

The Future of Residential Electric Water Heating is Off-Peak

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Introduction

Today, too many American homes continue to fulfill their water heating needs with a poorly-insulated conventional water heater installed at a location far-removed from the homeowner's point of end use. As the result of industry competition and current manufacturing techniques, water heaters are built to last for the length of their warranty, necessitating that virtually the entire installed inventory of residential steel water heaters will need to be replaced every ten years. Historically, energy economics have dictated that natural gas and propane were almost always a cheaper alternative than standard-rate electricity for homeowners to heat their water. In addition, standby losses, combined with little or no pipe insulation, assured that the water heater cycled often and rarely operated at its advertised efficiency.

This white paper explores specific actions that thoughtful electric cooperative program managers can take today to preserve and grow the net revenue potential of home electric water heating loads in ways that create win-win scenarios for the cooperative and its members.

Homeowner Economics

The commonly held wisdom has been that it is always cheaper to heat water with natural gas or propane than electricity. Or, is that an urban myth? Increasingly volatile gas prices are shifting the economics for homeowners in favor of electricity, particularly off-peak electricity. When the comparison includes a non-metallic, super-insulated thermal storage tank with a 50-year design life and a lifetime tank warranty, the lifecycle costs shift even more strongly in favor of off-peak electric water heating.

The economic story can vary, depending on the specifics of the local cooperative's rate structure. However, when managers consider the net effect of existing cooperative incentives for energy efficient equipment and peak load management (including rebates, bill credits and incentive rates), off-peak electric water heating is now almost always the homeowner's least-cost option.

But how would homeowners know? What is the cooperative's message about water heating costs? Has the cooperative examined the operating and lifecycle costs from the customers' perspective lately? If so, have those findings been shared with management and members? Has the cooperative's message been shared with local trade allies – often the primary gatekeepers of water heater sales and installation – such as plumbers, retailers, HVAC contractors and home builders?

Cooperative Reality

Water heater market transformation activities by electric cooperatives have been characterized by programs that give away, rebate or rent the highest efficiency, lifetime warranty electric storage water heaters. These water heaters, when installed prior to a home's initial occupancy or as replacement for a failed tank, have served to secure the residential water heating load. Innovative "all electric" and off-peak rates have also helped to capture this load for many Generation and Transmission (G&T) and distribution cooperatives as well.

The Energy Policy Act of 2005 has provided added urgency for cooperatives to both model and pilot the implementation of Critical Peak Pricing strategies that will give cooperative members additional economic incentive to shift electric water heating to off-peak hours.

Then, there are the emerging regulatory, legislative and societal pressures for cooperatives to link energy efficiency, demand response, and peak load management programs with efforts to help reduce the homeowner's "carbon footprint." It's too early to determine how effective electric cooperatives will be in addressing these emerging "opportunities". For example, managers may want (or be mandated) to determine how best to incorporate renewable energy "green tag" credits and/or

energy efficiency “white tag” credits that will result from these efforts. These credits will further reward the cooperative for encouraging homeowners to install higher efficiency electric thermal storage water heaters that only use electricity produced during designated off-peak hours.

Quantifying Cooperative Value

As cooperatives calculate and communicate the homeowner economics of electric water heating, they should take the additional step to quantify the value of this load to the cooperative as well. Consider the following questions:

1. What is the cooperative’s aggregated kilowatt hour (kWH) and kilowatt (kW) load and the net revenue impact of existing electric water heater saturation without load management?

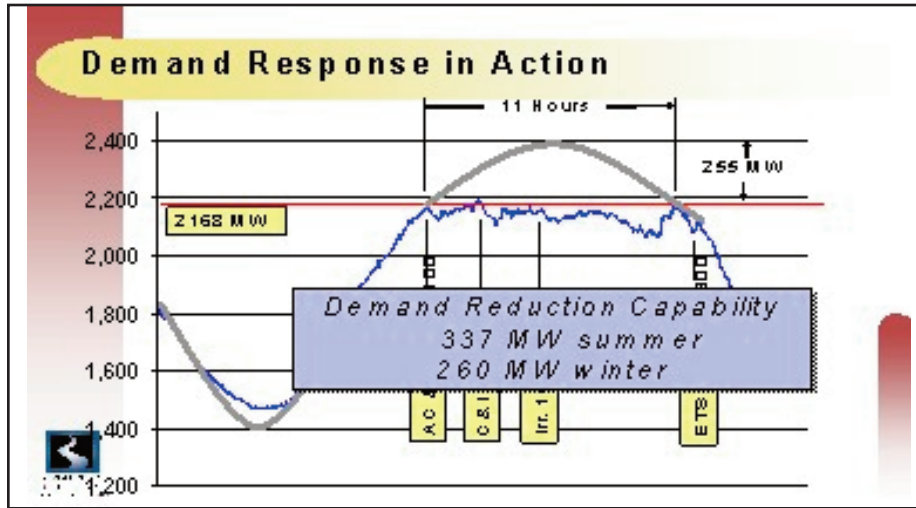


Figure 1: Demand Response in Action, Great River Energy

It is important to determine the gross revenue that the cooperative derives from residential electric water heating relative to the wholesale power purchases to serve this load without load management equipment. Table 1 illustrates the impact of a variety of demand response programs offered by Great River Energy, a G&T based in Minnesota.

Table 1: Comparison of Off-Peak Heating Options for Great River Energy - G&T

	Peak Shave Water Heating	Off-Peak or Electric Thermal Storage	Off-Peak Water Heating
Strategy	Peak Reduction	Valley Filling/ Strategic load growth	Valley filling
Number of Customers	37,800	NA	58,000
Peak Reduction Capability	20 MW	Off-Peak (ETS) water heating and (ETS) space heating	50 MW year round
Reduction Duration	4-8 hours		7 a.m. to 11 p.m.
Availability	Year round; control within 10 minutes is possible		

As the previous table shows, Great River Energy offers a variety of off-peak water heater programs in order to meet the unique needs of their diverse cooperative customers. But it important to note that not all off-peak water heating load

programs are driven at the G&T level. Table 2 summarizes the water heating load control activities conducted by Dairyland Power Cooperative, based in Wisconsin.

Table 2: Summary of Winter and Summer Water Heating Load Control 2005-06 Activities for Dairyland Power Cooperative¹

Month	Number of Hours	Average Duration (minutes)	Number of Events
December	96	20	25
January	27	20	10
February	155	35	39
July	110	20	28

More importantly, these load control activities lead to substantial cost savings, in both power purchases and capacity savings. Table 3 summarizes the value that Dairyland attributes to *all* of its load control programs, not just water heating².

Table 3: Summary of Savings Attributed to Dairyland Load Control Programs

Savings in replacement power	\$1.5 million
Operating reserves	\$1 million
Capacity savings	\$3.3 million

2. *What is the cooperative's existing electric water heating load and net revenue potential in new and existing homes (without load management), at current market saturation levels?*

It is also important for the cooperative to estimate the revenue potential of promoting electric water heating load. Table 4 provides an estimate based on projected annual revenue from each electric water heater of \$356 per unit (see Table 4) and calculated based on the size of the cooperative and its saturation rate for electric water heating.

Table 4: Summary of Water Heating Revenue Potential for Cooperatives and G&Ts³

Annual WH Revenue	\$356	# of Members		
Saturation Rate		10,000	50,000	100,000
25%		2,500	12,500	25,000
50%		5,000	25,000	50,000
75%		7,500	37,500	75,000
Saturation Rate		Water Heater Revenue Potential		
25%		\$890,000	\$4,450,000	\$8,900,000
50%		\$1,780,000	\$8,900,000	\$17,800,000
75%		\$2,670,000	\$13,350,000	\$26,700,000

¹ West, E. NON TRADITIONAL DEMAND RESPONSE ACTIONS - YOU WANT TO CONTROL WHAT!!, Dairyland Power Cooperative Presentation at Distrubtech Feb. 4, 2007

² Calculated based on the load reduction MW x the observed market price* hours of control

³ Based on spreadsheets provided courtesy of Dave Baldwin, Inside Information, Inc. Assumptions are wholesale power costs at \$0.02158/kWh for energy, and \$8.00 per kW/month for demand.

Co-ops that implement a water heater load control program have the potential to reduce their wholesale power costs, primarily by shifting a significant portion of water heater kW demand to off-peak periods. Assuming the co-op's G&T has a coincident billing structure for kW demand, and that the co-op can interrupt the operation of water heaters during the G&T's billable peak demand period, the co-op can then reduce what it pays in wholesale demand costs, and thereby increase overall margins.

Now, consider the financial benefit to the cooperative if 10% of the gas-fired steel tank water heaters being replaced in the service territory every year were to switch to electricity when their standard steel tank leaks. Then add to that number the percentage of new homes now being built which might be convinced to go electric as well. Remember, this percentage needs to be buffered against the homeowner economics and competitive technology options available in the area.

3. *How does the cooperative value this existing and potential electric water heating load change if the cooperative could be assured that it was all off-peak and controlled through a demand response/load control program?*

This valuation exercise helps the cooperative to quantify the investment level that management should make in water heating programs, whether in addressing existing programs and/or developing and implementing new demand response programs. Possible strategies for “reallocating” these dollars to create, enhance or maintain water heating marketing activities include:

- Customer education and enrollment
- Demand response infrastructure additions or enhancements
- Innovative “off-peak” rate incentive additions or enhancements
- Aggressive equipment rebate, rental and give-away programs

If others at the cooperative are already advocating for budget dollars to design and implement smart metering infrastructure, rate innovations and residential marketing initiatives for other reasons, then this water heater load exercise will help reveal internal program alliances that could emerge. The Act provides that each utility “shall provide each customer requesting a time-based rate with a time-based meter capable of enabling the utility and customer to offer and receive such rate, respectively⁴.

Understanding Market Threats

While it is important to quantify the value of promoting electric water heaters, it is equally important to understand the risk of doing nothing. The disruptive threat of tankless water heating technologies is real and growing. It is a worthwhile exercise for cooperatives to consider both the load and revenue impact of homeowners deciding to either replace their current water heater with an instantaneous, tankless water heater (either electric or gas), or to have one (or more) installed in their new home.

According to Progress Energy⁵, electric tankless water heaters are often connected to the electric utility's lines with little understanding of the technology itself or of its potential impact on energy costs. Most homeowners are not knowledgeable of the true cost implications of installing or operating an electric tankless water heater during the electric utility's peak load period.

It is important for cooperatives to help their members understand that tankless water heaters, while promising energy savings, also carry additional costs. Both Progress Energy and the Department of Energy have developed web pages, referenced below, addressing this technology⁶. These resources can assist the cooperative in educating members about tankless water heaters, and/or developing policies that address the installation specifics for the technology.

⁴ The full text of PURPA Section 111(d)(14)

⁵ <http://www.progress-energy.com/custservice/flares/builders/tankless.asp>

⁶ http://www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12820

Cooperatives and their members should be aware that:

- Electric tankless water heaters require a considerable amount of energy to heat water quickly (typically from 12kW to 28kW depending on the type of unit installed).
- The new load of an electric tankless water heater can sometimes equal the load of an entire new home.
- The installation of tankless technology often requires additional gas or electric equipment to be added in order to meet the on-demand requirements of this technology. This can increase the installation costs of tankless water heaters from \$1,300⁷ to \$2,000.
- The cooperative may have to charge additional “impact fees” as a way to offset the increased electric usage (and demand) created by electric tankless water heaters⁸.

Creating The Future

The future belongs to cooperatives who act now to take control of the available water heating loads within their service territories. For example, the potential exists for cooperatives to save program dollars by developing alliances with trade allies and offering incentives to pre-install load control devices on water heaters, according to Dick Preston of Converge, Inc, a leading water heater load control equipment manufacturer.

“The cooperative could use existing trade allies to promote these ‘special water heaters’ which would save on program costs,” Preston explained.

This capability will allow the cooperative to configure the communications link remotely to set targeted timed control without an in-home cooperative staff visit. While some cooperatives rely on simple electromechanical timers to keep water heater loads off-peak, the future may require a different response. For example, cooperatives and G&Ts may have to rely more on a remotely dispatchable communications link with the water heater to control peak power usage or to enable Time-of-Use or critical peak pricing programs. This approach would signal the appropriate number of water heater load control events necessary to “acquire” the energy savings during critical peak occurrences. These type of events in the future are much more likely to be driven by the wholesale power market conditions, transmission/distribution constraints, and other conditions that no longer fit within traditional peak energy time “bins” based on historical weather averages.

What Can Cooperatives Do?

The future belongs to cooperatives who act now to take control of the available water heating loads within their service territories. Those cooperatives that do not engage their members with targeted off-peak water heating programs may suffer the consequences of lost market share and diminished revenue.

continued

⁷ Hewitt, D., Pratt, J. & Smith, G., “Tankless Gas Water Heaters: Oregon Market Status” Developed for the Energy Trust of Oregon, December 6, 2005, pp 20-21.

⁸ <http://www.progress-energy.com/custservice/flares/builders/tankless.asp>

Here are some specific steps that cooperatives can use to create and maintain greater net revenues from residential water heating loads:

1. **Understand the market ... and then begin to build “Mind Share” with members.**

One challenge utility managers will face is in getting members to choose the water heating option offered, will be in establishing the cooperative as the place to get a water heater, or the place to call about water heating options. Buying a replacement water heater is usually an event driven, unplanned purchase. Homeowners generally do not think about replacing their water heater until it leaks and then often turn to a local plumber, home center or farm store, where they know water heaters are traditionally sold. The cooperative needs to build some “Mind Share” with its members, so they do not just do what they have always done. The newsletter, local radio, bill inserts and even brief messages on the back of the bill envelope are cost effective ways to get the message to members. Do not run big expensive ads. Just keep the message out there. It is also important to introduce the local plumbing contractors to the program.

2. **Decide how to run the program: Using utility personnel, or with the help of local contractors.**

The cooperative may decide to develop and run the entire program using its own staff, or it may decide to partner with local plumbing contractors, or local retailers. If the cooperative decides to partner with local trade allies, make sure to communicate with them on a regular basis and build some “mind share” with them as well. Great Lakes Energy in Michigan sells and installs all of the Marathon water heaters in its program through local plumbers and HVAC contractors to ensure that the cooperative has an influential role in the equipment replacement event⁹.

3. **What would happen if large numbers of electric tankless water heaters were installed tomorrow and plan the distribution system upgrade/extension policy accordingly.**

Make sure the cooperative’s distribution line upgrade and extension policy shift the true cost of accommodating the capacity necessary for an electric tankless water heater to the customer making the connection. At least one public power utility has taken the additional step persuading the City Council to limit the impact of electric tankless water heaters installed on municipal lines. The City of Marshall, Minnesota has established the maximum allowable wattage for electric water at 4,500 watts. Any electric water heater with wattage greater than 4,500 watts is subject to a demand charge. This city policy has been in place for over 25 years¹⁰.

4. **Tie today’s water heater equipment incentives to current and future demand response initiatives.**

If the cooperative has a load control program today, consider the incremental value of adding water heater equipment incentives that urge homeowners to install super-insulated tanks that are larger than they might otherwise install to allow for more dispatchable demand response while minimizing customer inconveniences due to interruptions

According to Tom Holt, Member Service & Marketing Supervisor at East River Electric Power Cooperative (G&T) in South Dakota, “Without access to Marathon technology and a rebate structure to support the program, we would not have been able to achieve the peak demand reductions we’ve enjoyed during the 20-plus years this program has been in place. We actually have a few distribution co-ops that have achieved 50% saturation of Marathon water heaters.”

If the cooperative anticipates water heater load control at some future time, then the current water heater incentives should be tied to the installation of a control switch or permission to install a load control device later. This positions the cooperative appropriately to take advantage of future demand response opportunities.

continued

⁹ <http://www.gtlakes.com/electcustsvc/waterheater/MarathonWaterHeaterRebates.cfm>

¹⁰ Personal correspondence with Mark Antony, Energy Services Coordinator, Marshall Municipal Utilities, April 2, 2007.

5. **Develop and implement programs that preserve and/or grow net cooperative revenue from water heating.**

These program types could include:

- **Channel partner promotions and incentives.** Leading cooperatives have determined that “upstream” incentives aimed at plumbers, retailers and home builders may be more effective than simply educating and/or encouraging homeowners to choose high-efficiency thermal-storage electric water heaters tied to cooperative load control or rate incentive programs. These efforts to “deputize” existing marketing channel partners and trade allies to carry the cooperative’s message can result in greater member acceptance and increased credibility compared to only having the electric cooperative alone telling its members that lifetime warranty electric water heaters are a better deal.
- **Load management promotion and incentives.** Some G&Ts like East River Electric Power Cooperative have enjoyed the system wide benefits of water heater load control programs for over 20 years. Others are discovering that new rate signals from their wholesale provider and smart meter infrastructure upgrades are dovetailing to offer new opportunities to initiate water heating load control programs. The incentives are structured to share power cost savings with load control participants through bill credits or innovative off-peak rate offerings.
- **Direct sales and rentals.** Cooperatives like Great Lakes Energy in Michigan are selling directly higher efficiency water heaters like the Marathon Water Heaters because they are not otherwise commercially available in the cooperative service territory. Often these equipment sales are bundled with installation by a local plumber or HVAC contractor who is happy to partner with the cooperative because he earns a competitive installation labor rate without having to incur any marketing costs. Other cooperatives offer their members a high efficiency electric water heater installed by a local plumber with no upfront cost but rather a modest \$15 monthly rental fee collected on the cooperative bill or billed by a third party, such as a turnkey rental program provider like America’s Water Heater Rentals. This is especially appealing to vacation homeowners and landlords who appreciate that the rental fee includes all repairs and maintenance visits.
- **Green Program integration opportunities.** Solar hot water, solar net metering, geothermal heat pump and green building programs are just a few examples of ancillary cooperative-sponsored programs that can integrate water heater program components to leverage opportunities across multiple cooperative program initiatives. Progressive cooperatives like Valley Electric Association in Pahrump, Nevada are seeing increased customer adoption of higher efficiency electric water heaters as an indirect result of efforts to promote related renewable energy programs.

Conclusion

The fundamental structure of the residential water heating market is changing, providing additional incentives for co-ops to incorporate both energy efficiency and demand response into their water heater program offerings. Competitive market pressures, rising energy costs, and environmental constraints now require that cooperatives develop a proactive, rather than a reactive, market presence. Off-peak water heating programs, which allow electric cooperatives to manage peak demand while enabling members to reduce their water heating costs, provide the ideal opportunity to achieve strategic demand response and load management objectives. It is essential to remember that off-peak water heating initiatives, when carefully designed and aggressively deployed, have the potential to transform the local water heating marketplace, for the benefit of those parties with the strongest, long-term financial interest -- the electric cooperative and its members.

To Learn More

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Market Development Group delivers high-energy marketing program strategies and tactics designed to achieve the cooperative's strategic base and peak energy load objectives. We also work with energy organizations and their allies to design, develop and deliver innovative marketing plans and programs. Visit www.marketdevelop.com

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Great River Energy, headquartered in Elk River, MN., is the second largest electric utility in the state, based on generating capacity, and the fourth largest generation and transmission (G&T) cooperative in the U.S. in terms of assets. It provides wholesale electric service to 28 distribution cooperatives in Minnesota and Wisconsin. Those member cooperatives distribute electricity to approximately 600,000 homes, businesses and farms. Visit www.greatriverenergy.com

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With headquarters in La Crosse, WI., Dairyland Power is a generation and transmission cooperative that provides the wholesale electrical requirements for 25 electric distribution cooperatives and 19 municipal utilities in 62 counties in Wisconsin, Minnesota, Iowa, and Illinois.

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Marathon Water Heaters is a manufacturer of non-metallic, lifetime warranty, thermal-storage electric water heaters with the highest efficiency ratings in the industry. Marathon has active programs with over 250 distribution and G&T cooperatives across the country.

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Formed in 1995, Inside Information has provided customer surveying, data collection and database target marketing services for more than 100 cooperatives in 28 states. One of the key advantages that Inside Information offers is the experience of a group of former electric cooperative marketing personnel, who are on staff and provide the primary services to clients. Inside Information is based in the Kansas City area, and is responsible for the development and administration of customer research, database marketing, Internet marketing services, and employee surveys for utility clients.