Managing energy and water: lessons from Europe, the United States and Australia

Dr Karen Hussey
The Australian National University
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Particular individuals:

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• *Ecology and Society* authors
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Presentation

- Policy briefs
- Framing questions
- Overview of climate-energy-water nexus and implications
- Regulation
- Conclusions and recommendations
FRAMING QUESTIONS
Do we know where links between energy and water exist?

Where are the synergies? Trade-offs?

Which links should be addressed as a priority?

What is the appropriate role for government (federal, state, local) in responding to energy’s water demand? Business?

What would a strategic plan for integrated energy-water research look like?

Is there a role for the UNFCCC to acknowledge the potential risks from climate change policies for freshwater resources?
OVERVIEW OF THE CLIMATE-ENERGY-WATER NEXUS
Why do we care, and why now?

- Increasing demand, vulnerability and integration of energy sector
- Water and energy are most important inputs to modern economies
- Links to food security
- Massive infrastructure expenditure and restructuring taking place now: expensive, irreversible, urgent
- History of myopic policy-making
- Knowledge and technologies are largely available – economics and stupidity are the challenge
## Water demands of the energy sector

### Electric Power / Energy

<table>
<thead>
<tr>
<th>Value chain segment</th>
<th>Raw material production</th>
<th>Suppliers</th>
<th>Direct operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraction and refining of oil, natural gas and coal</td>
<td>Suppliers of power generation equipment</td>
<td>Power generation; Power distribution; Maintenance</td>
<td></td>
</tr>
</tbody>
</table>

**Intensity**

- **Withdrawal**
  - **Description**: Water used for steam and water flooding of reservoirs, steam for oil extraction, cooling and steam generation for refining processes,
  - **Intensity**: High
  - **Suppliers**: Cooling water or steam generation in manufacturing facilities
  - **Direct operations**: Water use for cooling, steam generation, flue gas treatment; Hydropower generation requires reliable water flow

- **Discharge**
  - **Description**: Wastewater containing metals and hydrocarbons
  - **Intensity**: High
  - **Suppliers**: Wastewater containing heavy metals and other potentially toxic chemicals
  - **Direct operations**: Significant thermal discharge impacts on local ecosystems

Source: CERES Water and Climate Change Report, 2009
Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO₂e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0
Australian 2030 carbon abatement cost curve

Cost of abatement
A$/t CO$_2$e

- Reduction below 1990 levels, percent
- Break-even point

Industry
Buildings
Power
Transport
Forestry
Agriculture

Abatement below business as usual
Mt CO$_2$e

Note: Abatement opportunities are not additive to those of previous years
Source: McKinsey Australia Climate Change Initiative
Four major categories of abatement opportunities

1. Energy efficiency
2. Low-carbon energy supply
3. Terrestrial carbon (forestry and agriculture)
4. Behavioural change

The first three categories represent a total abatement opportunity of 38 GtCO$_2$e per year in 2030 relative to annual BAU emissions of 70 GtCO$_2$e

- Energy supply sector: 29%
- Industrial sector: 16%
- Forestry and agriculture: 33%
### Energy-water links: synergies and trade-offs

<table>
<thead>
<tr>
<th>Win-win</th>
<th>Win-lose</th>
</tr>
</thead>
</table>
| **Good agricultural practice**
Degraded land restoration
**Small and large hydropower***
Solar PV
Demand management measures
**Afforestation***
Population control
Renewable-powered desalination plants |
| **Biofuels***
**Afforestation***
**Nuclear power**
Carbon capture and storage
Solar CSP
Coal-to-gas shifts
**Underground thermal energy systems** |
| **Desalination**
**Inter-basin transfers** |
| **Biofuels***
Fossil fuels
Inefficient and outdated technologies
Unmitigated demand |

<table>
<thead>
<tr>
<th>Lose-win</th>
<th>Lose-lose</th>
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<tr>
<td><strong>Energy-Water</strong></td>
<td></td>
</tr>
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<td><strong>Lose-win</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Lose-lose</strong></td>
<td></td>
</tr>
<tr>
<td>Energy trend</td>
<td>Resulting trend in energy water use</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shift from foreign oil to biofuels</td>
<td>Increase water consumption if domestic agricultural irrigation water (and other inputs) is used for fuel production</td>
</tr>
<tr>
<td>Growth in domestic electricity demand</td>
<td>More water used for electricity generation; how much more depends on how the electricity is generated</td>
</tr>
<tr>
<td>Shift to renewable electricity</td>
<td>Concentrating solar power technologies can use more water than coal or natural gas; these solar facilities are likely to be located in water-constrained regions. Technologies are available to reduce this water use. Solar PVCs and wind, use little water.</td>
</tr>
<tr>
<td>Use of carbon mitigation measures</td>
<td>CCS may double water consumption for fossil fuel electricity generation</td>
</tr>
</tbody>
</table>

N. Carter, Congressional Research Service, Nov 2010
REGULATION
Daimler: high proportion of energy consumption in the production of Diesel engines lay in the metal processing work required in the production of wheel-carrier assemblies

By altering the process of metalwork from one which required lubricants (oils) and coolants (water), to dry metal processing, the company was able to reduce its CO2 emissions by 80% in that part of the product cycle

It also reduced its water consumption by 900 tons per year but that was an added bonus rather than an intentional objective
An increase in miles driven and the increasing water intensity of fuels, as a result of biofuels (from irrigation feedstock), overwhelms the water gains from improving vehicle fuel efficiency. Water intensity of those vehicles will increase from 40 gallons/100 miles, to over 90 gallons/100 miles. (University of Texas, Austin)
CONCLUSIONS AND RECOMMENDATIONS
Conclusions

Water shortages are here to stay.
Climate change, population growth and socio-economic changes are drivers
The climate-energy-water nexus needs to be considered in terms of decisions for climate mitigation, and in planning for climate adaptation.
Almost all our policies and technologies to deal with increasing demand and CC have a water footprint
Specific energy-water links are usually regionally or context-specific, but the implications of action are global in reach.
Recommendations (see PBs)

As with climate change, we need to consider the energy-water nexus in terms of preventing trade-offs, where possible, and learning how to manage them, where not.

Understand where policies and regulation might have knock-on effects

Start to talk the same language

Address the imbalance between climate change/energy and water

Implement existing processes, policies and approaches

Identify new legislative and administrative options to limit perverse impacts
Role for business?

Individual companies: Royal Dutch Shell, Coca-cola, Nestle, Dow Chemicals...

Collective initiatives:
- CEO Water Mandate (UN Global Compact 2007)
- Water Footprint Network
- World Business Council on Sustainable Development Water Initiative
- Alliance for Water Stewardship
- Water Economic Forum Water Initiative
- Global Environmental Management Initiative