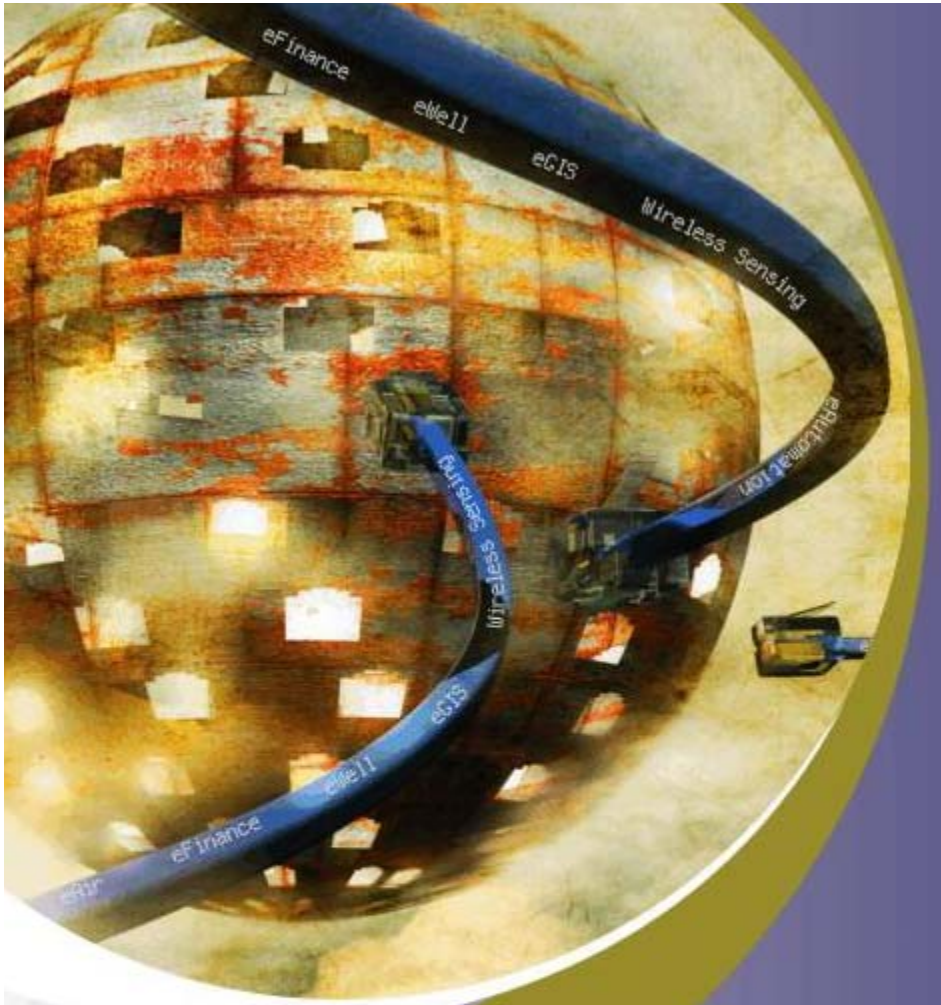


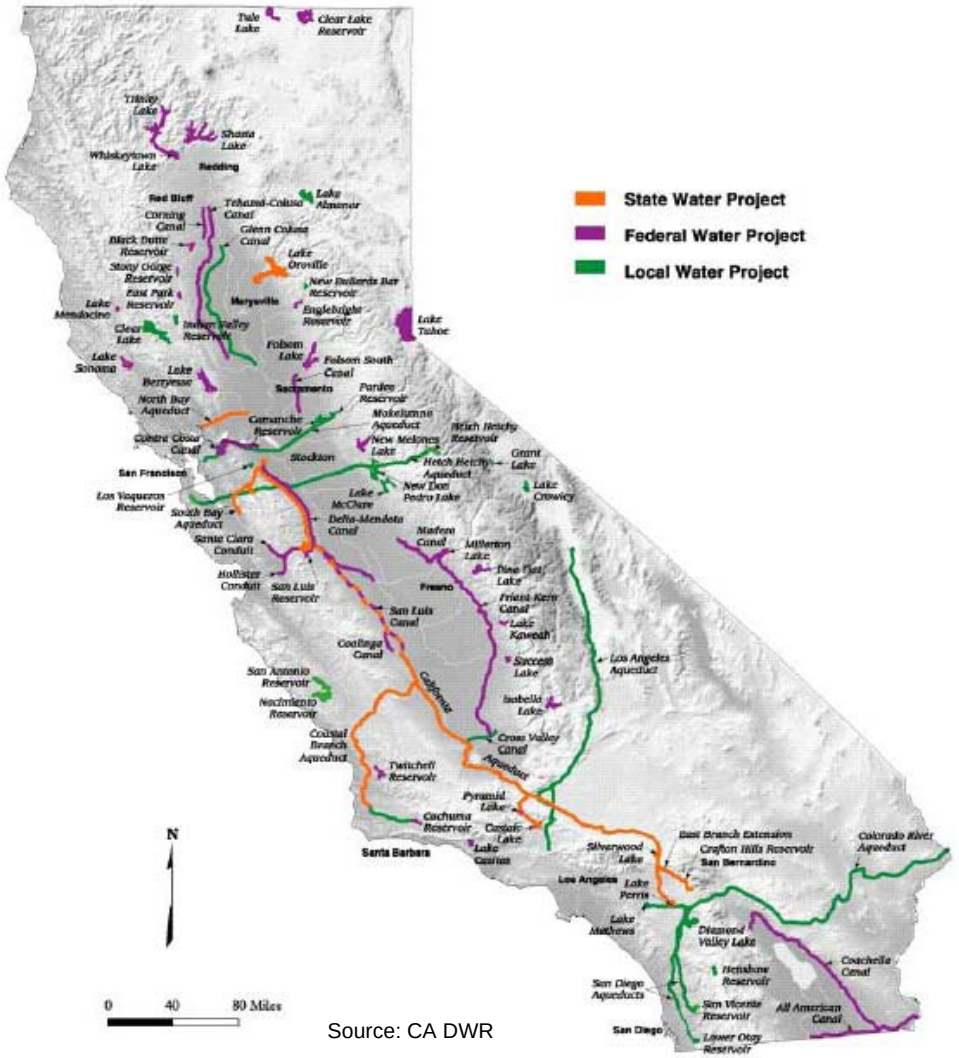
Water Footprints for the Nuclear Industry

Using Your Existing Data for Sustainability Reporting

Locus
TECHNOLOGIES

Why Focus on Water Resources?

- Water is a huge fundamental global problem
- Water is expected to become the next key metric for sustainability, after current wave of carbon regulations
- Water and energy are inextricably linked – about 15% of California's power is used on water related issues
- Annual energy needed to move water around CA is more than both of CA's nuclear facilities combined (48,000 GWh)
- Once contaminated, water is an expensive long-term problem



Source: CA DWR

Water Issues Facing Nuclear Industry: Past and Future

- Water availability has become a paramount issue for utilities operating and planning new facilities.
- New technologies needed to increase power plant water use efficiency and decrease the consumption of water, and a standardized metric needed to compare alternatives.
- Increasing public pressure to reduce water consumption at electricity generating stations.
- Water scarcity and the requirements for electricity generation are becoming more and more tightly interconnected.

Water Issues Facing Nuclear Industry: Past and Future

- Competition for water resources is expected to increase rapidly in the next two decades.
- Increased electricity demand overall, combined with alternative fuels production, could more than triple water use for energy production by 2025.

- Recently, California adopted a policy to phase out once-through cooling systems at nuclear facilities by 2024. NY and NJ also have similar draft policies in the works.

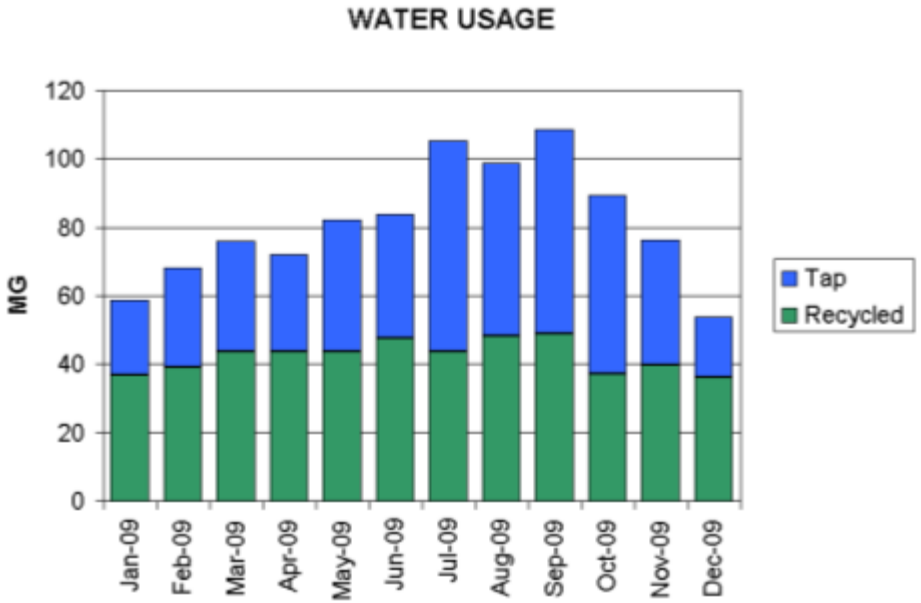
Water Management in Nuclear Industry

- ANSI/ANS-2.8, Determining Design Basis Flooding at Power Reactor Sites
- ANSI/ANS-2.9, Evaluation of Ground Water Supply for Nuclear Facilities
- ANSI/ANS 2.13, Evaluation of Surface-Water Supplies for Nuclear Power Sites
- ANSI/ANS-2.17, Evaluation of Radionuclide Transport in Ground Water for Nuclear Facilities
- ANSI/ANS-2.18, Standards for Evaluating Radionuclide Transport in Surface Water for Nuclear Power Sites

Water Footprints

- Water was once an overhead cost - now it's a source of brand and operational risk
  - Availability for operations
  - Quality (into and out of the enterprise); environmental fines
  - Impact on water availability for other beneficial uses

- Significant link between water footprints and carbon footprints
  - Pumping consumes power, which generates greenhouse gases
  - Power generation requires huge volumes of water for cooling



How Do You Measure It?

- Many reporting programs exist for carbon footprints, with varying methods and results
- Water footprint calculations are still evolving, but are likely to be just as complex and inconsistent
- CDP Water Disclosure —new reporting initiative introduced last December

Global Reporting Initiative™

Aspect: Water

CORE	**EN8**	Total water withdrawal by source.
ADD	**EN9**	Water sources significantly affected by withdrawal of water.
ADD	**EN10**	Percentage and total volume of water recycled and reused.

Water Management at Three Scales

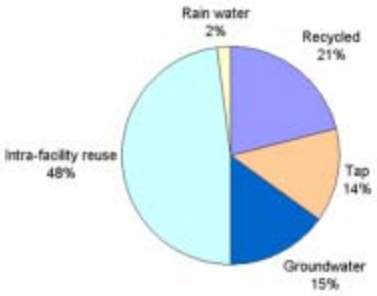
1. **The natural scale** (engineering entire watersheds)
    1. *Water resource mapping and availability (surface and groundwater)*
    2. *Water quality monitoring and management (surface and subsurface)*
    3. *Land use analysis*
    4. *Extraction monitoring (surface and subsurface)*
    5. *Flood control*

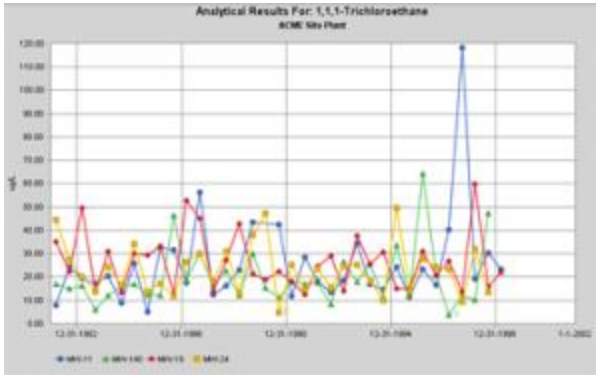
2. **The facility scale** (managing quality, discharge, energy use)
    1. *Water quality and usage from various sources*
    2. *Discharge, combined sewer overflow*
    3. *Asset and Energy management*
    4. *"Smart levees" and monitoring systems*
    5. *Weather event assimilation*
    6. *Flood control*

3. **The enterprise scale** (manage water resources across entire portfolio)
    1. *Water usage tracking, metrics, and management*
    2. *Water quality control (into and within plants, discharges)*
    3. *Supply chain optimization*
    4. *Energy management*
    5. *Business process improvements*

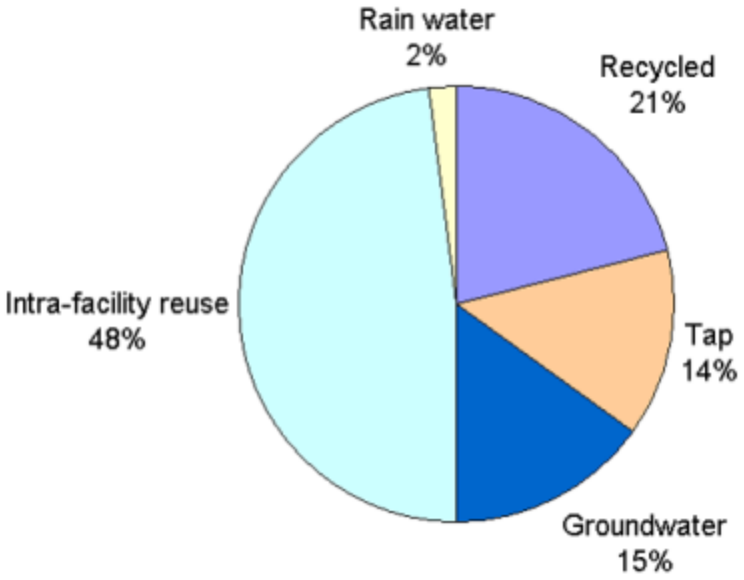
One more number to track… What's the big deal?

- Carbon footprints can be distilled to a single number without loss of significant information
- Water footprints will have critical associated information
  - Usage Information
  - Geographic Information
  - Water Quality Information
- Without this information, water footprints are somewhat meaningless



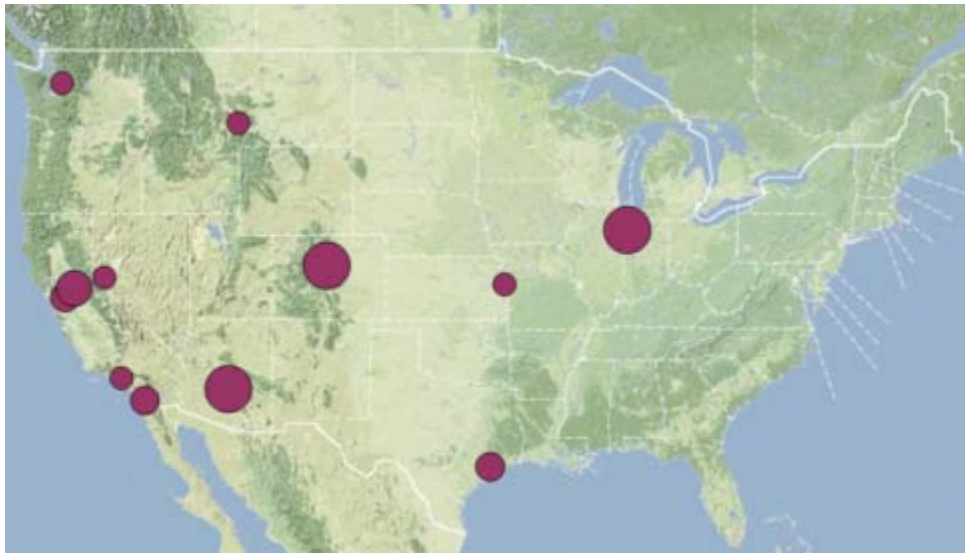


Usage Information (Origin & Destination)



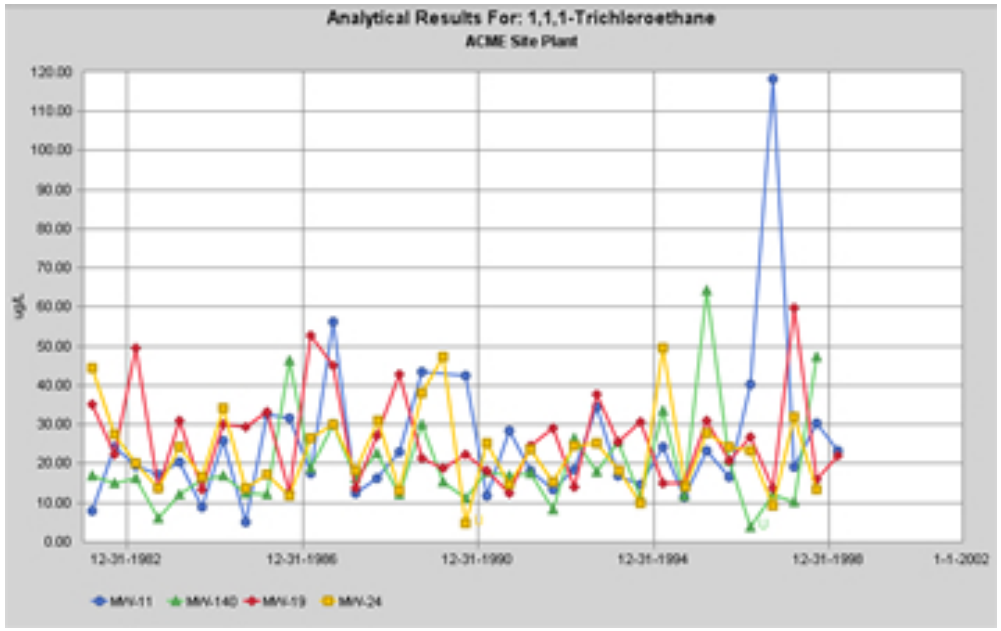
- What type water is used is just as important as the quantity
- What type of water are you using (drinking, groundwater, recycled)?
- How will water re-enter the hydrologic cycle (sewer system, ocean, steam)?
- Are any other resources affected by removal or re-entry of water?
- Some discharges may be considered renewable

Geographic Information (Location, Location, Location)



- Geographic distribution is much more critical for water than it is for carbon
- Whereas carbon footprints can be summed globally, water footprint reporting will necessarily have a geographic component
- Water used near the Great Lakes has a very different value than water used in Arizona or California.

Water Quality Information (Changing Beneficial Uses)



- Availability of water isn't the only concern… it's the availability of drinking-quality water
- While water quantity is a single number, water quality can include large volumes of data
- Several degrees of water quality can exist
- If water is impacted, can it be recovered?
- How much resources are needed to recover it?

Beyond Your Water Bill

- Significant volumes of water are used for cooling
- Most water is returned to the environment (use is high, but consumption is low)
- Water is usually discharged in a different form (e.g. from groundwater to steam or surface water)
- Water footprint may also include groundwater or surface water impacted by generation activities.
- Consumption for closed-cycle systems is similar to once-through systems, but water footprint can be substantially different when water quality and beneficial uses are considered

Example: Recycled Isn't Always Better

- Recycled water is generally perceived as a preferable resource because it reduces dependence on other water sources
- Recycled water frequently contains NDMA, PFCs, and EDCs and other chemicals that can impact surface and groundwater
- Current policies don't protect you from liability for environmental impact from recycled water use
- Considering the potential impacts to water quality, recycled water may have a larger footprint than other water sources

Considerations for Water Footprints

- Measuring Water Footprints.
  Gather, aggregate, and examine operational data on water usage, location, and quality.

- Correlate water to the broader sustainability issues like energy, waste, and carbon.
  Getting water to the desired location, form, and quality leads to need for energy (and lots of it).

- Water-related efficiency metrics.
  Values of Mgal/MWh are generally higher compared to other energy sources.

- Consider additional "indirect" water footprint. *Environmental impacts can make your indirect water use larger than your direct use.*

- Understand the real cost and value of water

Locus Implementation for Exelon's Fleet

Challenges

- Multiple types of data needed for comprehensive evaluation
- Required inputs residing in separate databases for each facility
- No way to easily analyze or compile data

Locus' Solution: EIM

- Analytical database customized for nuclear utility industry
- Centralized all data regardless of location or type
- Simple portfolio-wide analysis and real-time monitoring

A Comprehensive View of Water Footprints

Contact Information

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