Renewable Heating and Cooling Workshop

June 18th and 19th, 2018

Saratoga Springs, NY

This breakfast is brought to you by:

Join conEdison at 4:15 for a one-hour panel discussion on the company's clean thermal initiatives, including the upcoming conEdison Gas Innovation Program RFI to be released in June 2018

Renewable Heating and Cooling Workshop: Welcome and Introductions

Helle Gronli, Renewable Thermal Alliance
David Lis, Northeast Energy Efficiency Partnerships

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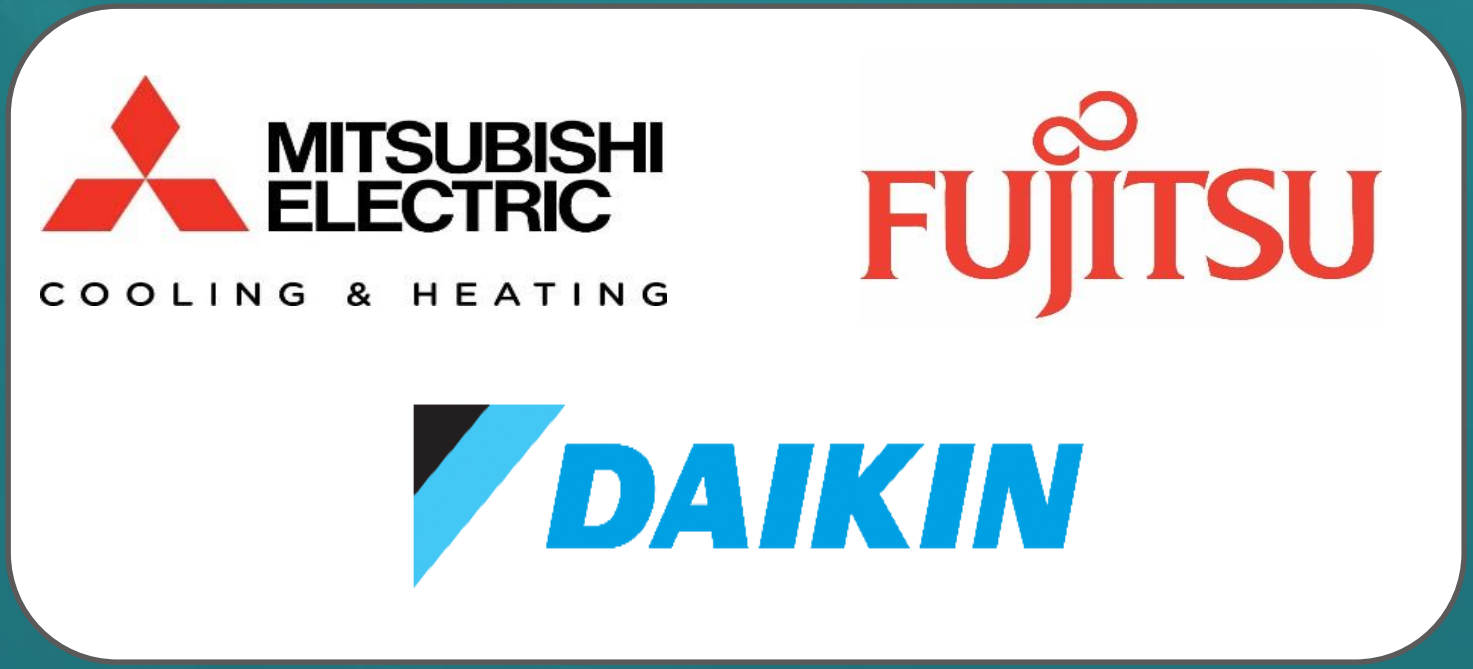

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Renewable Thermal Alliance - Mission

Catalyze and scale a regional market for Renewable Heating and Cooling through provision of an independent non-profit market building platform for financing solutions

RTA Renewable Thermal Alliance

Yale Center for Business and the Environment

CONNECTICUT GREEN BANK

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What we do


Engagement & Dialogue
Seed Innovation Grants
Independent Projects

RTA Seed Innovation Grant

Why	• Advance the mission of the RTA by supporting seed innovations that build market platforms for low-carbon H&C
Who	• For-profit and non-profit organizations • Multi disciplinary approaches
What	• Deliverables that can be made publicly available • Request funding not in excess of $20.000
Learn more	• cbey.yale.edu/programs-research/rta-seeds-innovation-grant

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About NEEP

A Regional Energy Efficiency Organization

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Northeast Energy Efficiency Partnerships

"Assisting the Northeast & Mid-Atlantic Region in Reducing Total Carbon Emissions 80% by 2050"

Mission

We seek to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities.

Vision

We envision the region's homes, buildings, and communities transformed into efficient, affordable, low-carbon, resilient places to live, work, and play.

Approach

Drive market transformation regionally by fostering collaboration and innovation, developing tools, and disseminating knowledge

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Regional ASHP Market Transformation Initiative History

2013

2014

2015

2016

2017

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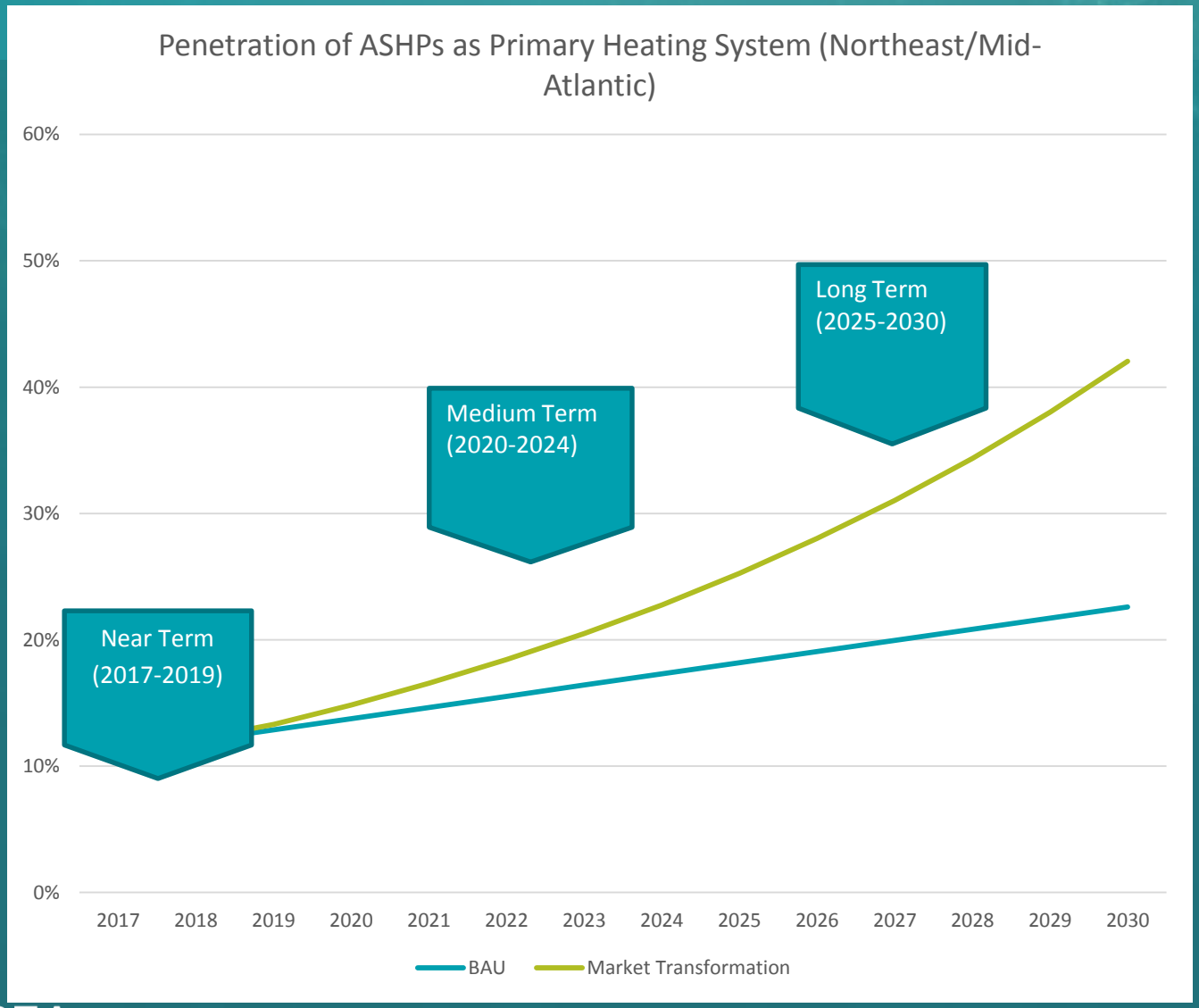
Theory of Change



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Market Transformation Strategies

1. Increase consumer education and awareness
2. Increase installer/builder awareness of, and confidence in, ASHP through expanded training and education
3. Reduce upfront costs of installed systems through robust and aligned promotional programs and the support of alternative business models
4. Mobilize state and local policymakers to expand support for ASHPs
5. Promote advanced control technologies to allow automated coordination among multiple heating systems
6. Enable the promotion of climate-appropriate ASHPs through improved performance metrics
7. Develop more accurate tools to predict energy, cost and GHG savings associated with ASHP installation through collection and analysis of real world performance data

Quick reminders

1. Use Microphones during Q&A
2. Please silence cell phones
3. Presentation slides will posted to Workshop site
4. Public Wifi available
5. Please complete online evaluation following workshop
6. Tweet #RHCW18

Workshop Agenda- Day 1

9:30 am	Welcome and Introduction
9:45 am	Keynote: Alicia Barton
10:30 am	Realizing the Full Value and Related Challenges of Renewable Heating and Cooling to the Energy System
12:00 pm	**Lunch**
1:00 pm	Moving Renewable Heating and Cooling Strategies from State Specific to Regional
2:15 pm	**Break**
2:45 pm	Realizing Synergies in Renewable Heating and Cooling
4:00 pm	Day 1 Debrief
4:30	**Adjourn**
4:45	Optional Sessions
6:00	Reception

Session 1: Renewable Heating and Cooling in the context of broader Energy and Climate

Keynote Speaker: Alicia Barton, NYSERDA

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Session 2: Realizing the Full Value and Related Challenges of Renewable Heating and Cooling to the Energy System

Mike Henderson, ISO New England
Michael Henchen, Rocky Mountain Institute
Courtney Eichhorst, National Grid
Christopher Raup, Con Edison
Emily Lewis, Acadia Center
Moderator: Helle Gronli, Renewable Thermal Alliance

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NEEP Renewable Heating & Cooling Workshop

June 18, 2018

What does 40x30 look like?

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National Grid has simulated Northeast energy evolution to 2030, spanning ISO-NE and NYISO, comparing cost and GHG emissions of two energy system pathways that meet reliability requirements: a “High RE Only Sensitivity” case and a “40x30 Pathway.”

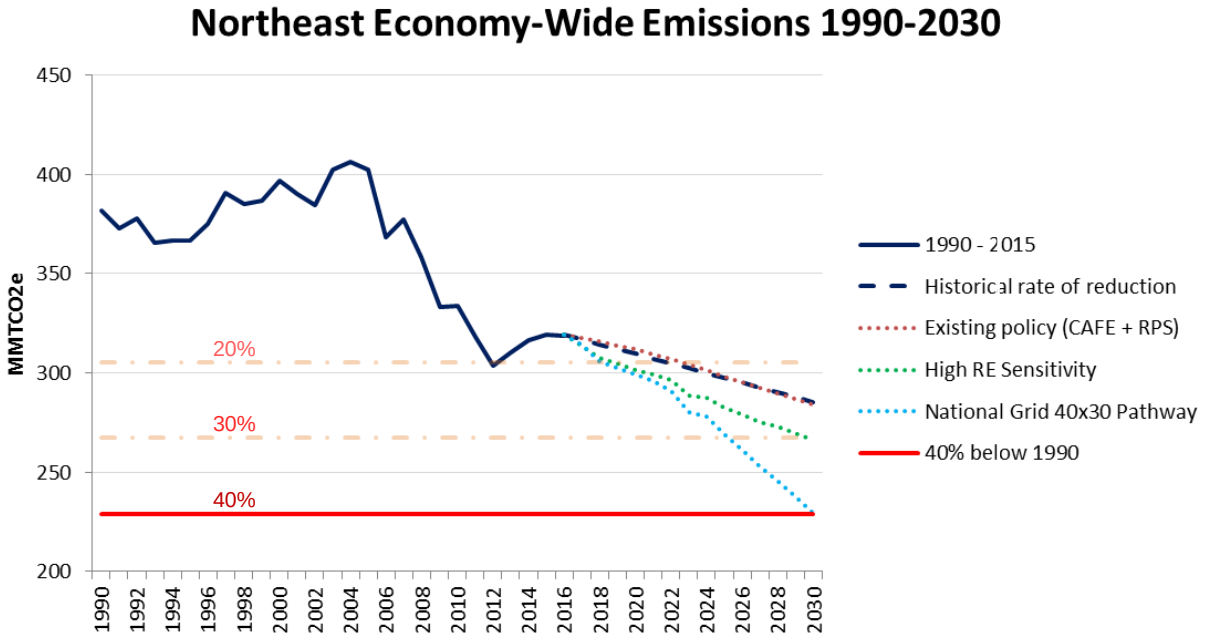
Electricity & Gas Demand

BAU

High RE Sensitivity
How far will a “High RE” scenario get us, absent significant electrification?

Increased Electrification & Oil-to-Gas

40x30 Case
Build out High RE capacity plus new capacity to meet increased transport and heat electrification. Increase rate of oil-to-gas heat conversions.



Existing policy achieves 25% by 2030.
The “High RE” Sensitivity achieves 30% by 2030.
The “40 x 30” Scenario achieves 40% by 2030.

Implications and Insights

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Implications

- Current policies and investment trends are **not on track for achieving 2030 or 2050** emissions targets.
- To stay on track for "80 x 50" targets, we not only have to increase the pace of renewable growth but **dramatically transform transport (~50% electrification) and heat (~25% electrified heat, accelerated oil-to-gas conversion).**
  - **Scale up heat pump conversions more than 10x from 25K to 300K annually**
- The electric system will move from an era of low load growth to load growth (+15% TWh inc by 2030)
- It will take **~$80B of additional RE capacity** to support 40% emissions reductions by 2030 across the Northeast (excluding distribution network upgrades).
- Compared to the base case without significant electrification, the National Grid 40x30 pathway would **drive lower electric and gas rates** through higher network throughput and reduced RE curtailment.

Insights

- Ambitious new policies needed across **all sectors**. Carbon pricing should apply not just to electricity, but to all fuels.
- **Utilities have an important role** in supporting wider EV adoption and heat decarbonization.
- Performance-based incentives, such as EAMs and PIMs, can help **align the utility business model** with beneficial electrification and economy-wide decarbonization
- To avoid unnecessary incremental network upgrades, **smarter time-varying rate design** is needed to encourage off-peak charging. AMI is foundational.
- Targeting the highest emitting sectors and fuels first, while optimizing the utilization of existing networks, can help keep electric and gas prices down while decarbonizing the existing networks

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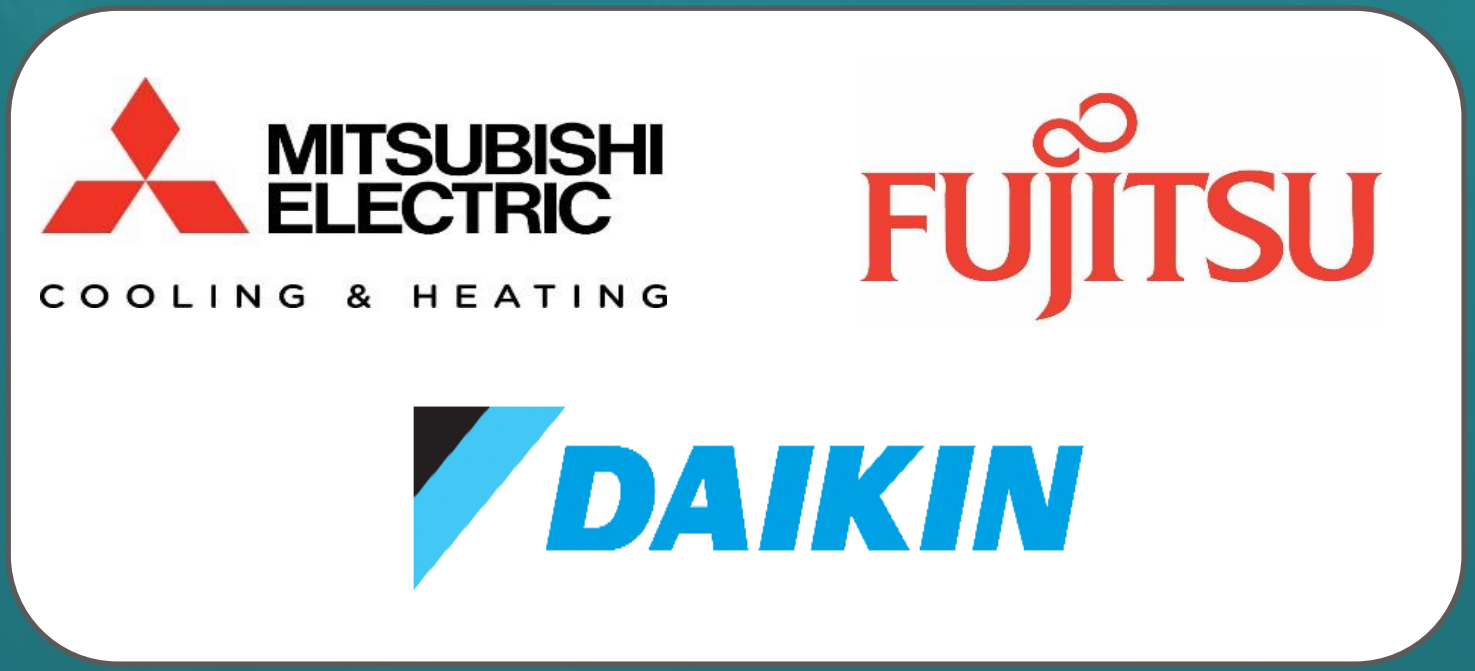

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Session 3: Moving Renewable Heating and Cooling Strategies from State Specific to Regional

Wendy McPherson, NYSERDA
Jeff Howard, Connecticut DEEP
Michael Judge, Massachusetts Department of Energy Resources
Adam Sherman, Biomass Energy Resource Center (VEIC)
Moderator: Neil Veilleux, Meister Consulting Group

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Session 4: Realizing Synergies in Renewable Heating and Cooling

Dan Kelley, Ramboll
Hal Smith, Halco
Peter Skinner, E2G Solar
Maura Adams, Northern Forest Center
Anthony Aebi, Greenhill Contracting
Moderator: John Ciovacco, Aztech Geothermal

Cold Climate NetZero Buildings & Heat Pump/Solar Thermal Hybrids

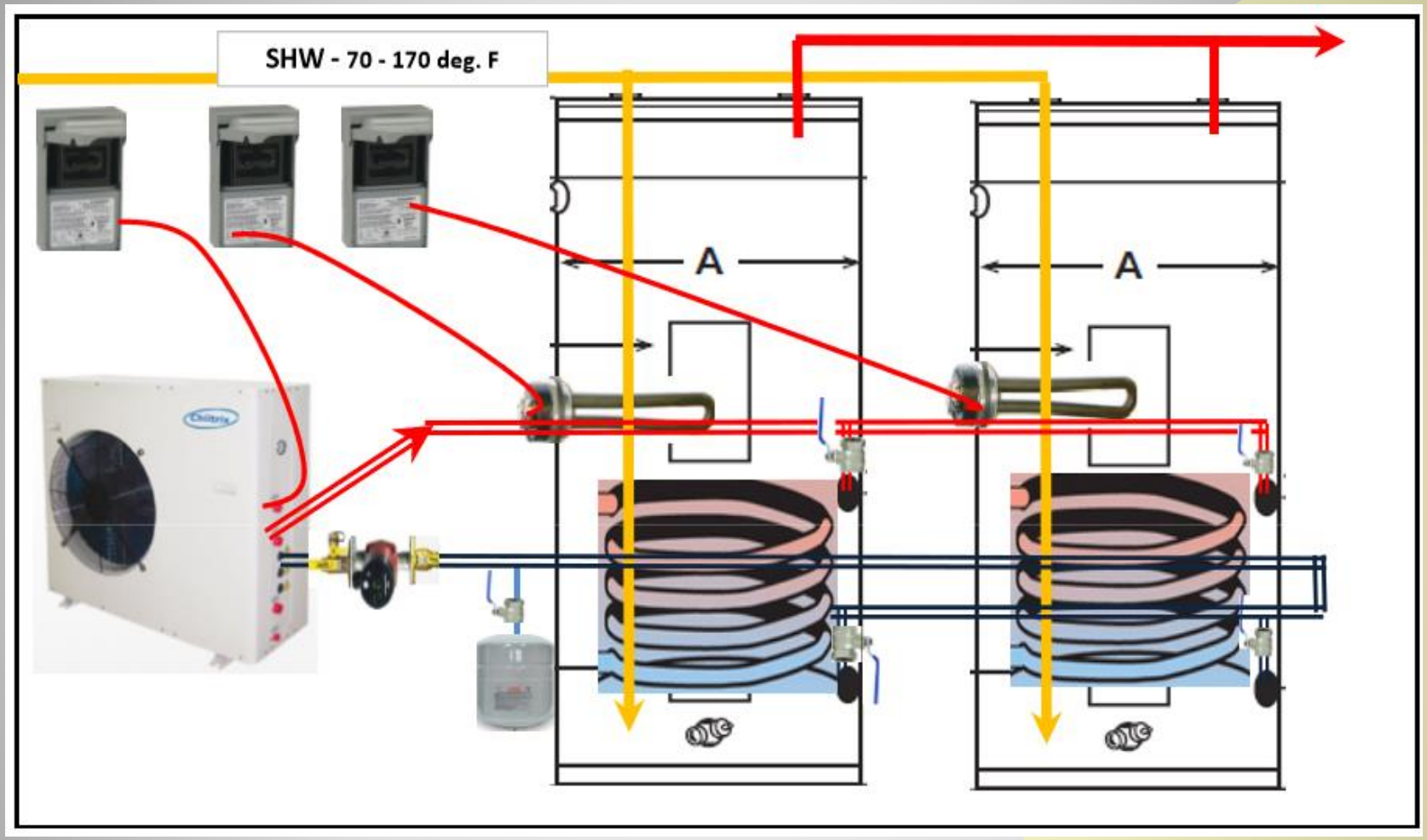
The SHW Revolution is at our feet & skies the limit!

- SHW & HP backups = good marriage for sustainable design
- Netzero & renovated multifamily projects are a very happy home – find the sweet $$ spot – fewer SHW & PV panels
- DHW use/person is dropping in NZ and renovated LMI projects
- A-W HPs are not expensive & are easy to install. Geo HPs with the tax credits and NYSERDA support may be competitive now

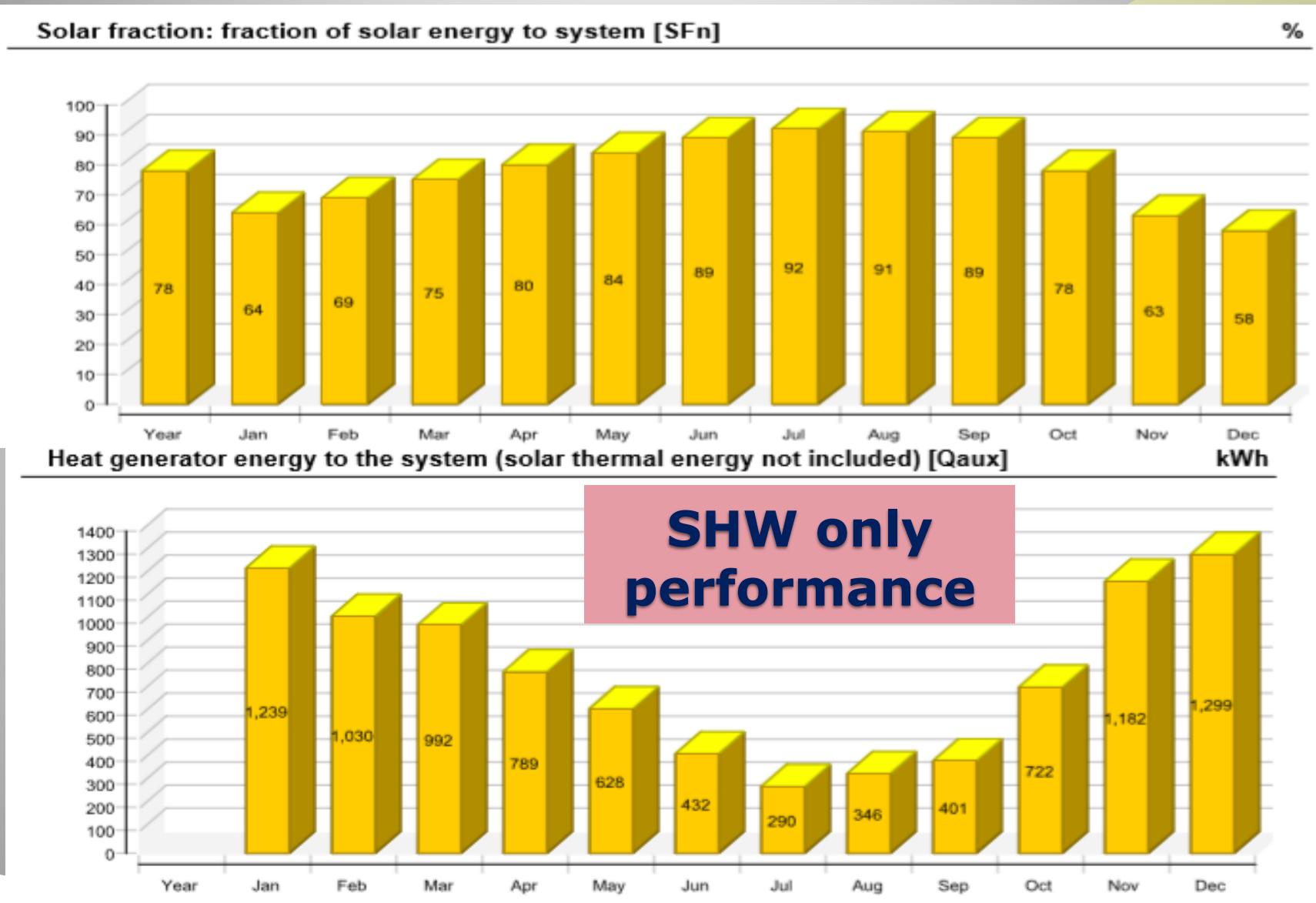
Solar Thermal – HP Hybrids
My Takeaways Today

- HP based SHW backup allows you to:
  - Reduce the number of SHW panels while keeping the power load for DHW low
  - Reduce the number of PV panels needed because the back up power load is low
- Incremental cost analyses
  - Three variable analyses
  - Cost per extra SHW & PV panels
  - Cost of HP back up per kw produced

Sizing the SHW system for a Hybrid system – find the most cost effective sweet spot



SHW – Heat Pump hybrid design



Month	Days/mo	Polysun Eaux kwhr	A-W HP COP	w/A-W HP kwhr/mo	w/A-W HP kwhr/day	A-W HP COP	w/geo HP kwhr/day
january	31	1304	2.1	621.0	20.03	3	434.7
february	28	1084	2.15	504.2	18.01	3	361.3
march	31	1044	2.22	470.3	15.17	3	348.0
april	30	830	2.6	319.2	10.64	3	276.7
may	31	661	3	220.3	7.11	3.5	188.9
june	30	455	3.5	130.0	4.33	3.5	130.0
july	31	306	4	76.5	2.47	3.5	87.4
august	31	364	4	91.0	2.94	4	91.0
september	30	422	3.5	120.6	4.02	4	105.5
october	31	760	3	253.3	8.17	3.5	217.1
november	30	1244	2.7	460.7	15.36	3.5	355.4
december	31	1367	2.2	621.4	20.04	3	455.7
		9841		3888.5			3051.7

Hybrid Performance Simplified analysis

What about the worst day?

- Spec for extreme conditions – design day
  - Extended cloudy weather
  - Extended days of very cold temperatures
  - Depleted solar thermal heat vault
  - Higher than average DHW demands

		12-1 am	1-2 am	2-3 am	3-4 am	4-5 am	5-6 am	6-7 am	7-8 am	8-9 am	9-10 am
24 unit DHW gpd	720										
% of daily total		0.2%	0.01%	0.01%	0.01%	0.01%	1.5%	3.4%	8.5%	11.2%	9.2%
Load (gph)		1.7	0.1	0.1	0.1	0.1	10.8	24.5	61.2	80.5	66.5
Load (#/hr)		14.6	0.6	0.6	0.6	0.6	90.5	204.2	510.6	671.1	554.4
Btu increment 3 floors		-948	-39	-39	-39	-39	-5879	-13276	-33190	-43621	-36035
1 HP contribution btu/hr	**18,000.0**	948	39	39	39	39	5879	13276	18000	18000	18000
contribution deficit		0	0	0	0	0	0	0	-15190	-25621	-18035
Elec. Elem. Contribution btu/hr	**32,524.5**	0	0					0	15190	25621	18035
dual contribution deficit		0	0					0	0	0	0
Tankless contribution btu/hr	**30,709.3**	0	0					0	0	0	0
dual contribution deficit		0	0	0	0	0	0	0	0	0	0
HP Contribution %		100%	100%	100%	100%	100%	100%	100%	54%	41%	50%
Elec. Elem. Contribution %		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	45.8%	58.7%	50.0%
Tankless Contribution %		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
total contribution		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

conclusion: the tankless isn't needed @720gpd DHW.... PNS 1-7-18

Catalog no.	Name	Manufacturer	Test Standard	Modulation	Heating power
1	Heat pump 5 kW	Anonymous	EN 255	None	21.16
2	Heat pump 10 kW	Anonymous	EN 255	None	60.07
3	Heat pump 15 kW	Anonymous	EN 255	None	70.99
4	Heat pump 5 kW	Anonymous	EN 255	None	21.16
5	Heat pump 10 kW	Anonymous	EN 255	None	60.07
6	Heat pump 15 kW	Anonymous	EN 255	None	70.99
7	Heat pump 50 kW	Anonymous	EN 14511	None	175.09
9	WPL18	AEG Mark...	EN 255	None	55.63
10	WPL 23	AEG Mark...	EN 255	None	68.26
11	LW 80N-I	Alpha-Inn...	EN 255	None	40.96
12	LW 110H-I	Alpha-Inn...	EN 255	None	61.09
13	LW 70M-A	Alpha-Inn...	EN 255	None	35.15
14	LW 80M-I	Alpha-Inn...	EN 255	None	41.3
15	LW 150M-I	Alpha-Inn...	EN 255	None	46.42
16	WLW91	AWP Wär...	EN 255	None	37.2
17	WB 4LCI	Bartl Wär...	EN 255	None	46.76
18	Buderus WPL 110 I	Buderus ...	EN 255	None	60.07
19	Buderus WPL 80 I	Buderus ...	EN 255	None	44.03
20	Buderus WPL 80 AR	Buderus ...	EN 255	None	43.35
21	LW 80N-I	Calmothe...	EN 255	None	40.96
22	LW 110H-I	Calmothe...	EN 255	None	61.09
23	LW 70M-A	Calmothe...	EN 255	None	60.07
24	LW 80M-I	Calmothe...	EN 255	None	41.3
25	LW 150M-I	Calmothe...	EN 255	None	46.42
32	Aerotec SLW 50	CTC Wär...	EN 255	None	56.66

SHW/HP Integrated Polysun

Day 1 Debrief

David Lis, NEEP

Day 1 Debrief – Small Group Questions

1. Any key reelections from Day 1 program?

2. What concepts would you like to dive deeper on tomorrow/into the future?

Optional Workshops

Win Room

Find about Con Edison Gas Innovation Program RFI to be released this month.

Show Room

Participate in NYSERDA's active market research (financing workshop)

See you at the reception at 6 p.m. in the hotel restaurant

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Adjourn Day 1

This breakfast is brought to you by:

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