AMERESCO QUANTUM

Green • Clean • Sustainable

New Energy Saving Technologies: What Works (and What Doesn't)

Energy/Facilities Connections 2011

Agenda

- Ameresco Quantum Overview
- Air to Water Heat Pump Technology
  - Grant Thorsland. Ameresco Quantum
- Lighting technology
  - Randy Owen. Northwest Edison
- Solar Assisted & Heat Pump Water Heating
  - Jeremy Keller, Ameresco Quantum

Who We Are

- Largest independent Energy Services Company (ESCO) in North America
  - Completed more than $3.5 billion in energy projects
  - 56 offices, including Renton, Spokane and Portland
  - Over 100 customers in WA and OR
  - Over 750 employees dedicated to energy performance contracting
  - Expertise in renewable energy technologies
- What is meant by an “independent ESCO”?
  - We don’t sell building controls or mechanical contracting services
  - We help each customer objectively select and procure the products, technologies and sub-contractors best suited to their needs
  - We reduce costs by competitively bidding labor and materials
  - We provide complete transparency and true open-book pricing

What We Do

- Energy Savings Performance Contracting
  - Development, design, engineering, and installation of measures that provide guaranteed reductions in energy and operational costs
- Renewable Energy
  - Biomass, geothermal (GSHP), solar thermal & solar PV
- Project Financing & Third-Party Ownership
  - Loan packaging/RFPs
  - Power Purchase Agreements (PPAs)
  - Design, Build, Own, Operate & Maintain (DBOOM)
- Facility Condition Assessments
  - A road map for strategic decisions that enable customers to reduce operating costs, enhance facility conditions, improve environmental scores and adapt to change

What Makes Us Different

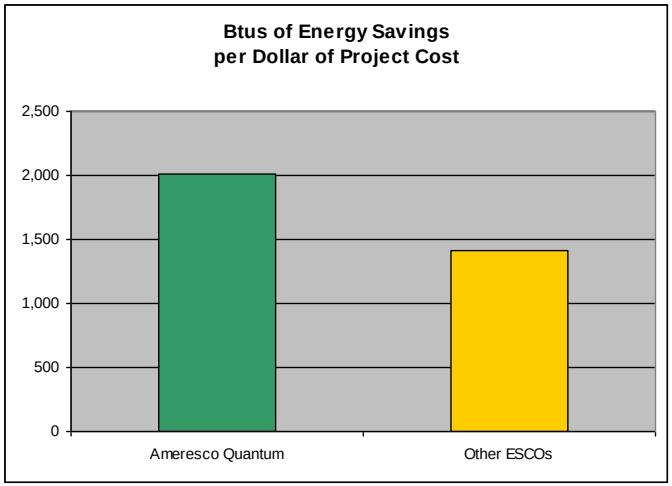
- Independence
- Unique Project Development Process
  - Our rigorous audits rely on system monitoring & measurement,
- Engineering Focus
  - Experts in energy and water conservation
  - Best commissioning team in the industry
- Collaborative & Transparent Approach
  - We focus on listening to and responding to customer needs
- Real savings guarantees
  - Based on clear, measureable criteria
- Reputation for quality, responsiveness, and post project support

Why We Provide the Most Value

- We **identify more savings** in the audit phase
- We **secure higher incentives** for our customers
- We **competitively bid** labor and materials to customer-approved subcontractors
- We **deliver he highest energy savings** per project dollar

OSPI/Commerce Grant Study

- Study compiled data from 113 ESPCs for 94 school districts[1]
- We secured grants for more projects than all other ESCOs combined
- We **secured higher incentives** for our customers
  - Our projects represented 41 % of project costs but 62% of all utility incentives
  - On average our projects earned utility incentives that offset 2.5 times more of the project costs than those of other ESCOs
- We **delivered the highest energy savings** per project dollar
  - On average our projects generated 43% more energy savings per project dollar (excluding ESCOs with less than 3 projects)



1. All ESPC projects for which Energy Services Proposals were available as of 3/15/11.

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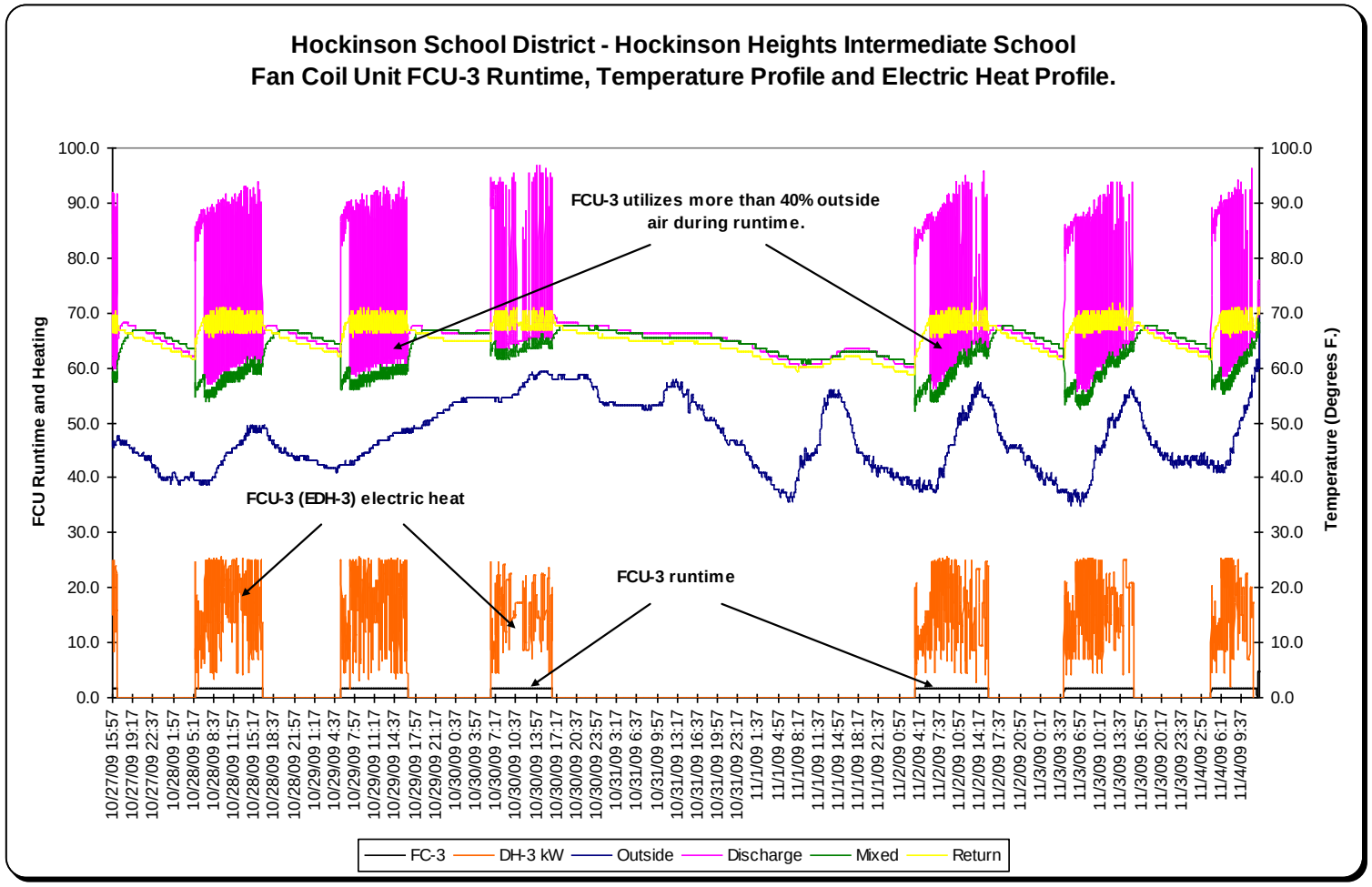
Air-to-Water Heat Pump Technology

Case Study – Hockinson Heights Intermediate School

- Existing System
  - Fan Coil Units with Chilled Water and Electric Resistance Heat
  - Failing Air Cooled Chiller
  - Annual Electrical Energy Use – Based on Monitored Data
    - 440,000 kWh and 1,360 kW Annually ($28,500)

Air-to-Water Heat Pump Technology

Case Study – Hockinson Heights Intermediate School



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Air-to-Water Heat Pump Technology

Case Study – Hockinson Heights Intermediate School

- Proposed Solution - Air-To-Water Heat Pump Retrofit
  - Replace Existing Air Cooled Chiller with a New Air-To-Water Heat Pump Chiller.
  - New Heat Pump Chiller Provides both Heating and Cooling
  - New Heat Pump Chiller has a COP of 2.5 to 3.0
    - COP = Coefficient of Performance (BTU In –vs- BTU Out)
  - Proposed Annual Electrical Energy Use
    - 206,000 kWh and 1,090 kW Annually ($16,400)
    - Heat Pump Selection has a COP of 2.6
  - Installed Cost - $200,000
  - Utility Incentive - $46,000
  - Simple Payback – 12.3 Years

Air-to-Water Heat Pump Technology

Case Study – Hockinson Heights Intermediate School

Things to Consider When Purchasing Fixtures

- Light source efficiency (lumens per watt or **Efficacy factor**)

Mathematical definition $\frac{\int_0^\infty y_\lambda J_\lambda d\lambda}{\int_0^\infty J_\lambda d\lambda},$

- Fixture efficiency – how efficient is the light fixture getting the linier light out of the box?
- Lumen maintenance – what percentage of initial lumens will the light source have at its rated end of life?
- Rated life of light source
- Was the fixture designed to be maintenance friendly?

Criteria for Putting Together a Lighting Project

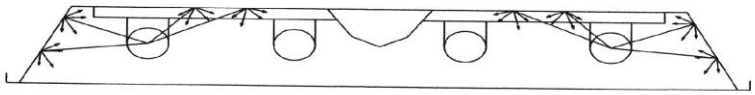
- **Energy savings** – While this is the driving factor it should not be the only consideration; other considerations should include:
- **Budget** – Reducing operating costs, bulb life, etc.
- **Awareness** – Public perception about an energy project can affect its ultimate acceptance by users
- **Correcting existing problems**
  - poor light levels
  - light pollution
  - previous misguided energy project

Pre & Post Retrofit Efficiency

Before Retro-fit

Typical Efficiency 55%

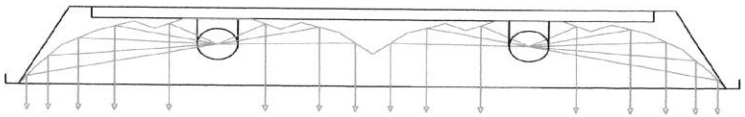
Typical Characteristics before retro-fit
1) Diffused light, unable to direct light to maximize efficiency.
2) Scattered light bounces too many times before exiting fixture.
3) Extra lamps producing more heat creating additional load on air conditioning.



After Retro-fit

Typical Efficiency 90%

Typical Characteristics of retro-fitted fixture
1) Aimable light, Able to redirect light in an efficient manner.
2) Most light is reflected out of fixture on first bounce
3) Half as many lamps needed to produce same or better light levels.



SUMMARY

It is crutial to redirect as much light as possible out of the fixture as possible, as you can see in the before retro-fit model, light is scattered and unable to exit fixture efficiently, whereas the 95% specular reflector is able to redirect light making the target efficiency much better, in other words putting light exactly where you want it and also reducing wattage 40% to 60%.

What Works and Reasons for Caution

What Works

- Latest generation of T8 lamp/ballast combination with standard, hi lumen, and reduced wattage lamps (32, 28, and 25watt). Up to 60,000 hours of rated life! (Make sure existing ballasts will drive them if doing a group relamp with 28 or 25 watt lamps.)
- T8, T5, and some cases induction for high bay replacements. Use controls whenever possible – instant on allows for hi/low or on/off to maximize savings.
- T8, T5, and some cases induction for parking lot and area lighting. Again, use controls whenever possible.
- LED's for recessed can lights, MR16's, PAR lamps, and areas such as flagpole lights or sign lights.
- Daylight harvesting with step dimming.
- Wireless sensors – allows for sensoring some areas previously not possible

Use Caution

- LED linier lamp replacements.
- LED panel replacements for lay in fixtures.
- LED or some cases induction for high bay replacements.
- LED's for parking lots, street lighting, and wall packs.
- Daylight harvesting with full dimming capabilities.

Efficient Water Heating

- Solar Hot Water
  - Also know as “Solar Thermal”
  - Basic Collector Types
  - Keys to Success

- Heat Pump Domestic Water Heating
  - Integrated tank models
  - Heat Pump Chiller integration

Solar Hot Water

- 3 Basic Collector Types
  - Flat plate Collectors
  - Evacuated Tube Collectors
  - “Plastic Mat” Pool Collectors
- No one collector is best
  - Depends on the load, location and system

Flat Plate Collectors

Schuco Premium LA panels installed in Seaford, DE

Evacuated Tube Collector

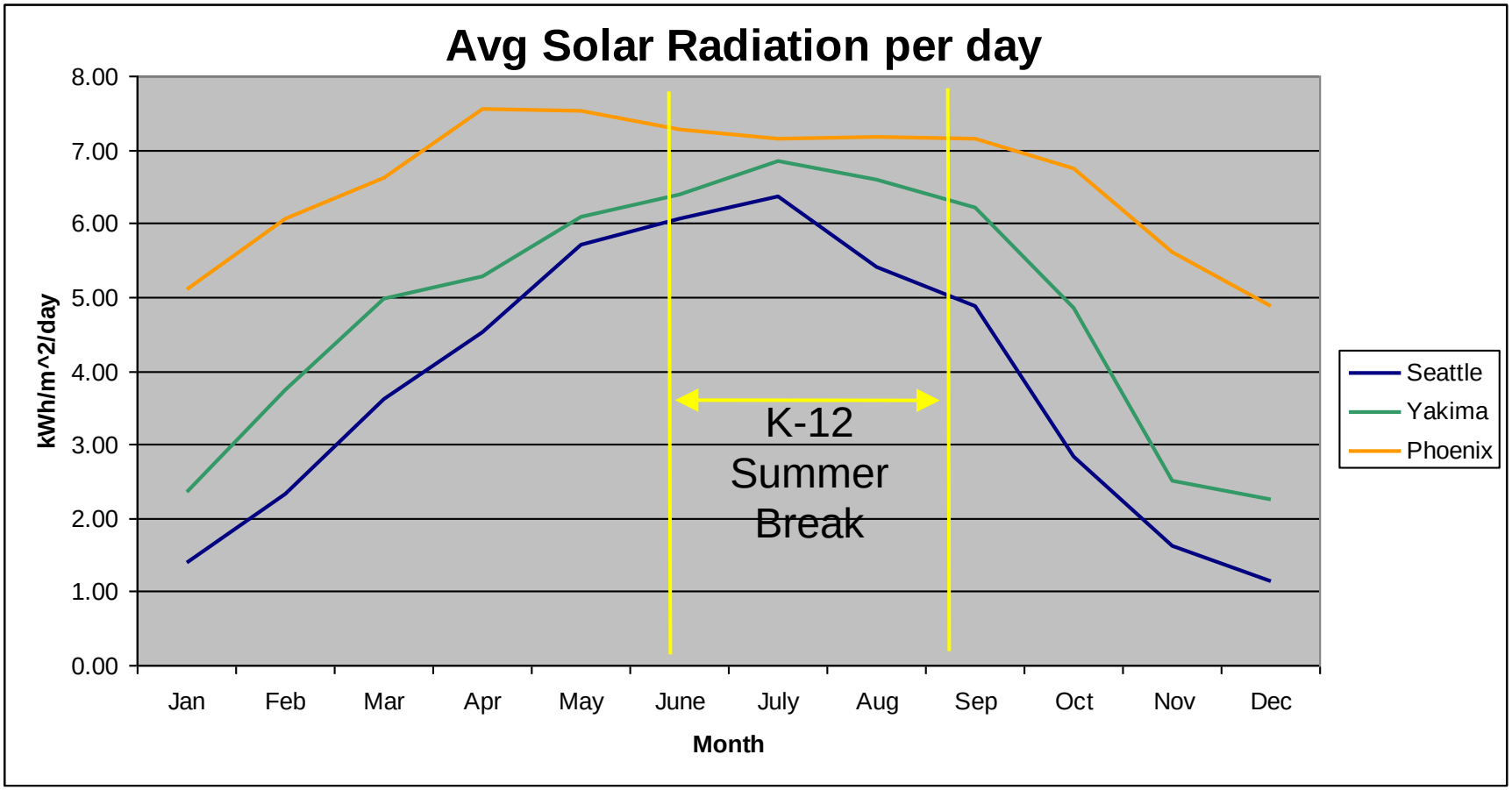
Endless Solar Evacuated Tube Collector

“Plastic Mat” Pool Collector

Pool Pro Solar, Sarasota, Florida

Domestic Hot Water Load Profile is Everything

- The water usage during the year needs to match the sunshine



Solar Hot Water

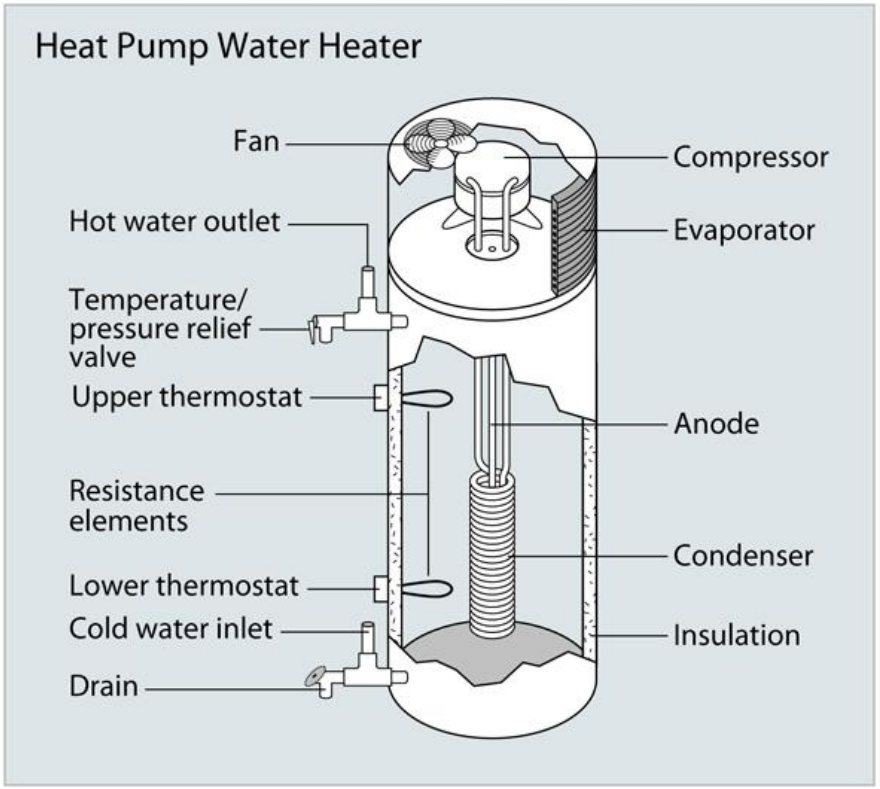
- Typical Best Uses, Benefits, Negatives
  - "Plastic Mat" Pool Collectors
    - Outdoor Pools
    - Lowest initial cost
    - Must be winterized
  - Evacuated Tubes
    - High Temperature Process Loads, 140F and higher
    - Look High Tech
    - Great System Durability
    - Most expensive to install
  - Flat Plate Collectors
    - Domestic Hot Water
    - Year Around Pool Heating
    - Good for "Large" systems
    - Most Proven

General Keys to Solar Energy

- Must have Southern unobstructed exposure
- Lower temperature Loads are better
- Collector installation location close to mechanical space is ideal
- Typical payback anywhere from 10-40 years
  - Fuel cost and load profile critical to payback
- Equipment Life span 20-30 years
  - Low maintenance costs
  - Well proven technology

Heat Pump Domestic Water Heating

- Integrated Tank Models
  - 50-80 gallon models
  - Heat pump with electric element back-up
  - 3 times more efficient then electric tanks
  - Pulls heat from the space!

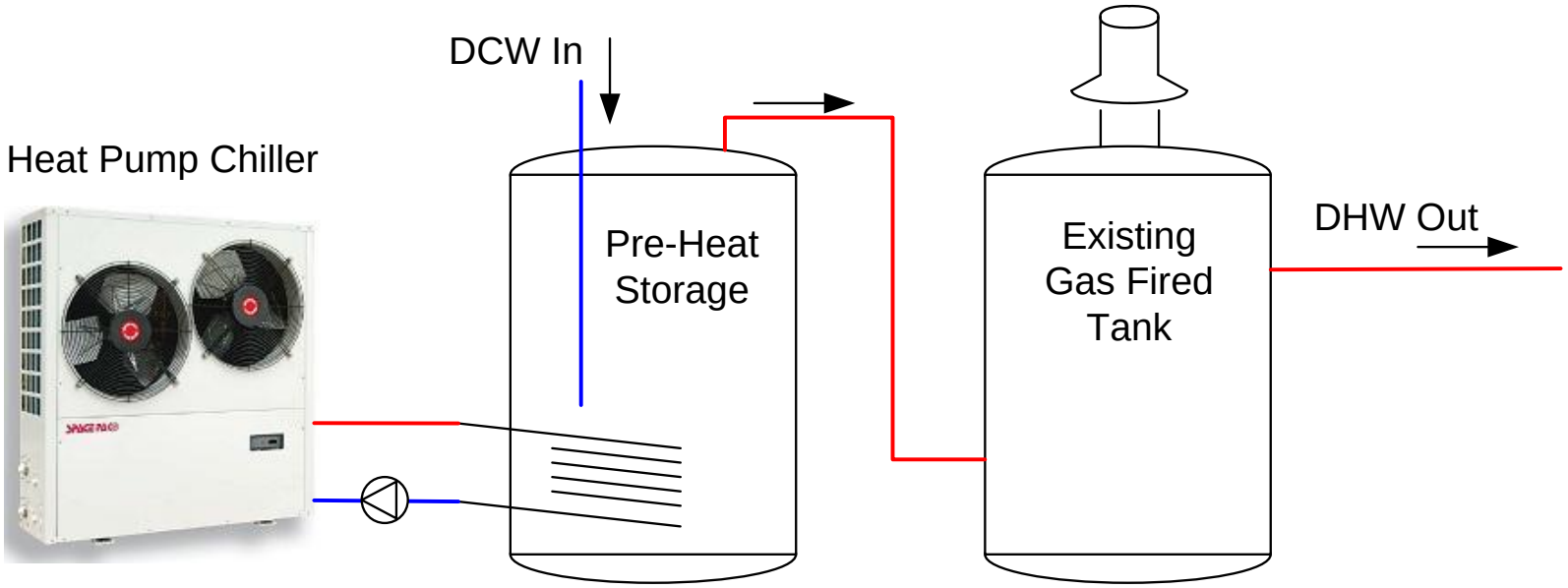


Pulls Heat from the Space

- Heat pump can quickly extract all of the heat from a small area
- Best Locations:
  - Conditioned spaces dominated by their Cooling Load
  - Boiler Rooms
  - Unconditioned spaces with access to Outdoor Air
- Poor Locations:
  - Janitorial closets
  - Conditioned spaces dominated by their heating load
    - The heating system will run to make up the heat for the DHW
  - Small tightly sealed spaces

Heat Pump Chiller Domestic Hot Water

- Additional load for large 20 ton+ units used for space heating/cooling
- Extremely high summer time heating efficiency, 600%+
- Pre-heat dhw, typically keep existing DHW tank



Q & A

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