Centre for Energy and Environmental Markets

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Emissions trading: Lessons learnt from Europe and Australia

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Fudan University

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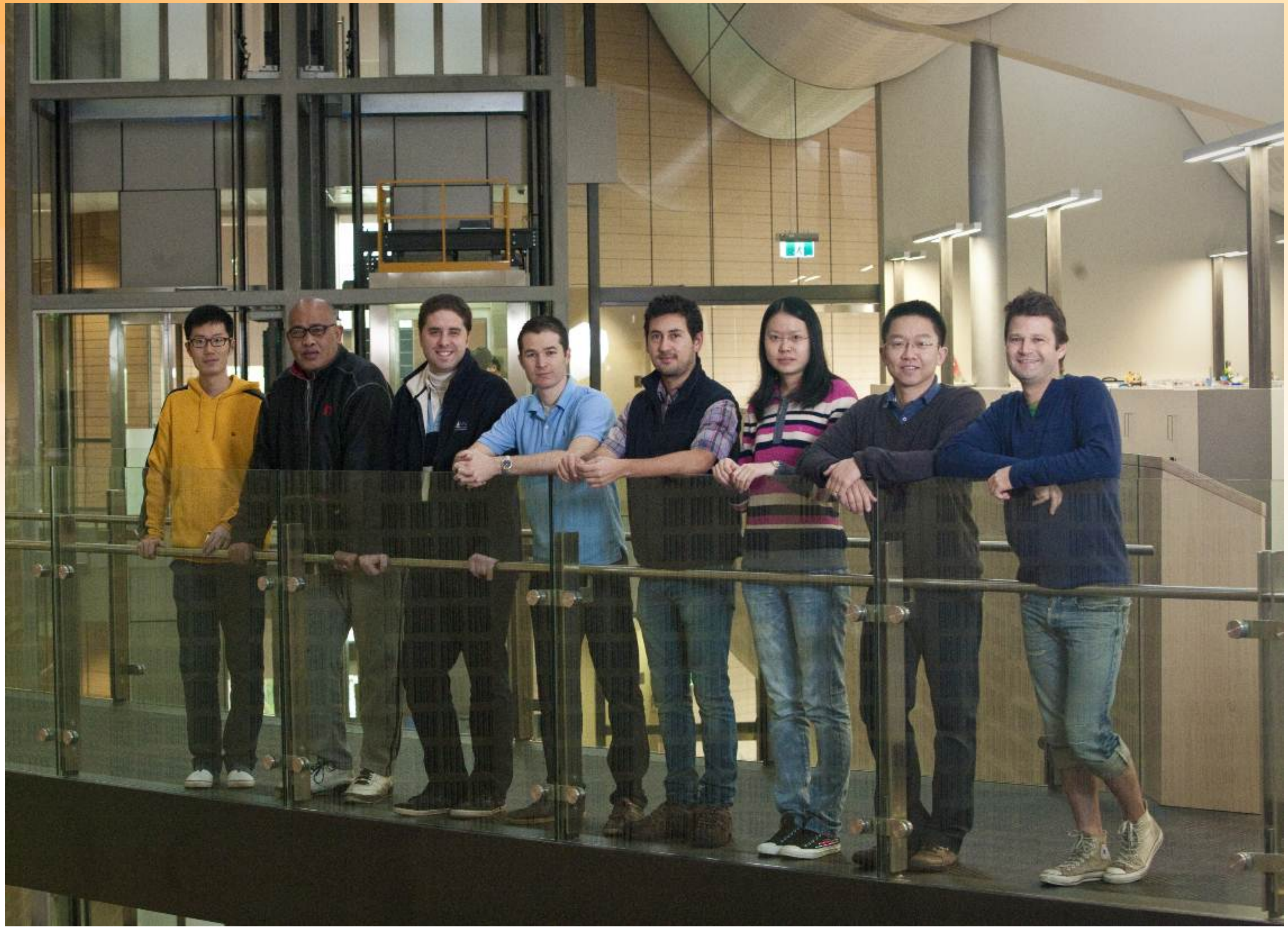
Centre for Energy and Environmental Markets facts

- Established in 2004
- Interdisciplinary Centre including reserachers from faculty of Engineering, Business, Social Sciences, Environmental Sciences, Built environment ,Law ….
- Staff: 2 Joint Directors, 7 Research coordinators for each faculty, 3-5 Post-docs and around 10 PhDs
- Core tasks: Research, education and policy impact



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

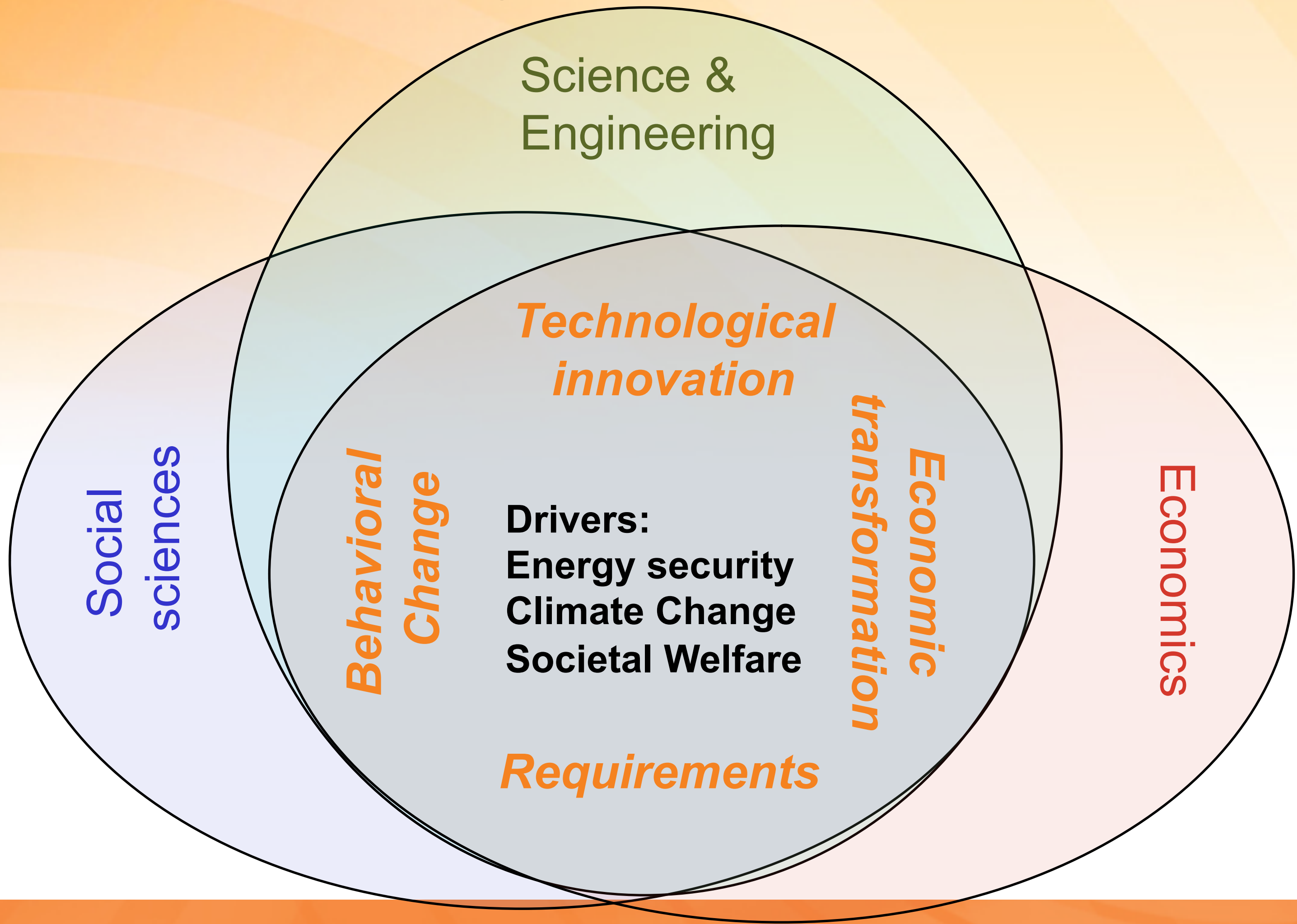
- Unsustainable energy use & emissions in industrialised world, unsustainable growth in emerging economies & unsustainable lack of energy services in developing countries

Possible Synergies

Renewable Energy

Cost-effective Energy Efficiency

Key interdisciplinary perspectives & tools required to address challenges – CEEM's unique strength

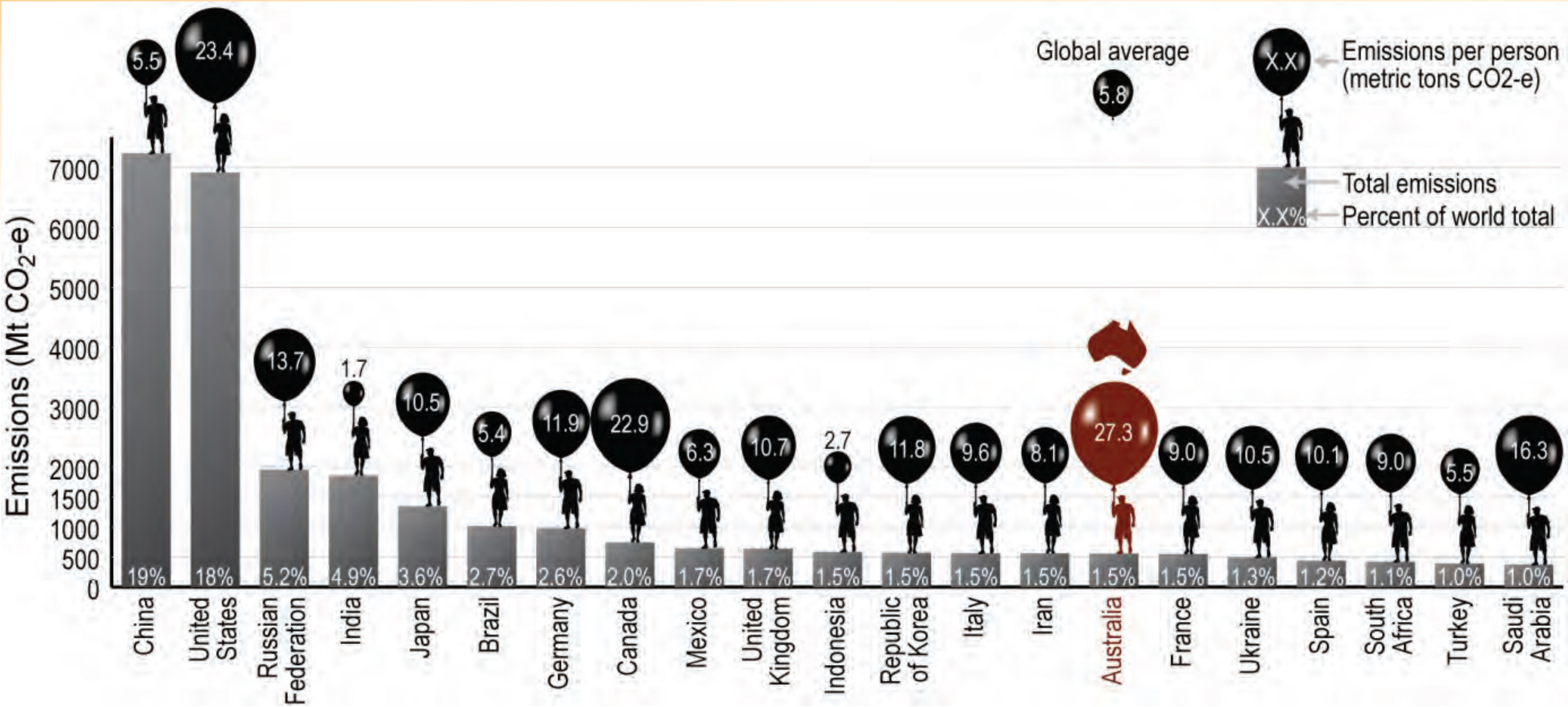


CEEM works in the areas of

- Energy markets
  - spot, ancillary services and derivative markets, retail markets
  - primary focus on the Australian National Electricity Market
- Energy related environmental markets
  - E.g. **Emissions Trading Systems (ETS)**, Renewable Energy Certificate Market, Energy Efficiency Certificate Trading, Renewable energy subsidies…
- Broader policy frameworks and instruments to achieve desired societal energy and environmental outcomes
- **Future: Work with Chinese University Partners on Climate and Energy policy in China**

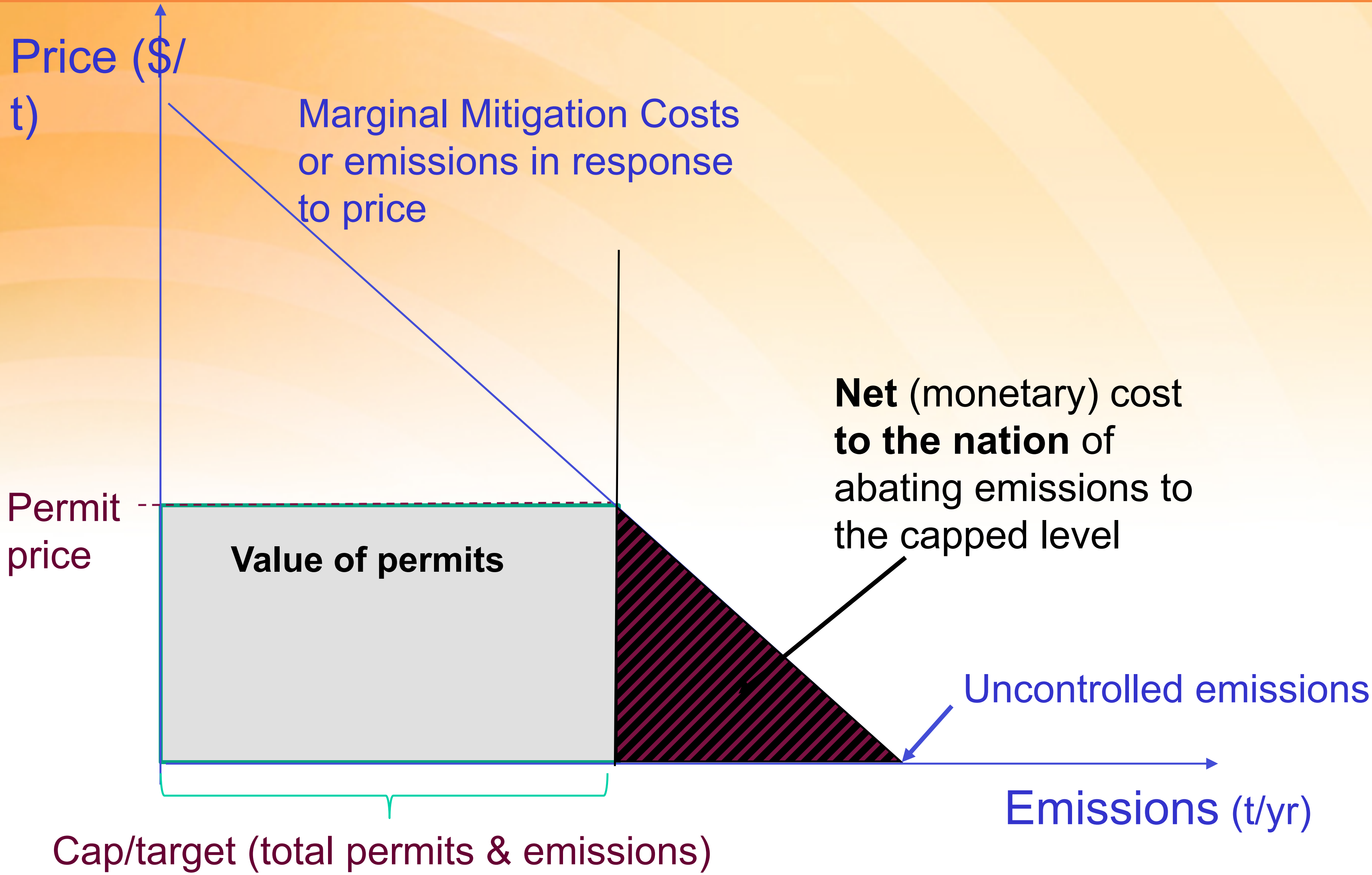
Greenhouse gas emissions

- **China** highest absolute emitter, but low per capita emissions
- **Australia** highest per capita emitter and within 20 top absolute emitters



Motivation for ETS research

- To combat climate change, effective and efficient policies are necessary to achieve high reductions (80-95%) in the long run
- Economic textbooks argue that a well-designed Emissions Trading Scheme (ETS) can be an efficient and effective policy instrument
- Emissions trading schemes are designer markets and policy makers have to choose the design
- More countries are planning to introduce emissions trading schemes in the future: e.g. China...
- Important lesson to be learnt from 8 years of operation of the biggest ETS and from 10 year preparation and 1 year operation of the Australian Carbon Pricing Mechanism!


Price ($/t)
Marginal Mitigation Costs or emissions in response to price
Net (monetary) cost to the nation of abating emissions to the capped level
Permit price
Value of permits
Uncontrolled emissions
Emissions (t/yr)
Cap/target (total permits & emissions)

Comparing Scheme Design

EU ETS

- Timing:
  - Phase 1 2005-2007
  - Phase 2: 2008-2012
  - Phase 3: 2012-2020
- Target/cap
  - Phase 1 and 2:
    - Cap left to the Member States (National Allocation Plans), approval by EU Commission,
    - No banking/borrowing between Phase 1 and Phase 2, from Phase 2 full banking and one year borrowing within a phase
  - Phase 3: EU wide cap -21% compared to 2005 (11.3% below phase II allocation)

Australian CPM

- Timing:
  - Fixed price period: 1st July 2012- 30th June 2015?
  - Flexible period 1st July 2015
- Target/cap
  - Fixed price period:
    - no cap and no banking/borrowing
  - Flexible price period:
    - Targets for first 5 years to be agreed by May 2014 based on Climate Change Authority advice
    - Default cap: 5% by 2020 on 2000 levels
    - Full banking and up to 5% borrowing.

Coverage

EU ETS

- 30 participating countries (EU-27 and Liechtenstein, Norway and Iceland)
- Around 12,000 installations
- Mainly CO_2 but now also N_2O and PFC and from 2012 aviation (~200 Mt)
- Downstream scheme covering combustion installations and industrial processes such as refineries, steel, cement, paper, glass
- Around 40% of total greenhouse gas (GHG) emissions of EU

Australian CPM

- Australian wide, linking to international schemes of suitable standard to be considered
- 372 liable entities in 2013 emitting ≥25,000 tCO_2/a
- CO_2, CH_4, N_2O, PFC
- Mixture of downstream and upstream covering stationary energy, industrial process, gas retailers, land fill facilities
- 60% of Australian GHG emissions
- Agriculture and Land-use not covered instead credits from the Carbon Farming Initiative (CFI)
- Some business transport emissions through changes in fuel tax credits or changes in excise.

Traded unit & Allocation

EU ETS

- Traded Unit
  - European Union allowances (EUA): Phase-dated permit
  - No harmonised definition
- Allocation

Phase 1 and 2:

- Allocation left to the Member States, approval by the European Commission
- Ceilings for auctioning Phase 1: potential ≤ 5%/ actual > 0.13%
  Phase 2: potential ≤ 10%/ actual 3%)

Phase 3:

- Auctioning: Almost 100% for electricity sector ~ 50% of permits
- Harmonised allocation based on BAT benchmarks

Australian CPM

- Traded Unit
  - Australian Carbon Units (ACUS): Time -dated single year permits
  - Australian Carbon Credit Units (ACCUS) from CFI
  - Personal property and regulated as financial product
- Allocation
  - Fixed price period: starting \$23tCO_2e rising by 5% real terms p.a.
  - Flexible price period:
    - Auctioning with compensation through free ACUS based on historic benchmarks
    - Price ceiling for first 3 years 20\$ above expected international price for 2015-16 rising at 5 % real terms p.a.

Compensation

EU ETS Phase 3

- 50% of auction revenue decided by Member states other 50% to be spend on
  - Demonstration projects for mitigation and adaptation;
  - Renewable energies and energy efficiency technologies;
  - REDD, technology transfer and adaptation in developing countries;
  - EU forestry sequestration;
  - Carbon capture and storage;
  - Public transportation;
  - R&D in energy efficiency and clean technologies;
  - Energy efficiency measures or financial support in lower & middle income households;
  - Administrative expenses.

Australian CPM

- Households
  - 50% of auction revenue
  - mainly through taxation and transfer system.
- Industry through Jobs and Competitiveness Program
  - Assistance in form of free permits to emissions-intensive trade exposed (EITE) activities (e.g. steel, coal, gas) and LNG projects
  - Worth ~AU$9.2 billion to be reduced over time and subject to review.
  - Energy Security Fund AU$10 billion in ’clean‘ energy, at least 50% investment for renewable energy

Use of offset credits

EU ETS

Phase 2:

- Eligible are Kyoto credits (Clean Development Mechanism (CDM) and Joint Implementation (JI))
- Limited use: On average 13.5% of allocations (or 1,420Mt over 2008-2012). This limit varies from 0% (in Estonia) to 20% (e.g. Germany)
- Excluding credits from sinks (RMUs, ICERs and tCERs), nuclear and big hydro projects

Phase 3:

- Even without intern. agreement, CERs from new projects in Least Developed Countries and CERs from projects registered prior to 2013
- Excluding HFC-23 and adipic N_2O credits

Australian CPM

Fixed price period:

- Use of CFI credits (ACCUS) up to 5% of verified emissions

Flexible time period:

- Unlimited use of CFI credits
- International units up to 50% of the total emissions liability for that entity for the year.
- Eligible units with provision to be extended: CERs, ERUs, RMUs
- Qualitative restrictions to be defined

Sanctions

EU ETS

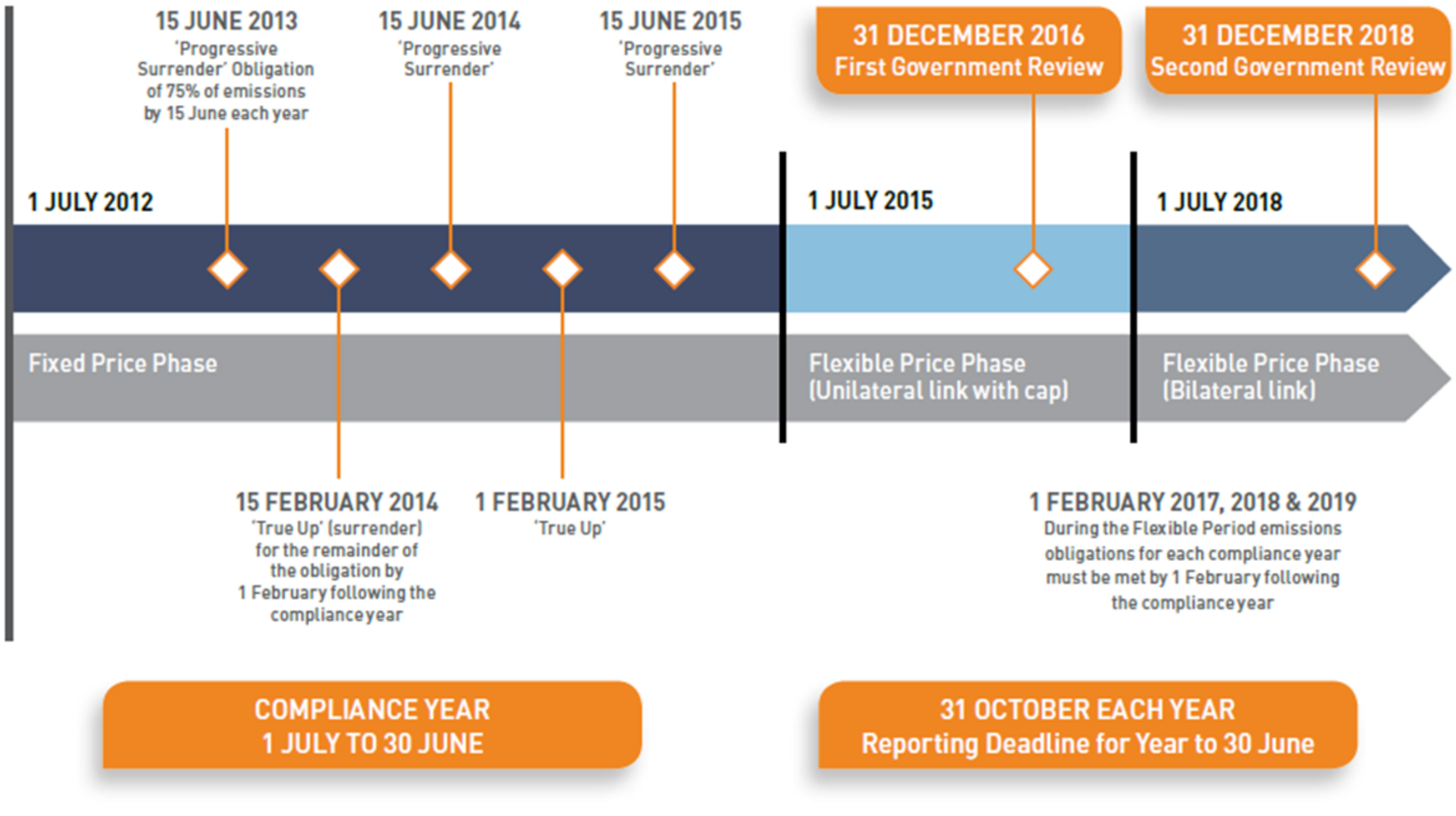
- Phase 1: 40€ per missing EUA + make good provision and public listing
- Phase 2: 100 € per missins EUA + make good provision and public listing
- Phase 3: same as Phase 2 but inflation is taken into account

Australia CPM

- Fixed price period : penalty 130% of fixed price for that year
- Flexible price period :
  a) 200% of the average annual auction price for that year,
  b) until June 2008 there is a price cap at 20$ above the expected international price

Linking Australia and EU ETS

- Linking rules up to 2020: Up to 50% of surrendered emissions can be EUAs and up to 12.5% can be Kyoto Units



Source: *Carbon Market Institute*

Evaluation criteria

- **Environmental Effectiveness**: the extent to which the environmental objective is achieved.
  - Macro Dimension: Does the ETS achieve emission reductions globally?
  - Micro Dimension: Does the ETS achieve the given (ineffective) target?
- **Efficiency**: the extent to which the required objective is met at least cost.
  - Macro Dimension: Does the policy achieve emissions reductions at lower costs compared to other instruments?
  - Micro Dimension: Does the ETS achieve the given target at least cost?
    - Static efficiency
    - Does it lead to innovation in the long run? (dynamic efficiency)
- **Equity aspects**: the extent to which any group is disadvantaged or favoured.
  - Burden sharing between generations
  - Burden sharing within generations (different sectors)

Relevant design elements

- **Environmental Effectiveness**
  - **Target**
  - Leakage
  - Offsets
  - Sanctions
  - Monitoring/Reporting/Verification

Macro dimension (Target, Leakage, Offsets)

Micro dimension (Sanctions, Monitoring/Reporting/Verification)

- **Efficiency**
  - Coverage
  - Target
  - **Market (firm decisions)**

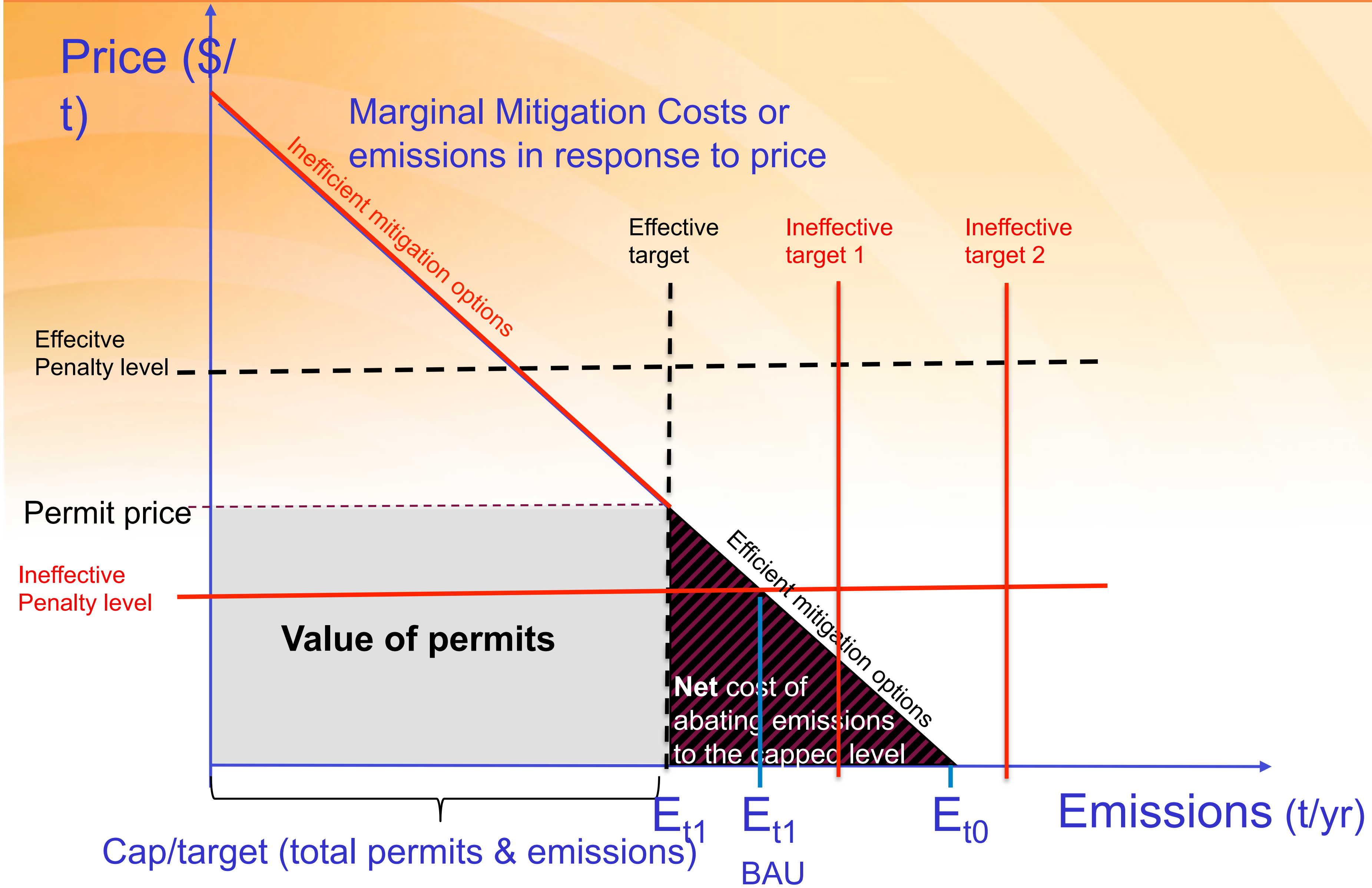
Macro dimension (Coverage, Target)

Micro dimension (Market (firm decisions))

- **Equity**
  - **Targets** over time
  - **Allocation** and revenue recylcing

Burdensharing between generations

Burdensharing within generations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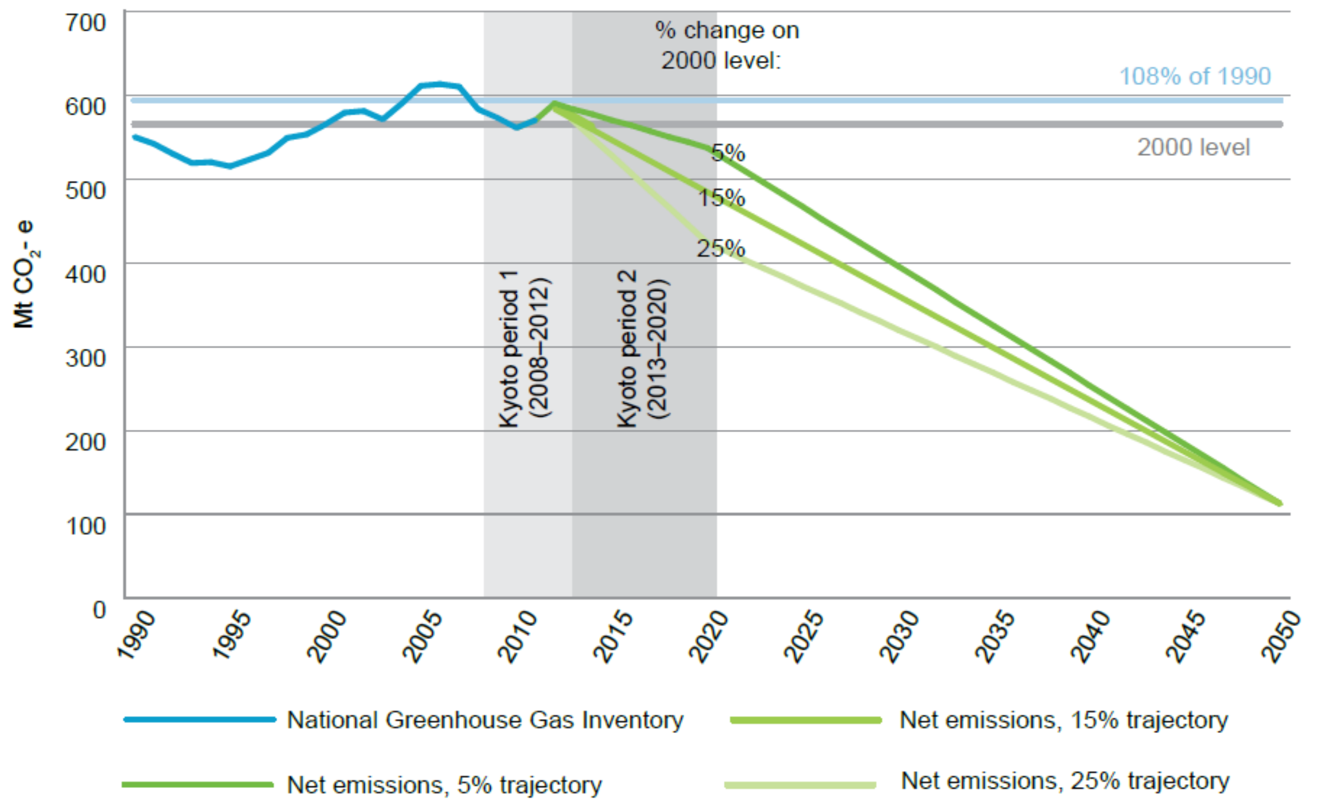
Marginal Mitigation Costs or emissions in response to price
Inefficient mitigation options
Effective target
Ineffective target 1
Ineffective target 2
Effecitve Penalty level
Permit price
Ineffective Penalty level
Value of permits
Efficient mitigation options
Net cost of abating emissions to the capped level
E_{t1}
E_{t1}
BAU
E_{t0}
Emissions (t/yr)
Cap/target (total permits & emissions)

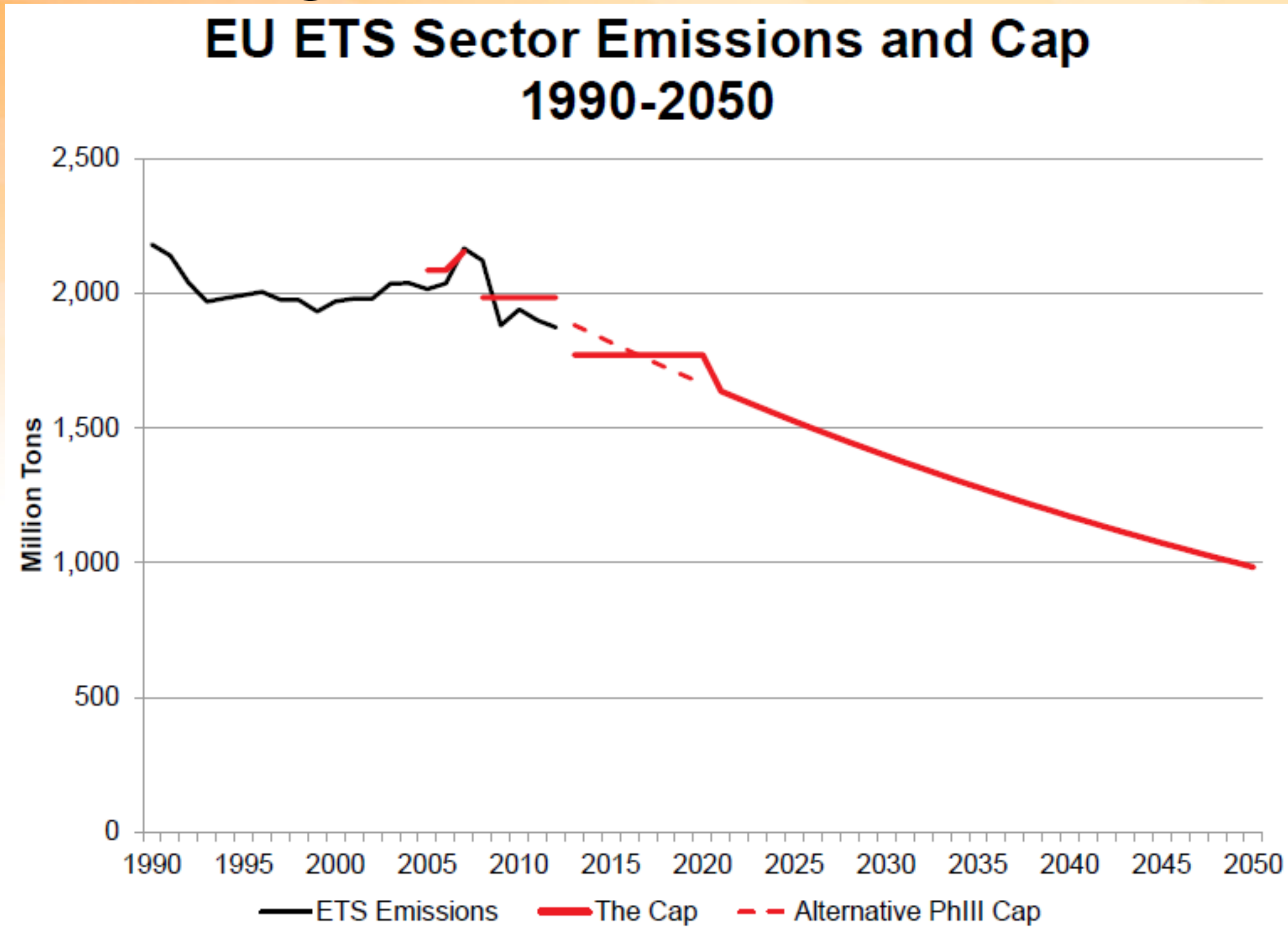
Australia`s target



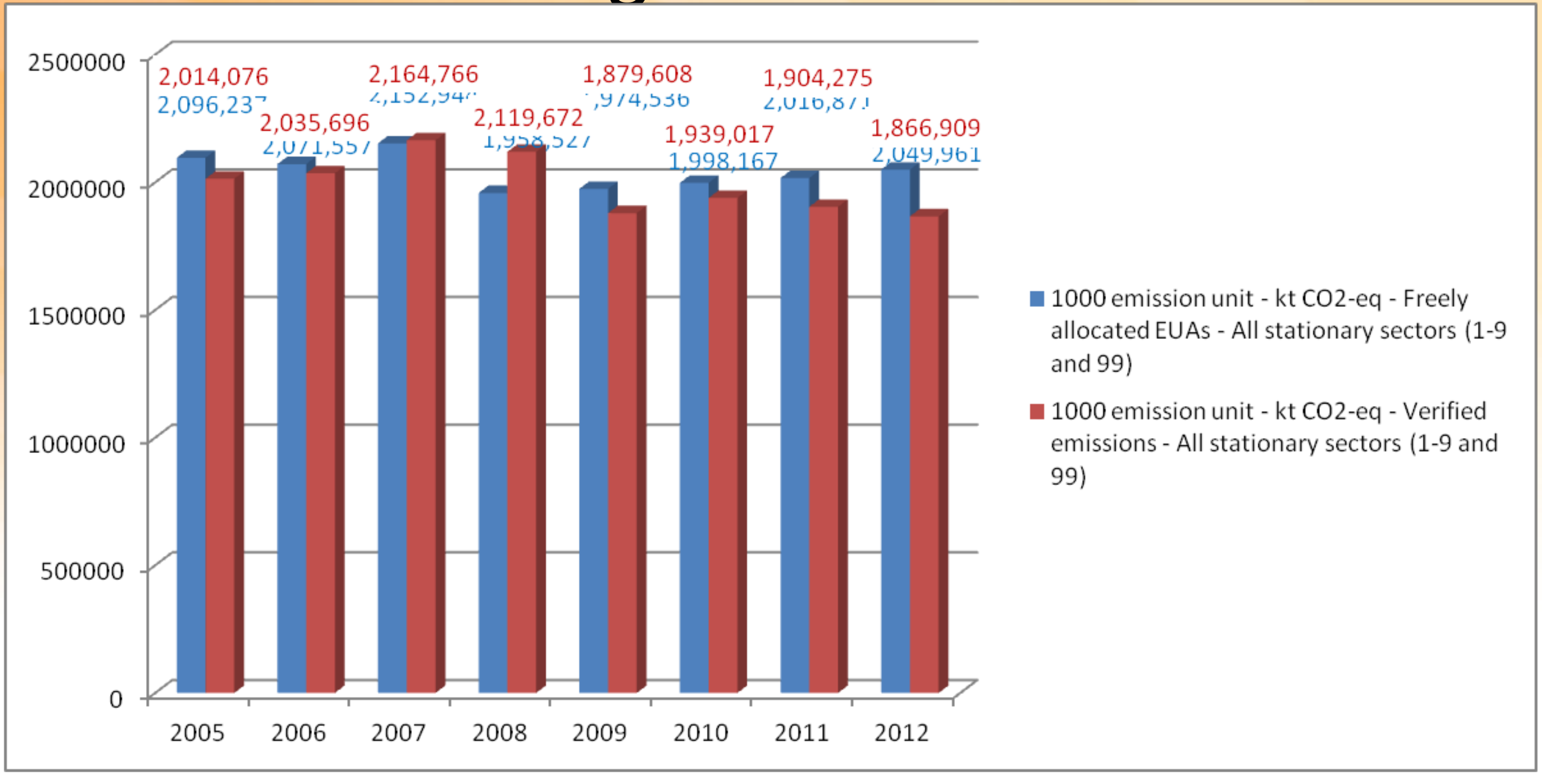
Note: Trajectories to the 2020 and 2050 targets are illustrative; they begin in 2012 and assume a straight line reduction to the target. The Authority will recommend a trajectory as part of its final report.

Source: Climate Change Authority, based on Department of Climate Change and Energy Efficiency, 2012b

EU ETS target



What were the targets of the EU ETS?



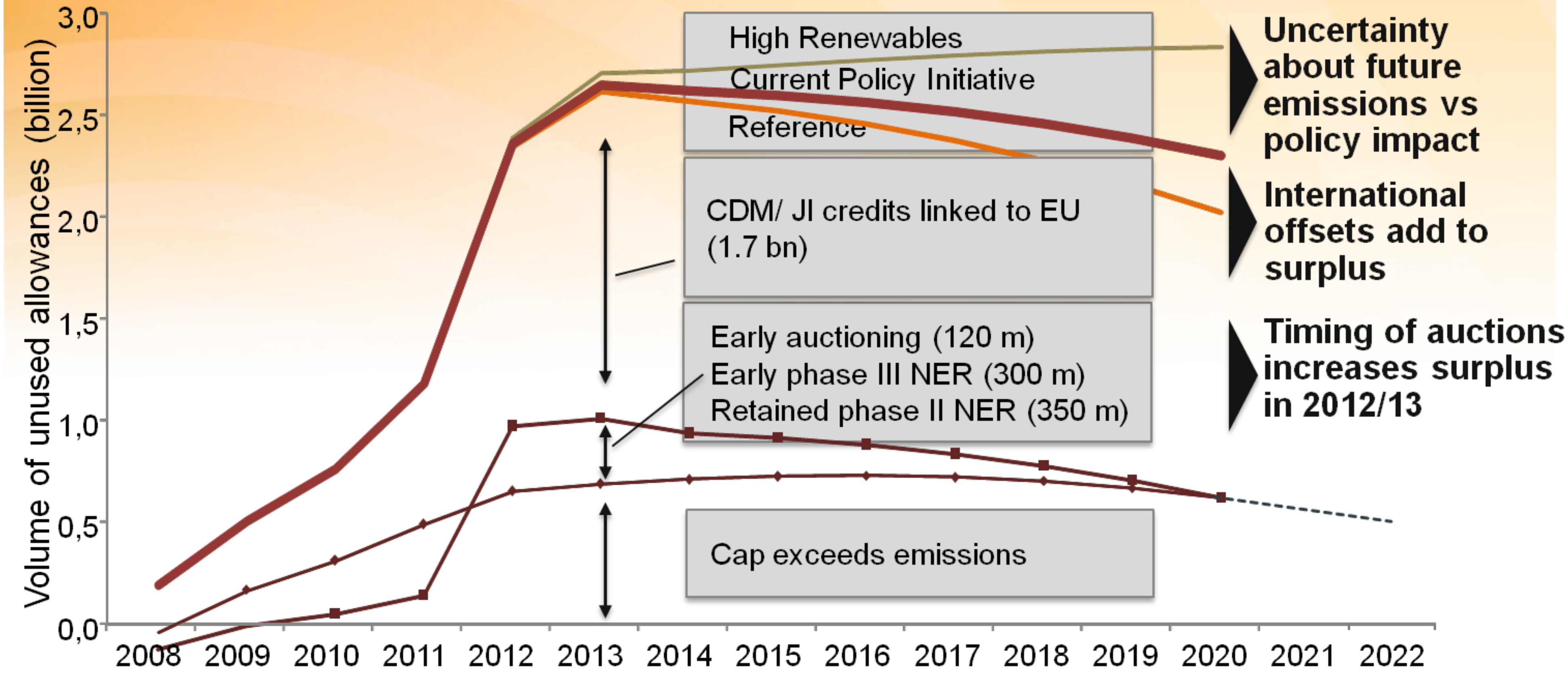
Phase I: EUAs allocation exceeded verified emissions by 141 Mio. tCO_2

Phase II: - Substantially improved by EC decisions
- 5.9% below 2005 verified emissions

Phase III Proposal: -21% compared to 2005 for ETS sector (11.3% below phase II allocation)

Source: CITL, EEA

Cumulative surplus of EU ETS allowances 2008-2020



Source: Banking of Surplus Emissions Allowances: Does the Volume Matter? DIW Discussion paper 1196

Was the EU ETS achieving emissions reductions?

- To assess emissions reductions a counterfactual has to be calculated
- Different studies with different approaches
  - Ellerman et al (2010) use a simple approach based on GDP intensity and emissions 1990-2007:
    - Phase 1: -210 Mt CO_2 (EU-25)
  - Anderson and Di Maria (2011) include temperature changes ect.

    Net Abatement in Mt CO_2 for EU-25 (Verified emissions – BAU emissions):
    2005=84; 2006=62; 2007=28; Total=174 (2.8%)
    Stringency of target: 27.9 Mt CO_2 (0.45%) (Allocation – BAU emissions)

- The EU ETS in Phase 1 did not lead to substantial emissions reductions
- In Phase 2 some reductions are likely given the banking options, however, the accumluated surplus will reduce prices substantially

Target setting: Lessons learnt

- High quality data is needed (same monitoring methods and externally verified) otherwise historical inflation of base year emissions has to be assumed
- Coverage has to be clear at the outset
- Target setting based on projections is likely to be inflated
- Small reductions compared to inflated base year emissions are likely to lead to an excess allocation
- Crucial role of the European Commission to limit excess allocation
- Overallocation accumulates a surplus if bankable and will impact on the price in long run

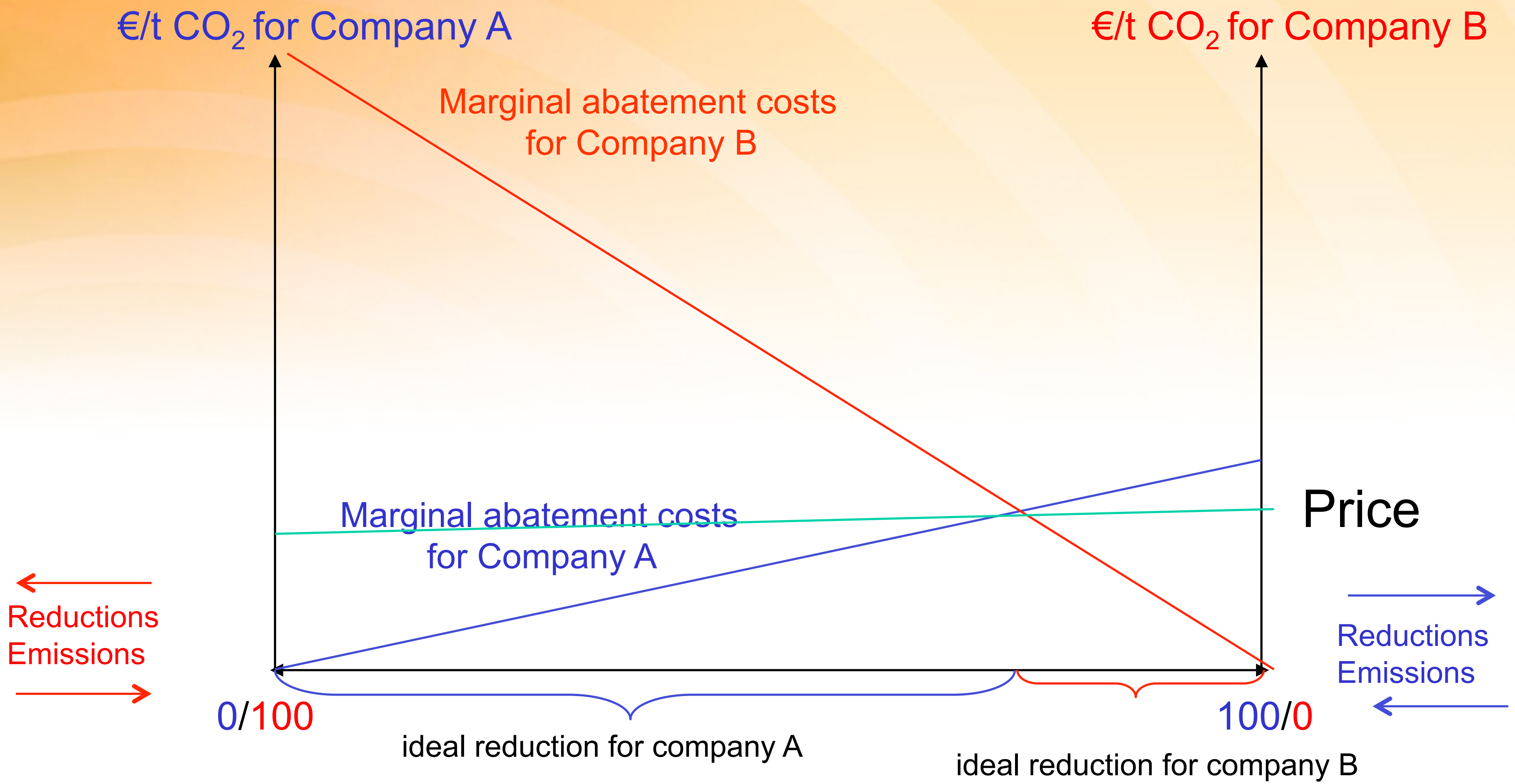
Cap fixes maximum abatement and no other policies for the same sectors can achieve further reductions!

Is the ETS efficient?

Market efficiency

- Market input related factors
  - Information on abatement options and costs (incl. offsets)
  - Transparency on scarcity e.g. emissions, reserves
  - Market structure e.g. competitiveness
  - Transaction costs
  - Uncertainty
  - Rational participants (profit maximising, risk neutral)
  - Market oversight
- Output
  - Price and volume development
  - Market transactions
  - Production volume
  - Import/Export volume
  - Technology and fuel use
  - Investment and investment plans

Theory: Efficiency of ETS based on trading



EU ETS market efficiency

Necessary market conditions	EU ETS
Information on abatement options and costs (incl. offsets)	60% of companies do not know their abatement costs[1]
Transparency e.g. emissions	Emissions are revealed annualy, uncertainty around New Entrant Reserve
Market structure	46% of emitters did not trade, mainly due to excess allocation. Under-allocated installations avoid trading on the market by internally transfering allowances without payment (61% of companies). Market power?
Transaction costs	Transaction costs are high, especially for small emitters, as they tend to be fixed costs
Uncertainty	UNFCCC process uncertainty affects trust in long -term future of EU ETS, backloading unsure
Rational participants	Theory and Experiments: free allocation and uncertainty aversion reduces market efficiency[2]
Market oversight	Oversight is missing, as scandals of VAT carrousel and phishing show

1) KfW/ZEW 2011 2) Theory: Baldurson and von der Fehr 2004; Experiments: Goree et al. 2010; Betz and Gunnthorsdottir 2009

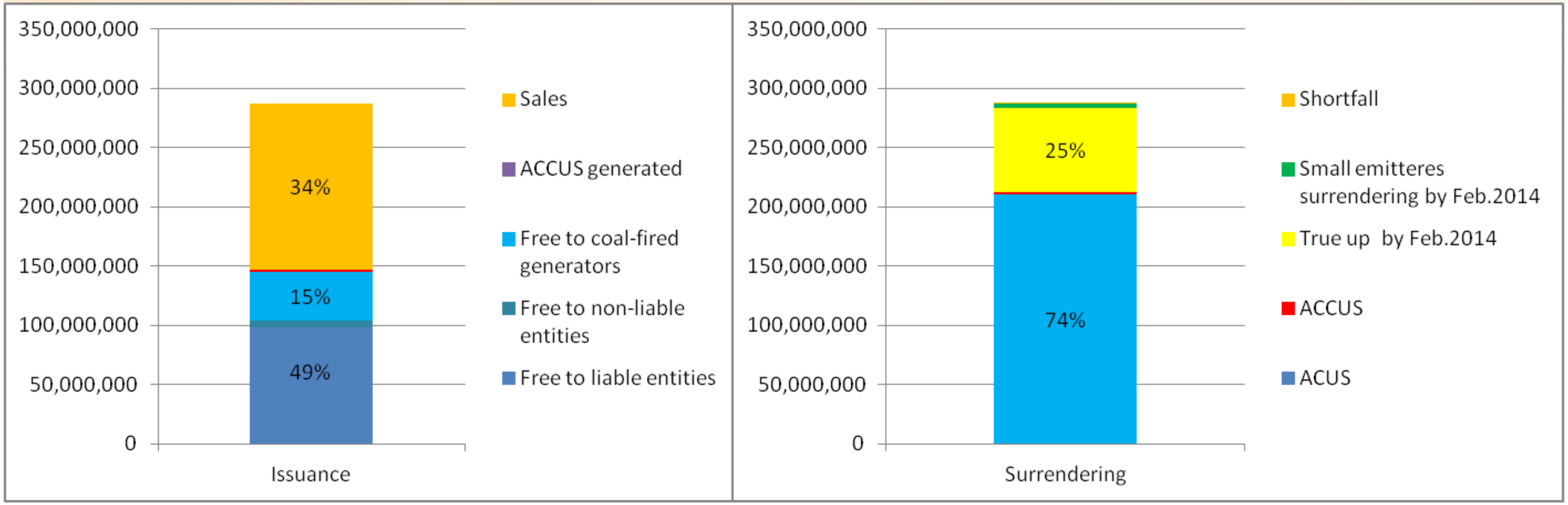
Price Development

- In theory: Prices should reflect scarcity of permits
- Efficiency should lead for a given target to a low permit price c.p.
- Other policies will impact on price
- Phase II: Influence of fundamentals (fuel prices, temperature, availability of hydro power, stock market) but also influence of policy decisions

Source EEX

Australia´s market 2012/2013

- Fixed price period, therefore not much trading
- Buy back of government: ≈ 40,000,000 ACUS
- Trade in secondary market ≈ 35,000,000



Is the EU ETS fair?

- Burden sharing **within generation: Allocation method**
  - Recall: Under ideal conditions, companies receiving free allocation will take the opportunity costs of allowances into account when making production and investment decisions and thus the final allocation of allowances is independent of the primary allocation and method.
  - Companies pass through the carbon opportunity costs to their customers and thus receive rents. The pass-through is necessary to achieve an efficient allocation of reductions (substitution effects etc.)
  - Who wins?
    - "Windfall profits" for those companies who receive free allocation and can pass-through the costs: Phase I electricity sector: €13 bn/a (Keppler and Cruciani 2010)
    - High income households profit more from increase in share values of those companies with windfall profits
  - Who loses?
    - Low income households will suffer higher impact compared to high income households (regressive impact)
  - What are the solutions to have less regressive effects in the long run?
    - Auctioning and using the revenue to compensate low income households

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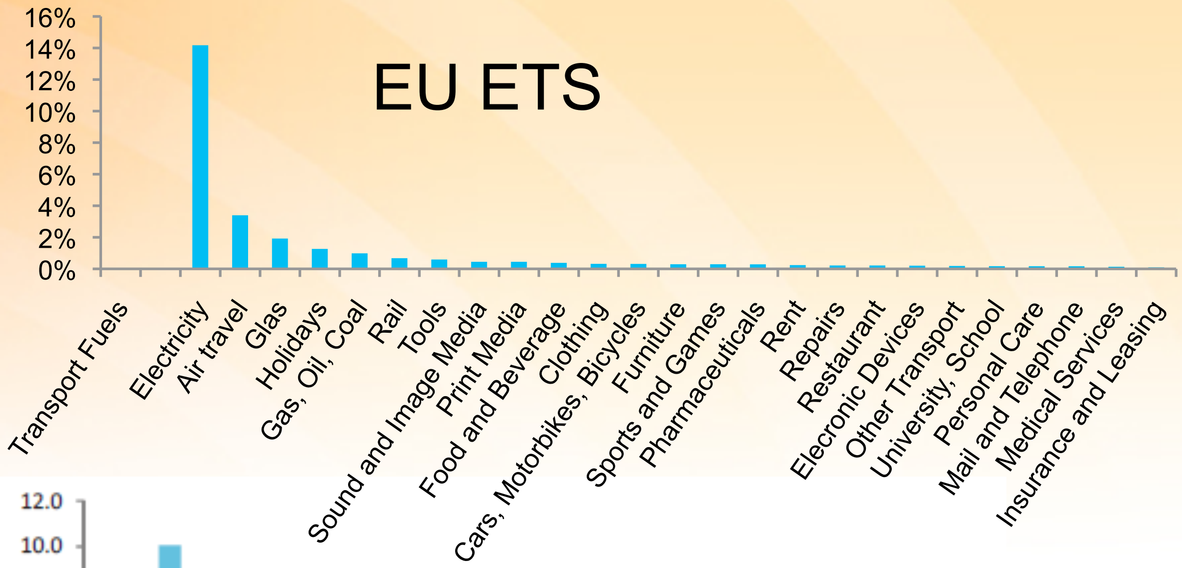
Estimated Increase in Consumer Prices

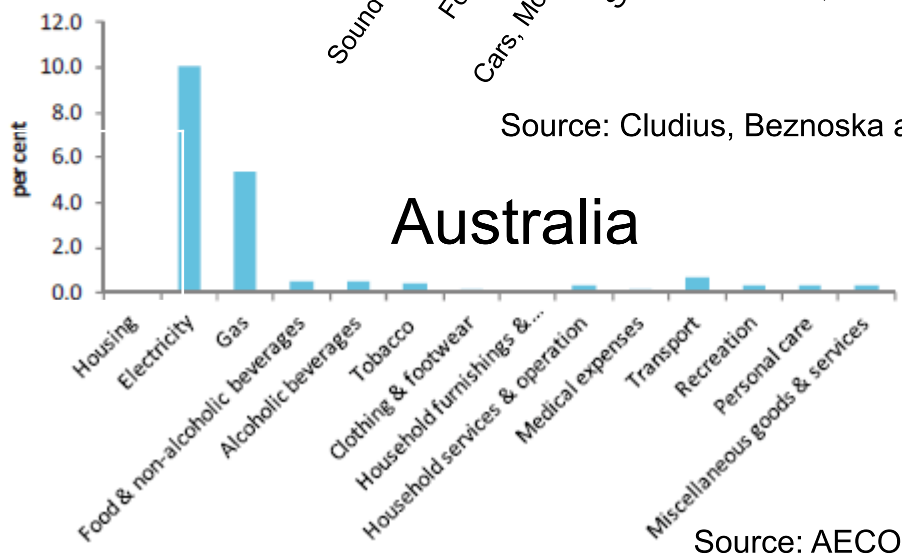
Remarks:

- A\$33/tCO_2 (25€) , Full cost pass-through
- EU ETS excludes transport fuels
- Other fuels: only extraction/refinement process covered



Source: Cludius, Beznoska and Steiner (*forthcoming*)

A\$23/tCO_2, Full cost pass-through

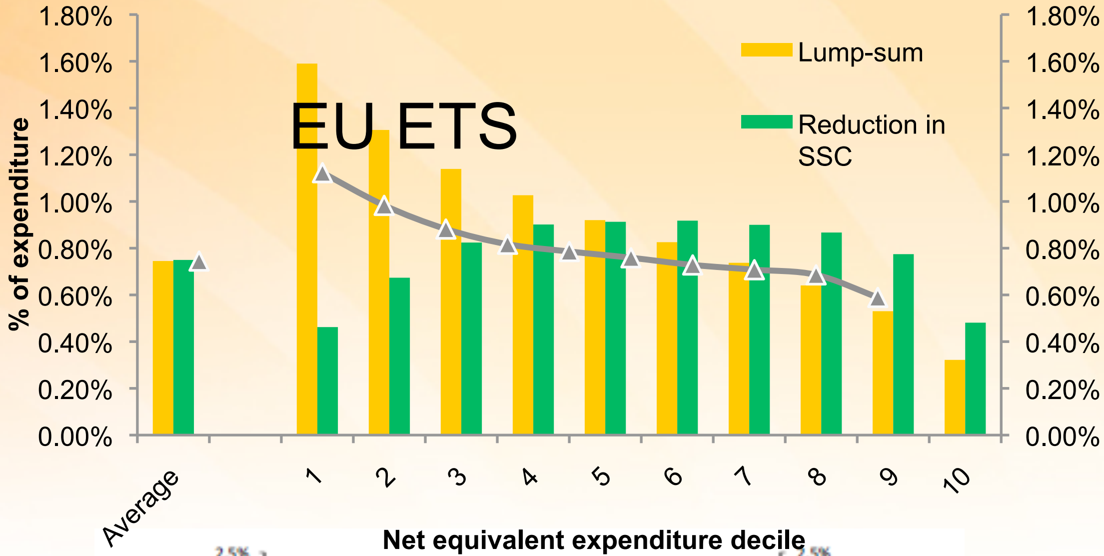


Source: AECOM/CSIRO (2011), Figure ES 1

Impact vs. estimated assistance

Remarks:

- €7.5 distributed back to households
- 2 Regimes: Lump-sum and reductions in social security contributions
- Hump shape of SSC reduction due to the fact that the self-employed do not benefit



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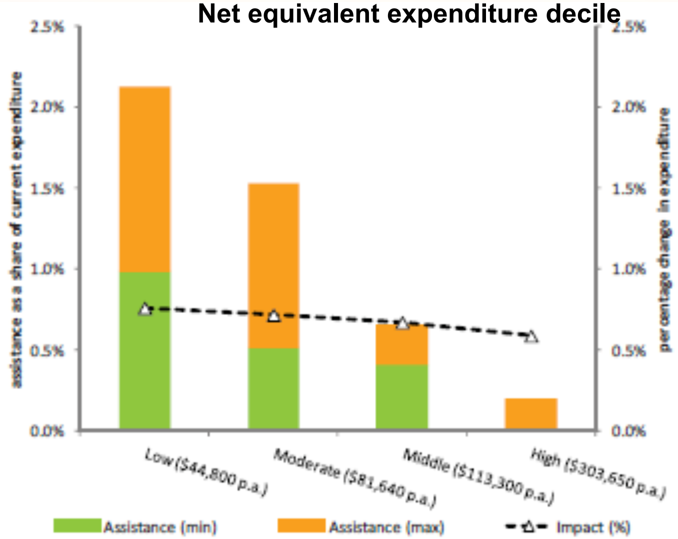

Source: AECOM/CSIRO (2011), Figure ES 6

Conclusions

- A flexible process to improve the design over time seems crucial to achieve an effective, efficient and fair ETS...
  - CPM has included formal processes to review the scheme
- Effectiveness:
  - Commission played a crucial role in target setting
  - Additionality is crucial and offsetting is no long-term solution. International offset may play a role in achieving a common price over different, not directly linked systems
  - For CPM the Climate Change Authority will play important role
- Efficiency:
  - EUA price impacted by other policies and financial crises, pressure to tightening cap
  - Complementary measures to increase efficiency (static and dynamic)
  - More transparency and disclosure of information necessary to improve market efficiency: e.g. moving from calculation to measurement
  - Oversight is necessary to have long term trust in the market
  - CPM implementation will need to insure market oversight and transparency
- Equity:
  - Difficult to judge for EU ETS as impact depends on Member States revenue recycling which has just started
  - CPM strong emphasis on compensation, however some of the regulatory details important to judge the impact on different industries

Thank you for your attention

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