

**THE OPPORTUNITY FOR MARKET
TRANSFORMATION
IN THE INDUSTRIAL PUMP MARKET:**

**A DISCUSSION PAPER
AND CALL TO ACTION**

DRAFT

January 6, 2006

DRAFT FOR DISCUSSION

EXECUTIVE SUMMARY

This paper is jointly developed by the Northwest Energy Efficiency Alliance and Pump Systems Matters to discuss and develop a common understanding of the definition of market transformation, the structure of the industrial pump industry, and identify the opportunities for market transformation of the industrial pump industry. Both organizations recognize that the industrial pump industry represents a significant opportunity for energy savings, and increased sales opportunity, by transforming the industry to be “life-cycle-cost” oriented.

The energy efficiency industry’s definition of market transformation is based on the regulatory need to justify the investment of rate payer funds on market activities as a means of achieving long term and sustainable energy savings. The process of justifying a market transformation program includes identifying the “market failure”, and what interventions are necessary to overcome the barriers to transforming the market. While each market transformation program requires different interventions most programs include some degree of product/service development, demonstration, marketing, as well as training and education. Some programs also leverage utility incentives in the early years in conjunction with these activities to help build and educate the market.

The pump industry, like many industrial supply chains, is made up of manufacturers, distributors, original equipment manufacturers (OEMs), engineering and construction companies, service shops, and finally the end-use customer. Approximately 40% of the pumps are sold as replacements for existing pumps, 30% are sold as retrofit, and 30% are new applications. Each of these market actors plays some role in what is sold and how it is sold – however the pump industry is currently a commodity driven industry where customers purchase based on first cost and do not pay attention to the total cost of ownership or life-cycle-cost, which includes the cost of service, energy, reliability, and other attributes included in life-cycle-costing.

The three primary barriers that must be overcome in order to transform the industry are:

1. The market doesn’t see the value in life-cycle-cost optimization;
2. The market doesn’t have the capability to deliver life-cycle-cost services on an industry wide basis;
3. Pump users don’t provide EPCs or operational personnel incentive to consider life-cycle-cost optimization.

Overcoming these barriers in the market place will take a concerted effort by the pump industry and energy efficiency community together. In particular it will require:

- Developing new products, services, and approaches;
- Training and education in the market;
- Demonstrating the new products, services, and approaches;
- Coordination between the pump industry and utility programs;
- Continued marketing throughout the transformation process.

DRAFT FOR DISCUSSION

The success of this effort will be, in part, determined by the authors' ability to engage our respective industries to assist in the continued development, and implementation, of this effort. As a first step to broader industry engagement, the authors of this paper are in the process of developing a work-plan to outline the specific goals, tasks, and organizational roles necessary to successfully transform the industrial pump market. A comprehensive PSM Marketing and Work Plan will be developed by PSM sponsors, with this paper serving as an important contribution to the dialogue with all interested parties. The next steps for engagement on this opportunity are pending review by the Pump Systems Matters sponsors during forthcoming meetings and conference calls.

INTRODUCTION

This paper provides a forum for discussing and developing an understanding of the definitions, process, techniques, market structure, and opportunities to achieve market transformation. This paper is intended to develop:

- 1.) An understanding of the purpose and process of market transformation;
- 2.) An understanding of the industrial pump industry; and
- 3.) A discussion of the opportunities for market transformation in that industry. This paper is intended to be a starting point for the discussion where addition/omission and editing are welcome to further the dialogue.

The Hydraulic Institute (HI) has recognized a significant opportunity for its industry to “transform” the industrial pump market from a commodity driven market to a value added market. HI has worked hard with its members, the American Council for an Energy Efficient Economy (ACEEE), and others to create the Pump Systems Matter Campaign. The primary focus of the Pump Systems Matter campaign is to provide education and outreach regarding the total cost of ownership and energy savings potential with industrial pump systems to end-users, engineering consultants, EPC's (engineering, procurement & construction) and pump suppliers.

The energy efficiency industry (utilitiesⁱ, policy and planning organizationsⁱⁱ) has a long history of working with industry to improve the energy efficiency of their mutual customers and constituents. This history has included conventional utility programs that provide rebates for customers to programs that work directly with the entire supply chain (from inventors and manufacturers through retail and installers) to get energy efficient products and services into, and accepted by, the market place.

The public and private entities have a common goal of transforming the industrial pump market to be “life-cycle-cost” (LCC) oriented, including the cost of the system. Each entity brings significant, and complimentary, relationships and resources to the development and implementation of a market transformation effort for the industrial pump industry. Prior to identifying the overall strategy (including activities, roles,

DRAFT FOR DISCUSSION

responsibilities, schedules, etc.) it will benefit all parties to have a common understanding of the terms, the market, and the opportunities in this market.

DEFINING MARKET TRANSFORMATION

Market transformation plays a critical role in private business. As Peter Drucker put it: "The purpose of business is to create and keep a customer. ... Because its purpose is to create a customer, the business has two basic functions: marketing and innovation. Marketing and innovation produce results, all the rest are costs."

Businesses transform markets by taking market share from a competitor (for existing products and services), developing new products or services with higher added value to meet existing market needs, or by creating new markets with new products and services. In either case, market transformation is part and parcel to the purpose and function of private business.

The energy efficiency industry has a different definition of "market transformation" than private business. The thinking behind (and definition of) market transformation for the energy efficiency industry is based on the need to justify the activity to regulators and other public policy forums from a cost/benefit perspectiveⁱⁱⁱ.

Planning for, implementing, and justifying any utility program (including market transformation) requires establishing very clear goals and objectives, which lead to implementation plans to guide the delivery of the program and are generally used to evaluate the programs in terms of their stated initial purpose. This process imposes a rigor on the energy efficiency industry that requires a clear definition of terms.

It is difficult to define market transformation from the energy efficiency industry's perspective independent of the other terms that are used to define when and how market transformation programs are useful. Perhaps the most useful definitions of market transformation and related terms, for the purpose of this initiative, are the following^{iv}:

Market Transformation - a reduction in market barriers resulting from a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced, or changed.

Market Intervention - a deliberate effort by government or utilities to reduce market barriers and thereby change the level of investment in (or practice of) energy efficiency.

Market Failure - a condition of a market that violates one or more neoclassical assumptions (e.g., perfect information, costless transactions, no externalities, rational behavior, etc.). These assumptions define an ideal market for products or services.

Market Barrier - any characteristic of the market for an energy-related product, service, or practice that helps to explain the gap between the actual level of

DRAFT FOR DISCUSSION

investment in, adoption of, or practice of energy efficiency and an increased level that would appear to be cost beneficial.

Market Effect - a change in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy-efficient products, services, or practices and is causally related to market intervention(s).

There is a large body of literature on the policy, planning, implementation, and evaluation of energy efficiency programs, including market transformation. The definitions above are one version of a definition for market transformation within the energy efficiency industry; a few other definitions include the following:

“...the term market transformation has gained a more technical meaning-that is, a policy objective of encouraging or inducing social, technological and economic change in the direction of greater energy efficiency. ... For our purposes it is sufficient that, at least in prospect, an MT program’s benefits are lasting (in the sense of not requiring continuing intervention in the market) and the value of the program’s benefits exceed its costs.”^v

“We define MTPs [Market Transformation Programs] narrowly as programs that attempt to commercialize new clean energy technologies by boosting short-term demand.”^{vi}

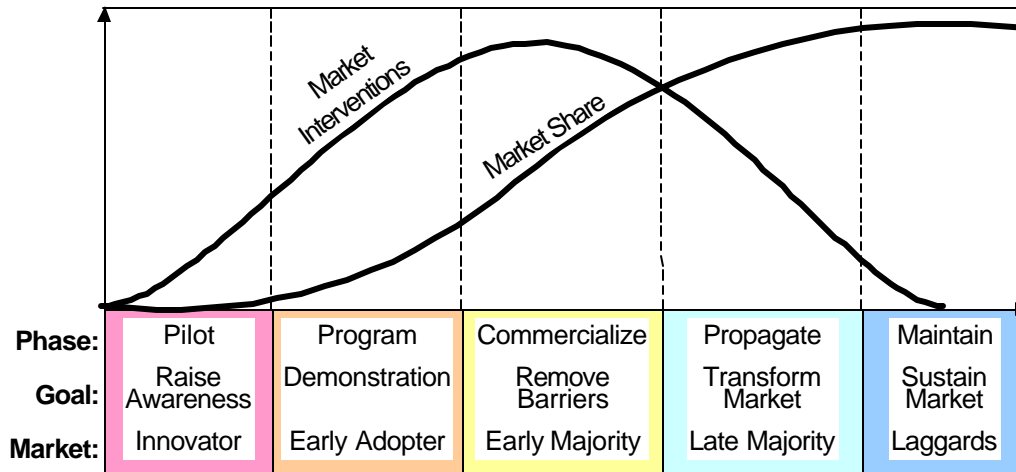
The primary purpose of market transformation is to create market share for products or services that are more energy efficient than the alternative (products, services, or behavior).

The overall strategy to achieve market transformation is determined by clearly identifying the market failure, along with the barriers and the respective market interventions necessary to overcome those barriers.

In terms of planning for, and developing the business case for market transformation it is useful to consider the market transformation process in terms of phases, and how the strategy will accomplish the intermediate goals for each phase through the process.

Exhibit 1 outlines the process of market transformation, by phase, with specific goals for each phase. Note that “Market Share” in Exhibit 1 means the share of the market held by transformed products and services vs. traditional products and services.

Exhibit 1. The Market Transformation Process:



While the specific process for each market transformation initiative will vary in terms of the market interventions, and how market share is created relative to those interventions the overall process generally follows a similar path. The market interventions raise awareness, demonstrate the value, remove market barriers, and ultimately transform the market. The activities conducted as market interventions evolve as market share grows.

In the Pilot phase, the goal is to raise awareness throughout the community – this includes awareness with end-use customers, the energy efficiency community, relevant manufacturers, distributors, and trade allies (A&E, EPC, etc.), associations, governmental organizations, etc. The innovators (again, customers, energy efficiency community, through governmental agencies) will be the first to recognize the opportunity. There are a variety of market interventions that can achieve this goal, including conducting market research, publishing papers and case studies, speaking at conferences, training and education, etc. This is also a stage where the new product/service is likely under development and the market share is negligible.

During the Program stage the goal is to demonstrate the product/service and begin to build market share. The Early Adopters are likely to get engaged at this point – when the product/service is defined, although may not be in the mainstream commercial market. The market interventions will build on, and may continue, the awareness activities in the Pilot stage. In addition to the awareness activities other market interventions may include funding select demonstration projects (by utilities, governmental agencies, or private entities).

The goal of Commercialization is to remove the market barriers necessary to engage the majority of the market and grow market share significantly. The market interventions may be a continuation of those described in the Pilot and Program stages, along with activities such as trade ally activities (marketing to distributors, retailers, installers, service organizations, etc.), standardized incentives offered to the market as a whole, etc.

DRAFT FOR DISCUSSION

Once the product or service is commercialized the objective is to propagate it throughout the market place such that it is standard practice within the industry. The market interventions to accomplish this goal will vary significantly from initiative to initiative, although may include activities such as cooperative marketing (between product/service providers and utilities or government agencies), training and education, continued incentives (at reduced levels or for higher efficiency products/services), etc.

As the market share reaches the peak the goal is to maintain the market. The ultimate goal for the energy efficiency industry is to have a market that is sustained without any market interventions. The market share gain is little if any at this stage. It is important to recognize that it will be impossible to get 100% of any market, there will always be laggards in the market that do not adopt the more efficient technology or service.

There are a number of market transformation examples in the residential and commercial sectors, including refrigerators and compact fluorescent lamps, although there are fewer industrial market examples. One industrial example is the Northwest Energy Efficiency Alliance's Evaporator Fan VFD Initiative (variable frequency drive). This program has been successful at getting the cold storage and controlled atmosphere storage markets to adopt variable frequency drives as standard practice on evaporator fans. The paper, *Focus on Cold Storage Evaporator Fan VFDs Is a Market Transformation Success*, (American Council for an Energy Efficient Economy, 2003), Eckman, et.al) is attached as an appendix to this discussion paper as a case study to a successful industrial market transformation program. It is important to note that the acceptance of VFDs has continued to increase in these markets since this paper was published.

OVERVIEW OF THE PUMP INDUSTRY

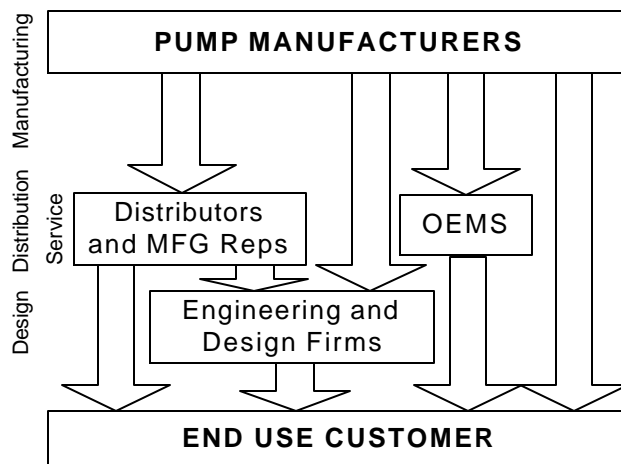
The industrial pump market can be categorized by the type of pump, whether the pump is sold as a replacement for an existing pump, as a retrofit of an existing system (both "brown field" applications), or as a new facility ("green field" application). The market may also be considered in terms of pump sales versus pump service. This paper touches on each of these market characteristics.

The vast majority of the industrial process pump sales are centrifugal pumps (as opposed to rotary or reciprocating). Of the 10.9 million industrial pumps sold in the US in 2001 (valued at over \$2.8 billion) 75% are centrifugal and the other 25% is positive displacement pumps. Approximately 40% of the process pumps sold are for replacement of existing pumps, with system redesign and new construction each accounting for 30% of the market^{vii}.

Exhibit 2 outlines the industrial process pump sales market. Note that Exhibit 2 does not explicitly address the service side of the market.

DRAFT FOR DISCUSSION

Exhibit 2. The Process Pump System Market



The three dominant process industries in terms of pump energy consumption are petroleum (pipelines and refining), chemical, and pulp and paper.^{viii} These industries represent 18%, 9% and 6% of the nation's pump energy use respectively.

The three primary market actors, serving customers with regard to industrial pumps, include manufacturers, distributors (including manufacturer's representatives), and engineering design firms. Manufacturer's representatives and distributors sell 67% of the industrial process pumps, with 20% sold directly by the manufacturers, 10% by OEMs and 3% by engineering and design firms^{vii}. While the roles will vary between market segments (Chemical vs. Pulp and Paper), manufacturers, and even from customer to customer within a single manufacturer, the characteristics for these market actors are outlined below.

Manufacturers sell pumps through a variety of channels, including manufacturer's representatives, distributors, OEMs, and directly to large end-users. While manufacturers (directly or through representatives) have quite a bit of influence on pump specification and selection they are much less involved in engineering the overall system. In general, manufacturers provide more service in terms of pump design for larger and more specialized pumps. There are a number of trends impacting industrial pump manufacturers, these include:

- Consolidation and globalization of the pump industry is changing the market dynamics in terms of competition as well as product types required for different markets.
- The financial outlook for industry in the U.S. is mixed, depending on the sector. Water and wastewater has slow growth, pulp and paper is depressed, and power, oil and gas, and chemicals are seeing growth. Many industries are also moving off shore as a result of increased global competition. The net

DRAFT FOR DISCUSSION

effect for pump manufacturers is a robust global market, and a focus on brown-field rather than green-field in the domestic market.

- The market has driven the purchasing decision to lowest first cost, which has commoditized the market and made efficiency a secondary consideration for suppliers and buyers. It should be noted that in many cases (as a cost saving measure) the pump user contracts an engineering firm to provide engineering, procurement and construction (EPC) for a project. This process virtually eliminates the pump user in the decision-making process beyond the basic requirements developed by the pump user. For contractual reasons, the EPC approach is first cost driven and forces the manufacturer to “court” the EPC as the EPC will be the purchaser of equipment. In order to introduce energy efficient pump systems pump users must be educated and it is the pump user who should prepare the equipment specification. The EPC’s have little or no incentive to optimize the systems for reduced LCC.
- Pump expertise is being lost, at the owner/operator level, at an alarming rate and greater burdens are being placed on manufacturers to assist with efforts to increase equipment reliability and improve operational efficiencies.
- Some manufacturers are recognizing the potential value of providing more engineering, maintenance, and other technology related services to customers.

Distributors and Manufacturers Representatives generally focus on a specific geographic area and provide end-users, engineering firms, and others with sales and technical support. The sales support may include providing pricing, taking orders, tracking product, and general outreach activities. Technical support ranges from assisting with pump specification and selection, general technical counsel, start-up advice, maintenance advice and troubleshooting, and training. Select pump OEM’s also provide “Turnkey” field service as well as system analysis. Distributors may stock product and provide value added equipment and service such as maintenance services (rebuilding pumps, etc.).

EPC involvement in pump sales is primarily (55%) existing system replacement, and secondarily new construction and equipment failure (26% and 19% respectively)^{vii}. End-users have been trimming engineering staff and relying more and more on outside engineering firms and, in some cases such as pump replacement, pump manufacturers. The engineering firms will generally specify the pump in conjunction with other system components (drive, piping, controls, etc.).

The primary motivation of the EPC (based on the communicated or perceived needs of the customer) is to reduce first cost, risk, and the time to project completion after approval - each of which typically has a negative impact on energy efficiency. Reducing first cost improves the EPC’s financial and competitive position, but frequently results in pump systems, which are not

DRAFT FOR DISCUSSION

energy efficient. Reducing risk is accomplished by adding a number of “safety margins” at each step through the design and construction process, which results in oversized equipment and in many cases contributes to mismatched pump and system which operates with increased maintenance costs and reduced energy efficiency. Minimizing the time to project completion can also work against energy efficient systems by not allowing the necessary time to analyze options, look at alternative equipment (as opposed to stock equipment), and propose alternatives to the customer to make decisions that trade off first cost with LCC.

The pump service market is significantly more fragmented than the sales side of the market. The Thomas Guide lists over 2,500 pump service companies in the U.S. with heavy concentrations in the industrial areas, including California, Texas, New York, New Jersey, and the southeast. These companies range from full service OEM service centers owned and operated by the major pump companies, to large independent distributor shops that sell and service pumps, to a large number of small independent service shops.

There are approximately 70 OEM service centers in the US run predominantly by the larger manufacturers. The consensus is that the quality and capability of the major shops is relatively consistent, although the quality and capability of the smaller and more independent facilities varies significantly. Some of the smaller shops are focused on low cost and others are strong in their local area where they dominate due to good service, personal relationships and connections.

In short, the services provided by these firms may be summarized into the following three categories:

- Repair and rebuild: these services vary from company to company depending on the range and type of equipment serviced. Some companies work on a wide variety of industrial equipment, including pumps, motors, heat exchangers, lubrication systems, etc. Other companies may specialize by industry or pump type. The range of service may also vary within their specialty in terms of the ability to perform emergency or on-site service, the ability to machine different metals, etc. The primary distinction of quality for these service shops is whether they perform onsite service, and the quality of onsite service. Some firms will provide a thorough disassemble and inspection process, with root cause analysis if the pump catastrophically failed. The quality also varies with the type and amount of testing and measurement conducted prior to disassemble, during repair, and after re-installing the pump. Poor testing and rebuild practices can cut the life of a rebuilt pump in half, and significantly reduce the efficiency of the pump.
- Parts: . Parts are supplied to the market in many different ways. Depending on what distribution agreements the pump manufacturers have with their resellers and end-use customers, parts can be sold by the resellers or directly from the manufacturers. Some parts, like seals, bearings, gaskets etc. are also sold directly from the companies that manufacture these items or their distributors. The parts market is also split between OEM parts and third party manufactured (referred to

DRAFT FOR DISCUSSION

as “pirates”) parts. Some “pirate parts” are of lower quality than the pump OEM’s but the opposite can also be true. Lower quality service shops will replace parts of a pump without testing or measuring attributes such as rotor stability – again this can decrease the life of the pump and increase energy required to operate the pump.

- Field service: varies from on site repairs, to troubleshooting, to providing alignment and balancing, to full engineering services. Most of the major manufacturers provide a full range of field services, although in some cases a third party provider provides these services. Quality service shops use laser alignment, vibration monitoring, and performance testing (flow, suction and discharge pressures, amperage, bearing temperatures, etc.) and compare the pre-disassembly measurements with the post installation measurements.

The pump industry is evolving and changing with the advent of technology and customer expectations. Some of the recent and upcoming changes are as follows:

- Condition monitoring (remote) is becoming more and more sophisticated and cost effective. For example, new equipment monitoring and control technology can save maintenance dollars and reduce downtime in several ways:
 - less time and personnel for “walk-arounds” to view equipment
 - automatic alerts to operators of impending problems
 - built in technology to interpret readings and plan maintenance/repair
 - built in fail safe capability to automatically adjust equipment until the problem is resolved.
- For example: One company offers a state of the art continuous monitoring system that will record up to 16 points. The unit can be installed and operational within one hour utilizing ultrasonic transducers, magnetic temperature sensors and pressure transducers that can be installed at existing pipe taps.
- Composite Impellers (non metallic) manufactured from different materials depending on application
- While not necessarily new, Turnkey Service is becoming the norm for Power Plants due to limited maintenance staff.
- Database driven CAD systems which assist owner/operators in asset management. With such capabilities in place, the barriers to obtaining installed system information are lowered. This will make it easier for service providers to apply their expertise and analytical tools to identify system modifications which will improve energy efficiency.
- Application of formal numerical optimization techniques to pumping system analysis. Such techniques allow automated searches to be performed for system improvement opportunities. These searches can effect improvements at both the design and installed/operational stage.

DRAFT FOR DISCUSSION

OPPORTUNITY FOR MARKET TRANSFORMATION IN THE INDUSTRIAL PUMP INDUSTRY

As noted above, the industrial process pump market is almost \$3 billion per year in the U.S. in terms of commodity sales. The pump market as a whole accounts for almost 20% of the world's, and 50% (or more) of some industrial facilities, electrical energy consumption. Evidence suggests that 20- 50% energy savings often is achievable through more efficient equipment and control strategies.

There is a convergence between the pump industry's interests and the energy efficiency community's interests in terms of market transformation. For the pump industry, getting customers to better understand, design, purchase, and operate based on LCC represents an opportunity to;

- 1.) Give pump users a competitive business advantage and
- 2.) Develop a value added market within the pump industry.

For the energy efficiency community pump systems LCC optimization represents a tremendous opportunity to achieve efficiency improvement in a cost effective manner.

As noted above, the overall strategy to achieve market transformation is determined by clearly identifying the market failure, along with the barriers and the respective market interventions necessary to overcome those barriers. Also, it is useful to consider the market transformation process in terms of phases, and how the strategy will accomplish the intermediate goals for each phase through the process.

The market transformation questions are:

- Where specifically is the market failure?
- What are the barriers to overcome the market failure?
- What market interventions are necessary to remove the barriers and achieve market transformation?

Pump Systems Matter facilitated a discussion regarding these questions at the American Council for an Energy Efficient Economy (ACEEE) Summer Study on Industry (July 20th, 2005). The session was well attended by industry, manufacturers, utility personnel, although not A&E firms, distributors or service shops. The following are a representative sample of the comments made regarding the market barriers during that session:

- Pump sales people do not understand systems optimization concepts
- Consulting engineers can be “gate keepers” and minimizing LCC is not a priority
- Excessive safety factors are thought to minimize risk although may actually reduce reliability
- Pump and motor companies focus only their product and not the system – pump sales people do not try to help existing operations
- Service Providers have lost credibility in the industry

DRAFT FOR DISCUSSION

In gross terms the market failure is that customers do not understand the value of optimizing systems for lower life-cycle costs, even though it is in their best economic interest. More specifically, because customers have focused on first cost, the market has not developed the services, tools, or capability (with some limited exceptions) to deliver LCC optimization services.

The barriers as we understand them today are outlined below. These barriers are based primarily on secondary research and it may be useful to conduct some market research to better understand these barriers prior to launching a full-blown market transformation initiative.

Market Barriers:

- Customers don't understand the value of LCC system optimization;
 - Focus on first cost;
 - Very low payback threshold;
 - Data is not available to justify initial cost;
 - Lack continuity between EPC, Pump OEM and Pump user
- Manufacturers have been pressured on price and don't generally get involved in the system design.
 - "Our customers don't understand the true value in terms of energy savings, reliability, product quality, and other non-energy benefits of LCC systems optimization".
 - Haven't done true systems optimization for LCC and don't have the knowledge or tools;
 - Don't have the business basics in terms of promoting, pricing, placing, etc.
 - Manufacturers generally work with the EPC not the Pump user (due to EPC contract) this leaves the Pump user out of the decision making loop.
- Distributors/Manufacturers Reps have been pressured on price and don't have time to get involved in the system design on smaller projects.
 - "Our customers don't understand the true value in terms of energy savings, reliability, product quality, and other non-energy benefits of LCC systems optimization".
 - Haven't done true systems optimization for LCC and don't have the knowledge or tools;
 - Don't have the business basics in terms of promoting, pricing, placing, etc.
- Design engineers add layers of "safety margins"
 - Need to reduce risk in terms of true safety, also plant expansion, system inefficiencies, etc.
 - Customer's focus on first cost and reduced design time;
 - Haven't done true systems optimization for LCC and don't have the knowledge or tools;
 - Don't have the business basics in terms of promoting, pricing, placing, etc.

DRAFT FOR DISCUSSION

- Do not understand the pump design, only interested in low cost and “EPC” warranty period.

In short, the three primary barriers that need to be overcome are:

- 1.) The market (customers and trade allies) don’t see the value of LCC systems optimization;
- 2.) The market doesn’t have the capability to deliver LCC systems optimization in the market place; and
- 3) The structural issues that result in owner/operators providing no incentive to EPC’s and little or no incentive to operational personnel to consider LCC.

While these barriers apply when a pump is sold during the construction of a facility and as a replacement or retrofit, the market actors and the decision making process is different. During construction of a facility the customer may contract with an engineering, procurement, and construction (EPC) company to do the design and construction. EPC firms are generally retained based on their experience in the industry and a quoted price to complete the project. The end customer does not generally require that the EPC consider life-cycle-cost. In retrofit applications, where engineering is often required, the end-use customer very often retains an outside engineering consultant – although they are not instructed to look at life-cycle-cost and the project decisions are based on first cost. In the case of equipment replacement and repair, it is often the customer’s facility staff that will remove the equipment and make a decision on what to replace – and again the decisions are generally based on first cost.

The following table provides a framework for considering the phases of a industrial pump market transformation effort with the respective goal, market interventions (by barrier), schedule, budget and the logical organizations to engage for each phase through the process. The barriers and interventions are provided as examples to illustrate the application of the table in terms of framing a market transformation strategy.

Table 1. Market Barriers and Interventions

Phase:	Pilot	Program	Commercializ e	Propagat e	Maintain
Goal:	Raise Awareness	Demonstrate Value	Remove Barriers	Transform	Maintain
Market:	Innovator	Early Adopter	Early Majority	Late Majority	Laggards
Barrier: The market doesn’t see the value. Respective Interventions:	Example: Educate customers and the A&E market on systems optimization opportunities.	Example: Get early adopter utilities to fund and publicize pilot projects.	Example: Get utilities to offer incentives for systems optimization design.	Example: Publicize the value of systems optimization to targeted audiences.	Example: Continue with training and education program.

DRAFT FOR DISCUSSION

Barrier: The market doesn't have systems optimization capability. Respective Interventions:	Example: Technical training targeted at market innovators throughout the supply chain.	Example: Develop the tools and resources necessary for mass-market systems optimization activities.	Example: Design utility programs to encourage development of new skills (Pump Engineer Certification), disseminate tools and resources, etc.	Example: Establish industry awards, publish articles in trade journals, etc.	Example: Incorporate systems optimization education into other channels (associations, colleges, universities)
Barrier: The market has contractual and technical structural deficiencies Respective Interventions:	Example: Educate owner/operators on how their contract award and personnel policies work to increase their operating costs	Example: Develop program to bring the EPC, OEM/manufacturer and owner/operator together to overcome market barrier.	Example: Develop program which identifies how to incentivize all entities to work towards energy efficient systems	Example	Example
Schedule:	TBD	TBD	TBD	TBD	TBD
Budget:	TBD	TBD	TBD	TBD	TBD
Organizations Involved:	Mfg, Customer, and A&E associations.	Utilities, PUCs, energy efficiency advocates, etc.	Specific customers, A&E firms, etc.	Specific customers, A&E firms, etc.	Mfg, Customer, and A&E associations.

The above table may be useful for the various organizations involved in a market transformation effort to use as a planning and coordination tool. The first step would be to re-visit the assumptions in terms of market failure and the respective market barriers. Once these are completed the market interventions, along with the respective schedule, budget, and logical organizations can be identified.

Creating a market transformation strategy is a combination of methodically outlining the market failures, barriers, and interventions to overcome those barriers, but also having some vision of what a transformed market could look like – what the products and/or services may be offered in a transformed market. It is important to recognize that the market may evolve different from that vision – but it helps to start with some ideas of specific possibilities. A few potential products or services that may exist in a transformed market are as follows (not in any order of priority):

- **Pump System Optimization Analysis:** This service is currently being offered, although the capability is limited to a relatively small number of individuals and companies. In short, this service is diagnosing a customer's pump system to identify reliability and energy improvement opportunities using monitoring, identifying operational root cause problems, and conducting life-cycle-costing

DRAFT FOR DISCUSSION

analysis. While monitoring, root cause, and life cycle costing analysis services are currently offered in the market – they are not generally combined to offer a comprehensive optimization service.

- **Pump Contingency Optimization Service:** This service would be targeted at existing pump systems and could be offered by manufacturers, distributors, service shops or consulting engineers. The purpose of the service would be to analyze the pump system, and conduct the necessary engineering and planning prior to failure or shut down so that the system could be optimized in a short period of time during a shut down. This service would establish the protocol for pump replacement and/or repair as well as system changes (piping, controls, etc.) to optimize the system. The service would conduct any analysis (measurements, metering, engineering), outline the necessary work orders, specify (and stock or have the distributor stock) particular equipment, and have a contingency operating plan for the system during this process.
- **Continuous System Optimization Monitoring:** This service is being developed and offered, although is not widely accepted. This service can facilitate predictive maintenance by providing system operators (or a third party) with a “dash board” indicating on-going reliability and energy performance for the system. The system would measure vibration, flow, speed, current, and other parameters to give an indication of system reliability and efficiency based on a pre-defined specification for that particular system. If the system is operating outside some pre-defined parameters it could trigger an alarm, which may warrant physical inspection, additional monitoring, or corrective action.
- **Engineering Life-Cycle-Cost Contract Specifications:** This document would provide industrial customers with the language necessary to require engineering and EPC firms to conduct life-cycle-cost analysis for the pumps systems they design. Currently, engineering and EPC firms have a disincentive to minimize life-cycle-cost because it increases the engineering time required and increases the perceived risk by right sizing the equipment (“nobody has been sued for a putting in a pump too large”). This document would provide the contractual language to give contractors the incentive to include life-cycle-cost analysis in the design and construction process. This would require getting the end-user to use the language in the bidding process so that life-cycle-cost was spelled out as one of the critical factors in the customer’s expectation, along with safety, reliability, etc.
- **Pump Repair and Root Cause Analysis Industry Specification:** This activity would create an industry standard for pump repair, and root cause analysis as a means of improving the quality (which affects the reliability and efficiency) of the service industry. This activity may start with a document analogous to the Electrical Apparatus Service Association’s “Guidelines for Maintaining Motor Efficiency During Rebuilding” for motors. The activity could provide service

DRAFT FOR DISCUSSION

shops with a logo or brand to use in advertising if they comply which would differentiate service shops in terms of quality.

Table 2. Market Concepts, Barriers, and Interventions

	Barriers			Primary Audience	Market	Program Phase and Respective Primary Activities				
	Market Doesn't See the Value	Market Doesn't Have Capability	Market Has Structural Deficiencies			Pilot	Program	Commercialize	Propagate	Maintain
Pump System Optimization Analysis	X	X		End-User, Engineer	Existing	Training	Demonstration	Utility Program	Marketing	
Pump Contingency Optimization Service	X	X		End-User, Engineer	Existing	Training	Demonstration	Utility Program	Marketing	
System Optimization Continuous Monitoring	X	X		End-User, Engineer, Service Shop	Existing	Demonstration	Utility Program		Marketing	
Engineering LCC Contract Specification	X		X	End-User, Engineer	New	Development	Training, Demo	Utility Program	Marketing	
Pump Repair & Root Cause Specification	X		X	End-User, Engineer, Service Shop	Existing	Development	Training, Demo	Utility Program	Marketing	

The five market concepts outlined above each address two of the three barriers, each applies to the end-user and engineering community, and has similarities in terms of the market intervention approaches. It is unlikely that any one of these market concepts would transform the market, although a combined approach with the appropriate support from the industry and other organizations would transform the market.

CONCLUSION: CALL TO ACTION

It is clear that pump users, the pump industry, and the energy efficiency industry would benefit significantly from a transformed industrial pump market. Given the market barriers and opportunities, it is also clear that transforming the market will require a significant coordinated effort, which may include:

- Product and service development;
- Training and education;
- Demonstration of new products, services, and approaches;
- Leveraging the activities between industry and utility programs;
- Marketing to continue to build awareness through the transformation process.

The success of this effort will be, in part, determined by the authors' ability to engage our respective industries to assist in the continued development, and implementation, of this effort. As a first step to broader industry engagement, the authors of this paper are in the process of developing a work-plan to outline the specific goals, tasks, and organizational roles necessary to successfully transform the industrial pump market. The next steps for engagement will be outlined after engaging more fully with Pump Systems Matters sponsors. A comprehensive PSM Marketing and Work Plan will be developed by PSM sponsors, with this paper serving as an important contribution to the dialogue with all interested parties.

DRAFT FOR DISCUSSION

ⁱ The term “utilities” is used in the broadest sense and includes public and private utilities as well as public benefits administrators, and regional market transformation organizations.

ⁱⁱ These organizations include the California Energy Commission, the Northwest Power and Conservation Council, and others.

ⁱⁱⁱ The costs may be limited to the expenses incurred by the utility (for the Utility Cost Test) or can include all costs by all parties involved (for the Total Resource Cost Test). The benefit is generally considered to be the value of the energy saved, although in some cases may include other benefits such as environmental externalities.

^{iv} These definitions are taken from: *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs*, Eto, Prah, Schlegel, Prepared for The California Demand-Side Measurement Advisory Committee, Project 2091T, July 1996.

^v *A Theory Based Approach to Market Transformation*, ACEEE, 1998, Blumstein, Goldstone, Lutzenhiser.

^{vi} *The Economics of Energy Market Transformation Programs*, The Energy Journal, 20(4):15-64. Duke, Kammen, 1999.

^{vii} *Commercial and Industrial Equipment Supply Chains, Industrial boilers, compressed air systems, and pump systems*, Quantum Consulting for Focus on Energy, Report 226-1, August 2003.

^{viii} *Energy Efficient Motor Systems, A Handbook on Technology Programs, and Policy Opportunities*, Nadel, et.al., ACEEE, 1991, page 167.