



Business Case for  
Natural Refrigerants

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June 12-14, 2018 – Long Beach

# CO<sub>2</sub> Hot Water

## Continuing Progress

John Miles

SANCO<sub>2</sub>



# CO<sub>2</sub> Heat Pump Water Heater

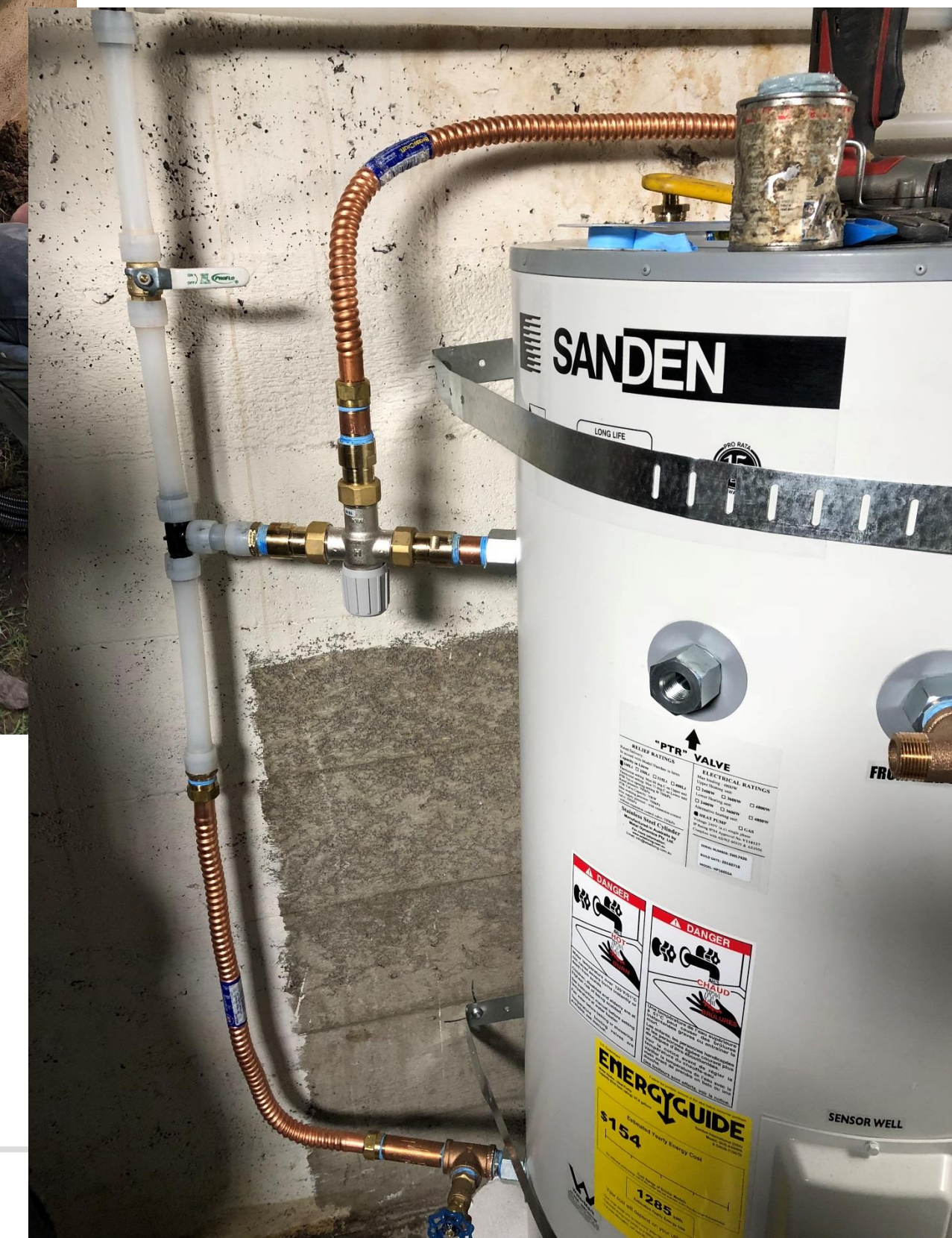


Split system HPWH, based on the Japanese Eco Cute CO<sub>2</sub> Water Heaters, ETL & ETLc approved, North American sales launch August 2016

2 Part system, uses 43 or 83 Gallon Stainless Steel storage tank or larger capacity Glass lined storage tanks coupled with a 4.5kw (15,400 Btu/h) capacity Inverter Compressor Outdoor unit

#1 in Real World Efficiency for ALL Water Heaters

# 1 in Performance for ALL Electric Storage Water Heaters

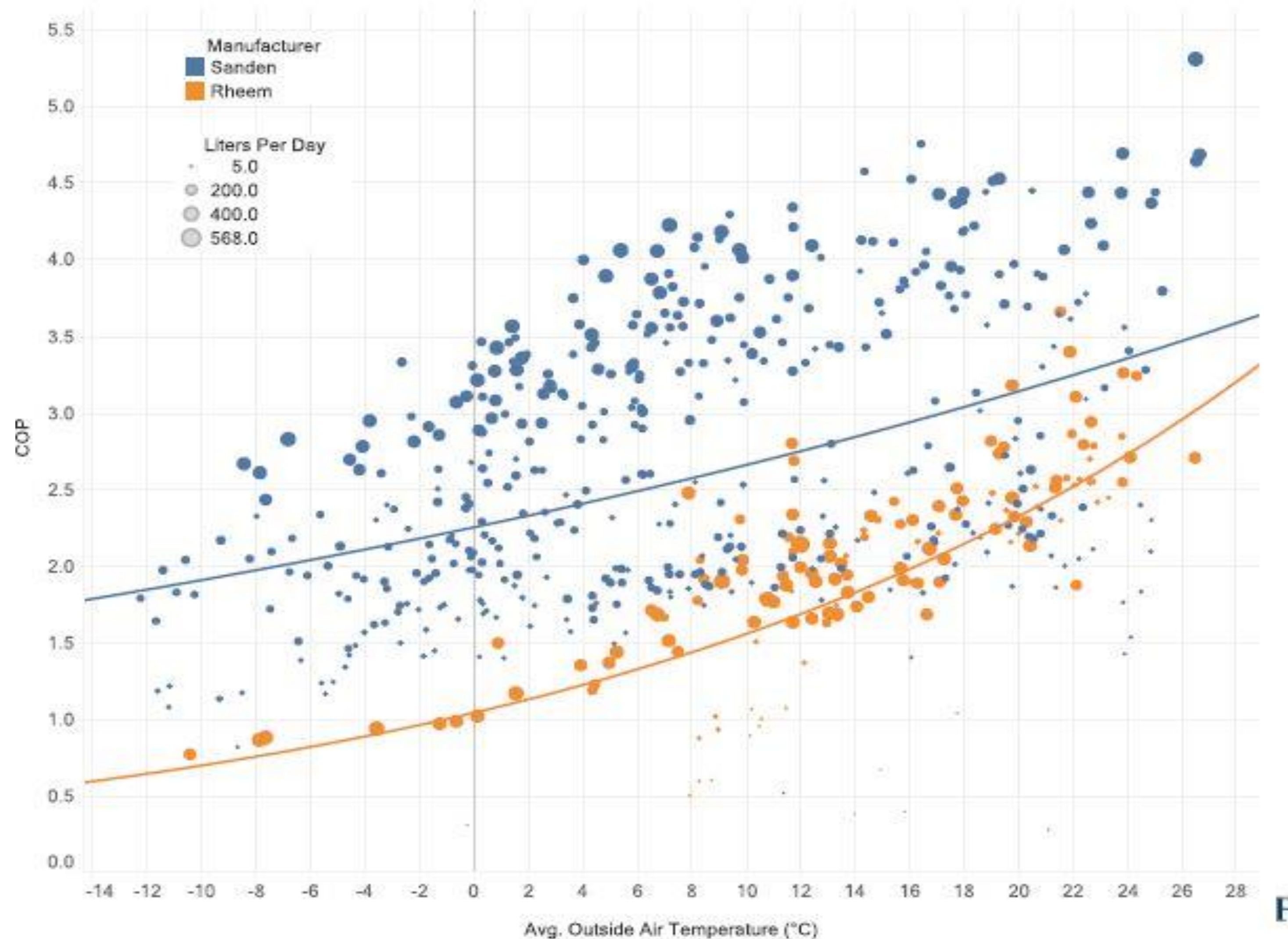


North American Hot Water market is approximately 9M units per year

Market is dominated by Gas or Electric Water Heaters with less than 60,000 **TOTAL** Heat Pump Water Heaters (HPWH) are sold (Both HFC & Natural refrigerant's, equals less than a 1% market share)

Apart from the SANCO<sub>2</sub> all other HPWH's sold use either HFC refrigerants, either R134a or R410A

On average a household can save over \$5,000 in lifetime electric utility costs using a SANCO<sub>2</sub> compared to a standard Electric Water Heater





# Utility Demand Response Program



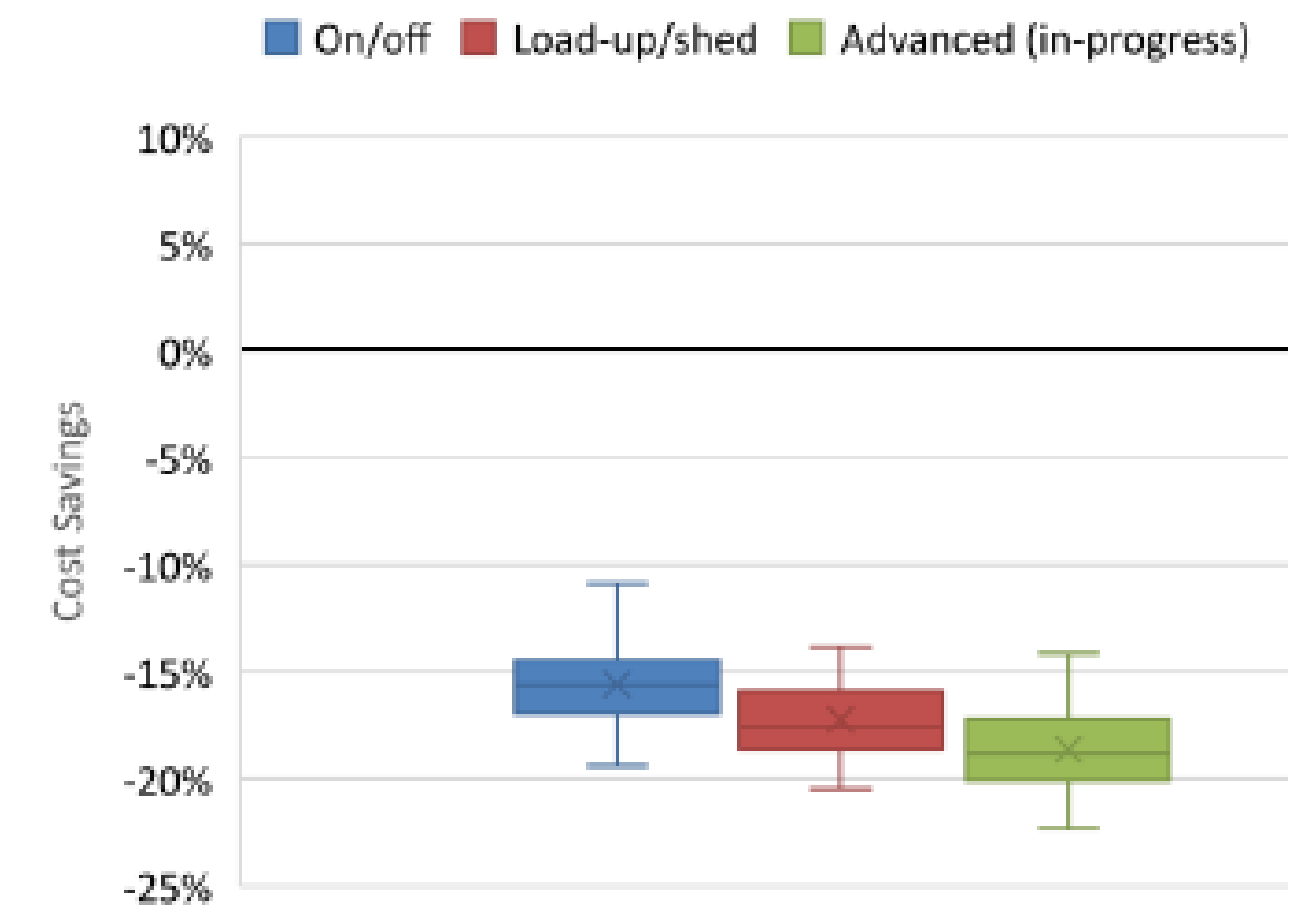
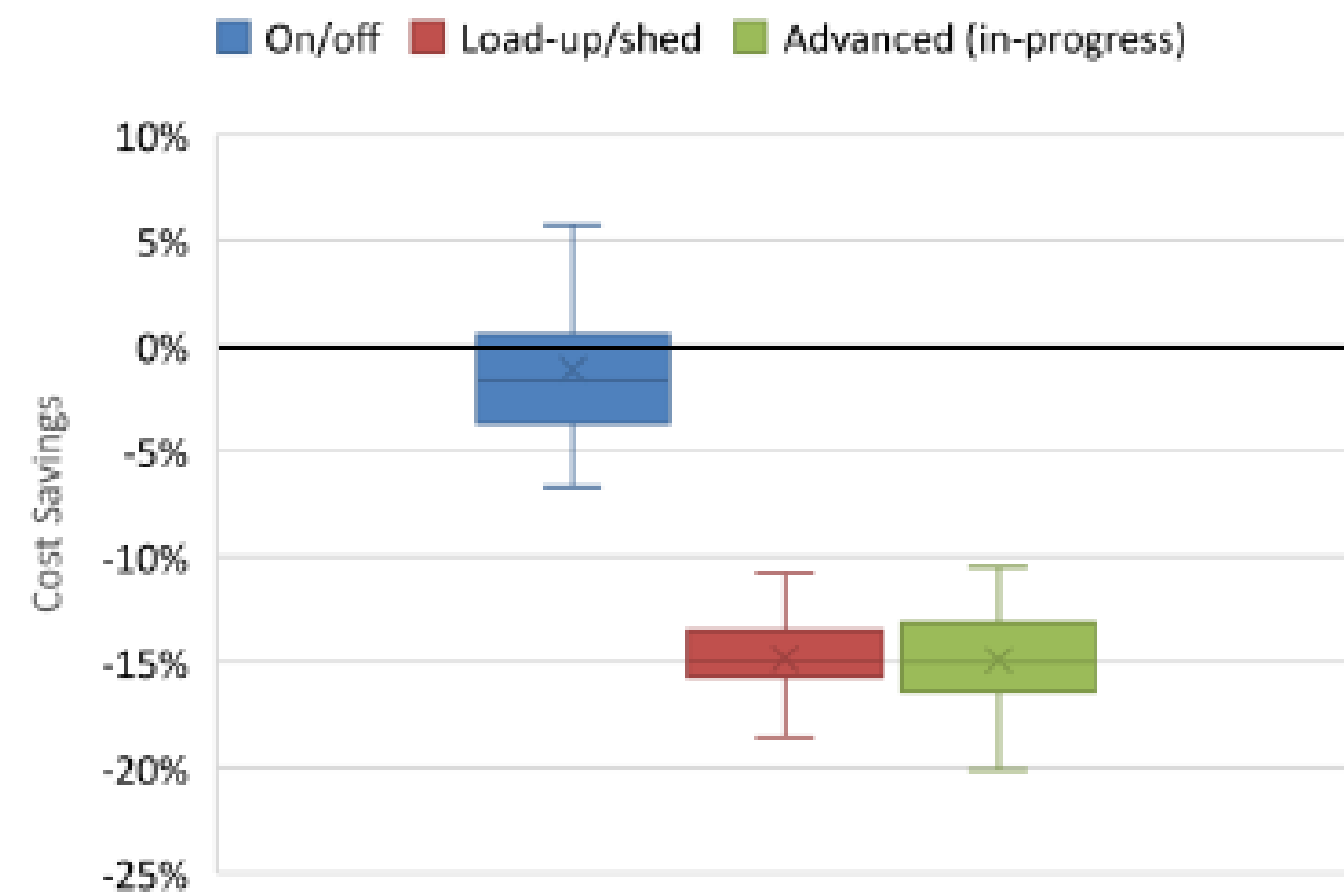
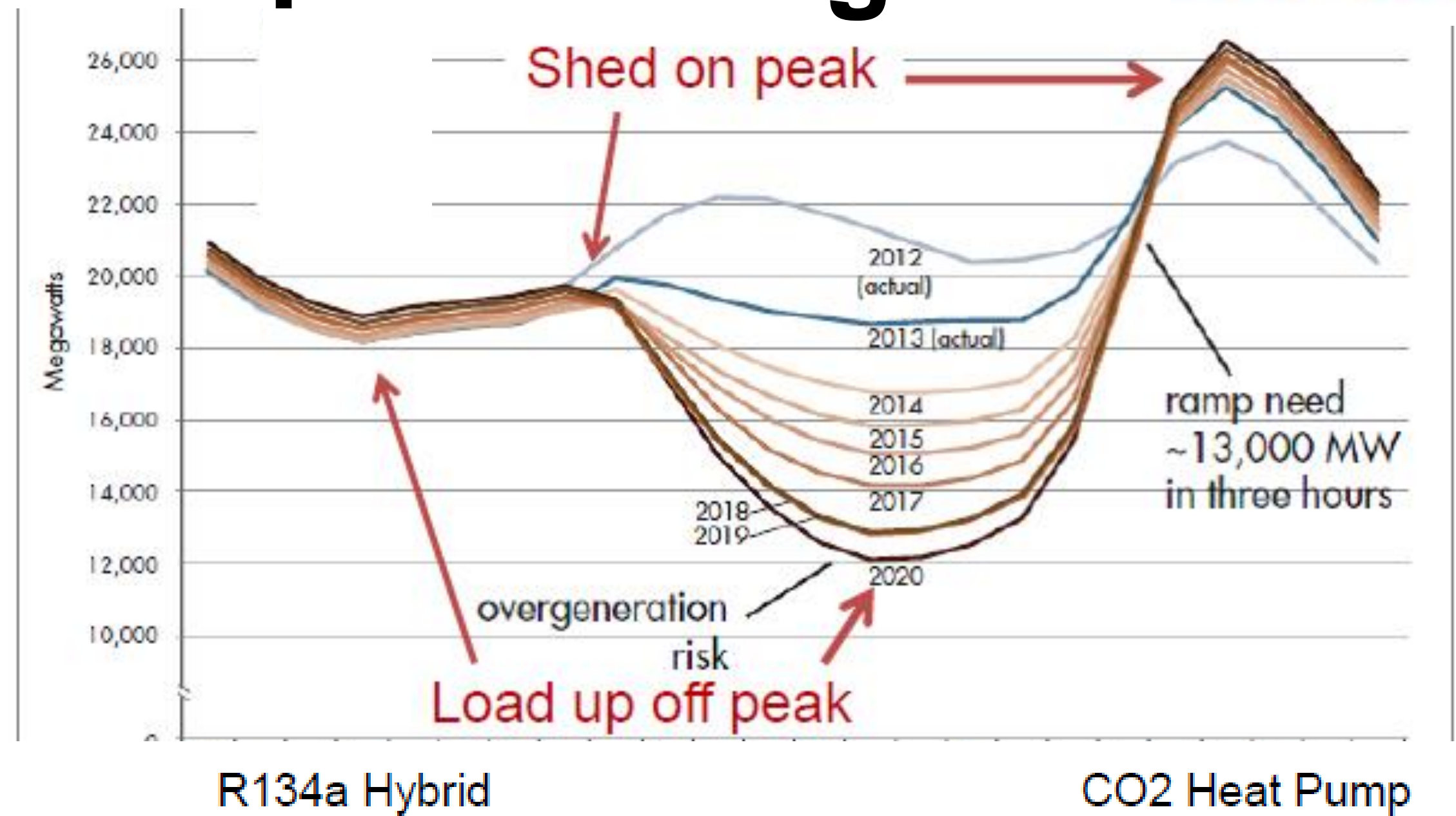
Utilities are looking at Water Heating as a way to control the power grid and solve growing Duck curve issues

Fuel switching to replace Natural Gas with Electric Water Heating to reduce GHG emissions is being studied heavily

Heat Pump Water Heaters have great potential in this application

Independent Lab Testing is being performed at this time

SANCO<sub>2</sub> is outperforming the HFC refrigerant products, even without control optimization



➤ On/off strategy yields limited savings with R134a hybrid technology, and causes significant runouts

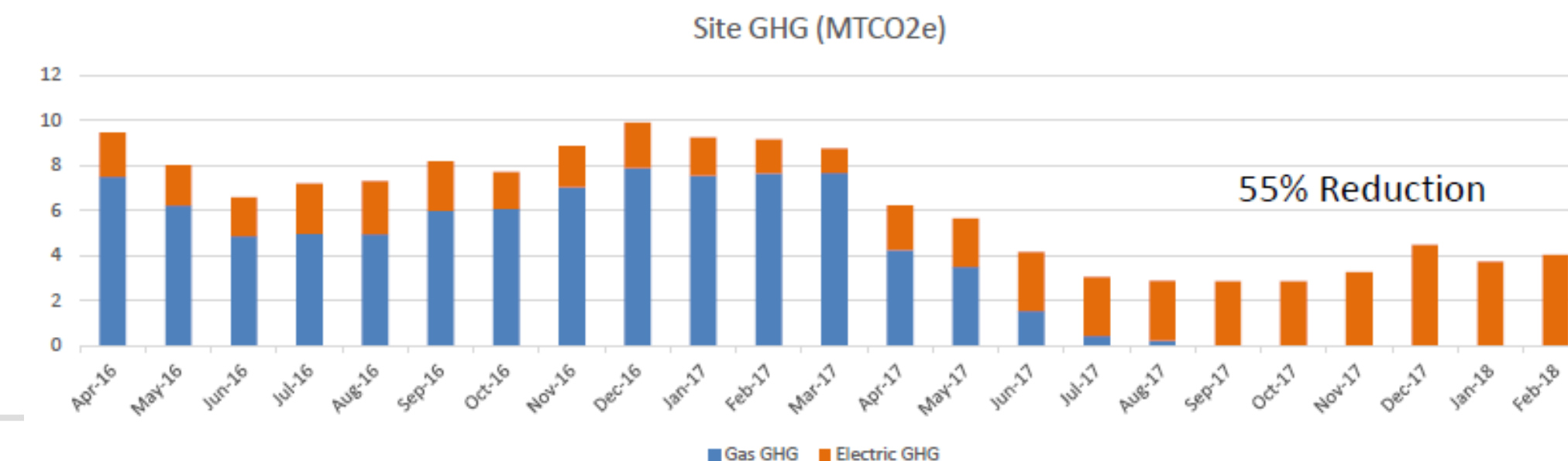
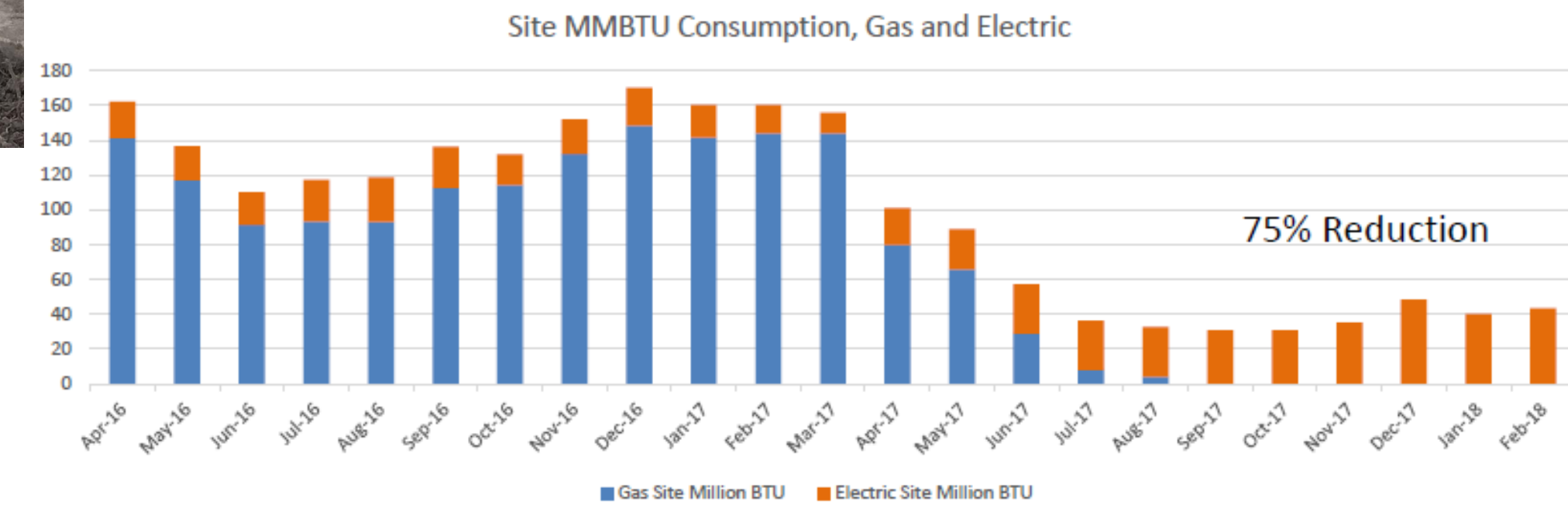
Multi Family is a good application for the SANCO<sub>2</sub> as the volume of Hot Water used is greatly multiplied reducing ROI time

Case Study in Fresno, CA  
 93 Apartments in 16 Buildings  
 Previous Hot Water : 3 x 500 Mbtu/h, 80 Gallon Water Heaters  
 Replaced with 26 x SANCO<sub>2</sub> units attached to 22 x 83 Gallon Tanks



## Results :

75% reduction in total Water Heating Energy Use AND 55% reduction in GHG emissions  
 30kw Solar PV array provides power for SANCO<sub>2</sub> units



Case Study : School in Mobile, AL

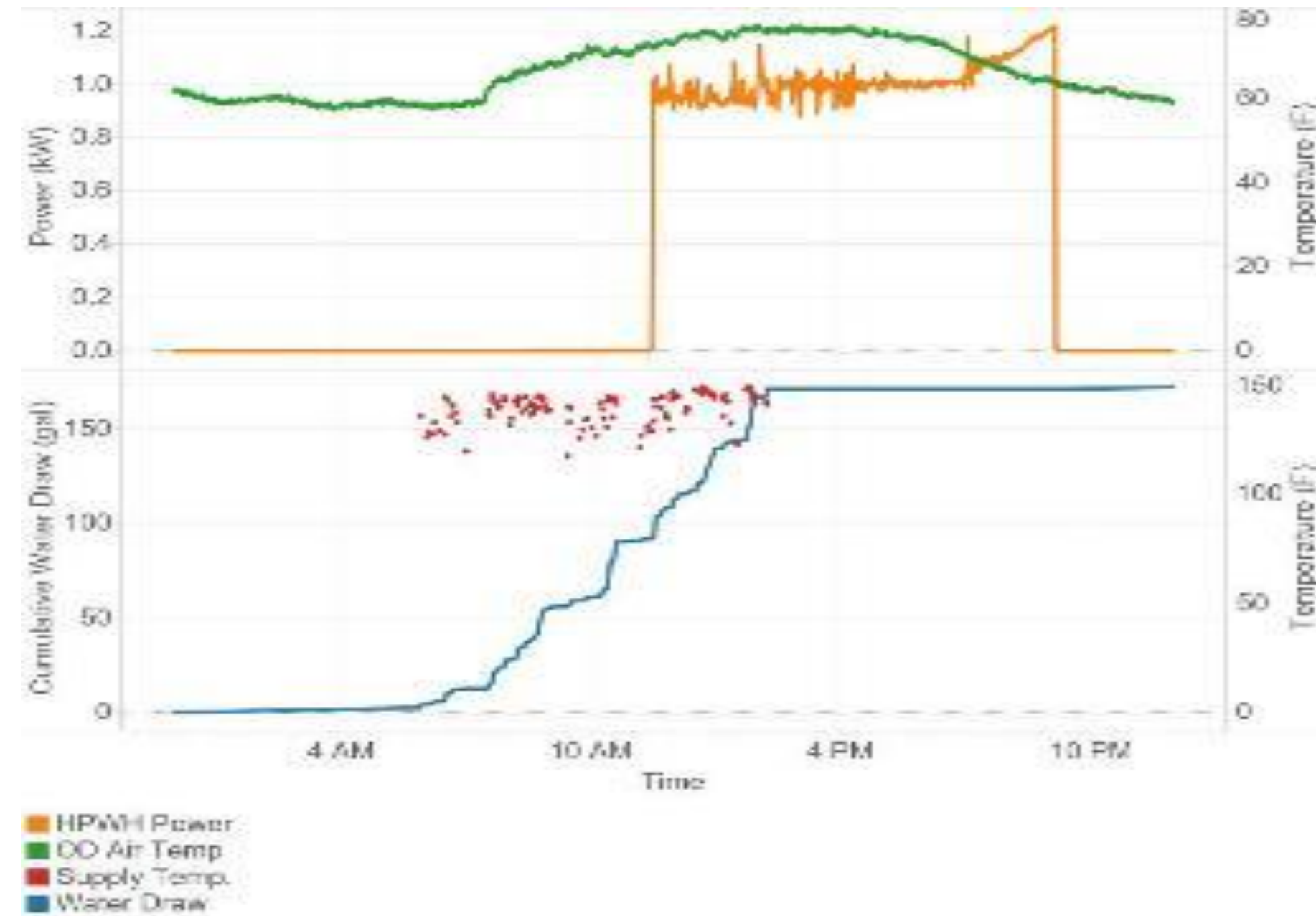
1 x Heat Pump + 2 x 83 Gallon storage tanks, replacing 1 x 80 and 1 x 120 Gallon Electric Water Heaters

Private School, Grades 1-12 serving Breakfast & Lunch

750 to 1000 meals daily, with daily average of 165 gallons hot water usage.

Average daily power consumption 8.6kw/h with a COP  $\approx$  3.0

SANCO<sub>2</sub> units kept after test period was completed





# Alternative Markets – DHW + Heating



Combining the DHW with small load space heating in ZNE or highly insulated homes using Radiant, Fan Coil or Radiators

Work undertaken in conjunction with Washington State University and various NW Utility partners to explore opportunity for combination Heat/DHW concept to replace separate Electric Heat and Electric DHW units

- Learning curve – SANCO<sub>2</sub> does not like hot water return
- Reduces Efficiency – Solution : System design + use more DHW
- Reduces Capacity – Solution : System design + use more DHW
- Defrost Control - Solution : Programming change

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|                     | HP (kWh) |     | Aux (kWh) |          | Pump & Control (kWh) |          | Total kWh |          |
|---------------------|----------|-----|-----------|----------|----------------------|----------|-----------|----------|
|                     | Heating  | DHW | Heat      | Non Heat | Heat                 | Non Heat | Heat      | Non Heat |
| <b>Olympia</b>      | 521      | 49  | 0         | 0        | 120                  | 6        | 641       | 55       |
| <b>Grass Valley</b> | 1,669    | 927 | 312       | 371      | 306                  | 176      | 2,287     | 1,475    |
| <b>Nevada City</b>  | 926      | 526 | 0         | 0        | 105                  | 43       | 1,031     | 569      |



|                     | CO <sub>2</sub> Split System Combi, kWh/ft <sup>2</sup> | Air-to-Air Heat Pump (Mini Split) plus Tier 2 HPWH in Garage for DHW kWh/ft <sup>2</sup> |
|---------------------|---|--|
| <b>Olympia</b>      | 2.4   | 5.2  |
| <b>Grass Valley</b> | 2.9   | 3.2  |
| <b>Nevada City</b>  | 1.4   | 4.1  |



# Research – Eco Runo Heating + DHW



Product sold in Japan and China for Space Heating

Adapting to the US market with addition of DHW production via Indirect Tank

Testing started mid 2017 across the North West, sponsored by NEEA (Northwest Energy Efficiency Alliance)

## Preliminary Results :

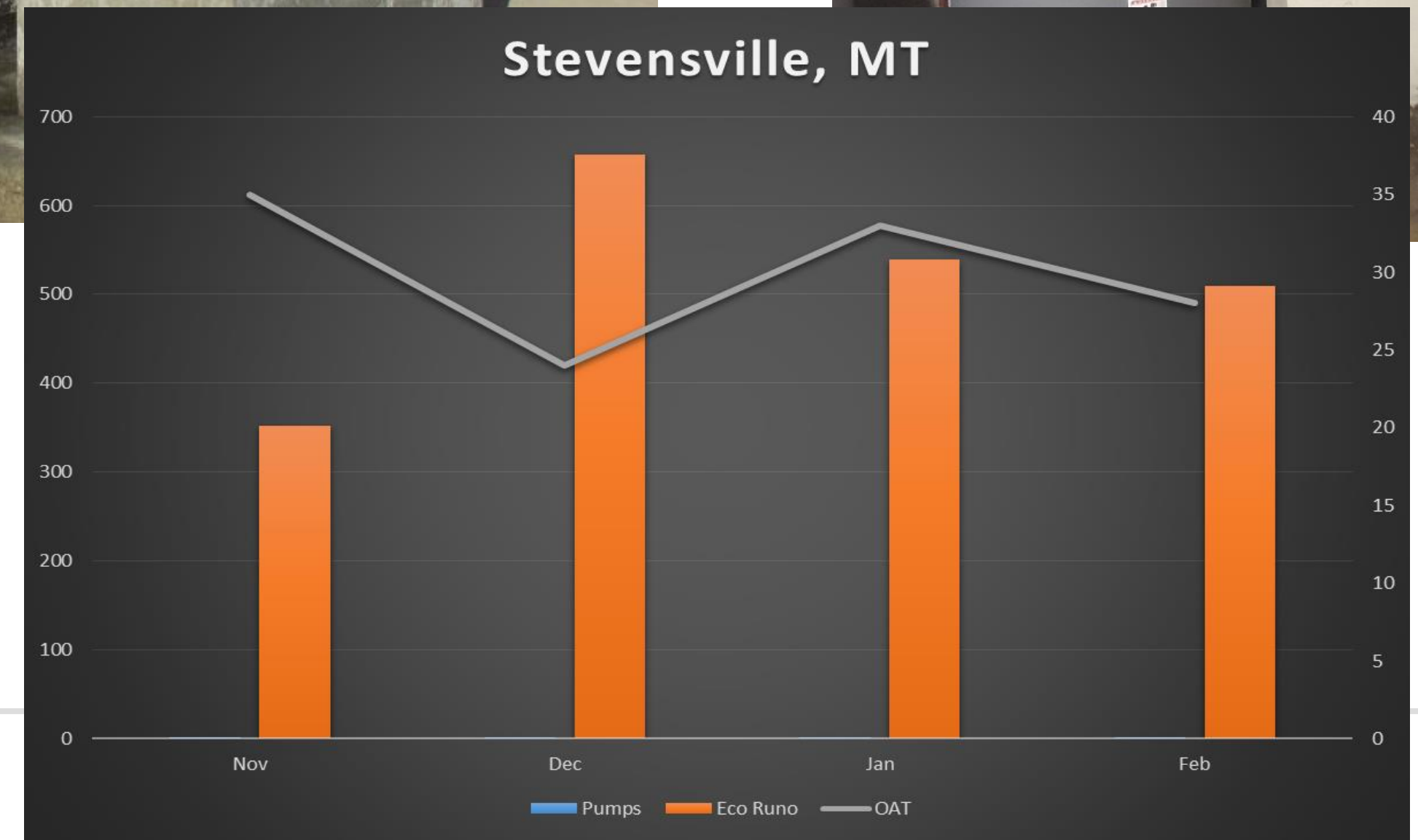
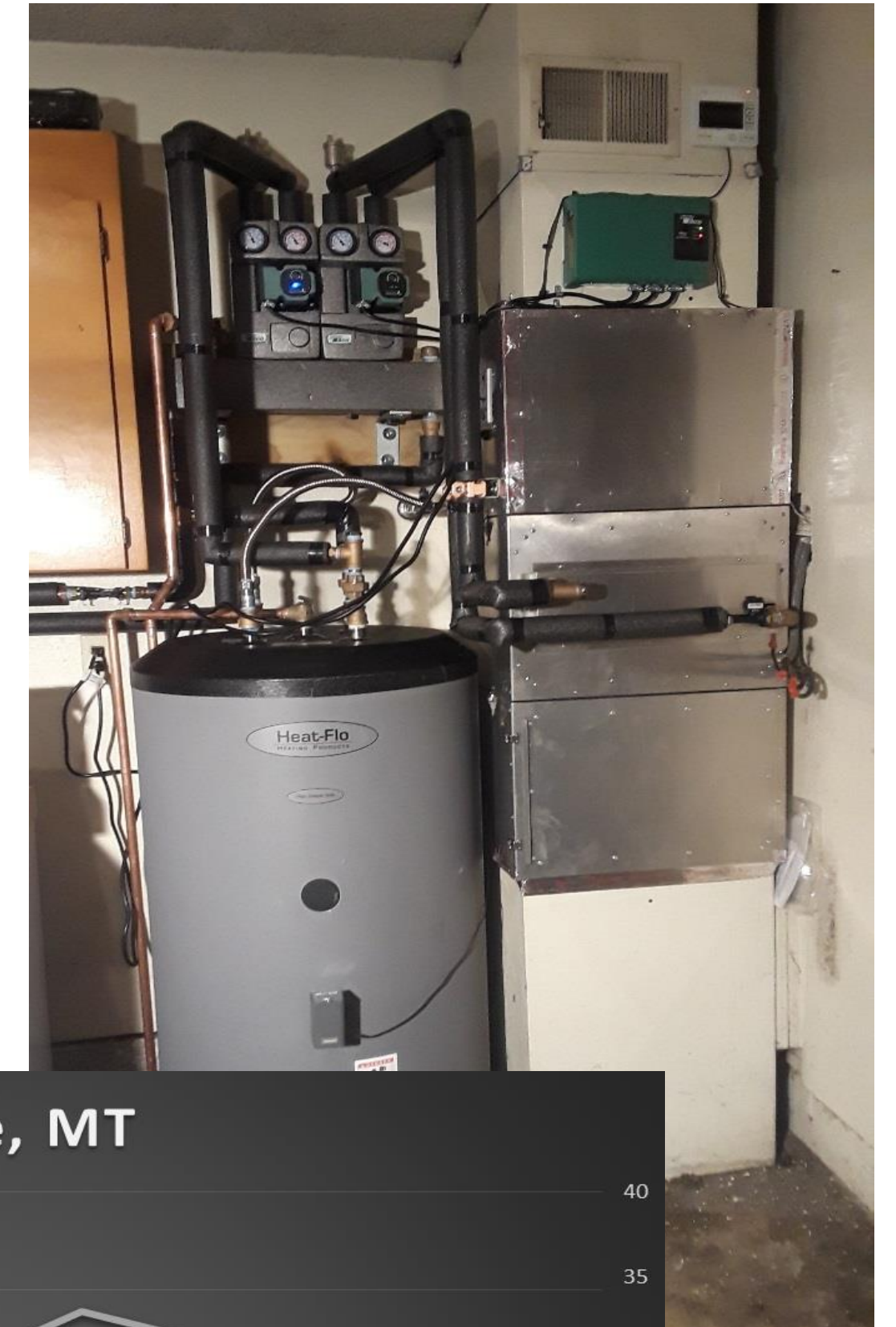
Home in MT, approx. 2500 sqft, better than code insulation

Heating + DHW Energy use Nov 17 to Feb 18

Eco Runo 2,058 kw/h

@ \$0.11 kw/h = \$226.38 utility bill

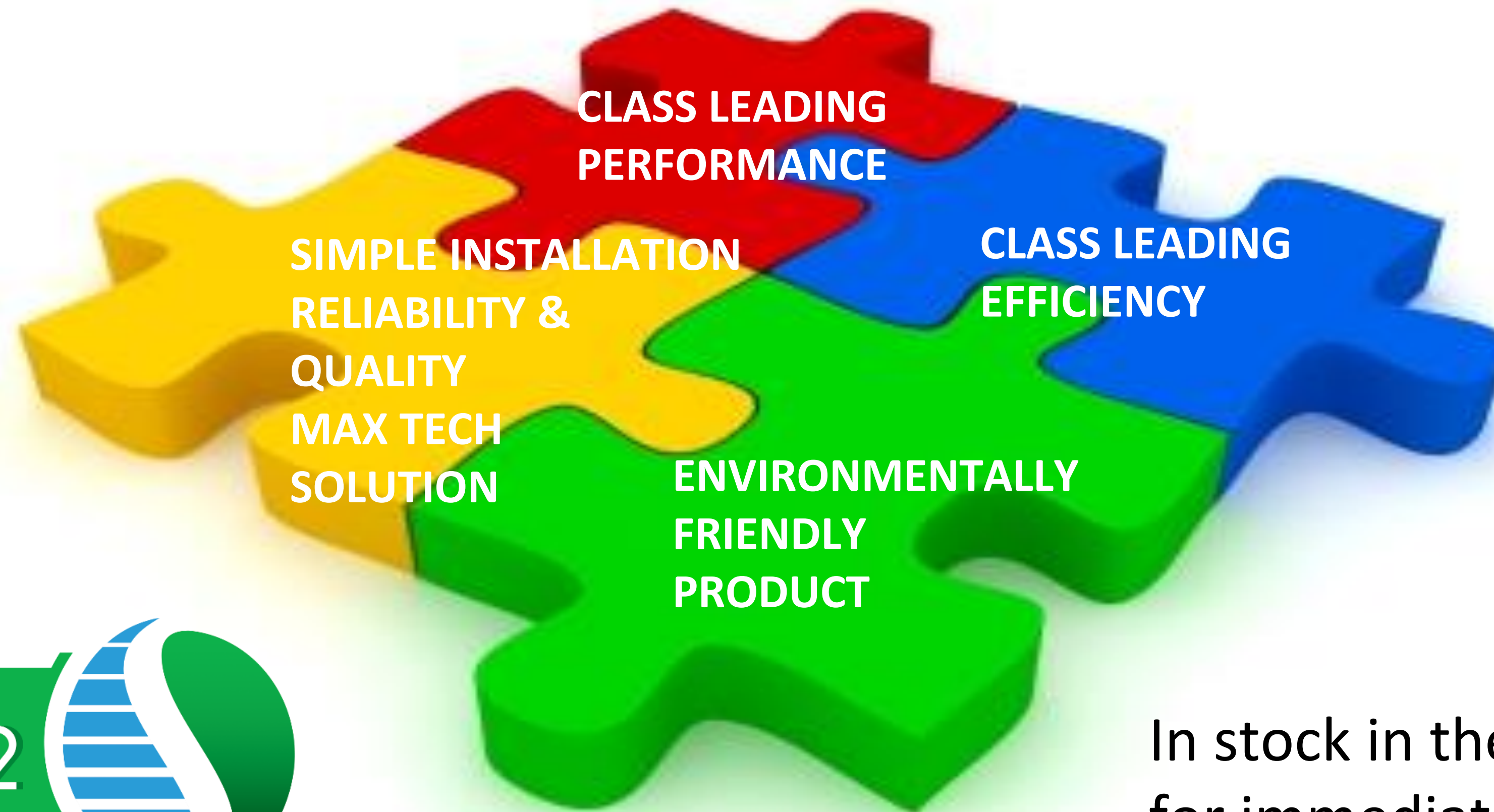
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# ***Creating Hot Water using Outside Air, a Natural refrigerant & Heat Pump technology!***



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**Thank you very much!**

