Motor System Use and Efficiency in Agriculture

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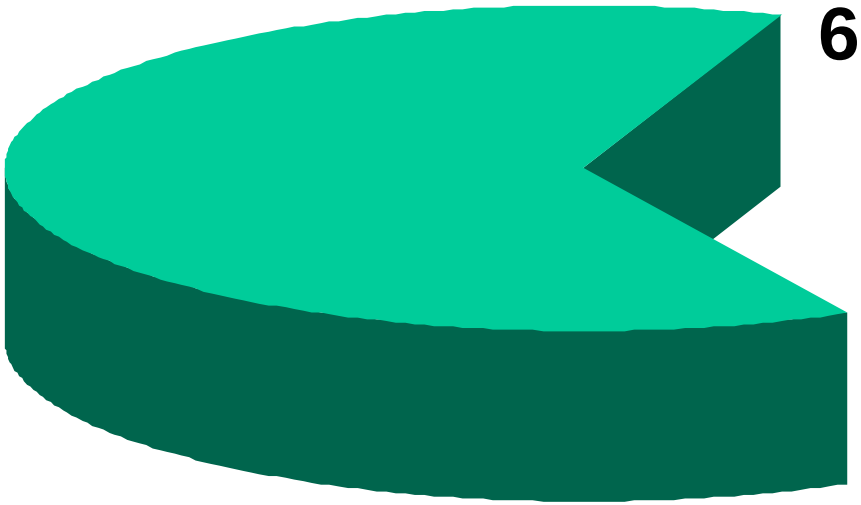
Outline

- **Life Cycle Cost**
- **Typical Savings Opportunities**
- **Case Study – Dairy Pumps**
- **Think “Out of the Box”**
- **Survey Equipment**
- **Partner with Utility and Motor Shop**

The Issue is Energy Costs…
The Answer is Premium Efficient Electric Motors (and Drives)

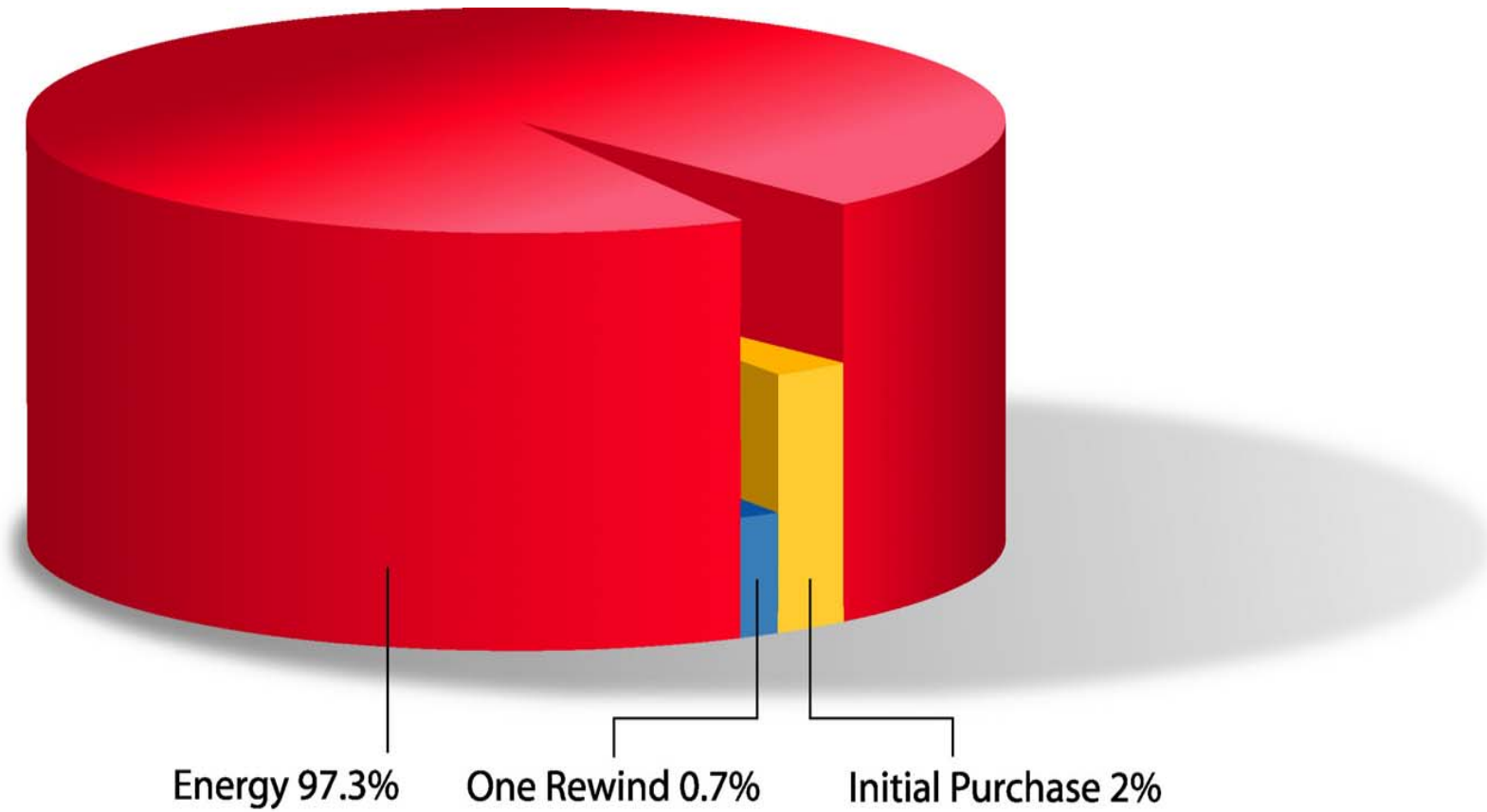
Why Energy-Efficient Electric Motors?



Electric motors consume 63% of the electricity used by American industry

Source: U.S. Department of Energy, 2002

Consider Life Cycle Costs

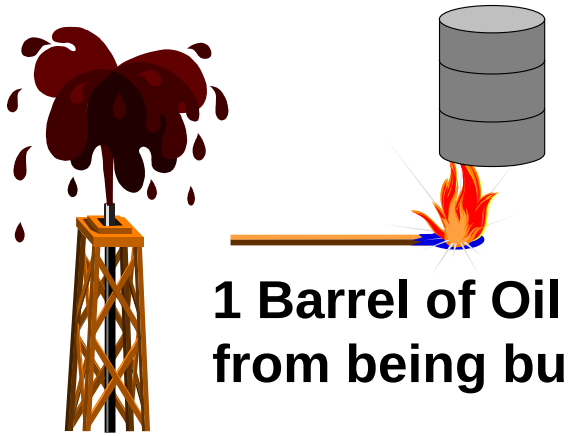


Compare Motor Operating Costs to Automobile

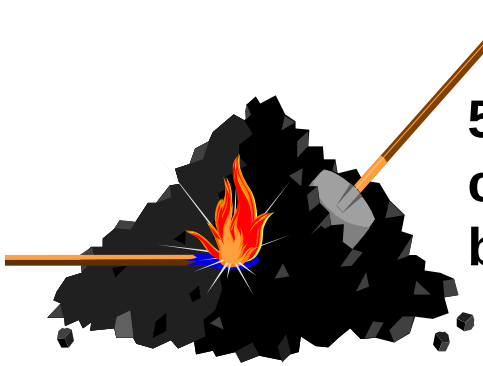
	Car	50 HP motor
Purchase Price	$20,000	$2020
Annual use	15,000 mi.	8760 hrs.
Efficiency	30 MPG	93.6%
Fuel/Energy Cost	$2.20/gal.	$0.75 / kWh
Annual operating cost	$1100	$8788
Annual operating cost as % of purchase price	5.5%	435%

Upgrading one, 1 HP (.75 kW) motor to a Premium Efficient motor ....

Every year will eliminate:



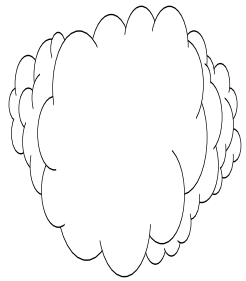
1 Barrel of Oil from being burned



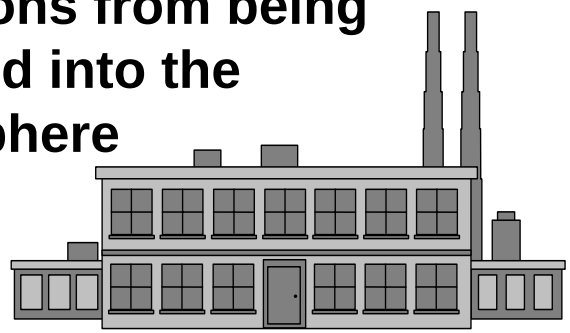
520 lbs. of coal from being burned

or....

and....



Up to 1,400 lbs. of carbon dioxide emissions from being released into the atmosphere



That is just one year!

Motors can last 15+ years

Motor Efficiency

Iron core losses

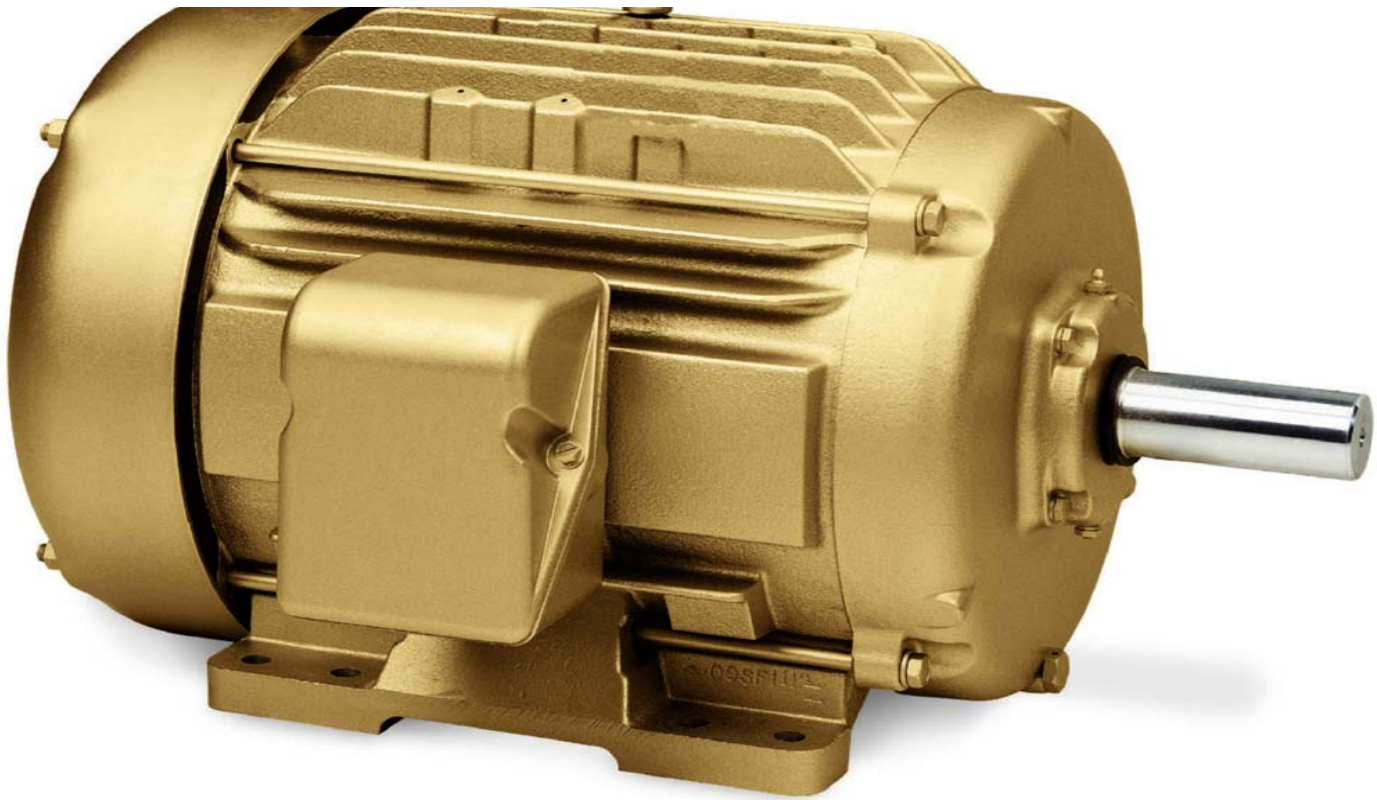
Stator resistance

Rotor resistance

Windage & friction

Stray load losses

Total Losses 7.6%



Input Power 100%

Output Power 92.4%

Case Study – Dairy Vacuum Pumps

- **Several farms in Wisconsin installed adjustable speed drives on milk vacuum pumps**
- **Works with blower or lobe-type pumps only (not rotary vane or water ring type)**
- **“Right-size” pump for worst case operation – drive can adjust for lower demands**
- **Reduces electric consumption**

Case Study – Dairy Vacuum Pumps – Reduced Energy Use

Herd Size	Installed Cost Range*	Annual Savings (Dollars / Year)	Typical Payback**
<100	$3000 – 4000	$250 – 1200	3 – 6 years
100 – 199	$3000 – 4500	$250 – 2500	2 –5 years
200 – 499	$3000 – 4500	$400 – 3500	1.5 – 3.5 years
>500	$3500 - 5000	$1300 - 6000	6 months – 2 years

*Installation costs and savings may vary depending on the site conditions and use.
**Payback before any incentives

Case Study – Dairy Vacuum Pumps – Additional Benefits

- **Improve milk quality – somatic cell count reduces below 100,000 extra $0.10 to milk price**
- **Lower noise level**
- **Reduce maintenance costs**
- **Limited lubrication required – lessens potential to contaminate soil**

Typical Savings Opportunities

- **Premium Efficient Motors**
  - **Typical Single Phase 80.0%**
  - **Premium Single Phase 86.5%**
  - **Typical Three Phase 87.5%**
  - **NEMA Premium® Three Phase 90.2%**
- **Always use three phase motors when possible**

Think “Out of the Box”

- **Make own three phase power**
  - **Phase converter – poor efficiency**
  - **AC Inverter – good efficiency**
- **Inverter offers adjustable speed to save more energy**
  - **Fans & pumps can save over 50%**
    - **Vacuum pumps for milking**
    - **Ventilation fans in barns & poultry houses**
    - **Crop dryer fans**

Getting Started

- **Look for assistance in your area**
  - **Motor sales and service provider/distributor**
  - **Motor manufacturer**
  - **Check availability of financial/technical assistance from your local utility, statewide energy office and/or regional energy efficiency program**

Getting Started

- **Assess your company's needs**
- **Assemble your motor management team**
- **Perform a 1-2-3 Assessment**
  - **Sample a few motors' operating costs**
- **Survey and replace motors on a wider scale throughout the facility**

The 1 ● 2 ● 3 Approach to Motor Management

- **Calculate energy costs and potential savings**
- **Determine the payback periods**
- **Calculate ROI and NPV**
- **Compare the financial impact of repairing or replacing motors**
- **Print tags for motors to communicate repair/replace decisions**
- **Generate a summary report**

The 1 ● 2 ● 3 Approach to Motor Management

- **Select a representative sample (5) of motors**
- **Collect nameplate data, operating hours, and cost of electricity for each motor**
- **Enter data into the worksheet**
- **Review the financial results and make a repair/replace decision**
- **Consider other appropriate motor management strategies**

Motor Decisions Matter

Management & Planning
make the DIFFERENCE

RECENT NEWS

MDM Welcomes Three New Sponsors
January 28, 2004

1-2-3
THE 1-2-3 APPROACH TO MOTOR MANAGEMENT
>> Click Here

MOTOR PLANNING KIT
>> Click Here

Motor Decisions Matter is a national campaign encouraging the use of sound motor management and planning as a tool to cut motor energy costs and increase productivity. The campaign is sponsored by a consortium of motor industry manufacturers and service centers, trade associations, electric utilities and government agencies.

The campaign encourages commercial and industrial customers to develop a motor plan, with the assistance of their local distributor, repair center or utility representative. A motor plan addresses common motor decisions before they become a crisis and ensures motor availability, enhanced productivity, and lower energy costs. The Department of Energy estimates that greater attention to motor system management can reduce energy costs by a dramatic 18 percent.

For more information about the *Motor Decisions Matter* campaign, contact the DOE's Office of Industrial Technologies Clearinghouse at 1-800-862-2086 or MDMinfo@cee1.org

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Send comments about this site to MDMinfo@cee1.org

The 1·2·3 Approach to Motor Management: Input Page

Version 5.0

Company Information			
Company Name	Nat'l Mfg Wk - Boston	Contact	
Location		Date Evaluated (mm/dd/yy)	Oct-14-04

Input: Representative Motor 1 — * Required fields

Motor Nameplate Data	
Motor ID *	Sample 1
Manufacturer	
Model	
Size (hp) *	100
RPM	1800
Enclosure type	ODP
Full-load efficiency(%) *	90.0%
Frame size and type	
Voltage rating	
Full-load amps	
Financial Information	
Cost of Electricity (note 1) *	$0.0800
Desired Payback Period (yrs)	
Horsepower breakpoint (hp)	

Motor Application Information	
Year motor installed	
Motor location	
Application	
Total yearly operating hours *	7,488
Actual load (amps) (optional)	
Repairs/Rewinds	
Quantity of similar motors *	12
New Motor & Best Practice Rewind Costs	
Motor Installation Cost *	$200.00
NEMA Premium Motor Cost *	$3,240.00
NEMA Premium Efficiency *	95.4%
EPAct Motor Cost *	$2,530.00
EPAct Motor Efficiency *	94.1%
Best Practice Rewind Cost *	$1,300.00

Results: Representative Motor 1

All values represent results for one motor. Cumulative results for the full quantity of similar motors are displayed on the ROI and Summary pages.	Act Now		Act Upon Motor Failure		
	Current Costs (Base Case)	Replace Immediately with NEMA Premium	Rewind Using Best Practice (Base Case)	Replace with EPAct	Replace with NEMA Premium
Annual Energy Cost	**$49,654**	**$46,843**	**$49,654**	**$47,490**	**$46,843**
Capital Investment	N/A	$3,440	$1,500	$2,730	$3,440
Incremental Investment Cost	N/A	$3,440	N/A	$1,230	$1,940
Annual Energy Savings	**N/A**	**$2,811**	**N/A**	**$2,163**	**$2,811**
Net Present Value	N/A	$4,926	N/A	$4,675	$5,861
Return on Investment	N/A	51.73%	N/A	114.68%	94.66%
Simple Payback Period	N/A	1.22	N/A	0.57	0.69

Decision: Representative Motor 1

Review the results with your customer. Decide on the appropriate course of action. Then, click the corresponding button and the 1·2·3 software will generate label(s) that you can use to tag this representative group of motors. It will also enter the decision in the 1·2·3 Motor Inventory.	Act Now	Act Upon Motor Failure		
	Replace Immediately with NEMA Premium	Rewind Using Best Practice	Replace with EPAct	Replace with NEMA Premium

The 1·2·3 Approach to Motor Management: Input Page

Version 5.0

Company Information			
Company Name	Nat'l Mfg Wk - Boston	Contact	
Location		Date Evaluated (mm/dd/yy)	Oct-14-04

Input: Representative Motor 2 — * Required fields

Motor Nameplate Data	
Motor ID *	Sample 2
Manufacturer	
Model	
Size (hp) *	50
RPM	1800
Enclosure type	TEFC
Full-load efficiency(%) *	92.0%
Frame size and type	
Voltage rating	
Full-load amps	
Financial Information	
Cost of Electricity (note 1) *	$0.0800
Desired Payback Period (yrs)	0
Horsepower breakpoint (hp)	0

Motor Application Information	
Year motor installed	
Motor location	
Application	
Total yearly operating hours *	2,080
Actual load (amps) (optional)	
Repairs/Rewinds	
Quantity of similar motors *	10
New Motor & Best Practice Rewind Costs	
Motor Installation Cost *	$150.00
NEMA Premium Motor Cost *	$1,860.00
NEMA Premium Efficiency *	94.5%
EPAct Motor Cost *	$1,435.00
EPAct Motor Efficiency *	93.0%
Best Practice Rewind Cost *	$945.00

Results: Representative Motor 2

All values represent results for one motor. Cumulative results for the full quantity of similar motors are displayed on the ROI and Summary pages.	Act Now		Act Upon Motor Failure		
	Current Costs (Base Case)	Replace Immediately with NEMA Premium	Rewind Using Best Practice (Base Case)	Replace with EPAct	Replace with NEMA Premium
Annual Energy Cost	**$6,746**	**$6,568**	**$6,746**	**$6,674**	**$6,568**
Capital Investment	N/A	$2,010	$1,095	$1,585	$2,010
Incremental Investment Cost	N/A	$2,010	N/A	$490	$915
Annual Energy Savings	**N/A**	**$178**	**N/A**	**$73**	**$178**
Net Present Value	N/A	($803)	N/A	($123)	($121)
Return on Investment	N/A	-13.54%	N/A	-5.92%	-0.54%
Simple Payback Period	N/A	11.26	N/A	6.75	5.13

Decision: Representative Motor 2

Review the results with your customer. Decide on the appropriate course of action. Then, click the corresponding button and the 1·2·3 software will generate label(s) that you can use to tag this representative group of motors. It will also enter the decision in the 1·2·3 Motor Inventory.	Act Now	Act Upon Motor Failure		
	Replace Immediately with NEMA Premium	Rewind Using Best Practice	Replace with EPAct	Replace with NEMA Premium

Communicate Your Decisions

Tag Motors with action:

- **Replace immediately with NEMA Premium®**

On failure:

- **Rewind per Best Practices**
- **Replace with EPAct**
- **Replace with NEMA Premium®**

The 1·2·3 Approach to Motor Management:

Summary

Version 5.0

Company Information			
Company Name	Nat'l Mfg Wk - Boston	Contact	

1-2-3 Service Provider Information			
Company Name		Phone	
Contact Name		E-Mail	

Summary of Results

	Sample Motor					Grand Total
	1	2	3	4	5	
Location						
Date Evaluated	Oct-14-04	Oct-14-04	Oct-14-04			
Quantity of Similar Motors	12	10	20			42
Gross Connected Horsepower	1200	500	1500			3200
Cumulative Yearly Operating Hours	89,856	20,800	83,200			193,856
Cumul. Current Annual Energy Cost	$595,845	$67,464	$406,998			$1,070,308
Decision	Replace Immediately with NEMA Premium	Best Practice Rewind at Failure	Replace with NEMA Premium at Failure			
Cumulative Capital Investment	$41,280	$10,950	$65,700			$117,930
Cumulative Annual Energy Savings	$33,727	N/A	$16,638			$50,365
Average Simple Payback Peri	1.22	N/A	2.21			1.71
Average Return on Investmen	51.73%	N/A	23.77%			37.75%

The Bottom Line

To improve the efficiency of the representative (and similar) motors in your facility, INVEST:	$117,930
Your organization's ANNUAL ENERGY SAVINGS could be:	$50,365
Over FIVE YEARS, these annual savings could total:	$251,827
And the AVERAGE RETURN ON INVESTMENT based on incremental costs for this project would be:	37.75%

The Building Blocks of Motor Management

- **Comprehensive motor inventory**
  - **Critical spares inventory**
- **Purchasing and repair policy**
  - **Hp breakpoint**
- **Motor application analysis**
  - **Loading**
  - **Add adjustable speed drives**

Comprehensive Motor Inventory

- **Many managers underestimate the number and cost of operation for motors in the facility**
- **Large motor populations can be a stumbling block**
  - **Replace the inventory over time focusing on older, less efficient motors first**
  - **Multiple tools available (MotorMaster+ and motor manufacturers' software)**
- **Include maintenance information**

Critical Spares Inventory

- **Minimize downtime and future costs when failures occur**
- **Ensure that the most cost-effective motor is available when you need it**
- **Review the current motor population – develop appropriate spares plan**
- **Confirm location, suppliers and availability**

Purchasing Policy

- Plan long-term strategy for motor population
- Standardize policy throughout organization
- Consider hours of operation for the year and electricity costs
- Streamline the purchasing process

Partner with Electric Motor Repair Facilities

- **Survey assistance**
- **Shops have application knowledge for motors and drives**
- **Learn from failed motors**
  - **Don’t replace with same motor enclosure or level of protection - upgrade**
- **Shops may be able to help facilitate incentive programs**

Hp Breakpoint

- **Develop general repair/replace guidelines for all motors based on Hp**
- **Comparison tools available (MotorMaster+, 1-2-3, Advanced Energy Bulletin, motor manufacturers' software)**
- **Breakpoint can be affected by incentives**

Repair Policy

- **Develop a repair specification**
  - **DOE, EASA or your own**
- **Develop a relationship with your service providers**
- **Visit your service providers to observe operations, methods, and materials used**
- **Assess failure mechanism to address the need for motor enclosure improvements**

Reduce Electric Consumption and Downtime

- **Evaluate failed motors**
- **Do not replace with same design that fails from outside source**
  - **Upgrade enclosure**
  - **Install correct motor rating**
  - **Provide overload protection**
- **Add adjustable speed drive when application allows**

Motor Loading

- **Right sizing**
  - **Motors often run at 40% load or less**
  - **Oversized during design – “bigger is better”**
- **Adjustable speed drives**
  - **Centrifugal applications – fans & pumps**
  - **Applications that restrict flow mechanically**

Preventive Maintenance

- **Perform routine checks of the operating environment**
- **Check for bearing noise, heating, stock or chips over the motor**
- **Maintain a usage history and schedule routine maintenance to minimize unexpected failure**
- **Document maintenance activities to optimize intervals**

Partner with Electric Utility for Incentives

- **Rebates from utility**
  - **Prescriptive – Motors & Drives**
  - **Custom**
- **Technical support**
  - **Survey assistance**

Resources

- **Motor Decisions Matter (MDM)**

  www.motorsmatter.org
- **Electrical Apparatus Service Association (EASA)**

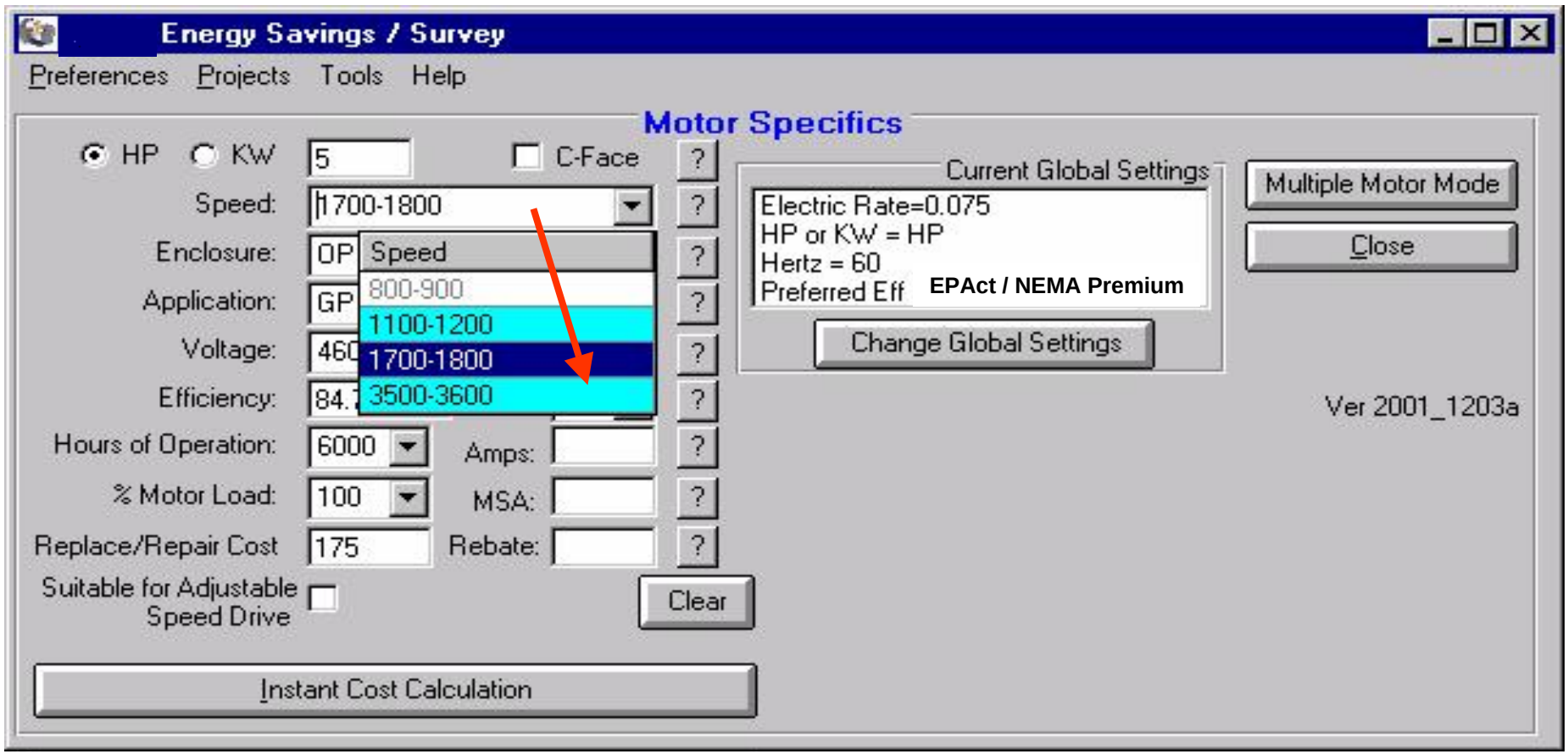
  www.easa.com
- **U.S. Dept of Energy Best Practices**

  www.oit.doe.gov/bestpractices

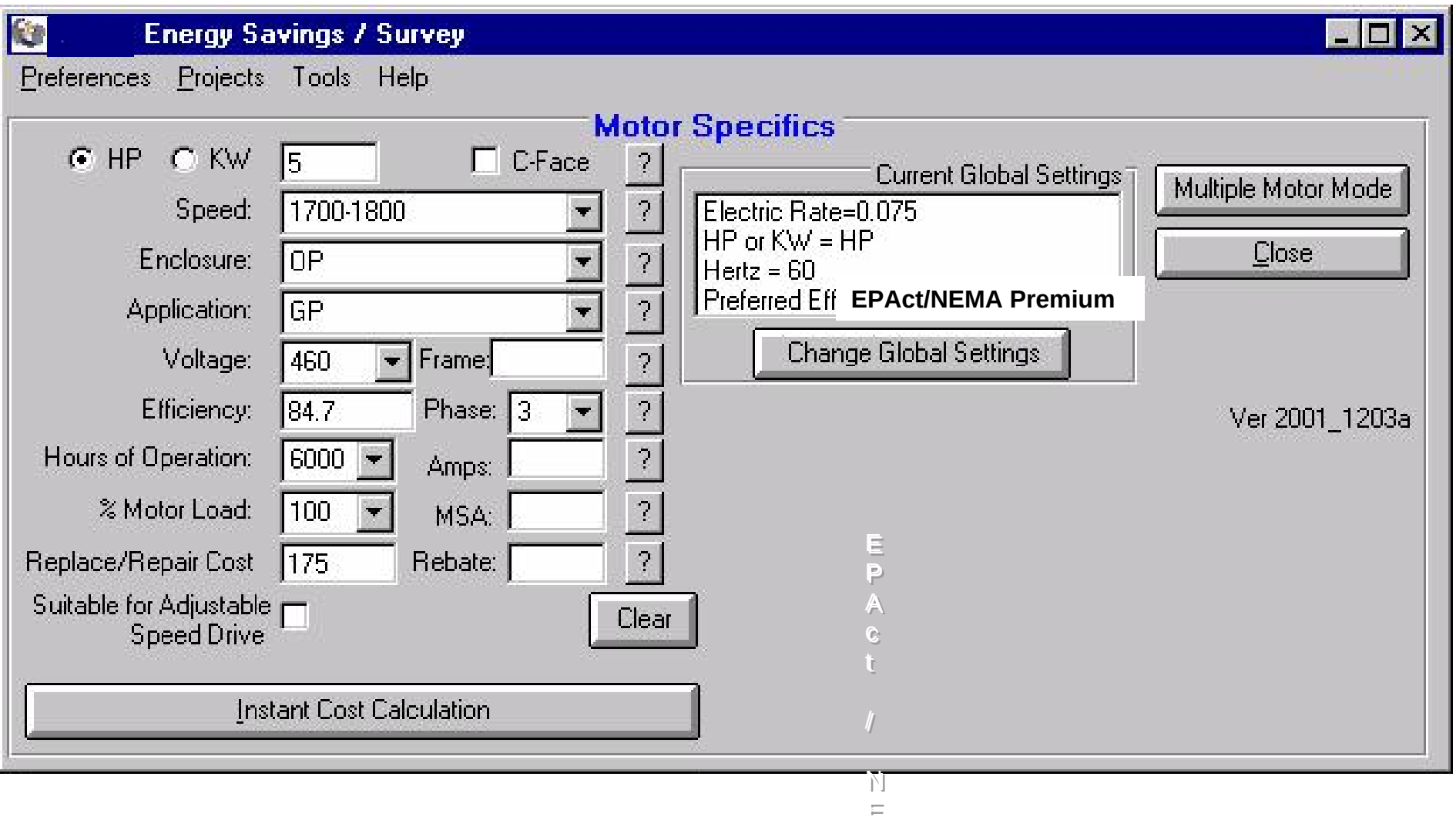
Complete Motor Survey

- **Use more advanced analysis software**
  - **MotorMaster+, motor manufacturers', others**
- **Can account for repair or rebate cost offset**
- **Add ASD drive into savings**

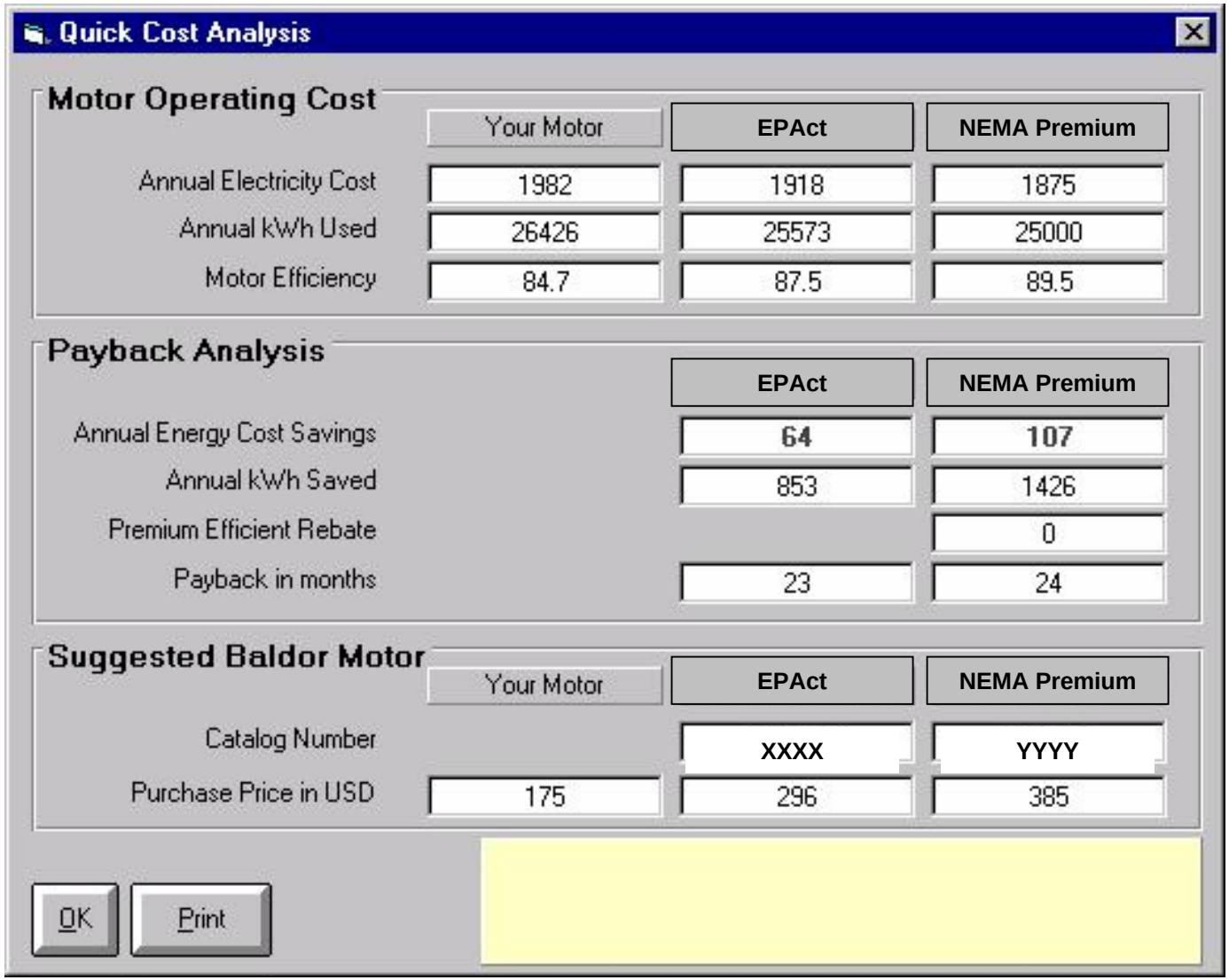
Define Motor Using Drop-down Data Boxes



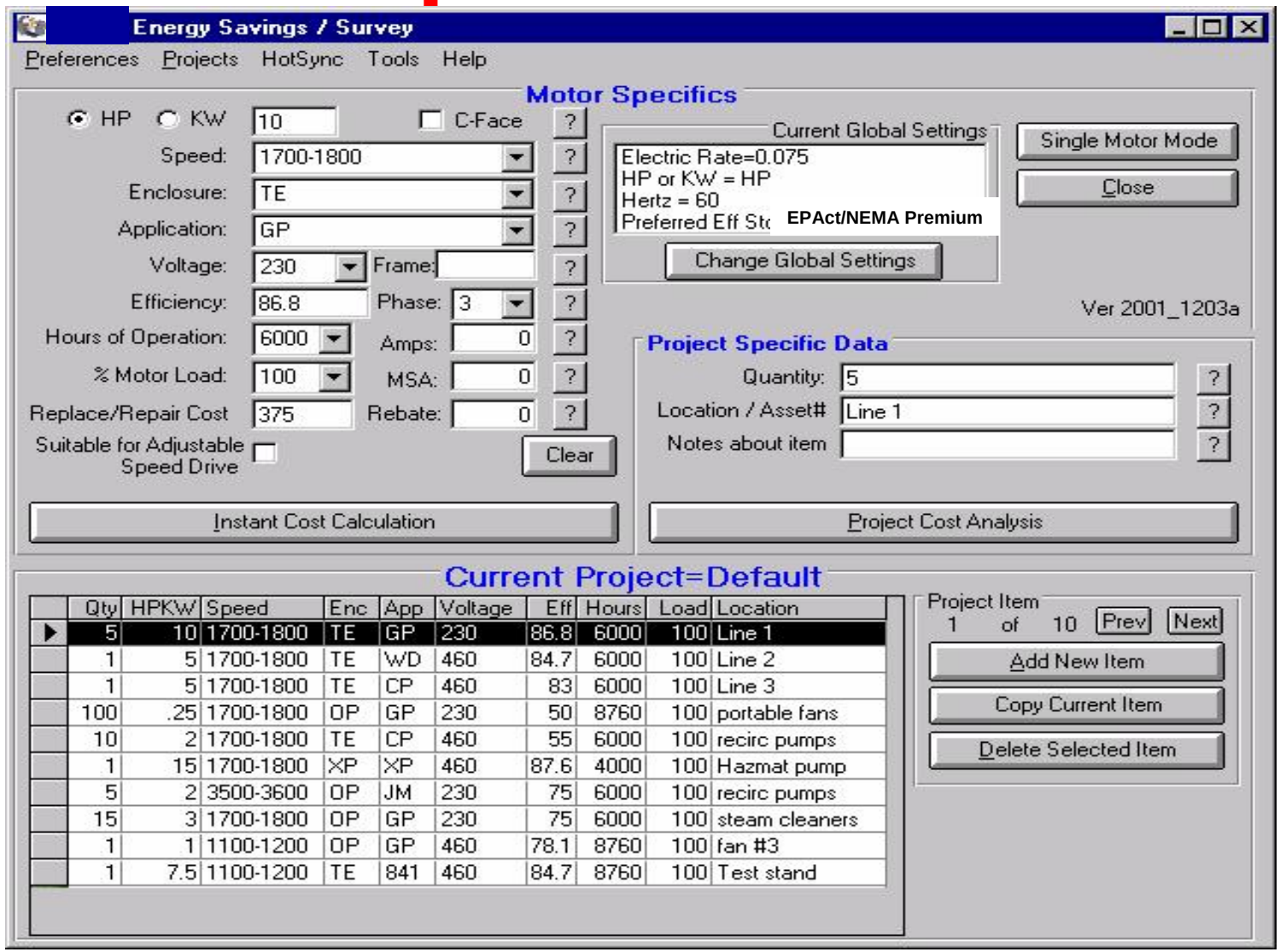
Single Motor



Instant Cost Calculation

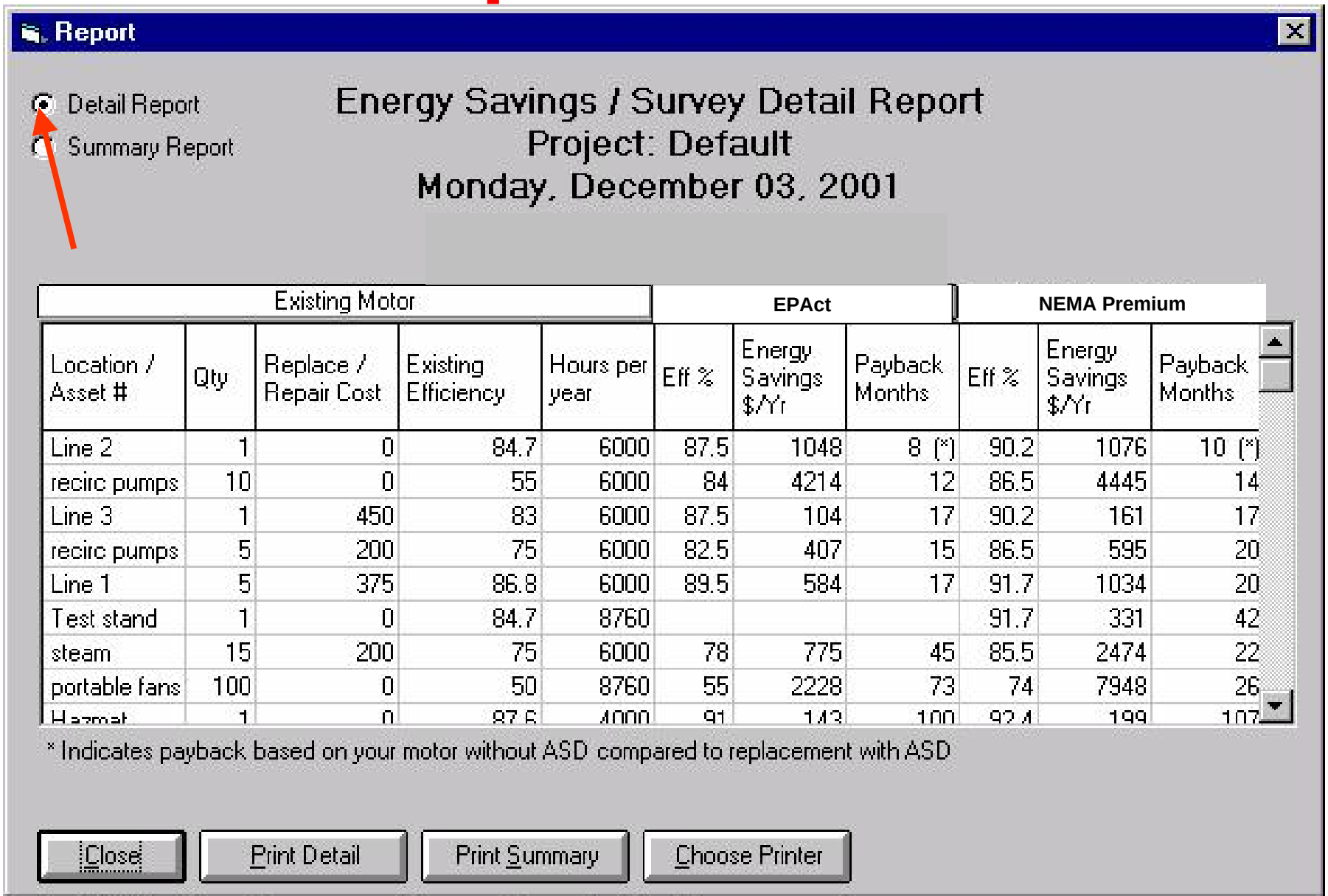


Multiple Motors

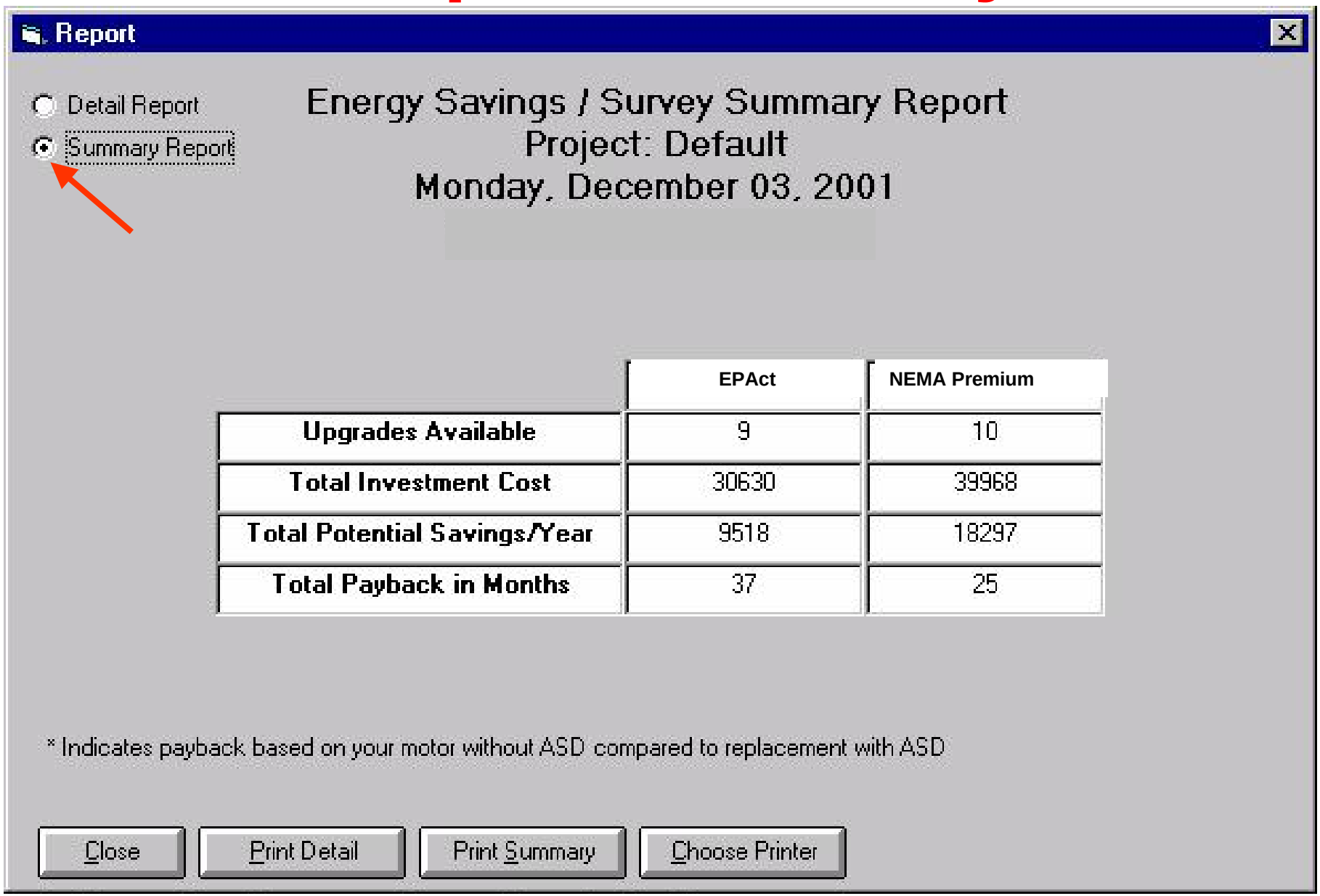


Qty	HPKW	Speed	Enc	App	Voltage	Eff	Hours	Load	Location
5	10	1700-1800	TE	GP	230	86.8	6000	100	Line 1
1	5	1700-1800	TE	WD	460	84.7	6000	100	Line 2
1	5	1700-1800	TE	CP	460	83	6000	100	Line 3
100	.25	1700-1800	OP	GP	230	50	8760	100	portable fans
10	2	1700-1800	TE	CP	460	55	6000	100	recirc pumps
1	15	1700-1800	XP	XP	460	87.6	4000	100	Hazmat pump
5	2	3500-3600	OP	JM	230	75	6000	100	recirc pumps
15	3	1700-1800	OP	GP	230	75	6000	100	steam cleaners
1	1	1100-1200	OP	GP	460	78.1	8760	100	fan #3
1	7.5	1100-1200	TE	841	460	84.7	8760	100	Test stand

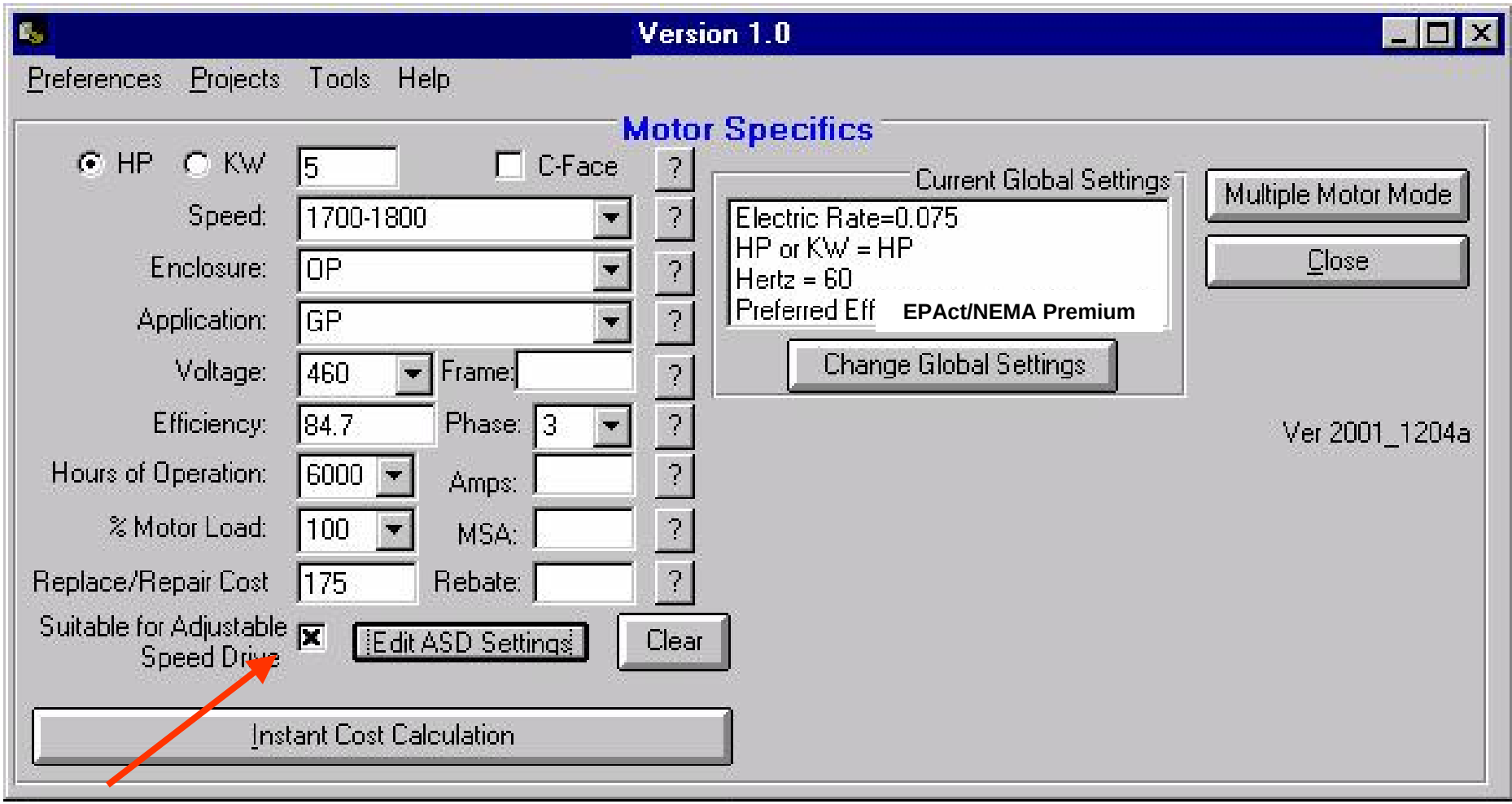
Report Details



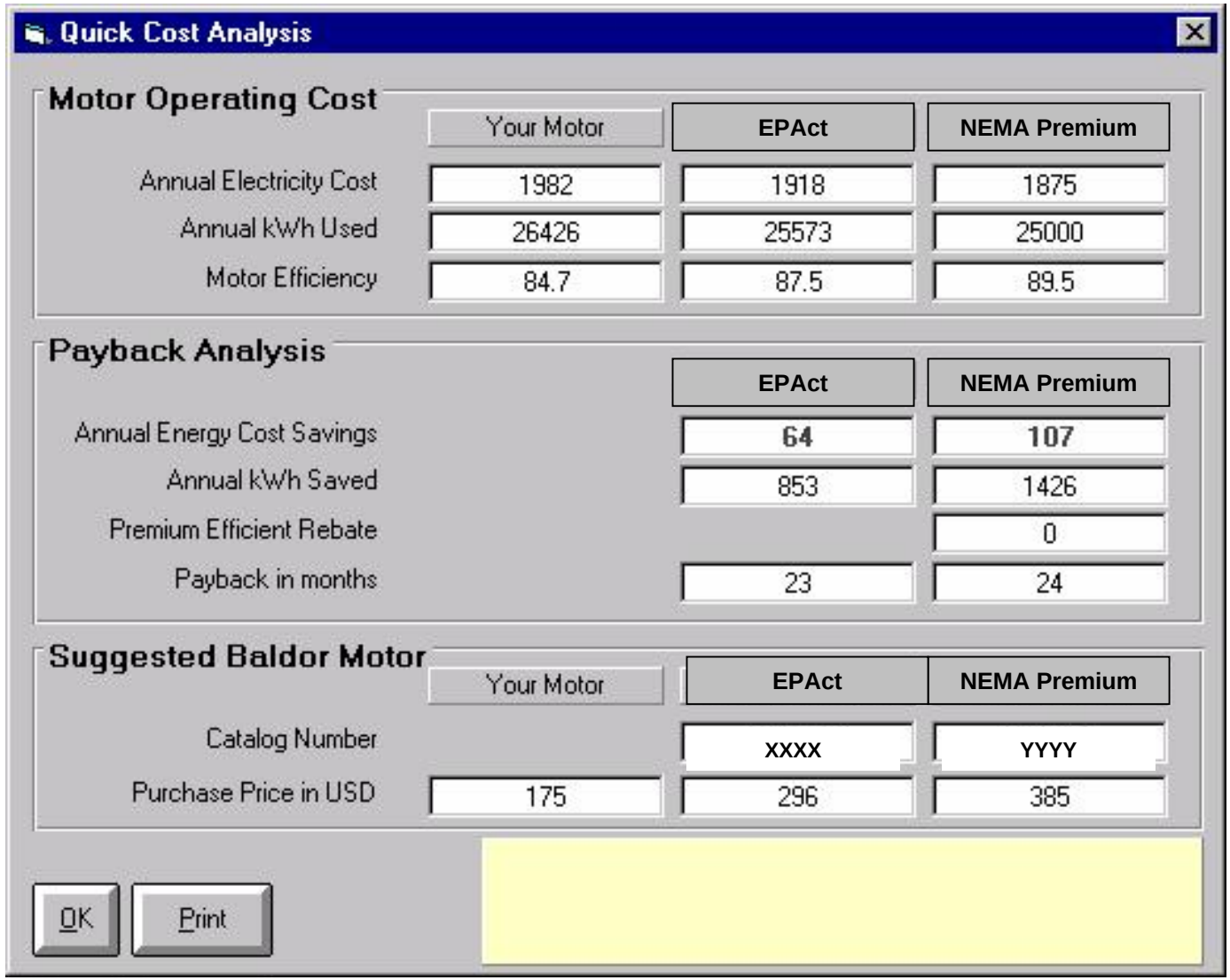
Report Summary



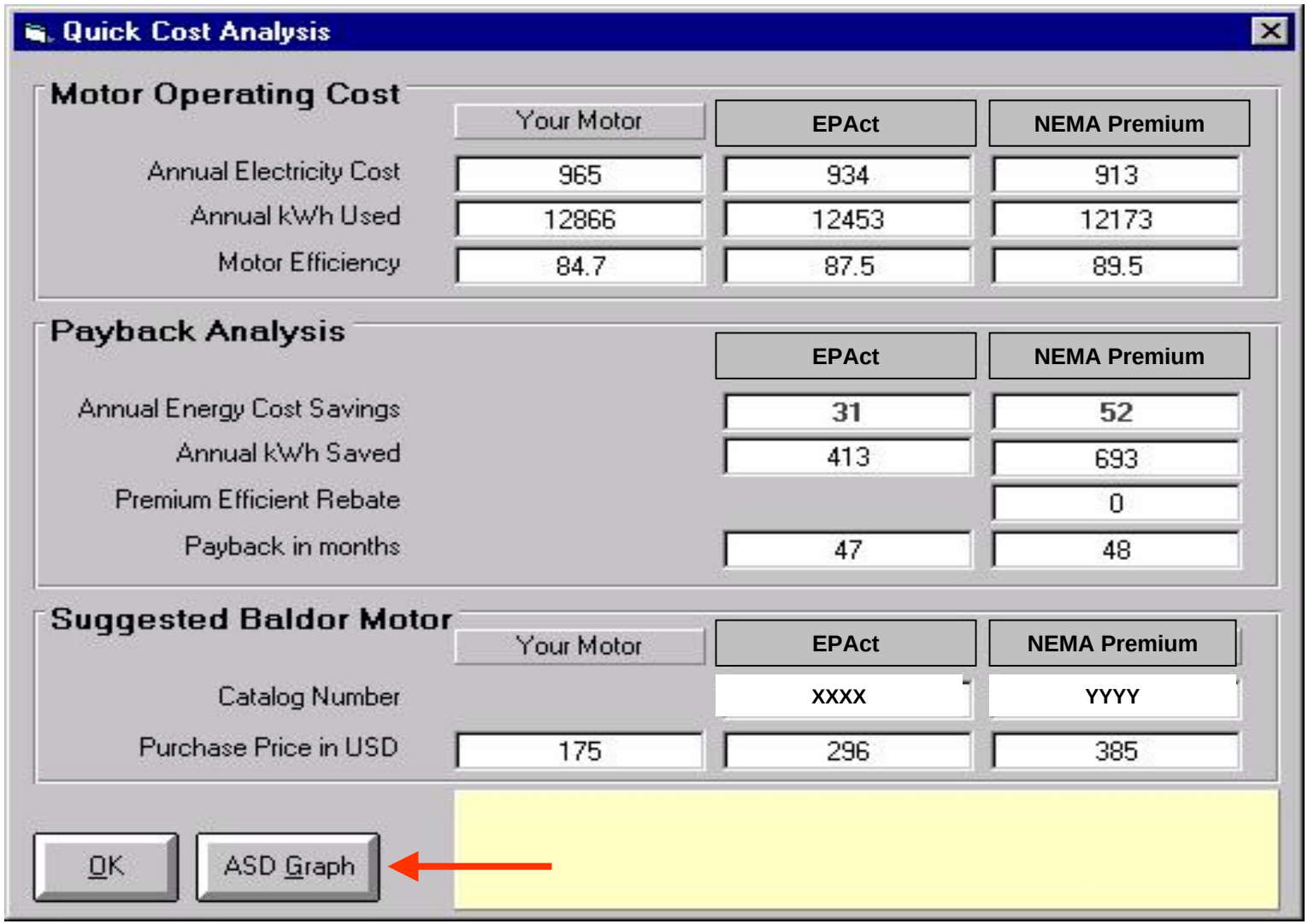
ASD Checkbox



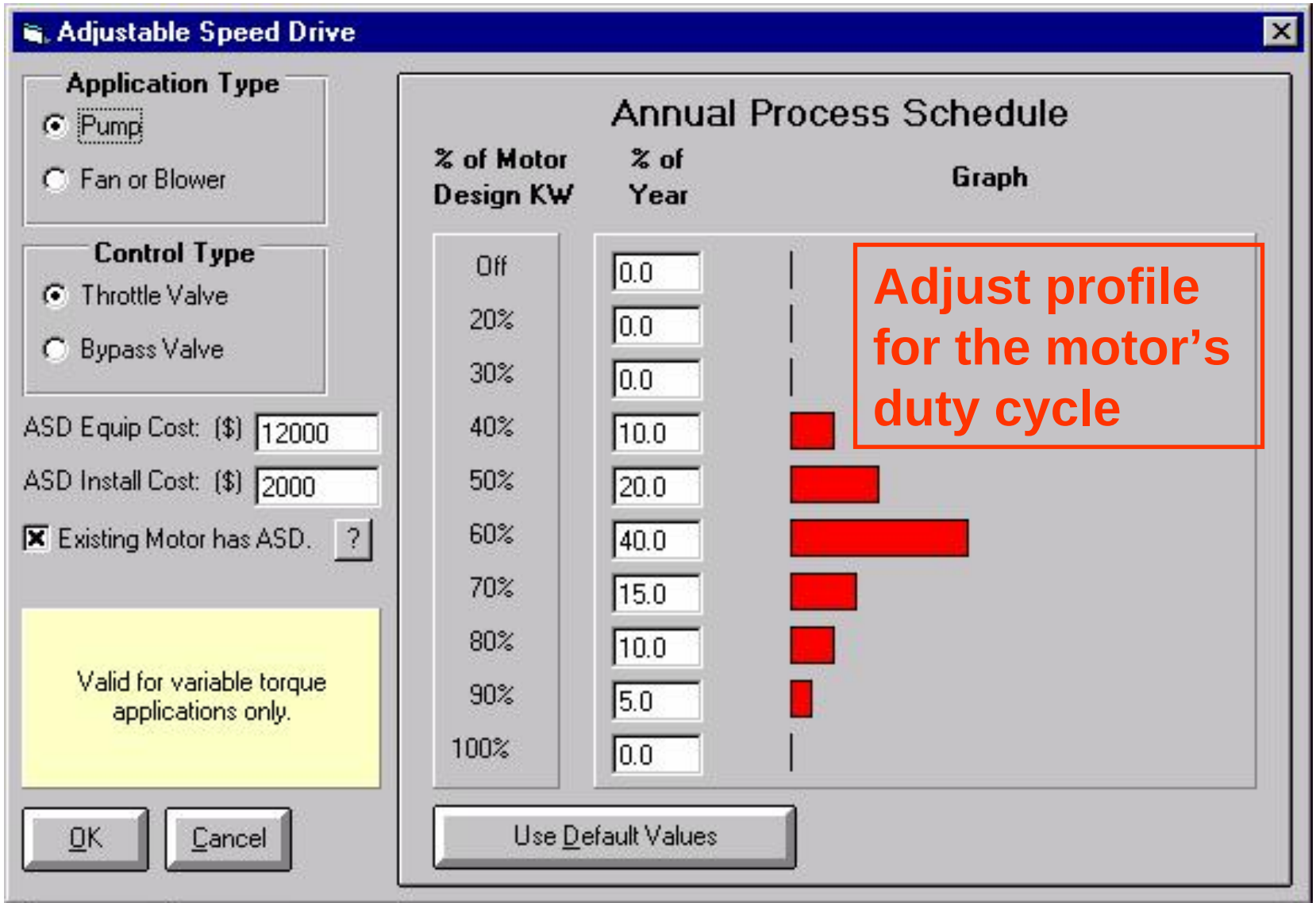
Instant Cost Calculation



ASD Graph Button



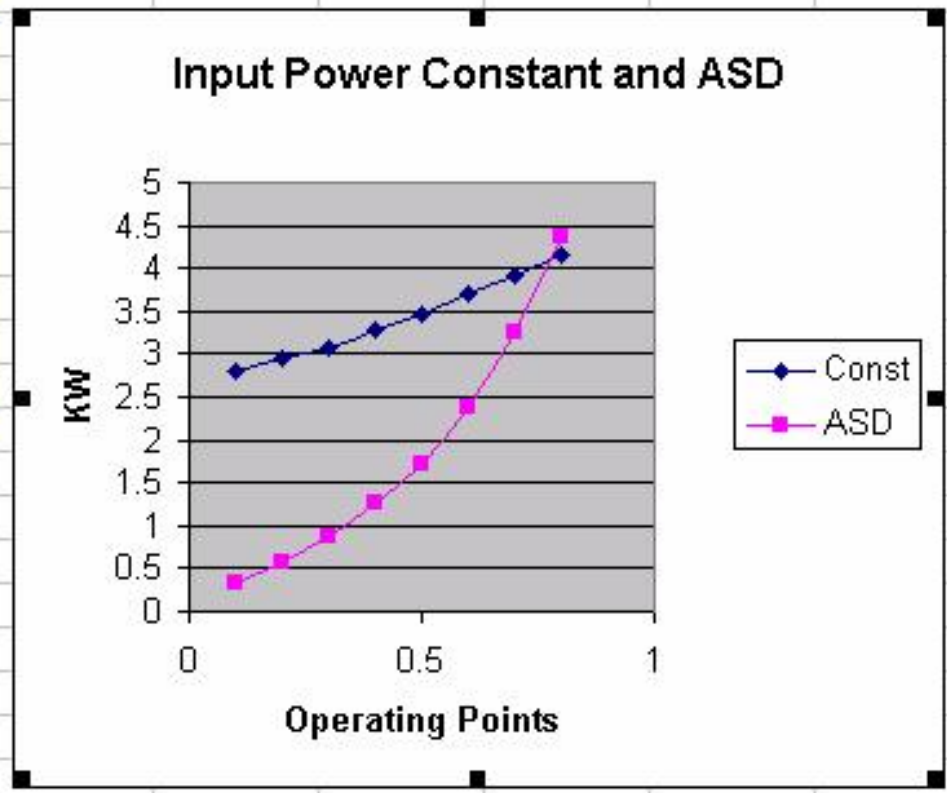
ASD Load Data



ASD Graph & Data

summary.xls

	A	B	C
1	Operating Points	KW Const	KW ASD
2		2.625587	0.20838
3	0.1	2.792291	0.333408
4	0.2	2.958994	0.583464
5	0.3	3.084022	0.875196
6	0.4	3.292402	1.250279
7	0.5	3.459106	1.708715
8	0.6	3.709162	2.375531
9	0.7	3.917542	3.250726
10	0.8	4.167598	4.375977



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Inbox - Mi... | SnagIt/32 | ESave_C... | Baldor En... | Microso... | 10:3

Questions?

Thank you.