



DOE Pump Regulations & HI Energy Rating Program

The Journey to Efficiency





The Starting Point: DOE Regulations

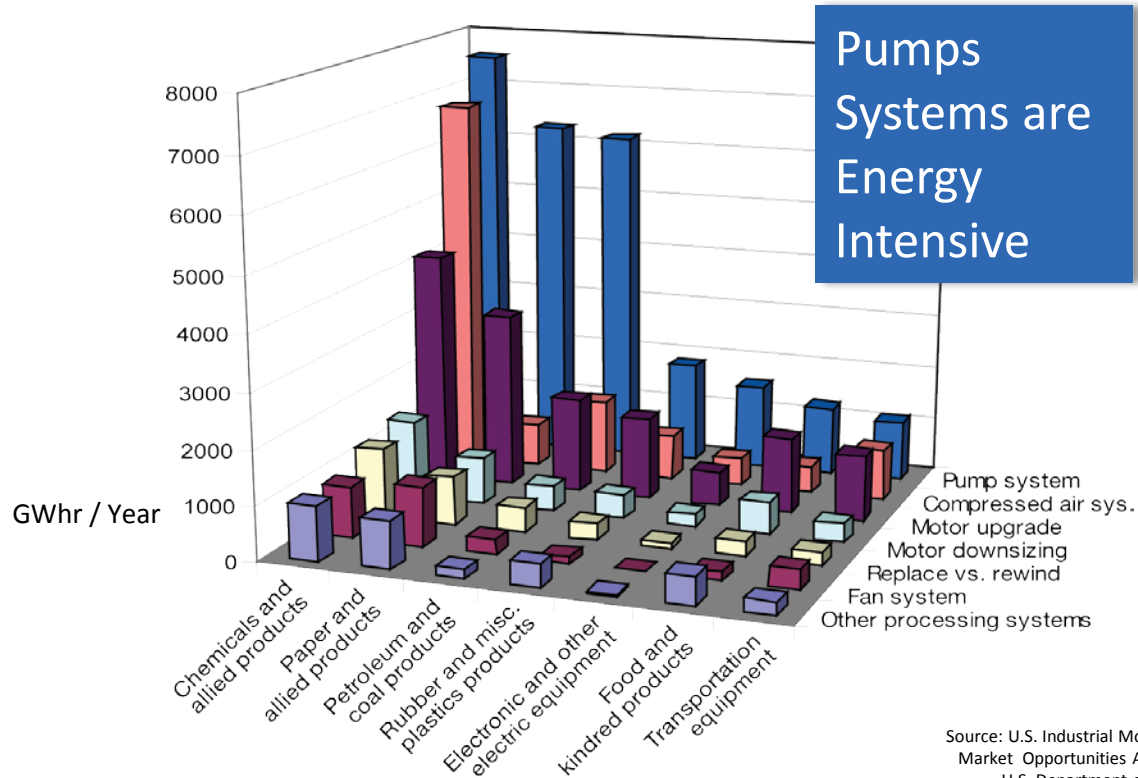


Energy Policy & Conservation Act - 1975

- Created comprehensive approach to federal energy policy
 - Formed strategic petroleum reserves
 - DOE enforces minimum Energy Conservation Standards for appliances/equipment



Electrical Energy Savings Potential



The regulation is estimated to save 0.27 quadrillion BTU's over a 30 year period or approximately the annual electricity required by 1.5 million homes annually

Commercial & Industrial Pump



GOVERNMENT Rulemaking Timeline

The Pump Energy Index (PEI) rating system created to measure amount of energy conservation

DOE initiates efforts to develop efficiency standards for pumps



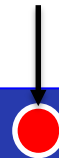
2011

ASRAC working group negotiates testing and efficiency terms



2013-2015

Publication of the final rules in the U.S. Federal Register



Jan 26, 2016

Compliance is required for “certain clean water pumps”



Jan 27, 2020



What Does This Mean To You?



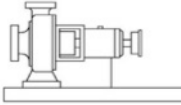


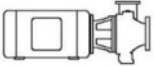








By January 27, 2020:

1. All covered pumps sold in U.S. must meet minimum efficiency standards
2. 25% of currently offered pumps will not be saleable on January 27, 2020
3. Pumps must be labeled to show energy efficiency (PEI)
4. Pump testing must comply with specified procedures, data must be shared with DOE
5. The standards use holistic approach encompassing pump, motor and VFD



Accelerates the shift to higher efficient pumps through education and easier inclusion in utility incentive programs

Scope of Commercial & Industrial Pump Rulemaking

Diagram	Nomenclature (DOE) / [Industry]	Relevant Taco Products	Scope Refinement
	End Suction Frame Mount (ESFM) / [OH0, OH1]	 FI Series – Base Mounted End Suction Pumps	<p><u>Included</u></p> <ul style="list-style-type: none"> Clean Water Pumps BEP Pump Power Input : 1 – 200 HP BEP rate of flow: 25 gpm or greater BEP head: 459 ft or less Temperature: 14 – 248 °F Nominal Speeds (RPM): 1800 (1440-2160) & 3600 (2880-4320) Radial Flow (n_s less than 5000) <p><u>Excluded</u></p> <ul style="list-style-type: none"> Non-clean water designs (API, ASME, Slurry, Wastewater, Etc.) Nuclear controlled Mil Spec Magnetic Driven Fire Pump (GT, TA, TC pumps) Sanitary (3-A std) Self-priming Prime Assist Circulators (Separate Rulemaking) Pool Pumps (Separate Rulemaking) ST [VS0] with a bowl diameter > 6.0" 
	End Suction Close Coupled (ESCC) / [OH7]	 CI Series – Closed Coupled End Suction Pumps	
	In-line (IL) / [OH3, OH4, OH5]	   KV Series – Closed Coupled End Suction KS Series – Vertically Split Coupled In-Line Pumps 1900 Series	
	Radially Split multi-stage vertical in-line diffuser casing (RSV) / [VS8]	N/A	
	Submersible Turbine (ST) / [VS0]	 Hydroflo Pumps Fluid Solutions	

Key Terminology - What Is *PEI*?

PEI is the rating that will determine DOE compliance

- The Pump Energy Index (PEI) metric is a ratio of the pump being rated (basic model, PER_{CL} or PER_{VL}) over the representative performance of a minimally compliant pump (PER_{STD}) for that specific pump type (e.g. ESCC or IL).

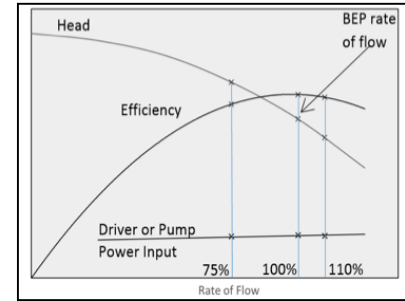
$$PEI_{CL} = \frac{PER_{CL}}{PER_{STD}} \leq 1.00$$

$$PEI_{VL} = \frac{PER_{VL}}{PER_{STD}} \leq 1.00$$

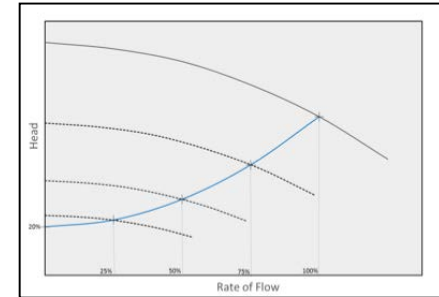
Only Pumps with a PEI less than or equal to 1.00 can be sold in the United States after January 27, 2020

Key Terminology

- **Constant Load (CL):**
Bare Pump or
Bare Pump + Motor



- **Variable Load (VL):**
Bare Pump + Motor + Continuous Control
 - Also called the Extended Product



Key Terminology

- **Manufacturer can choose to rate pump as:**

1. Bare Pump



Constant Load (PER_{CL})

2. Pump and Motor *or*



3. Pump, Motor and Drive
(extended product)



Variable Load (PER_{VL})

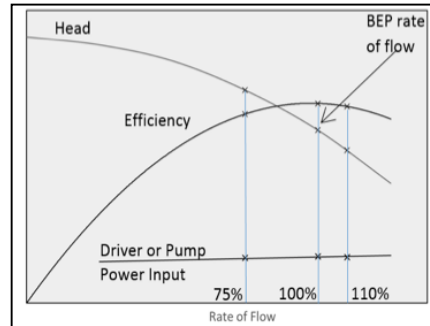
PER_{CL} & PER_{VL} Calculations

- **Pump Energy Rating (PER)**

Standard calculation to determine pump's average energy usage

PER_{CL} Calculation

$$PER_{CL} = \sum_i w_i (P_i^{in})$$



Where:

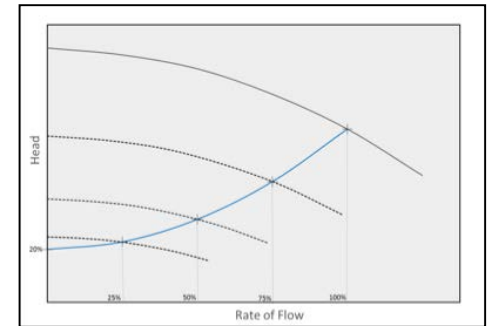
P_i^{in} = measured or calculated input power to the motor at rating point I, for the rated pump

w_i = weighting at load point, this is equal to 0.3333

I = 75%, 100% and 110% of BEP

PER_{VL} Calculation

$$PER_{VL} = \sum_i w_i (P_i^{in,c})$$



Where:

$P_i^{in,c}$ = measured or calculated input power to the motor at rating point I, for the rated pump

w_i = weighting at load point, this is equal to 0.25

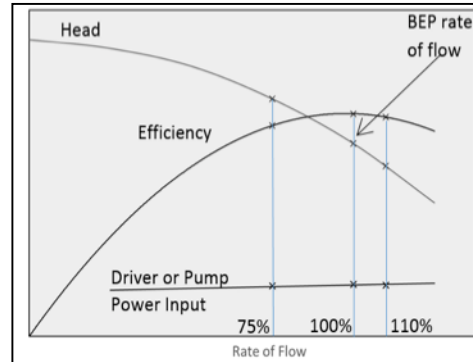
I = 25%, 50%, 75%, 100% of BEP

The Testing Methodologies

Method 1: Testing

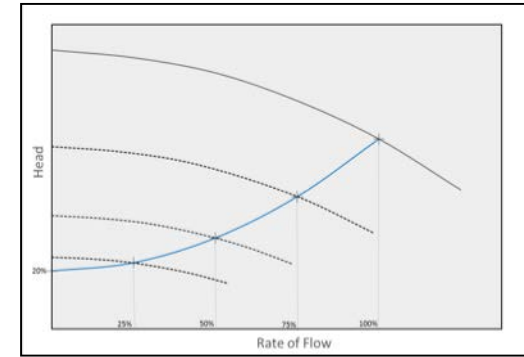
- Measures **wire-to-water** power consumption
- Inclusive of driver & controls, when applicable
- Describes **weighted average performance** of rated pump at specific load points

Bare Pump + Motor



PER_{CL} - Constant Load
75%, 100% and 110% of BEP

Bare Pump + Motor + Drive



PER_{VL} - Variable Load
25%, 50%, 75%, and 100% of BEP

Method 2: Calculation

- Uses default loss calculations for a driver or driver and controls that are applied to bare pump test data.

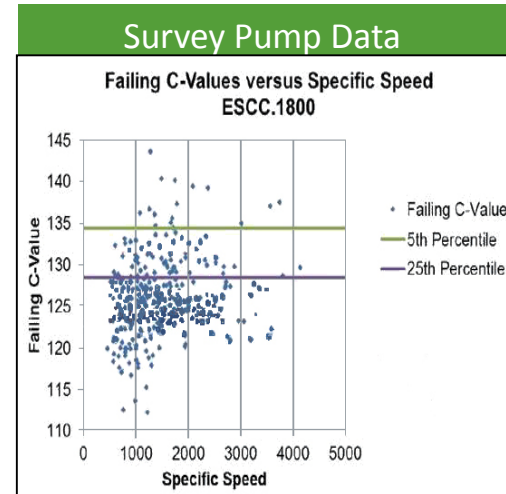
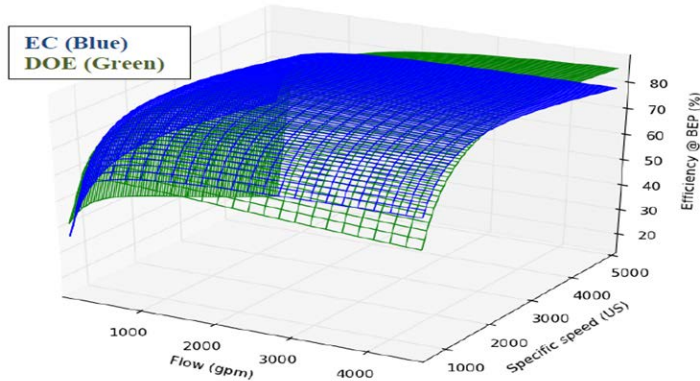
NOTE: Results in a higher PEI value than test method

DOE testing based on
HI 40.5-2016 Standard



Minimally Compliant Pump Calculation

- Minimally compliant pump (PER_{STD}) efficiency is a function of specific speed, the BEP flow, and a constant defined by the DOE based on pump survey data
- Equals a representative pump that would fall on the compliant line (25th percentile)



Pump Energy Rating Summary

PEI is the rating that will determine DOE compliance

- The Pump Energy Index (PEI) metric is a ratio of the pump being rated (basic model, PER_{CL} or PER_{VL}) over the representative performance of a minimally compliant pump (PER_{STD}) for that specific pump type (e.g. ESCC or IL).

$$PEI_{CL} = \frac{PER_{CL}}{PER_{STD}} \leq 1.00$$

$$PEI_{VL} = \frac{PER_{VL}}{PER_{STD}} \leq 1.00$$

Only Pumps with a PEI less than or equal to 1.00 can be sold in the United States after January 27, 2020

Labeling Requirements

Performance labeling:

- PEI is the final metric used to determine if the rated equipment is compliant with the DOE standard
- The compliant (≤ 1.0) PEI_{CL} or PEI_{VL} is required to appear on the pumps permanent nameplate and all catalog and marketing material

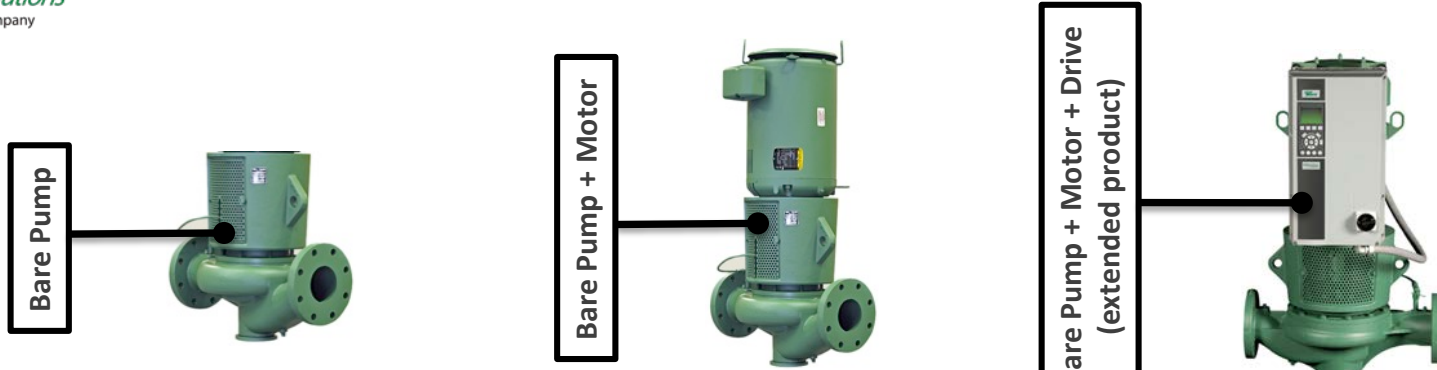


The pump needs to display the following:

- PEI_{CL} or PEI_{VL}
- Pump's basic model number
 - As listed with the DOE
- Impeller diameter
 - Or space left for it if final trim is determined later in commerce

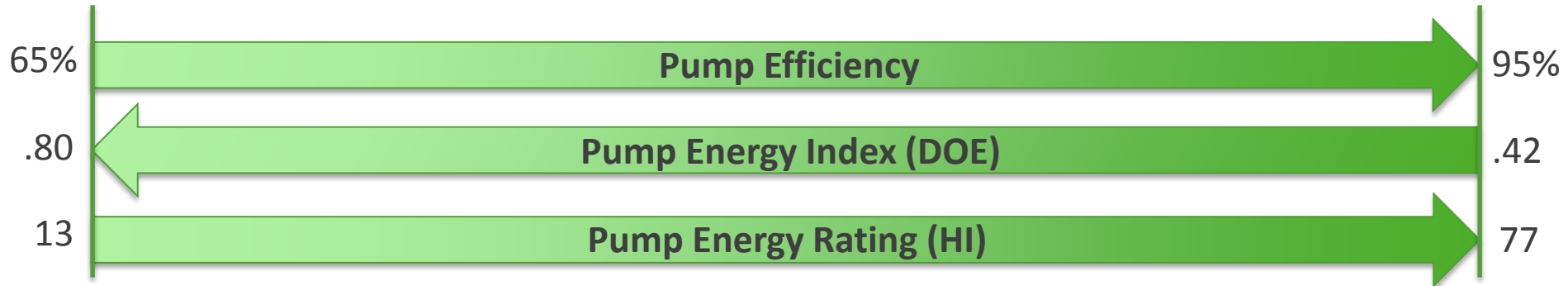
Note: All testing is based on performance at full impeller trim, max HP, normalized to 1800 or 3600 rpm

A NEW way to think about Efficiency



Least Efficient

Most Efficient



Most Consumptive

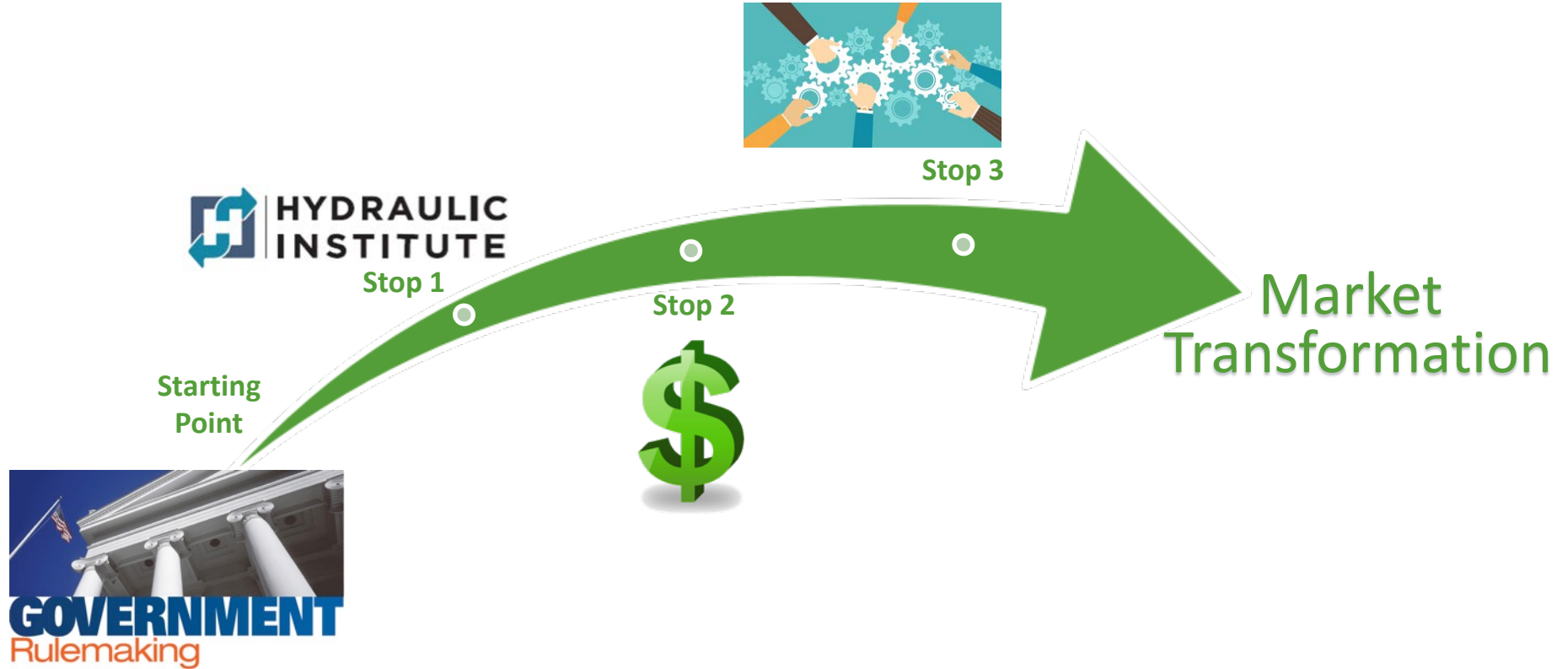
Least Consumptive

Future specifications will be driving to PEI and ER rating numbers

Now What?..

1. Look for labelling starting to appear in 2018 from all major pump manufacturers
2. Understand PEI so you can add requirements to specifications and use to compare pump options
3. 2020 is the regulation's effective date but many new pumps are being introduced now
4. Embrace high-efficiency pumping!
5. Contact **REP NAME** for any assistance

The Journey to Efficiency



HI Energy Rating Program

Program Goals:

1. Based on HI standards and DOE regulations
2. Develop rating system for bare pump & extended products
3. Suitable for utility programs to enable deemed incentives
4. Provides easy comparison to determine estimated energy savings

Provides additional value by:

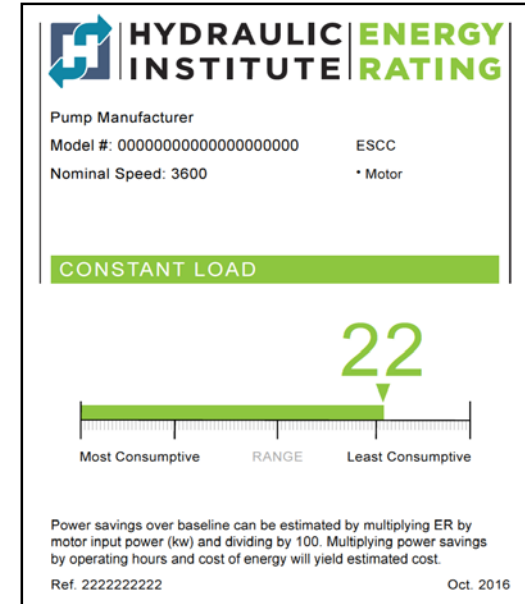
- Third party lab approval
- Provides data required for utility deemed incentive programs
- Certificate program for value added to a bare pump in the commerce stream. ******Missed by DOE regulation******



Bare Pump → Extended Product



- Yardstick approach
- Can be applied to:
 - Bare pump
 - Pump + motor
 - Pump + motor + drive/controls
 - Certificate option - capture downstream savings from added drivers/controls
- Aligns with proven appliance label concept
- Ready now - ahead of the 2020 DOE compliance date



The HI Energy Rating - Calculation

$$ER = (PEI_{Baseline} - Rated\ PEI_{CL/VL}) * 100$$

ER Represents the percent power savings over the base case

$$Power\ Savings = \frac{ER}{100} * Rated\ Motor\ Power$$

$$Power\ Savings = \frac{ER_1 - ER_2}{100} * Rated\ Motor\ Power$$

Average PEI - Baseline and Standard Level			Average ER - Baseline & Standard Level	
DOE Type	Baseline	Standard level	Baseline	Standard level
ESCC 1800	1.09	1.00	0	9
ESCC 3600	1.09	1.00	0	9
ESFM 1800	1.10	1.00	0	10
ESFM 3600	1.09	1.00	0	9
IL 1800	1.11	1.00	0	11
IL 3600	1.12	1.00	0	12
RSV 1800	1.00	1.00	0	0
RSV 3600	1.00	1.00	0	0
ST 1800	1.00	1.00	0	0
ST 3600	1.06	1.00	0	6

The HI Energy Rating - Calculation

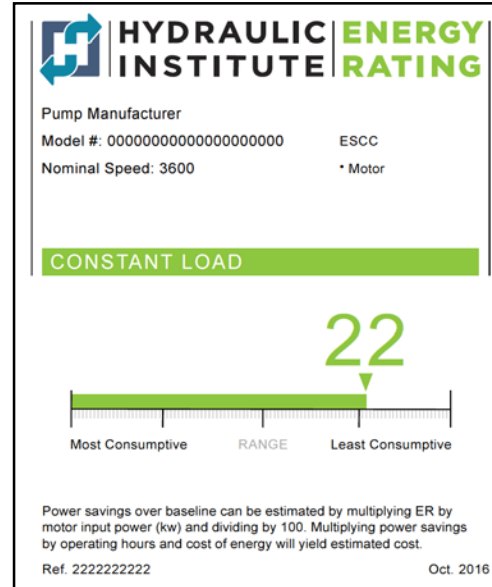
PEI to ER Calculation:

$$ER = (\text{Baseline} - PEI_{CL/VL}) * 100$$

Example for variable load: $ER = (1.09 - 0.49) * 100 = 60$

Example for constant load: $ER = (1.09 - 0.87) * 100 = 22$

*Energy Rating
is a direct
derivative of
the PEI*



Note: Energy Ratings are relative to the variables selected. Look at where the number lies within that particular label.

Power Savings Calculation - Example

50 HP ESCC Pump, Motor and Variable Speed Drive
Use label to calculate power savings over baseline value

$$\text{Power Savings} = \frac{60}{100} * 50 \text{ (hp)} * 0.7457 = 22.4\text{kW}$$

50 HP ESCC Pump and Motor
Use label to calculate power savings over baseline value

$$\text{Power Savings} = \frac{22}{100} * 50 \text{ (hp)} * 0.7457 = 8.2\text{kW}$$

\$13,500

The estimated annual savings
(assuming a 50HP motor running 4,000 hours at \$0.15 kwh)



\$8,500

The estimated annual savings between the pumps
(assuming a 50HP motor running 4,000 hours at \$0.15 kwh)



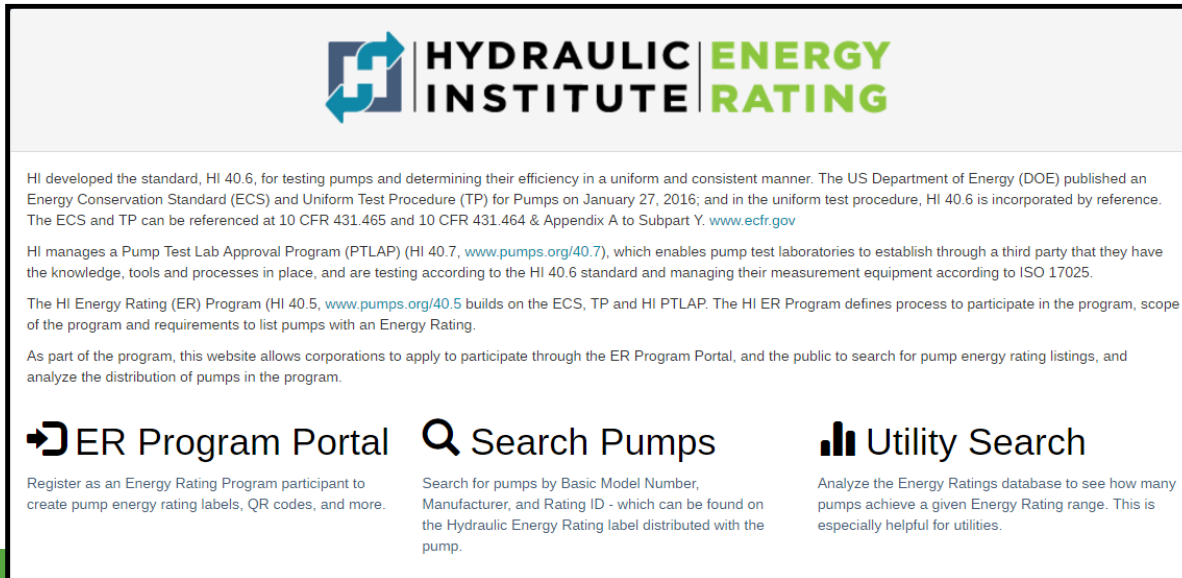
\$5,000


The estimated annual savings
(assuming a 50HP motor running 4,000 hours at \$0.15 kwh)

Multiply power savings by operating hours and cost of energy to yield estimated cost savings over baseline

HI Energy Rating Database

- HI Energy Rating Home Page: <http://er.pumps.org>
- Participants register, apply to participate and list pumps at the ER Program Portal
- Customers and Utility program can search pumps






 **HYDRAULIC INSTITUTE ENERGY RATING**

HI developed the standard, HI 40.6, for testing pumps and determining their efficiency in a uniform and consistent manner. The US Department of Energy (DOE) published an Energy Conservation Standard (ECS) and Uniform Test Procedure (TP) for Pumps on January 27, 2016; and in the uniform test procedure, HI 40.6 is incorporated by reference. The ECS and TP can be referenced at 10 CFR 431.465 and 10 CFR 431.464 & Appendix A to Subpart Y. www.ecfr.gov

HI manages a Pump Test Lab Approval Program (PTLAP) (HI 40.7, www.pumps.org/40.7), which enables pump test laboratories to establish through a third party that they have the knowledge, tools and processes in place, and are testing according to the HI 40.6 standard and managing their measurement equipment according to ISO 17025.

The HI Energy Rating (ER) Program (HI 40.5, www.pumps.org/40.5) builds on the ECS, TP and HI PTLAP. The HI ER Program defines process to participate in the program, scope of the program and requirements to list pumps with an Energy Rating.

As part of the program, this website allows corporations to apply to participate through the ER Program Portal, and the public to search for pump energy rating listings, and analyze the distribution of pumps in the program.

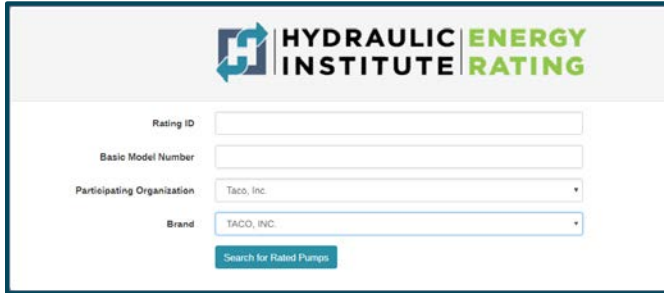
 ER Program Portal Register as an Energy Rating Program participant to create pump energy rating labels, QR codes, and more.	 Search Pumps Search for pumps by Basic Model Number, Manufacturer, and Rating ID - which can be found on the Hydraulic Energy Rating label distributed with the pump.	 Utility Search Analyze the Energy Ratings database to see how many pumps achieve a given Energy Rating range. This is especially helpful for utilities.
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HI Database – Search Tools

- Enter Basic Model Number
- Search by manufacturer

Scan the QR Code
found on
the pump

both take you directly
to the public listing



HYDRAULIC INSTITUTE ENERGY RATING

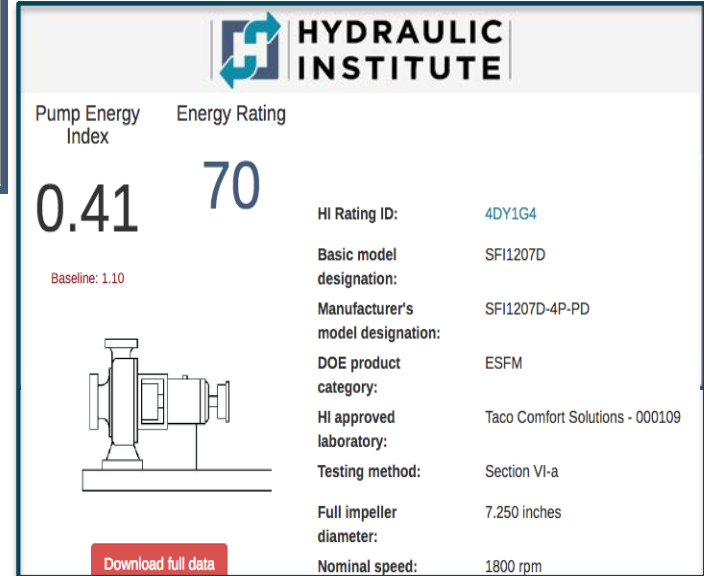
Rating ID:

Basic Model Number:

Participating Organization:

Brand:

[Search for Rated Pumps](#)

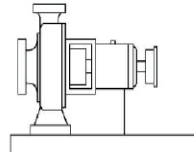



HYDRAULIC INSTITUTE

Pump Energy Index: **0.41**

Energy Rating: **70**

Baseline: 1.10



[Download full data](#)

HI Rating ID:	4DY1G4
Basic model designation:	SF11207D
Manufacturer's model designation:	SF11207D-4P-PD
DOE product category:	ESFM
HI approved laboratory:	Taco Comfort Solutions - 000109
Testing method:	Section VI-a
Full impeller diameter:	7.25 inches
Nominal speed:	1800 rpm

Certificate Program

ER certificate option is only applicable when a motor and/or control is added to a pump listed in HI's database



HI Certificate Program produces serialized certificate that can be used for deemed incentives

- Pump manufacturers
- Pump distributors/ reps/ packagers
- End users

Manufacturers are required to report PEI for basic models to DOE. They are not required to report "system" or extended product PEI.

Program Alignment

Data & Trust = Added Value & Speed

Enforceability

Results



Performance Metrics + Reporting = Compliance



9 BILLION

The Incentives

- Rebate programs vary by utility (check yours!)
- Most deemed incentives based on variable speed ECM
- Future programs will feature HI Energy Rating label & extended product efficiency
- Automatic price reduction direct to reseller or to customer via mail-in rebate
- Rebates will be available past 2020



Teamwork to Savings

- We want to be your partner in reaching out to and working with utility incentive programs for your next project
- Although deemed incentives are coming almost all utilities have custom programs and we want to help you get that money
- ECM is the future
 - Taco is your source for education & information
 - Taco has the most extensive line of ECM circulators and pumps – available shortly up to 30HP!



Let's partner to deliver energy savings, increased performance and advanced functionality!



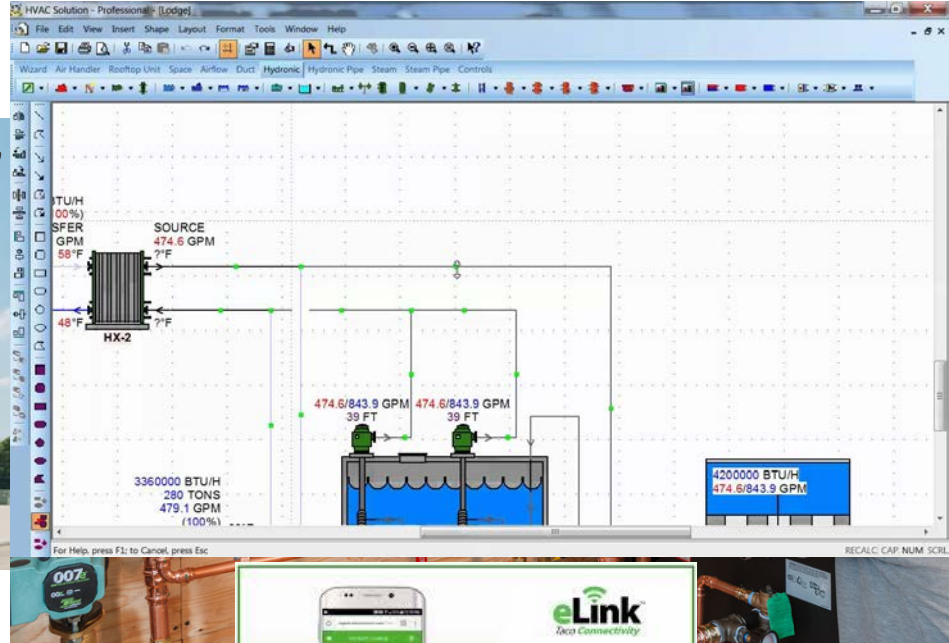
A Quick Taco Comfort Solutions Primer...

- 98 years old, still family owned

• Commercial/residential pumps, valves, controls & accessories

• Largest ECM pump company in North America

• Tools for Engineers



eLink
Taco Connectivity

- Instruction manuals
- Catalogs
- Submittal data sheets
- Rep and support contact information
- Replacement part information



A Taco Group Company

TacoComfort.com

Reference Links

- DOE Energy Conservation Standard for Pumps
 - <https://www.federalregister.gov/articles/2016/01/26/2016-00324/energy-conservation-program-energy-conservation-standards-for-pumps>
- DOE Test Procedure for Pumps
 - <https://www.federalregister.gov/articles/2016/01/25/2016-00039/energy-conservation-program-test-procedure-for-pumps>
- Hydraulic Institute DOE Rulemaking Page
 - http://www.pumps.org/DOE_Pumps.aspx
- Hydraulic Institute Energy Rating Portal
 - <http://er.pumps.org>
- Hydraulic Institute E-Store for Standards & Guides
 - http://estore.pumps.org/Hi_40-7.aspx
- DSIRE Database of State Incentives
 - <http://www.dsireusa.org/>



Thank You



FOR MORE INFORMATION

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