



Research at the Centre for Energy and Environmental Markets: *Auctioning emissions permits and predicting the carbon price in Australia*

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Presentation Overview

- CEEM's Vision
- Research context: Energy and Environmental Challenges
- Approach and core implementation strategy
- Past, current and future research programs
- Project examples:
 - Auctioning permits in the Carbon Pollution Reduction Scheme
 - Prediction market for the Price of the Carbon Pollution Reduction Scheme
- Outlook on CEEM's future research agenda and cooperation potential

2





CEEM's Vision

*The Centre for Energy and Environmental Markets
inspires and informs the transition to a more sustainable
energy future nationally and internationally through
objective interdisciplinary research.*

3



Growing Energy and Environmental Challenges

Complex, multi-dimensional & interacting drivers

Possible
Conflicts

eg. Coal
vs. Gas?

Equitable
supply

Energy Security

- Oil, gas & coal prices increasing & more volatile, emerging stresses on energy industries worldwide
- Australia: 'energy rich' yet emerging challenges

Climate Change

- Growing global emissions and climate change concerns yet little evidence of an effective international or national policy response to date
- Australia: High & growing per-capita emissions, significant market-based policies (CPRS, MRET) coming yet coherent & comprehensive?

Societal welfare

- Unsustainable energy use & emissions in industrialised world, unsustainable growth in emerging economies & unsustainable lack of energy services in developing countries

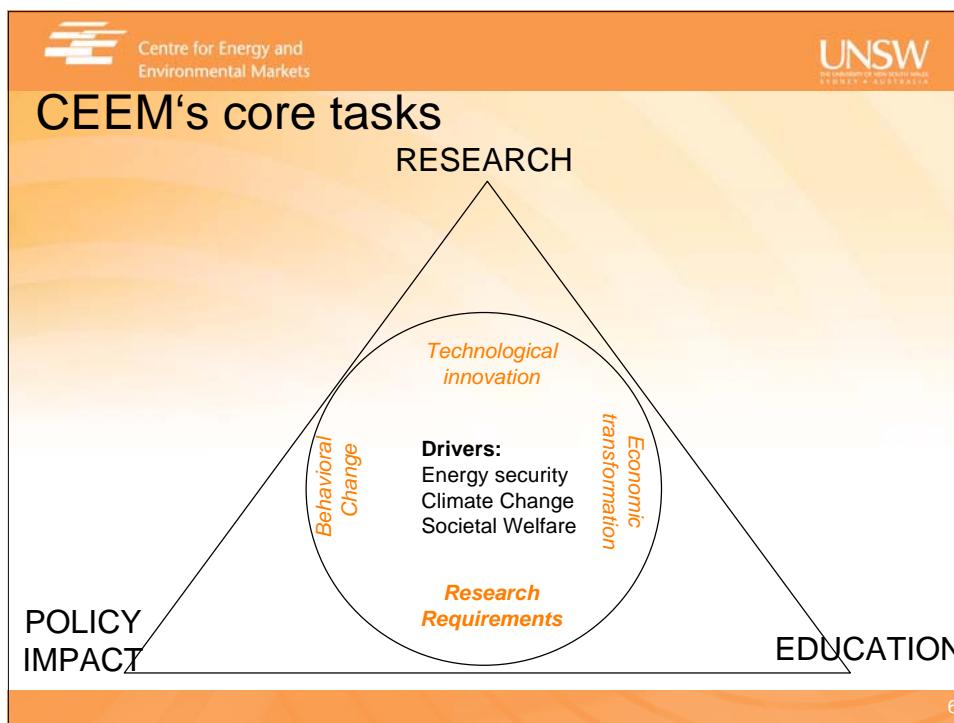
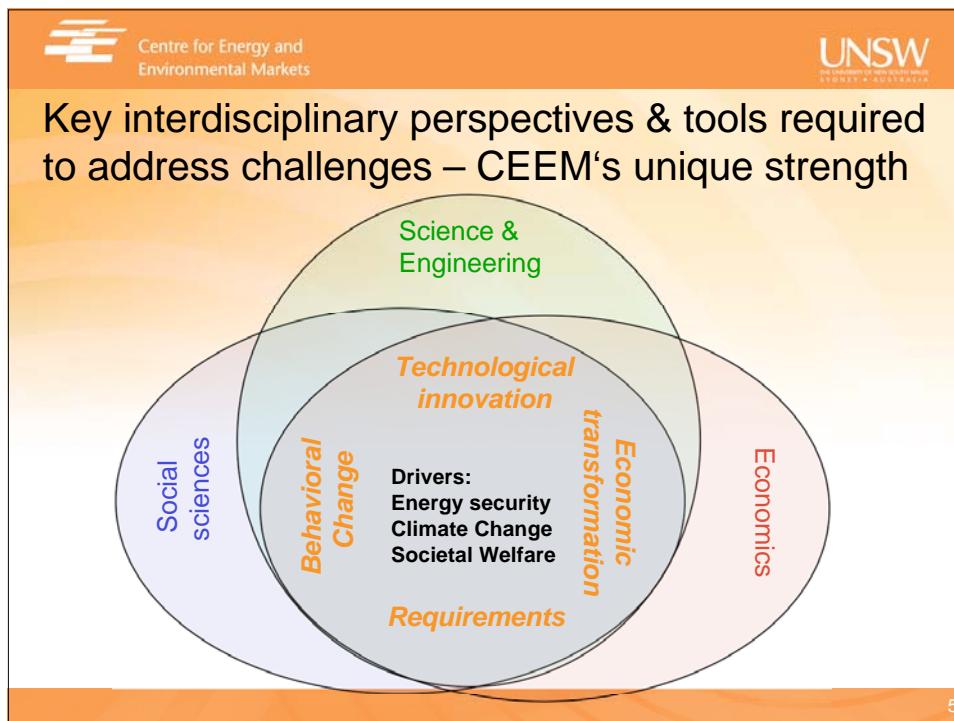
Possible
Synergies

Renewable
Energy

Cost-effective
Energy
Efficiency

4







CEEM's core implementation strategy

Research: undertake interdisciplinary research in the design, analysis and performance of energy and environmental markets and their associated policy frameworks.

Education: conduct short courses, workshops, public seminars and train postgraduate and undergraduate students in energy and environmental markets.

Policy Impact: provide expert input and leadership into government, shaping policy priorities and goals.

7



CEEM's founding research agenda

Topics:

- Design and performance evaluation of energy markets (ancillary services, spot market and network services for electricity and gas, and associated forecasting methodologies)
- Design and performance evaluation of energy-related derivative markets (financial and environmental derivative markets and associated forecasting methodologies)
- Design and performance evaluation of energy policy framework and energy policy instruments
- Design and performance evaluation of environmental markets and environmental policy

Methodologies:

- Formal analysis
- Experimental market platforms to facilitate the development of efficient market designs
- Applications of artificial intelligence (AI) techniques to energy and environmental market analysis.

8





CEEM's current research agenda

- Sustainable Energy Transformation
 - Facilitating renewable energy deployment
 - Sustainable energy technology assessment
 - Sustainable energy services in developing countries
- Energy & Environmental Market Design, related policies
 - Emissions trading, renewable & energy efficiency market design
 - Interactions between electricity market and emissions trading
- Energy-related decision making for distributed energy
 - Distributed energy options: energy efficiency, distributed generation, demand-side participation
 - Decision drivers - information, pricing, socio-cultural & 'infrastructures of provision'

9



Example 1: Sustainable Energy for Developing countries

- Key Research Questions:
 - Why some renewable energy projects succeed while others fail to facilitate sustainable rural development in developing countries
 - Identify & disseminate ways to overcome barriers to renewable energy in rural Indonesia by community capacity building
- Research Team:
 - Prof. Hugh Outhred, Dr. Maria Retnanestri, Dr. Stephen Healy, Dr. Muriel Watt, Ms. Long Seng To (PhD Candidate)
- Funding:
 - Australian Development Research Award (ADRA): AU\$ 310,000 over 3 years
 - BP Solar, e8, Azet Corporation, STTNAS Jogjakarta (In-kind & cash)
- Projects and activities:
 - Interdisciplinary research project involving Australian & Indonesian collaborators
 - Fieldworks, workshops, seminars and public lectures in Indonesia & Australia
 - Development of best practice project guidelines, educational curriculum, training materials, papers, journals, policy recommendations, proposal for renewable energy education and proposal for rectifying failed past projects

10





Example 2: Emissions trading and its interactions with the electricity industry

■ Key Research Questions:

- How do electricity and emissions trading markets interact?
- How to design an efficient emissions trading scheme?

■ Research Team:

- Dr. Regina Betz, Dr. Iain MacGill, Prof. Fushuan Wen, Dr. AJ Bostian, Christoph Heinzel, Dr. Paul Twomey, A/Prof. Hugh Outhred, Prof. Eddie Anderson (Uni Sydney), Phillipa Restiani (PhD)

■ Funding:

- ARC and CERF grant
- \$1.1 Million over 3 years

■ Examples of projects and activities:

- Linking emissions trading schemes internationally
- **Design of greenhouse gas permit auctions in Australia**
- Interaction of emissions trading and renewable energy markets
- Role of transparency in energy and environmental markets
- **Prediction Market for the Carbon Pollution Reduction Scheme**

11



Example 3: End-user decision making for distributed energy options and systems

■ Key Research Questions:

- Why are many highly promising energy end-user options for a more sustainable energy future failing to achieve widespread acceptance and deployment, and what can be done
 - What are the respective roles of information, pricing, socio-cultural factors and, infrastructures of provision in driving decision making
 - What technical, behavioural and policy approaches can help overcome existing barriers to meaningful participation and action by energy end-users in decision making

■ Research Team:

- Dr Iain MacGill, Dr Stephen Healy, Dr Rob Passey, Dr Muriel Watt, Ted Spooner, and Michael Pedrasa and Stephen Tansing (PhD candidates)

■ Funding:

- FRGs and CSIRO Collaboration grants (approx. \$140k to date). More funding sought

■ Projects and activities:

- The potential contribution of advanced end-user interfaces to facilitate participation
- Retail electricity market design – tariffs and supporting policy frameworks
- Assessing socio-cultural factors and „infrastructures of provision“ influences for different energy end-users and what they mean for policy development
- Institutional challenges – from technical standards for distributed generation technologies to the need for Energy Service Companies (ESCOs)
- Analysis of some existing policy approaches: Energy Efficiency Certificate Trading (EECT), Feed-in tariffs for small-scale generation

12





Research Project: How to auction emissions permits in Australia?

13



How to auction?

- Many different options exist to design the auction: sealed-bid vs. open-bid, dynamic vs. static, uniform price vs. pay as your bid...
- Challenge:
 - Multi-unit, multi-item (different vintages) auctions
 - Trade-off between simple vs. complex design and efficiency for the type of good (e.g. Simultaneous auctions seem to be favoured in a multi item setting when partial substitution is possible)
- White Paper: Simultaneous clock auctions with intra-round and proxy bidding held monthly
- CERF/EERH-Project: Test different designs experimentally to see if complexity outweighs efficiency, compared to the more simple design

14





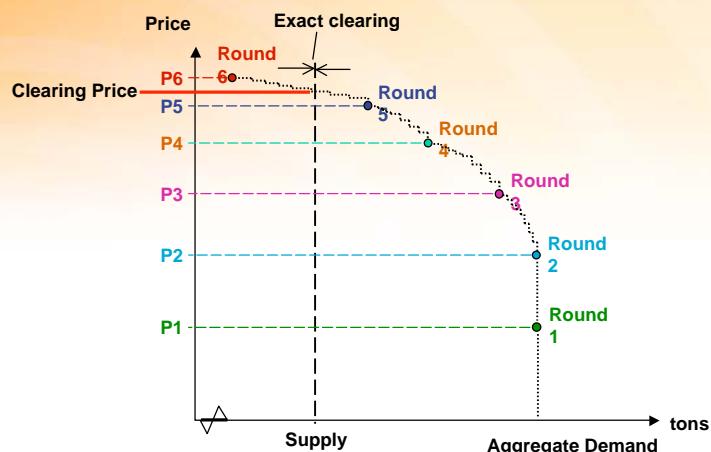
Ascending Clock Auction

- Auctioneer publishes total available quantity, initial reserve price and further schedule of price offers
- Participants hand in demand bids for the reserve price
- Auctioneer reveals total demand
- As long as total demand > total available quantity auction goes on
- Demand bids cannot increase
- Auction ends when total demand \leq total supply
- Final price: **uniform pricing**: p_t =if total demand = total supply or p_{t-1} = if total demand < total supply (normal case)
- All bidders receive their quantity of last round (normal case)
- The remaining supply is allocated proportional according to residual bids at p_{t-1}

155



Ascending clock auction with intra-round bidding



Source: Peter Cramton presentation 2007

16





Timing and frequency

Box 9.9: Possible timing of auctions and proportion of permits available at each auction in 2009-0 to 2011-12

Vintage	Financial years																							
	2009-10						2010-11						2011-12											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010-11				1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16						1/16
2011-12					1/16	1/16	1/16												1/16	1/16	1/16	1/16	1/16	1/16
2012-13						1/16	1/16												1/16					
2013-14			Transition				1/16												1/16					
2014-15																			1/16					

Note: Entries represent the fractions of permits from each vintage year cap excluding administrative allocations.

At most 4 simultaneous clocks

Source: White paper 2008

17



2. Research Project: Prediction Market

18





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Prediction market

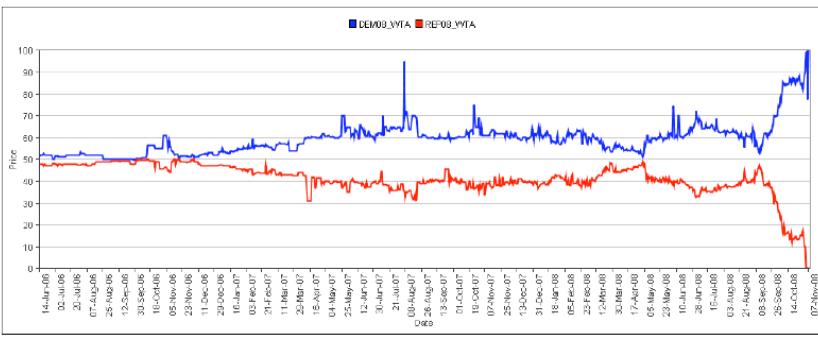
- Why do we need a prediction market for CPRS?
 - Early price is important as investment takes time
 - Future markets will not be liquid at the beginning
- Wisdom of Crowds: A case in which the information needed to generate a forecast is held collectively, not by any single individual.
 - Aggregation problem: How can the collective information be aggregated into a forecast?
 - A Prediction Market uses a competitive market to aggregate collective information.
- Why Does This Work?
 - Markets are belief aggregators by nature.
 - Eliminates cheap talk in the forecast.
 - Forecast is based on the marginal trade, which is typically better informed than the average opinion.

19

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Prediction market for US elections

2008 Presidential "Winner Take All" Market



Source:
http://iemweb.biz.uiowa.edu/quotes/Pres08_Quotes.html

20





Prediction Market on CPRS price

Prediction Markets involve trading Shares of Events.

Multi-Event Winner Take All market to forecast the price of CPRS permits at the first auction.

- Event 1: Auction price is \$0 to \$9.99.
- Event 2: Auction price is \$10 to \$19.99.... etc.
- Shares pay \$1 if the Event occurs, \$0 otherwise.
- Share prices interpretable as the probability of the Event occurring.
- Provides a forecast about the likelihood of all prices, not just a point forecast.
- Runs from Early 2009 to first auction (tentatively Early 2010).
- To start early 2009 (sorting out legal details with Bank partner)
- A Rare Operationalisation of a Pure Prediction Market:
 - Open to anyone in Australia.
 - Participants use their own money, up to \$500.
 - No transaction fees. Not-for-profit Ethics approved.

21



CEEM's future research agenda and cooperation potential

- Sustainable Energy Transformation
 - Sustainable energy technology assessments
 - Pathways of technology innovation & transitions
- Energy & Environmental Market Design, related policies
 - Evaluation of emissions trading, renewable & energy efficiency market design
 - Interactions between different policy measures
 - Coherent policy frameworks
 - Market governance
- Energy-related decision making for distributed energy
 - Distributed energy options: energy efficiency, distributed generation, demand-side participation
 - Behavioural framework - information, pricing, socio-cultural & infrastructures of provision'
 - End-user participation for sustainable energy services delivery

22





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12