Different Transport World by 2020
Rail to the rescue

Long distance commuting by urban rail

Trucks loaded on intermodal trains

Night trains instead of domestic flights

Prepared by Matt Mushalik (MIEAust, CPEng) April 2008  mushalik@tpg.com.au
Contents

(1) Disconnect between oil reserves and annual oil flows
(2) Current crude oil production plateau
(3) Australian oil supply situation
(4) Melting of ice caps
(5) CO2 targets
(6) Future of long distance commuting in capital cities
(7) 10 point program

Summary

The proximity and magnitude of the double challenge imposed by peak oil and global warming require immediate action. The nation needs to abandon business as usual, scale back its carbon based consumer economy instead of growing it and transform the existing infrastructure with energy saving and clean energy producing systems. In order to avoid tipping points the initial time frame for rapid change is the period up to 2020. This means we have to be put on a war footing. A 10 point program should include:

(1) Immediate moratorium on new freeways, airport expansions, car-dependent shopping centers and subdivisions, multi-level car parks and other oil dependent infrastructure
(2) Set aside – by legislation – oil and gas fields for diesel, petrol and CNG supplies to civil works needed to mitigate the impact of peak oil and to de-carbonize our economy
(3) Build up Strategic Oil Reserve; prepare fuel rationing plans
(4) Re-industrialization with a focus on renewable energies and rail transport, in particular urban rail
(5) Bio fuels to run farming machinery, trucks and other vehicles to transport agricultural produce and implements
(6) Develop compressed natural gas (CNG) for buses, trucks, construction and mining machinery
(7) Replacement program for all coal fired power plants; re-tool car factories and suppliers (BEFORE they go out of business after peak oil) to mass-produce components for wind farms, solar power plants and solar water heaters
(8) Drastic power down and energy efficiency. Permanent Earth Hour.
(9) Interstate rail development and electrification; both passenger and freight; replace domestic flights with night trains; coastal shipping for freight
(10) Public education program
(1) The disconnect between oil reserves and annual oil flows

This is an extract from “World’s fragile oil flows from Declining Reserve Base”
http://sydneypeakoil.com/matt/Worlds_Fragile_Oil_Flows_From_Declining_Reserve_Base.pdf
or also here: http://www.theoildrum.com/node/3664

The above graph shows the oil reserve and production history, together with oil production in 2006 (arrows). All data are from the BP Statistical Review.

(a) The recently added Canadian tar sand reserves produce only 1 Mb/d, negligible in comparison to the total global oil production. Prof. Aleklett from ASPO found in a special study that their dependence on natural gas as a source of hydrogen is unsustainable. Climatologist James Hansen warns that emissions from unconventional fuels must be constrained in order to avoid dangerous climate change. The EIA estimated that - leaving aside all environmental concerns - the maximum syncrude production possible by 2030 (in more than twenty years) could be just 3.6 mb/d. The hype about these tar sands lead to reports in the media about Canada becoming another Saudi Arabia. That is wishful thinking. BP shows responsibility by reporting tar sand reserves separate from conventional oil.

1 Canada’s Oil Sands Resources and Its Future Impact on Global Oil Supply
http://www.peakoil.net/uhdsg/OilSandCanada.pdf
2 Implications of “peak oil” for atmospheric CO2 and climate http://arxiv.org/abs/0704.2782
(b) OPEC's overstated reserves from the so-called quota wars, which have to be re-classified as resources, are shown to produce no oil. In a very simplified procedure, the yellow shaded area on the graph has been calculated as the difference between BP's reserves and a rounded 400 Gb, the approximate reserves in 1983/84, before the spurious reserve additions. In view of the uncertainties, it would be purely academic to be more accurate than this.

The problem with OPEC's reserves has indirectly been confirmed by Ex-Saudi Aramco Vice President Sadad-Al-Husseini who presented the following slide at an oil and money conference in London, in October 2007:

"Reserves" are inflated with >300 B bbls of "resources"

For many attending the conference, the distinction between reserves and resources must have been quite technical because the media did not take notice of this hidden warning. In fact, the point was almost lost as Sadad also showed his own projection of oil production as a 15 year long oil production plateau so no one seemed to have worried too much. Both oil geologist Colin Campbell and Dr. Bakhtiari calculated declining oil production up to 2020, using the same reserve figure of 900 Gb.

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ASPO newsletter March 2007. Irish oil geologist Colin Campbell writes:

"Prices fell as production from other areas, including the North Sea, rose during the 1980s, and the OPEC countries found themselves facing low revenues and competing with each other for production quota which was based largely on reported reserves. Kuwait had been consistently reporting reserves as originally determined by Gulf and BP, but in 1985 announced a massive increase from 64 to 90 Gb (billion barrels), although nothing particular had happened in the oil fields. Having already produced 22 Gb, this was close to the sum of past production and remaining reserves.

2 years later it added further 2 Gb, which exhausted the patience of its neighbours, causing Abu Dhabi to match Kuwait, reporting the same 92 Gb (up from 31 Gb), for Iran to go one better at 93 Gb (up from 49 Gb) and Iraq to cap both with a rounded 100 Gb (up from 47 Gb). Saudi Arabia could not match Kuwait because it was already reporting more, but 2 years later announced a massive increase from 170 Gb to 258 Gb, probably following Kuwait’s example of reporting the total found, not the remaining reserves. Abu Dhabi continues to report the same 92 Gb, despite 11 Gb of subsequent production, and the reports of the other countries are barely changed. Accordingly, little credence can be placed on these reserve estimates, with as much as 300 Gb being in doubt."

http://www.aspo-ireland.org/contentFiles/newsletterPDFs/newsletter75_200703.pdf

(c) 3 countries, Libya, Nigeria and Venezuela, with around 160 Gb reserves deplete at a low 1.7% pa and contribute 9% of global production. Venezuela’s low depletion rate results from reserves containing heavy oil

(d) 130 Gb from countries of the former Soviet Union deplete at 3.3% which is average, to contribute 15% of global oil flows

(e) 6 Middle East countries (Iran, Iraq, Kuwait, Qatar, Saudi Arabia, United Arab Emirates) produce only a very low 2.2% pa of their reserves of around 400 Gb. It represents 30% of the total global production. It is unclear whether, apart from the problem mentioned in (b), these reserves have been adjusted for production or into which reserve category they fall. The low production rates indicate that even the reduced, remaining reserves may be too high or contain more of the probable and possible categories difficult to prove up. Sour oil is also a problem.

(e) Around 120 Gb of reserves from countries like the US, Canada (conventional), China, Mexico, Norway, Oman, Indonesia, Malaysia, Australia, UK and others are in decline, despite reserve growth in fields, and deplete at a whopping rate of 8.2%, almost 4 times the OPEC rate.
Here are some examples in this group of countries:

The endgame of offshore oil in UK

![Graph showing UK offshore oil production](http://www.og.dti.gov.uk/pprs/full_production.htm)

The depletion level in the US

![Cumulative Plot for US Oil](http://www.aspousa.org/proceedings/houston/presentations/Talk%20for%20ASPO%20from%20Dave%20Rutledge.pdf)

(f) Another 70 Gb from Algeria, Brazil, Angola, Sudan, India, Ecuador and Vietnam have been growing but could just offset decline in the (e) group. Reserves deplete at 5.3 %

The last 2 groups together, with only 190 Gb reserves, contribute almost half of the global production although their reserve share of the total is just around
20%. These reserves have remained at the same level for 7 years now, that is reserve growth in some countries has just offset reserve depletion in other countries.

The annual oil production coming from these reserves has been falling for 4 years and the decline rate is now -0.9% pa.

The combined depletion rate of 7.1 % pa means that these countries will exhaust their reserves very quickly and the global oil supply system will increasingly become dependent on a rather small number of countries sitting on 80% of the remaining reserves. Since their production rates in % of reserves are very low, the current level of global oil supplies cannot be maintained.
(2) The current crude oil production plateau

This is an extract from: “Bumpy Crude Oil Production in the Rear View Mirror”
http://sydneypeakoil.com/matt/Crude_Oil_In_Rear_Mirror.pdf

or here: Bumpy Crude Oil Plateau in the Rear View Mirror
http://www.theoildrum.com/node/3793

Incremental production profiles of various countries or groups of countries are stacked in such a way that it gives us information about production trends. Incremental production in a given country and period is defined as the production exceeding the minimum production in that period.

The following graph shows these incremental production profiles individually:

<table>
<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Iraq with production drops during and after the Iraq war</td>
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<tr>
<td>Venezuela on a steady decline and a big drop during the strike in 2003</td>
</tr>
<tr>
<td>Growing countries Brazil, Algeria and Libya</td>
</tr>
<tr>
<td>Russia and FSU maxing out</td>
</tr>
<tr>
<td>Saudi Arabia boosting production during the Iraq war and in 2004 but then not being able to maintain production levels in 2006/07</td>
</tr>
<tr>
<td>A group of countries including UAE and Kuwait starting to peak end 2006</td>
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<tr>
<td>Countries which peaked in 2005</td>
</tr>
<tr>
<td>The North Sea in terminal decline</td>
</tr>
<tr>
<td>A post peak group in terminal decline</td>
</tr>
<tr>
<td>The US on a declining path since its peak in 1971, showing production drops during hurricane seasons</td>
</tr>
</tbody>
</table>
To get a better overview of the underlying trends further groups are formed:

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Iraq and Venezuela shown separately with their big production drops in 2003</td>
</tr>
<tr>
<td>(b) the growth wedge (+ 8 MMb/d) showing clear signs that Russia plus some other hitherto growing countries are maxing out</td>
</tr>
<tr>
<td>(c) the late 2005 peak group dominated by Saudi Arabia, Kuwait and UAE but with a rebound in 2007, again mainly from SA. Production went up by a whopping 6 MMb/d in just 3 years from a low in 2002. But when comparing 2001 to 2007, the production level is just 2 MMb/d higher now.</td>
</tr>
<tr>
<td>(d) the decline wedge (US, North Sea, others post peak). This group’s incremental production went down from 6 MMb/d in 2001 to 2 MMb/d in 2007.</td>
</tr>
</tbody>
</table>

Note: base production not shown

These groups can now be stacked in 2 different ways to give us different information

(a) Starting with declining countries

From bottom to top: declining group, peaking group and growing group. Iraq and Venezuela are put on top as their one-off production drops in 2003 distort the picture if stacked somewhere in between. They are represented over-proportionately in the graph as the definition of incremental production results in a low base production and a high incremental component for these 2 countries.

The graph on the next page clearly shows an underlying peak in 2005 formed by the declining and peaking group, as indicated by the trend lines.
The growing group of countries was able to offset the declining trend after the peak and lift total crude production to an only slightly declining trend.

White and black crosses mark the points used for the declining trend lines. Increasing trend lines have been inserted by eyeballing the growth between a low in 2002 and up to a maximum in May 2005.

(b) Starting with growing countries
In a different view of the same data, production profiles from growing countries are stacked at the bottom and Saudi Arabia on top. The graph clearly shows that Russia, the former FSU and
Brazil have maxed out and that Saudi Arabia is no longer performing its function as swing producer.

In conclusion: The current crude oil production plateau is bounded by 2 underlying peaks. The plateau starts with the peak as shown in Fig 1c and will end when the peak of hitherto growing countries is established according to Fig 1d.
Other fuels can replace oil only partially

An energy double whammy: simultaneous coal phase out and oil decline
Australian crude oil imports come from diverse sources but net oil exports from the 4 main suppliers have already peaked.

Australian petroleum imports are unsustainable; high dependence on Singapore refineries, which are supplied from the Middle East.
(4) Melting of ice caps

This chapter is to show that we should abandon any dreams of electric or hydrogen cars with the primary energy coming from coal fired power plants. It also highlights issues in chapter 7.

1 year ago, ABC TV had this interview with NASA climatologist James Hansen:

KERRY O'BRIEN: What is the most recent evidence of what's really going on with the ice caps, the Arctic and the Antarctic?

JAMES HANSEN: There are two things that are cause of concern. First of all, if we look at the history of the Earth, we know that at the warmest interglacial periods, which were probably less than 1 degree Celsius warmer than today, it was still basically the same planet. Sea level was perhaps a few metres higher. But if we go back to the time when the Earth was two or three degrees Celsius warmer, that's about three million years ago, sea level was about 25 metres higher, so that tells us we had better keep additional warming less than about one degree. And the other piece of evidence is not from the history of the Earth but from looking at the ice sheets themselves, and what we see is that the disintegration of ice sheets is a wet process and it can proceed quite rapidly. We see that the ice streams have doubled in their speed on Greenland in the last few years and even more concern is west Antarctica because it's now losing mass at about the same rate as Greenland, and west Antarctica, the ice sheet is sitting on rock that is below sea level. So it is potentially much more in danger of collapsing and so we have both the evidence on the ice sheets and from the history of the Earth and it tells us that we're pretty close to a tipping point, so we've got to be very concerned about the ice sheets.

KERRY O'BRIEN: You said just a couple of weeks ago that there should be a moratorium on building coal fired power plants until the technology to capture and sequester carbon dioxide emissions is available. But you must know that that's politically unacceptable in many countries China, America, Australia for that matter, because of coal industry jobs and impact on the economy.

JAMES HANSEN: Well, it's going to be realised within the next 10 years or so that we have no choice. We're going to have to bulldoze the old style coal fired power plants.....

http://www.abc.net.au/7.30/content/2007/s1870955.htm

Hardly 6 months later, after a hearing in the Iowa coal case, this time frame has come down to “next several years”

"...... What's become clear, with global climate, is that the only way we are going to keep the climate within a reasonable range is if we phase out the use of coal except where we capture the CO2 and sequester it. Because most of the carbon dioxide in the fossil fuels is in coal. So we could solve the problem, it would be 80% of the solution, but it does require that we have a moratorium on any new coal fired power plants. And over the next 25-30 years we are going to have to phase out those that exist. And this is going to become very clear within the next several years. So it is just plain silly to build a new one now because you are not going to be able to grandfather these in and say: oh we have got it so we can keep it. It's not going to work that way. Once the government really understands how serious the problem is these plants are going to have to go. So it just makes no sense to make another one now."  

http://www.youtube.com/watch?v=gMDS5kEA2ZM

The same applies of course to new facilities like the 3rd coal loader in Newcastle
What prompted this increased urgency?

**The disappearance of Arctic summer sea ice has now become a major issue**

Already in the 1990s, sea ice volume was reduced by a shocking 40% and the public was not told. A report from the year 1999:

http://psc.apl.washington.edu/thinning/thinning.html

Quote: "In summary, ice draft in the 1990s is over a meter thinner than two to four decades earlier. The mean draft has decreased from over 3 m to under 2 m, and volume is down by some 40%. The thinning is remarkable in that it has occurred in a major portion of the perennially ice-covered Arctic Ocean. This is not a case of thicker ice appearing in one region simultaneously with thinner ice appearing in another, induced perhaps by a change in surface winds and ice advection" (graph Grl99fig4.gif) attached.

The sea ice extent is shown here


Scroll down to the middle of the page to:

**Figure 4: Disappearance of old ice, 1982–2007**

"Results from this study reveal the area of oldest ice (i.e., ice older than four years) is decreasing in the Arctic Ocean, and being replaced by younger, and therefore, thinner ice. The region of the oldest (and thus thickest) ice is now confined to a relatively small area north of the Canadian Archipelago. Replenishment of old, thick ice is essential to the maintenance and stability of the Arctic summer ice cover, since thinner ice requires less energy to completely melt out in summer than thicker ice."

The following study found that if current trends continue, the Arctic sea ice will have disappeared by 2013:

![Modeled Sea Ice Area, Thickness, and Volume](http://www.ametsoc.org/atmospolicy/documents/May032006_Dr.WieslawMaslowski.pdf)

Causes of Changes in Arctic Sea Ice; by Wieslaw Maslowski (Naval Postgraduate School)

For illustration of how quickly ice can become instable, watch how fast an iceberg can roll over and then disintegrate if stresses in and loadings on the ice change

[http://www.youtube.com/watch?v=HLL40eShmGw](http://www.youtube.com/watch?v=HLL40eShmGw)

Greenland Ice Sheet - melt water
[http://www.youtube.com/watch?v=IfT7TB7miBMI](http://www.youtube.com/watch?v=IfT7TB7miBMI)
Ice sheet collapse
http://www.youtube.com/watch?v=KyE0Fsy-WYI

NASA: Jakobshavn Glacier Retreat Update 2006
http://www.youtube.com/watch?v=zpM4CbiX1og

Polar ice melt 2007
http://www.youtube.com/watch?v=JjHlNA2dql4

The Swiss camp (in Greenland's melt lake area) shown on map_JAV.jpg was established by Konrad Steffen, quote:

Steffen's ground-based instruments and satellite data were showing that the ice under Swiss Camp was accelerating as temperatures rose, flowing at speeds of up to 20 inches a day as ice melted in places where it had once stood solid. Seismographs picked up increasingly frequent ice quakes, as the 5,000-foot-thick ice cap lurched toward the sea. By 2006, Greenland's ice sheet was shedding some 150 gigatons per year—a mass surpassing all the ice in the Alps. "We realized that something was going wrong," Steffen says. "Greenland was coming apart."

http://www.popsci.com/popsci/science/6661e3568cc83110vgnvcm1000004eecbccccdr.html

Latest on the cryosphere: In December 2007, the American Geophysical Union held a conference on climate change in San Francisco. The Federal government should acquire the full set of transcripts and study them carefully. Then hopefully it wall dawn on departments what is at stake.

Session Information AGU 2007 Fall Meeting Cryosphere
http://www.agu.org/cgi-bin/sessions5?meeting=fm07&sec=C

Here are just 2 extracts:
C21C-07 Arctic sea ice melt in summer 2007: Surface and bottom ice ablation
http://www.agu.org/meetings/fm07/fm07-sessions/fm07_C21C.html
Perovich, D K (donald.k.perovich@erdc.usace.army.mil), ERDC-CRREL

**Bottom ablation in the Beaufort Sea was extreme, ranging from 0.6 m to 1.2 m. At one site (75 N, 141 W), ice that was 3.2 m thick in May, had completely melted by the end of August, with a 8:5 ratio of bottom to surface melting. There was an anomalously large amount of bottom ablation for this region, requiring an average ocean heat flux of approximately 70 W m-2 from mid-June through August. These observations suggest that the ocean heat flux played a significant role in the dramatic reduction of the 2007 summer sea ice extent in the Beaufort Sea region.**

C11B-0421 Arctic Sea-Ice Freeboard Heights and Estimated Ice Thicknesses from ICES at: Seasonal and Interannual Variations (2003-2007)
http://www.agu.org/meetings/fm07/fm07-sessions/fm07_C11B.html
Zwally, H J (zwally@icesat2.gsfc.nasa.gov), Cryospheric Sciences Branch

**The mean thickness and ice volume in the fall appears to be decreasing, while the mean thickness in the winter has had significant interannual variability. In 2004, a significant decrease of thicker ice occurred in the classic region of thicker ice north of Canada and**
Greenland, followed by some regrowth in 2005, and then by decreases of the thicker ice in 2006 and 2007. Compared to the typical ice thickness distributions typical of the Arctic Ocean in 1980-1990’s, there appears to have been a fundamental loss of much of the thicker 3 to 5 m ice in recent years.

After the last Northern winter, the latest assessment of what is happening with the Arctic sea ice can be found here: “As the winter extent numbers indicate, new ice growth was strong over the winter. Nevertheless, this new ice is probably fairly thin. Thin ice is vulnerable to melting away during summer. Figures 4 and 5 indicate that relatively thin, first-year ice now covers 72% of the Arctic Basin, including the region around the North Pole; in 2007, that number was 59%. Usually, only 30% of first-year ice formed during the winter survives the summer melt season; in 2007, only 13% survived. Even if more first-year ice survives than normal, the September minimum extent this year will likely be extremely low.”

http://nsidc.org/arcticseainews/

We can expect a major climate change on the northern hemisphere in the next years.
In West Antarctica dramatic events happen as the Wilkins ice shelf starts to disintegrate.

Ice shelves do not cause sea level rises, but they bring about a positive feedback loop for warming ocean waters around Antarctica as sunlight is no longer reflected by the ice surface but absorbed by the ocean. Once the whole ice shelf is gone the ice sheet itself is exposed and will flow faster into the ocean, resulting in immediate sea level rises.

http://nsidc.org/
Watch how fast ice disintegrates when loadings on and stresses in the ice change.

The alarming warming in Westantarctica can best be seen on this graph.

(5) CO2 stabilization targets

Flowing from the research as presented in chapter (4), James Hansen has revised CO2 targets

**Assessment of Target CO2**

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Target CO2 (ppm)</th>
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<tbody>
<tr>
<td>1. Arctic Sea Ice</td>
<td>300-325</td>
</tr>
<tr>
<td>2. Ice Sheets/Sea Level</td>
<td>300-350</td>
</tr>
<tr>
<td>3. Shifting Climatic Zones</td>
<td>300-350</td>
</tr>
<tr>
<td>4. Alpine Water Supplies</td>
<td>300-350</td>
</tr>
<tr>
<td>5. Avoid Ocean Acidification</td>
<td>300-350</td>
</tr>
</tbody>
</table>

→ *Initial Target CO2 = 350* ppm

*assumes CH₄, O₃, Black Soot decrease

http://www.columbia.edu/~jeh1/RoyalCollPhysms_Jan08.pdf

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We are now in emissions overshoot mode for 20 years. It means we not only have to reduce CO2 emissions but we also have to extract CO2 from the atmosphere.

(6) Future of long distance commuting in Capital cities

The end of long distance commuting by car at the end of the next decade can be estimated in this calculation:

### Availability of fuels in 2020


Past and future oil production from the Energy Watch Group. Peak in 2006

Assume a 30% reduction in annual oil production by 2020.

Not everyone can save 30%. Many important transports (e.g. for food supplies) and other essential services must be maintained. Rural areas and regional towns have no alternative transport.

So who will have to save? And who can save? It’s the motorists in capital cities which have to organize public transport.

Assume technical feasibility to adjust petrol/diesel mix at refineries

<table>
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<th>2006</th>
<th>Changes</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mill. litres</td>
<td>Remaining for Capital cities</td>
<td>mill. litres</td>
</tr>
<tr>
<td>Passenger vehicles in Capital cities</td>
<td>10,699</td>
<td>Remaining for Capital cities</td>
<td>2,031</td>
</tr>
<tr>
<td>Passenger vehicles other areas</td>
<td>7,131</td>
<td>Cannot save &gt;&gt;</td>
<td>7,131</td>
</tr>
<tr>
<td>Other vehicles</td>
<td>11,067</td>
<td>Cannot save &gt;&gt;</td>
<td>11,067</td>
</tr>
<tr>
<td>Total</td>
<td>28,898</td>
<td>70% x 28,898 &gt;&gt;</td>
<td>20,229</td>
</tr>
</tbody>
</table>

Conclusion: by 2020 Capital city motorists have only 1/5th of current fuel supplies if we want all other transports to continue as usual!!!

No transition to other engine technologies or fuels can achieve this much in this short time. Transport must become more efficient by an order of magnitude to offset decline in the availability of energy. Only electric rail can do that

^ Transperth electric train on freeway. Picture book design at Whitfords >> Bus terminus on top of station, kiss&ride loop, park&ride nearby. Ideal for carpooling and a train trip to the city.

Annual consumption data from: ABS 9208.0 Survey of Motor Vehicle Use, October 2006

<table>
<thead>
<tr>
<th>Events/impacts/problems</th>
<th>10 point program</th>
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<tbody>
<tr>
<td>Global oil shortages around 2010. OPEC’s paper barrels may lead to social unrest in</td>
<td>(1) Immediate moratorium on new freeways, airport expansions, car-dependent shopping</td>
</tr>
<tr>
<td>the next decade. Iran (introduced petrol rationing last year) will no longer export</td>
<td>centers and subdivisions, multi-level car parks and other oil dependent infrastructure.</td>
</tr>
<tr>
<td>oil by 2015-2017 due to high local demand</td>
<td>No more business as usual.</td>
</tr>
<tr>
<td>Catch 22: Diesel shortages will delay implementation of essential rail and clean</td>
<td>(2) Set aside – by legislation – oil and gas fields for diesel, petrol and CNG</td>
</tr>
<tr>
<td>energy projects</td>
<td>supplies to civil works needed to mitigate the impact of peak oil and to de-carbonize</td>
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<tr>
<td>Oil crisis will start with intermittent supply disruptions</td>
<td>our economy</td>
</tr>
<tr>
<td>Globalization built on cheap oil will go backwards; bunker oil shortages will limit</td>
<td>(3) Build up Strategic Oil Reserve; prepare fuel rationing plans</td>
</tr>
<tr>
<td>import/export volumes. Peak oil, together with global warming, will trigger clean</td>
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<td>primary energy crisis. End of internal combustion engine which wastes 90% of energy</td>
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<td>as heat.</td>
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<tr>
<td>Bio fuels in competition with food production, limited by GW</td>
<td>(4) Re-industrialization on the basis of renewable energies; abandon unrealistic</td>
</tr>
<tr>
<td>Other alternative fuels</td>
<td>car dreams; electrification of land transport system is required which must be more</td>
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<tr>
<td>Disappearance of Arctic summer sea ice (abrupt climate change on Northern</td>
<td>efficient by an order of magnitude; urban rail on all free-</td>
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<tr>
<td>hemisphere ??) and collapse of ice shelves and ice sheets in West Antarctica in the</td>
<td>ways (Transperth) and major roads; all genuinely renewable energies produce</td>
</tr>
<tr>
<td>next years will force us to abandon coal without geo-sequestration of CO2</td>
<td>electricity, not fuels; time is now running out for these solutions; too late for</td>
</tr>
<tr>
<td>Power shortages unavoidable</td>
<td>large scale rail tunnel projects</td>
</tr>
<tr>
<td>Airlines will come into financial problems</td>
<td>(5) Bio fuels to run farming machinery, trucks and other vehicles to transport</td>
</tr>
<tr>
<td>Public largely unaware of the physics of the coming oil and energy crisis. Political</td>
<td>agricultural produce and implements</td>
</tr>
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<td>system and corporate sector in denial mode and unable to grasp magnitude and urgency</td>
<td></td>
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<tr>
<td>of problem. Society lives on too many untested assumptions about future.</td>
<td></td>
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<tr>
<td>Public education program; participation of public is absolutely essential. Nation</td>
<td>(6) Develop compressed natural gas (CNG) for buses, trucks, construction and mining</td>
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<tr>
<td>needs to be put on a war footing; change of value system is needed. Prepare motorists</td>
<td>machinery</td>
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<td>for car-pooling as this is the only “solution” if a physical oil crisis were to hit</td>
<td></td>
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<td>tomorrow</td>
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