

San Diego Regional Construction Procurement Committee

2014 Top 4 Issues

Sustainable Infrastructure

April 8, 2014

Background

We are at the crossroads of crisis with respect to sustainable strategies and practices in the greater San Diego region.

The sustainability break out group evaluated a number of issues impacting sustainable development in the region ranging from the water-energy nexus, the need for innovative extra-municipal financing mechanisms, life cycle cost management and total cost of ownership of facilities assets, and the need for education of public employees, elected officials, and the general population on these subjects. The reason that San Diego is in crisis regarding natural resources can be attributed to two things:

1. Consumptive culture
2. Inadequate policy updates to keep up with necessary crisis mitigation measures

With the reality of a current unsustainable model, our region must realize that we cannot keep building our way out. The question then becomes:

“How do we integrate sustainability into our facilities infrastructure required to meet the demands of our population?”

San Diego public agencies do not currently implement sustainable life cycle considerations into the public infrastructure assets capital planning and implementation consistently nor robustly. Public entities have the responsibility to be leaders in this arena and in educating the public and their publicly elected officials in understanding the culture shift that needs to take place. The recommendation of the group is to develop a holistic approach for sustainable practices in planning, designing, constructing and operating our region’s infrastructure. This should be focused in two areas:

1. Total Cost of Ownership & Life Cycle Cost Management
2. Water/ Energy Nexus

This will require elements of technical, political, and advocacy strategies as part of a holistic solution.

This paper will explore the translation of historical data into providing possible solutions that can be implemented by local agencies.

Current Conditions

Understand that there is a problem

Our societal culture’s negligence of sustainable resource management practices spanning multiple generations has given very little consideration to the global repercussions of our decisions. California

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expends 20% of its energy usage to water-related energy consumption, according to the California Energy Commission. For that percentage, the embedded energy costs account for 30% of the natural gas consumption and 88 billion gallons of diesel fuel every year to transport water, as stated by the County of San Diego's Strategic Energy Plan 2013-2015. Water conveyance captures 31% of the estimated energy intensity components in a report by the National Resources Defense Council called "Energy Down the Drain: The Hidden Costs of California's Water Supply."

The same report says that the bulk of the energy used falls under the End Use category defined as the "further treatment of water (e.g. softeners, filters), circulating and pressurizing it (e.g. with building circulation pumps or irrigation systems), and heating and cooling it." The Union Tribune article called "Can San Diegans Save More Water?" published in February 2014 stated that speeding up your shower by two minutes can save about five gallons of water each day and piping leftover shower water to your lawn can conserve 25 gallons a day – or more than 9,100 gallons in a year.

The region imports at least 45% of its water from other sources that require extensive amounts of energy to transport, according to the San Diego County Water Authority. California has implemented regulations that severely curtail the option of additional fossil fuel or nuclear power plant construction and prompted a more urgent examination of regional plans moving forward. In addition, the closing of the San Onofre power plant equated to 2700 MW of lost power production compounding the effect on an already diminishing supply in the greater San Diego region. The relationship of energy and water is critical to updating conservation strategies.

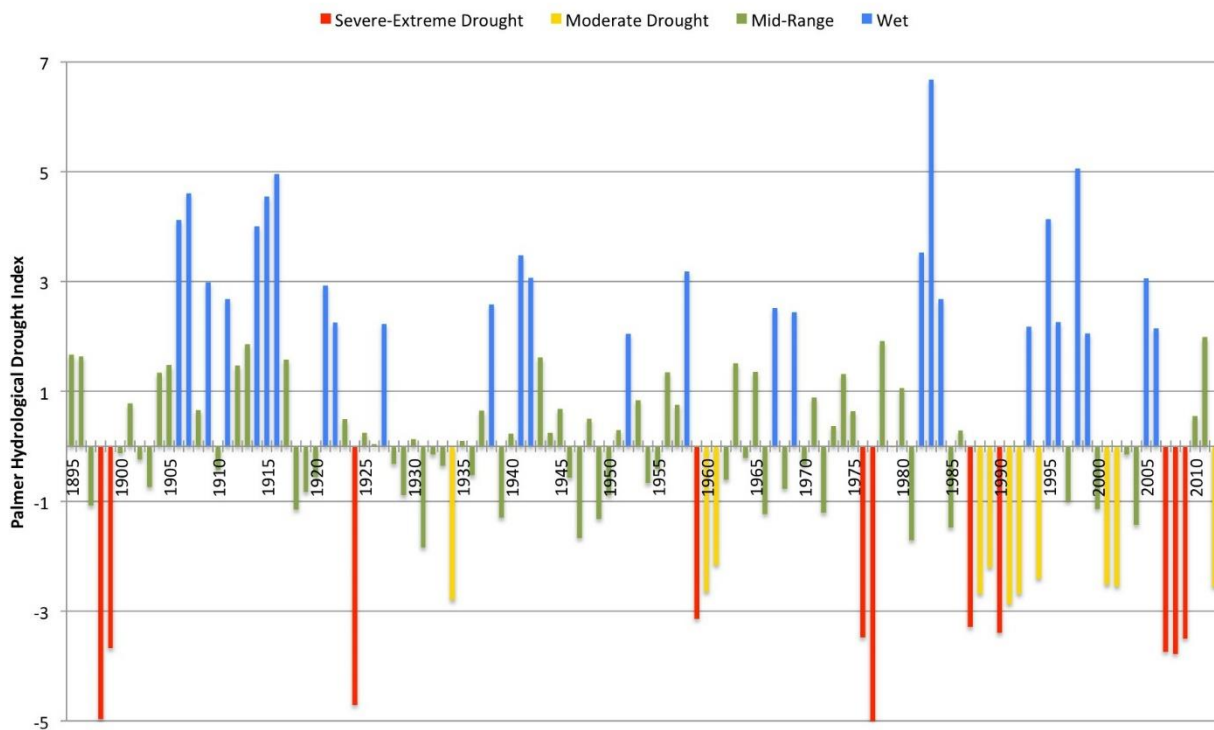
San Diego County Water Authority stated that per-capita water use in their service area is down 23 percent despite a population increase of roughly 140,000 people, between 2007 and 2013. California is currently in a severe drought with a recently declared state of emergency by Governor Jerry Brown. Figure 1 shows precipitation in California since 1895 and the Palmer drought index. In our current state of reliance on sources of water outside southern California, those sources have recently declared themselves in crisis as well.

Tied to this water crisis are alarming trends in power generation, transmission and distribution within our region. The September 2013 rate increase, as SDG&E stated on their website, was attributed to environmental costs that support the use of green resources and enhancements to the electric system making it more reliable, safer and secure. Mitigation efforts by SDG&E will need to be re-evaluated as energy's current base rate could stand to triple over the next four years, without residential rate restructuring, reported by the Union Tribune.

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Figure 1: Palmer Hydrological Drought Index, 1895-2012 for California



Infrastructure

The American Society of Civil Engineers (ASCE) gives the country's infrastructure a grade of D+ in its 2013 report card on the state of our nation's infrastructure (ASCE, 2013). They estimate that the U.S. needs an investment of \$3.6 trillion by 2020, with an expectation to fall short of that goal by \$1.6 trillion.

The San Diego region's infrastructure is dated and failing to meet the current demand, much like the national trend. In an article titled "14 U.S. Cities That Could Disappear Over The Next Century, Thanks To Global Warming" featured in the Huffington Post Green section, local news station KPBS reported that San Diego could see rising tides of 18 inches to four feet by the year 2050 that will make the need for infrastructure upgrades much more critical. The question becomes a matter of financing. Councilman Mark Kersey, who heads up the City of San Diego's infrastructure committee, told the Union Tribune that the price tag for necessary infrastructure upgrades is at least \$1 billion, possibly upward of \$2 billion (Union Tribune, September 25, 2013).

Most San Diego public agencies are focused on initial capital cost (first cost) of infrastructure rather than total cost of ownership over the life of the asset. Some public agencies share that there is a lack of knowledge how to evaluate life cycle costs and lack of specialized training with maintenance and operations staff.

The Institute for Sustainable Infrastructure <http://www.sustainableinfrastructure.org/> has recently developed the Envision™ rating system for use in sustainable infrastructure. Envision™ provides a

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holistic framework for evaluating and rating the community, environmental, and economic benefits of all types and sizes of infrastructure projects. It evaluates, grades, and gives recognition to infrastructure projects that use transformational, collaborative approaches to assess the sustainability indicators over the course of the project's life cycle.

Policy

The current state of public infrastructure discussed above, in tandem with overloaded transmission lines, forces the entire region to search for innovative funding sources and creates a need for public and private partnership, despite SDG&E's best efforts to keep up with current demands.

On the policy front, our current tax codes are written to expect a rate of return within 7 years where infrastructure projects of this magnitude would require 30 year terms for a public private partnership to become an option. The private sector and real estate community can become partners with the right education. At the Urban Land Institute's 2013 Fall Meeting, a Fundamentals in Real Estate series brought to light the importance of city officials' understanding how developers evaluate profitability in deals to show private investors how these infrastructure projects can prove to be a lucrative endeavor and mutually beneficial to all parties involved.

Current California Energy Code is targeting a goal of all new buildings to be net-zero energy from a power perspective by 2030. The new Title 24 requirements that go into effect July 1, 2014 are a significant step towards this goal requiring all new buildings to be solar ready and with significant changes that increase energy efficiency requirements.

Crisis is a driver than changes a mindset

The ramifications of deferred infrastructure maintenance have begun to affect the land development community. Interim Mayor of San Diego, Todd Gloria, was quoted at an Urban Land Institute breakfast held locally saying, "My district is starting to say no to projects because of the lack of infrastructure --- parks, libraries, etc., that were promised but aren't there."

Goals and Targets

"How do we get that culture shift to happen sooner?"

Shift towards a long-term focus

(Political Leadership) From a behavioral psychology standpoint, one needs to understand what perception of responsibilities motivates consumptive behaviors in order to begin the public campaign to address them. Beginning with decision makers, there is a need to create an understanding of the link between water and energy both of which are vital to a region's livelihood. Through education, significant movement towards real mitigation of these environmental issues may commence. San Diego imports 60% of its power and water from outside of California which makes educating consumers and public agencies about the current drought conditions as well as the drought emergency declaration in California and throughout the Colorado River basin so critical. Educating public decision makers is the first step to building the necessary critical mass in order to shift the paradigm.

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(Agencies) The shift of San Diego public agencies' mindset needs to be geared towards a more proactive approach in anticipating the requirements of life cycle cost management through training, collective discussion, and appropriately timing the involvement of policy makers.

The Urban Land Institute recommends that due to the magnitude of capital requirements and the multi-jurisdictional scope of most infrastructure improvements that a closely coordinated approach to closing the gap between funding provided through federal, state, regional, and local governments is a necessity.

(Individuals) For the general public, emphasis must be made on accepting the premium of conservation measures with a collective long term benefit in mind.

Analysis

The first step is to examine where sustainability has been integrated successfully in environments similar to San Diego. With familiarity of what works, the region can move forward with establishing our own benchmarking study for our current and future infrastructure assets.

Currently, the San Diego County Water Authority is evaluating a diversification of our water supplies through recycled water and groundwater with emphasis on regional control of our resources. They are exploring reuse strategies as well as desalination, even though this requires significantly more energy than traditional water treatment methods. From an operational perspective, the Authority is shifting much of their costs away from the purchase of water to more fixed asset costs in an effort to practice fiscal sustainability.

SDG&E offers incentives for charging of electric vehicles during off-peak hours to alleviate demands on the grid. They are also working towards refining the price structure and developing technology to evaluate actual usage.

An increasing awareness of the total cost of ownership associated with public infrastructure has prompted a need to assess the condition of the region's assets with the intent of moving towards a more holistic approach. Many public agencies are structured with different sources of funding for capital projects and ongoing maintenance and operations of existing infrastructure assets. Because of this, many organizations have developed specialized departments with a focus on capital planning, development, and construction which are independent of departments responsible for ongoing energy management, facilities maintenance and operations. Because of this disconnect and insular nature of departments, there has historically not been an awareness of the impacts made during design and construction that may lower initial first cost, but significantly increase the total cost of ownership over the life cycle of an infrastructure asset through higher utilities consumption and cost, higher maintenance costs, and higher operational expenses. First costs of buildings typically represent only 10 to 20% of the total cost of ownership over the life of the building. Greater awareness is required to facilitate sound analysis and understanding of how assets are maintained and operated over their useful life when designing and funding new capital construction.

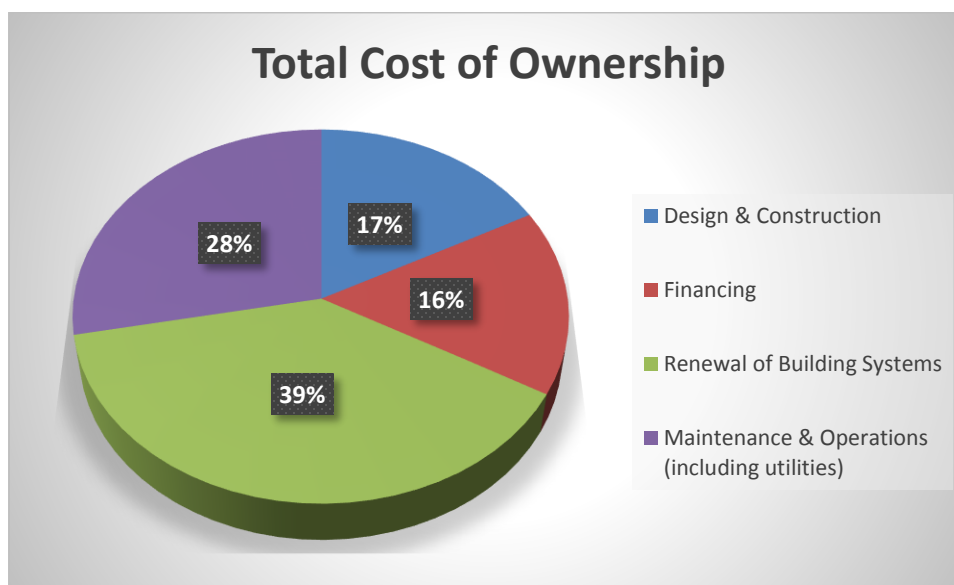
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A Total Cost of Ownership Example

An example of total cost of ownership is presented below for a hypothetical 100,000 square foot public building that is 100% financed through general obligation bonds issued at 5.0% annual interest rate for 30 years. At a construction cost of \$300 per square foot and associated soft costs for design, permitting, commissioning, and inspection of 15% of the total construction costs, the design and construction costs total \$34.5M. The financing costs of this project over 30 years are \$32.2M. Annual operating costs were estimated at \$5 per square foot annually for maintenance, operations and utilities. Assuming a 3% annual inflation rate, these costs total \$56.4M over 50 years. Separate from maintenance are the major renewal and replacement of building systems that will be required at various intervals in a building's life. APPA recommends the use of 2% annually of the current replacement value for major capital renewal, or \$77.8M in this case. So a building costing \$34.5M in a capital improvement program may ultimately cost taxpayers as much as \$200M over its expected 50-year life cycle.

As can be seen in the figure below, the initial capital costs for design and construction in this example represent only 17% of the total cost of ownership of the building. This is one of the primary reasons why public agencies should be considering life cycle considerations in their capital planning and design to reduce fiscal impacts on operating budgets post-construction.



There are established methodologies for determining total cost of ownership. These methodologies consider numerous additional details and variables, but the primary lesson is that the real value of investment in the design and planning of a facility is not the cost in design fees, but what the team can save over the life of the building.

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Education/ Outreach

What are the current literacy levels by local jurisdictions and the public at large of sustainable best practices? By understanding these levels, an appropriate education plan can be enacted to ensure that both agencies and consumers are technically knowledgeable in the arena of current best practices.

Proposed Best Practices

These efforts will not happen on their own and will require a collective effort between the public and private sector to create the policy to support initiatives and establish the means to enforce implementation.

Public Private Partnerships

Engineering News Record's December 30, 2013 issue reported that Public Private Partnerships (P3) are an important part of the solution. In addition to their short-term benefits, a critical but often overlooked advantage of P3s is their whole-life approach, offering greater cost and schedule certainty over time. In a typical P3 contract, operations and maintenance (O&M) costs must be accounted for during the life of the concession and cannot be deferred.

Creating Value at Point of Sale

Regulations that assign value to water and energy conservation measures in point of sale transactions will create a market demand for those conservation features built into projects moving forward. Adoption of the Property-Assessed Clean Energy program is just one way to gain traction on financing energy efficiency, water efficiency and renewable energy projects.

Establishing a return on investment formula for water similar to the formula for energy which factors in tax depreciation on equipment, net operating costs, property appreciation can persuade property owners consider implementing sustainable strategies into their projects.

Life Cycle Cost Analysis and Total Cost of Ownership

The following are recommended best practices for evaluating life cycle costs and the total cost of ownership of publicly funded assets:

1. For existing infrastructure, benchmark current facilities conditions with facilities condition assessments.
2. Require life cycle cost analysis as part of each project during funding and development.
3. Implement continuous commissioning of buildings and assets through smart metering, advanced controls technology, data analytics and dashboards. Operating physical facilities assets sustainably is the most logical solution by minimizing over-consumption with the mantra in mind that "the best energy is what is not used." Enforcement standards combined with a well-structured incentive program seem to offer the most qualified method for assuring that updates on conservation limits are maintained, aiming for higher than the current energy codes.
4. Develop a model policy for total cost of ownership analysis for use by San Diego public agencies.

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Implementation Plan

Life Cycle Cost Analysis and Total Cost of Ownership

With respect to shifting to a more holistic approach to the total cost of ownership and sustainable infrastructure, the following steps are recommended for public agencies.

1. Develop an education plan that explains life cycle cost analysis, total cost of ownership, return on investment approach, and why it is important.
2. Develop a protocol and procedure for life cycle cost analysis for each project. Consider utilization of the Envision™ rating system where appropriate.
3. Develop a resource plan to address implementation of total cost of ownership. Who should participate within an agency and with what parameters?
4. Develop comprehensive funding plans for both capital project development and ongoing maintenance, operations and utilities costs.
5. Leverage technology (current and future) to reduce life cycle costs.
6. Require life cycle cost analysis for each project as part of project development and funding.
7. For the existing infrastructure portfolio that will require ongoing capital renewal, benchmark existing conditions.
8. Develop comparative metrics system that can be used by San Diego public agencies to evaluate their benchmarking and ongoing performance related to peer organizations.
9. Address anticipated ongoing costs as part of governing body's project approval.
10. Develop a sustainable culture and processes for continuous improvement within the organization.
11. Draft a model policy for total cost of ownership analysis for San Diego public agencies use and potential adoption by their respective governing authorities.

Focus on New Construction

Updating and implementing more stringent building codes focused on water and energy will encourage the collective effort towards regional climate resiliency. Adoption of new policies is required by agencies to consider life cycle cost analysis and Total Cost of Ownership. Public agencies need to lead by example in the construction and continuous commissioning of public facilities. Offering incentives for home energy ratings as a standard could also motivate the general public to participate in their responsibility to the environment

Rewarding Good Behavior

Adopting policies that incentivize leadership in conservation in new projects and requiring accountability of infrastructure performance over time through continuous commissioning would support the regional goals of climate resiliency. Creation of an enforcement standard would also ensure that the region's assets are operating at optimal capacity for the duration of the project's life cycle.

Deliver the Message to Policymakers

As discussed previously, policymakers need to be at the forefront of the sustainability effort in education and practice. Creating regulations and policies towards the goal should be an important focus of decision makers. Leadership by example in enacting legislation or adopting policies showing a commitment to the environment is a responsibility that elected officials have to their communities.

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Elected officials also have the ability to consider renewable energy as an alternative strategy that would certainly exceed the current region usage. Distributed generation is another alternate strategy for consideration to augment other power sources. This effort could help utilities in building a model to maintain the base load creating a reliable local source, with the exploration of energy storage solutions.

Creating a Regional Education Campaign

Public officials' responsibility to their communities is to provide education that will enable decision making that benefits the long-term goals of the environment. Implementing a two-fold, region-wide education program targeting agencies and the general population to see the rewards with a long-term focus is the first step to shifting culture standards about conservation. This program should teach the entire professional spectrum of community building advisors to be technically knowledgeable in areas integral to decision making and implementation of climate change mitigation and resilience. The result of an aggressive education campaign will be a region-wide adaptation of emerging technologies that move our region towards achieving climate resiliency.

Potential Metrics

As part of the evaluation of the plan, potential metrics that may be considered to benchmark initial public infrastructure asset conditions and monitor improvement over time may include:

- Cost per square foot for maintenance
- Cost per square foot for capital renewal of existing assets
- Energy intensity usage (Btu/square foot)
- Number of projects with total cost of ownership calculations
- Facility condition index of existing facilities
- Carbon dioxide/greenhouse gas emissions per square foot

Follow-Up

Use the Regional Construction Procurement Committee forum as an opportunity to:

1. Develop a draft education plan on benefits and importance of life cycle cost analysis and total cost of ownership
2. Draft a model total cost of ownership analysis protocol
3. Identify regional benchmark metrics for peer comparison
4. Draft a model policy for governing Board consideration and adoption
5. Enlist policymakers as champions asking the right questions when approving projects

To achieve these goals, it will be necessary to work with public officials to implement these recommendations. Furthermore, this will support the symposium's intent to provide a collaborative avenue for public agencies and the design and construction communities to improve how the region builds sustainably with considerations to the total cost of ownership of an asset and mitigate the effects of climate change. Persistence in educating the public about our impact of our resource management decisions and creating a means of accountability will be the key to successfully addressing the issue of community resiliency.

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Definitions

Continuous Commissioning - the ongoing evaluation of a building's energy consumption and systems to ensure that it continues to perform as designed

Capital Renewal - a systematic management process to plan and budget for known cyclic repair and replacement requirements that extend the life and retain usable condition of facilities and systems and are not normally contained in the annual operating budget. Included are major building and infrastructure systems and components that have a maintenance cycle in excess of one year.

Distributed Generation - electricity that is produced at or near the point where it is used

Envision™ Rating System - a rating system based on a holistic framework for evaluating and rating the community, environmental, and economic benefits of all types and sizes of infrastructure projects. It evaluates, grades, and gives recognition to infrastructure projects that use transformational, collaborative approaches to assess the sustainability indicators over the course of the project's life cycle.

Facility Condition Assessment - an industry term that describes the process of a qualified group of trained industry professionals performing an analysis of the condition of a group of facilities that may vary in terms of age, design, construction methods, and materials

Facility Condition Index (FCI) - used in facilities management to provide a benchmark to compare the relative condition of a group of facilities. The FCI is primarily used to support asset management initiatives of federal, state, and local government facilities organizations. It is defined as the total cost of Maintenance, Repair and Replacement Deficiencies Costs divided by the Current Replacement Value of a facility.

Life Cycle Cost Analysis - a tool to determine the most cost-effective option among different competing alternatives, when each is equally appropriate to be implemented on technical grounds. For example, for a highway pavement, apart from the initial construction cost, LCCA takes into account all the user costs, (e.g., reduced capacity at work zones), and agency costs related to future activities, including future periodic maintenance and rehabilitation. All the costs are usually discounted and totaled to a present day value known as net present value (NPV).

Net Zero Energy - the total amount of energy used by the building on an annual basis is equal to the amount of renewable energy created on the site.

Public Private Partnership - a contractual arrangement between a public agency (federal, state or local) and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public.

Sustainable Infrastructure - a broader, sustainable approach to water, wastewater, storm water, solid waste, and energy systems with a focus on climate-friendly strategies.

Sustainability – practices and philosophy of development which meets the needs of current generations without compromising the ability of future generations to meet their own needs. Requires the reconciliation across the "three pillars" of economic demands, environmental resilience, and social equity.

Total Cost of Ownership - a financial estimate intended to help owners determine the direct and indirect costs of a product, system, or asset which includes total cost of acquisition, operating costs and disposal over its life.

Water-Energy Nexus - the relationship between how much water is evaporated to generate and transmit energy, and how much energy it takes to collect, clean, move, store, and dispose of water.

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