Water System Sustainability

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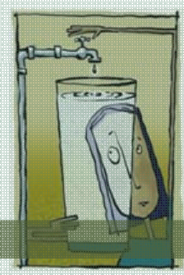

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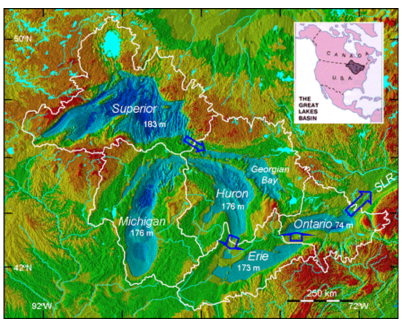
What is sustainability?

- When is blue… green?
- *Per-capita* water use is actually stable or declining
- Importance of appropriate unit of analysis – time and space
- A sustainable water system operates for the long term within an ecologic and economic budget
- The ecological budget is defined in watershed terms
  - Imports
  - Exports
- The economic budget is defined in financial terms
  - Subsidies
  - Transfers
- Sustainability includes both efficiency and conservation practices on the supply and demand sides

Ecological sustainability

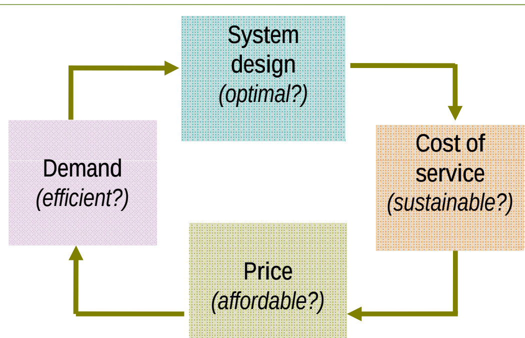


http://sst.rncan.gc.ca/ercc-rrcc/theme1/t9_e.php

Economic sustainability

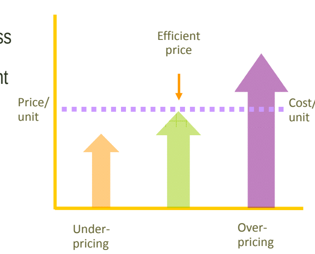
	Expenditures relative to sustainable need (based on ecological, engineering, and fiscal criteria)		
Prices relative to expenditures	*<1 expenditures are too low relative to need ("cost avoidance")*	*= 1 expenditures meet needs*	*➢1 expenditures exceed needs ➢("gold plating")*
<1 prices are below expenditures ("price avoidance")	Failing system	Subsidized system	Budget deficit system
=1 prices are at expenditures	Under-investing system	Sustainable system (ideal)	Over-investing system
>1 prices are above expenditures ("profit seeking")	Revenue diverting system	Surplus generating system	Excessive system

System sustainability



Pricing and resource efficiency

- Efficient prices support efficient resource allocation and use
- Prices too low encourage excess (wasteful) usage, which in turn can lead to too much investment in capacity
  - Under-pricing = subsidy
- Prices too high discourage use and can be harmful to consumers and the economy
  - Over-pricing = transfers
- If affordability is a barrier to full-cost pricing, the only options are subsidy or abandonment



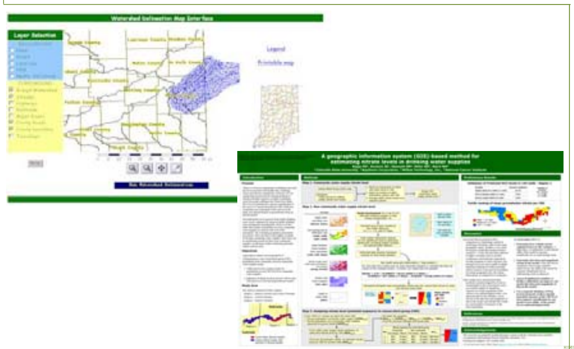
Reasons for the public-private rate disparity

- Profits (return on equity)
- Taxes (all levels)
- Financing (including SRF)
- Subsidies (often hidden)
- Costing (depreciation expense)
- Rate practices (outside rates)
- Charges (system development)
- Investment deferral (by cities)
- Cost differentials (in some cases)
- Economic regulation (cost of service)

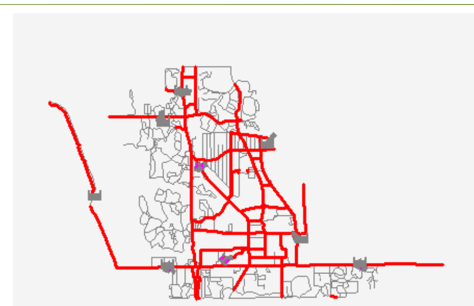
Sustainability practices

- Adopt an inclusive and science-based watershed perspective
- Re-optimize water systems – evolutionary models (genetic algorithms)
- Reduce water supply losses – monitor, analyze, and plug leaks
- Increase operational efficiency – water and energy (motors, off-peak pumping)
- Practice comprehensive and timely asset management
- Allocate costs on the basis of usage and amplify price signals with information
- Conduct water-energy audits – supply and demand
- Reduce uneconomic discretionary use and bottled water
- Promote smart growth, blue-green buildings, and xeriscapes
- Implement low-water and waterless solutions and water reuse
- Explore decentralized solutions – particularly storm-water management
- Install solar and wind energy facilities on water properties
- Cogenerate at wastewater facilities – biofuels and biochar
- Invest in research and development and demonstration projects

Digital watershed planning and remote sensing



Genetic algorithm optimization



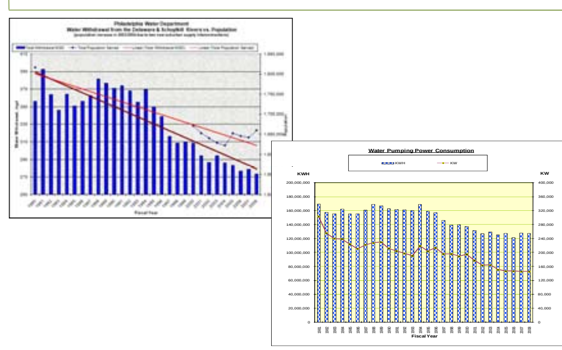
http://www.optimatics.com/opt.htm

Water requires energy

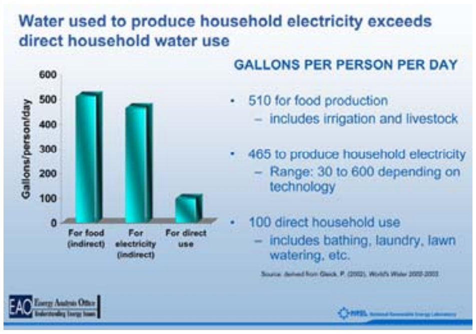
- Water use is highly energy intensive: 2-3% of the world's energy use is related to water (possibly more)
- About 4% of the energy in the U.S. is used to treat, transport, and heat water; as much as 20% in California
- About 15% of home energy use is for heating water
- Energy is a major O&M cost for water (pumping, treatment) – as much as 30% and often second only to labor
- Water systems are large energy storage devices - at any moment energy in water systems equals the amount of electricity used by 1,644 U.S. households in one year (+/- half order of magnitude)
- Water systems should be on smart meters
- Water systems can control energy costs by plugging leaks, pumping off peak, improving motor efficiency, and implementing pressure management
- Reducing water losses is shovel ready and should be a national priority in terms of energy policy
- The water-energy nexus is also gaining global attention

HARNESSING THE WATER ENERGY NEXUS नीरजा

Water system power consumption (Philadelphia)



Energy requires water



Wastewater to energy

Aspen Dialogue on Sustainable Water Infrastructure in the U.S. (2008-2009)

1. "Infrastructure" should be redefined to include the natural environment
2. Watershed-oriented entities should play a management role
3. Federal, state, and local officials should adopt a watershed approach
4. Water utilities should lead in integrated resource planning
5. Governments should reduce barriers to sustainable management
6. Utilities and regulators should ensure that prices reflect true costs
7. Utilities should adopt practices consistent with a sustainable "path"
8. Government aid should help systems build capacity for sustainability
9. Federal funding should target 21st century priorities such as efficiency
10. Utilities and agencies should direct assistance to households in need

Pricing reforms for sustainability (jb)

- Promote cost knowledge and sound accounting
- Use future test years and more frequent rate cases (v. decoupling?)
- Refine forecasting and cost-of-service models
- Price water at the full cost of service (including depreciation expense)
- Design multi-objective rates to promote sustainability, as well as other social goals (intergenerational and other forms of equity)
- Differentiate prices according to water usage ("five products, one pipe")
  - Drinking and cooking
  - Personal and home hygiene
  - Waste removal
  - *Fire protection – price partly based on property value?*
  - *Discretionary/luxury (outdoor) usage – price based on marginal cost?*

Policy reforms (jb)

- Define sustainability in appropriate temporal and geospatial terms
- Adopt meaningful but rational externalities policies at the appropriate level
- Promote regional coordination and organization on a watershed basis
- Manage water, wastewater, and stormwater jointly
- Promote integrative water-energy technologies and practices
- Encourage water system operational efficiency and asset management
- Use subsidies strategically and on a limited basis to avoid price distortion
- Leverage financial assistance to achieve long-term sustainability
- Direct financial assistance to households not water systems in most cases
- Prohibit diversions or transfers of funds collected through water rates

Political reforms (jb)

- Adopt sustainability policies and standards
- Communicate with and engage the public
- Consider a sustainability-based universal service policy for water
- Recognize water's role in energy resource management
- Invest in both economic and environmental regulatory capacity and coordinate jurisdiction and decision-making (intra- and inter-state)
- Expand economic regulatory jurisdiction and (at a minimum) regulate publicly owned water utilities in the absence of local political will to price water correctly