Renewable Energy Technologies: Key to Sustainable Futures

Ian Lowe
Summary

• Energy as the key variable
• ~ 6 kW / person
• Resources
• Environment / Ecology
• Choosing futures
• Do we have the energy?
The fundamental premise

• Future not somewhere we are going, but something we are creating

• Many possible futures

• We should be trying to shape a sustainable future
So we should consider:

- Resource demands
- Environmental impacts
- Social consequences
- Economic impacts of future energy use
Resources

- affected by economics
- affected by technology
- affected by politics
- therefore always relative
- depletion of rich deposits
- no absolute shortage except oil
- economic & environmental costs
Discovery of large oil fields

DISCOVERY IN GIANT FIELDS 1865 TO 1985
5 year moving average

Billion barrels

Cumulative Reserves billion barrels

Years


Note: Cumulative Reserves attributed to discovery year
Giant Field > 500 billion barrels reserve

Resources

• Coal - for > 1000 years
• Gas - for ~ 100 years
• Oil - peak ~ 5 years
• Solar ~ 10,000 x energy use
Earth is overheating

Australia's temperatures have increased

Source: Bureau of Meteorology, 2004

Trend in mean temperature
1910-2002 (°C/100 yrs)
Global warming is affecting Australia today

Trend in annual total rainfall 1950 – 2003 (mm/10 yrs)

Source: Bureau of Meteorology, 2004
Carbon dioxide concentrations in the atmosphere are at a higher level than for 400,000 years.

Source: Co-operative Research Centre for Greenhouse Accounting, 2001
Projected global warming

Scenarios
- A1B
- A1T
- A1FI
- A2
- B1
- B2
- IS92a

Several models
all SRES envelope

Model average
all SRES envelope

Bars show the range in 2100 produced by several models
Increased likelihood of non-linear changes

There is established but incomplete evidence that our impacts on ecosystems are increasing the likelihood of non-linear changes … with important consequences for human well-being.

Millennium Assessment Report 2005
An example of non-linear change

Fish landings in tons

Source: Millennium Ecosystem Assessment

Millennium Assessment Report 2005
Possible non-linear changes

- North Atlantic circulation
- Methane from Arctic tundra
- Melting of [polar] ice
- Drying of rainforests
- Clearing and burning of peatlands
Not just a new century!
But a just new century!
Australia’s Emissions (Mt)

Where we are going

What we need to achieve

Business As Usual

Kyoto target

60 - 90% reductions

Source: Adapted from the Australian Greenhouse Gas Inventory and ABARE projections
Sustainable energy future

• Improve efficiency of turning energy into services [transport, cooling, lighting, motive power etc]
• Move away from supply technologies based on problematic resources
• Move away from technologies imposing unacceptable environmental costs
Energy efficiency

• Much current technology...

• Modern car vs 1963, hybrids
• Eco-efficiency: factors of 2 - 4
• Buildings
• Minimum appliance standards
• Hot water & thermodynamics
Renewable resources are enormous!
Some possibilities

- Wind turbines
- Solar hot water
- Solar thermal power
- Solar electricity
- Biomass: wood, crop wastes, sawdust
- Tidal or wave energy
- Geothermal: NZ, Italy, SA, Birdsville
- Hydro-electricity
- OTEC
Wind Energy: Worldwide
Rooftop PV Targets for 2010

Number of Houses in Japan with Rooftop PV

National Targets

Europe   500,000
Japan    1,500,000
USA      1,000,000
Total    3,000,000
Scale of acceptance

- Wind alone now ~ 50,000 MW
- Renewables ~ 25% California’s installed capacity, 32% Sweden’s energy, 53% Norway’s, 73% Iceland’s
- Only feasible sources for developing world
Global growth rates, 1993-2003

<table>
<thead>
<tr>
<th>Source</th>
<th>Rate</th>
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<tbody>
<tr>
<td>Wind</td>
<td>29.7</td>
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<tr>
<td>Solar</td>
<td>21.6</td>
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<tr>
<td>Natural gas</td>
<td>2.2</td>
</tr>
<tr>
<td>Oil</td>
<td>1.3</td>
</tr>
<tr>
<td>Coal</td>
<td>1.0</td>
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<tr>
<td>Nuclear</td>
<td>0.6</td>
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</table>
Is nuclear an option?

- Too expensive
- Too slow
- Scale high – grade resources
- Radioactive waste
- Weapons proliferation
- Few benefits, high costs
- Fusion?
Renewables

• 30% of power would increase cost 10%
• 100% of power at 50% extra cost
  [DRE 1992 report, NERDDC paper no. 2]
• Much shorter timescales
• Greater GHG reductions

• Why would a rational person choose nuclear?
One example: Australia 2040

- Biomass 30 %
- Wind 30 %
- Gas 20 %
- Coal 8 %
- Hydro 8 %
- Solar 4 %
Transport options

- Public transport, rail freight, bicycle
- Other fuels?
- The task
Alternative transport fuels

• Liquid fuels from coal?
  – No technical problem, CO₂

• Oil shales or tar sands?
  – Energy, environment

• Ethanol from fermentables?
  – Energy, environment, ethical issues

• Pyrolysis for methanol?
  – Scale of production

• Electric vehicles?
  – Storage
The hydrogen car?

- Jan. 1999, Shell’s hydrogen filling station [Hamburg]
- BP trialling hydrogen
- Iceland operating hydrogen fuel-cell buses now, then boats, then cars...
- Moving to hydrogen economy within 15-20 years
The hydrogen economy?

- Inevitable?
- Technical issues
- Resources: Gas? Solar? Wind?
- Economic problems
- Environmental implications
  - local
  - global

[one estimate, 60-120 mt/yr released]
### Two new towns compared

<table>
<thead>
<tr>
<th>Mode</th>
<th>Milton Keynes</th>
<th>Almere</th>
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<tbody>
<tr>
<td>Car</td>
<td>59%</td>
<td>35%</td>
</tr>
<tr>
<td>Transit</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td>Bicycle</td>
<td>6%</td>
<td>28%</td>
</tr>
<tr>
<td>Walking</td>
<td>18%</td>
<td>20%</td>
</tr>
<tr>
<td>Trips &lt; 3 km</td>
<td>45%</td>
<td>85%</td>
</tr>
<tr>
<td>Dwellings / Ha</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>

Ian Lowe
WCED view of energy

A safe, environmentally sound and economically viable energy pathway that will sustain human progress into the distant future is clearly imperative. It is also possible. But it will require new dimensions of political will and institutional co-operation to achieve it.

Doing nothing is not an option. Energy is vital. So we need to be planning now for a sustainable future.
Desirable Responses

• Set targets to reduce emissions: 60-90% by 2050, 20% by 2020
• Improve efficiency of energy use, say by 25% by 2012
• Set strong targets for renewables, e.g. 20% by 2020, 50% by 2030
• Price carbon releases by emissions trading [or carbon tax?]
So specific policies:

- Phase out fossil fuel subsidies
- No new coal-fired power
- Gas as transitional fuel
- Commitment to mix of renewables
- Urban planning, public transport
- World’s best practice in efficiency
- Plan for expensive petroleum
- Adaptation strategies
LIVING in the HOTHOUSE
how global warming affects Australia

Ian Lowe

Published by Scribe
Conclusion

• Our decisions shape the future
• Aim: a sustainable future
• Many dimensions: resources, economic, social, environmental, health, cultural, spiritual…
• Crucial role of energy
• Efficiency + Renewables