Energy Problems

Energy Problems, Near-term

- Thermal cooling
  - Less water available due to
    - Irrigation
    - Navigation
    - Fish and wildlife
    - Recreation
  - Storage for hydro used for thermal
  - Demographic pressure for competing uses
  - How much is used vs withdrawal with different technologies
    - Variation in thermal quality
    - Return issues
    - Input issues—use, ok grey water
    - How much treatment
    - In existing plants (what to do with it)
  - Permitting new surface water supplies for power
- Hydropower
  - Increase at existing dams—only 3% of dams developed
  - 41,000 MW of potential
    - still lots of development
  - Climate change a concern for future operation and availability
    - Ex: variability and intensity could focus dam operation on flood control
    - Will hydro reliability be impacted?
    - Changed in hydrology
  - Decommissioning pressure, impact on supply
  - Need enhanced forecasting because of unpredictability
  - Reservoirs in demand for cooling, fish, recreation, property values

Row 1, Extraction

- water produced—saline, brackish
  - unusable
  - potentially usable
  - regulation on reuse
- coal bed methane (increasing prob over time)
  - Appalachian
  - Lot of water during development, then falls off
  - Get dependent, then it falls off
  - Recirculation of salts if reused
    - A surface to groundwater impact
  - A fair amount of uncertainty but a growing issue

- Strip mining impacts on hydrology
  - Surges instead of recharge
  - Flooding in valleys
  - Quality from sedimentation
  - WV/PA documented/increasing problem
  - Has existing treatment
- Impact of climate change of these problems—different hydrology (10+ years out)
  - Intensification due to climate change
    - More frequent rainfall
    - Good certainty
    - TN study shows frequency and intensity (Study)
- Underground coal (increasing problem)
  - Water quality problems growing with closed mines
  - Potential source of reuse
  - Typically acid
  - MS, OH, TN, WV
    - Whole coal region
  - Recharge/discharge impacts
  - Active mines below river level—hydrologic conditions dominate problems—ground and surface water
  - Steady state seepage
    - Maps to ag and urban area defines problem
  - Impact on community water supplies (existing, increasing problem)
    - People going off wells to surface water
    - May be a base of knowledge to develop
  - Knowledge gap on the problems
- Management of wastes from mining—impoundments and their implications on water quality
  - In all mining areas
- Impoundment failures (near term, increasing problem)
  - Impact of climate change
    - Increase in intensity could increase number of failures
    - Not designed to standards of today
    - To 50-year event—uncertainty of direction, more extreme events
- Still oil and gas in east—Have high water content in OH, PA, WV
  - Located in old fields
  - May continue with high prices
  - Localized but important—complicates coal
  - Quality issues—brackish to very saline
  - Metal/contaminant issues
  - Subsurface to surface water

Row 2

- Hydrogen production (10+ years out, high uncertainty)
    - Electrolysis needs water
    - High energy consumption
    - Potentially enormous
    - From reservoir to city streets? Displacement
    - How much water?
    - How much energy?
    - Water vapor feedbacks
    - Run off
    - Energy from 400 new nuclear plants for h2 initiative
        - 100 in place now
        - 39% new for thermal electric—increase for h2 production
    - water use for cooling dwarfs water for h2
- Fuel cell distribute generation—water and T&D infrastructure/where water will be (high uncertainty, rising trend)
    - Data needs to be developed
    - Increasing issue of grey water/sewer/potable
    - Impact on municipal systems—capacity to model it
    - Pres H initiative
    - Concentrated areas of generation—pollution, water use
- LNG facility
    - Water use? Unknown
    - Electricity demand?
- Biofuels production (increasing problem)
    - Ag and forestry
    - How much irrigation and groundwater/surface water
    - Growing with ethanol—steady state if it is woody feedstock
    - With feedstock and in plant
    - Electricity production
    - Waste timber? grasses

Row 3

- Interbasin transfers by wire
    - Not recognized
    - Don't see physical transfer
- Cooling demand thermal
    - Built-in demand
    - We are 3x more efficient on a water basis compared to 1950
    - Challenges in that type of use
    - Dry cooling penalties
    - Startup costs of replacing once-through with closed loop
    - Water availability hasn't shifted
    - Existing surface and groundwater laws

    - Prediction of supply on surface and groundwater
    - New technology not being deployed in new capacity
- Thermal cooling (increasing problem, high certainty)
    - Less water due to competition
        - Irrigation
        - Navigation
        - Fish and wildlife
        - Recreation
    - Storage for hydro is used for thermal and competing demands
    - Demographics increase
- Hydropower
    - Water reservoirs in demand for cooling
        - Irrigation
        - Navigation
        - Fish/wildlife
        - Recreation
- Climate change and hydropower, management of variables
- Permitting new surface water supplies for power
- Hydropower
    - Increase at existing dams—only 3% have it
    - 41000 MW of potential
    - still development potential
    - Climate change
        - Sedimentation threatens
        - Changes in hydrology/drought/extremes
        - Unpredictability complicates management/need enhanced forecasting
        - Variability could shift to flood control and other uses
        - Will its reliability role be impacted?
        - Decommissioning impact on supply
- Population growth
    - Fl going to be 3rd largest, GA 4th
        - Over 1 million in SC in coastal areas
        - All demanding electricity
        - Piedmont growth—relation to coastal plains—small rivers and a little groundwater
    - Storage facility potential generation—but fish and other impacts limit it.
        - If you can avoid issues, economics have limited to this point
        - Severe problem as costs go up
        - Large MW involved
    - Growing water demand from FCR and other pollution control equipment
        - Will need tech to get at even lower emissions levels
        - Acid rain and mercury pollution from generation—even if not in the region
        - Long term total loading
    - Carbon emissions

        - Pressure on fossil
        - Growing nuclear and hydro
- Sequestration and water (near term, mid uncertainty)
    - Deep well injection
    - Power companies on future gen
    - Seq r&d roadmap—deep aquifer injection could
    - Regulated by EPA as produced water
        - Like EOB

Row 4, Renewables

- RE backup generators for water supply systems
    - Fossil constrained by emissions
    - Backup power and peak shaving
    - Ability to take loads off peak
    - Not implementable
    - Interconnection, etc.
- Anaerobic digestion (increasing issue…ag extensive, ag poultry industry, Chesapeake, other key water supplies)
    - Farm and POTW
    - Nutrient management
    - Methane control
    - Wastewater treatment
    - Barriers to use of the tech
    - Money to use

Energy Dream Catcher

- new cooling technologies
- technology for pumped storage
- seq. solution
- feedstock of carbon to other uses—as a coolant for thermal

Data and modeling energy, near

- Lots of unknowns in water availability in east
    - Groundwater not as well understood as in west
    - No modeling/projections of competing uses
    - SC State water plan is a reference (working on regional model)
    - Unknown recharge availabilityf
    - Plant collocation information—water reuse availability
    - Water not where and when you need it
    - How much is used vs withdrawn with different technologies
        - Variation in thermal quality
        - Return issues
        - Input issues—use of grey water, how much treatment—on existing plants, what to do with it?
        - Urban growth areas are increasing

Water Problems

Row 6, Urban Use

- Growing population
    - SE—megalopolis from boston to Birmingham
    - Maldistribution wrt water
    - 4 million more people in next 25 years (piedmont)
    - 1 million in SC
    - Census Bureau population projections
    - NAHB
    - Overdrafting groundwater –within 20 years using conjunctive uses
    - Surface water too—interlinked
- Non-point source water quality impacting surface water—will impact availability for hydropower
- Exurban growth—growth near headwaters reduced infiltration and recharge
    - Increasing groundwater demand
- Demand for desal and other alternative supply technologies
    - Very energy intensive
    - Desal in VA—demo
        - Shift to coasts will boost that energy demand
    - Impossible to site other
- Aging population=more demand (increasing problem over time)
- Aging infrastructure
    - Hollowing of mid-cities
    - 40% leakage in some cities
    - oversized from needed
    - elimination of POTW treatment fund by fed government (EPA infrastructure funding gap study)
        - billions of dollars
    - Not designed for modern use
        - CSO
- Energy required for short-term water need given aging infrastructure—how much energy to deal with 40% leakage?
- More urban, more waste, more power demand but degraded water quality
- Industrial water use—flux (uncertainty/knowledge gap)
    - Shifts overseas may affect users/supplies
    - Have declined significantly
    - New industry shifting to public supply
- Lack of unified data set to understand and analyze competing uses (increasing problem, high certainty)
    - Limited data sets
    - Fragmented by state and utility
    - No cost information
    - Little analytical tools
    - No EIA for water
    - Different methodologies

    - Proprietary in some cases
    - Data management
    - Accuracy/comparability
    - SC as a reference
        - Mandated program reporting on uses and changes
- Water law and ownership (increasing problem…conflicts emerging…extensive)
    - Large withdrawers and who gains control once they give it up at right quality and location
        - Rights to water—who decides use?
    - Making water available doesn't mean it will go to next highest use
    - Difference for surface vs groundwater
    - Economic development issue
    - Permitting adjustments
- Urban heat island
    - Impervious surfaces build demand, increase runoff, reduce recharge
- Smaller communities trying to lock in supplies
    - In competition, no regional way to coordinate, after water for energy
- Small community systems made unusable by groundwater contamination from extraction
    - Speeds up urbanization
    - Local governments focus on water supply, ignore wastewater
    - POTWS for these communities
    - More connecting up—driven by drought issues
    - Competing with big cities and industrial—becoming part of urban
- Energy used for water supply -- #1 cost for utilities
- Water delivery costs/energy with urban growth, impacting supplies
- Public acceptance/knowledge of problem, DSM
    - Don't see connection of water and energy
    - Lacks public case
- Move from wells to central also goes from groundwater to surface water—that is the way we grow
    - Associated with sprawl—no incentive for compact development
    - Can put in well and septic anywhere
- New drinking water regs make it more complex—new requirements—more energy intensive
    - How much real difference?
    - From 3% worst for once through, closed loop boosts to 75% or greater

Row 7, Agricultural

- Irrigation—quantity
    - Mostly groundwater, while power is surface water—not a conflict yet
    - In GA, most growth is in north
    - Groundwater does compete—it pulls more surface water in faster—correlation is a bit uncertain but there—certainly clear in part of FL
    - Everywhere large scale ag irrigation is going, it is competing
    - Depends on overlap of power with ag

    - Interference with domestic well from ag
    - Irrigation/ag water quantity
    - Energy needed for fertilizers
    - Water will be energy use of irrigation?
        - Near-term
        - Shifts to golf courses, super farms
        - Landscape irrigation—mostly dup peak energy seasons—coincides with worst time
- Climate change
    - Irrigation is first response to unpredictability
    - May be in areas we never thought of it
    - Lending institutions may demand irrigation
    - Don't have tools/acceptance for risk mitigation or things like insurance

Row 8, Energy Production

- Quality for intended use—all water treated to same quality
    - Could be used for cooling, not …
    - Levels of quality for use
    - Grey water—mismatch between demand and population (winter and irrigation)
    - Infrastructure to deliver it

Row 9, Electricity Production

- Defining/understanding use
- Defining withdrawal vs consumption
- Discharges confused with consumption
- Future gen, but at much lower gal/mwh withdrawal, higher consumption
    - Siting will change—next to wastewater

Row 10

- Dam relicensing will reduce power, competing demands, environmental demands
    - Recreational pressures
- Fishing, cottage, others don't want to be with some power sites
    - Can also benefit, can help
    - Recreational competition – fish vs boaters
    - Cooling reduces lake levels
- Recreation/water creates high-value property that can trump energy use
- Increase of energy emissions and climate on environment and recreations
    - Mercury, co2, acid rain
- Navigation competition for water volume/flow (large issue on MO river)
    - Model info
- Flow for env. Issues
    - Along with navigation the biggest competition
        - Periodic
        - Model info

Cross-cutting

- Water laws between states
  - Ref Region IV studies for EPA
  - No mechanism but courts to deal with it
- Increased demand for recreation/environmental use
  - From urban growth, lifestyles—conflicts with each other
- Costing/pricing
  - Lack of a consistent pricing structure
    - Doesn't reflect full cost of water—economic drivers not there
  - Deregulation and price signals
    - Water/electricity—if you can spread usage to non-peak times, signals are there
  - There are some examples—inverted block rate structures
  - Coincident peaks for water and electricity
  - Water utilities main users in CA/LA?
- Vulnerability of centralized systems
  - Distributed water systems
  - Do water at a smaller scale
  - Make smaller more efficient
  - Availability of small units
  - Acceptability
  - Upgrades intensive
  - 1 intake vs multiple intakes
  - fragmentation reduces available supply
- location of people on coasts will make it difficult to site and cool using seawater – in central part of country most vulnerable to climate change and already with water problems
- Need pressure to move away from once-through cooling—they consume more, withdraw less