

# Illinois Stakeholder Advisory Group (SAG)

## Pumping Systems Energy Optimization & Program Deployment

### Grundfos North America - Business Development Managers (Utility Team)

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# Who is Grundfos?

- Founded in 1945 by Poul Due Jensen in Bjerringbro, Denmark
- “Grundfos” is Danish for ground water
- Started building piston driven well pumps for Danish farmers
- 1950s developed first centrifugal pump – basis of design for circulators
- Expanded to the US in 1973 where it opened sales and manufacturing channels
- Today, Grundfos manufactures +16 million pumps/ motors worldwide

## Why is Grundfos Different?

- Owned by the Poul Due Jensen Foundation – can never be bought, sold or traded
- 5% of revenue towards research and development – driving innovation



“The Pig” (1945) > Magna3 (2013)



# Plan of Attack...

1. Technology Details & Energy Savings Opportunities
2. Success in Other Jurisdictions
3. Target Market/ Customers
4. Delivery/ Deployment Approach
5. Marketing Strategy



“The Pig” (1945) > Magna3 (2013)



# 1. Technology Details & Energy Savings Opportunities

## *Framing The Opportunity...*

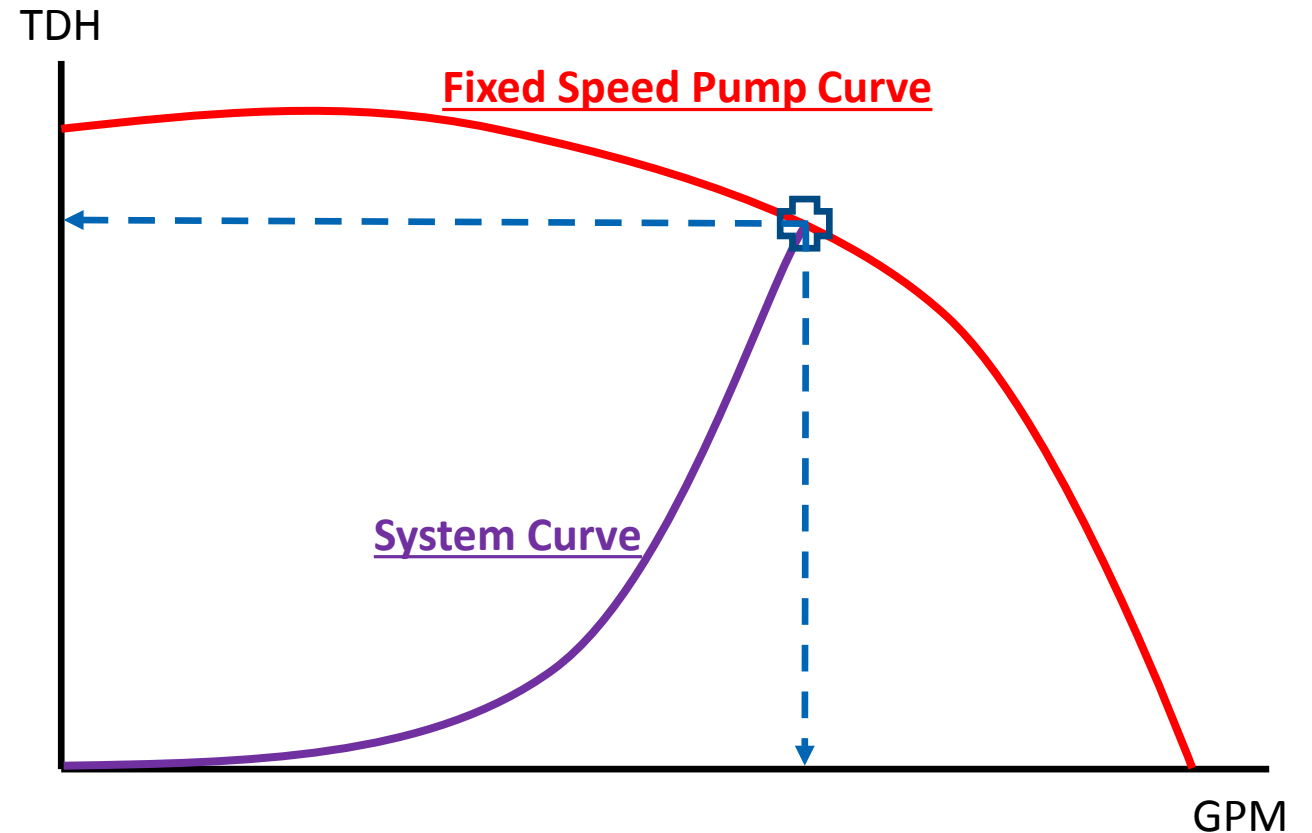
- Pump is a machine that **adds pressure** liquid product (Residential, Commercial & Industrial Applications)
  - Pressure Boosting, Hot Water Recirculation, Heating & Cooling
  - Typically driven by an **electric motor** (fractional to hundreds of HP)
- **Variable Frequency Drive (VFD)** can be used **to regulate speed to adjust speed/ pressure** for applications
  - VFDs typically used for larger pumps (approx. 25 HP and Higher)
- Work a pump does is described in terms of **FLOW (GPM) vs HEAD (psi or TDH/ Head)**
- **Pumps can work independently or together** to do perform work that needs to be done
- Different pump designs for varying application needs
  - In-Line, End Suction, Split-Case
  - Single or Multiple Stage
  - Horizontal or Vertical



# 1. Technology Details & Energy Savings Opportunities

## *Fixed Speed Pump Basics...*

- Work expressed as GPM vs. TDH (pressure)
- Fixed speed pumps dominate the market
  - Operates along pump curve
- System Curve
  - Pump operates at intersection of pump and system curve
  - System curves are dynamic



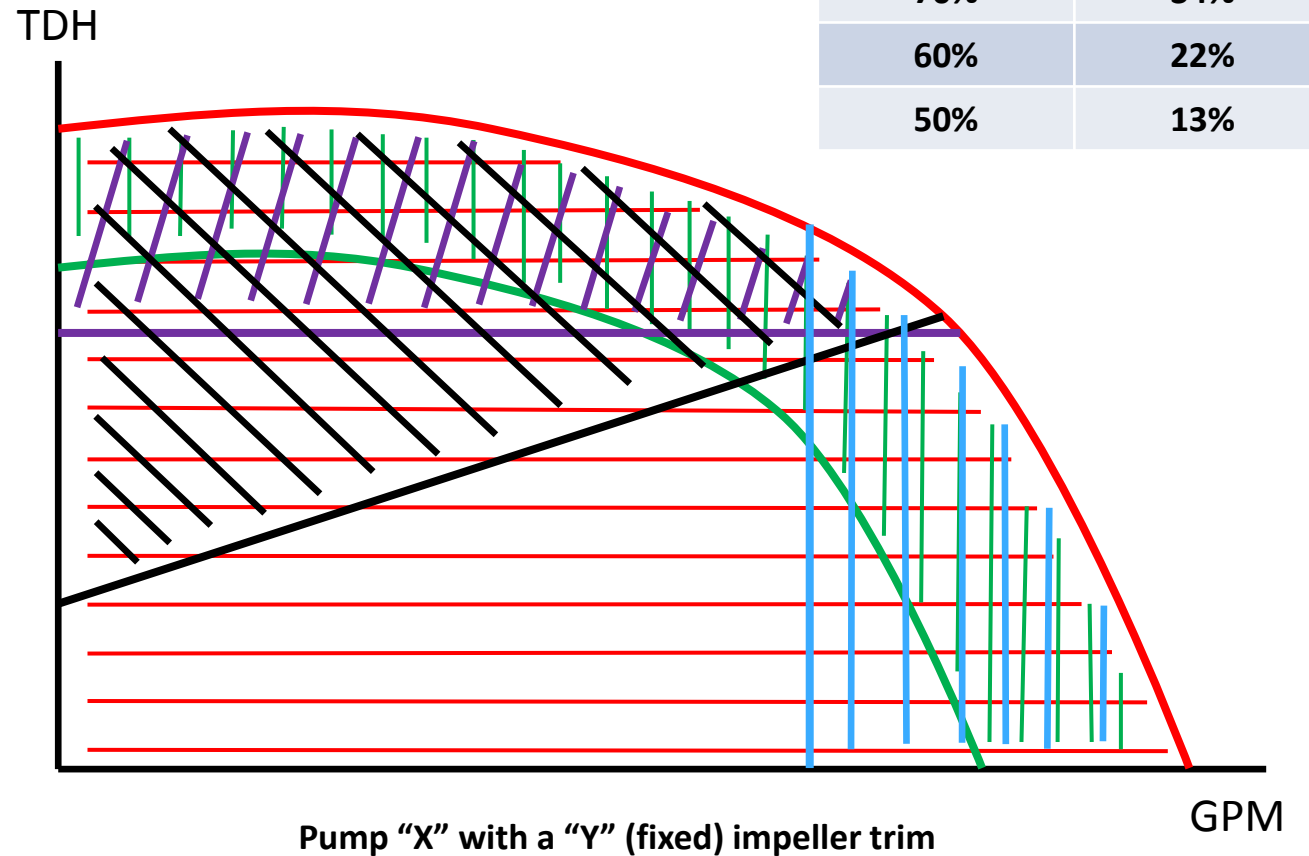
# 1. Technology Details & Energy Savings Opportunities

## Pumping Systems Evolution...

### VFD Institution Allows For Control Scheme Flexibility

- **Fixed Speed Pump Operation (3500 rpm)**
  - **Energy Consumption**
- **Institution of VFD (2800 rpm)**
  - **20% Decrease in speed... 49% savings**
- **Constant Pressure Control Mode**
- **Proportional Pressure Control Mode**
  - **Self Optimizing**
- **Institute of Flow Limit**
  - **Capable w/ Integrated System**

Index Speed	Power (kW) Input
100%	100%
90%	73%
80%	51%
70%	34%
60%	22%
50%	13%



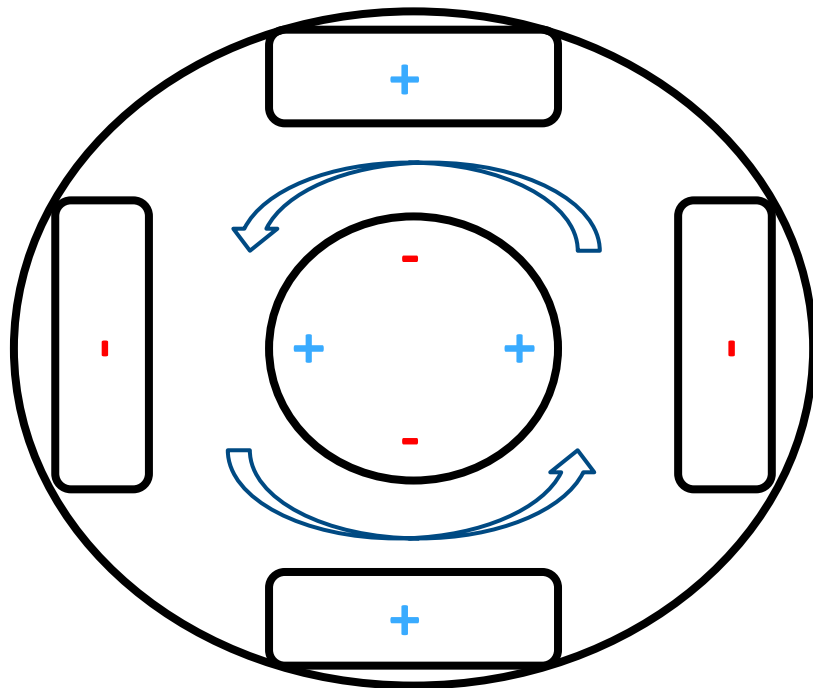


# 1. Technology Details & Energy Savings Opportunities

## *Driver Systems Evolution...*

### Standard Induction Motor

Industry Norm

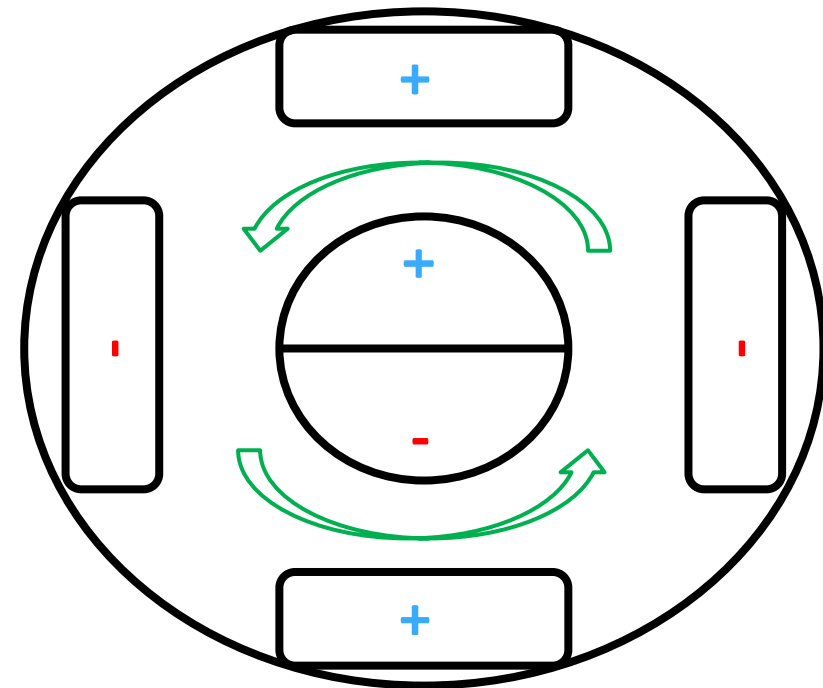


*Alternate polarity in BOTH ROTOR and STATOR*

VS.

### Electrically Commutated Motor

Energy Optimized



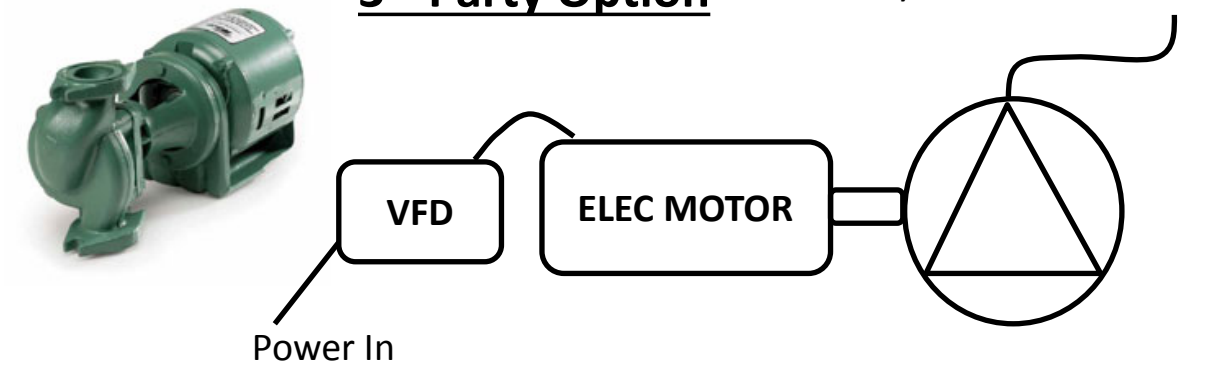
*50% Energy Savings*

# 1. Technology Details & Energy Savings Opportunities

## Unitary Solution Evolution...

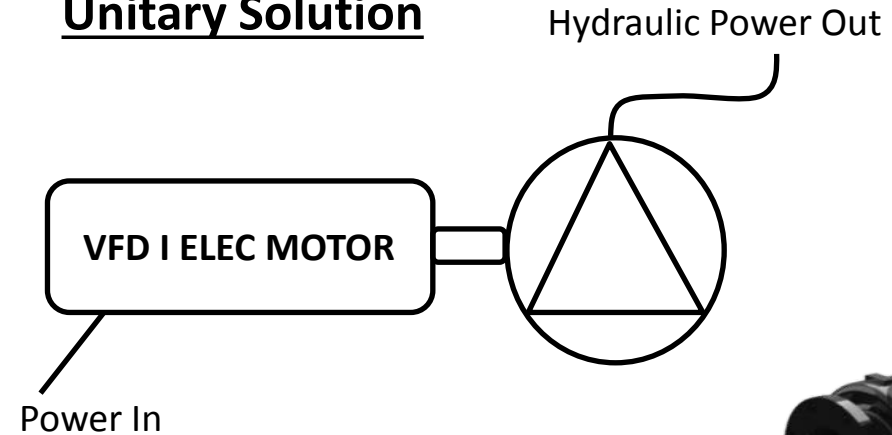
### Thought Experiment: How Is A Pump Like A Car?

#### 3<sup>rd</sup> Party Option



- 3<sup>rd</sup> Party Logic driving
  - 3<sup>rd</sup> Party VFD
  - 3<sup>rd</sup> Party Electric Motor
  - 3<sup>rd</sup> Party Pump
- Very complicated programming
- No efficiency standards on pumps
- Full energy optimization is NOT realized

#### Unitary Solution



- Grundfos Logic driving
  - Grundfos VFD
  - Grundfos Electric Motor
  - Grundfos Pump
- Very simple and quick programming
- Pumps efficiency is basis of design
- Full energy optimization IS realized

$$\text{ETA \% (Wire-to-Water)} = \text{VFD Efficiency} \times \text{Motor Efficiency} \times \text{Pump Efficiency}$$





# 1. Technology Details & Energy Savings Opportunities

## *Energy Savings (Residential/ Light Commercial)...*

### **Pump Life Cycle Costs: A Guide to LCC Analysis for Pumping Systems (Hydraulic Institute & US DOE)**

- Pumps account for nearly 20% of the worlds energy usage

What does the combination of...

- “Self-Optimizing” Proportional Pressure Controls
- Electrically Commutated Motor
- Unitary Solution

... mean in terms of energy savings in the real world?



**Market Standard**



**New Technology**

### **Crown Point Elementary School (Charlotte, NC) HWR Loop for Cafeteria**

kWh/ Year:	1,463 kWh	166 kWh
Savings/ Year (kWh):	-	1,297 kWh
kW/ Year:	0.167 kW	0.019 kW
Savings/ Year (kW):	-	0.148 kW (89%)

# 1. Technology Details & Energy Savings Opportunities

## Energy Savings (Commercial)...

### Pump Life Cycle Costs: A Guide to LCC Analysis for Pumping Systems (Hydraulic Institute & US DOE)

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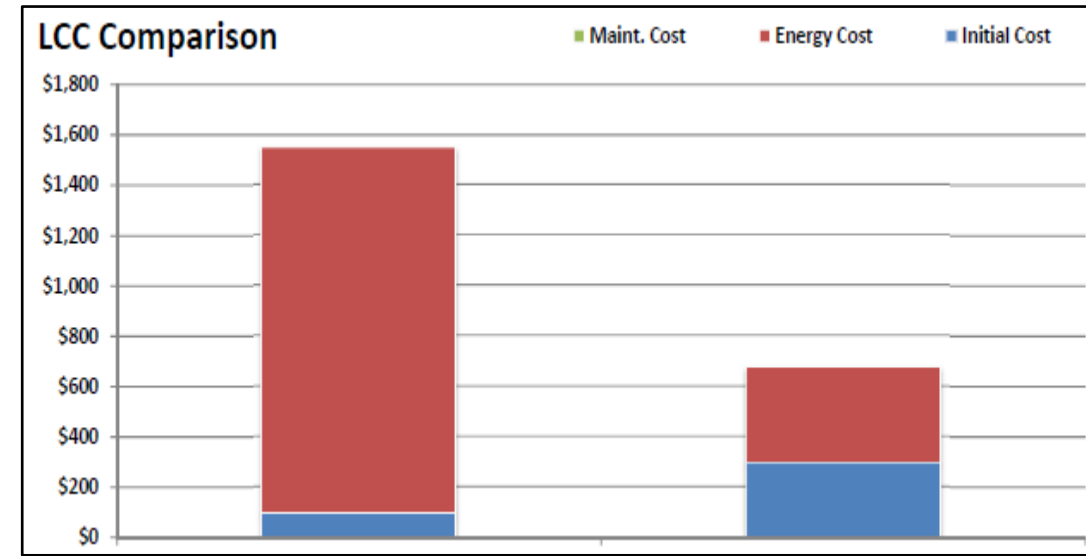
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- Unitary Solution

... mean in terms of energy savings in the real world?



University of Florida



**UP 15-42 F (1/25 Hp)**

**Alpha 15-55 SF (1/16 Hp)**

kWh/ Year:

661 kWh

173 kWh

Savings/ Year (kWh):

-

488 kWh

kW/ Year:

0.075 kW

0.020 kW

Savings/ Year (kW):

-

0.056 kW (74%)

# 1. Technology Details & Energy Savings Opportunities

## Energy Savings (Commercial)...

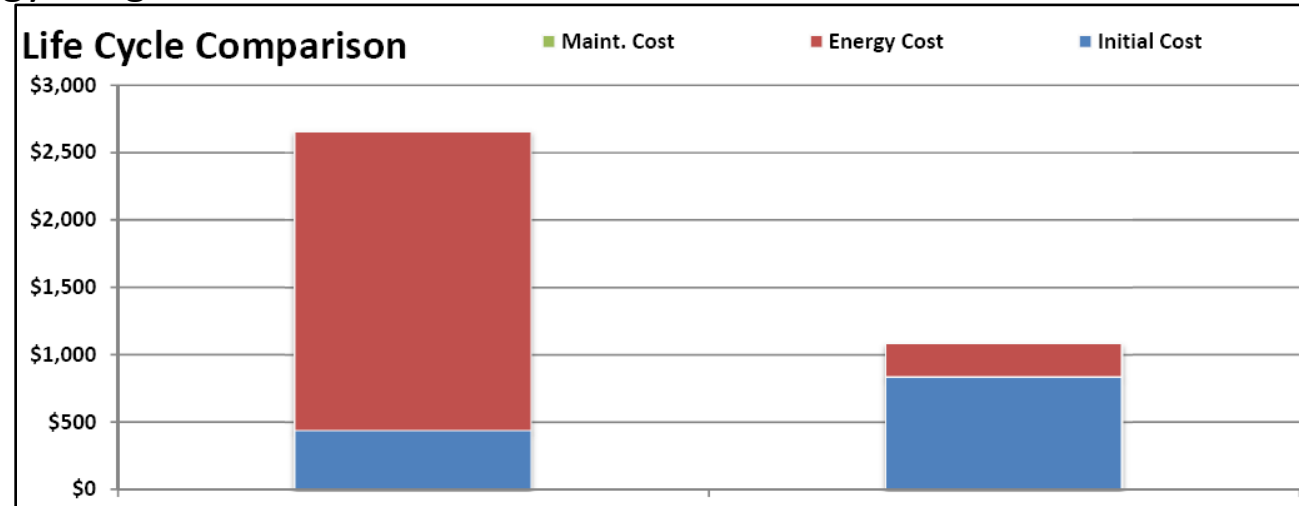
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... mean in terms of energy savings in the real world?



	<u>Market Standard</u>	<u>Magna3 32-60 FN</u>
kWh/ Year:	1,108 kWh	124 kWh
Savings/ Year (kWh):	-	984 kWh
kW/ Year:	0.130 kW	0.010 kW
Savings/ Year (kW):	-	0.120 kW (89%)



# 1. Technology Details & Energy Savings Opportunities

## Energy Savings (Commercial)...

### Pump Life Cycle Costs: A Guide to LCC Analysis for Pumping Systems (Hydraulic Institute & US DOE)

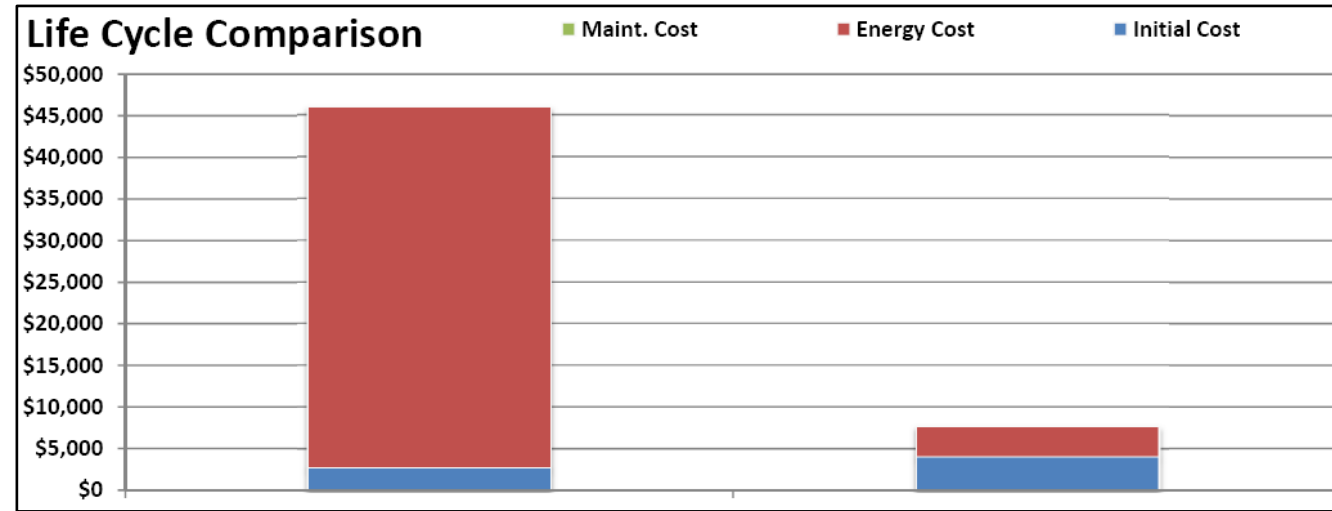
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What does the combination of...

- “Self-Optimizing” Proportional Pressure Controls
- Electrically Commutated Motor
- Unitary Solution

... mean in terms of energy savings in the real world?

### ATL Marriott Hotel



	<u>Market Standard</u>	<u>Magna3 40-80 FN</u>
kWh/ Year:	21,636 kWh	1,813 kWh
Savings/ Year (kWh):	-	19,823 kWh
kW/ Year:	2.47 kW	0.21 kW
Savings/ Year (kW):	-	2.26 kW (92%)

# 1. Technology Details & Energy Savings Opportunities

## Energy Savings – Residential Hot Water Recirculation...

Row Labels	2015 Estimated Building Permits	2013 SF_Homes	2015 Est. New Construction Pumps	2015 Potential kWh Savings
[-] Central	176,079	29,483,646	176,079	31,762,451
Illinois	24,366	5,296,715	24,366	4,395,322
Ohio	20,570	5,127,508	20,570	3,710,571
Indiana	18,441	2,795,541	18,441	3,326,526
Missouri	17,823	2,712,729	17,823	3,215,046
North Dakota	17,203	317,498	17,203	3,103,206
Wisconsin	16,622	2,624,358	16,622	2,998,401
Minnesota	16,596	2,347,201	16,596	2,993,711
Michigan	15,378	4,532,233	15,378	2,773,999
Iowa	10,006	1,336,417	10,006	1,804,957
Nebraska	7,581	796,793	7,581	1,367,518
Kansas	7,553	1,233,215	7,553	1,362,467
South Dakota	3,940	363,438	3,940	710,727
[+] North East	122,256	23,647,636	122,256	22,053,454
[+] South Central	224,307	14,923,094	224,307	40,462,179
[+] South East	321,062	35,057,735	321,062	57,915,572
[+] West	269,402	28,592,619	269,402	48,596,753
<b>Grand Total</b>	<b>1,113,106</b>	<b>131,704,730</b>	<b>1,113,106</b>	<b>200,790,409</b>

# 1. Technology Details & Energy Savings Opportunities

## Energy Savings – Residential Hydronic Heating...



Row Labels	Sum of Total SF Homes	# of SF Hydronic Homes	kWh - Existing Market	kWh - Transformed Market	kWh - Potential Savings
<b>Central</b>	<b>29,659,725</b>	<b>509,790</b>	<b>330,017,106</b>	<b>83,816,792</b>	<b>246,200,314</b>
Illinois	5,321,081	162,102	104,938,299	26,651,926	78,286,373
Indiana	2,813,982	17,877	11,572,929	2,939,259	8,633,670
Iowa	1,346,423	27,988	18,118,266	4,601,625	13,516,641
Kansas	1,240,768	2,636	1,706,467	433,404	1,273,064
Michigan	4,547,611	66,063	42,766,703	10,861,764	31,904,939
Minnesota	2,363,797	69,508	44,996,602	11,428,107	33,568,495
Missouri	2,730,552	8,455	5,473,539	1,390,154	4,083,385
Nebraska	804,374	1,272	823,432	209,133	614,299
North Dakota	334,701	7,421	4,804,338	1,220,192	3,584,146
Ohio	5,148,078	72,570	46,978,786	11,931,536	35,047,249
South Dakota	367,378	2,648	1,714,466	435,435	1,279,031
Wisconsin	2,640,980	71,248	46,123,278	11,714,257	34,409,021
<b>Grand Total</b>	<b>29,659,725</b>	<b>509,790</b>	<b>330,017,106</b>	<b>83,816,792</b>	<b>246,200,314</b>



# 1. Technology Details & Energy Savings Opportunities

## *Energy Savings – Commercial Domestic Water Pressure Boosting...*



### Existing System...

- Three pump skid where controller has pumps run at 100% only as pressure requires. Third party controlled to maintain a set point pressure. When needed each pump runs at 100% speed and excess pressure is removed with pressure reducing valves (PRVs).
- 127,359 kWh/ Yr

### Grundfos Option...

- Three pump skid with Grundfos pumps, motors, drives and controllers running in constant pressure mode. Each pump runs at a specific speed in order to maintain set point pressure with a change in flow. Project was incented by Georgia Power.
- 52,644 kWh/ Yr
- 75,445 kWh/ Yr Savings
- **59% Savings**



# 1. Technology Details & Energy Savings Opportunities

## Energy Savings – Commercial Domestic Water Pressure Boosting...

AHR Expo 2012 Product Preview

January 2012 **pmengineer** www.pmengineer.com

PM Engineer - The must-read resource for engineering excellence



**Hello, Savings**

Advanced pump system dramatically lowers New Jersey building's energy costs.

> Rainwater Harvesting 101

Eron Mechanical President Eron Samochos at Parkview Towers in West New York, N.J.

Scan with your smartphone to access pmengineer.com.

Get the free mobile app at <http://gettag.mobi>

A bnp PUBLICATION

### Existing System...

- 2-40 Hp pumps w/ 20 Hp backup
- All 3<sup>rd</sup> party equipment
- 132,132 kWh/ Year
- \$19,820/ Year (Energy Cost)



### Grundfos BoosterpaQ...

- “Right-Sized” w/ 2-15 Hp Pumps
- Unitary Solution – All Grundfos Components
- 11,065 kWh/ Year
- \$1,660/ Year (Energy Cost)
- 92% Savings



## 2. Success in Other Jurisdictions

### Michigan Energy Measures Database (MEMD)...



### New Measures Implemented for 2016...

Sector	End Use	Measure	Measure File	Change
Residential	Motors	Residential ECM Pumps	.FESM5	Updates basis of savings from per Watt to per Motor
Commercial	Motors	Commercial ECM Pumps	.FESM5	Updates basis of savings from per Watt to per Motor

**Measure Life:** 15 Years

**Incremental Cost:** Estimated \$6/ Watt for ECM Circulating Pump

### Technology Description:

Electronically commutated motors (ECM) are high-efficiency brushless DC motors. They are typically fractional horsepower motors that enjoy several benefits over the more common permanent split capacitor (PSC) fractional horsepower motor. One of these advantages is higher overall efficiency. **PSC motors are generally 20-60% efficient**, depending on their loading, while **ECM motor efficiencies range from 70-80%**. Other advantages include the ability to provide constant flow with varying pressures, a wider range of rpm and the ability to be controlled by direct digital controls (DDC).

These fractional horsepower motors are frequently found in **domestic hot water recirculating pumps, hydronic (boiler) recirculating pumps, geothermal and solar hot water systems**. Recirculating pumps are commonly used in multifamily buildings to shorten the amount of time it would otherwise take for hot water to reach the tenants on the upper floors. These recirculation pumps can be operated continuously or can be controlled by an aqua-stat, which turns on the pump only when the temperature of the return line falls below a certain setpoint. Many of the ECM recirculating pumps currently on the market have integrated aqua-stat controls and the ability to be controlled and monitored wirelessly.

### Rolling Out Prescriptive Programs in 2016...

- Consumers Energy
- DTE Energy



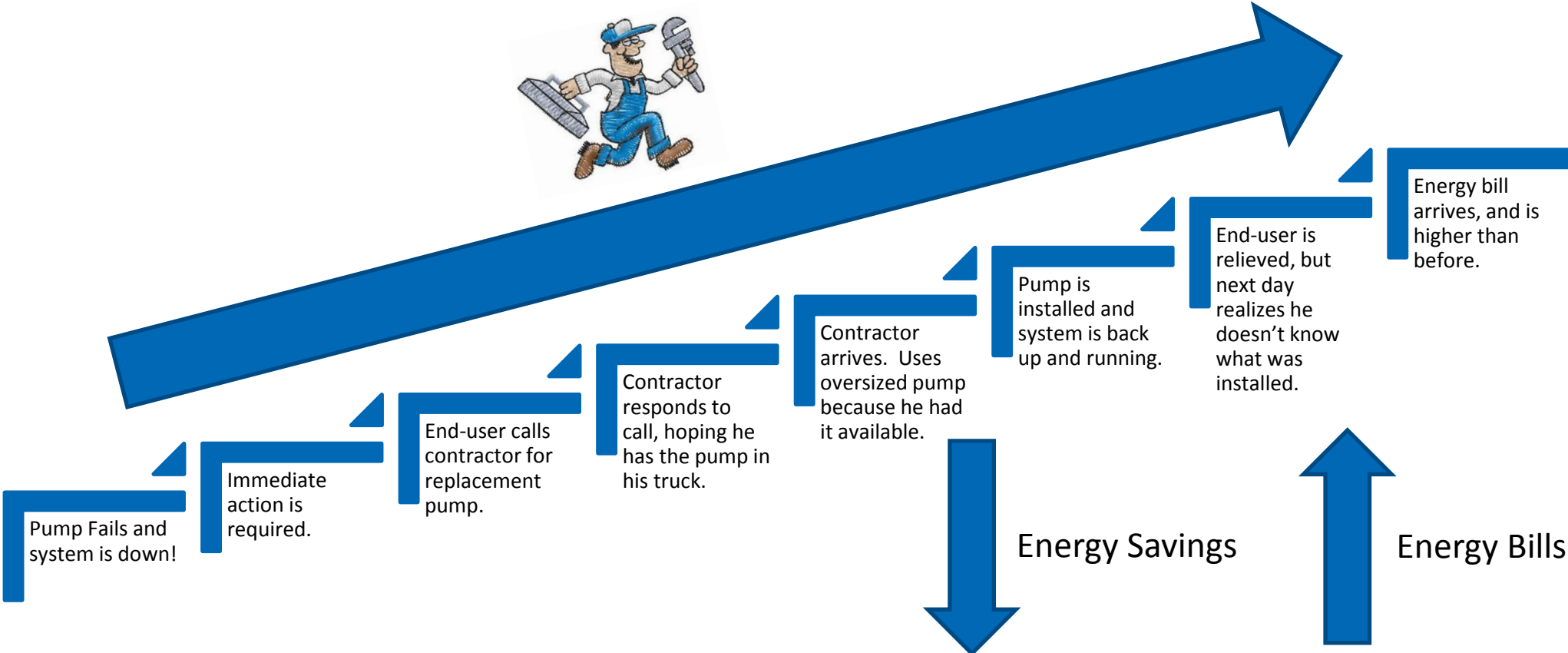
# 3. Target Market/ Customers

## Products and Applications...

Pump	Residential	Commercial	Plumbing	HVAC	BMS
 Comfort PM	✓		✓		
 Alpha	✓	✓	✓	✓	
 Magna3	✓	✓	✓	✓	✓
 CRE		✓	✓	✓	✓
 LCSE		✓	✓	✓	✓
 BoosterpaQ		✓	✓		✓

# 3. Target Market/ Customers

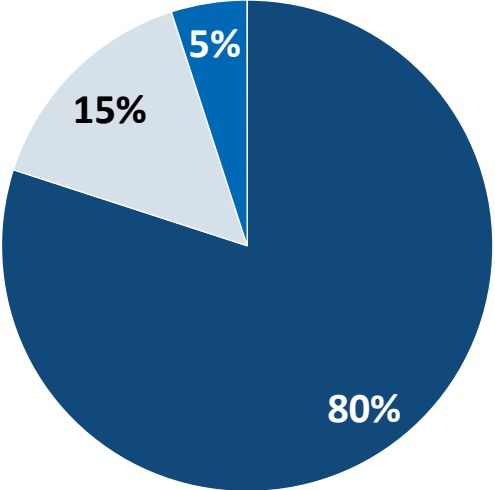
## The Contractors Dilemma...



Missed Opportunity for Utility Programs

# 3. Target Market/ Customers

## The Pumping Market Story...



■ Replacement ■ New Installation ■ Retrofit

95 % of pumps today are fixed speed, no VFD, no ECM, Absolutely NO LOGIC!

This means 50 – 90% more energy

Missed Opportunity for Utility Programs



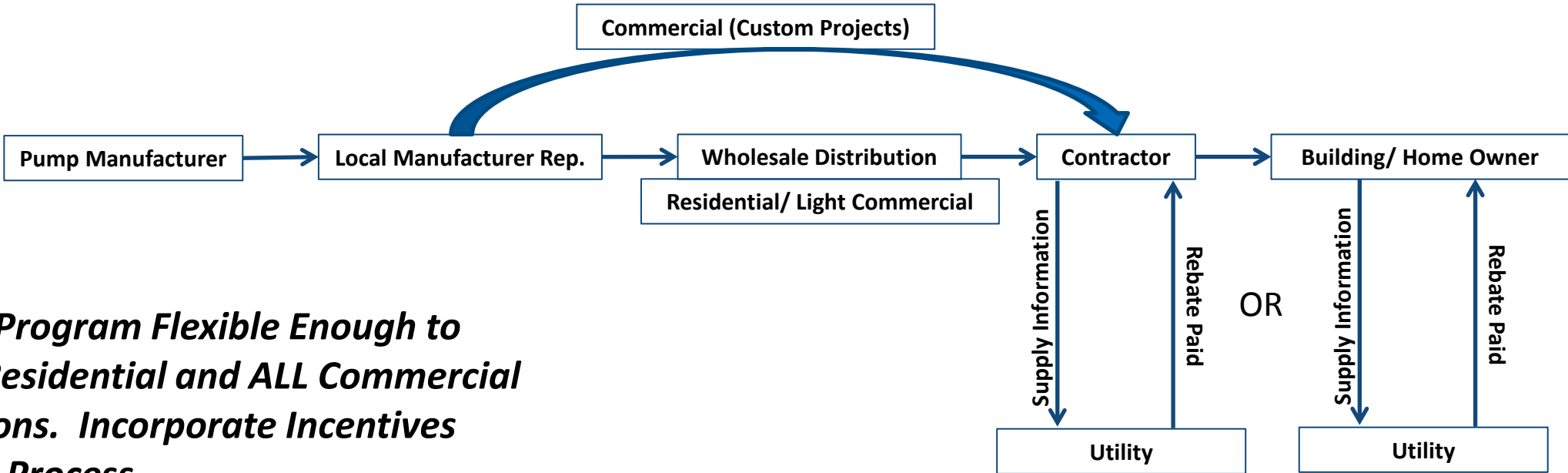


# 4. Delivery/ Deployment Approach

*Proposed Avenue to Market and Incentive Structure...*

**PROBLEM:** How best to capture incentives for all E-pump transactions?

**SOLUTION:** Open midstream portion for majority of transactions, keep downstream option for projects



**BENEFIT:** Program Flexible Enough to Capture Residential and ALL Commercial Transactions. Incorporate Incentives into Sales Process.

# 4. Delivery/ Deployment Approach

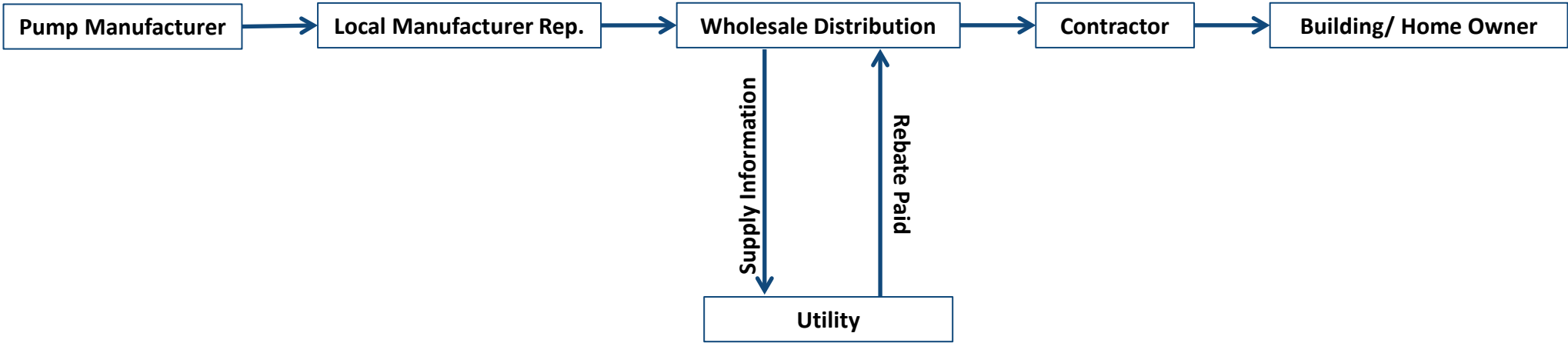
## Midstream Program Deployment – Success Story...



- Efficiency Vermont ran Pilot Program ran in Q4 of 2013, midstream model adopted
- Program written around the residential heating and HWR applications

- **RESULTS**

- 2010: 65 Smart Pumps
- 2011: 49 Smart Pumps
- 2012: 73 Smart Pumps
- Average: 62 Smart Pumps
- **Q4 2013: 2,870 Smart Pumps (4,629% Growth)**



# 5. Marketing Strategy

## Strategic Partnership w/ Utilities and Implementers...

### THE NEXT ENERGY CHALLENGE IS HERE AND GRUNDFOS IS READY TO PARTNER WITH UTILITIES TO CONQUOR THE CHALLENGE

According to the Hydraulic Institute and the DOE, pump systems consume 20% of the world's electrical energy. With a product portfolio that can provide as much as 85% energy savings over industry norms, Grundfos is ready to strategically partner with electric utilities to help achieve your energy efficiency goals.

#### BENEFITS OF PARTNERING WITH GRUNDFOS:

- Grundfos is the pumping industry leader in energy optimization and has a proven supply and distribution channel we are ready to meet market demands.
- With an in depth knowledge of local market Grundfos is prepared to unbiasedly assist in program research.
- We have a complete product line to service the Residential, Commercial, Industrial and Municipal markets.

Contact the Grundfos Utility Team Today!



Jessica Morrison / (414) 208-5330  
jmorrison@grundfos.com

Stephen Putnam / (832) 302-4201  
sputnam@grundfos.com

be  
think  
innovate

**GRUNDFOS** 



**Grundfos (with a dedicated utility team and proven sales channels) is ready to partner with utilities and implementers...**

- Provide insights into the markets and applications
- Design programs to capture as many transactions as possible
- Have additional “boots on the ground” to gain even more participation
- Help implementers build value for their utility customers and utilities build value for their end user customers
- Incorporate program participation into normal sales process
- **ACCOMPLISH MARKET TRANSFORMATION TO EFFICIENT PUMPING SYSTEMS**

# 5. Marketing Strategy

## Point of Sales – Marketing Material (Efficiency Vermont)...

ENERGY **SAVE** MONEY



**YOU'VE JUST INSTALLED  
THE MOST ENERGY  
EFFICIENT PUMP IN  
THE WORLD.**

Your Grundfos ALPHA saves energy everyday and provides you the heating you need.

Grundfos is proud to partner with Efficiency Vermont and professional installers to bring you efficient products at **discounted prices**—saving you energy and money. Learn more about other energy-saving opportunities, including special pricing on ENERGY STAR® qualified CFLs and LEDs. Visit [www.efficiencyvermont.com](http://www.efficiencyvermont.com) or call 888-921-5990.

Proudly installed by:

[www.grundfos.us](http://www.grundfos.us)

**GRUNDFOS**

# SPECIAL PRICING



## brought to you by

**Efficiency Vermont**  
[efficiencyvermont.com/pumps](http://efficiencyvermont.com/pumps)

Efficiency Vermont's High-Performance Circulator Pump program promotes the installation of efficient brushless permanent magnet motor circulator pumps with integrated variable speed controls in Vermont homes and businesses. This program will help drive energy savings for homeowners and business owners. This pilot program provides financial incentives at the wholesale level for qualifying energy efficient circulator pumps sold for installation in a commercial facility or residential home in Vermont.



## BENEFITS OF THE PROGRAM

### For the distributor:

Vermont distributors can partner with contractors to deliver high-value, high-performance equipment to the marketplace at a reduced price resulting in lower energy costs and a better, quieter experience for customers.

### For the contractor:

Contractors can offer homeowners premium products at a lower cost, thus increasing sales calls.

### For the homeowner:

Vermonters can enjoy the lower energy costs and a better, quieter experience in their homes with high-performance circulator pumps.

For a list of participating distributors, go to [www.efficiencyvermont.com/pumps](http://www.efficiencyvermont.com/pumps).

## CONTACT

For product information, contact:

**Urell, Inc.**  
86 Coolidge Avenue  
Watertown, MA 02471-0321  
tel: 617-923-9500  
[www.urell.com](http://www.urell.com)

For program information, contact:

**Efficiency Vermont**  
128 Lakeside Avenue, Suite 401  
Burlington, VT 05401  
tel: 888-921-5990  
[www.efficiencyvermont.com/pumps](http://www.efficiencyvermont.com/pumps)

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