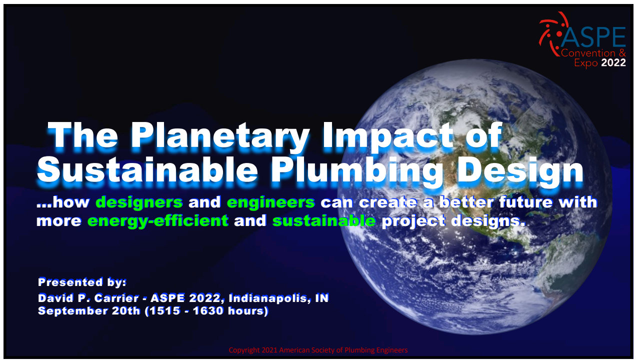
ASPE Convention & Expo 2022
The Planetary Impact of Sustainable Plumbing Design
...how designers and engineers can create a better future with more energy-efficient and sustainable project designs.
Presented by:
David P. Carrier - ASPE 2022, Indianapolis, IN
September 20th (1515 - 1630 hours)
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Agenda
• What must Change and Why?
• A Holistic Approach to the Future.
• Total Cost elimination through Design.
• Sustainability with the 70% Method.
• Our collective re-usable future.
• Your Sustainable Design Impact.

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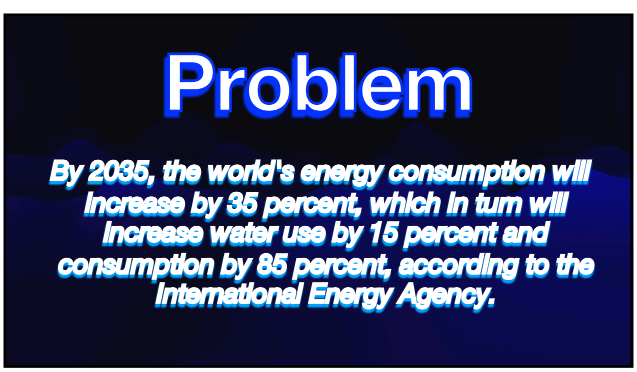
Problem
By 2035, the world's energy consumption will increase by 35 percent, which in turn will increase water use by 15 percent and consumption by 85 percent, according to the International Energy Agency.

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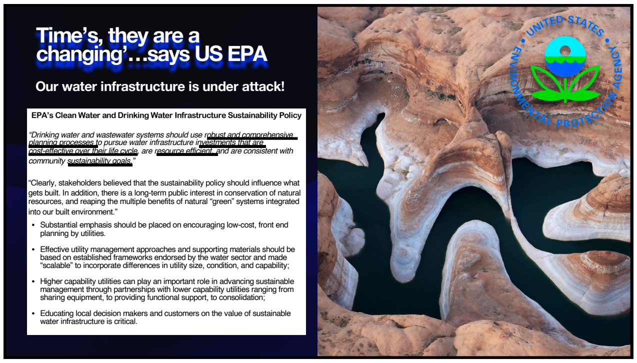
Time's, they are a changing'…says US EPA
Our water infrastructure is under attack!
EPA's Clean Water and Drinking Water Infrastructure Sustainability Policy
"Drinking water and wastewater systems should use robust and comprehensive planning processes to pursue water infrastructure investments that are cost-effective over their life cycle, are resource efficient, and are consistent with community sustainability goals."
"Clearly, stakeholders believed that the sustainability policy should influence what gets built. In addition, there is a long-term public interest in conservation of natural resources, and reaping the multiple benefits of natural "green" systems integrated into our built environment."
• Substantial emphasis should be placed on encouraging low-cost, front end planning by utilities.
• Effective utility management approaches and supporting materials should be based on established frameworks endorsed by the water sector and made "scalable" to incorporate differences in utility size, condition, and capability;
• Higher capability utilities can play an important role in advancing sustainable management through partnerships with lower capability utilities ranging from sharing equipment, to providing functional support, to consolidation;
• Educating local decision makers and customers on the value of sustainable water infrastructure is critical.
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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According to the EPA, these are some of the benefits of sustainable design.
Using energy more efficiently is one of the fastest, most cost-effective ways to save money, reduce greenhouse gas emissions, create jobs, and meet growing energy demand. The many benefits of energy efficiency include:
• Environmental: Increased efficiency can lower greenhouse gas (GHG) emissions and other pollutants, as well as decrease water use.
• Economic: Improving energy efficiency can lower individual utility bills, create jobs, and help stabilize electricity prices and volatility.
• Utility System Benefits: Energy efficiency can provide long-term benefits by lowering overall electricity demand, thus reducing the need to invest in new electricity generation and transmission infrastructure.
• Risk Management: Energy efficiency also helps diversify utility resource portfolios and can be a hedge against uncertainty associated with fluctuating fuel prices.
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What Can We Do? Taken directly from the U.S. EPA website
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• Architects and Engineers: By 2035, 75 percent of the buildings in the United States will be either new or renovated. Architects have a unique opportunity to change the way buildings use energy and contribute to carbon emissions.
• Commercial Real Estate: The average building wastes about a third of the energy it consumes. This impacts the retro-fit market for sustainability!
• Congregations: Most congregations can cut energy costs by up to 30% by investing strategically in efficient equipment, facility upgrades and maintenance.
• Health care: Every dollar a nonprofit health care organization saves on energy is equivalent to generating new revenues of $20 for hospitals or $10 for medical offices. How does 10-20 Times ROI sound
• Higher Education: ENERGY STAR helps institutions become environmental leaders and save money for repair and renovation, hiring of new faculty, new construction, and other core activities. This frees up funds for more development, hence more for money for Designers!
• Hotels and Hospitality: On average, America's 47,000 hotels spend about 6 percent of their operating costs on energy each year. Whether the facility is a large convention hotel, part of a national chain, or a small inn or motel, there are energy efficiency opportunities that will improve guest comfort, lengthen equipment life, and reduce operating costs.
• Manufacturing and Industry: Whether making steel, refining oil, or canning vegetables, there is a lot of room for improving energy efficiency throughout the industry. All the discussions today are applicable.
• Schools: The annual energy bill to run America's primary and secondary schools is a staggering $8 billion. Government is great at legislation and terrible at execution, so they really need OUR HELP as a constituency!
• Restaurants: Restaurants are energy-intensive operations due to cooking equipment, heating, cooling, lighting, and sanitation, often using five to seven times more energy per square foot than other commercial buildings.

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Global Governments within the United Nations also realize that we can capitalize on the "domino effect" that is created when the "built environment" is pre-planned for very specific outcomes. This begins at the Design Stage with you!

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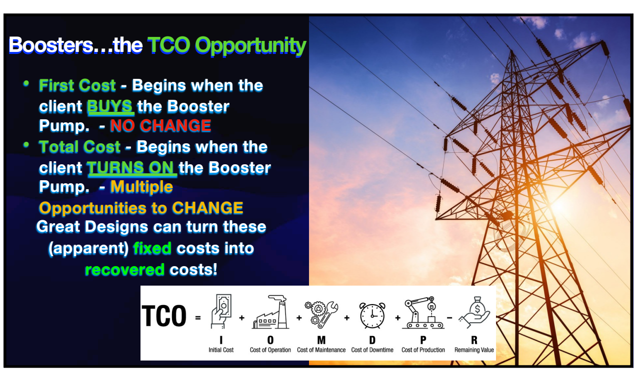
SUSTAINABLE DEVELOPMENT GOALS
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
To build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
SUSTAINABLE DEVELOPMENT GOALS
the UN
many
will be
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

9


Boosters…the TCO Opportunity
First Cost - Begins when the client BUYS the Booster Pump. - NO CHANGE
Total Cost - Begins when the client TURNS ON the Booster Pump. - Multiple Opportunities to CHANGE
Great Designs can turn these (apparent) fixed costs into recovered costs!
TCO = I + O + M + D + P - R
I Initial Cost
O Cost of Operation
M Cost of Maintenance
D Cost of Downtime
P Cost of Production
R Remaining Value

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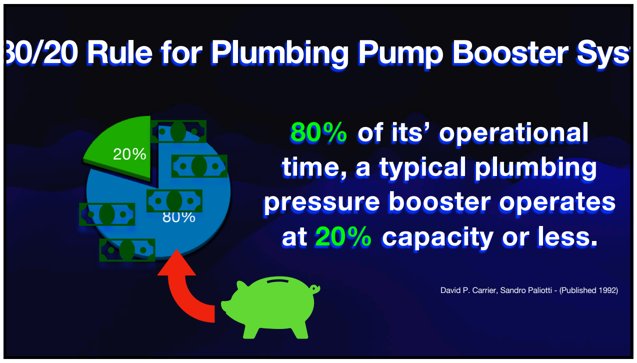
30/20 Rule for Plumbing Pump Booster Sys
20%
80%
80% of its' operational time, a typical plumbing pressure booster operates at 20% capacity or less.
David P. Carrier, Sandro Paliotti - (Published 1992)

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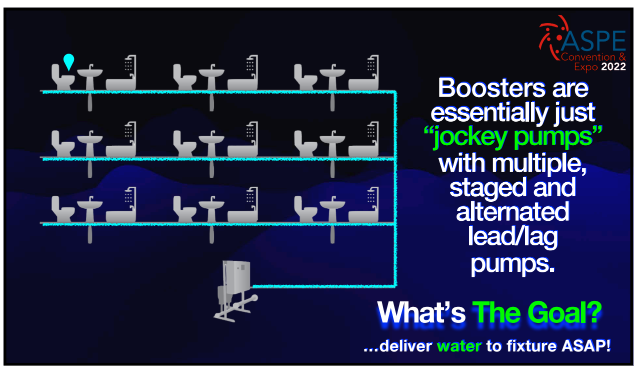
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Boosters are essentially just "jockey pumps" with multiple, staged and alternated lead/lag pumps.
What's The Goal?
...deliver water to fixture ASAP!

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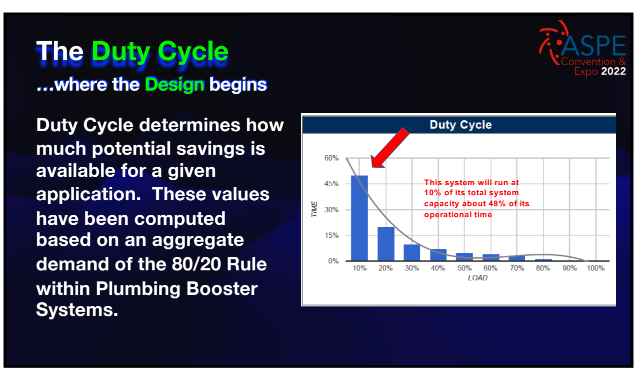
The Duty Cycle
...where the Design begins
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Duty Cycle determines how much potential savings is available for a given application. These values have been computed based on an aggregate demand of the 80/20 Rule within Plumbing Booster Systems.
Duty Cycle
This system will run at 10% of its total system capacity about 48% of its operational time
TIME
60%
45%
30%
15%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
LOAD

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The Load Cycle

...where Design becomes dollars

Load Cycle shows the corresponding time required for the system to run at a specific GPM to meet make-up DEMAND. This correlates to the power required to perform under load and may include one or more pumps in parallel!

Load Cycle			
Load[%]	Flow[GPM]	Time[%]	Hours per Year[hr/y]
100	210	0	0.00
90	189	0	0.00
80	168	1	87.36
70	147	3	262.08
60	126	4	349.44
50	105	5	436.80
40	84	7	611.52
30	63	10	873.60
20	42	20	1,747.20
10	21	50	4,368.00

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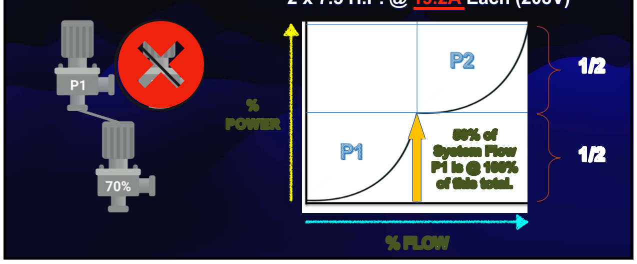
The 70% Method

Turning efficiency into sustainability

2 x 7.5 H.P. @ 19.2A Each (208V)



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The 70% Method

Maximizing the Method...

12.7 Amps P1 Full Load
+ 3.68 AMPS P2 @ 66% Load (29%)
= Total Power of 16.38 AMPS

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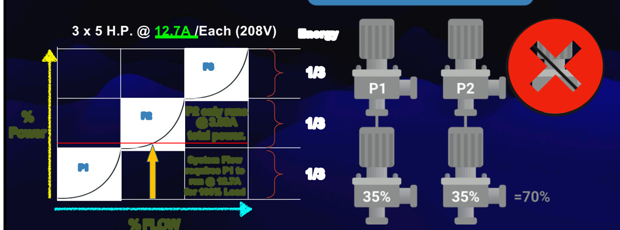
3 x 5 H.P. @ 12.7A /Each (208V)



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70% Method - Summary
more pumps, smaller pumps, same redundancy, greater savings!
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Duplex System example used (2) 7.5. Motors.
Triplex example sized for the same condition requires (3) 5 H.P. Motors
Net estimated Savings per day ONLY by selection optimization equals 12.4% based on an 8 hour day.
The 70% Method forces the designer to embed the concept of Total Cost of Ownership into the design rationale.
The 70% Method is better than past methods!
Add another Pump
Increase the GPM flow arbitrarily
Double the result of the GPM Flow required
Now featured in the Plumbing Engineering Designers Handbook, Volume #4 - Chapter 5!

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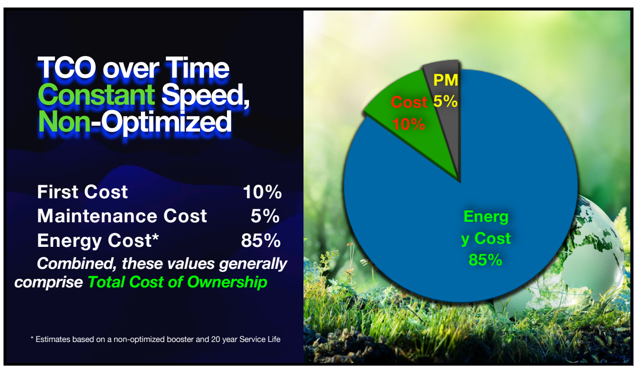
TCO over Time
Constant Speed,
Non-Optimized
First Cost 10%
Maintenance Cost 5%
Energy Cost* 85%
Combined, these values generally comprise Total Cost of Ownership
* Estimates based on a non-optimized booster and 20 year Service Life
PM 5%
Cost 10%
Energ y Cost 85%

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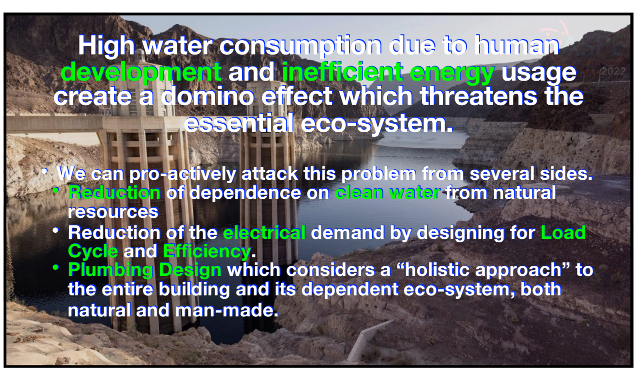
High water consumption due to human development and inefficient energy usage create a domino effect which threatens the essential eco-system.
We can pro-actively attack this problem from several sides.
Reduction of dependence on clean water from natural resources
Reduction of the electrical demand by designing for Load Cycle and Efficiency.
Plumbing Design which considers a “holistic approach” to the entire building and its dependent eco-system, both natural and man-made.

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Cost-Effective Reuse
Rainwater not Graywater!
• Water is one of Earth's commodities for which there is NO economic substitute.
• Rainwater is plentiful in certain areas requiring less storage.
• Rainwater storage can supplement in areas requiring conservation.
• Rainwater is essentially free and in a near-clean state.
Coupled with Proper Sizing and the 70% Method, these strategies can Supercharge your TCO Goals!

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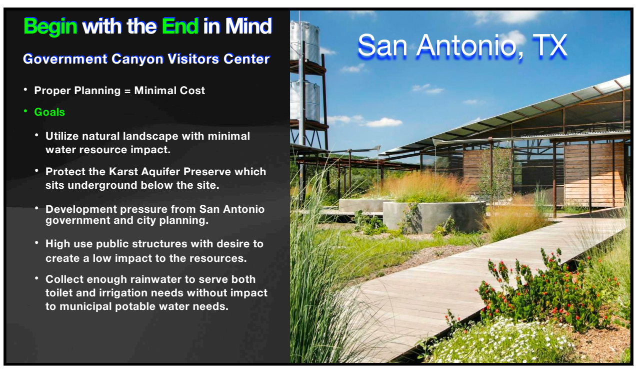
Begin with the End in Mind
Government Canyon Visitors Center
• Proper Planning = Minimal Cost
• Goals
• Utilize natural landscape with minimal water resource impact.
• Protect the Karst Aquifer Preserve which sits underground below the site.
• Development pressure from San Antonio government and city planning.
• High use public structures with desire to create a low impact to the resources.
• Collect enough rainwater to serve both toilet and irrigation needs without impact to municipal potable water needs.
San Antonio, TX

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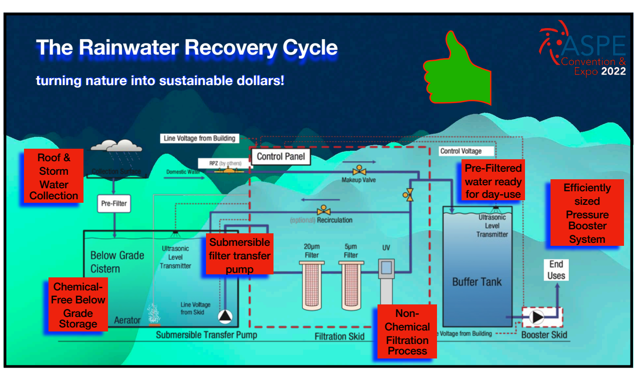
The Rainwater Recovery Cycle
turning nature into sustainable dollars!
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Line Voltage from Building
Roof & Storm Water Collection
Collection Surface
Domestic Water
RPZ (by others)
Control Panel
Control Voltage
Makeup Valve
Pre-Filtered water ready for day-use
Efficiently sized Pressure Booster System
Pre-Filter
(optional) Recirculation
Ultrasonic Level Transmitter
Below Grade Cistern
Ultrasonic Level Transmitter
Submersible filter transfer pump
20μm Filter
5μm Filter
UV
Buffer Tank
End Uses
Chemical-Free Below Grade Storage
Aerator
Line Voltage from Skid
Submersible Transfer Pump
Filtration Skid
Non-Chemical Filtration Process
Voltage from Building
Booster Skid

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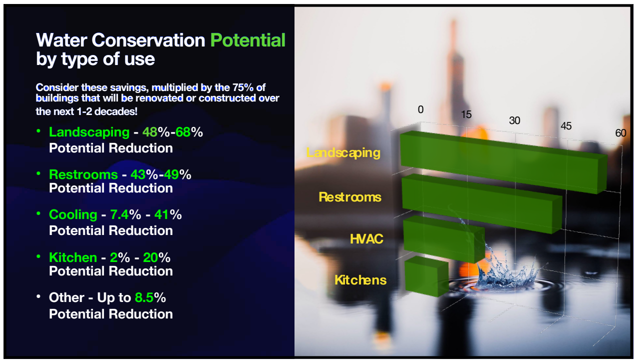
Water Conservation Potential by type of use
Consider these savings, multiplied by the 75% of buildings that will be renovated or constructed over the next 1-2 decades!
Landscaping - 48%-68% Potential Reduction
Restrooms - 43%-49% Potential Reduction
Cooling - 7.4% - 41% Potential Reduction
Kitchen - 2% - 20% Potential Reduction
Other - Up to 8.5% Potential Reduction
0
15
30
45
60
Landscaping
Restrooms
HVAC
Kitchens

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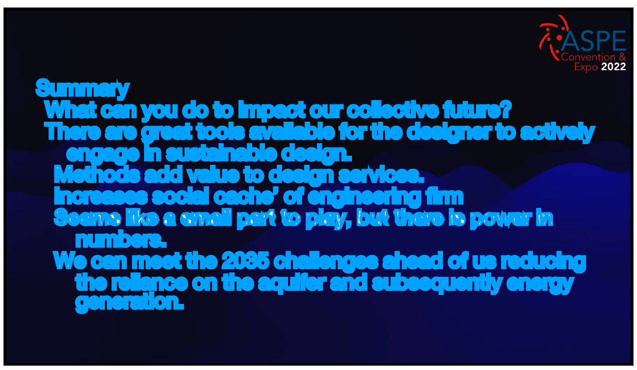
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Summary
What can you do to impact our collective future?
There are great tools available for the designer to actively engage in sustainable design.
Methods add value to design services.
Increases social cache' of engineering firm
Seems like a small part to play, but there is power in numbers.
We can meet the 2035 challenges ahead of us reducing the reliance on the aquifer and subsequently energy generation.

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