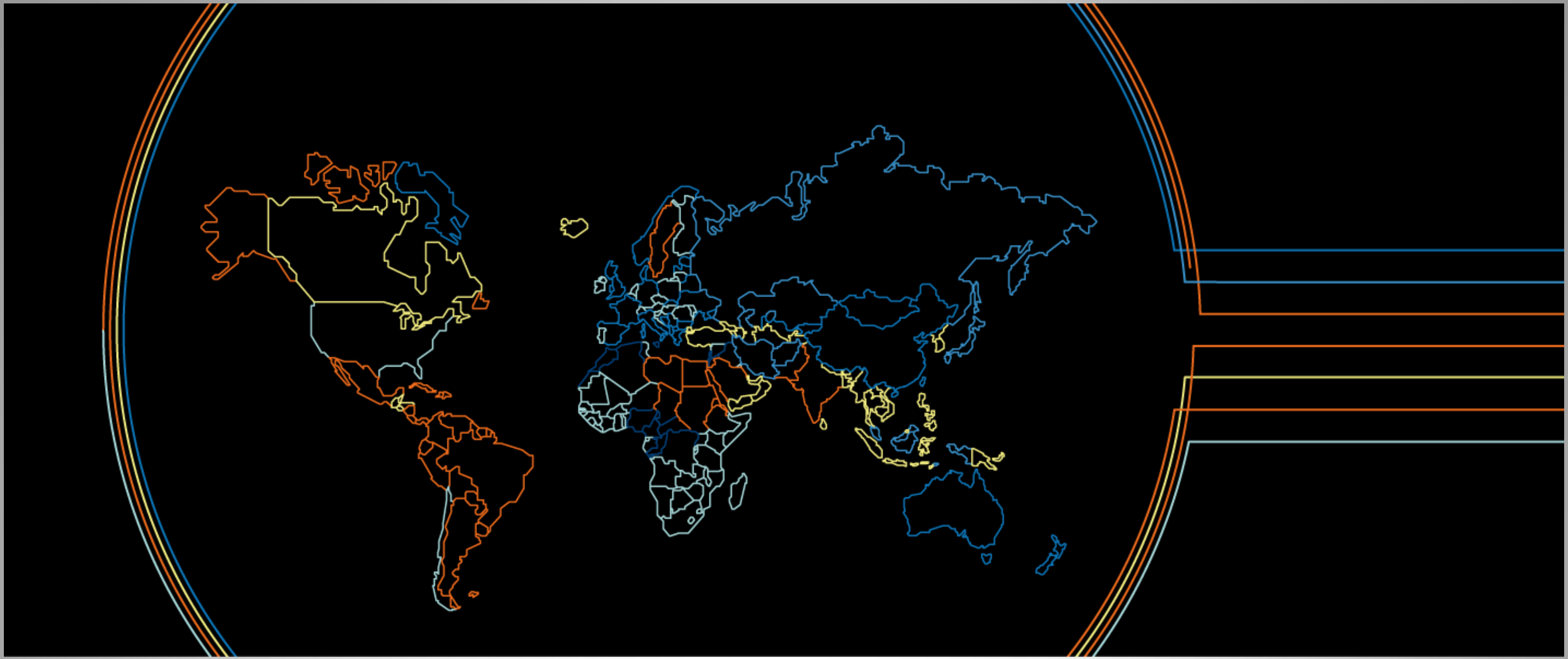

Energy Savings through the use of Baldor Variable Speed Drives & Motors

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How Do I Accomplish Energy Savings?

- You save energy by improving the overall efficiency of the driven system. There are many energy wasters within a given system, but one component that should always be checked is the power input side or the electric motor.

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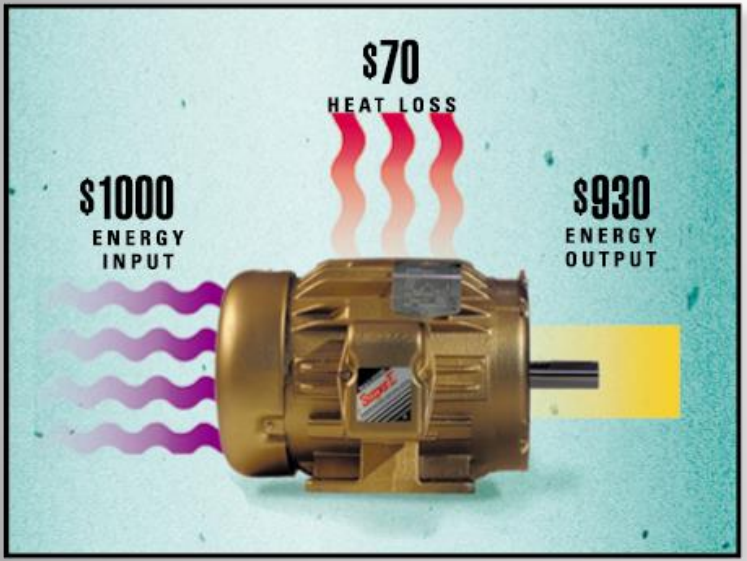
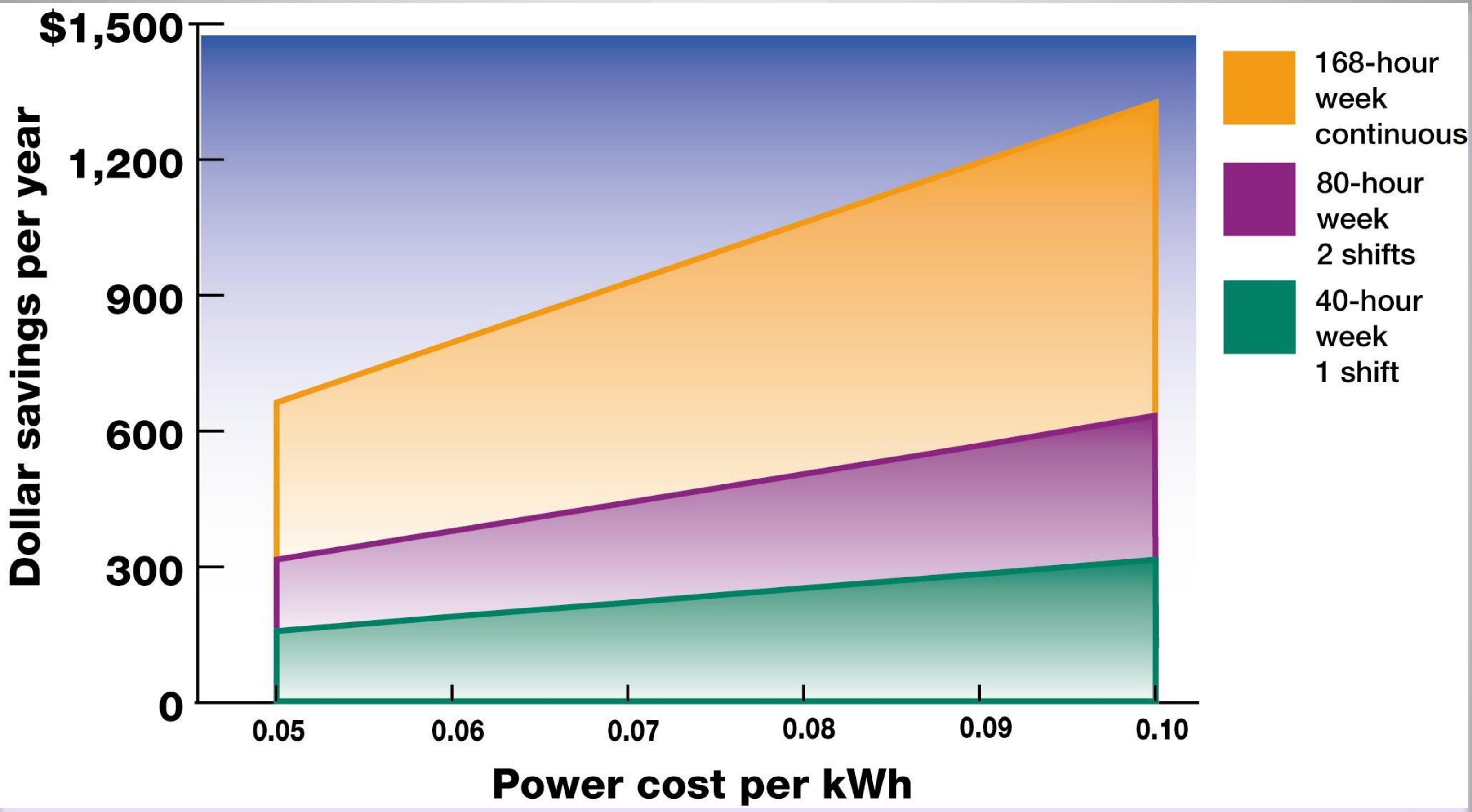
Why is Motor Efficiency Important?
Wasted Energy $



- 10 Hp motor running at full load
- Measured Power in - 8,025 Watts
- Power out = 10 Hp x 746 = 7460 Watts
- Efficiency = Power Out / Power In
- Efficiency = 7460 / 8025
- Efficiency = .930 or 93.0%

What is Higher Efficiency Worth?

Even a 4.5 point efficiency gain is important.



- 40 HP Super-E with 94.5% efficiency compared to standard motor with 90% eff.
- Operating 50 weeks/year

Basic Motor Calculations

Annual Motor Operating Cost

- To find the annual operating cost of one motor

  (HP * .746Watt/HP * %ML * Hours * ¢/kWh) / Efficiency

- To find the annual operating cost difference between two motors

(HP * .746Watt/HP * %ML * Hours * ¢/kWh) / {1/(E_{new} – E_{old})}

- %ML = percent motor load, Hours = annual operating hours, E = efficiency

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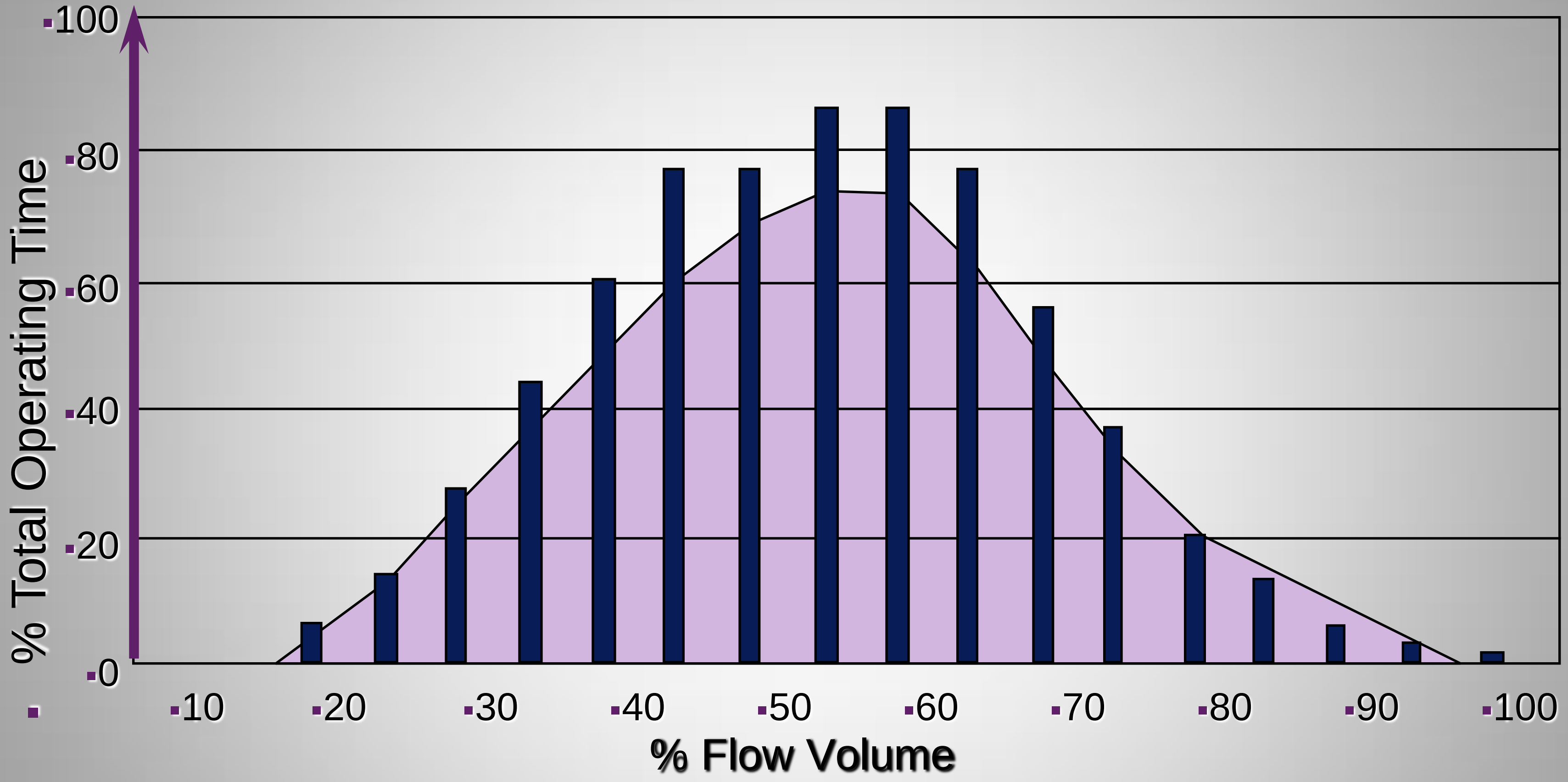
Few applications Require 100% Pump and Fan Flow Continuously

- Systems are designed for worst case
  - Emergency conditions require higher volumes
- They are sized up to next rating
  - Multiplying safety margins
- System Demand Changes
  - Weekend and Night Time Occupancies are lower

Typical Duty Cycle – Centrifugal Fan



- Source: Electric Power Research Institute

Affinity Laws for Centrifugal Loads

Speed	Volume	Pressure/ Head	Horsepower Required
100%	100%	100%	100%
90%	90%	81%	73%
80%	80%	64%	51%
70%	70%	49%	34%
60%	60%	36%	22%
50%	50%	25%	13%
40%	40%	16%	6%
30%	30%	9%	3%

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Energy Savings Opportunity

- Centrifugal loads, such as pumps and fans, offer the greatest energy savings potential when less than 100% flow or pressure conditions are required.

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Electrical Energy Costs

- 100% Speed
- 100% Load
- 100 HP Induction Motor

$$(100\ \text{HP}) \times \left(\frac{1}{95\%\ \text{eff.}}\right) \times \left(.746\ \frac{\text{kW}}{\text{HP}}\right) \times (.08\ \$/\text{kWh}) \times (12\ \text{H/Day}) \times (360\ \text{D/Year}) =$$

$27,139 per year!

Electrical Energy Costs

- 60% Speed
- 22% HP
- 100 HP Induction Motor

$$(100\text{ HP})\text{x}(0.22)\left(\frac{1}{95\%\text{ eff.}}\right)\text{x}\left(.746\,\frac{\text{kW}}{\text{HP}}\right)\text{x}(.08\ \$/\text{kWh})\text{x}(12\text{ H/Day})\text{x}(360\text{ D/Year}) =$$

$5,970 per year!

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Annual Electrical Energy Savings

- 100% Speed $27,139
  - 60% Speed $5,970

$21,169 per year!!

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Reduced Flow May be accomplished via several methods:

- Changing Motor and/or Equipment
  - Fan belts
  - Motor base speed
  - Pump Impeller
  - Blade pitch
- Inlet Guide Vanes
- Pump Valves
- Variable Frequency Drive (VFD) – only method to take advantage of affinity laws

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