Creating a Total Value Proposition for an Energy Efficient Technology

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ABSTRACT

This paper will demonstrate how to apply a valuation framework developed at the National Renewable Energy Laboratory (NREL) to an energy efficient technology, namely tankless hot water heaters. This framework provides a context that is broader than avoided cost for explaining the value of a residential or commercial technology. This context proves valuable for a wide range of users:

- policy and decision makers determining which technologies to incorporate into their programs,
- firms bringing an emerging technology to market, and
- investors deciding how to integrate energy efficiency into their portfolios.

This paper demonstrates how to create and capture value across the value chain – from suppliers, to the manufacturer, distributors, purchasers, end users, and power providers. Actors at all stages must have the proper incentives to develop, sell, and use a technology; program developers, technology developers, and investors alike must be aware of how different motivations at each stage of the value chain can affect the long-term success of their investments.

Introduction

Why is it that some technologies thrive in the marketplace and others suffer slow, painful, and expensive deaths? How do these successful technologies overcome barriers to success in the marketplace, surviving from the research and development phase, through pilots, and then through the phases of market adoption? More important for energy professionals, how can new energy efficiency technologies be steered from the product development cycle into the marketplace in time to help reduce the need for expensive, new generation in the near future?

Many scholars have identified characteristics that affect the rate at which products are brought to market. Rogers (1962, 1983, 1995) developed one of the most familiar groups of these characteristics: relative advantage, compatibility, complexity, observability, trialability, risk. Ostlund (1974) discussed the importance of perceived risk (e.g., obsolescence risk, pricing risk) as a factor affecting the rate of diffusion. Tornatzky and Klein (1982) identified three of Rogers' characteristics as statistically significant in predicting diffusion, based on analysis of a suite of studies on market diffusion: compatibility, relative advantage, and complexity. Other characteristics studied in the Tornatzky and Klein analysis but not recognized as statistically significant included cost, communicability, divisibility, profitability, and social approval.

Traditionally, these characteristics have been examined in the context of the target market. Does the technology fit in with the existing system being used by the end user? How does this technology's benefits compare with those of the technology which it is replacing? Attempting to see a technology through the eyes of the consumer is intuitive and provides initial feedback about the technology's appeal to the end user.

Looking at the technology through the eyes of the end user, however, is only one component of determining a technology's actual market success. Between the innovator and the end user lie many market actors that together for a *value chain*: manufacturers, distributors, retailers, installers, and contractors, to name a few. These characteristics for market diffusion must be examined in the context of each of these market actors in order to create a complete picture of the technology's market potential.

In other words, the innovating team must create a total value proposition for the technology. The total value proposition must demonstrate to each market actor that interacts with the technology why the market actor should manufacture/distribute/sell/install it over any alternatives. If any one of the market actors fails to see the value of the technology, the technology may not be moved further down the value chain. Depending on where along the value chain this omission is made, the technology's death may be hastened or drawn out.

The framework for the Total Value Proposition is important for innovators, policy makers, and utility personnel alike. Any of these groups attempting to increase the rate of market adoption for an energy efficient technology can apply the framework to further that goal. By identifying gaps in the value chain, the framework can help innovators, policy makers, and utility personnel understand where to focus their incentives or market transformation efforts.

An Overview of the Total Value Proposition Framework

The framework for a total value proposition for clean energy technologies used in this paper is based on two fundamental business concepts: value proposition and value chain. First, a value proposition creates a picture of how the product creates benefits for a target audience (e.g., end user, manufacturer, retailer) (Lawrence and Moyes 2007) in response to the target audience's needs. The value proposition forms the foundation for all marketing efforts directed at that target market, and it typically varies from one target audience to the next.

Second, the value chain is used to describe all of the actors for whom benefits must be created in order for the technology to succeed. In essence, it is a variation on a supply chain. All of the market actors represented in the value chain must recognize benefit in using the technology instead of the alternatives available. Such value chains can be very complex, representing all of the supply chains of each market actor in detail (Figure 1. Example of a Value Chain with Tangential Supply Chain

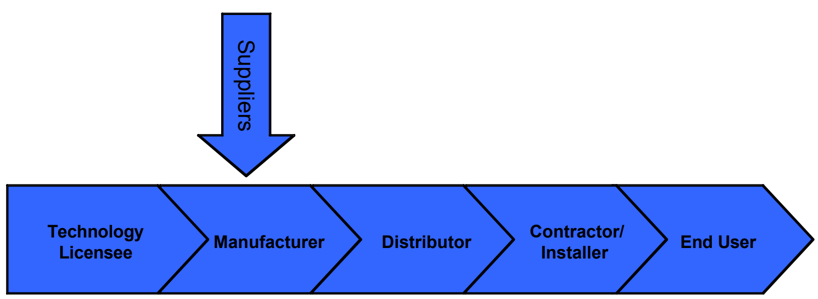

Figure 1. Example of a Value Chain with Tangential Supply **); others will simplify the story by representing the critical actors in the supply chain in a single line (Figure 2. Example of a Value Chain with Embedded Supply Chain**

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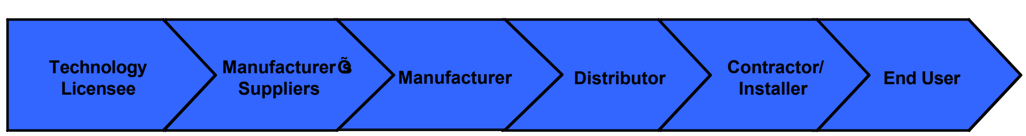

Figure 2. Example of a Value Chain with Embedded Supply Chain

Examining Categories of Value

By combining these two elements – the value proposition and the value chain – with several categories of values, the total value proposition framework provides a methodical approach to creating a value proposition for each critical actor in the value chain. It enables the developer of the value proposition to systematically consider several types of values for each actor in the value chain. Whether the developer is the innovator, a marketing strategist, a policy maker, or a utility staff person, the framework approach will help them identify areas in which value must be created in order to successfully commercialize the technology. This approach is ideally used when the commercialization strategy is developed, but it can also be used to troubleshoot a value framework for a technology that is encountering difficulty in overcoming market barriers.

The framework for creating a total value proposition (TVP) for clean energy technologies requires careful consideration of a suite of values beyond the basic revenue calculations. In some cases, the TVP categories of value will identify enhanced revenue, in other cases reduced costs, and in some cases the benefits may be less tangible in nature. The TVP categories of value are often overlooked when creating a value proposition for different market actors. The TVP framework begins with six central categories of value to consider (Pater 2006):

- Risk Management
- Benefits of Emissions Reduction;
- Direct Policy Incentives;
- Reduced Resource Use;
- Corporate Social Responsibility (or “Green Marketing”); and
- Societal Benefits.

These categories of value are explained in further detail in the following pages.

Risk Management. Consumers and providers of electricity face a host of uncertainties in today’s market. Volatile fuel prices, especially for natural gas, can drive up the price of electricity on short notice. Capital costs of new generation resources are increasing, as evidenced by a two-year 83% increase in the capital cost of a coal plant planned by Duke Power (Wald 2007). Some states are implementing greenhouse gas (GHG) regulations, while Congress has proposed several bills to initiate federal regulations of GHGs, each with different anticipated costs. Regulation requiring the acquisition of all cost-effective energy efficiency resources by utilities was recently adopted in Washington State (through I-937), and similar regulations could be adopted elsewhere.

All of these uncertainties could have cost implications for generators, which in many cases, will be passed on to ratepayers. Energy efficiency technologies can help mitigate several of these risks for both utilities and end users by reducing the costs of associated fuel or new capital investments. Several utilities in the Pacific Northwest, for example, are planning to ramp up their energy efficiency programs in order to meet continually growing demand in the face of anticipated declines in allocations from the federal hydropower system. Thus, this value must be accounted for in creating the total value proposition.

Benefits of Emissions Reductions. Generators, and through them their customers, already pay for emitting criteria and hazardous air pollutants, and in some states (California and 13 Northeastern states), they will start to pay for GHG pollutants in the near future. On the horizon are federal regulations for GHGs, which would create additional costs for generators and users of electricity. Energy efficient technologies reduce the intensity of emissions for a given end use. In doing so, they can create value by either avoiding emissions fees (e.g., for hazardous and criteria pollutants) or by freeing up emissions credits (e.g., in a cap-and-trade system) for sale.

At the other end of the spectrum are voluntary organizational commitments to reduce GHG emissions, such as those made by SC Johnson, DuPont, and the City of Chicago. Reductions in GHG emissions through energy efficient technologies can enable these organizations to meet their goals without compromising their operations. They can move early to meet anticipated regulatory standards while delivering on their sustainability commitments. This type of benefit is not captured in a valuation based only on discounted cash flows.

Direct Policy Incentives. Policy makers at the federal, state, local, and utility level provide financial incentives for select energy efficient technologies. Some technologies may take advantage of these already, and others may seek to obtain this preferential treatment. The types of incentives included in this category are diverse but can add up: federal tax credits, rebates, rate credits, accelerated depreciation (and the resulting tax breaks), and subsidized loans. While the technologies that policy makers include in these programs can change over time, creating some uncertainty, this can be a very tangible benefit of energy efficient technologies.

Reduced Resource Use. For electric generators, the use of natural resources, such as water or minerals, directly affects the bottom line. In the West, for example, water resources are becoming scarcer, and the ownership of water rights dramatically affects manufacturing and energy generation activities alike. Further, corporations can reduce their use of energy by using energy efficient technologies, which also affects the bottom line. Energy efficient technologies generate benefits for generators by reducing the use of such resources and the associated costs, savings that can be passed down to end users and, when appropriate, their customers.

Corporate Social Responsibility. Today's society exerts increasing pressure on organizations to act as good corporate citizens while continuing to deliver high returns on investment. The type of behavior is called many things – sustainable development, corporate sustainability, or business ethics. While the definition of these terms can be broad – including everything from the acknowledgment of human rights, treatment of workers, transparency, and environmental performance – organizations' environmental performance has become the most scrutinized. Corporate sustainability reports abound. The number of members of the Chicago Climate Exchange, a voluntary greenhouse gas trading platform, has blossomed to over 250, from its initial 13 Charter Members in 2003. *The Economist* runs a 15-page report, touted on its cover as *Cleaning Up*, about how corporations are tackling climate change (June 2, 2007).

Acting as a good corporate citizen has its financial rewards today as well. Here are just three examples:

- A 2003 study found a correlation between corporate social performance and corporate financial performance, by conducting a meta-analysis on 52 earlier papers (Orlitzky, Schmidt & Rynes 2003).
- Real estate developers that follow the principles of green building find that they can reduce the cost of operating their buildings, and their tenants realize gains from increased productivity and higher worker retention rates (Lockwood 2006).
- Firms with reputations for considering the social and environmental aspects of its core business can attract higher quality employees, creating a sustained competitive advantage over its rivals (Turban & Greening 1997) (Bauer & Aiman-Smith 1996).

Such benefits are not always captured in developing a value proposition for supply chain actors, but they can create important benefits for those actors.

Today, companies are building competitive advantages based on the principles of corporate sustainability. GE launched its landmark Ecomagination campaign to promote the sustainable aspects of its business – wind turbine manufacture and wind power development, energy efficient appliances, lending practices that reward home buyers that select Energy Star homes. Whole Foods has flourished in a market that was dominated by price competition for decades because it created benefits for its customers that went beyond ingredients for their weekly meals – improved health, a sense of belonging to a community with similar priorities, environmentally friendly fishing techniques. It has doubled in value since November 2001, while Kroger's stock price has only increased by 7 percent. That is value that makes a difference.

Putting the Framework to Work

Figure 3 demonstrates how these value categories are combined with the value chain to create a value proposition for each actor. The value proposition is created by considering benefits to each actor in the value chain that fall into each of the six value categories, in addition to any direct revenue benefits. By

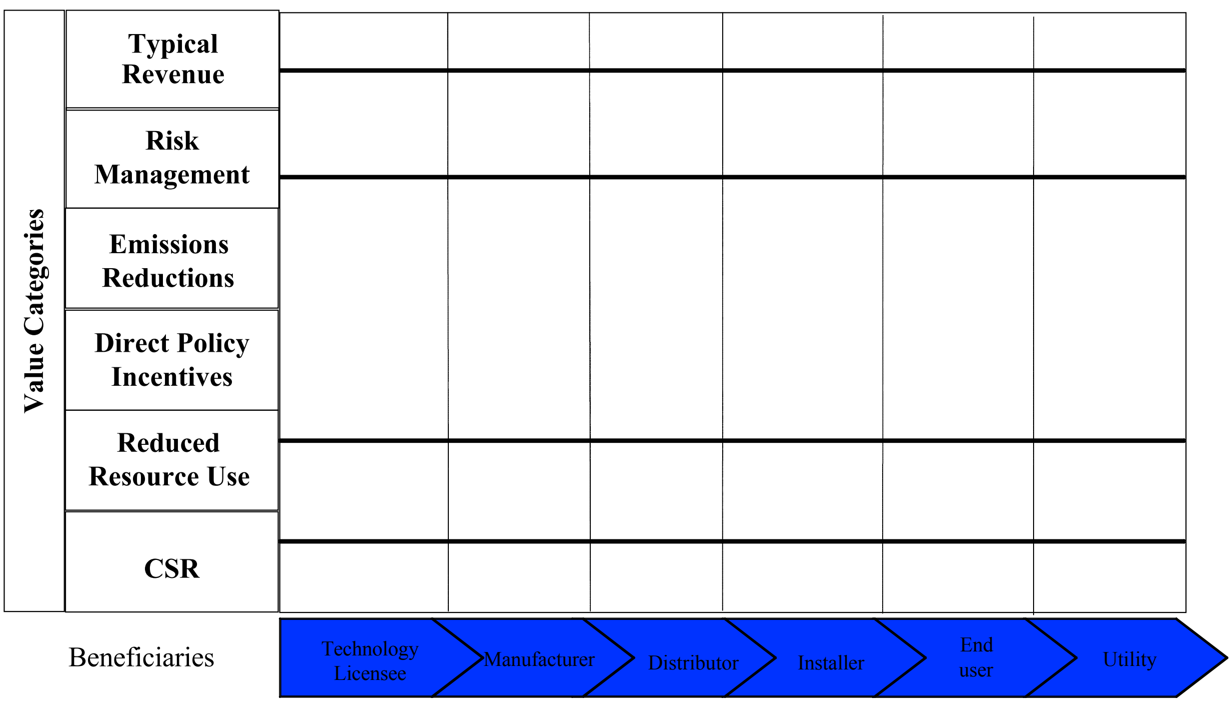

Figure 3. The Framework for Creating a Total Value Proposition

looking down a column, it is possible to create the *total* value proposition for the technology.

Some of the values are quantifiable, while others are less tangible. Calculating the amount of GHG emissions reductions is fairly straightforward if the alternative technology and generation mix providing the electricity are known. On the other hand, predicting the impacts on stock price or valuation, for example, is difficult because research is lacking to support such an approach.

It is not always vital to develop precise calculations for each of the values at first, however. At first, a checklist approach can be taken, simply identifying if a certain value applies to each actor in the value chain. Using that list as a basis, the developer of the value proposition can determine which values would hold the most traction with its stakeholders. Based on that information, estimates can be developed to a level of detail that is useful for marketing the technology.

Applying the Framework to Tankless Hot Water Heaters

With energy savings ranging from 45-60 percent compared to traditional tank water heaters, tankless hot water heaters represent an important opportunity in the energy efficiency market (EPA 2006). Though conventional hot water heaters have gained efficiency over the years, there are still inefficiencies associated with holding water in a tank until it is needed. A fundamental issue is that the water in the tank is re-heating when it dips below a pre-set temperature, often called a "stand-by" loss. Tankless water heaters eliminate this standby loss by warming the water only when it is needed. Tankless water heaters have significantly higher energy factors than conventional tank heaters – 0.8 compared to 0.5.

Despite this opportunity to realize significant energy savings, they have had difficulty gaining traction in the market. In the Pacific Northwest, for example, only 5% of water heaters installed each year are tankless, despite the region's estimate of 335 aMW that could be gained through the more efficient technology (NEEA 2006). This leaves a lot of energy savings on the table.

The total value proposition framework provides insight into why the technology has not made a more significant impact by examining how it brings value to each actor in the value chain. While conventional valuations and market evaluations only consider the direct revenue and cost estimates, they often omit the values in the categories that were outlined earlier. This approach identifies where there are gaps in the value chain so that those promoting the technology can do so more effectively.

Figure 4 represents the total value proposition of residential tankless hot water heaters from a qualitative standpoint. The TVP was developed by considering how each actor in the value chain gained value in each of the categories. Some of these values are fairly straightforward or were explained earlier in the paper, but a few are worth a brief explanation:

- *Additional Training Required:* The gray boxes in this diagram demonstrate the added costs of implementing the tankless hot water heaters. For distributors and installers, the tankless units require a different set of skills than the traditional units. Gas, electrical lines, and plumbing must often be moved to accommodate the tankless unit. Vents can be required, which often requires a second tradesman to participate in the installation. In order to overcome these hurdles, the installers must undergo hands-on training. The distributors are often a source of information for the installers, requiring that they also develop the additional knowledge necessary to work with the tankless units.
- *Delay need for new CAPX:* By reducing energy intensity, the utility can serve additional end uses with the same infrastructure, enabling it to delay the need for expanded facilities. As there is increasing pressure on energy resources throughout the country, utilities increasingly look to energy efficiency resources to help reduce the growth. Capital expenditures can be delayed.
- *Preferential loan treatment:* Some utilities offer an option for favorable loan rates instead of or in addition to rebates. By offering lower interest rates or longer repayment schedules, the utility overcomes part of the barrier of the increased upfront cost of the technology.
- *Peak load impacts:* Because energy demand for tankless units is concentrated at the time of use, which takes place when the residents are home, some utilities are concerned about increasing peak load (Progress 2007). A strong body of research on this issue is not yet developed.
- *Competitive advantage – new skill sets:* As mentioned earlier, the skills required to sell and install tankless units are different from those used to sell and install conventional tank units. Since there is such a low penetration of tankless units in the market, distributors and contractors can develop a competitive advantage at this early stage by developing the skills needed to implement the new technology. As the market grows, this skill set can put them ahead of the competition.

- *Not visible:* For consumer technologies, the benefits of "going green" are often related to the status that the green product can afford them. Toyota learned this with the Prius, a hybrid vehicle with an appearance that is clearly different than a normal vehicle. This difference is visible to the owner's friends and colleagues, demonstrating their commitment to living out their environmental values. Tankless hot water heaters are often out of sight, which means that the consumer's "green commitment" is not as evident.
- *Improved stakeholder relations:* Utilities often battle with their regulatory agencies over the inclusion of demand-side management (DSM) technologies in their portfolio. Offering incentives for a technology such as tankless units demonstrates a commitment to demand-side resources that can be quantified for the regulatory agency.[1]

One of the critical takeaways from this assessment of value proposition is the lack of incentives for the actors early in the value chain. Although the distributors and installers increase their revenue, their margins actually decrease, in part due to the additional cost of training to learn the equipment. With the current tax incentives, downstream actors have significant incentive to purchase the equipment, but if upfront costs, especially those related to installation, are too high, the incentives won't create enough consumer pull to move the technology into the market.

This brings up a major issue in the diffusion of technology: how to balance two approaches to technology diffusion. The first approach empowers consumers to *pull* the product into the marketplace through increases in demand ("market pull"). The second approach relies on upstream market actors to identify market needs, to create technologies to respond to those needs, and to *push* the technology into the market place ("technology push"). In this case, it is evident that a market pull approach is being taken, but it has omitted the "middle market" players – the installers and distributors.

[1] For electric tankless units that replace conventional gas-fired tank units, fuel switching may actually introduce new concerns to regulatory agencies, gas utilities, or other stakeholders. This paper will examine only gas tankless units, as explained in further detail in the next section.

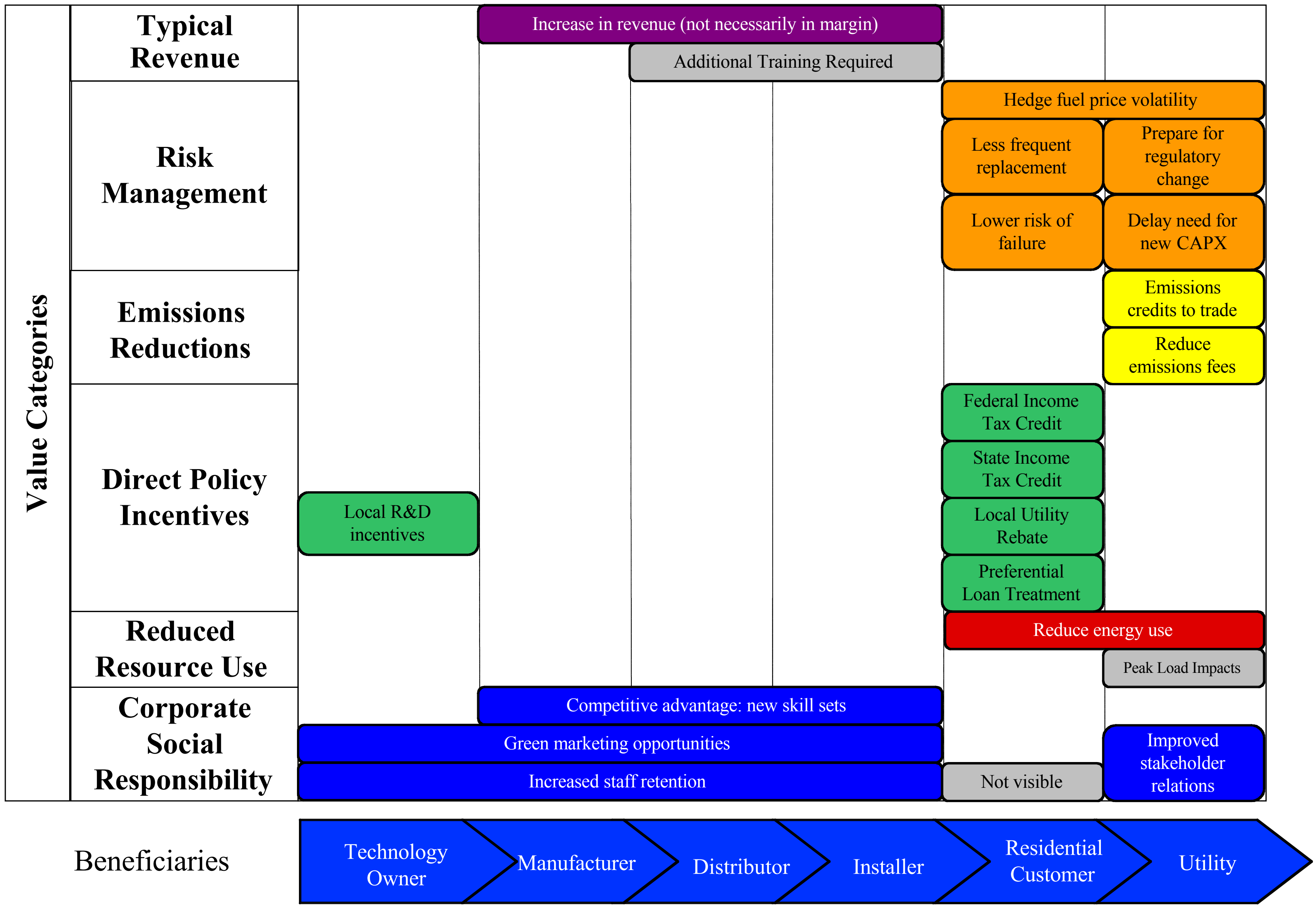

Figure 4 Total Value Proposition for Tankless Hot Water Heaters

Why it Doesn't Add up: Quantifying the Total Value Proposition

After examining the initial categories of value to identify where to look to quantify additional value, the next step is to try to quantify these benefits. As mentioned earlier, this is difficult to do with some of the categories. In some cases, there is limited data to serve as a basis for making those estimates. In other cases, the value may represent more of a "hassle factor," such as having to replace the technology less often; different people will assign different values to their time. Despite these hurdles, where quantification is possible, it creates a more comprehensive picture of where the value lies.

Table 1 serves as a starting point for quantifying the value of an average size natural gas-powered tankless hot water heaters for new construction in Oregon. Oregon was selected for two main reasons:

- Data is publicly available about the hot water heater market in Oregon, due in large part to the efforts of the Northwest Energy Efficiency Alliance and the Energy Trust of Oregon; and
- Incentives for high efficiency hot water heaters are especially attractive in Oregon, through a combination of utility rebates and state income tax credit, which leverage the federal income tax credit on this equipment.

Natural gas-fired units were chosen because the opportunity for efficiency gains is so much more significant than for electric-powered tankless units. The EPA (2007) has disqualified electric tankless units from developing ENERGY STAR specifications because they are only 9% more efficient than conventional electric-powered water heaters. Thus, natural gas-fired tankless units are the focus.

This table calculates the *change in value*, relative to conventional tank units. For example, the top-line change in revenue for the distributor assumes that it retains the same percentage of the price of the tankless unit as it would for the conventional unit. The amount that the distributor retains, however, increases because the wholesale cost of the unit increases. Thus, the $184 difference reflects that change.

The calculation of additional expense incurred by the distributor and installer to learn how to sell and install the equipment warrants some additional explanation. It includes the cost of formal training and the hours of paid productive time that that training would displace, and it includes some on-the-job learning that slows down the installer's efficiency. The up-front training expense could be distributed among many projects if the installer was able to secure more projects, but it is included as a lump sum to capture the viewpoint of the distributor and installer. Especially for self-employed plumbers and small businesses, this is a significant hit if the certainty of generating additional business installing tankless units is not high enough. It goes back to a very fundamental business principle: money is more valuable now than it is later. Accordingly, this captures that aspect to demonstrate the difficulty of overcoming that first-cost hurdle from the trades' perspective as well.

Appendix A includes assumptions used to develop these estimates.

Value Category	Value	Beneficiary					
		Technology Owner	Manufacturer	Distributor	Installer	Residential Customer	Utility
Revenue	Direct Revenue		$12	$49	$353		-$272
Costs	Increased Training			-$320	-$2,400		
	Increased Equipment + Installation Cost					-$951	
Risk Management	Hedge Fuel Price Volatility						
	Less Frequent Replacement						
	Lower Risk of Failure						
	Prepare for Regulatory Change						
	Delay Need for New Capital Expenditure						
Emissions Reductions	Emissions credits to trade (PV)						$55
	Reduce emissions fees						
Policy Incentives	R&D Incentive						
	Federal Income Tax Credit					$300	
	State Income Tax Credit					$340	
	Local Utility Rebate (or Preferential Loan Treatment)					$200	
Reduced Resource Use	Reduce Energy use (PV)					$272	
Corporate Social Responsibility	Competitive Advantage: New Skill Sets						
	Green Marketing Opportunities						
	Increased Staff Retention						
	Improved Stakeholder Relations						
Quantifiable Value		$0	$12	-$271	-$2,047	$162	-$217

Table 1 Quantifying the Total Value Proposition of Natural Gas Tankless Units in Oregon, Assuming New Construction

Moving Forward

The two components of the approach to creating a total value proposition for clean energy technologies demonstrates the importance of identifying points of leverage for all entities in the value chain. The initial checklist approach provides a quick way to identify where gaps in the value chain exist and to identify opportunities to leverage hidden value in a technology.

Other technologies may create environmental benefits for the actors in the value chain that are typically overlooked. The total value proposition framework provides an opportunity to capture those values using a systematic approach. Today, the "green marketing" aspect is perhaps one of the most valuable aspects that falls into this environmental benefits bucket, but it is still difficult to quantify. In cases where electric utilities are part of the value chain, reductions in criteria pollutants and greenhouse gases and fuel price hedging value will be much more visible – and valuable – and can create significant drivers for energy efficient technologies. By positioning the technology to take advantage of those benefits, utility staff, innovators, and policy makers can increase the technology's likelihood of success in the marketplace.

All of the actors that influence the market adoption of a technology can create a total value proposition for a technology or service. Utility staff, federal, state, and local policy makers, and marketers of the technology/service play a critical role in developing incentives to accelerate the market adoption of energy efficient technologies and services. Five steps can help these parties develop effective incentives:

1. ***Map out all of the relevant actors in the value chain*** – from the owner of the intellectual property (e.g., a patent), through to the party that feels the effect of the technology (e.g., students in a school) to the party that pays for the technology (e.g., a school district).
2. ***Determine what benefits each actor is seeking.*** These may include financial benefits, status associated with making a green commitment, the recognition that comes from being a leader in the field, a reduction in the amount of hassle associated with a given technology (such as that caused by sudden failure), a smaller environmental footprint, among others.
3. ***Identify which of these benefits are already in place for each actor in the value chain.*** Account for both the obvious direct financial benefits (including incentives offered by other policy makers) as well as some of the less tangible benefits that may create financial (or emotional) benefits in other ways. Quantify where possible. Understand how this technology performs relative to its competitors.
4. ***Specify the gaps in the value chain.*** Who is not realizing benefit from this technology? What benefits are lacking?
5. ***Develop strategies for filling those gaps.*** Ensure that all market actors recognize adequate incentives for making, selling, installing, using, and enjoying this technology. These strategies may include working with the owner of the technology or the distributor to address the gaps or adjusting the target of direct financial incentives.

These principles are fundamental to marketing any product or service, including energy efficient ones. From the perspective of the firm offering the product or service, this approach can be useful in developing an effective marketing strategy, including the product, price, placement, and promotion. From the perspective of entities developing incentives, this approach can be useful in identifying where those incentives will most effectively accelerate the rate of market adoption. Especially where those gaps are related to increased first costs – first cost of the technology/service or of training required to sell, install, or use it – well-placed incentives can be particularly effective.

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Appendix A: Assumptions underlying calculations

Average annual energy savings: 71 therms
Average cost per therm (in Oregon): $1.54

Calculation of energy cost savings for the consumer took the present value of the annual energy savings for the first three years, applying a discount rate of 10%.

Cost of 50-gallon conventional tank unit: $409 (NEEA)
Cost of 5.3-gallon tankless unit: $672 (average of prices listed on November 30, 2007)

Cost to install conventional tank unit: $275 (NEEA)
Cost to install tankless unit: $575 (based on an interview with a Colorado plumber)

Margins:

	Conventional Unit	Tankless Unit
Manufacturer	50%	30%
Distributor	30%	30%
Installer	25%	25%

CO_2 Emissions rate: 11.62 lb CO_2 per therm
Cost per ton CO_2: $20

Calculation of value of emissions credits to sell assumes a cap-and-trade system and a price of carbon that is on the conservative end of what has been proposed in Congress. The calculation takes the present value of the first 10 years of emissions credits, using an 8% discount rate. It assumes that the emissions accounting is performed at the level of the natural gas utility, rather than at the level of individual households. Since it is not clear what these rules will be, this is simply a placeholder to demonstrate that the value could be counted.