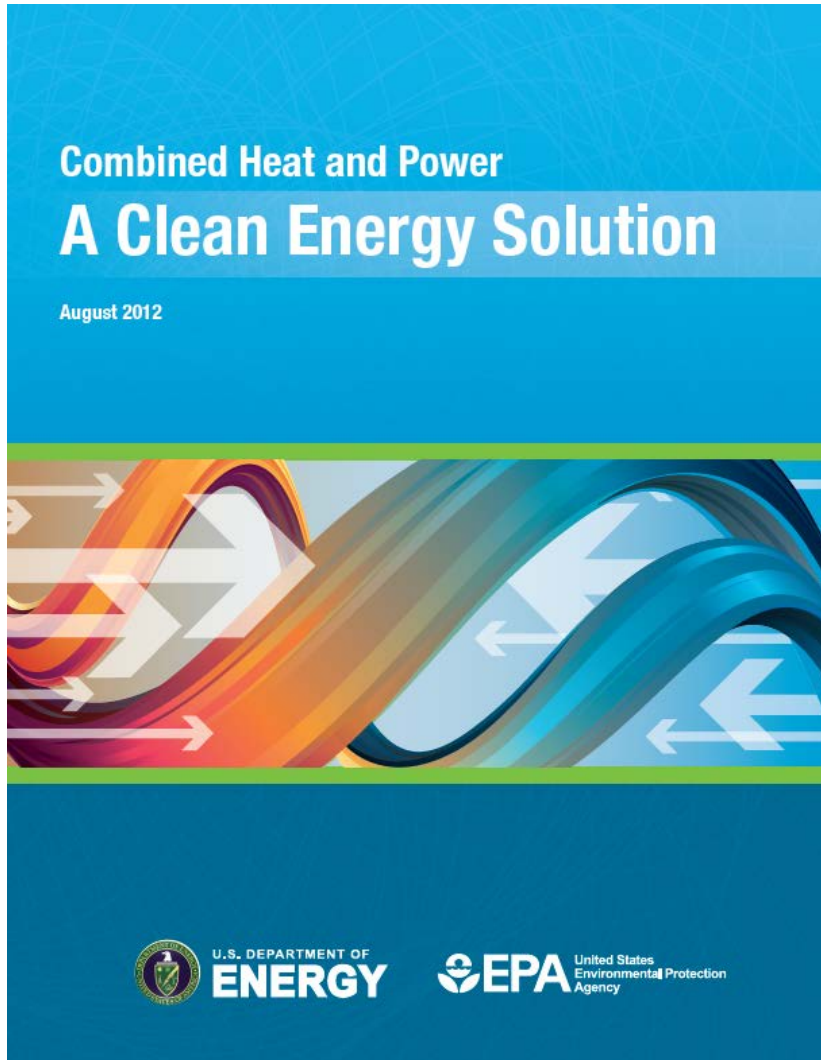




**BRASH CHP:
A Better Clean Energy Solution for Homeowners**

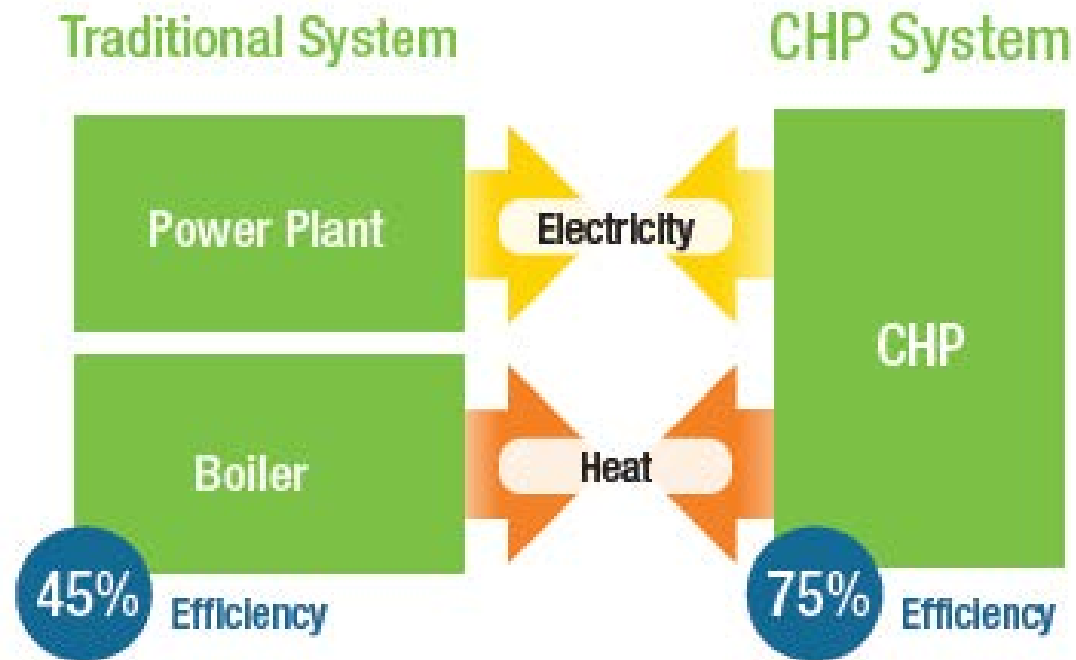
Michael Brookman, President & CEO
mbrookman@brashpower.com
203-747-4923

In 2012, DOE/EPA Agree: “CHP is Best!”



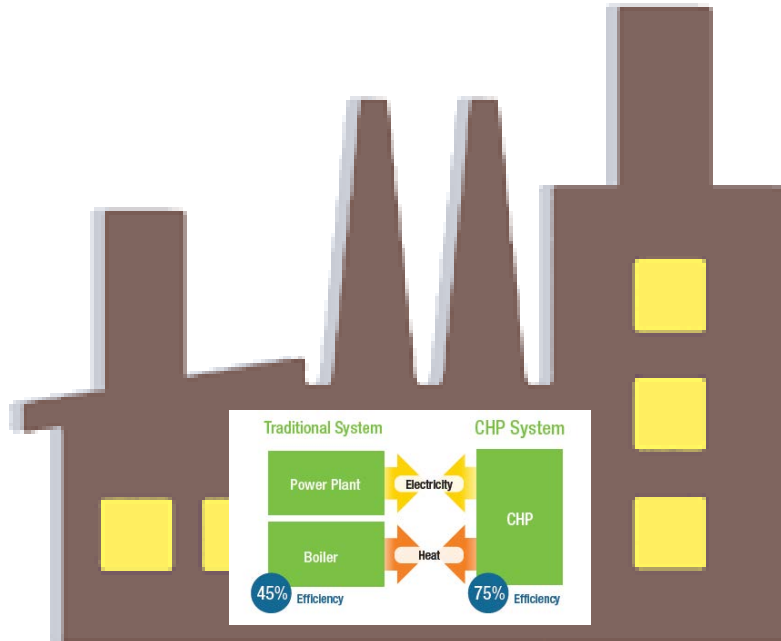
	<u>CHP</u>	<u>PV Solar</u>	<u>Wind</u>	<u>Comb. Cyc.</u>
Capacity Factor	Best	Poor	Fair	Good
Annual Electricity	Best	Poor	Fair	Good
Useful Heat	Best	Poor	Poor	Poor
Footprint	Best	Poor	Fair	Fair
Cap Cost	Good	Poor	Fair	Best
Energy Savings	Best	Good	Best	Fair
CO2 Savings	Best	Fair	Good	Good
NOx Savings	Best	Poor	Fair	Good

Why is CHP so clean and efficient?



CHP is efficient, because the heat and power are generated closer to where they are used.

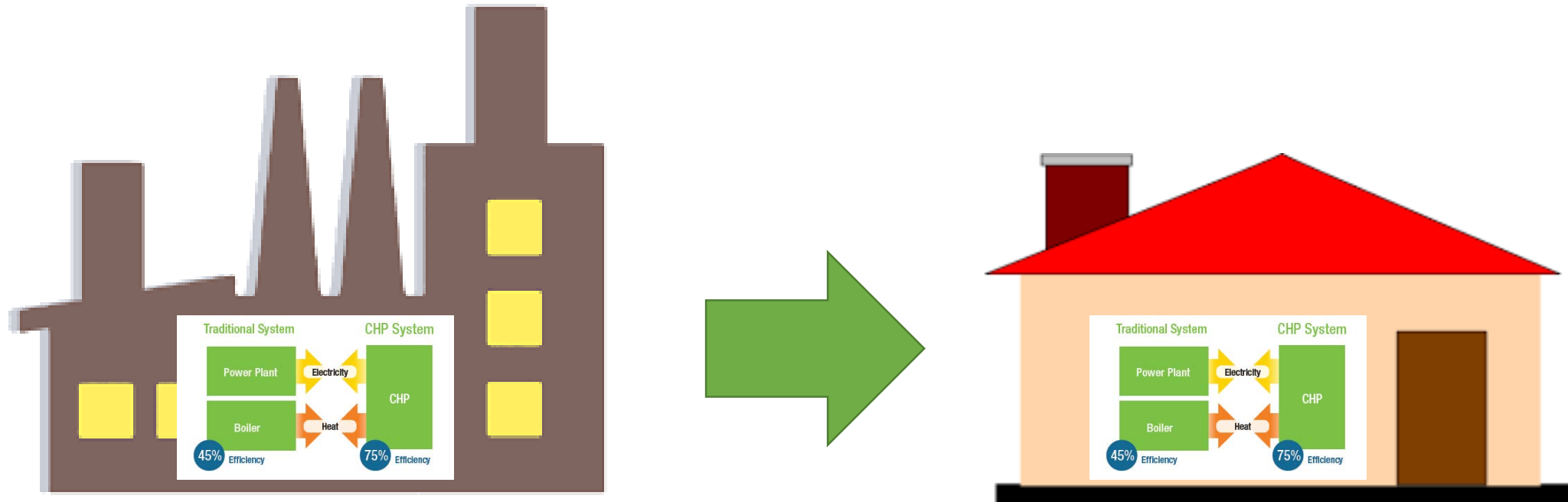
CHP provides >8% of total grid power, but most is used by Industry “behind the meter.”



CHP works for Industry because of the continuous demand for heat and power in factories.

BRASH CHP patented technology brings this 100 year old CHP solution to millions of family homes.

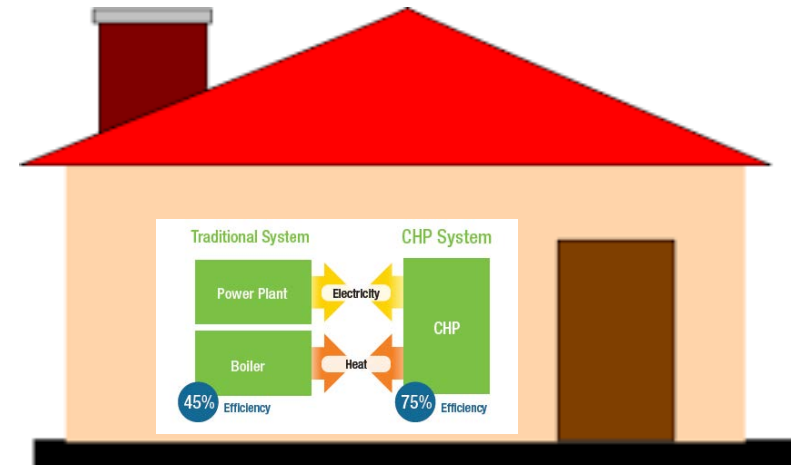
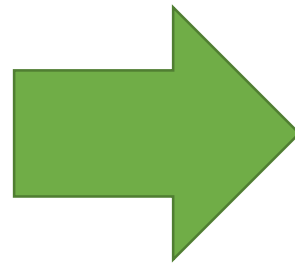
In New York, 22% of total energy usage is residential heat and power.



In NY, home energy demand is greater than industrial and commercial demand combined!

What attributes make BRASH CHP a better distributed generation solution?

Dispatchability
Granularity
Low Cap Cost



**BRASH CHP brings CHP performance and
efficiency to the scale of the family home.**

“I got an upgraded boiler from the gas company! It cuts my monthly energy bills in half and also gives me back-up power!”

-The first of 3.2 million NY Homeowners, 2018

BRASH CHP is a Distributed Generation (DG) node for the new Grid 2.0: supplying homeowners with heat and power, while lowering GHG emissions by 40%.

Right Solution for Home, Grid, & Planet

First home product:
125 kBTU/hr boiler
Variable 1-5 kW output

Natural gas fired
Hydronic or hot air
90% Turndown



Patented, Home-Scaled Heat & Power:

- Reliable power at home(24/7/365) from reliable fuel
- **Value Proposition: 50% lower energy** cost year-round
- **3-4 year Payback** vs. 10+ years for heat-only furnace
- **Stand-by emergency backup** built in.

Grid-Stabilizing Power:

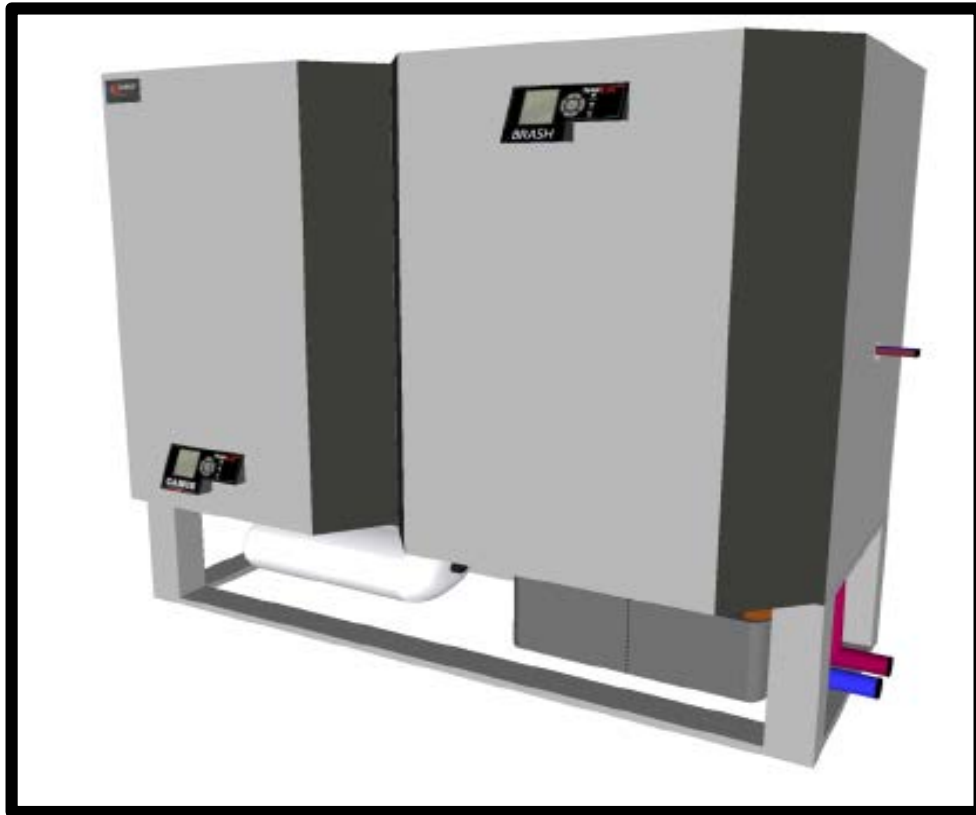
- True distributed generation (DG) for Grid 2.0
- **Granular, dispatchable** power in minutes
- Improved grid resilience: one house at a time.

Environmental Benefit:

- **Reduce GHG emissions by 40+%**
- Zero NOX/SOX, multi-fuel compatible, including **biomass**



Business Model: Utility-Sponsored Upgrade



“I’ve been tasked with developing a DG solution for UI. Before today, I had no solution, but now I do.”

- Comments by UIL VP Anthony Marone following a BRASH Demo

UIL Strategy:

- Target Most 20 + Year Old Heaters
- Bill Insert: “Upgrade your boiler for less...”
- Scale: 10,000 per year (US Now: <1000 units)

Go To Market Path, and Partners



EVERSOURCE



NYSERDA



Utility Sponsorship & Support: Lower GHGs

- Purchase Financing, subsidized installation
- DOE and State incentives for DG solutions
- Later: IoT links for installed homes = true DG solution

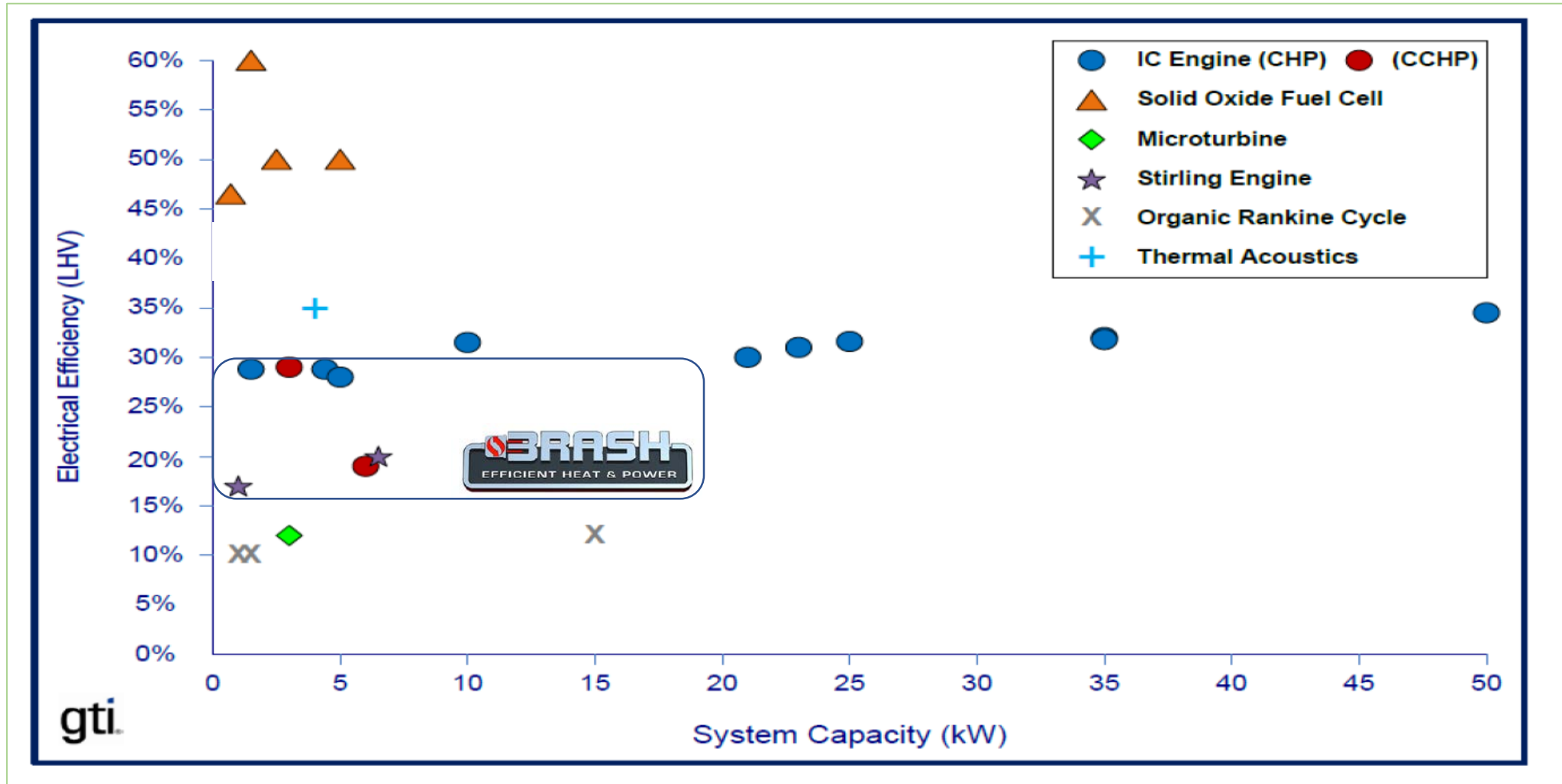
HVAC contractor: “Last Mile” Installation/Service

- Simplified, two-box installation & service
- Industry standard power connections

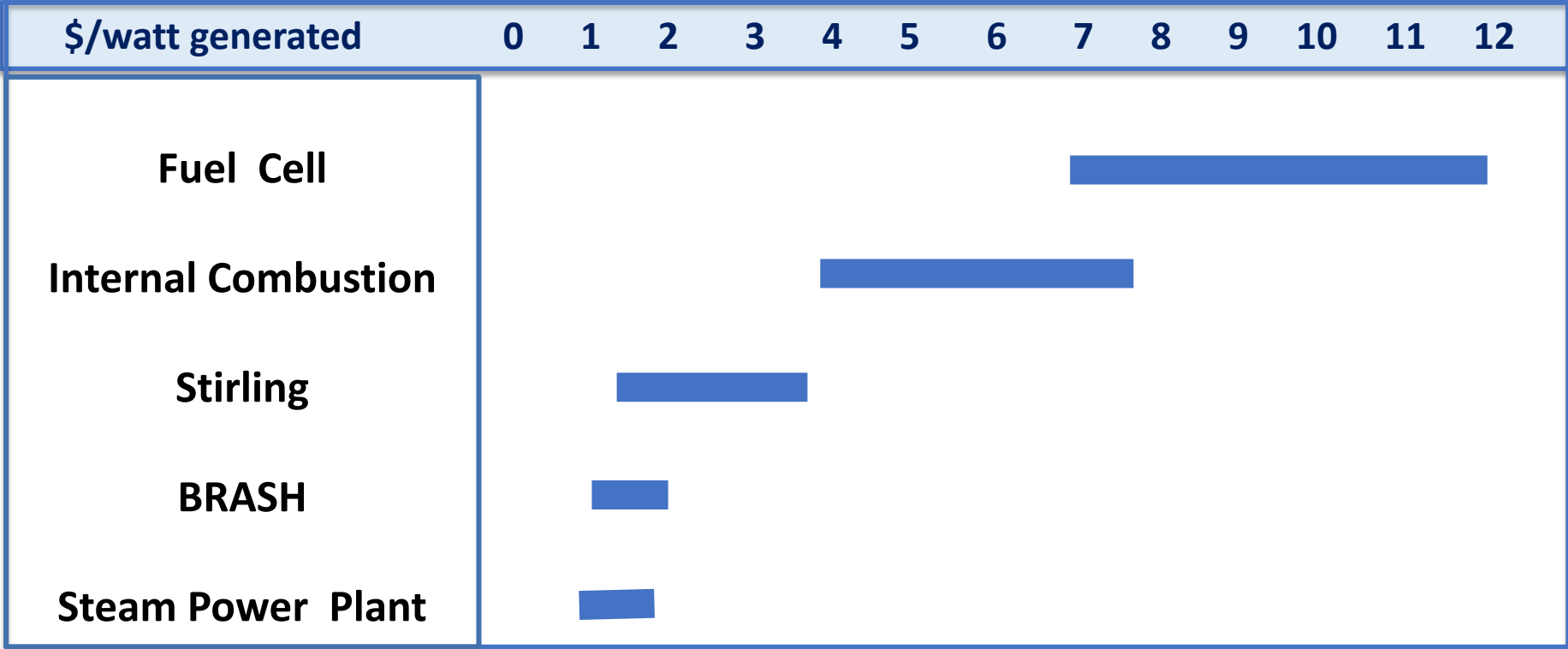
OEM Boiler Partners: Experience and Reliability

- “BRASH Ready” Heating Systems
- Providing reliable power, heat and hot water
- Liaison with local HVAC contractors

Micro-Combined Heat & Power Competition



Capital Cost of Power, by Technology



BRASH Management Team



Mike Brookman - President



Gary Mullin, FTG Financial - CFO



Nathan Jones, BSME - Lead Engineer Mechanical & Controls



Dr. Robert Knight, BKi Oakland CA – Marketing Advisor



Dennis Lockhart – Technical/Commercial Advisor



BRASH CHP Development Status



New Home for BRASH:
120 Hawley St.
Binghamton, NY 13901

TRL-4 Prototype (2017):

- 1.2 kW proof of concept
- High speed turbine generator
- Modified 80 kBTU/hr boiler (residential scale)
- Underperforming coil: lateral orientation, < 40 ft.

First UL Product/MVP (2018):

- Variable (1-5.3 kW) Rotary Lobe, Low Speed Expander
- Optimized Heat Exchanger/Coil
- Single shell, but still seeking Boiler partners
- Relocation to Koffman Incubator (NYSERDA-Binghamton)

Development Pipeline:

- Residential 1-3, Low Cost, to 5-25 kW Commercial
- Higher inlet temperature to boost Carnot efficiency





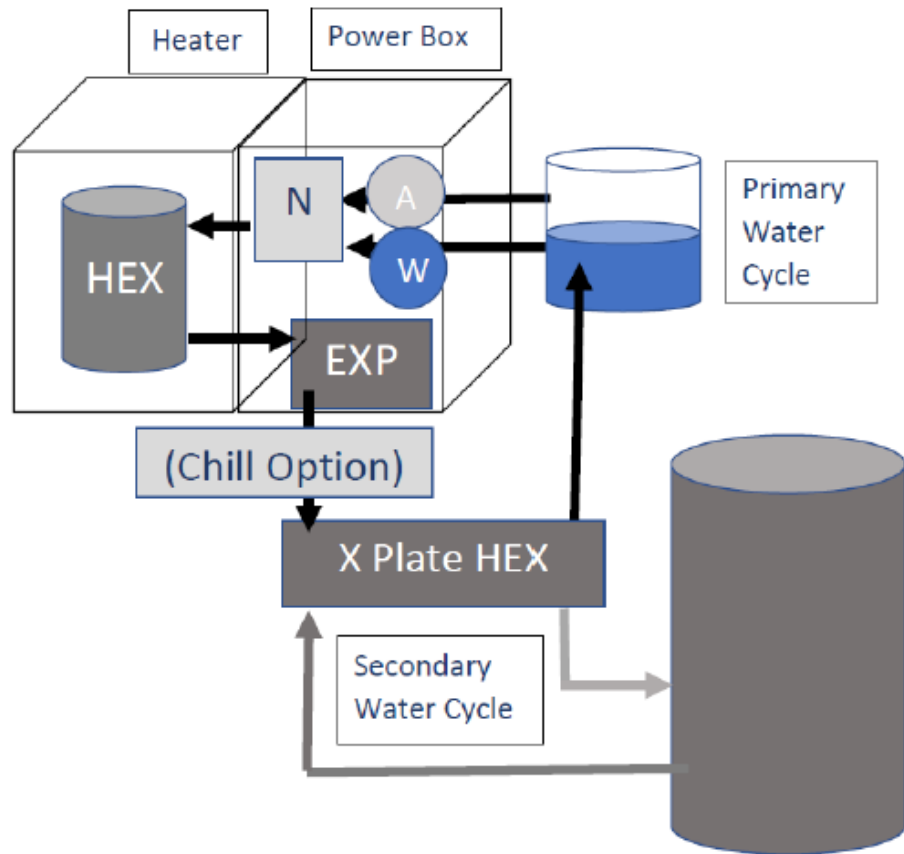
Thank You.

Michael Brookman, President

mbrookman@brashpower.com

203-747-4923

BRASH Power – How it Works



Two Box “Appliance” Like Washer/Dryer pair:

Patented External Combustion (EC) Power Cycle:

Water and Air from Primary Tank injected through Nozzle into Heat Exchanger inside Heater. The steam/air mixture passes through the Expander in Power Box, generating power.

Secondary Hydronic Heating Cycle:

“Waste” heat from the expander step flows through a crossflow exchanger to generate hot water for indirect DHW tank, and then room heat withdrawn from the DHW tank, (forced hot water or forced hot air)

System Controls:

System “ON” when low temp sensed in room or tank, or Inverter/switch (**D**) senses low stack voltage

Typical BRASH Savings: Current and Future

Change Black Box values to reflect your current home energy demand and local market prices.

Red Boxes are "Current" values and Blue Boxes are "Future" BRASH installation.

Gold circle values determine power/heat ratio.

Green Boxes show net savings each year.

GAS Model																
	Current			Heat		Current		Power		Future	Power	mCHP	Heat	Addnl	Heat	
	S/gal	S/kWh	kWh			kW	\$	kW	\$	Spark Spr						
Oil	\$3.00	0.079	16466.67							5.3						
Gas		0.034	38278							0.034				0.034		
										Efficiency	30%	63%				
Hr.			4	\$0.19		1.3	0.234			1.3	0.14717		3.9	0	1	\$0.02
Day			106	\$4.51		31.2	\$5.62			31.2	\$3.53		93.6	0	13	\$0.43
Month			3190	\$108.33		936	\$168.48			936	\$105.96		2808	0	382	\$12.98
Year			38278	\$1,300.00		11232	\$2,021.76			11232	\$1,271.55		33696	0	4582	\$155.78
Current Cost				\$1,300.00			\$2,021.76									49510
Future Cost										\$1,271.55		0			\$155.78	\$1,427.33
Net Savings per Year																\$1,894.43
																-57%

OIL to GAS Model																
	Current			Heat		Current		Power		Future	Power	mCHP	Heat	Addnl	Heat	
	S/gal	S/kWh	kWh			kW	\$	kW	\$	Spark Spr						
Oil	\$3.00	0.079	38000							5.3						
Gas		0.034	88333							0.034				0.034		
										Efficiency	30%	63%				
Hr.			4	\$0.43		1.3	0.234			1.3	0.14717		3.9	0	0	\$0.02
Day			106	\$10.42		31.2	\$5.62			31.2	\$3.53		93.6	0	12	\$0.41
Month			3167	\$250.00		936	\$168.48			936	\$105.96		2808	0	359	\$12.19
Year			38000	\$3,000.00		11232	\$2,021.76			11232	\$1,271.55		33696	0	4304	\$146.34
Current Cost				\$3,000.00			\$2,021.76									\$5,021.76
Future Cost										\$1,271.55		0			\$146.34	\$1,417.88
Net Savings per Year																\$3,603.88
																-72%

This is "Greener" than PV Solar, because power generating fuel efficiency is nearly 3x status quo:

Utility avg: 34%
BRASH avg: 30 + 63%

BRASH Power is "dispatchable"

Solar and Wind are "non-dispatchable" so utility must keep generating back up power.

2012: A Clean Energy Solution

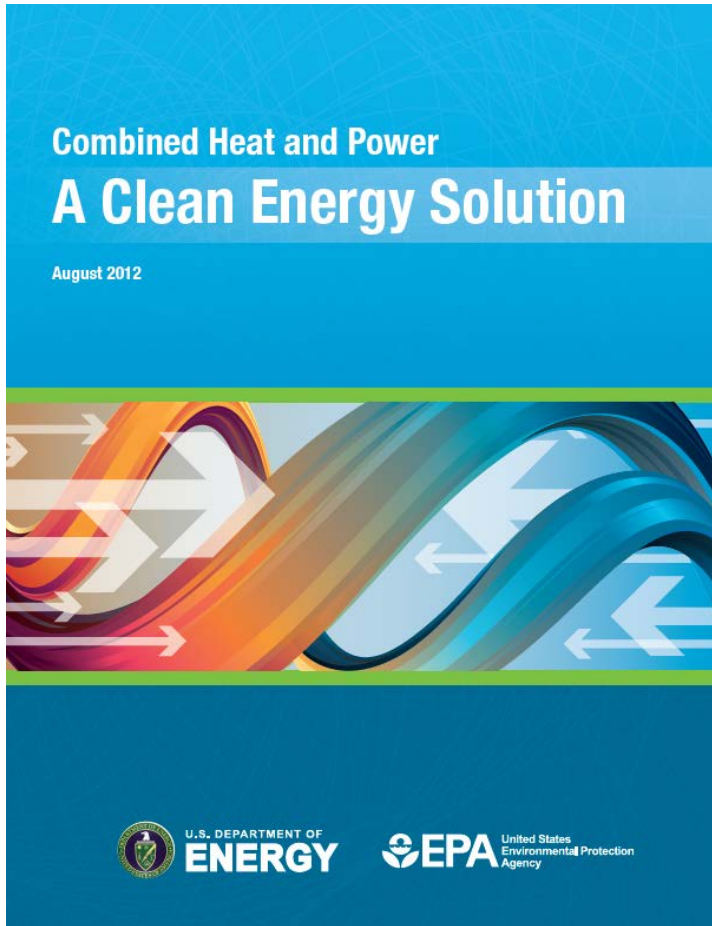


TABLE 1 | CHP Energy and CO₂ Savings Potential

Category	10 MW CHP	10 MW PV	10 MW Wind	Combined Cycle (10 MW Portion)
Annual Capacity Factor	85%	22%	34%	70%
Annual Electricity	74,446 MWh	19,272 MWh	29,784 MWh	61,320 MWh
Annual Useful Heat	103,417 MWh _t	None	None	None
Footprint Required	6,000 sq ft	1,740,000 sq ft	76,000 sq ft	N/A
Capital Cost	\$20 million	\$60.5 million	\$24.4 million	\$10 million
Annual Energy Savings	308,100 MMBtu	196,462 MMBtu	303,623 MMBtu	154,649 MMBtu
Annual CO ₂ Savings	42,751 Tons	17,887 Tons	27,644 Tons	28,172 Tons
Annual NO _x Savings	59.4 Tons	16.2 Tons	24.9 Tons	39.3 Tons

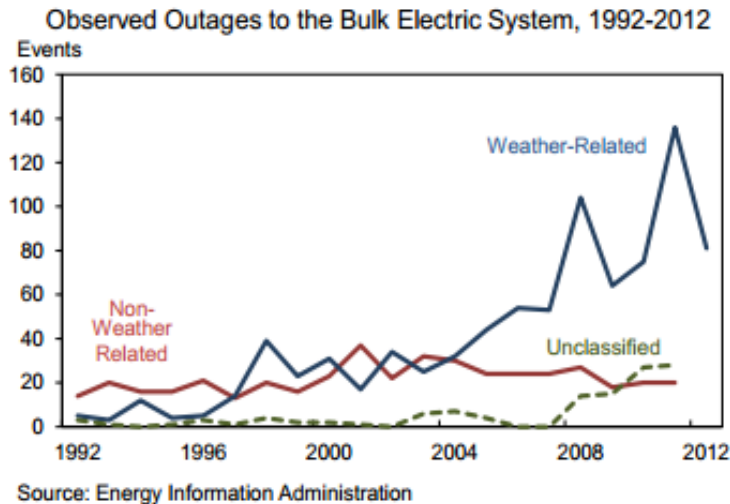
“Real” Sandy Lesson: Grid vs. Gas

“It is our view that the grid...is about to be disrupted by -of all things, the unheralded natural gas distribution system [when it's] connected with **an appliance that will convert natural gas into electricity in your home.**

There are **34 million homes** served by both electricity and natural gas distribution systems [wouldn't it be logical] to pick the one that is **reliably below ground versus the one above?**”

All we need is a technology that converts...natural gas into electricity in your basement and then [we can] tell the owners of the grid to just shove off and disconnect [the] wire.”

David Crane, former CEO of NRG



		<u>Grid</u>	<u>Gas</u>
Outages/month*:	2000-04	44	0
	2005-09	100	0
	2010-13	200	0
	2014	260**	0
Energy delivery efficiency	33%	80+%	
US Rate Payers (in millions)	125	75	
Cost per delivered kWh (cents)		18	6
Cost Trend		Up	Down

* <http://insideenergy.org/2014/08/18/power-outages-on-the-rise-across-the-u-s/>. (Data for more than 50K impacted.)

**Rise in overgeneration/negative prices/instability from duck curve: <http://large.stanford.edu/courses/2015/ph240/burnett2/>

