First International Congress on Sustainability Science and Engineering (ICOSSE)

Design Tools For Sustainable Water Transmission and Distribution

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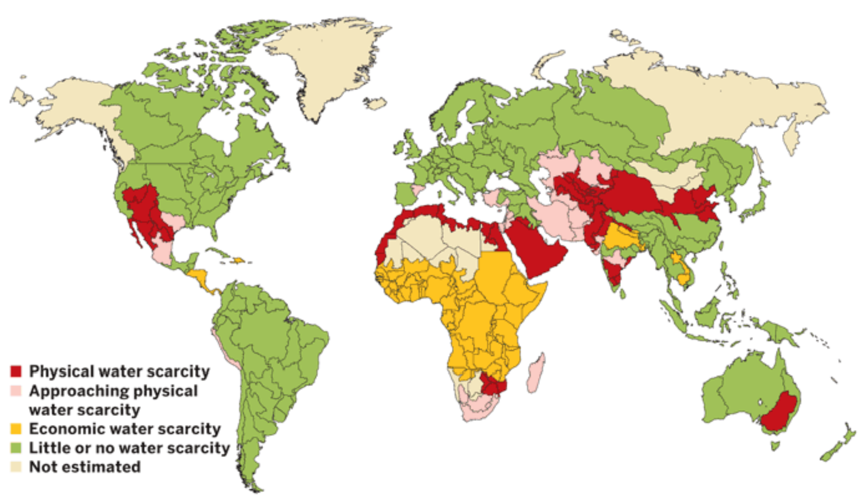
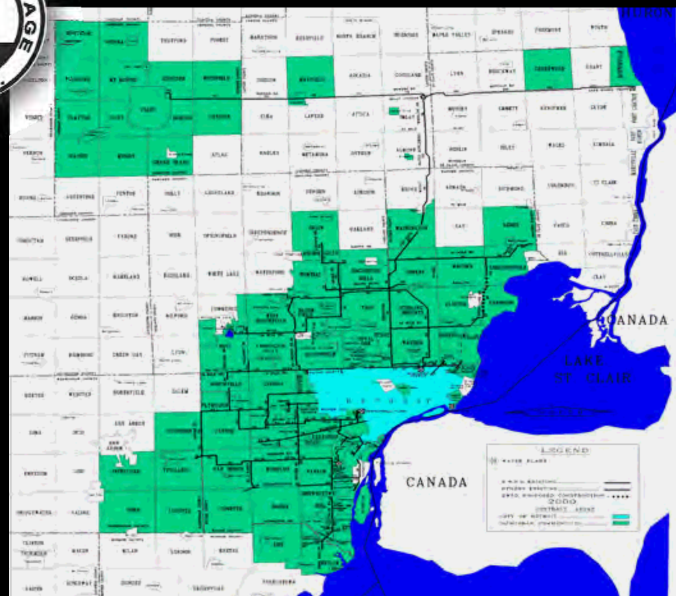
WATERWORLD Areas of physical and economic water scarcity



NOTE: When more than 75% of a region's river flows are withdrawn for agriculture, industry, and domestic purposes, it suffers from physical water scarcity. Economic water scarcity is when human, institutional, and financial capital limit access to water, even where water is available locally. **SOURCE:** Comprehensive Assessment of Water Management in Agriculture, 2007

Energy Management
AWWARF, 2005

Energy use at drinking water utilities represents one of the utilities' largest operating costs, consuming as much as ***35 percent of annual operating budgets****….energy use is expected to increase…with implementation of new treatment processes….*

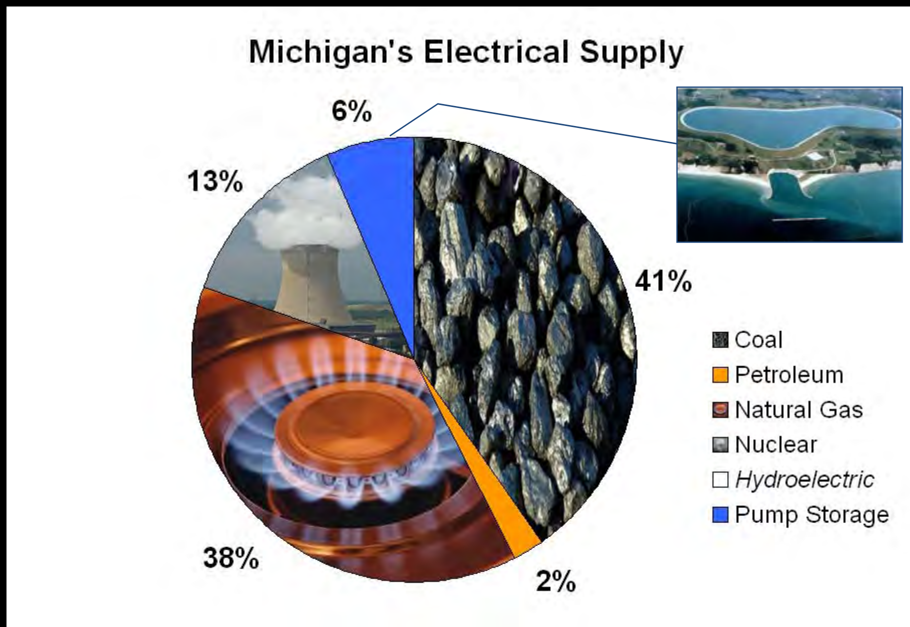


DWSD

Third largest energy customer of DTE

Annual water withdrawal from Lake Huron and Detroit River of 220 billion gallons

~300 Million KW-Hours of electricity annually by high- and low-lift pumps



Contaminant loading to Great Lakes basin

DWSD energy (US DOE, 2002)
- 475 M lbs. carbon dioxide
- 4,400 lbs. methane
- 7,500 lbs. nitrous oxide
- 2 M lbs. sulfur dioxide

Coal-fired electrical plants account:

16 of the top 25 sources of Lake Michigan mercury pollution (Johnson, 2005)

90% of toxic loadings to Great Lakes (GLIN, 2008)

Real-Time System Optimization for Sustainable Water Transmission and Distribution

Tucker, Young, Jackson, Tull, Inc.
Consulting Engineers

Optimization Parameter

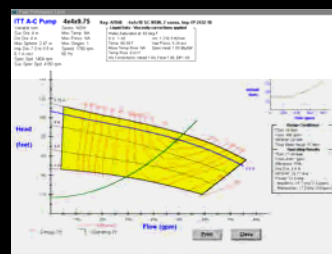
Cost

Energy Consumed

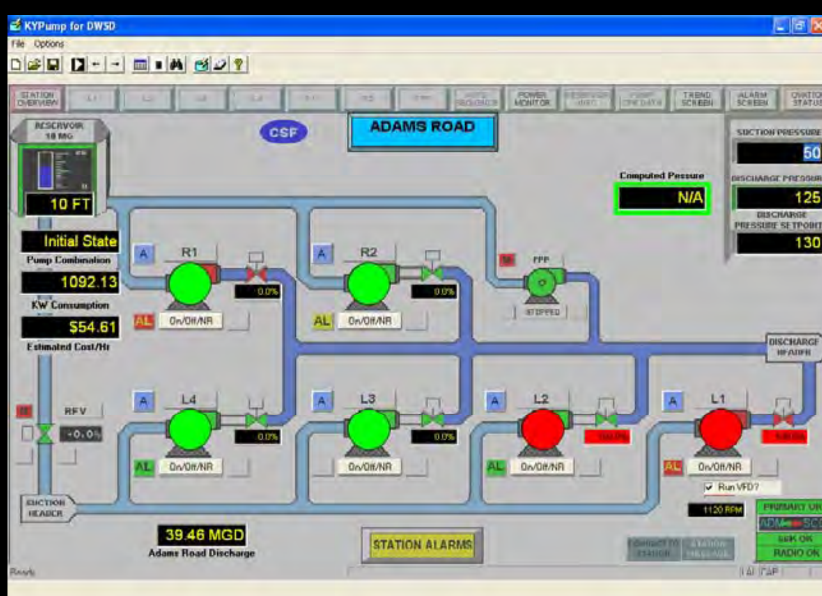
Environmental Benefit

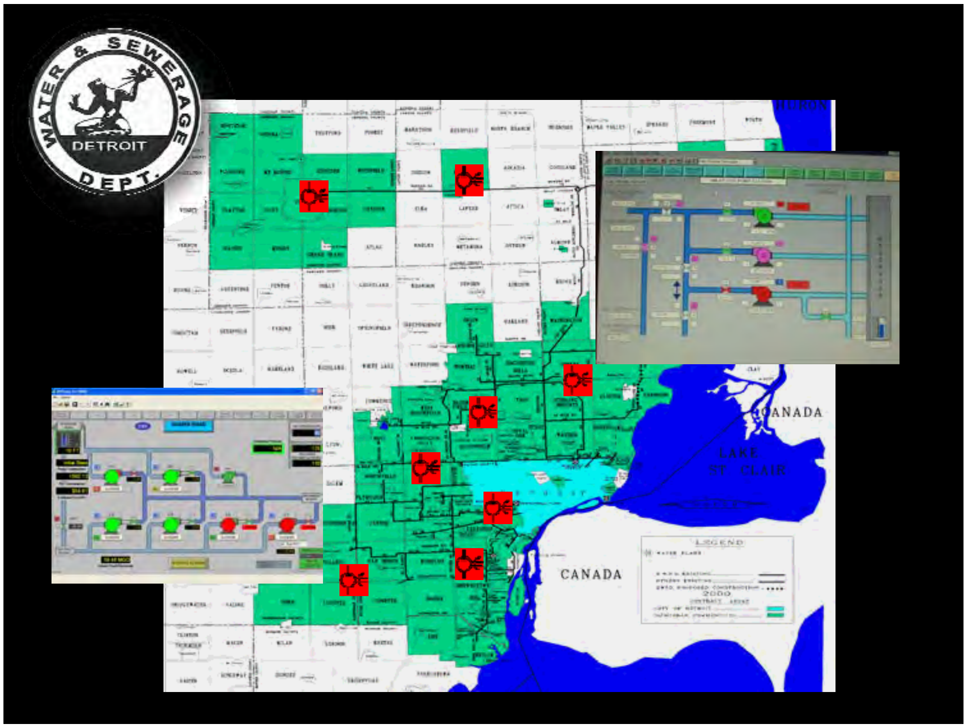
Previous Optimization

- Developed a computer program and guidelines for operators to optimize pump operations

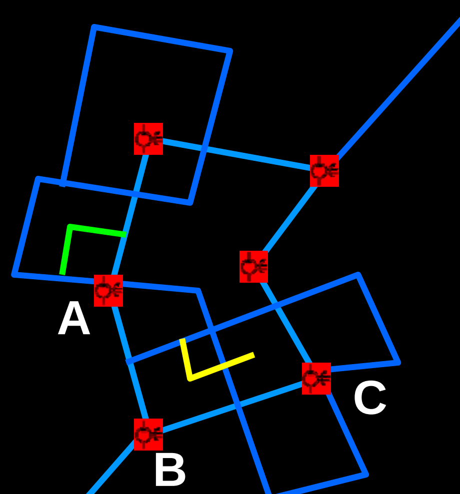


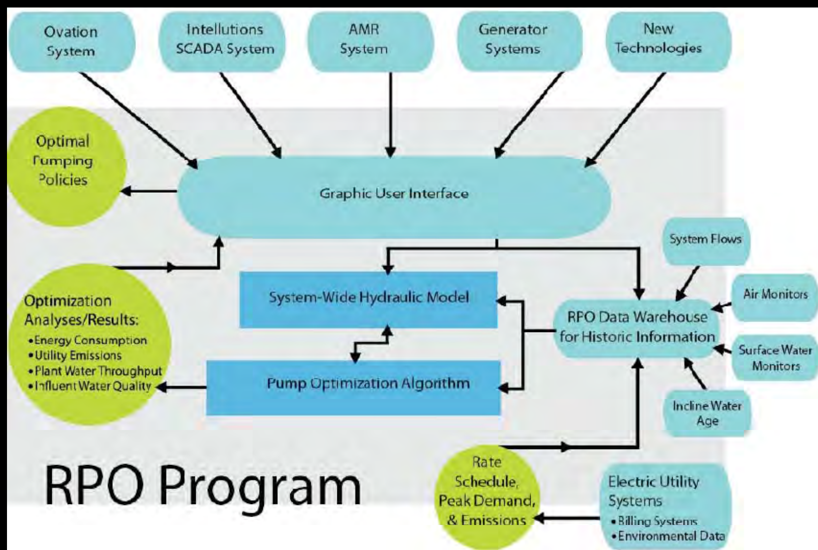
- Provided SCC operators with the ability to minimize energy use by selecting energy efficient pump operations to reliably meet system demands



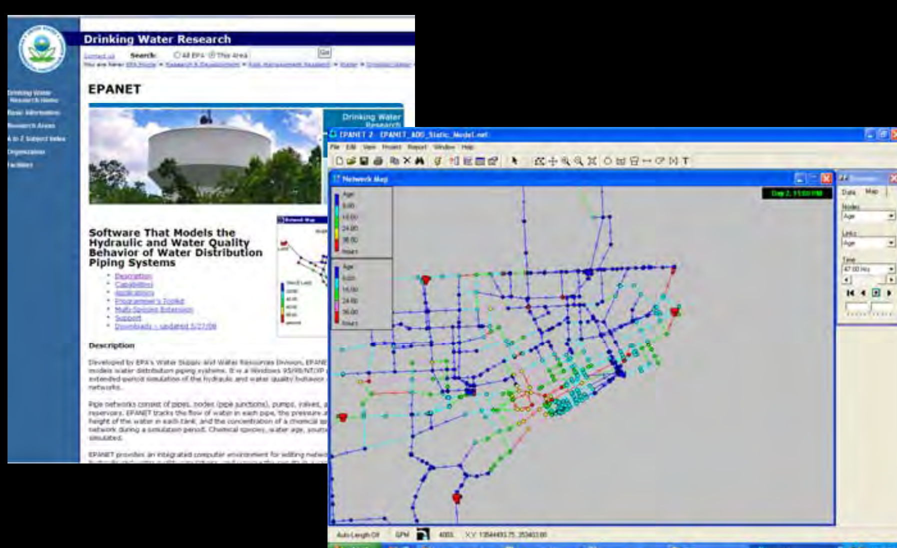


Hypothetical Pumping Network:





Hydraulic Model: EPAnet

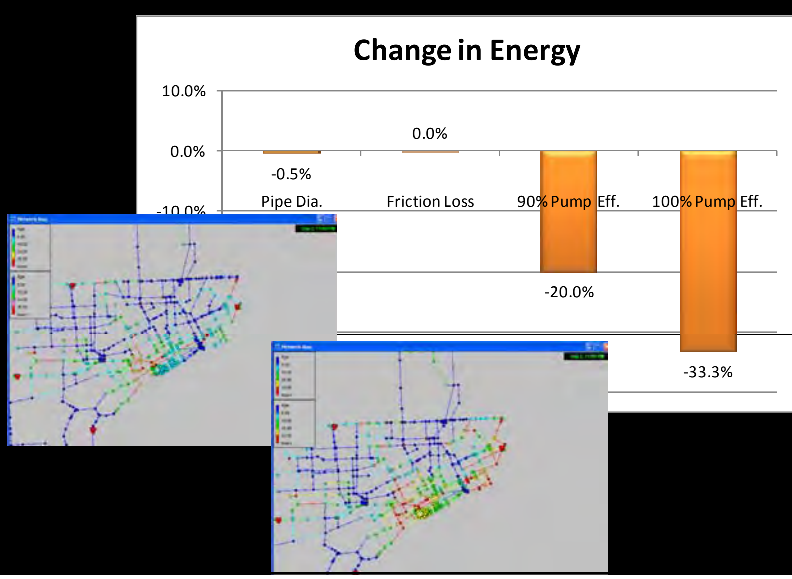


Example Scenario Modeling

Scenarios:

1. Current System
2. Increase Pipe Diameter (<54" to 72")
3. Eliminate Friction Losses
4. Increase Pump Efficiency (90%)
5. Increase Pump Efficiency (100%)

Scenario Modeling



Scenario Modeling
Environmental Benefit

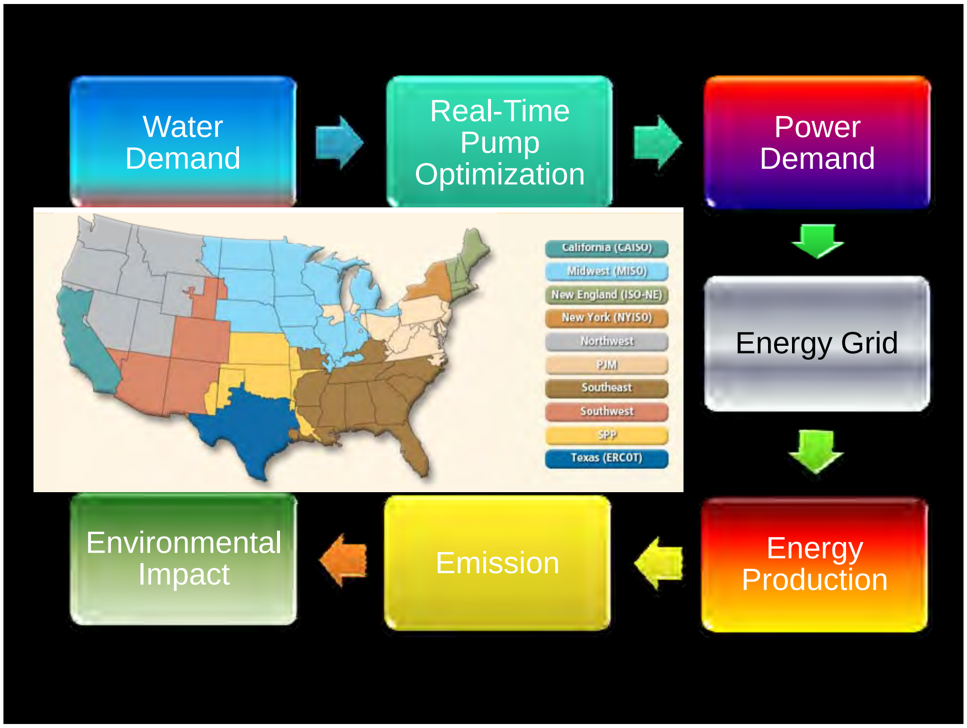
For every 5% reduction in energy:

- 50 lbs Pb managed (0.5 lbs – air)
- 1.17 lbs Hg managed (0.85 lbs – air)
- 47.5 lbs As managed (46 lbs – land)
- 4,487 lbs Ba managed (4,467 lbs – land)
- 0.13 lbs PAHs (0.12 lbs – land)
- ~25 Million lbs CO_2 emitted
- ~40,000 lbs NOx emitted
- 115,000 lbs SOx emitted

Challenges

1. Operator Control

2. Multi-Utility Collaboration



The New York Times

Web-Enabled Smart Grids

Clay Risen

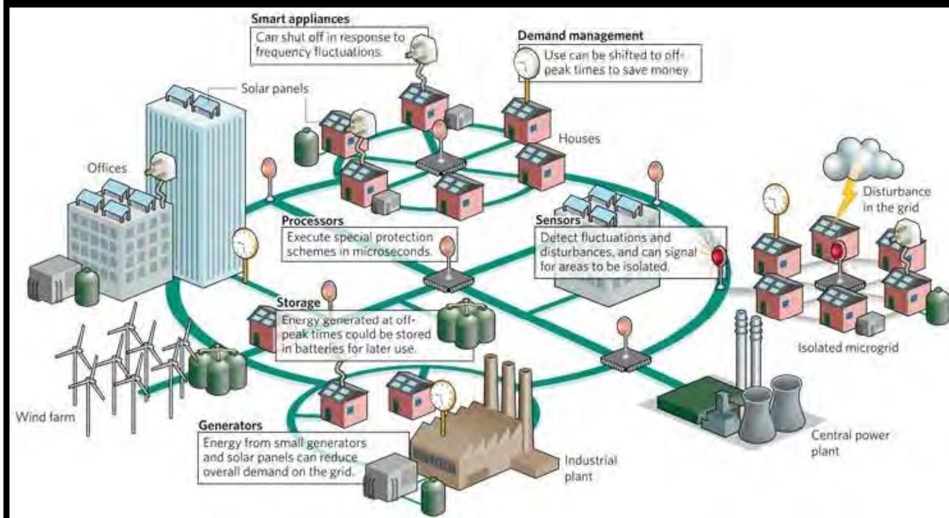
December 12, 2008

Xcel Energy of "plans to build the country's first city-scale 'smart grid' is "a response to what economists would call a tragedy of the commons: people use as much energy as they are willing to pay for, without giving any thought to how their use affects the overall amount of energy available."

Because "there's no way to monitor power use once it leaves the station -- utilities error on the side of oversupply, which wastes energy and harms the environment."

But, "Xcel's $100 million initiative, called *Smart Grid City*," is "a set of technologies that give both energy providers and their customers more control over power consumption. It relies on a network of fiber-optic cables, high-tech meters, and sensor-laden transformers to provide power stations with real-time data on demand all along the grid, allowing them to fine-tune the electrical supply, detect failing equipment, and predict overloads." A "Web-enabled control panel in their homes" allows consumers "to regulate their energy consumption more closely -- for example, setting their AC system to automatically reduce power use during peak hours."

Integrated Grid (*Smart Grid*)



Source: Energy: Upgrading the grid, *Nature,* vol. 454, pp. 570-573, 2008

Beyond the Obvious

- $H_2$0 Pricing Strategies
- The New Economy
  - Taking Advantage of Existing Infrastructure


Great Lakes
Protection Fund
Ideas in Action
WAYNE STATE UNIVERSITY
1868
UNIVERSITY of
DAYTON
WATER & SEWERAGE
DETROIT
DEPT.
Tucker, Young, Jackson, Tull, Inc.
Consulting Engineers