



Elements of Climate Policy - Carbon pricing and complementary instruments

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Outline

- Rationale for carbon pricing
- Can a carbon pricing scheme work?
 - Experience and lessons for the EU ETS
 - Grubb et al (2011) *Ten Insights in from the EU Emissions Trading Scheme – With Reference to Carbon Pricing in Australia*
- Do we also need alternative instruments?
 - Rationales for using multiple policy instruments
 - Twomey (2011) *Rationales for Multiple Instruments in Climate Policy*

The Centre for Energy and Environmental Markets (CEEM) was established to...

- *...to formalise* growing shared research interests + interactions between UNSW researchers
 - Faculties of Engineering, Business (Economics and Management), Arts and Social Sciences, Science, Institute for Env. Studies...
- *...through a UNSW Centre* aiming to provide Australian research leadership in interdisciplinary analysis + design of energy and environmental markets
- *...focussing in the areas of*
 - Energy markets – spot, ancillary and derivatives – within restructured electricity industries
 - Related environmental markets – emissions trading, renewable obligations, Greenpower...
 - Wider policy frameworks and instruments for achieving overall energy and environmental objectives



Rationales for using carbon pricing

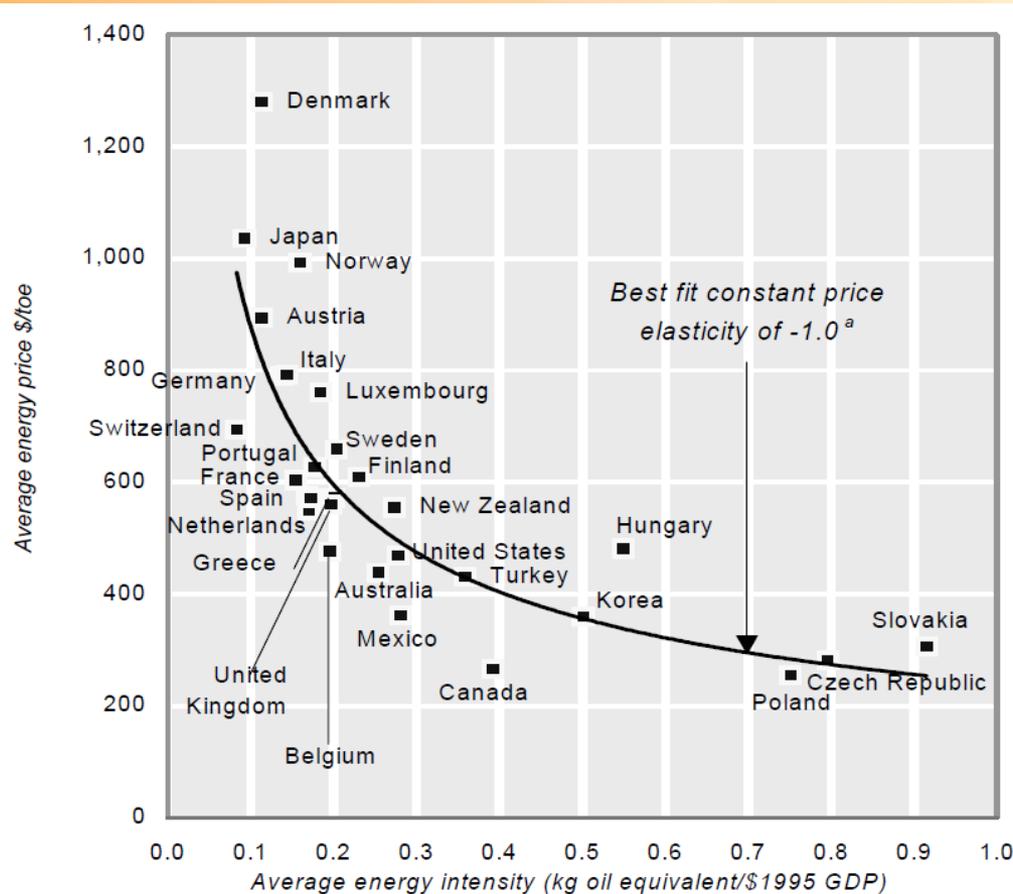
Recap – the rationale for using carbon pricing

- The power of a carbon price:
 - creates incentives for production to use of more carbon efficient technologies;
 - induces substitution towards lower carbon fuels, products and services by industry and consumers;
 - stimulates innovation and development of lower carbon technologies, products and services.
- The price signal permeates the economy and feeds into individual decisions that would be difficult to target with regulation.
- The price signal incentivizes management to find novel ways of lowering emissions intensity that regulators may not have even been aware of.

Recap – the rationale for using carbon pricing (II)

- Some technological advances will always require some type of extra incentive to install
 - E.g. Carbon Capture and Storage (CCS), even if it does work, will always be an extra cost to a coal plant.
- Compared to regulation prescribing or subsidising the use of energy efficient or low-carbon technologies carbon pricing helps discourages a '**rebound effect**'.
- Economists like it, of course, because it leads to the **least-cost** uptake of mitigation opportunities (without the regulator or government required to know all the marginal abatement costs of all of the firms out there)

Relationship between energy prices and energy consumption is suggestive that carbon pricing can work



...and at least one paper has demonstrated that Sheikh Yamani did much more to reduce global CO₂ emissions than did the Kyoto Protocol!

Example of efficiency of carbon tax or ETS

- Example: An industry has three 3 firms having the following marginal abatement costs of three firms. Each firm is now emitting 10 tonnes/week; total emissions are 30 tonnes /week.

Emissions (tons/week)	Marginal Abatement Costs (\$/ton)		
	Firm 1	Firm 2	Firm 3
10	0	0	0
9	4	1	1
8	8	2	2
7	12	4	3
6	16	6	4
5	20	8	5
4	24	12	6
3	28	20	7
2	36	24	8
1	46	28	9
0	58	36	10

Note: the marginal cost is the cost of *one extra* tonne of emissions reduction.

Assume that the total efficient level of pollution has been found to be 15 tonnes

- One way to achieve this is require that all three firms reduce emissions by 5 tonnes (e.g. implementing the same performance standard for all firms). Is this efficient?

Emissions (tons/week)	Marginal Abatement Costs (\$/ton)		
	Firm 1	Firm 2	Firm 3
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Five tonnes of
emissions reductions
by each firm

- Total costs = $(4+8+12+16+20) +$

- $(1+2+4+6+8)+(1+2+3+4+5)=60+21+15 = \96

No, the equi-proportionate reductions are not efficient

- Cheap abatement opportunities of firm 3 are being missed while firm 1 has taken on expensive abatement reductions

Emissions (tons/week)	Marginal Abatement Costs (\$/ton)		
	Firm 1	Firm 2	Firm 3
10	0	0	0
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Expensive Opportunities taken up

Cheap opportunities missed

- Arbitrage opportunities are available

The efficient level of reductions should have all firms at the same marginal cost (equi-marginal principle)

- In this case, all firms should reduce up a marginal cost of 8 tonnes/week (which will lead to a total of 15 tonnes of reductions)

Emissions (tons/week)	Marginal Abatement Costs (\$/ton)		
	Firm 1	Firm 2	Firm 3
10	0	0	0
9	4	1	1
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2	36	24	8
1	46	28	9
0	58	36	10

Total cost = $(4+8) + (1+2+4+6+8) + (1+2+3+4+5+6+7+8) = 12+21+36 = \69



This can be see graphically, by lining up all the marginal costs from cheapest to most expensive for the total industry

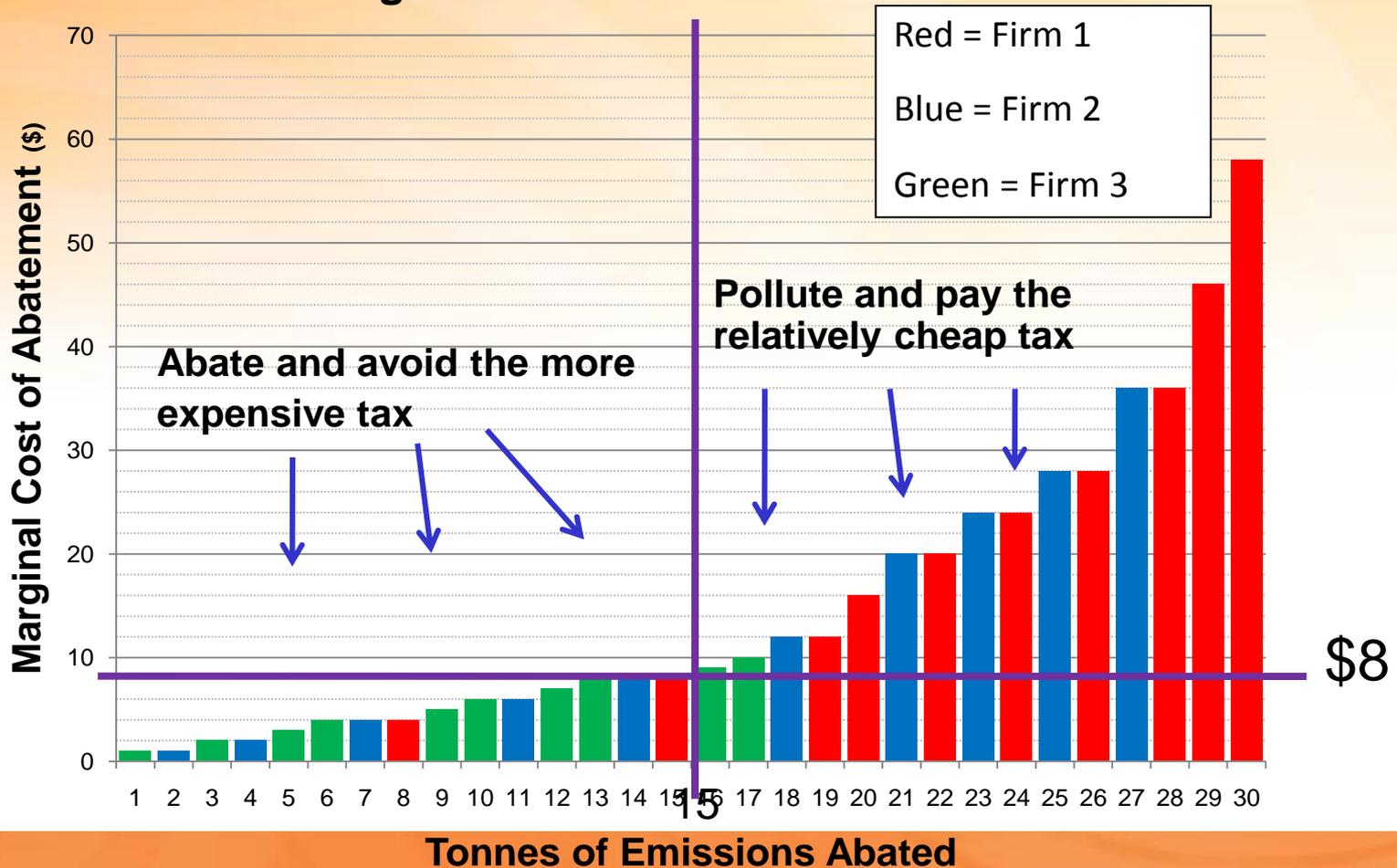
Marginal Abatement Cost Curve





One way of achieving this is to have an emission tax set at \$8/tonne

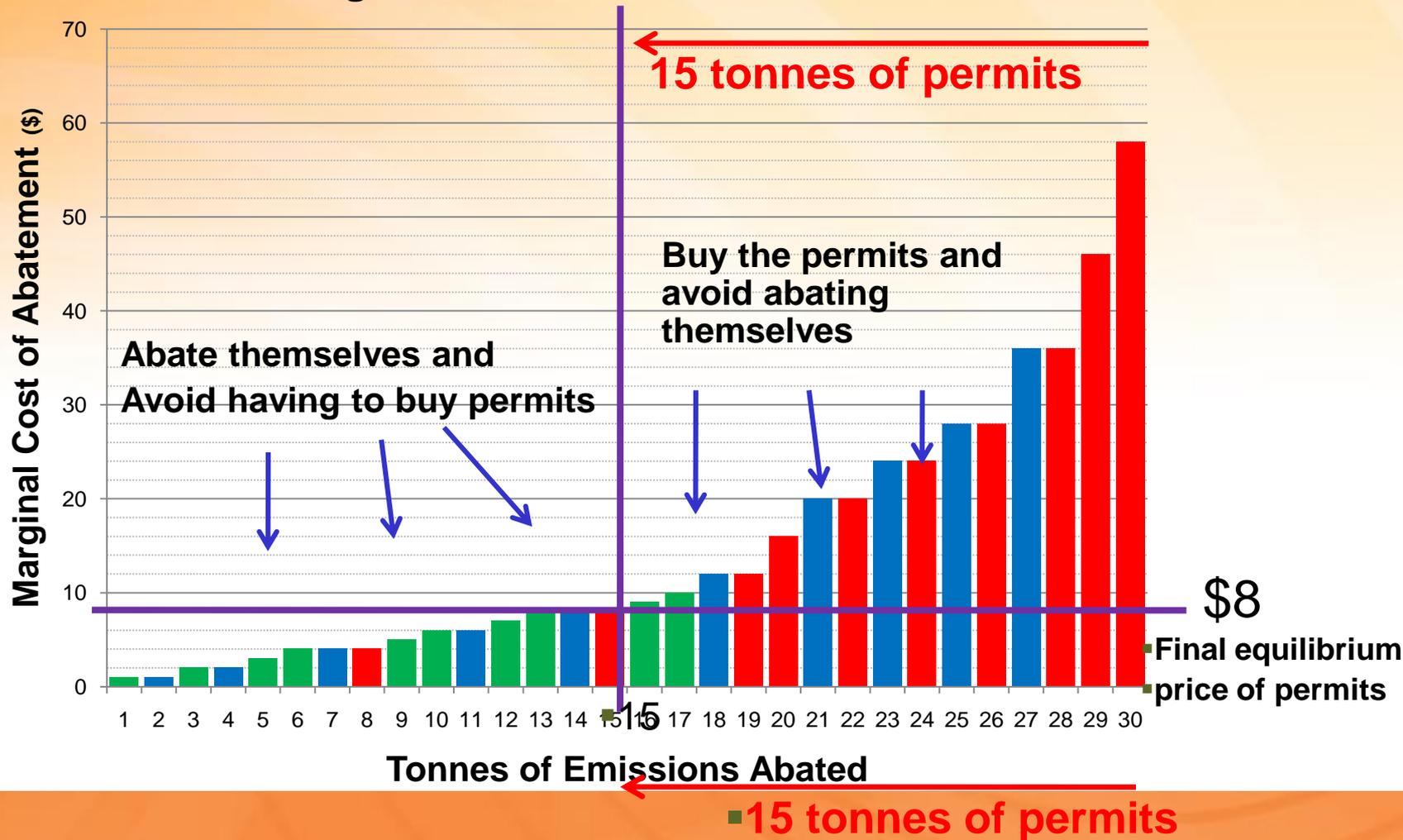
Marginal Abatement Cost Curve





Another way is to set up a emission trading scheme with 15 available permits

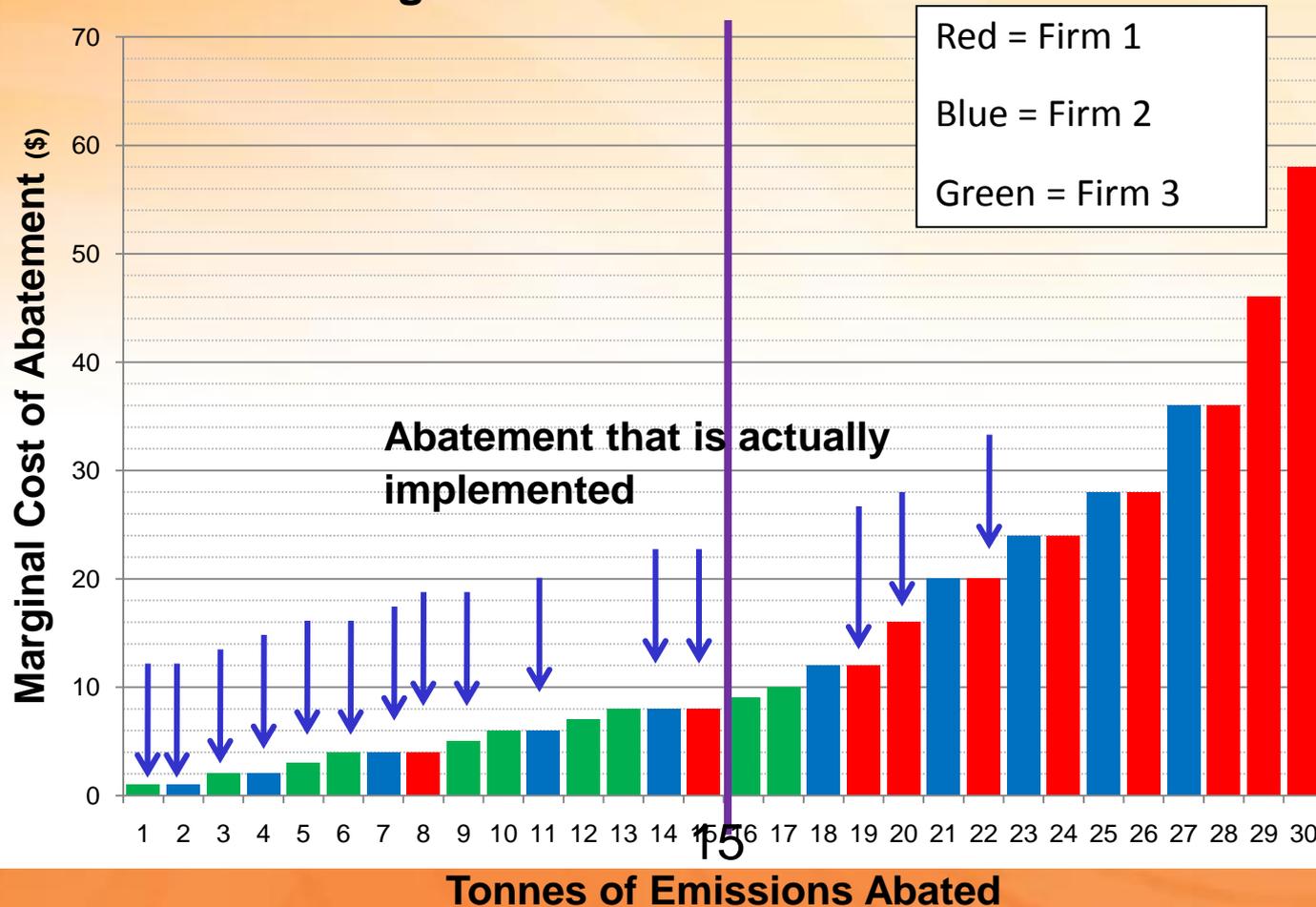
Marginal Abatement Cost Curve





By contrast, the earlier (command-and-control) standards approach is inefficient

Marginal Abatement Cost Curve





Experience and Lessons from the EU ETS

Basic details of the EU ETS

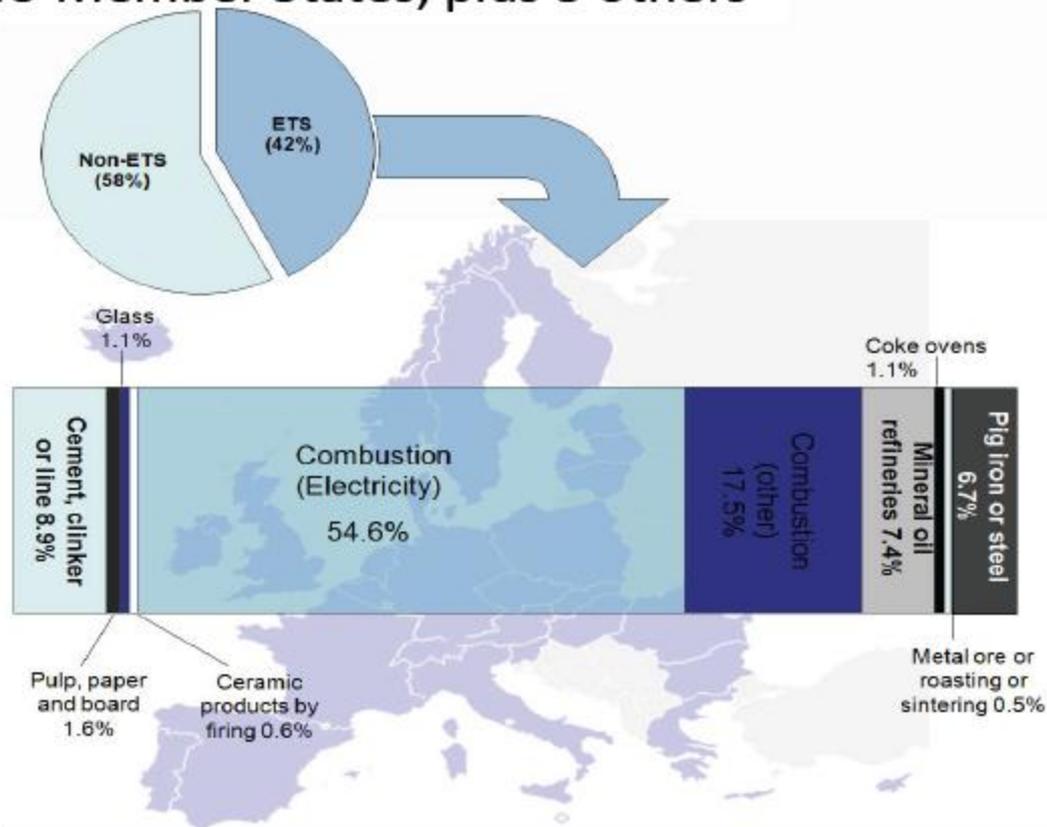
- Launched in 2005
- Covers more than 10,000 installations
- Close to half of the EU's emissions of CO₂ and 40% of its total greenhouse gas emissions
- Phase 1 Jan 1995-Dec 2007 (pilot phase)
- Phase 2 Jan 2008-Dec 2012 (Kyoto phase)
- Phase 3 Jan 2013-Dec 2020 and beyond (no sunset clause)
- Allows for a level of use international trading credits
- 27 EU countries plus Norway, Iceland and Lichtenstein have joined the EU ETS

Basic details of the EU ETS

- Simple “downstream” cap-and-trade system for major emitting industries
- Initially, largely free allocation based on historical emissions – moving to benchmarks and auctioning
- Monitoring rules for direct emissions, independent verification.
- Robust penalties to ensure compliance (€100 + shortfall)
- Electronic registry system to record holding, transferring and surrendering allowances
- Market development driven by the private sector

Scope and sectors covered by the EU ETS

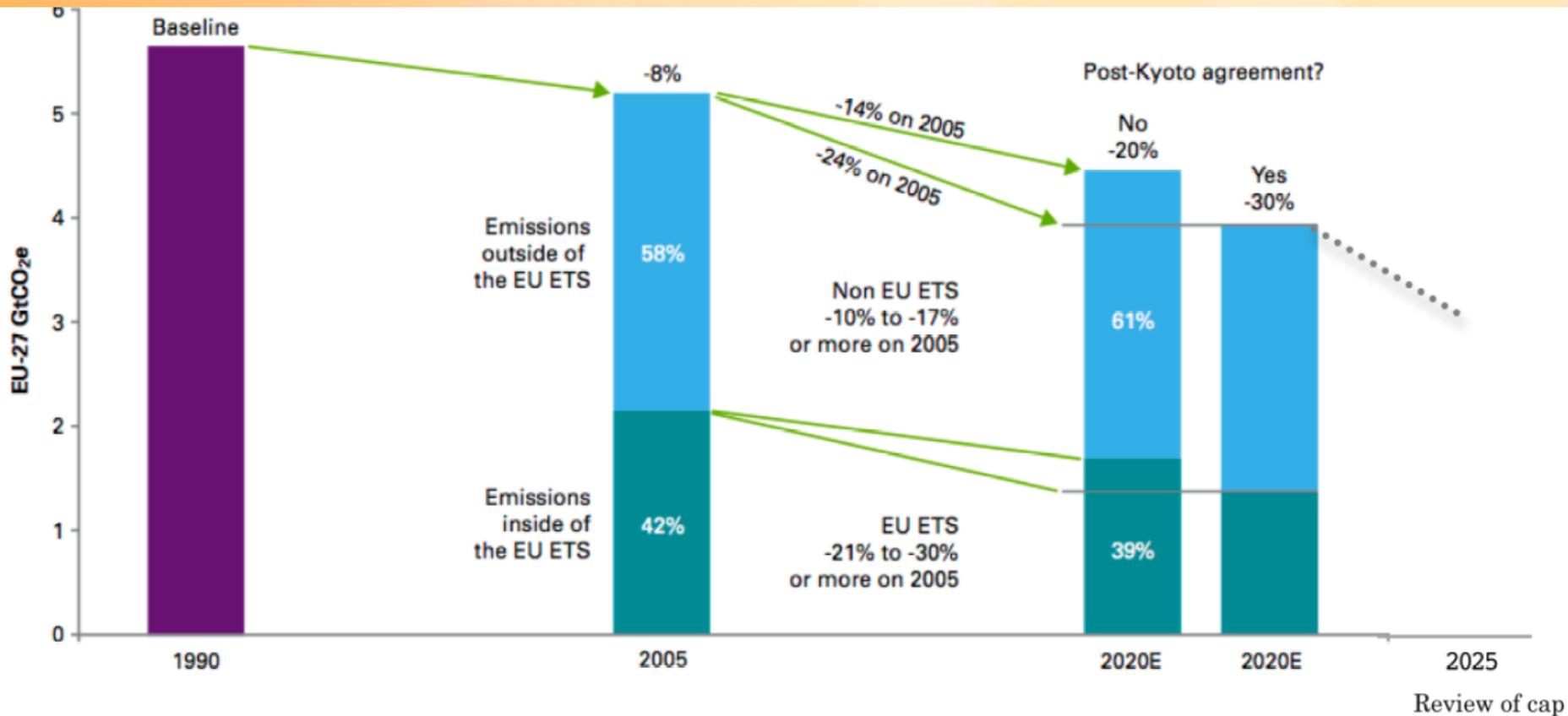
EU ETS Caps *direct* emissions from power and heavy industry in 27 EU Member States, plus 3 others



Note:

- CPRS originally 75% coverage
- Waxman Markey 87% coverage

EU Greenhouse gas emissions, 1990 – 2020 and the EU ETS component

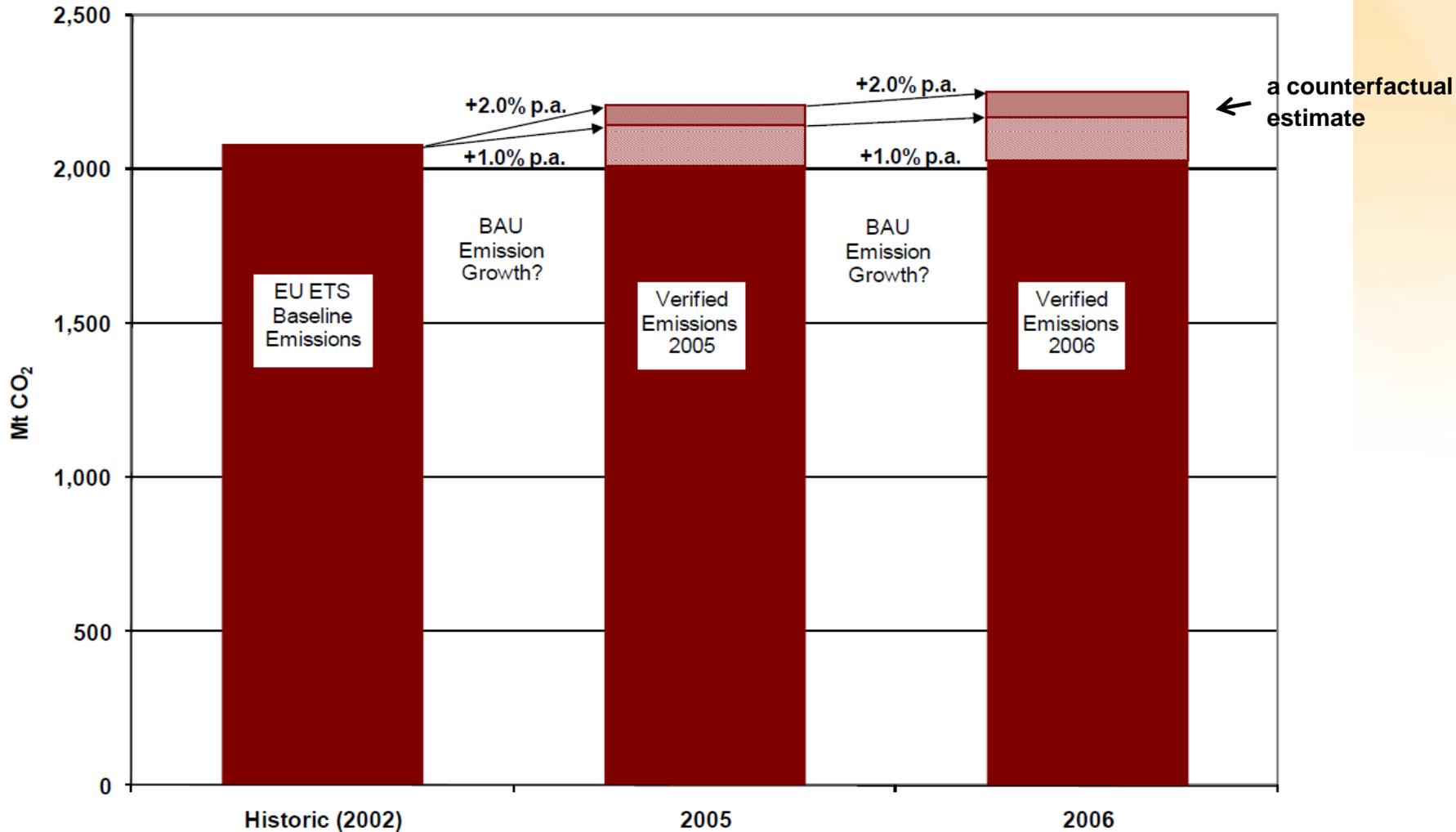


Source: Carbon Trust, 'Cutting carbon in Europe: the 2020 plans', June 2008

Emissions were reduced

- Estimated by MIT researchers to have cut European CO₂ emissions by 120-300 MtCO₂ during its first, highly imperfect phase – up to 5% of emissions from the covered power and manufacturing sectors
 - despite excessive allocations of emissions allowances
- It captured private sector attention like no other climate initiative
 - its rapid introduction and impact contrasted with a decade of dispute over (failed) attempts to introduce a European carbon tax

Potential emissions and the impact of the EU ETS

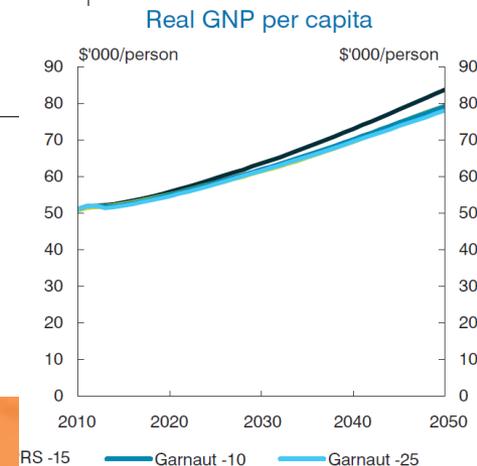


Economic costs were not severe

- Thus far, the EU ETS has been able to achieve its environmental objectives at costs significantly below those projected; a small fraction of 1% of EU GDP.
- The cost of the tougher action to 2020 is estimated at about 0.5% of GDP, or a few months of foregone economic growth

Not dissimilar from Australian and global projections

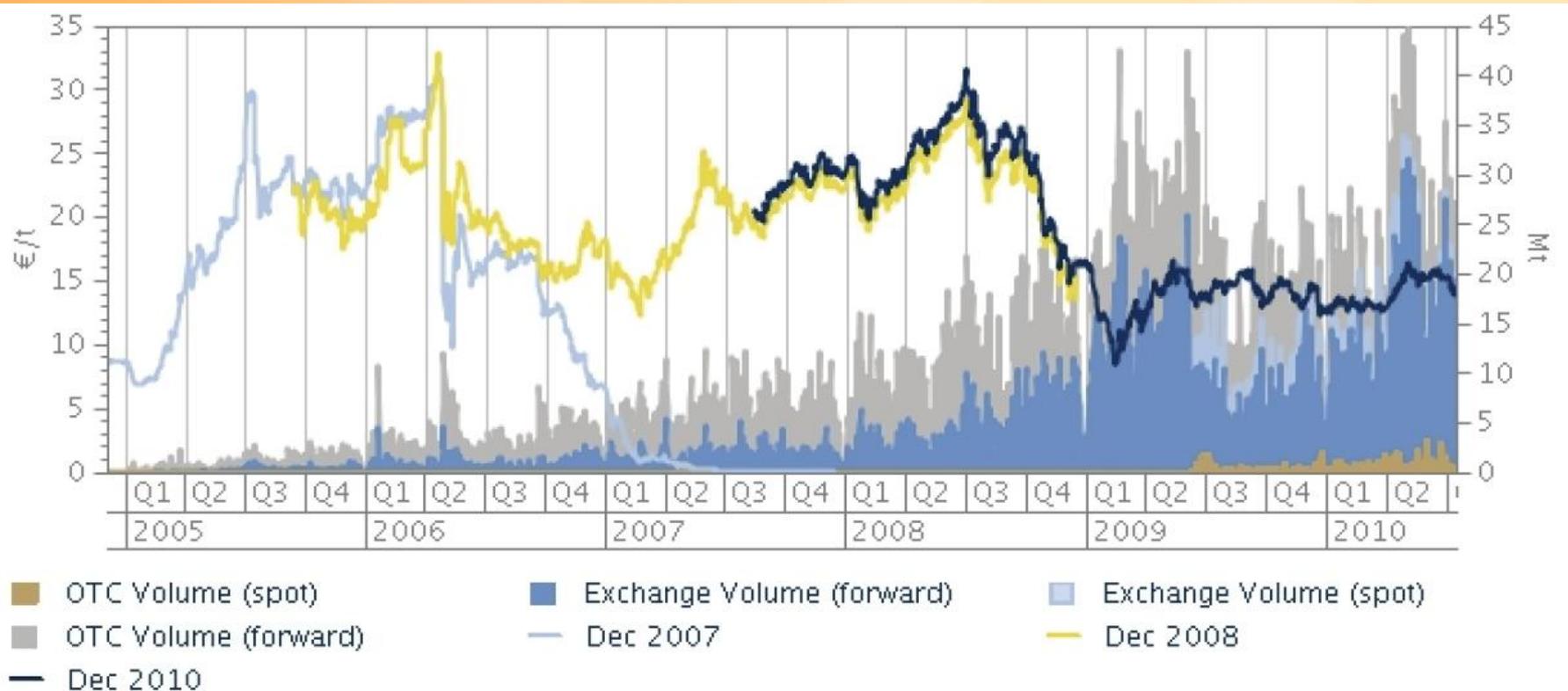
Study	Policy	Region	Timeframe	GDP impact
EU Commission (2008)	EU ETS caps to 2020	Europe	Out to 2020	-0.3% to -0.7%
Garnaut Review	Reduction of emissions by 10-25% relative to a 2000 Baseline	Australia	Out to 2020	-1.1% to -1.6%
CPRS	Reduction in emissions by 5-15% relative to a 2000 Baseline via the introduction of an emissions trading scheme	Australia	Out to 2020	-1.1% to -1.5%
Frontier Economics	Meeting the emission reductions in the CPRS	Australia	Out to 2020	-1.25% to -1.07%
Stern Review (2007)	Reducing GHG emissions to avoid the worst impact of climate change	Global	Out to 2050	-1%



Is has political and and industry support

- After initial difficulties, support for the EU ETS is now widely shared across governments, industry and political groups
- Carbon pricing has become a normal cost of business
- Much of the public probably doesn't know it exists!

Prices were volatile



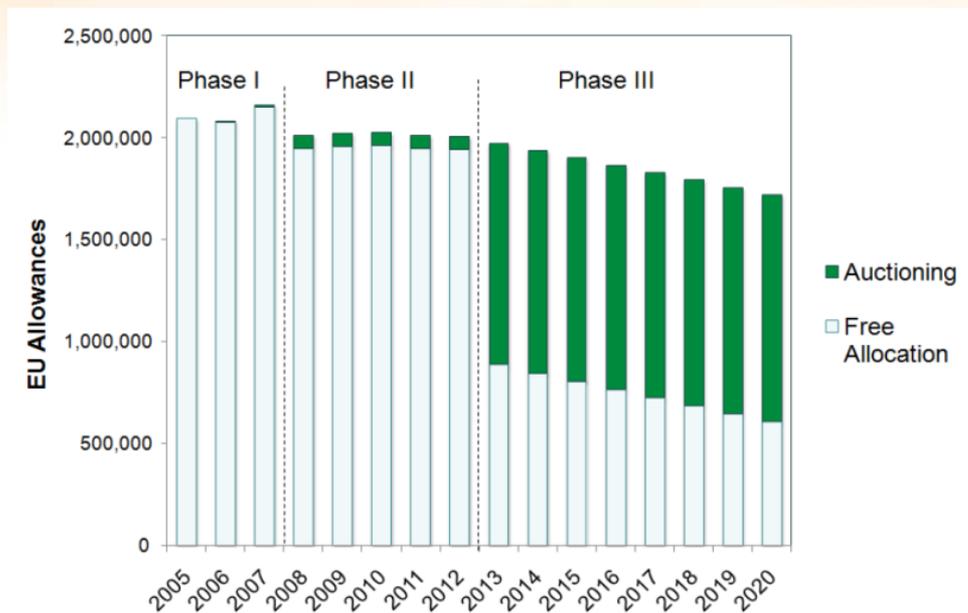
Source: Point Carbon

Free allowance allocation is not free (I)

- In Phase 1 and 2, allowances were mostly given out free (grandfathered)
- Free allocation degrades efficiency and introduces risks of windfall profits and/or other inefficiencies.
- Allocating allowances for free intensifies lobbying and can inflate the cap.
- Some economic inefficiencies can be avoided by basing free allocation on historical data or benchmarks, but there is the risk in some sectors that this approach will generate windfall profits and may not prevent international carbon leakage
 - In particular, electricity companies passed through costs anyway (as one would expect from opportunity cost pricing) and resulted in large windfall profits (of many billions of Euros)

Free allowance allocation is not free (II)

- Tying compensation to production levels ('output-based allocation') can tackle windfall profits and leakage but at the cost of further reduced efficiency.
- In Phase 3 there will be much more auctioning, particularly in the electricity sector.



Summary of distortions from different allocation methods

Allowance allocation method	Impacts	More expenditure on extending plant life relative to new build		Increase plant operation		Less energy efficiency investment
	Distortions	Discourage plant closure	Distortion biased towards higher emitting plants	Shields output (and consumption) from average carbon cost	Distortion biased towards higher emitting plants	Reduce incentives for energy efficiency investments
Auction						
Bench-marking	capacity only	X				
	capacity by fuel/ plant type*	X	X			
Updating from previous periods'	output only	Y		X		
	output by fuel/ plant type*	X	X	X	X	
	emissions	X	X	X	X	X

Note: X indicates a direct distortion arising from the allocation rule. Y indicates indirect distortions if allocation is not purely proportional to output/emissions.

* Differentiating by plant type adds additional distortions compared to purely fuel-based.



There were some financial ‘scandals’

- As the value of the system attracted attention, there have been problems with fraud and theft
 - Carousel ‘VAT’ fraud
 - Registry thefts in some of the New Members

...just like in an other financial market!



Was investment and innovation stimulated?

- Too early to tell – the volatility of price may not have helped in the early days.
- Certainly, the credibility of the idea that this is going to stay for the long run has increased which is likely to improve the incentive for investment and innovation.

The international competitiveness impacts were limited to a small number of industry sectors.

- Less than 0.5% of total GDP
 - Iron and steel; Aluminium, alumina and some non-ferrous metal production; Nitrogen fertiliser; Cement and lime; Basic inorganic chemicals; Pulp and paper
- For most manufacturing sectors, cost differentials due to labor and other input costs far outweigh those induced by international differences in the cost of carbon
- The cost uncertainty induced by emissions trading is correspondingly very small compared to those arising from, for example, fluctuating exchange rates and energy costs.

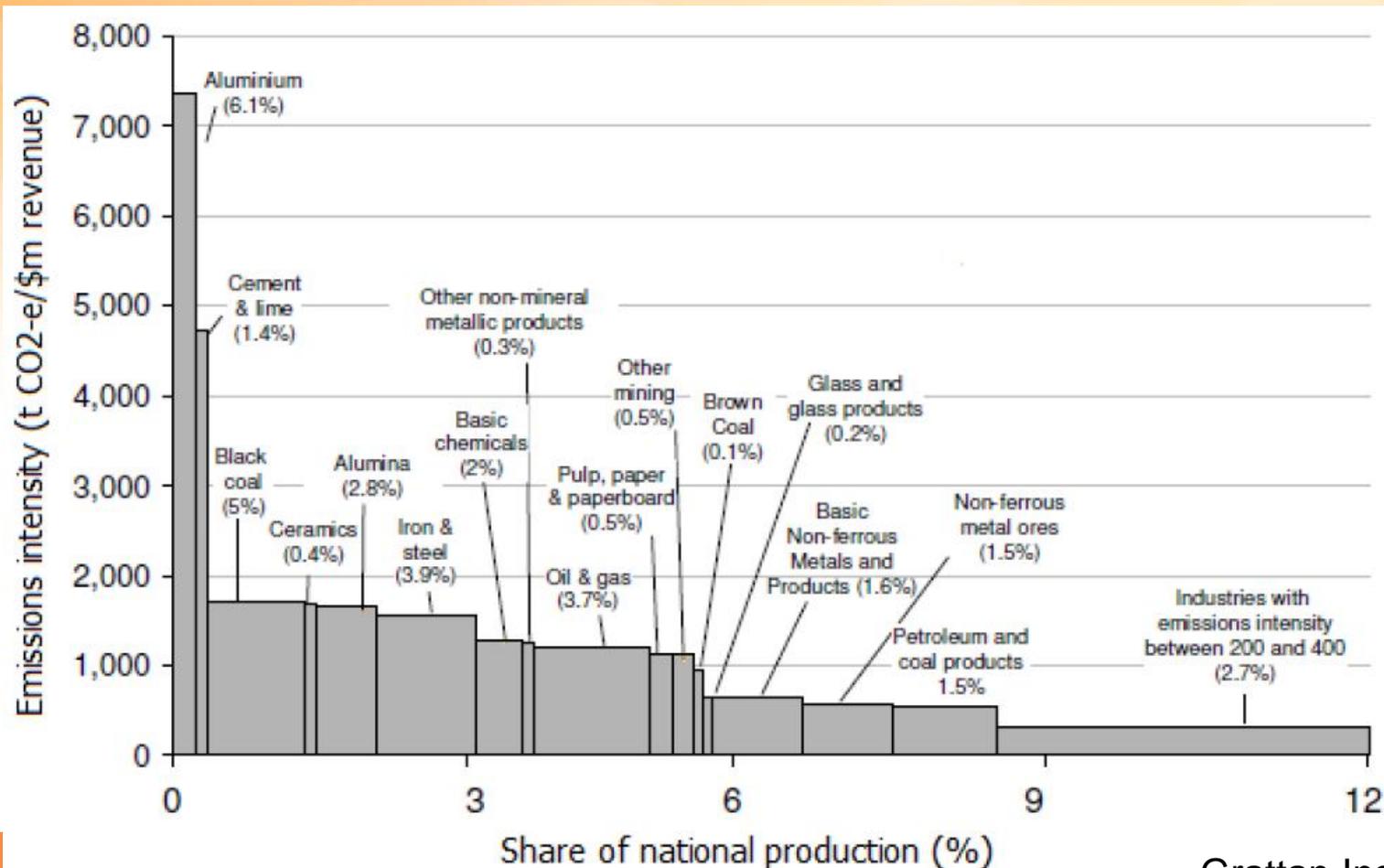
The international competitiveness impacts were limited to a small number of industry sectors. (II)

- Most sectors can accommodate carbon costs without significant impacts to their profits, sales or competitiveness
- There was little evidence of companies leaving the EU – carbon leakage.

Aside: The Australia numbers are slightly larger but still manageable

- A carbon price would have a significant effect on only a few industries that constitute less than 8% of Australian GDP, but emit 30% of Australia's greenhouse gases either directly or through their consumption of electricity.
- A carbon price of \$35/tCO₂ would increase the costs of about 8% of Australia's industry by more than 1.4% of revenue.

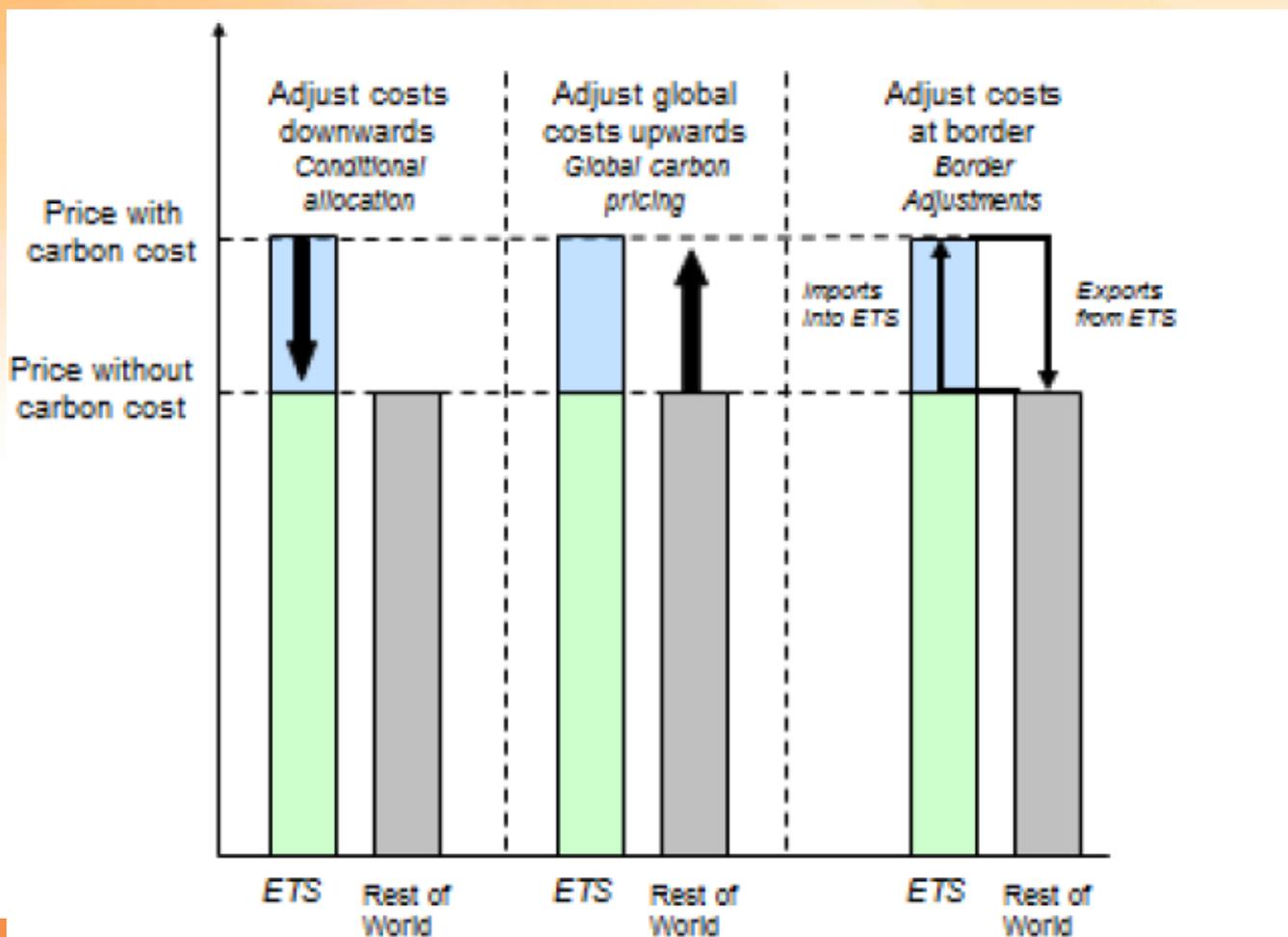
The Australia numbers are slightly larger but still manageable



‘Border leveling’ of carbon costs is a longer term option

- The possibility of adopting border adjustments was discussed in Europe, but so far resisted.
- Although they appeal to particular industries and associated interests, they risk being abused as disguised trade protectionism.
- However in principle, border levelling of carbon costs focused upon tackling carbon leakage would be environmentally and economically more effective than free allocation, and some forms can be entirely compatible with WTO principles

Border adjustments have been discussed but so far rejected – still a possibility in the future

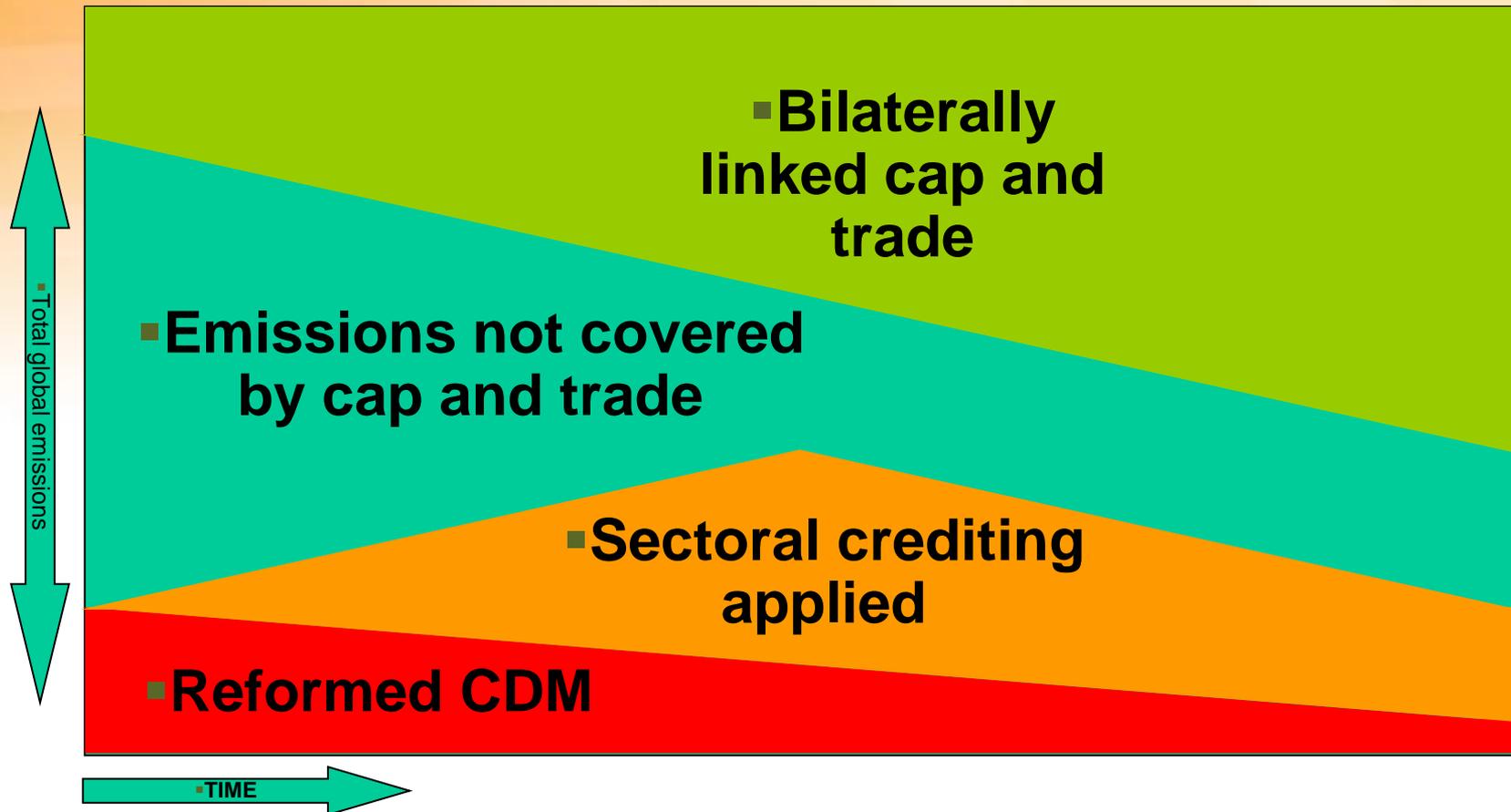




The importance of learning and insulating the damage of the early design flaws was clear

- The EU ETS has benefited enormously from its design as a series of Phases, each of which has allowed improvements on the previous one, particularly concerning scope and allocation

Global carbon market: The EC vision for the future



Recommendations (I)

1. Emissions trading works.

- Recommendation: Develop an emissions trading system that learns from and improves upon the EU experience.

2. Everyone will learn.

- Recommendation: Build in a capacity to strengthen the system if and as experience supports this.

3. Prices can be volatile and impacted by numerous unforeseen factors - which to date have reduced prices below expectations.

- Recommendation: Consider carefully the lessons from the EU experience on price volatility, around unavoidable uncertainties in emission projections, the contribution of other policies, and systematic tendencies to underestimate the abatement and innovation responses. Additional supporting technology policy will be required to accelerate innovation.

Recommendations (II)

4. GDP impacts are small.

- Recommendation: Don't let concerns about macroeconomic impacts dictate the environmental targets – economic impacts have been consistently less than projected.

5. Industry can profit.

- Recommendation: Resist inevitable pressures to maximise free allocation, but engage companies more constructively in designing and understanding the full implications of the system.

6. Robust regulation of the market is required

- Recommendation: Since emissions trading creates valuable assets, the systems for security must match those of finance.

Recommendations (III)

7. International competitiveness impacts are limited to a small number of industry sectors.

- Recommendation: Concerns about competitiveness impacts should focus on a few, potentially exposed industries. For these, tailored solutions should be pursued such as benchmarked free allocation, auctioning with border leveling, or effective sectoral agreements.

8. Free allocation degrades efficiency and introduces risks either of windfall profits or other inefficiencies.

- Recommendation: A balance of free allocation should strive to minimize economic distortions as well as windfall profits. Relative risks are determined by sector specific characteristics namely: the ability of each major sector to pass through prices, its exposure to international leakage, and its potential for emissions abatement through radical innovation or demand reduction.

Recommendations (IV)

- 9. There is a compelling economic rationale to increase auctioning over time.**
 - Recommendation: Increase auctioning over time.
- 10. ‘Border leveling’ of carbon costs – rebating on export, or charging on imported goods – is an option for longer term consideration and negotiation in relation to particular sectors at risk of carbon leakage.**
 - Recommendation: Negotiate multilateral arrangements to contain or structure the use of border adjustments, focused upon minimising emissions leakage, by rebating (or charging) carbon costs on exports (or imports) as and when specific problems can be demonstrated.



Rationales for multiple policy instruments

Instrument options for environmental policy

- **Direct Regulation**
 - bans on certain products or practices.
 - emission standards, technology standards, etc.
- **Economic Incentive-Based Instruments**
 - charge systems (e.g. taxes, charges, license fee, etc).
 - market creation (e.g. emissions trading schemes).
 - other financial instruments (e.g. soft loans, R&D grants).
 - liability instruments – using the threat of legal action to recover the cost of damages.
- **Information and Education Instruments**
 - corporate reporting requirements
 - public education campaigns
- **Self Regulation, Voluntarism, and Moral Suasion**

A selection of some Australian climate related policies and measures

- **Direct Regulation**
 - All new coal-fired power stations to required to meet best practice emissions standards.
 - Energy standards for buildings.
 - Ban on incandescent lights.
- **Economic Incentive-Based Instruments**
 - Emission and Green certificate trading scheme: CPRS(?), eRET, GGAS, Energy Savings Scheme, Carbon Farming Initiative.
 - R&D grants: Clean Energy Initiative (\$5-10 billion; CCS Flagships Program, Australian Solar Institute, Renewable Energy Future Fund), International Forest Carbon Initiative.
 - Subsidies: Cleaner Car Rebate, Green Start program, Solar Bonus Scheme.

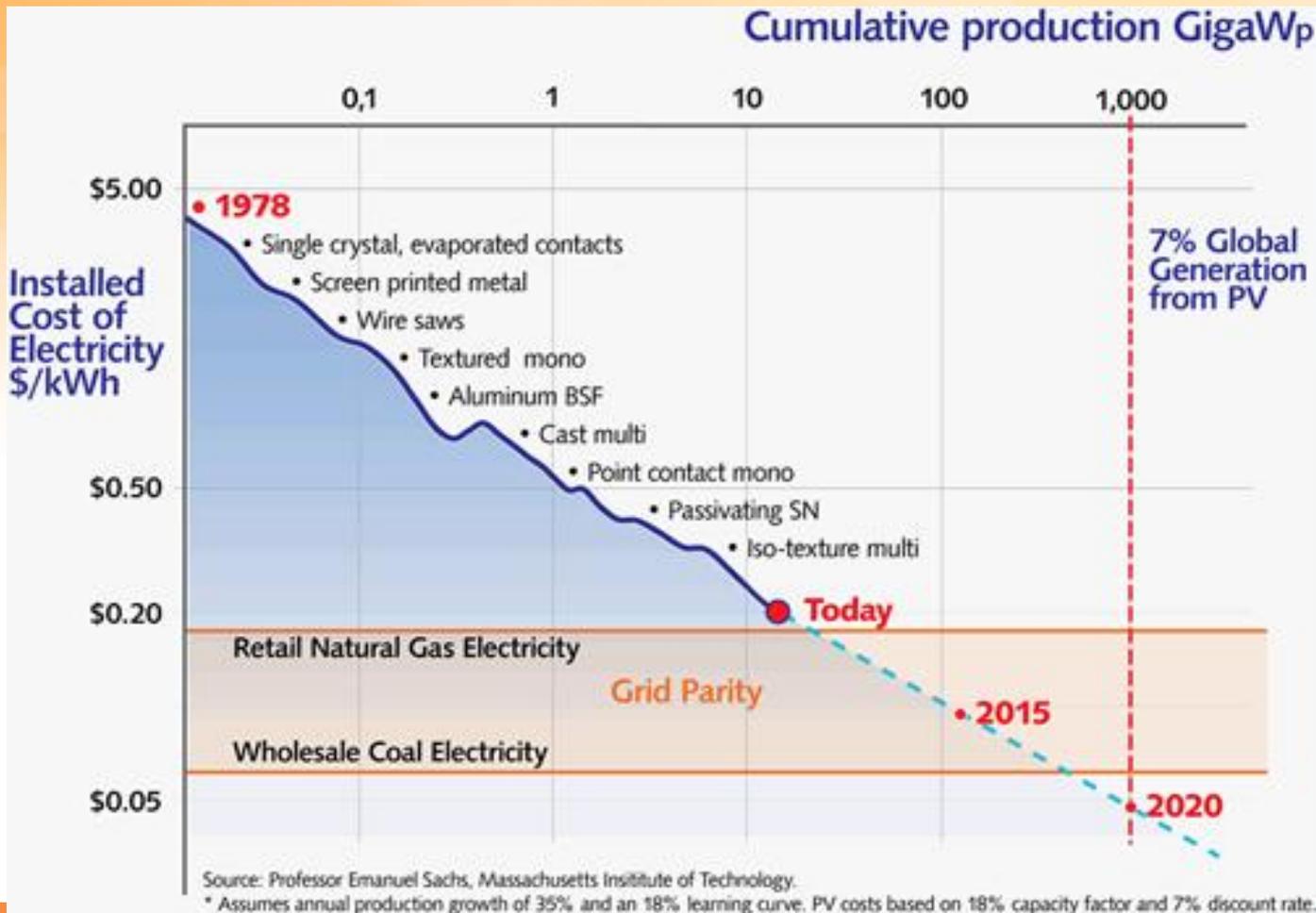
A selection of some Australian climate related policies and measures (cont)

- Information and Education Instruments
 - National Greenhouse and Energy Reporting Act (NGER)
 - Greenhouse Friendly™, National Carbon Offset Standard (NCOS)
 - Australian Carbon Trust
 - Travel Smart
 - Green Vehicle Guide
 - Save Power (NSW)
- Self Regulation, Voluntarism, and Moral Suasion
 - Greenhouse Challenge Plus
 - GreenPower Scheme
 - Local Greenhouse Action

Multiple Market Failures

- Knowledge and learning spillovers from technological innovation and development
 - If firms cannot capture the returns from new ideas and learning due to the diffusion of knowledge through various channels, then firms likely to invest less in R&D than would be desirable for society.
 - Studies such as Grubb et al. (1995) have indicated that technological spillover effects may dominate the effect of a carbon pricing mitigation policy.
 - Argument for R&D grants, etc. and perhaps demand-support policies such as feed-in tariffs and renewable permit trading schemes.

Learning curve for U.S Photovoltaic (PV) electricity generation



Multiple Market Failures (cont)

- Information problems and incentive misalignment
 - Households and firms who are poorly informed may act inefficiently even if faced with adequate incentives such as an energy or carbon tax.
 - e.g. households may not be aware of the energy efficiency of electrical appliances they buy or how to optimise the energy consumption of such devices.
 - Similarly, the energy efficiency of buildings may be undermined if information and incentives to act differ between landlords and tenants. tenant-landlord relationship:
 - the landlord has to pay for insulation but only the tenant benefits from lower heating bills
 - Argument for standards, information disclosure, labelling, landlord investment support schemes.



Multiple Market Failures (cont)

- Imperfect functioning of financial markets
 - Information differences between the firm and potential investors about the future returns from R&D and/or adoption of existing technologies may hamper a firm’s ability to raise capital for such activities.
 - Imperfect financial markets may affect the ability of households and small firms to finance investments in profitable energy-saving equipment that has high “upfront” costs but low running costs
 - Argument for loan support, information disclosure and assisting in industry standardization.

Additional System Failures

- Social and technological lock-in
 - From institutional and evolutionary economics.
 - Path dependency is a technological trajectory that favours the incumbent technology and biases against potential competing technologies through shaping all the supporting technological, organizational, industrial, society and policy & legal infrastructure that favour the incumbent technology.
 - Policies may be needed to specifically assist change in physical infrastructure, knowledge and learning networks, supply chains, and social receptiveness, policy making process etc.

Administration and compliance costs

- Implementing a first-best policy may involve prohibitively high transaction costs.
 - it may be possible that a portfolio of policies result in higher net value of internalization benefits minus total transactions costs than is possible from any single instrument.
- e.g. in an emission trading scheme such as the EU ETS, for small and medium size enterprises, the administration and compliance costs can outweigh the efficiency benefits of having them in the scheme
 - it may be more cost effective to regulate these smaller firms using other instruments such as emission standards.

Multiple modes of behaviour – Non homo economicus

- A carbon pricing mechanism for climate policy is relying on a conception of human behaviour that is rational, purposeful and narrowly self-interested.

There are numerous issues that complicate this view:

- **Habit** - many of our emission-related activities have a habit basis (turning off lights or changing local travel patterns) → Small price increases may not jolt behavioural change.
 - An argument for education and other consciousness raising programs and measures.

Multiple modes of behaviour – Non homo economicus (cont)

- **Intrinsic motivation** - excessive emphasis on extrinsic motivation (external rewards) as opposed to intrinsic motivation such as curiosity, bettering out world, etc.
- Extrinsic motivators can “crowd out” (discourage) intrinsic motivation:
 - Paying someone for lowering their carbon footprint from recycling may actually push them away from doing those tasks.
- A problem raised of the design of the CPRS was that a cap on emissions meant that ‘voluntary action’ would make no difference to Australia’s aggregate emission -> concern that it would discourage such behaviour.

Multiple modes of behaviour – Non homo economicus (cont)

- **Endogeneity of preferences** - the general level or specific form of consumption is not an issue of analysis (outside of price signalling), as these are driven by exogenous preferences.
 - e.g. using SUV for school and shopping trips
- Veblen's 'conspicuous consumption' or Frank's 'positional good externality' which create a futile 'expenditure arms race' for goods and services. This phenomenon is clearly wasteful.
- Perhaps an argument for luxury good tax or moral suasion policies to ameliorate this dynamic.

Uncertainty

- Weitzman (1974) on relative efficiency of price instrument (e.g. Carbon tax) versus quantity instrument (e.g. ETS) given uncertainty in marginal damage and marginal abatement costs.
 - Robert and Spence (1976) demonstrated that, under a range of realistic conditions, a combination of quantity and price instruments (or hybrid instruments) would provide a better outcome.
- Radical uncertainty surrounding the performance outcome of a policy instrument
 - Argument for the portfolio theory maxim of ‘not putting all of one’s eggs in one basket’?

Other constraints

- **Conflicting public policies**
 - *Energy policies* - fuel tax rebates and other energy price subsidies are still being used as social policy devices in many developing and middle-income countries.
 - *Trade policies* – e.g. trade in bio-ethanol
 - *Other social policies* – effects on electricity prices may conflict with the concern to avoid ‘fuel poverty’ of households.
- **Political acceptability**

The three pillars of policy

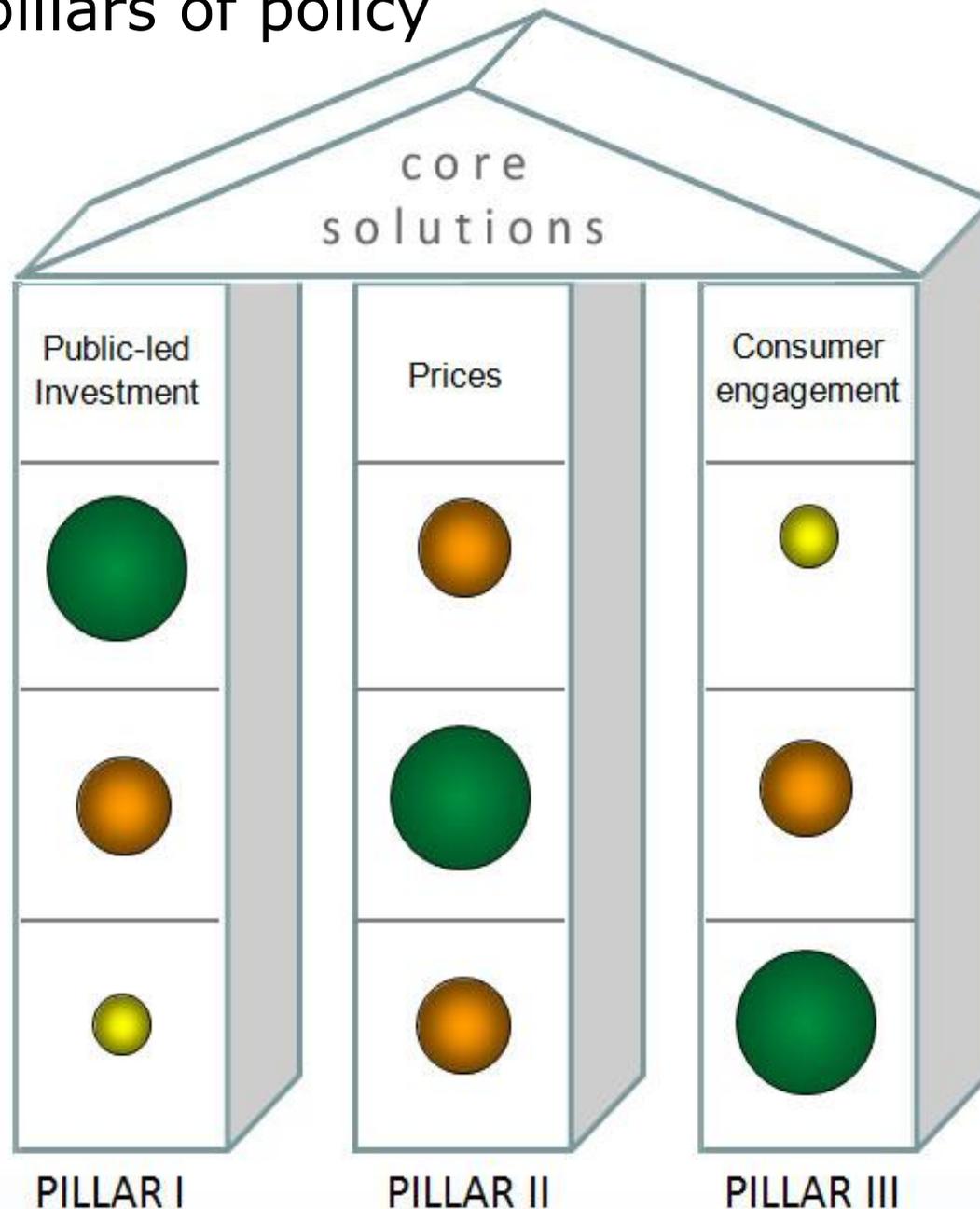
Response

Innovation and infrastructure investment

Substitute low for high carbon investments

Energy efficiency and 'no regrets'

Grubb et al (2011)



'Economic' analytic basis

Evolutionary economics

Classical economics

'Behavioural economics'

(eg. barrier, transaction, psychology & satisficing theories)

Conclusions

- No single policy instrument is likely to be sufficient to tackle the problem of reducing GHGs
- A policy mix will be needed to tackle...
 - Multiple multiple market and system failures
 - Information problems
 - Heterogenous actors with multiple modes of behaviour.
 - Uncertainty, and other policy constraints.
- Of course, plausible rationales for using more than one policy instrument does not mean that any given policy mix is sensible
 - The evaluation of any policy mix therefore requires careful analysis and is dependent on the many contextual factors
 - The heterodox economic traditions, may help provide a more nuanced perspective to evaluate such policies.



Thank you