Peak Oil, Climate Change & Global Sustainability
- the case for emergency action -

ASPO Oil Vulnerability Symposium

Brisbane
4th June 2013

Ian T. Dunlop
Director Australia 21
Member, Club of Rome
Chairman, Safe Climate Australia
Fellow, Centre for Policy Development
Deputy Convenor, Australian Association for the Study of Peak Oil
Humanity as the dominant global force
- needs 1.5 planets to survive

Source: Global Footprint Network
Converging Limits

Global Risk Management

Peak Oil & declining EROEI

Climate Change

Water

Food

Financial & Social Instability

All Symptoms of an unsustainable World

- and all inextricably linked
Food: 30% of world energy use

Food, metals, commodities and oil prices are now in lock-step

Source: IMF, January 2013
Eating oil
This is not just about oil rigs, tankers & pipelines

• Every person’s food contains the distillate from 66 barrels of oil a year.
• We ‘eat’ 4.1 litres of diesel per day.
• There are currently no easy alternatives to oil for farming or the food chain
• Oil crisis = food crisis

Source: Julian Cribb 2012
Likely loss over time of all ice sheets. No ice sheets on planet = 70 metre sea-level rise

Likely loss over time of Greenland & West Antarctic ice sheets = 6-7 metre sea-level rise

Paleoclimate History

Deep ocean temperature change (as proxy for surface temperature)

- **Peak Holocene**: over last 10,000 years up 1900AD
- **Global average temperature now**: ~0.6C above peak Holocene
- **2C of warming**: consequence of current level of greenhouse gases
- **4C of warming**: consequence of current government policy commitments

Implications

The “official” objective, of limiting warming to less than 2°C above pre-industrial levels, is likely to produce 6-7m sea level rise over time, wiping out cities like London, New York, Shanghai, Singapore, Tokyo & Melbourne in their current form.

Current policies, if implemented, are likely to result in temperature increase above 4°C and produce sea level rise of 70m over time, with catastrophic impact on humanity.
Global Surface Temperature Changes

Decadal Surface Temperature Anomalies (°C)

1970s .00
1980s .18
1990s .31
2000s .51

Arctic and West Antarctica are warming fastest

Decadal mean surface temperature anomalies relative to base period 1951-1980.

The evidence - Arctic Sea Ice Volume

- accelerating melt – ice free in summer by 2015?
- ice free all year by 2030?

Source: Neven et al, PIOMAS, University of Washington 2012

Years 1979 – 2012 actuals

Sea Ice Volume Km$^3$

Months
- actual volume

Months
- forecast quadratic trend

Climate
Potential Climate Tipping Points

Source: Schellnhuber, after Lenton et al, PNAS, 2008
Global Fossil Fuel & Cement Emissions
- following a “worst-case” path

Emissions are heading to a 4.0-6.1°C “likely” increase in temperature.
Large and sustained mitigation is required to keep below 2°C.

Source: Global Carbon Project, January 2013
Implications

We have probably already passed climatic tipping points at the 0.8°C warming already experienced, let alone the additional 1.2°C to which we are committed by virtue of historic emissions.

This was not supposed to happen until end-21C

Without emergency action to avert the worst impacts, this is likely to trigger sooner or later:

- irreversible runaway warming globally
  - with counter-intuitive regional variations
- rapid sea-level rise
- permafrost melt leading to increased methane & CO₂ emissions
- potential slow-down of North Atlantic thermo-haline conveyor with major impact on European climate
- severe implications globally

Our inaction is probably locking in these changes today
Much talk about adaptation to 4°C - what does it really mean?

“In such a 4°C world, the limits for human adaptation are likely to be exceeded in many parts of the world, while the limits for adaptation for natural systems would largely be exceeded throughout the world”

Professor Hans Joachim Schellnhuber
Director, Potsdam Institute for Climate Impact Research, June 2011

“What is the difference between a 2°C world and a 4°C world?”
“Human Civilisation”
“A 4°C temperature increase probably means a global carrying capacity below 1 billion people”

Professor Hans Joachim Schellnhuber
Director, Potsdam Institute for Climate Impact Research, June 2011

It’s extremely unlikely that we wouldn't have mass death at 4°C. If you have got a population of nine billion by 2050 and you hit 4°C, 5°C or 6°C, you might have half a billion people surviving.”

Kevin Anderson, Deputy Director,
Tyndall Centre for Climate Change Research, 2009

“There is no certainty that adaptation to a 4°C world is possible. The projected 4°C warming simply must not be allowed to occur”

“Turn Down the Heat”, World Bank, 19th November 2012

Ian Dunlop 2013
Does this matter?
Yes!

Climate Change has moved into a new and highly dangerous phase

It is the most urgent issue now confronting the world

The “official” target of limiting temperature increase to $2^\circ$C is far too high
Cheap Energy has been the basis for our prosperity - but those days are now over, just as the bulk of the world’s population moves up the growth escalator.
The world is currently following a trajectory which will increase temperature by 6°C relative to today, for which the energy sector is largely responsible. If that is allowed to happen, we are all in trouble


World Energy Outlook 2011
- conventional oil peaked in 2005 -

World Oil Production by Type in the New Policies Scenario

We are now scraping the bottom of the proverbial barrel

4 Saudi Arabia’s are required by 2035 to just maintain current supply
– highly unlikely, and unconventionals will not solve it –

Peak Oil
- fundamentally changes energy supply

Peak
50% still to be produced

Lifecycle of a typical oil reservoir

Source: Resources to Reserves, IEA 2013 & W Schutte
The Growing Gap

THE GROWING GAP
Regular Conventional Oil

- Past Discovery
- Future Discovery
- Production

Revisions backdated & rounded with 3yr moving average  Campbell, 2008

Source: Colin Campbell 2008
Oil Availability “Official Future” 2013
- abundant resources, but far more expensive
- and environmentally problematic

Source: IEA - Resources to Reserves 2013
Converting resources to oil flows is proving difficult

- Not discovering new oilfields quickly enough
  - certainly no giant fields

- Data on existing oil reserves is suspect
  - particularly in the Middle East - “the paper barrels”

- Many established oil provinces are in decline
  - depletion rates may be more rapid than officially admitted

- Unconventional resources proving difficult to develop
  - technically, economically & environmentally

- Oil producing nations
  - using more oil domestically & exporting less
  - conserving for future generations
Energy Return on Energy Invested is dropping rapidly - conventional economic growth cannot be sustained

EROEI to maintain industrial civilisation is around 10:1

Source: Murphy & Hall 2010
An Alternative Oil Supply Picture

Shale Gas

Shale Gas - Rapid Decline Rates
Barnett Shales USA – Horizontal Wells

Source: IEA 2009
Shale Gas Drilling
- large spatial impact on agriculture & water -
An Alternative Fossil & Nuclear Fuel Supply Picture

Climate & Energy are Inextricably Linked
- global carbon budget to avoid dangerous climate change

From 2011 onwards, we can only afford to burn 30% of existing fossil fuel reserves to have a 50% chance of remaining below 2°C temperature increase (and 2°C is too high)

20% is more realistic

So why are we continuing to explore for fossil fuels?

- and what value should we place on fossil-fuel companies?

“Official” solutions are not working

- Carbon Capture & Storage may make a significant contribution to addressing climate change, but not in the time, or to the extent, required.

- Other clean coal technologies do not achieve the emission reduction required.

- Rush from coal to gas worsens warming.

- New high-carbon infrastructure locks in emissions for next 50 years and eliminates potential solutions.

- Major changes to our energy system will take decades to implement if we rely on conventional reform processes.
Avoiding a 4°C World and managing resource scarcity requires an Emergency Response

– We have less than 3 years to see global emissions peak, then decline rapidly at 5-9% pa.
  • an unprecedented challenge.
– Existing political & corporate processes will not deliver either:
  • required level of technological, social and economic innovation and implementation.
  • in time, or in substance.
– A circuit-breaker is required to move:
  • from incrementalism to rapid transformation.
– There is no alternative to an emergency war-footing approach to speed up the process, akin to:
  • Marshall Plan for re-construction of Europe post-WW2.
  • Apollo Project.
  • Mobilisation of US, UK, German economies pre-WW2.
Australia’s emissions in the global context

Australia will be the 4th or 5th largest carbon emitter in the World, including exports, when the latest estimates of coal & gas expansion are included:

Do we really think this is either sustainable or responsible?

Australia’s oil supply shortfall - an increasing financial burden

A$30-60 billion import bill by 2020

Source: Peak oil & the advent of demand destruction, Zeibots & Bell, Australian Planner, December 2010
The UK’s projected import dependency will increase to 44 per cent of the consumption of oil by 2020. That level of imports has been assessed as having a significant impact on the UK’s oil security ...

Source: J. Blackburn, Australia’s Liquid Fuel Security, NRMA February 2013
Supply Chain Vulnerabilities

Remaining refinery locations in Australia (post Clyde and Kurnell closures)

Figure 9: Fuel supply chain elements and vulnerabilities

Source: J. Blackburn, Australia's Liquid Fuel Security, NRMA February 2013
Figure 1: Imports of Crude Oil (2006-07)

Source: Australian Petroleum Statistics

Figure 2: Imports of Petroleum Products (2006-07)

Source: Australian Petroleum Statistics
Do we have a problem?

Energy White Paper 2012 - “Australia is linked into well-established global supply chains to meet our liquid fuel needs and import dependency itself does not imply an energy security threat.”

Liquid Fuels Vulnerability Assessment 2011 – “Given that there has been no major disruption to liquid fuels supplies in Australia for decades, as well as Australia’s competitive fuel prices by international standards, it would be reasonable to conclude an appropriate balance is being maintained by fuel suppliers.”

Risks - Security ?

Source: J. Blackburn, Australia's Liquid Fuel Security, NRMA February 2013
The in-country stockholdings of oil and refined fuel is in the order of 23 days ...

Supply chain depth in States with no refineries ???
<table>
<thead>
<tr>
<th>DAYS' SUPPLY</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled/frozen goods</td>
<td><img src="image" alt="1" /></td>
<td><img src="image" alt="2" /></td>
<td><img src="image" alt="3" /></td>
<td><img src="image" alt="4" /></td>
<td><img src="image" alt="5" /></td>
<td><img src="image" alt="6" /></td>
<td><img src="image" alt="7" /></td>
<td><img src="image" alt="8" /></td>
<td><img src="image" alt="9" /></td>
</tr>
<tr>
<td>Dry goods</td>
<td><img src="image" alt="1" /></td>
<td><img src="image" alt="2" /></td>
<td><img src="image" alt="3" /></td>
<td><img src="image" alt="4" /></td>
<td><img src="image" alt="5" /></td>
<td><img src="image" alt="6" /></td>
<td><img src="image" alt="7" /></td>
<td><img src="image" alt="8" /></td>
<td><img src="image" alt="9" /></td>
</tr>
<tr>
<td>Hospital pharmacy supplies</td>
<td><img src="image" alt="1" /></td>
<td><img src="image" alt="2" /></td>
<td><img src="image" alt="3" /></td>
<td><img src="image" alt="4" /></td>
<td><img src="image" alt="5" /></td>
<td><img src="image" alt="6" /></td>
<td><img src="image" alt="7" /></td>
<td><img src="image" alt="8" /></td>
<td><img src="image" alt="9" /></td>
</tr>
<tr>
<td>Retail pharmacy supplies</td>
<td><img src="image" alt="1" /></td>
<td><img src="image" alt="2" /></td>
<td><img src="image" alt="3" /></td>
<td><img src="image" alt="4" /></td>
<td><img src="image" alt="5" /></td>
<td><img src="image" alt="6" /></td>
<td><img src="image" alt="7" /></td>
<td><img src="image" alt="8" /></td>
<td><img src="image" alt="9" /></td>
</tr>
<tr>
<td>Petrol stations</td>
<td><img src="image" alt="1" /></td>
<td><img src="image" alt="2" /></td>
<td><img src="image" alt="3" /></td>
<td><img src="image" alt="4" /></td>
<td><img src="image" alt="5" /></td>
<td><img src="image" alt="6" /></td>
<td><img src="image" alt="7" /></td>
<td><img src="image" alt="8" /></td>
<td><img src="image" alt="9" /></td>
</tr>
</tbody>
</table>

Figure 3: Australia's estimated stockholdings at point of sale

Source: J. Blackburn, Australia's Liquid Fuel Security, NRMA February 2013
The recent findings of a Japanese Government panel reviewing the Fukushima nuclear disaster, which followed the devastating tsunami that struck Japan in 2011, are worth reflecting on:

“... The utility and regulatory bodies were overly confident that events beyond the scope of their assumptions would not occur ... and were not aware that measures to avoid the worst situation were actually full of holes.”

Our society is about a month deep … and getting shallower
Climate Change
- must be our primary concern

• Maximum temperature increase target < 1.5°C, not 2°C
• Early introduction of:
  – Carbon pricing, leading to clean emissions trading
    • without escape clauses and with minimal compensation
    • revenue recycling to community and low-carbon innovation
  – Regulatory measures to accelerate innovation
  – Personal carbon trading
• Remove fossil-fuel subsidies
• Major support for biosequestration, soil carbon, reforestation
• Continued objective research into Carbon Capture & Storage (CCS)
  – But not as the “silver bullet”
• Retain our options – no more high-carbon projects
  – Export or domestic
  – Unless CCS in place – “carbon-ready” is a nonsense
• Stringent vehicle & aircraft emission standards
• Geoengineering is probably inevitable
  – Initially to slow and reverse Arctic ice-sheet melt
Energy
- policy must be dictated by climate requirements

• Energy efficiency & conservation
• Full range of renewables
• Serious consideration of new-generation nuclear
• Careful development of:
  – biofuels, avoiding food conflict. Particularly algae
  – gas-to-liquids (possibly),
  – coal-to-liquids (unlikely)
• Gas - as a transition fuel only
  – but coal seam gas and shale gas are probably environmentally unacceptable
• Fuel cells
• Prepare contingency oil allocation system
Infrastructure

- Urban re-design
  - using high-density sustainability principles, integrated with efficient public transport
  - De-centralisation of work centres
- Rail becomes major transport mode
  - for high-speed passengers and freight
- Electricity from clean energy becomes dominant energy supply
- Halt to freeway and airport construction
- Air travel will reduce
  - unless quality biofuels emerge
- Localised food production
- Major IT innovation to reduce ecological footprint
  - built around high speed broadband
- Enhanced resource productivity
  - zero-waste design, with waste becoming a major resource
“The times they are a’ changing”
In Summary

The climate & energy challenge is far greater & more urgent than is acknowledged officially

“Official” solutions, and current processes, are not working and will not deliver the required transformation either to the extent, or in the time, required.

Market forces will not deliver without fundamental regulatory change

If we are serious about avoiding catastrophic outcomes, emergency “war-footing” action is essential

“You already know enough. So do I. It is not the knowledge we lack. What is missing is the courage to understand what we know and draw conclusions.”  

Sven Lindquist

Thank you

www.aspo-australia.org.au
www.clubofrome.org
www.safeclimateaustralia.org

itdunlop@ozemail.com.au