Avoiding Dangerous Climate Change: The Dynamics of Global Action

Briefing 1
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The Context

- There is increasing recognition that even warming of 2°C (relative to pre-industrial) is likely to create serious damage
- The meeting of 16 major nations (9 July) ‘recognised the scientific view that warming should not exceed 2°C’
- The G8 nations supported ‘a goal of developed countries reducing emissions …by 80% or more by 2050’ (9 July)
- The IEA has suggested (6 October) that, because of the GFC, global emissions will fall by 3% in 2009 and will be 5% lower in 2020 than would otherwise be the case
- There is limited knowledge in the literature on the paths for developing countries consistent with holding warming to less than 2°C, given an 80% reduction in advanced country emissions by 2050
The Questions

- What has been the impact of the global financial crisis on emissions, compared for example to that of policy change over recent years?
- What is the likely path of emissions post the GFC, on current policies?
- What are the characteristics of the emissions paths for developing countries consistent with holding global warming to $\leq 1.5^\circ$C, given achievement of an 80% reduction in advanced countries by 2050?
- How important is the time path of the adjustment to the 80% lower level?
- What are the implications of the nature of these paths for policy and for an international agreement?
The Presentation Structure

1. The global financial crisis and unchanged policy projections for emissions to 2030 (Peter Sheehan)
2. Modelling emissions paths, given that advanced countries achieve a reduction of 80% in emissions by 2050 (Roger Jones)
3. Implications for policy and an international agreement (Peter Sheehan)
1. The global financial crisis and unchanged policy projections for emissions to 2030

Understanding the global financial crisis GFC:

- While we speak of a ‘global crisis’ it is transmitted across countries in many different ways
- Distinguish eight different transmission channels
- The differential impact of these channels across countries, together with antecedent conditions, helps explain the diversity of outcomes
- These differences are very relevant for understanding the impact of policy
Transmission channels

• Financial market conditions
• Real activity in the impact industries
  • Housing, motor vehicles, some other durable and capital goods
• Expectations
  • Rise in the savings ratio; early inventory reduction; labour productivity adjustment
• Export shocks – impact industries
• Export shocks – other industries
• Wealth and profitability effects
• Resources and the terms of trade
• Reduction in capital flows, FDI and foreign aid
The outcomes have indeed been very different

- Deep recession in countries at the epicentre of the financial disturbance (USA, UK, some EU)
- Quick impact on those specialised in value-added exports in the impact products (Germany, Japan, South Korea, Singapore), but with the possibility of a sharp recovery when inventory cycle settles
- Initial modest impacts on various types of countries (low value-added exporters such as China; resource exporters such as Australia), in some cases offset by big stimulus packages
- Diverse impacts across developing countries – eg limited impact in India, Indonesia, but strong impacts elsewhere.
Methods for assessing future GDP paths post GFC

- General approach is as described in Sheehan, Jones et al (2008)
- Simple model, using the projections and parameters of the IEA World Energy Outlook (2008) as the default
- Default GFC GDP projections are those of IMF April 2009
- Specific analysis of China, India and some other countries
- Recovery paths beyond the crisis are based on various assumptions about recovery of lost GDP after 2010 (Cerra and Saxena 2007)
  - No catch up in OECD
  - Full catch up in China, India and some other countries
  - Partial catch-up elsewhere
OECD emissions on current policies, pre GFC and post GFC

- Prior to the GFC, OECD was on a path of slow decline in emissions, driven especially by falls in gases other than CO₂.
- The impact of the crisis has been sharp, including in industry and emissions generating industries.
- Even with some economic recovery in 2010, emissions in that year will be about 5% lower as a result of the GFC.
- While there will be some cyclical recovery of emissions intensive industry, much of this cut will persist through to 2030.
- The post GFC projection has total OECD emissions 4.3% lower in 2030 than in 2005.
Chart 1: Total GHG emissions, OECD, actual 1990-2005 and projected 2010-2030, pre and post GFC (MtC-e)
Three stories about China and the GFC in China

1. Massive stimulus package in a context of modest impact, leading to rapid coal-fired growth of a traditional type
   - China now likely to grow 10% in the year to the Dec quarter 2009
   - Coal production and energy intensive industries growing rapidly

2. Increased emphasis on climate issues in the GFC response
   - Innovation and energy efficiency in the recovery phase
   - Expansion of nuclear energy and other renewables programs
   - Many programs of support for increased energy efficiency and for related R&D

3. Aspirations for leadership in the low carbon economy
   - Recognition that the low carbon economy is a new competitive framework
   - The 2050 report: the possibility of a peak and decline path by 2030
   - Planning for the low carbon economy in the 12th Five Year Plan (2010-15)
Chart 2: Steel and cement production in China, 2000-2009 (index Jan 2000=100, seasonally adjusted)
Chart 3: China’s energy and coal production, and electricity generation, 2000-09 (index Jan 2000=100, seasonally adjusted)
Chart 4: Emissions scenarios for China to 2050: the joint academies report

China should set firm targets to limit greenhouse gas emissions so they peak around 2030, a new study by some of the nation’s top climate change policy advisers has proposed ahead of key talks on a new global warming pact.

Possible approaches to reducing carbon dioxide output include:

- **Business as usual**
- **Low Carbon**
- **Enhanced Low Carbon**

Graph shows the following:

- **2020**: 1.41 billion tonnes of carbon dioxide.
- **2030**: Peak emissions.
- **2050**: Reductions in emissions.

Top 10 emitters in 2007 (in billions of tonnes):

- **China**: 8.082
- **US**: 5.572
- **Japan**: 1.043
- **India**: 0.643
- **Germany**: 0.370
- **Canada**: 0.210
- **UK**: 0.165
- **South Korea**: 0.160
- **Iran**: 0.130

Sources: 2006 China Energy and CO2 Emissions Report, Carbon Dioxide Information Analysis Center

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Unchanged policy projection of China's emissions to 2030

1. On balance we expect the first effect to prevail in the short term, with China's emissions higher in 2010 than expected pre GFC
2. But increasingly the stronger emphasis on energy and climate policy will lead to lower emissions relative to pre GFC expectations
3. Nevertheless emissions in China are projected, on current policies, to grow by 3.8% per annum between 2005 and 2030
   • this is much higher than in the base case of the joint academies report
4. But this is about 30% lower than projected, on the same methodology, on 2006 policies
   • highlights the key role of policy changes since 2006
   • and the possibility of further policy to achieve a peak and decline path by 2030
Chart 5: Total GHG emissions, China, actual 1990-2005 and projected 2010-2030, pre and post GFC (MtC-e)
Overall unchanged policy emissions projections to 2030

- On current policies we project GHG emissions to rise by about 50% over 2005-30, from 11.9 GtC to 18 GtC, a growth rate of 1.7% pa
- Indeed it is likely that, if current policies are continued, the low growth in emissions over 2005-10 associated with the GFC will be temporary, as in 1990-95
- The reasons for renewed growth in global emissions at about 2% per annum after 2010 are:
  - The resumption of rapid growth in key developing countries
  - The coal-based nature of that growth, and hence its emissions intensity
  - The progressive shift in the balance of global growth to these economies
Chart 6: Total global GHG, actual 1990-2005 and projected 2010-2030, pre and post GFC (MtC-e)
Chart 7: Growth in total global GHG emissions, actual 1990-2005 and projected 2010-2030, post GFC (% per annum)
Longer term, policy based emissions paths - MEPs

- Climate models require a method to go from a projection to 2030 to a climate path out to 2100, which can take account of policy changes
- In our 2008 CEC paper we introduced the idea of a minimum emissions path from a given point on a projection – the best outcome reasonably achievable by that country at that time – defined in terms of
  - the time from t taken for emissions to be stabilised
  - the rate of decline in emissions after the peak
- Here we adapt this approach to the current problem
  - OECD emissions are reduced by 80% between 2010 and 2050, using a decay function
  - For other countries, both the time to stabilisation and the period after peaking over which emissions are reduced by 80% is defined in terms of relative GDP per capita
  - The per capita GDP/years to peak relationship in shown in Chart 8, and the actual parameters for countries/regions in Table 1
  - Two decay functions are used – straight line (V2) and exponential (V3) – see Chart 9
Chart 8: GDP per capita by region/country, and years to peak emissions, regions other than OECD
Table 1: GDP per capita by region/country, and parameters of MEP functions

<table>
<thead>
<tr>
<th>Region</th>
<th>GDP (US $b, PPPs)</th>
<th>Population (million)</th>
<th>GDP per capita (US$ '000s, PPPs)</th>
<th>Years to peak</th>
<th>Years to 80% reduction from peak</th>
<th>Total years to 80% reduction</th>
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</thead>
<tbody>
<tr>
<td>OECD Total</td>
<td>33,991</td>
<td>1,174</td>
<td>28,950</td>
<td>0</td>
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<td>40</td>
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<td>Transition Latin</td>
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<td>447</td>
<td>10,269</td>
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<td>America</td>
<td>3.078</td>
<td>366</td>
<td>8,414</td>
<td>7</td>
<td>54</td>
<td>61</td>
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<tr>
<td>Middle East</td>
<td>2,865</td>
<td>358</td>
<td>8,000</td>
<td>8</td>
<td>56</td>
<td>64</td>
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<tr>
<td>China</td>
<td>5,594</td>
<td>1,311</td>
<td>4,267</td>
<td>16</td>
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<td>88</td>
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<tr>
<td>Africa</td>
<td>1,832</td>
<td>826</td>
<td>2,219</td>
<td>20</td>
<td>80</td>
<td>100</td>
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<tr>
<td>India</td>
<td>2,341</td>
<td>1,101</td>
<td>2,126</td>
<td>21</td>
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<td>103</td>
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<tr>
<td>Other Asia</td>
<td>684</td>
<td>545</td>
<td>1,255</td>
<td>22</td>
<td>84</td>
<td>106</td>
</tr>
</tbody>
</table>

Note: GDP per capita and other parameters are based on 2006 data in purchasing power parity (PPP) prices, and MEP specifications.
Chart 9: Alternative decay functions for emissions from peak level (set = 1), by years from peak
Minimum emissions paths used in this analysis

The following MEPs are used here:
- MEP2030V2No80% (the base case)
- MEP2030V2
- MEP2020V2
- MEP2015V2
- MEP2010V2
- MEP2010V3

All of the MEPs other than the base case assume that OECD emissions are reduced by 80% over 2010-50;
The year refers to the time $t$ at which non-OECD countries begin stabilising emissions; V2 refers to straight-line reduction from the peak and V3 to exponential adjustment.
Warming curves, baseline pre-industrial temperature, for emission scenarios introduced in the previous slide. Run using the MAGICC simple climate model with default climate sensitivity of 3°C. Only the MEP2010V3 scenario avoids 2°C warming.
Article 2 of the UNFCCC laid out as a risk management problem. The way Article 2 is phrased sets it up as a risk that is managed by establishing long-term equilibrium conditions for stabilised CO₂, that is, it invites target setting for CO₂ stabilisation.
2°C mean global warming may not be safe

- The last time the Earth was at current CO₂ levels for an extended period, sea level was 25±5 m higher
- Greenland and Antarctica both have negative mass balance and are contributing to sea level rise
- About ¾ of the Great Barrier Reef could be bleaching every second year
- Recent studies on food security show potential for declining yields in key regions and globally
- Glacial meltwater reductions threaten Asia’s three large river systems – Yangtze, Ganges and Mekong

Schematic diagram calculated from a MAGICC simple climate model run of the WRE750 stabilisation scenario 1990–2400. The ice sheet calculation is assuming a maximum melt rate of 2 m per century, with a threshold value of 5°C warming scaled as the square of warming.

This schematic illustrates the equilibrium model for setting stabilisation targets to avoid dangerous climate change. The principal issue is that impacts of ocean and ice continue changing for centuries, and are associated with large uncertainties. Recent scientific findings suggest that long-term targets associated with high likelihoods of avoiding DAI can only be set with a high degree of precaution involving overshoot, rather than stabilisation scenarios.
Schematic diagram calculated from a MAGICC simple climate model run of the WRE450 stabilisation scenario 1990–2400. The ice sheet calculation is assuming a maximum melt rate of 2 m per century, with a threshold value of 5°C warming scaled as the square of warming.
Annual CO₂ emissions in Gt C for six emissions scenario. The later generation scenarios such as the Treasury, MEP new baseline and MEP scenarios are higher growth than the generation of WRE stabilisation scenarios.
Total atmospheric loading at peak in both the WRE450 and MEP2010V3 scenarios in atmospheric CO₂ and CO₂-e concentrations. They show that stabilisation and overshoot targets under current growth rates, with rapid but not precipitate reductions in CO₂, peak at about 500 ppm CO₂-e is the best that can be anticipated. Therefore, it is a more important target than long-term stabilisation, because it is a key point for policy to aim for on the path to long term stabilisation/reduction that minimises the likelihood of DAI.
Three policy scenarios shown in terms of likelihood of exceeding 2°C from total CO₂ emissions between 2000–2050 as established by Meinshausen et al. 2009.
Long-term projections for the MEP2010V3 scenario if emissions are maintained at 2100 levels, showing how with low global emissions, return to sub CO₂ 400 ppm levels is very slow. Only net removal of CO₂ from the atmosphere could pull levels down faster.
Schematic diagram calculated from a MAGICC simple climate model run of the WRE450 stabilisation scenario 1990–2400. The ice sheet calculation is assuming a maximum melt rate of 2 m per century, with a threshold value of 5°C warming scaled as the square of warming.
Projections to 2100 for the MEP2010V3 scenario. This shows it is possible to have cooling by the end of the century under median assumptions taking account of known scientific uncertainties.
Testing of the sensitivity of OECD targets (used as a proxy for Annex 1 countries) to different target ranges for 2020 and 2050 for avoiding 2°C by stabilising GHGs
3. Implications for policy and an international agreement

The argument to date has been that any major delay in serious climate action may make holding warming to \(<2^\circ C\) impossible, but that such paths can still be achieved with:

- reduction in advanced country emissions by 80%, relative to 2010, by 2050
- achievement of peak and decline paths by major developing countries, especially China, and
- early action to put these in train.

Furthermore, even post GFC and policy to date, global emissions are running at the top end of the SRES marker range (Chart 3.1), whereas the \(<2^\circ C\) paths are, by 2030-40, well below anything envisaged in that SRES range (Chart 3.2).
Chart 3.1: GHG emissions to 2100: MEP 2030 and SRES marker scenarios (Index 1990=100)
Chart 3.2: GHG emissions to 2100: two MEP 2010 scenarios (broadly consistent with <2°C) and SRES marker scenarios (index 1990=100)
Some characteristics of the <2°C paths

- The <2°C paths require effective elimination of GHGs in advanced economies over about 50 years, with similar but later action in developing countries.
- Given the pervasive role of fossil fuels in modern economies, this effectively implies a new industrial revolution, and a new basis for competitiveness.
- The level of investment in new technologies, industries, and communities will be massive, implying:
  - a new era of growth, with old relationships about GDP growth and emissions no longer applicable.
  - that markets and businesses will respond rapidly when they are convinced this is likely to occur.
  - that there will be major winners and losers, across industries, firms, and countries, and
  - there will be great uncertainties about timing and impact in different industries and countries.
- Experience over the 20th century suggests that:
  - firms and countries that set out to drive the change will be the winners, while
  - firms and countries that seek to resist the change and preserve existing structures and processes will fall behind.
Some policy implications of the <2°C paths

• The key policy issue is to cement the advanced country commitment to -80% by 2050, and key developed country commitment to peak and decline paths
• While timing matters, a focus on stringent and specific targets for 2020 may be counterproductive
  • concern about committing to stringent binding targets, give the uncertainty of impacts
  • pursuit of tricks (eg 50% of emissions reduction purchased offshore) to meet national targets
  • deep US concern about repeating the Kyoto problem (commitment to a specific target without domestic support)
• China’s strong perception of the competitiveness implications of the low carbon economy and its potential willingness to adopt a peak and decline path may be a critical factor
Implications for international agreement

The Australian Government has suggested that all countries enter into national schedule commitments, appended to any agreement, and that for developing countries these schedules replace their participation in binding international agreements.

In current circumstances this proposal might have more general value, as providing a way to pursue both
- the developed country commitment to -80% reduction by 2050 and
- peak and decline paths by developing countries.

The incentive for countries to enter into strong schedule commitments would be the growth and competitiveness benefits, and well as perhaps access to international funding for technology change and mitigation activity.
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