that incentivise profit-maximising market participants to undertake decisions that contribute to maximising societal welfare over the long term

Decision-making in the 'real world' EI

- Some centralised decision-making inevitable:
  - Instantaneous & continuous energy flow
  - Network, generation & end-use services hard to separate
- Some decentralised decision-making inevitable:
  - Demand-side of the industry largely privately owned
- Traditional industry structure centralised supply-side
- Some industries worldwide have undertaken restructuring to provide a greater role for market-based competition
  - Requires 'designer' markets as special characteristics of electrical flows not amenable to traditional commodity markets:
  - Possible wholesale, ancillary service and retail energy markets
  - Some decision making still centralised – security & networks
  - *Not so much deregulation as re-regulation*

Challenges and opportunities for Distributed Energy

- How well do restructured industry arrangements establish and allow DE to suitably receive
  - Energy and network values
    - Locational, time varying + contingent value of energy and necessary network flows: *spot but also future prices b/c decisions now impact on later decisions*
  - Environmental values
    - 'command and control' regulation yet also possible schemes incl. ETS, MRET and feed-in tariffs that internalise environmental & social externalities
- A question of wholesale & retail market design, network regulation and surrounding policy frameworks
  - Challenges of technology and participant neutrality for emerging DE options that have very different technical & economic characteristics, location near and ownership by end-users
  - *Retail markets where DE resides are the 'unfinished' business of many electricity industry restructuring processes*
  - *Intersection of regulated network and competitive supply/demand options invariably complex and imperfect*
  - No serious efforts yet in most jurisdictions to address environmental, energy security and wider social externalities of energy markets

One perspective on Smart grids and DE

(Outhred, 2008)

- The key objective for the “smart grid” concept is:
  - Coordinated, decentralised investment in & operation of distributed resources to deliver net societal benefits
- Key requirements in achieving this objective are:
  - A protocol for interfacing “smart grid” elements to create an effective technological system (electricity industry)
  - An associated communications system
  - A formal decision-making framework to allocate authority & accountability to decentralised decision-makers
  - A formal incentive/penalty regime to align the incentives of decentralised decision-makers with societal objectives
  - A robust migration path to a “smart grid future”

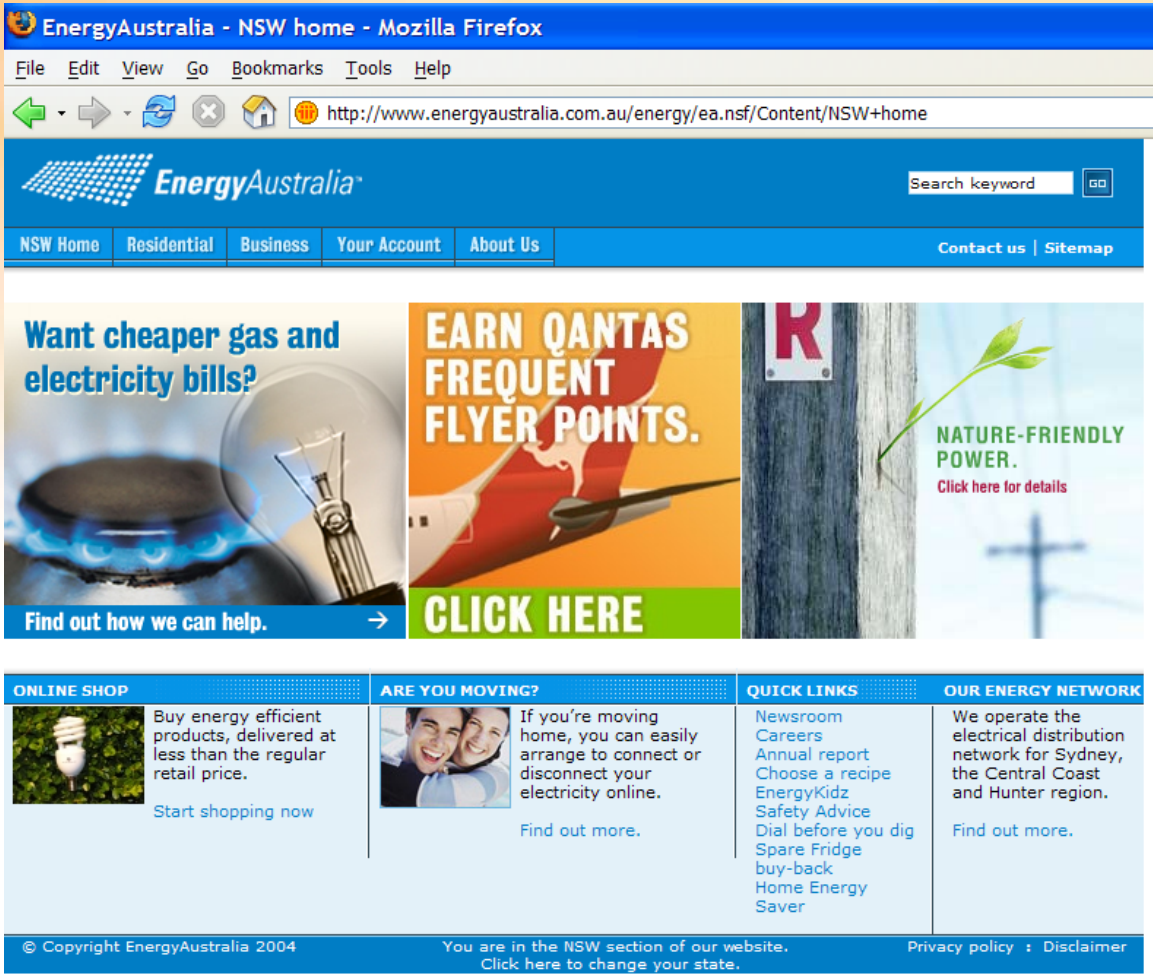
Present retail market design in Australia

- Retail market design for large end-users:
  - Competitive retail market (not yet mature)
  - Regulated network pricing (not yet mature)
- Retail market design for small end-users:
  - Regulated or partially competitive retail market
  - Simplified tariff structure; immature metering; profiling
  - Network charges usually passed through retailer
  - Little support for informed end-user decision making
- Some social policy objectives internalised
- Some environmental objectives internalised
- Limited opportunities for distributed energy

Current Full Retail Competition limited

". an important reason there is effective competition in Victoria is "Because the provision of energy is viewed as a homogenous, low engagement service… "

AEMC, *Effectiveness of Competition in Victoria,* 2008



Load growth driving major network expenditure

Figure 1.1: Building Block components of the annual revenue requirement ($bn nominal)

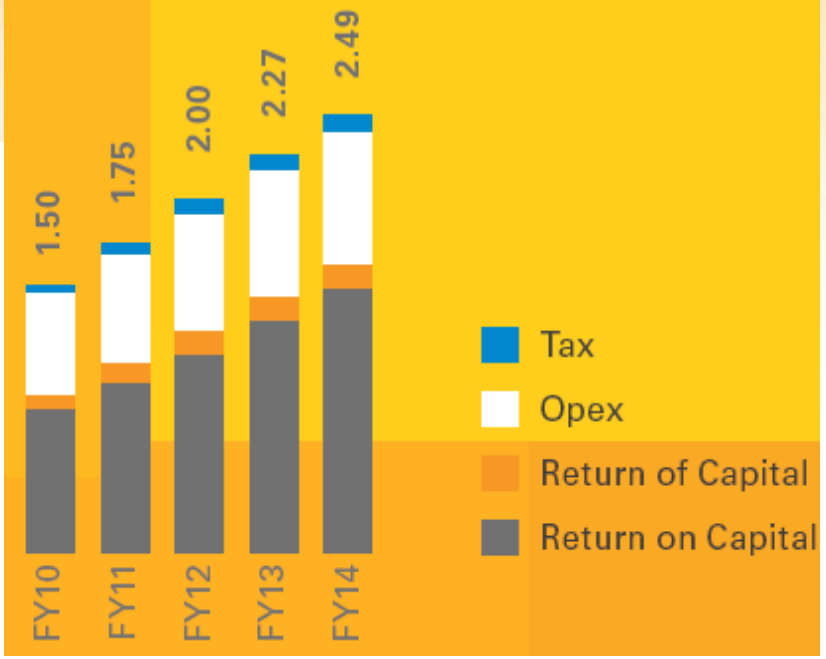
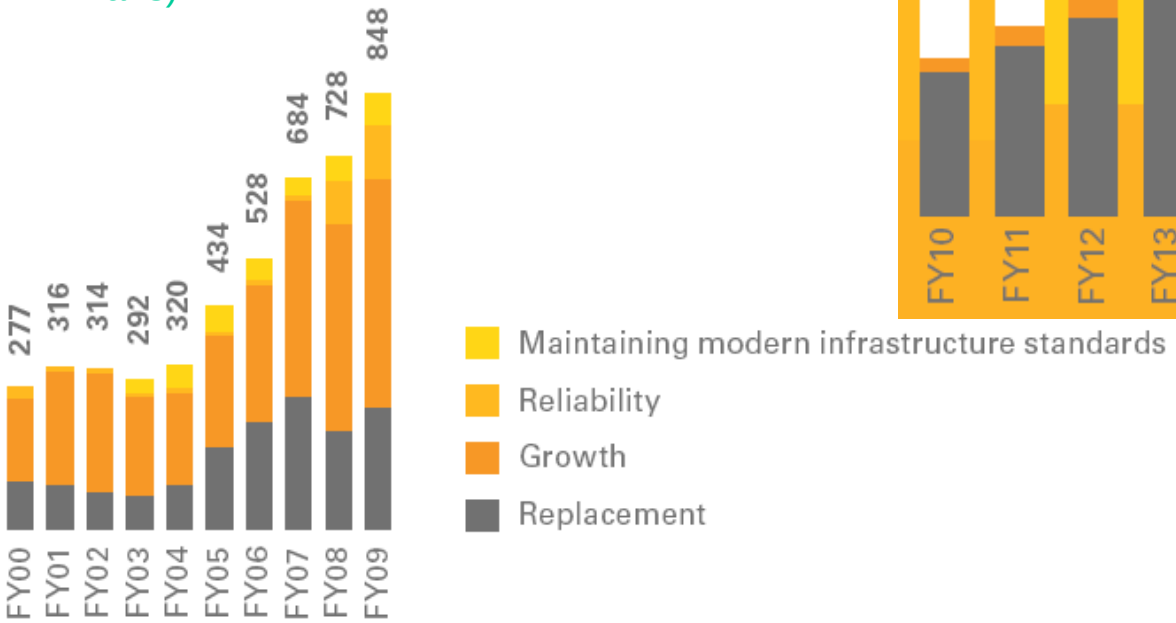
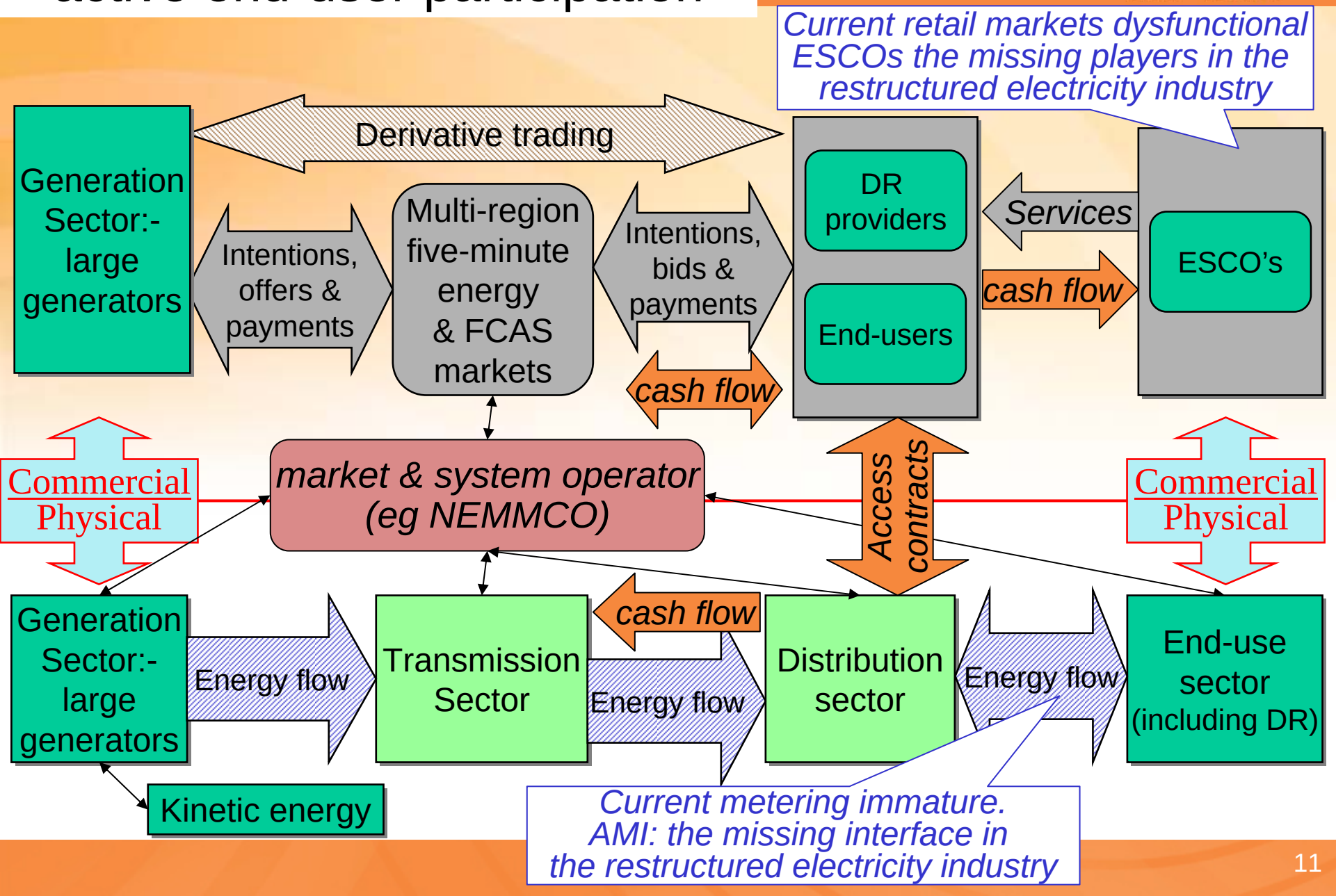


Figure 5.5: Capital expenditure by driver (FY07 $m real)

(Energy Australia, 20010-14 Expenditure Plans)



Enhanced NEM structure with active end-user participation



Wider policy frameworks to address externalities

- Emissions trading to date largely a debacle
  - EU ETS has had very limited impact on emissions yet sending extraordinary cashflows to large emitters and other major energy market participants
    - Little support for DE beyond higher energy prices
- Renewables deployment
  - Some measures have achieved far greater success in reducing emissions, establishing new industries & beginning transformation of electricity industries
  - Challenge of finding policy approaches that maximise electricity industry value of these renewables while driving transformation
    - Mixed experience with some Green Certificate schemes
    - Feed-in tariffs demonstrated success but 'hide' energy market signals
- Distributed Energy
  - Diversity of technologies and opportunities will require comprehensive & coherent policies wrt information, regulation & incentives sufficient to overcome existing barriers

Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

Thank you… and *questions*

Many of our publications are available at:
www.ceem.unsw.edu.au