

Trends in Drive Technology and Opportunities in the Industrial Sector

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Outline

- **Drive Classifications**
- **North American Market Trends**
 - **Segmentation by type**
 - **Technology Trends**
 - **Motor/Drive penetration**
- **Unit Industry Segmentation**
 - **Drives**
 - **Motors**
- **End User Opportunities and Concerns**

Drive Classifications

By Rating (ARC Advisory Group)

- **Micro** **Below 5kW**
- **Low-end** **5-40kW**
- **Midrange** **41-200kW**
- **High-end and mega** **201+kW**

By type (IMS Research)

- **Compact**
 - generally micro or low end (sensorless vector and Volts/Hz)
 - Typical applications are pumps and fans
- **Standard**
 - Less than 500kW
 - Material Handling/packaging
- **Premium**
 - 1kW to largest (closed-loop flux vector)
 - Metals, paper, high speed and systems applications

Drive Technology Trends

- **Electrical drives were originally applied where process required variable speed to produce product**
 - **Used DC drive technology**
 - **Mostly in WEB handling such as paper, metals, plastic etc.**
 - **Constant Torque applications where energy savings is not dramatic ...but does decrease proportionally with load or speed**

Drive Technology Trends cont'd

- **AC Drive technology with the advent of the IGBT allowed for lower cost AC drive control**
- **Applying drives to Variable Torque loads such as pumps and fans offers potentially large energy savings**
- **Electrical drives cost/unit continues to decrease**

Drive Technology Today

- **Power density continues to increase**
 - In the early 1980's a 100HP AC drive was a large floor standing cabinet
 - Today this is only about 2 cubic feet in size
- **Digital Control**
 - Today's drives can be set-up much like typical consumer electronics
 - Just a few years ago drives required factory trained people to set-up even simple drives
- **Reliability**
 - As with all electronic products reliability and built-in diagnostics continue to improve

Installation Practices

- **CE standards from Europe have driven US manufacturers to provide EMC mains filters on their products**
- **2005 National Electrical Code has specifically addresses motors applied on drives and now requires some form of thermal protection**
- **Retrofit versus new:**
 - **Even on a retrofit, it is often best to upgrade to a NEMA Premium[®] efficient motor**
 - **New drives/motors are designed to operate together (insulations systems, cooling systems, feedback devices)**

Market Information: Unit Growth

- **Fastest growth is in Micro-Drive category**
 - Over 70% of unit volume in market
 - Estimated at over 13% CAGR
- **Second fastest is in the Low-end**
 - Over 10% of unit volume in market
 - Estimated at close to 10% CAGR
- **As unit growth increases the average selling price is forecasted to decrease**
 - For standard and compact drives this is expected to be in the 3-5%/year range

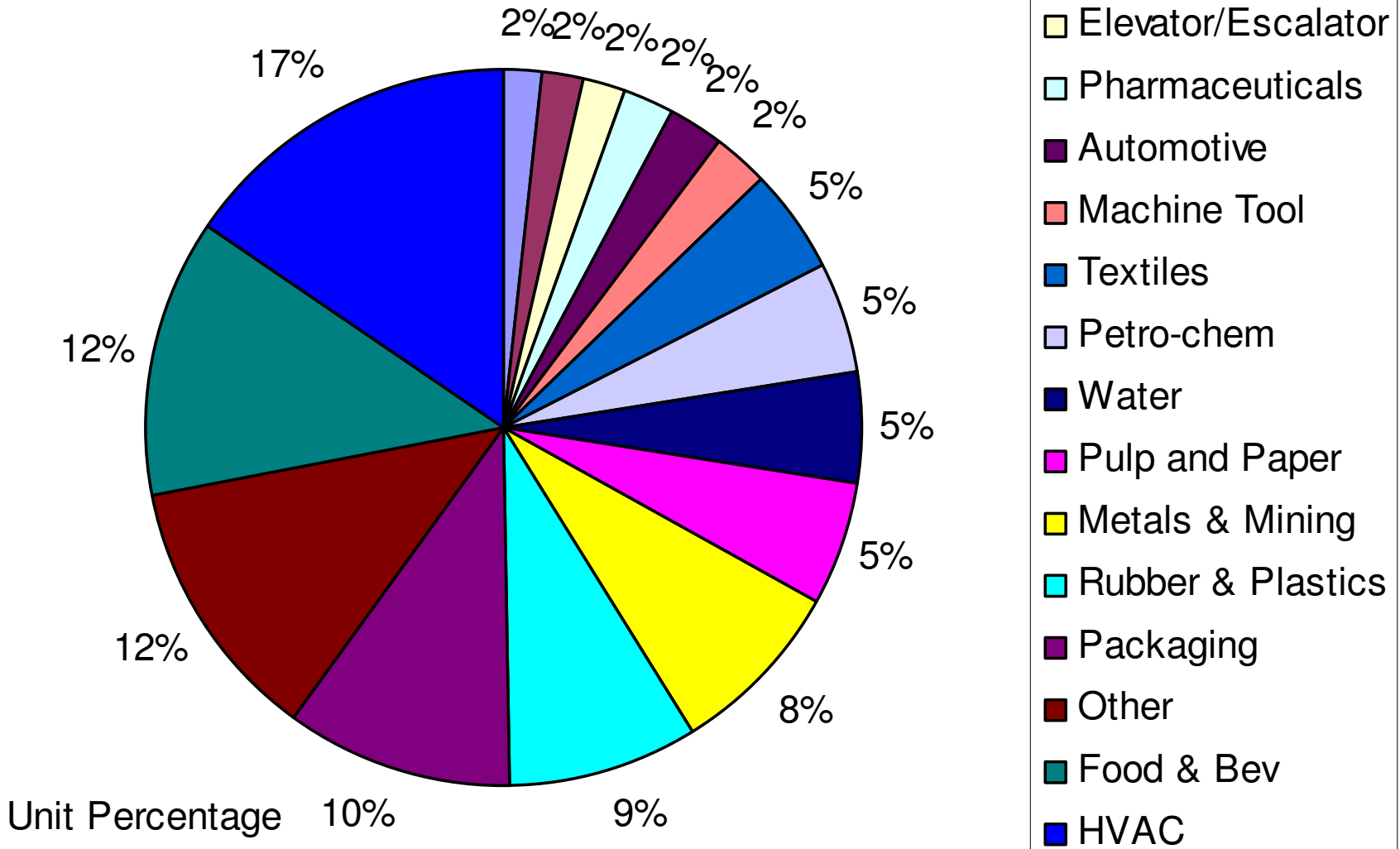
Motor/Drive Penetration

- **The number of drive units sold relative to the number of motors sold is increasing.**
 - **Current estimates of the drive/motor penetration is increasing and estimated at about 13 to 15%**
 - **Forecasters predict this to be up to over 16-18% by the end of the decade**
- **Average cost/unit or cost/horsepower is also decreasing as technology improves and volumes increase**

The Data used in the following charts:

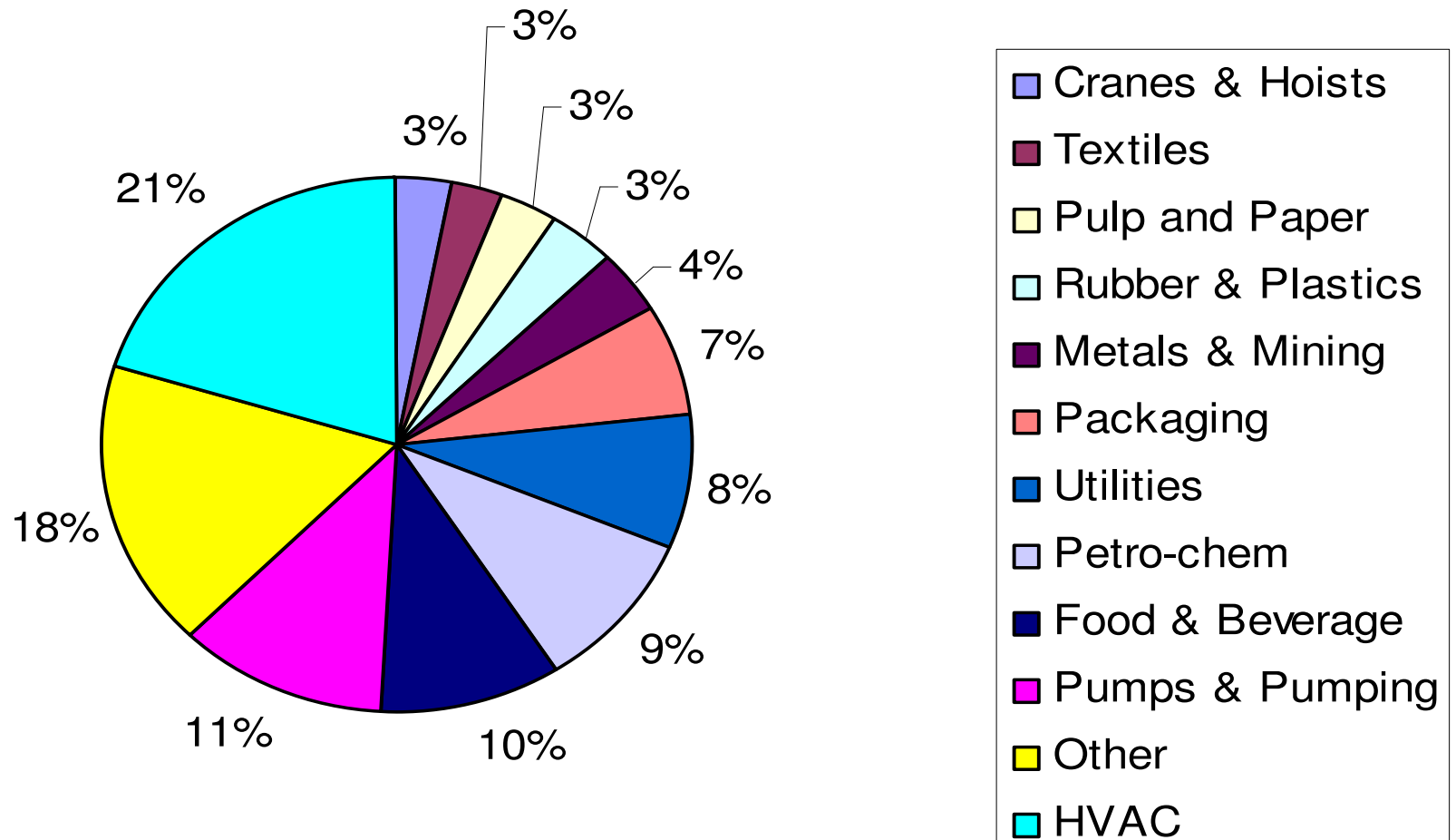
- Is taken from multiple studies
- Different time periods (forecast vs. actual)
- Slightly different Industry classifications and groupings
- But, never-the-less we can gain some insight into the market dynamics and opportunities for future energy savings when applying premium motors with Drives

2004 Estimated DriveShipments by Industry



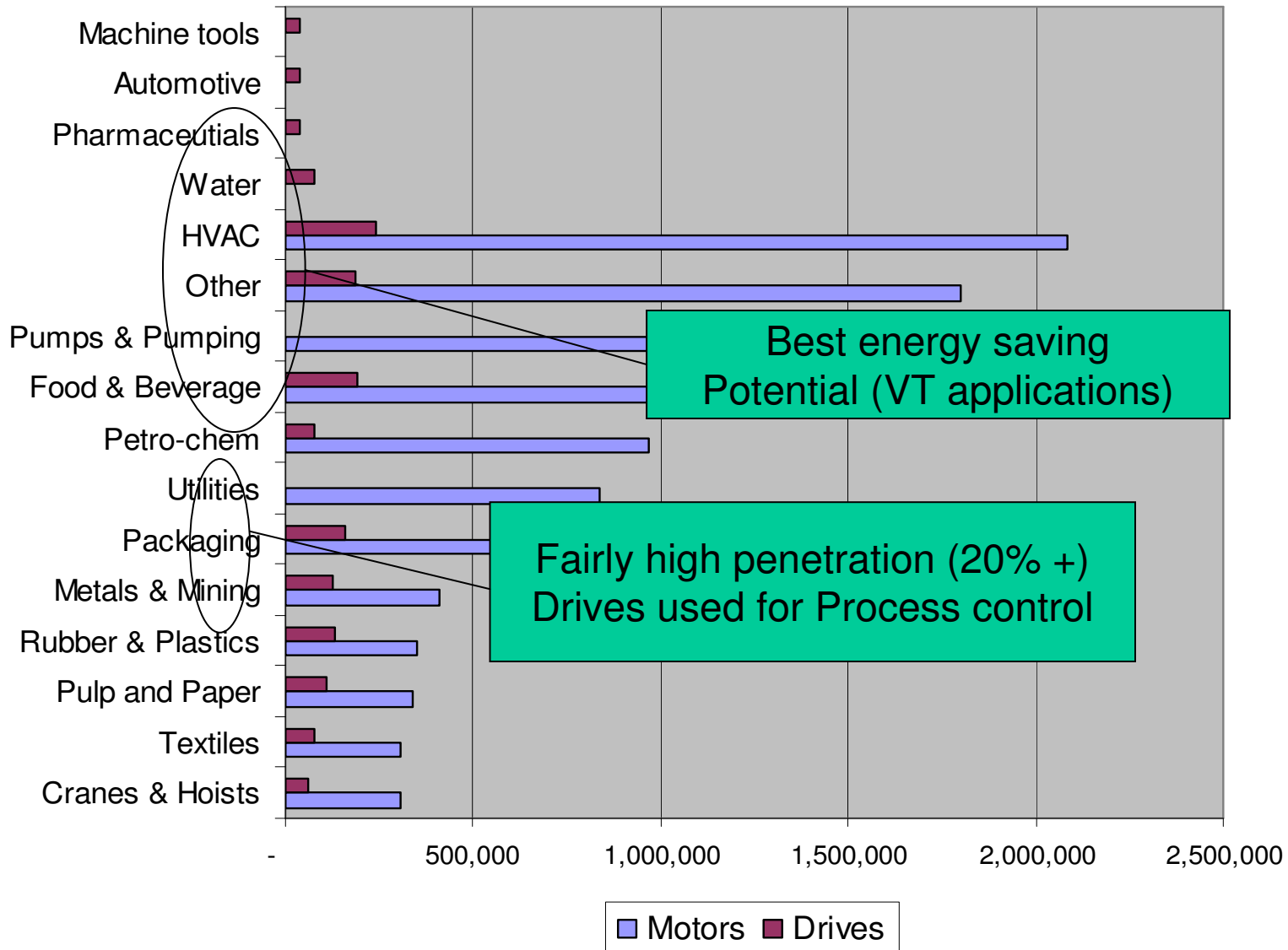
Source: 2005 IMS Research "The Worldwide Market for AC & DC Motor Drives

Estimated 2004 Motor Units/Industry



Source: 2003 IMS Research "Low Voltage Induction Motors"

Unit volume comparisons of motors to drives



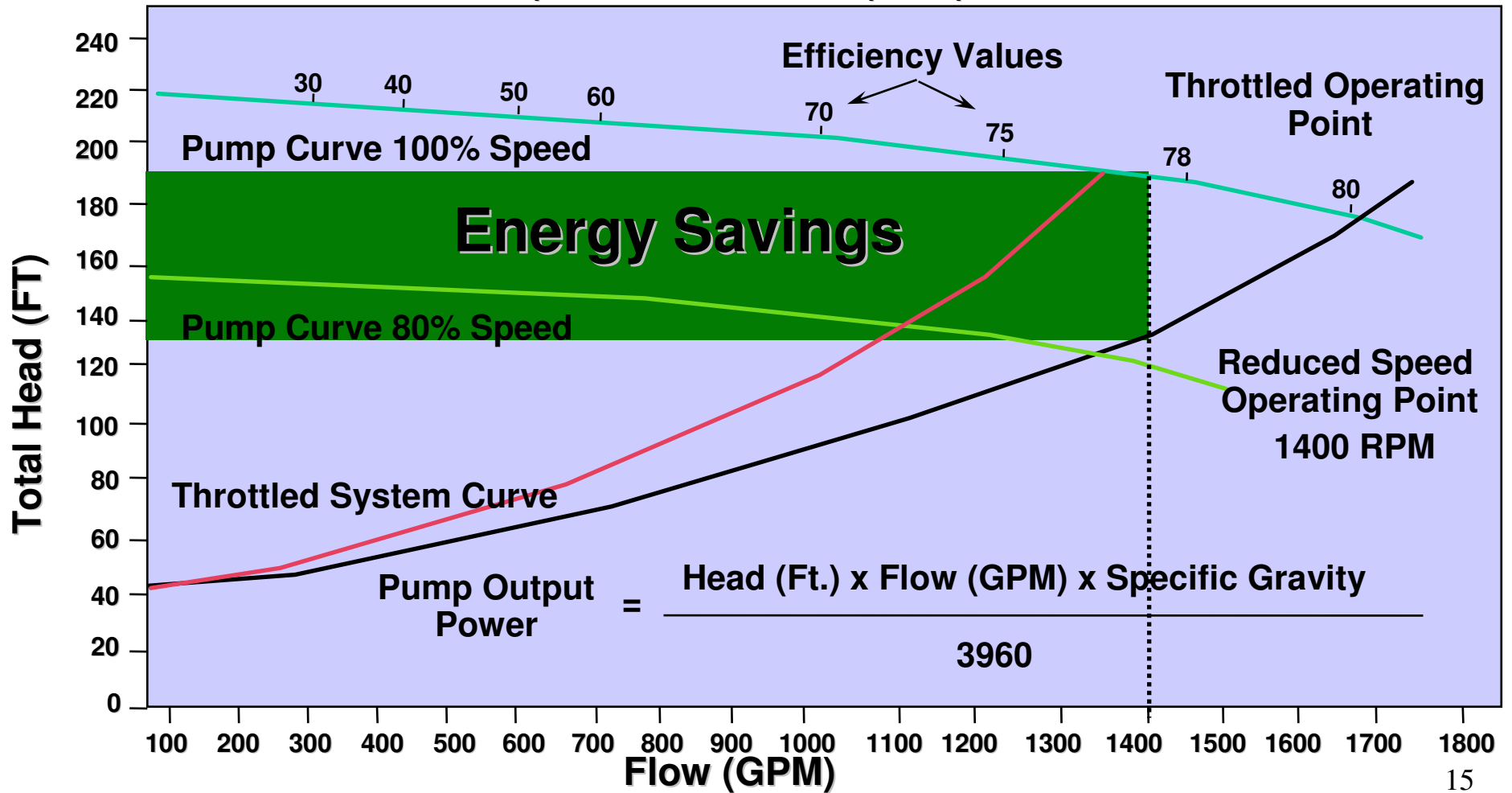
Where a VFD is Most Beneficial

- **All friction system (No static head)**
- **System where control valve is constantly modulated**
- **Pumps in parallel or series operation**
- **Pumping system with multiple design points**
- **System with modulating bypass valve**
- **Cooling towers that start and stop frequently**

Typical 100 HP Pump Application

80% Flow, 1360 GPM

Valve Operation Versus Reduced Speed Operation



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, Night Time Occupancies are lower**

Energy Savings

- **Centrifugal loads, such as pumps and fans, offer the greatest energy savings potential when less than 100% flow or pressure conditions are required.**
- **22% of worldwide electric motor demand is used by pumping systems**
- **In certain industrial plants, 50% of the electrical energy is in pumping systems**
- **75% are centrifugal type pumps**
- **When applying an electrical drive in the right place, energy savings can be substantial**

Statistics from Europump and Hydraulic Institute publication

“Variable Speed Pumping : A guide to successful applications”, 2004

Additional Benefits of Drives

- **More precise adjustment of flow than valve or damper**
- **“Soft start” of motor – less wear on equipment**
- **Process control**
- **Leader and follower**
- **Ratio of multiple motors**
- **Doesn't create sags on power distribution when starting**
- **Form factor correction**

End User Concerns

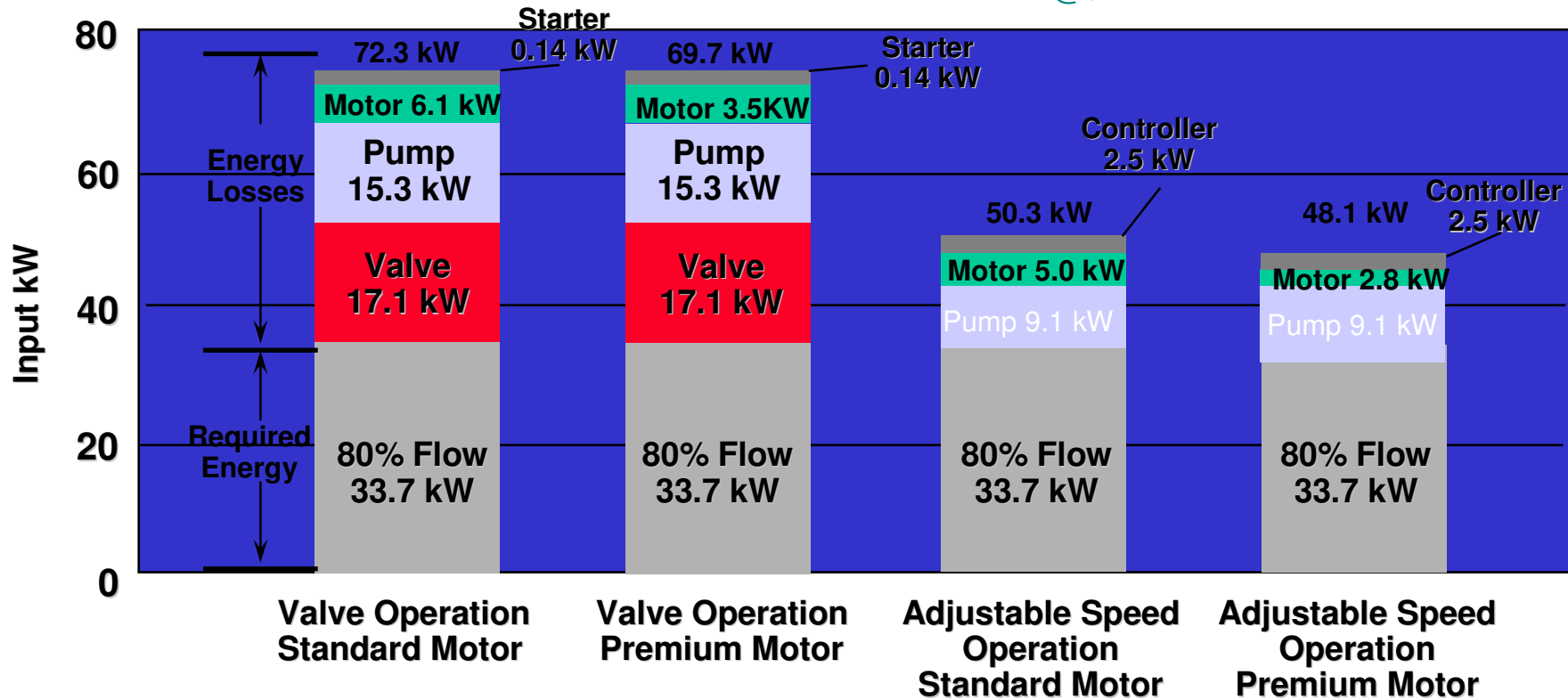
- **Inverter power may harm older motors with poor insulation**
- **Correct wiring procedures**
- **“Too high tech”**
- **Drive failures shuts down system – use bypass**

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**

VFD vs. Valve Operation

Typical 100 HP Pump Application
80% Flow with 25% Lift 6000Hrs/Yr @\$0.05/kwh



System Efficiency	46.6%	48.4%	67.0%	70.4%
Operating Cost	\$21,690	\$20,910	\$15,090	\$14,430
System Prem Cost	\$0	\$700	\$8,000	\$8,700

Questions?

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Source of Data

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