THE NEXUS OF ENERGY & WATER

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DRIVING FORCES

Population Growth, Urbanization

Improve Standard of Living in Emerging Countries

Economic Development

Climate Change
WORLD ENERGY USE INCREASES BY 50% FROM 2007 TO 2035

Source: Energy Information Administration (EIA), May 2010.
AND GLOBAL WATER DEMAND ALSO CONTINUES TO INCREASE
WHAT KEEPS WATER & ENERGY INDUSTRY LEADERS UP AT NIGHT?

- Economic pressure
- Public pressure
- Political / policy pressure
- Sustainability / climate change pressure
- Pressure to innovate
THE NEXUS OF ENERGY & WATER

Water’s Impact on Energy

Energy’s Impact on Water Technology Intersections

Energy, Water, & Sustainability – Assessing Options
WATER’S IMPACT ON ENERGY
CHANGING PERCEPTIONS OF THREE KEY STAKEHOLDERS

Consumers and Customers

Policy Makers and Politicians

Industry Owners and Leaders
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IF YOU WANT TO SAVE WATER, TURN OFF THE LIGHTS!

*An 8 oz. glass of water requires the same amount of energy as running a 60-watt light bulb for an average of 30 minutes

*Virginia Polytechnic Institute

Large amounts of electricity are required to acquire and process water, and large amounts of water are needed to produce electricity.
HOW MUCH WATER DOES A GOOGLE SEARCH USE?

1/10 of a teaspoon of water

*March 2009, Goggle searches reach 293 Million per day
CHANGING PERCEPTIONS OF THREE KEY STAKEHOLDERS

Consumers and Customers

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Industry Owners and Leaders
PUBLIC POLICY TO ENTERPRISE PERSPECTIVE

- Public policy clearly needs to address energy-water nexus
- Long-term viability of both essential energy and water services
- Many areas of mutual dependency
- Enterprise perspective
  - Supply planning decisions
  - Operational paradigms
CHANGING PERCEPTIONS OF THREE KEY STAKEHOLDERS

Consumers and Customers

Policy Makers and Politicians

Industry Owners and Leaders
THE NEXUS OF WATER AND ENERGY
WATER AND ENERGY ARE INEXTRICABLY INTERTWINED

Water supplied to Southern California from the State Water Project travels 2,000 feet over the Tehachapi Mountains, the largest lift of any water system in the world. The electricity used to deliver water to customers there is equal to one-third of the total average household electricity use.

(NRDC and Pacific Institute)
ENERGY USE AND COSTS IN WATER VALUE CHAIN

• Second largest operating cost, after labor
• Current financial distress for water / wastewater utilities
• Spectrum of measures to shrink energy costs, increase energy (and water) efficiency
  • Leakage
  • Energy management data
  • Equipment choice
  • Process optimization
  • Peak demand shifting
  • Micro-hydro
  • Digester gas capture / use
  • Biosolids

Energy consumption for the water and wastewater sectors is expected to increase by 33 percent in the next 20 years because of global population growth. *(Source: Watergy)*
HIERARCHY OF ENERGY-EFFICIENT OPTIONS FOR WATER

- Reduce demand where possible (directly or indirectly)
- Meter all consumption
- Delay demand to less carbon intensive periods, where possible
- Use energy efficiently (e.g., avoid standby or partly loaded equipment)
- Purchase and install energy- and water-efficient devices / appliances
- Supply energy efficiently (e.g., combined heat & power and cooling)
- Recover energy and water where possible (e.g., biogas)
- Use renewable energy (viewing waste as a renewable fuel)
- Use low carbon energy (e.g., hydro)
- Use conventional energy for the rest
- Use carbon markets to meet any further obligations
HOLISTICALLY CONSIDER THE WHOLE

Think globally

Integrate across multiple sectors

Avoid silo-ed thinking

The developed world often takes a constant supply of potable water for granted, unaware of the growing challenges facing the world's water supply.
Electric utility industry leaders say water supply is top environmental concern and water management top business issue in 2011 survey.
ENERGY’S IMPACT ON WATER TECHNOLOGY INTERSECTIONS
THE ENERGY PUZZLE

Solutions in all these areas will be required.

Alternative Fuels
Energy Storage
Smart / Strong Grid, Smart Meters
Electric Transportation (PHEV)
Micro-Generation
Regulation
Electric Power Generation
Consumer Behavior
Unconventional Drilling
Energy Efficiency
Future Mix of Technology
Transmission Efficiency
ENERGY AND WATER ARE INTENSELY INTERDEPENDENT

Water used to produce household electricity exceeds direct household water use.

Energy required to deliver 1 m³ of treated water from:

- Lake or River: 0.37 kWh/m³
- Groundwater: 0.48 kWh/m³
- Wastewater Treatment: 0.62-0.87 kWh/m³
- Wastewater Reuse: 1.0-2.5 kWh/m³
- Seawater: 2.58-8.5 kWh/m³

Source: Amended diagram based on Scientific American, October 2008.
ELECTRICITY PRODUCTION REQUIRES SIGNIFICANT WATER

Withdrawal

Irrigation: 39%
Thermoelectric: 38%
Domestic: 6%
Commercial: 5%
Industrial: 7%
Mining: 3%
Livestock: 1%

Consumption

Irrigation: 82%
Thermoelectric: 3%
Domestic: 8%
Commercial: 7%
Industrial: 10%
Mining: 1%
Livestock: 1%
WORLD NET ELECTRICITY GENERATION BY SOURCE*

- Coal: 40.2%
- Natural Gas: 19.7%
- Hydro: 16.4%
- Nuclear: 15.1%
- Petroleum: 6.5%
- Other: 2.1%
- Biomass: 1.2%
- Wind: 0.55%
- Geothermal: 0.31%
- Solar: 0.01%
- Tidal: 0.0%

WATER WITHDRAWAL BY POWER PLANT TECHNOLOGY

A modified generation mix would change water demands
WATER USE AND COSTS IN ENERGY VALUE CHAIN

- Energy: Largest user of water
- Cooling and feedwater needs for thermal generation
- Current siting and permitting issues
- Likely regulatory trends on water usage
- Longer term regulatory and climate scenarios
- Risk reduction strategies
  - Lower gross generation
  - Cost / risk / flexibility in cooling
  - Alternative water supplies
- Smart Grid: Water utilities piggy-backing on customer connectivity
WATER SOLUTION STRATEGIES FOR ENERGY

- Integrate energy and water resource planning / management
  - Reduced generation / water demand
  - Diversified energy mix
- Advanced technologies
  - Dry / hybrid cooling
  - Increase thermal conversion efficiency
- Alternative water supplies
  - Recycle / recapture water within plant
  - Gray / reclaimed / brackish water
  - Sub-stratum water
  - On-site desalination
- Consumer behavior / DSM0
ENERGY, WATER & SUSTAINABILITY – ASSESSING OPTIONS
WHAT IS “SUSTAINABILITY?”

- Energy-water nexus shows need for sustainability perspective
  - Growing demographic and economic needs for energy and water
  - Many inter-related long term issues
- Sustainability is “the capacity to endure”*
  - Not just business continuity
  - Integration of economic, social and environmental spheres (triple bottom line) to “meet the needs of the present without compromising the ability of future generations to meet their own needs”
- No commonly accepted definition yet in utility industry

WHY BE CONCERNED?

- Global path not sustainable
- Exponential demand growth
- Increasing marginal resource costs
- Scramble for commodities control
- Potential climate change impacts
- Uncertain technological progress
- Fiduciary responsibility
- Compliance with current and future legislation, governance, regulations
- Potential “no-losers” improvements to supply chain efficiency

How to incorporate in enterprise decision process?
SUSTAINABILITY IS MORE THAN BEING “GREEN”

- Integrating and balancing the “3 Ps” or “triple bottom line” (TBL)
  - Planet (environment)
  - People (social)
  - Profits (economic)
- Can be project- or enterprise-focused
- Economic drivers still very important
- Decision makers (and stakeholders) determine weightings
- Must be commercially feasible
BEYOND ENERGY AND WATER USAGE

- Footprinting
  - Carbon, GHG, other emissions
  - Energy, water footprint
  - Materials footprint
  - Waste, toxicity footprints
- Community improvement index
- Financial / economic measures
- Habitat health and diversity index
- LEED incentives
- “Embodied” carbon and life cycle analysis
- Other client-specific measures
CONCLUDING REMARKS
Energy and water interdependency... need to plan together

Water getting scarcer... solutions are expensive

Technologies available and evolving... change the mix, do more with less

All stakeholders... a call to action
Black & Veatch Launches Nexus of Water & Energy Microsite: (www.nexuswaterenergy.com)

The site includes a Water+Energy in Action interactive map. This map shows success stories as well as challenge areas.
Building a world of difference.

Together