Indirect energy impacts of urban water choices

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Utility energy use is set to grow 300-500% by 2030. If we aim to reduce greenhouse gas emissions 80% by 2050 a 25-fold gap exists between desired and actual pathways.

The water sector has a large indirect influence on total urban energy use (3-6%) estimated.

Urban metabolism principles will help identify solutions and opportunities.
Urban metabolism and water

**a) Present**

**Inputs**
- Imported water
- Rainwater
- Energy
- Materials
- Food

**Outputs**
- Wastewater
- Stormwater
- Biosolids
- Greenhouse gas
- General wastes

**Sustainable direction**

**Urban Water System**

**Recycling**
+ Efficiency

**Information & Knowledge**

**b) Future**

**Inputs**
- Imported water
- Rainwater
- Energy
- Materials
- Food

**Outputs**
- Wastewater
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- Greenhouse gas
- General wastes

**Human wellbeing and ecosystem health**

s.kenway@uq.edu.au 21 September 2009
Energy use in water provision, consumption and “total urban system” for 2006-07

<table>
<thead>
<tr>
<th>City</th>
<th>Water Utility (W)</th>
<th>Residential Hot Water (R)</th>
<th>Urban system (T)</th>
<th>Water utility use as %</th>
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<th>Utility energy use as % of hot water energy use</th>
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<tbody>
<tr>
<td>Sydney</td>
<td>2.7</td>
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Kenway et al 2008 a,b
Energy use in water provision, heating and “total urban system” for 2006-07

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By 2030, with 25% population growth, existing supplies continue, and new sources with 40% or 100% desalination

- 26-36PJ (300 L/cap/d) = 260-400% growth
- 16-21PJ (225 L/cap/d) = 130-200% growth
- 7PJ (150 L/cap/d) = 0% growth

80, 68 or 52 PJ for heating based on 300, 225 or 150 L/cap/d residential use
Why study “indirect” effects or “side-effects” or the “links” between water and energy in urban systems?

1/ Indirect effects are substantial......In California, water-related energy use comprises 19% of State electricity use and 32% of natural gas use (Klein et al 2005).

2/ Indirect effects are difficult to assess..and they keep changing.

3/ Understanding water-energy links in cities will address the root cause, not just the symptom. It will help us solve the problem, not simply move it from one domain to another.
Water-related energy use - a hypothetical city of 1 million


- Direct Energy
- Indirect Energy

- Water use
- Water supply

Urban heat island (cooling energy reduced) (200%)
Urban agriculture (imports offset) (100%)
Carbon loss (not captured) (50%)
Nitrogen loss (resynthesis) (50%)
Non-residential use (50%)
Residential use (hot water) (20%)
Rainwater tank pumps (50%)
Bottled water (50%)
Highrise basement pumps (50%)
Energy use by utilities (10%)
Conclusions and discussion points

- Urban water management can play an integral role in driving down the urban metabolic rate. This opportunity has been overlooked and undervalued.

- There is a wide need to report openly, analyse and discuss indirect impacts, much more than is currently the case.

- By addressing water and energy inefficiencies in the design of our cities, and their water systems, we will find technologies and system-based solutions of high value.
Thanks to WSAA, CSIRO and contributing utilities. Thanks to Paul Lant and Tony Priestley for supervising work. The Urban Water Security Research Alliance for supporting the PhD.
Reference basis