Rob Jolly, Director

Policy roadmap for energy efficient air conditioners

ENERGY EFFICIENCY, CLIMATE AND CHINA'S DEVELOPMENT STRATEGY
Realising Technological Innovation and Effective Policy Implementation
Beijing, 9 September 2010

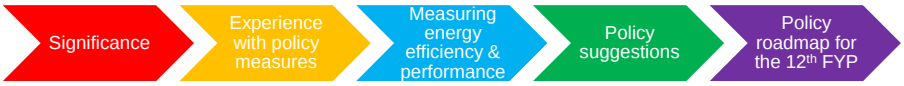
VICTORIA UNIVERSITY

国家发改委能源研究所
Energy Research Institute, NDRC

Disclaimer

Carbon Market Economics Pty Ltd (including the directors and employees) makes no representation or warranty as to the accuracy or completeness of this presentation. Nor shall they have any liability (whether arising from negligence or otherwise) for any representations (express or implied) or information contained in, or for any omissions from, the presentation or any written or oral communications transmitted in the course of the presentation.

Outline



3

carbon market economics

Air conditioners are a major source of demand for electricity in China

- consume around 20% of household electricity
- 40% in summer household demand
- 40% of peak demand in major Chinese cities
- significant contribution to greenhouse gas emissions

Focus of policy review

- Air conditioners
- Energy efficient products
- Lessons of experience

4

carbon market economics

Air Conditioner Standards

Countries with MEPS for air conditioners
- Australia, Canada, China, Korea, Korea, Mexico, New Zealand, Taipei, USA

Japan has adopted a different approach
- Top Runner Program
  - COP set for manufacturer's of air conditioners, does not set minimum standard
  - Required COP is weighted average of air conditioners sold by manufacturer
  - Shift to Annual Performance Factor (APF) in 2010

Range of policies that complement COP standard for air conditioners

5

carbon market economics

Complementary Policies

Financial
- ➢Product Rebates
- ➢White Certificate Schemes
- ➢Renewable Energy Certificates

Behavior
- ➢Energy cycling
- ➢Electricity pricing
- ➢Smart meters

6

carbon market economics

Air Conditioners – policy objectives

- Total demand for electricity
- Peak demand for electricity
- Greenhouse gas abatement

Measurement Issues

- Peak capacity operation
- Seasonal variation
- Regional differences

Energy Efficiency

- Cooling
- Heating
- Combination

Peak Demand

- major issue now
- greater problem in future
- impacts on investment in electricity generation capacity

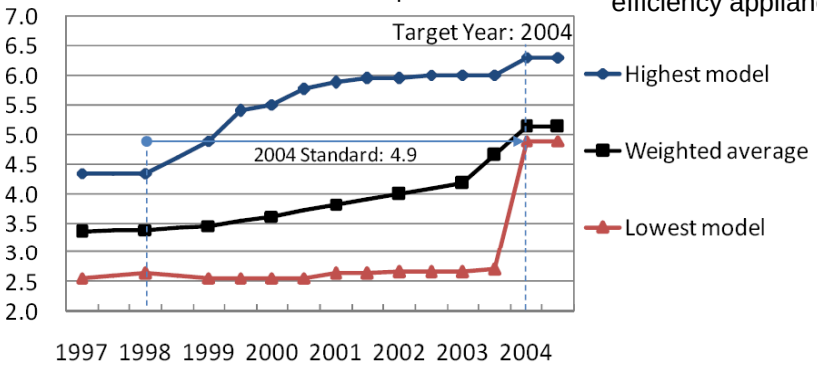
carbon market economics

Measuring energy efficiency & performance

Japan's Top Runner Policy

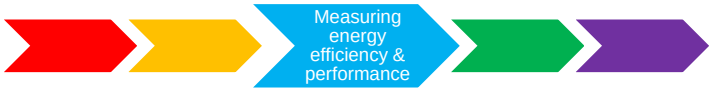
Objective: to develop the world's best energy efficiency appliances

COP 2.8kW class Air Conditioners Japan, 1997-2004



Source: Central Research Institute of Electric Power Industry (CRIEPI) 2010

carbon market economics

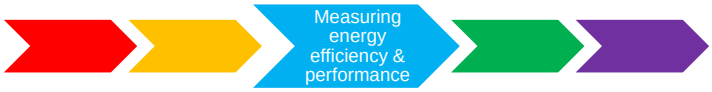


Japan post 2004

- Increase in energy efficiency of air conditioners 1997 to 2004 was 67.8%
- The COP for the most efficient room air conditioner has increased substantially over 2004 to 2009
- COP for small room air conditioners increased from 4.9 in 2007 to 5.8 for 2010
- Encouraged super efficient air conditioners
- COP of some air conditioners in Japan is 9.0

9

carbon market economics



Future improvements in energy efficiency

Signs potential to increase the COP of super efficient air conditioners on the market will be **limited** in the future: Japan's CRIEPI (2010) concluded that cost effective improvement in energy efficiency of air conditioners is **virtually exhausted**.

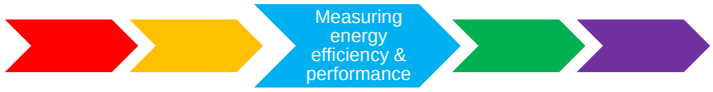
Justification:

- The motor efficiency of compression has reached 95%
- Heating insulation efficiency has reached 80%
- Improvement in recent years has been achieved by expanding the size of heat exchanges. Space restraints are likely to prevent significant increases in the future.

Although there appears to be significant restraints on improving the energy efficiency of heat pump air conditioners there are new air conditioning technologies on the horizon in the long term.

10

carbon market economics

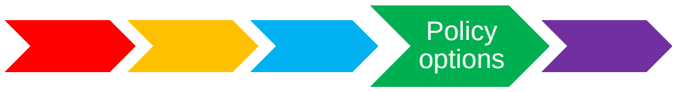


Energy Performance of Central Air Conditioners

- More than the COP
- Quality of the ducting system an important factor
- COP assumes that the air conditioner ducts are well insulated
- Poor insulation leads to large energy losses
- Need for minimum standards for duct insulation
- Insulation standard proposed to be included in Australian building codes
  - In 2011 air conditioning ducts required to meet an R rating insulation standard

11

carbon market economics



Energy Efficiency Labels Selected Countries

Country	Energy efficiency star ratings	Super efficiency star ratings	Capacity output in kWh		Power input kW		Measure of the Performance	Annual energy use	Annual operating cost
			Cooling mode	heating mode	Cooling mode	heating mode			
Australia	√	√	√	√	√	√	X	X	X
USA	ES	X	X	X	X	X	X	X	X
Japan	√	X	√	√	√	√	√	√	√
Germany	A+	X	X	X	X	X	X	√	X
Canada	ES	X	X	X	X	X	√	X	X

12

carbon market economics

Impact of Air Conditioner Energy Labels

Evidence suggests attract attention, yet may not change behavior.

Japanese experience
"*many efficient models on the market are so expensive that they cannot achieve payback within the lifetime of the room air conditioners, considered to be around 10 to 15 years.*" (Osamu Kimura, Central Research Institute of Electric Power Industry, 2010)

Chinese experience
"*Consumers were well aware of the China Energy Efficiency Label and tended to pay more attention to products with such labels*."

"*the willingness to pay values for more energy efficient refrigerators were higher than those of air conditioners, implying that Shanghai consumers have greater incentive to pay more for appliances they use more frequently*." (Shen, J & Saijo, T, 2009)

13

carbon market economics

Financial Incentive: White Certificate Schemes

- Certificate created from estimated greenhouse gas abatement of product
- Value from mandated energy efficiency target for electricity retailers
- Eg. UK, Australia (New South Wales, Victoria)

Inherent Difficulties
- Setting comparable baselines for accredited products
- Estimating comparable lifetime greenhouse gas abatement
- Ensuring greenhouse gas abatement is beyond 'business as usual'
- Potential 'free good' problem

Operating White Certificate Schemes show a strong tendency for schemes to favor low cost products that may not even result in additional greenhouse gas abatement.

14

carbon market economics

Other Financial Incentives

- **Government Rebates**
  - Australian experience
    - Solar PV – surge in solar PV, much greater than expected
      - » Highlights great care in setting size of rebate
    - Insulation – very high take up, scheme abandoned because of serious installment problems
      - » Highlights significance of governance
      - » Great care needed in designing programs
      - » highlights challenges of meeting different policy needs: economic stimulation/jobs & energy efficiency/CO2 abatement

15

carbon market economics

Other Financial Incentives

- **Tax Credits**

  USA
  - Air conditioners – 30% Tax Credit up to cost of $1,500
    - ❖Effectively rebate limited to taxpayers
    - ❖Short-term stimulus measure (expires Dec., 2010)
  - Geothermal heat pumps - 30% & no upper limit
    - ❖Also covers solar systems & micro-turbines
    - ❖Expires Dec. 2016
  - Residential fuel cells – 30% tax credit up to $500 per .5 kW capacity
    - ❖New and existing homes
    - ❖Principal residence only
    - ❖Expires Dec., 2016

energy ENERGY STAR

16

carbon market economics

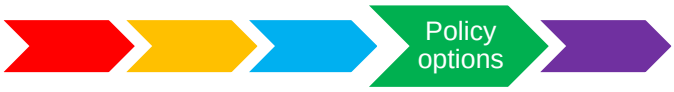
Future Policy Approach (1): Energy Performance Measure

Measure performance of air conditioner on a steady state basis in cooling and heating mode.

- COP superior to SEER
  - Easier to relate energy use
  - Absolute performance not just relative
- Pay particular importance to the COP in cooling mode
  - Indicates impact of air conditioners at time of peak electricity demand factor
- MEPS to be set for major climate zones in China

17

carbon market economics



Future Policy Approach (2): MEPS or Top Runner

- Top Runner stimulated air conditioner innovation in Japan
- Innovation likely to be less significant in future in increasing EER
- Large gap between MEPS and super efficient air conditioners (3.3 MEPS up to 9.0 for super efficient)
- Challenge moving MEPS closer to current super efficient standards over the next two FYPs (2011-2015; 2016-2020)
- Key issues
  - Response of manufacturers
  - Consumer demand
  - Costs of changing system

18

carbon market economics

Suggested Policy Approach (2): Labeling

Continue to develop Energy Efficiency Labels on air conditioners

- Studies suggest that consumer pay close attention to energy performance labels
- Simplified star/bar system provides ranking of different air conditioners
- Consider including reference to super efficient air conditioners on label along the lines of the Australian label
- Consider including total estimated energy use in cooling and heating mode
- Consider providing information on estimated annual electricity cost of using air conditioner

19

carbon market economics

Suggested Policy Approach (3): Financial Incentive

Rebates to consumers for purchasing super efficient conditioners

- Incentives to be directed at encouraging the purchase of super efficient air conditioners in cooling mode
- The level of the rebate to be sufficient to encourage consumers to buy super efficient air conditioners – is 10% discount enough?
- Rebate provided at point of sale of air conditioner independently of the installer of the product
- Regular review rebate to ensure that it remains at an appropriate level

20

carbon market economics

Suggested Policy Approach (4): Central Air Conditioners

Set MEPS for central air conditioners

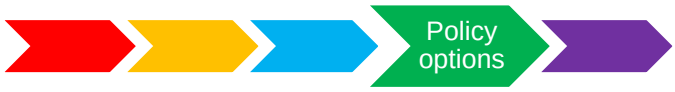
- The MEPS standard based on same principles as room air conditioners

Set MEPS for insulation of air conditioning ducts

- Options standard could be included in building code or stand alone
  - Criteria – administrative
    - Effectiveness of enforcement
    - Cost of administration

21

carbon market economics



5. Governance

Setting energy efficient standards not a sufficient condition for improvement

Many “good” energy efficient programs that have ended in disaster because of ineffective governance.

Key Issues

Ensure that:

- shipped air conditioners conform with the standards specified
- air conditioners are correctly installed
- air conditioner ducts are insulated to minimum standards

Requires

- effective monitoring of air conditioner installation and duct insulation
- Heavy penalties if standards are not met

22

carbon market economics

Current MEPS for air conditioners to apply until end of 2015

2011 *Undertake detailed research to determine MEPS to apply in 2015*

- In determining MEPS for all air conditioners take into account best COP in world market for all relevant air conditioners
- Consider the capacity of Chinese manufacturers to manufacture air conditioners that approach world's best performance for air conditioners in 2010
- As a guide to setting MEPS for air conditioners consider setting the MEPS close to Japan's Top Runner COP applying in 2011
- Assess cost of significantly increasing MEPS for air conditioners including cost of meeting world's best standard in 2016

2013

- Set MEPS that provides a feasible stretch target for Chinese manufacturers
- Set minimum standard for insulation of air conditioning ducts

23

carbon market economics

Supplementary Measures to MEPS

2011-2013

- Review Energy Efficiency Labeling
- Field research to be undertaken on consumer response to existing label
- Test response to energy label that includes more information and/or potential cash savings and emission reductions on air conditioners
- Review rebate for super efficient air conditioners
- Undertake research into cost and effectiveness of rebate scheme
- Review process of monitoring installation of air conditioners
- Select random sample of installations where air conditioners have high installation rate
- Assess impact of poor quality installations on energy consumption
- Develop an approach that encourages resellers to promote the sale of super efficient air conditioners
- Public procurement of super efficient air conditioners

24

carbon market economics

Encourage the adoption of latest proven technologies

- Refrigerants
  - Assess the feasibility of moving to less greenhouse gas intensive refrigerants
- Combined space conditioning and power
  - Tri-generation: combining water heating, space conditioning and power, Eg. gas-fired fuel cells
- Hybrid technologies
  - Assess the potential of solar/heat pump technologies
- Geothermal
  - Assess the scope of geothermal space conditioning

25

carbon market economics

Air Conditioners, Behavior & Smart Meters

Smart Meters

- Provide real time data on energy consumption in buildings
- Evaluate the effectiveness of substantial smart meter programs
  - Price levels
  - Consumer response – reduce use of air conditioners, comfort levels
  - Impact on air conditioners in peak demand period

Smart Grid

- Potential to transform existing services and enable new services
- Possibility of central administration of air conditioning demand during peak periods
  - Identify strategic areas for implementation: peak load and grid stress
  - Trial & monitor effectiveness of 'voluntary' central control in public offices, commercial buildings and residential apartments

26

carbon market economics

Key Observations

Performance Measurement

- Priority to impact on peak demand
- COP/EER measure

Increasing Energy Efficiency

- Technology available
- Challenge moving the standard towards super efficient air conditioner

Complementary policies

- Energy Labeling – include estimated annual use and cost
- White Certificates Scheme – little benefit to air conditioners
- Rebates – 10% discount may not be sufficient
- Duct Insulation – need for minimum standard

Program Design

- Stretch targets need to carefully considered
- Program design critical to success
- Good governance essential

27

carbon market economics

THANK YOU!

Rob Jolly

Rob.Jolly@carbonmarkets.com.au

www.carbonmarkets.com.au

28

carbon market economics

References

Australian Government, Air Conditioners (July 2009), Facts Sheet – Standards & Regulations, http://www.energyrating.gov.au/pubs/factsheet-standards-reg-ac.pdf

International Energy Agency, (2010), Energy Technology Perspectives – Scenarios & Strategies to 2050

Feng, Y., Wu, Y., & Liu, C. (2009). Energy-efficiency supervision systems for energy management in large public buildings: Necessary choice for China. *Energy Policy, 37(6), 2060-2065*

Hong, T. (2009). A close look at the China Design Standard for Energy Efficiency of Public Buildings. *Energy and Buildings, 41(4), 426-435*

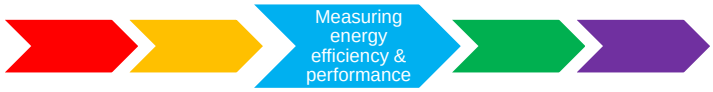
Kimura, Osama, (2010) Japanese Top Runner Approach for energy efficiency standards, Central Research Institute of Electric Power Industry

Kishimoto, Tetsuro, (March 2009), Standards & Labeling System for Air-conditioning Equipment in US, Europe and Japan

Sachs, Harvey M., Henderson, Hugh, Shirey, Don III, and Nadel, Stephen, (2008), American Council for an Energy-Efficient Economy, Improving Central Air Conditioner Performance Ratings: A Review of Seasonal Energy Efficiency Ratings (SEER) leads, DSM

Spotlight, The Newsletter of the International Energy Agency Demand Side Management Programme, January 2009

Shen, J., & Saijo, T. (2009). Does an energy efficiency label alter consumers' purchasing decisions? A latent class approach based on a stated choice experiment in Shanghai. *Journal of Environmental Management, 90(11), 3561-3573.*



Current MEPS Small Room Air Conditioners (RACs)

Country	Year	MEPS	SEER
Australia	2010	3.33	
Canada	2010		10
China	2010	3.20	
Japan	2007	4.90	
Korea	2008	3.45	
Mexico	2010		10
Taipei	2010	3.45	
USA			10

Policy options

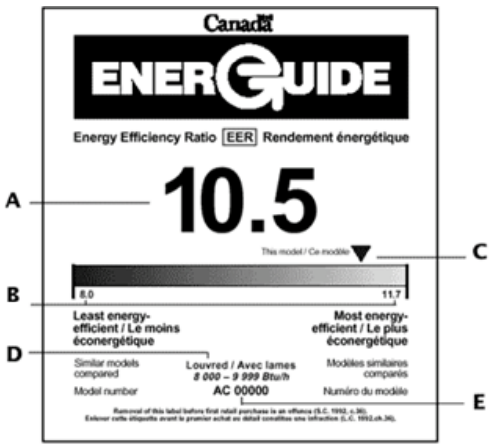
Energy Label Japan

31

carbon market economics

Policy options

Energy Label Canada

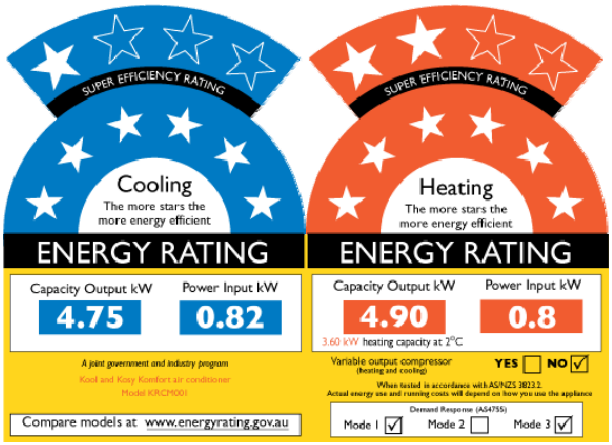


32

carbon market economics

Policy options

Room Air Conditioners : Energy Label Australia



carbon market economics

Policy options

White Certificate Schemes

Australia

New South Wales

- Bias to low cost items
  - Compact Flourescent Lights (CFL's) – not additional
  - Low flow showerheads

Victoria

- Swamped by CFL's

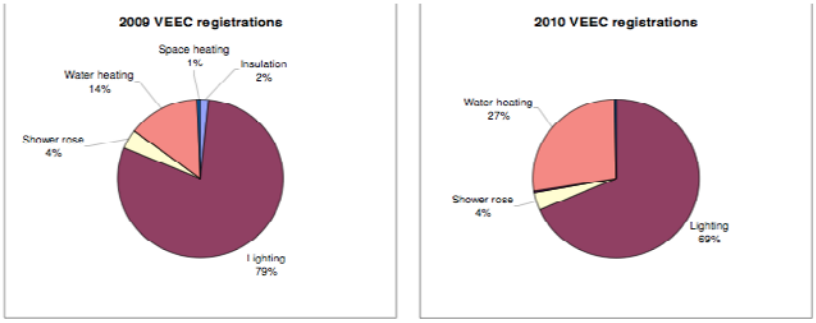
Europe

UK and Italy experienced similar problems with CFL's

carbon market economics

Victorian Energy Efficient Certificate Creation 2009 and 2010

- Mix of activities is changing



www.esc.vic.gov.au/public/veet
www.saveenergy.vic.gov.au

ESSENTIAL SERVICES COMMISSION energytargets

A Victorian Government initiative

35

carbon market economics