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Tariffed On-Bill Financing Feasibility

Assessment of Innovative Financing Structures For Minnesota

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Energy Transition Lab
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CADMUS

Contents

List of Acronyms

AC	Air Conditioner
AFUE	Annual Fuel Utilization Efficiency
ASHP	Air Source Heat Pump
BC	Benefit-Cost
BCA	Benefit-Cost Analysis
CAC	Central Air Conditioner
CFM50	Cubic feet per minute at fifty pascals of pressure
CIP	Conservation Improvement Programs
COP	Coefficient of Performance
EER	Energy Efficiency Ratio
EF	Energy Factor
FTE	Full-Time Employee
GSHP	Ground Source Heat Pump
HPWH	Heat Pump Water Heater
HSPF	Heating Seasonal Performance Factor
HVAC	Heating, Ventilation, and Air Conditioning
IOU	Investor-Owned Utility
LED	Light-Emitting Diode
LMI	Low and Moderate Income
NEEP	Northeast Energy Efficiency Partnership
OBF	On-Bill Financing
OBR	On-Bill Recovery
PAYS	Pay As You Save
PCT	Participant Cost Test
PV	Photovoltaic
RIM	Ratepayer Impact Measure
SCT	Societal Cost Test
SEER	Seasonal Energy Efficiency Ratio
TOB	Tariffed On-Bill
TRM	Technical Reference Manual
UEF	Uniform Energy Factor
UCT	Utility Cost Test
WACC	Weighted Average Cost of Capital

Introduction to Tariffed On-Bill Financing

Study Background

This study assesses the economic feasibility of *Tariffed On-Bill (TOB)* financing, an inclusive financing approach for home energy upgrades. TOB has been implemented as a tool to expand access to home energy upgrades in numerous utility jurisdictions nationwide, but not previously in Minnesota. Loan-based on-bill financing programs have been implemented in Minnesota and have strong precedent among Investor-Owned Utilities nation-wide, though TOB is distinct from these offerings in several key aspects. The purpose of this effort is to draw on the best available information from prior TOB programs implemented in other jurisdictions, as well as the wealth of energy planning information available and regularly used in Minnesota, to assess the feasibility of TOB in Minnesota. This study primarily considers economic and financial elements of program feasibility, though it also serves to catalogue key policy and regulatory items that were flagged by working group participants and which must be addressed in any future program design process.

This assessment was conducted on behalf of the Energy Transition Lab at the University of Minnesota's Institute on the Environment, with major funding from the City of Minneapolis and the Institute for Local Self-Reliance, and financial support from Xcel Energy, the Marcy-Holmes Neighborhood Association, and the City of Warren. As the convener of the study, University of Minnesota staff assembled a broad group of stakeholders to serve as an advisory working group, which represented the perspectives of utilities, state and local government, energy efficiency program implementers, community organizations, and others. A full list of advisory working group members is provided in Appendix 1.

What Is Tariffed On-Bill Financing?

On-bill financing is an established tool to make financing for energy improvements available to utility customers. In a traditional on-bill loan program, a utility customer borrows funds for an energy improvement, and the utility bill serves as the vehicle for collecting loan payments. Traditional loan-based on-bill programs are sometimes divided into two categories:[1]

- **On-Bill Repayment (OBR):** In an OBR program, a customer receives a loan from a third-party lender (such as a bank or credit union), and the utility acts as an intermediary to collect payment on its utility bill. The utility passes on the collected loan payments to the lending party.

[1] Various sources offer differing opinions of whether on-bill tariffs are a subset of or a separate program design from on-bill financing. This document borrows from and follows the terminology used by the *American Council for an Energy-Efficient Economy (ACEEE)* in their overview of on-bill energy efficiency, available at: https://aceee.org/sector/state-policy/toolkit/on-bill-financing

- **On-Bill Financing (OBF):** In an OBF program, the utility itself serves as the lender.[2]

Various forms of on-bill financing have been implemented since the 1970s, and today more than 100 utility jurisdictions nationwide offer some form of on-bill financing.[3] On-bill loan programs can have several advantages for customers, including:

- The **potential for lower default rates**, as customers are assumed to be likely to pay their utility bills (which may result in lower loan program interest rates than a comparable off-bill program).
- The potential to use **alternative credit standards** in lieu of traditional credit scores, such as history of utility bill payment, to broaden program eligibility.
- **Simplicity**, as customers receive only one combined bill for energy and financing payments.

In contrast to traditional loan-based offerings, this study specifically assesses *tariffed on-bill* (TOB) programs.[4] The key distinction in a TOB program is that it is structured as a utility investment that is recovered via a tariffed charge paid by the recipient utility customer, rather than a loan made to and repaid by that customer. The upfront capital in this case may be provided by the utility directly, or it may be arranged via a financing partner. The tariffed nature of TOB has several implications, including:

- The tariffed recovery of utility investment costs is treated as a full component of the customer utility bill, and normal utility procedures would apply in the case of non-payment.
- The tariffed charge is tied to a billing location, rather than a specific customer. If a customer were to move, the tariffed cost recovery charges would apply automatically to the next occupant of that site.

Most TOB programs in place today are based on the *Pay As You Save® (PAYS®)* system developed by Energy Efficiency Institute, Inc. and licensed to implementing utilities.[5] PAYS programs are designed with strict cost-effectiveness criteria regarding tariffed investments. Generally, the tariffed investment in a PAYS program must be able to be repaid via a monthly cost recovery charge that does not exceed 80% of expected average first-year energy savings, and that persists for a maximum of 80% of the expected useful life of the installed energy upgrades. The utility typically recovers its cost of capital through these

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[2] Note that, while this distinction is sometimes used to differentiate program capital sources or program design partnership, the use of the term "Tariffed On-Bill Financing" in this report is not intended to imply that the utility would provide the source of capital, and several options for capital source are included in this analysis.

[3] The Environmental and Energy Study Institute (EESI) has developed a map of existing OBF programs, available at: https://www.eesi.org/obf/map

[4] A broader discussion of the differences between tariff-based and loan-based on-bill programs is provided in a 2018 ACEEE Summer Study paper on the topic, available at: https://aceee.org/files/proceedings/2018/node_modules/pdfjs-dist-viewer-min/build/minified/web/viewer.html?file=../../../../../assets/attachments/0194_0286_000158.pdf

[5] While this assessment considers the feasibility of tariffed on-bill financing as a general concept, all of the existing TOB programs that are reference in this study utilize the PAYS system, and PAYS is the primary method of implementing a TOB program.

payments as well. In cases where expected cost recovery payments are not sufficient to fully finance installed energy upgrades, the customer may contribute an upfront co-payment that reduces the cost of the investment to a level that may be financed according to PAYS' cost-effectiveness criteria.

Tariffed on-bill financing, and PAYS specifically, is often considered an *inclusive financing* approach because it is designed to be accessible to customer segments that typically face barriers to participation in energy efficiency programs. Unlike many loan-based on-bill programs, TOB programs do not involve consumer credit, and as a result, they do not require minimum credit scores or forms of security. This makes the programs accessible to low-and-moderate income (LMI) residents and parties that may be deemed to have too high a credit risk by lenders. Renters are also generally eligible to participate in a TOB program using the PAYS system—because the cost recovery charge is tied to the location rather than the customer. Also, as the cost recovery charge at each location is set at a level below expected customer energy savings, any new occupant in a location that has received a TOB upgrades would experience net benefits as a result of the upgrade.

Key Tasks and Questions Answered

This assessment considers the feasibility of tariffed on-bill programs to serve utility customers in Minnesota, with particular interest in its feasibility for LMI and rental households.

This assessment includes four primary components:

- **Customer Segmentation.** As TOB programs provide particular benefits for market segments that face barriers to participating in rebate and loan-based energy efficiency programs (such as LMI households and renters), this analysis considers whether and how the housing stock of these customer segments may differ from statewide housing stock, as well as the program design implications of any differences.
- **Measure Screening.** This section assesses the feasibility of a range of home energy upgrades for TOB financing, conducted from the perspective of potential program participants.
- **Program Benchmarking**. This section compiles information on program participation and administrative costs from prior TOB programs, as well as from loan-based on-bill programs implemented by investor-owned utilities.
- **Benefit-Cost Analysis.** This section assesses the costs and benefits of a potential TOB program in Minnesota according to standard metrics of energy efficiency cost-effectiveness.

In addition to these primary components, this assessment includes a brief discussion of various policy and regulatory issues that were identified by stakeholders during this process, and which must be addressed during any program design process. Additionally, an appendix to this report includes a discussion of the policy and law considerations of a TOB program in Minnesota, in response to a request by the Energy Transition Lab and the Minnesota Department of Commerce.

Characterizing Key Customer Segments

As an inclusive financing program, TOB is often advanced as a solution to financing barriers for home energy programs. Notably, TOB is offered as a solution for LMI households and renters, which can face barriers to participation in existing energy efficiency programs.

LMI households may face difficulties participating in rebate-based programs due to remaining upfront cost requirements, and may also have difficulty satisfying eligibility requirements for loan-based programs. While grant-based programs, such as the low-income energy efficiency programs operated by Minnesota's IOUs, are often available for income-qualified residents, eligibility thresholds may exclude moderate-income families that still face barriers related to upfront cost and access to capital. Rental households face barriers to participation due to *split incentives* between landlords and tenants, where neither party is motivated to invest in home energy improvements (property owners because they do not directly benefit from energy reductions, and tenants because they may not expect to reside in the property long enough to recoup investments). Renters are also often ineligible to participate in energy financing programs.

As a TOB program may be designed either implicitly or explicitly with LMI and rental households in mind, this section aims to understand the characteristics of the building stock of these customer segments in Minnesota, in comparison to overall housing stock statewide and by region.

This analysis uses data from the US Census Bureau's 2017 American Community Survey 5-year estimates.[6] The data was analyzed separately by the three regional climate zones used in Minnesota's Conservation Improvement Programs, as well as for the cities of Minneapolis and St. Paul (which are also represented within the southern Climate Zone 3) due to stakeholder interest. These climate zones are shown in Figure 1.

[6] Data available at https://factfinder.census.gov. PUMA-level microdata was downloaded and analyzed to develop the cross-tabulations shown in this analysis.

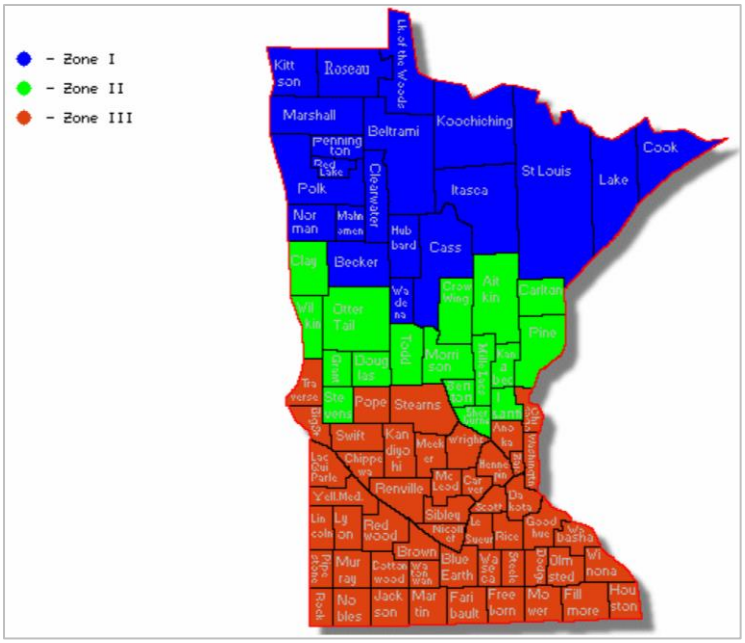

Figure 1. Minnesota Climate Zones (Minnesota Technical Reference Manual)

Size of Customer Segments

Within each region, households were coded based on whether household income was at least 80% of the Area Median Income (as defined by HUD), which served as the threshold for determining LMI status.

Statewide, 50% of households qualify as low-to-moderate income, and 28% are rental households. Regionally, the rental population is far greater in the Twin Cities (51%) than the state as a whole. The share of LMI households is generally consistent across regions as this analysis bases LMI status on local area median income.

Table 1. Share of LMI and Rental Households by Region

Region	North	Central	South	Twin Cities	Statewide
Total Households	258,048	366,993	1,757,804	303,307	2,382,845
Percent LMI	55%	52%	50%	46%	50%
Percent Rental	26%	20%	29%	51%	28%
Percent LMI and Rental	22%	16%	22%	33%	21%

Heating Fuel Distribution

Heating fuel can dramatically affect the economics of home energy upgrades. Natural gas is typically the most affordable means of residential heat and is disproportionately found in urban areas and town centers. Electric resistance heat is disproportionately found in multi-family housing in Minnesota, while propane heat and other less common heating sources like fuel oil and wood are disproportionately found in rural areas. Households that are not heated with gas heat may have greater opportunities for cost-effective energy improvements.

Statewide, two-thirds of households are heated by natural gas, with electricity and propane accounting for most of the remainder. Regionally, natural gas use is much higher in southern Minnesota and the Twin Cities specifically, and propane is disproportionately common in northern and central Minnesota. Generally, it is expected that more densely populated areas will have a greater share of gas heat, and rural areas will have greater shares of propane heat, though this granularity is not captured by the regional statistics provided below. LMI and rental households tend to have higher rates of electric heat than the state as a whole.

Table 2. Home Heating Fuel Mix by Region and Customer Segment

Household Type	Heating Fuel	North	Central	South	Twin Cities	Statewide
All	Utility Gas	38%	42%	73%	75%	66%
	Electricity	25%	19%	16%	20%	17%
	Propane	19%	25%	7%	2%	10%
	Fuel Oil	8%	4%	1%	0%	2%
	Wood	6%	8%	1%	0%	2%
	Other	3%	2%	2%	2%	2%
LMI	Utility Gas	37%	40%	68%	67%	61%
	Electricity	27%	22%	21%	28%	22%
	Propane	17%	23%	6%	2%	10%
	Fuel Oil	9%	5%	1%	0%	2%
	Wood	5%	8%	1%	0%	2%
	Other	4%	2%	3%	3%	3%
Rented	Utility Gas	38%	41%	58%	62%	55%
	Electricity	41%	39%	34%	32%	35%
	Propane	9%	11%	3%	2%	4%
	Fuel Oil	3%	3%	1%	0%	1%
	Wood	1%	1%	0%	0%	0%
	Other	7%	4%	4%	4%	4%
LMI and Rented	Utility Gas	38%	40%	55%	59%	52%
	Electricity	42%	41%	36%	35%	37%
	Propane	8%	10%	3%	2%	4%
	Fuel Oil	3%	2%	1%	0%	1%
	Wood	1%	1%	0%	0%	0%
	Other	8%	4%	5%	4%	5%

Building Type Distribution

Statewide, three-quarters of households are single-family homes, and this number drops to 50% in the Twin Cities. Both LMI households and (especially) renters are substantially more likely to reside in multi-family housing than the state population as a whole. In the Twin Cities, two thirds of LMI households and more than 80% of renters reside in multifamily housing.

This difference in building stock can have implications for energy efficiency program delivery. While many existing energy efficiency offerings are available to residents in either single-family or multi-family

housing, participation can be considerably more complicated for multi-family residents. As a result, many utilities, including Xcel and CenterPoint, have developed dedicated programs for multi-family buildings.

Table 3. Building Type Distribution by Region and Customer Segment

Household Type	Building Size	North	Central	South	Twin Cities	Statewide
All	Single Family	76%	83%	73%	50%	75%
	2-4 Unit	5%	2%	5%	12%	4%
	5+ Unit	12%	8%	20%	37%	17%
	Mobile Home	7%	8%	2%	0%	3%
LMI	Single Family	63%	71%	59%	32%	61%
	2-4 Unit	8%	4%	6%	14%	6%
	5+ Unit	21%	16%	32%	53%	29%
	Mobile Home	9%	9%	3%	0%	4%
Rented	Single Family	29%	39%	26%	17%	27%
	2-4 Unit	17%	13%	12%	18%	13%
	5+ Unit	50%	44%	61%	64%	59%
	Mobile Home	4%	4%	1%	0%	1%
LMI and Rented	Single Family	26%	34%	21%	14%	23%
	2-4 Unit	17%	13%	12%	17%	12%
	5+ Unit	53%	49%	66%	69%	63%
	Mobile Home	4%	4%	1%	0%	2%

Discussion

Compared to the state housing stock as a whole, the LMI and rented households are less likely to have gas heat (though this still represents a majority market share in all cases), and are more likely to reside in multifamily housing.

This may have implications for a potential TOB program. Outreach and marketing for several past TOB programs have either explicitly or implicitly targeted homes with high energy costs and consumption. Based on the cost of different heating fuels, households that utilize electric or propane heat may have a greater opportunity for cost-effective energy savings than those that utilize gas heat. Regarding building size, a program offering that accommodates multi-family housing would be critical to serve LMI and rented households in Minnesota, and especially in the Twin Cities.

Home Energy Efficiency Measure Screening

This section assesses the participant opportunity for accessing a range of home energy improvements through a tariffed on-bill program. Cadmus conducted a measure screening analysis to identify measure types and customer segments where TOB could be financially viable for participants.

Based on the feedback and request of the stakeholder working group, this analysis was not limited to current energy efficiency program offerings available through utility Conservation Improvement Programs (CIPs), but also included applications that are not currently offered in the CIP, such as fuel-switching measures and installations that target propane heat. In including these measures and applications in the analysis, Cadmus does not offer any commentary on their viability from a program design perspective, but provides the results of the analysis based on stakeholder request to demonstrate and catalog the range of use cases where TOB may be financially viable for participants.

This analysis is designed to identify applications where TOB satisfies the following criteria:

- **The energy upgrade is cost effective for the customer** as indicated by passing the Participant Cost Test in a scenario where no financing is offered (that is, the measure must represent a cost-effective energy improvement for the customer).
- **After TOB financing, the customer is left with a reasonable copayment.** This analysis treats this as a scenario where the a TOB program accounts for either (A) at least 70% of the *total* installed cost with a resulting copayment of $1000 or less or (B) at least 80% of the *incremental* installed cost compared to the baseline equipment with an incremental customer upfront cost of less than $200. [7]

In all cases, consistent with standard practices in TOB programs, this analysis assumed that participant cost recovery payments would be capped at 80% of expected annual energy savings (calculated on an all-fuels basis) and the cost recovery period limited to 80% of the expected useful life of the installed measures. The analysis assumed that any rebates currently available to utility customer in these jurisdictions would be made available to TOB program participants as well.

Measure Selection

In current TOB programs, measures installed at each site are determined on a case-by-case basis. In a pre-installation audit, a program contractor will identify a package of measures that provides the greatest energy savings for a customer while requiring either no co-payment or a manageable co-payment. Generally, most participants in TOB programs have installed a suite of home envelope measures (such as insulation and air sealing), often in combination with a heating or cooling system. In TOB programs in the southeastern US where information is most readily available, air source heat

[7] Measures were evaluated on the basis of financing a portion of the incremental cost at the request of the stakeholder working group. This could reflect a scenario, for example, where a participant's heating system fails and the customer must purchase a new system, and TOB financing is used to mitigate the incremental upfront cost between a standard heating system replacement and a high-efficiency heating installation.

pumps have been a dominant heating and cooling installation type. A suite of additional smaller and highly cost-effective measures, such as LED lighting and low-flow showerheads, are often incorporated into the installation package as well.

In this analysis, the list of measures included in existing Conservation Improvement Programs in Minnesota was used as the starting point to develop a measure list. This list was filtered to remove measures that are not typically permanently installed in a home (such as room air conditioners), and was further modified based on stakeholder input.

The resulting list of measures is shown in Table 4 below. A select group of space heating and water heating equipment measures were also evaluated as part of an installation package that also included a package of small measures and a home envelope upgrade.[8]

Table 4. List of Measures Included in Screening

Category	Measure
Home Envelope	Attic/Ceiling Insulation + Air Sealing
	Wall Insulation
Space Heating and Cooling	Air Source Heat Pump [a]
	Ground Source Heat Pump
	Ductless Minisplit [a]
	Furnace [a]
	Boiler
	Central Air Conditioner
Water Heat	Heat Pump Water Heater [a]
	Gas Tank Water Heater [a]
	Gas Tankless Water Heater
Appliances	Clothes Washer
	Clothes Dryer
	Refrigerator
Other	Solar Photovoltaic [b]
	Multifamily Whole Home Upgrade [c]

[a] Also evaluated in combination with small package and home envelope bundle.

[b] Modelled separately with and without federal Investment Tax Credit, and in the case of Xcel with and without income-based upfront incentive.

[c] Assumed a whole-building upgrade based on Xcel CIP.

Analysis Scenarios

Based on stakeholder feedback, measures were evaluated across a number of modeling scenarios. Cadmus prioritized responsiveness to stakeholder working group requests in developing this list of scenarios, and not all scenarios have been vetted for feasibility (for example, the availability of low-cost

[8] The bundled home envelope upgrade included attic insulation, air sealing, and wall insulation.

financing through institutional partnerships, and assumptions regarding below-average levels of attic or ceiling insulation). These following inputs were subject to scenario analysis:

- **Utility jurisdiction.** The analysis was conducted separately for customers of five Minnesota utilities: Xcel Energy (gas and electricity), CenterPoint (gas), Minnesota Power (electricity), East Central Energy (electricity), and the City of Warren (gas and electricity). Inputs regarding retail energy prices, utility avoided costs, state climate zone, and available rebates were customized to each utility.[9]
- **Heating Fuel.** Home envelope and potential fuel-switching measures were assessed for homes served by each of Minnesota's three primary heating fuels (gas, electricity, and propane). Clothes washers and dryers were evaluated for both gas and electricity.
- **Existing Insulation Levels.** At stakeholder working group request, the existing level of ceiling and wall insulation was subject to scenario analysis, assuming both a standard level of existing insulation (based on utility CIP programs) and a below-average level of insulation.[10]
- **Current Gas Price.** At stakeholder working group request, a scenario with high gas prices was included in the analysis.[11]
- **Participation Rates.** As discussed in the below section on program benchmarking, Cadmus developed a base projection of program participation based on prior TOB programs and Minnesota loan-based OBF program planning assumptions. At stakeholder request, Cadmus also developed a second scenario that assumed higher participation levels.
- **Program Cost of Capital and Funding Source.** At stakeholder request, four different potential program funding sources were included in the analysis, each with a corresponding program cost of capital. These included a capital scenario that assumes that financing would be available from commercial capital providers at a similar rate as current loan-based program offerings in Minnesota, a scenario where this private capital is subsidized to provide zero-interest financing to program participants, a scenario where low-cost capital is available via a partnership with an

[9] East Central Energy was not able to provide wholesale energy cost information for this study. As a result, only participant measure screening results are provided for ECE, not benefit-cost results (which include the calculation of utility avoided energy costs).

[10] Existing wall insulation variants were R-5 (CenterPoint CIP planning value) and R-0.9 (CenterPoint 2018 program average). Existing attic insulation variants were R-17 (Xcel CIP planning value) and R-10 (low end of the range of CenterPoint 2018 data).

[11] Default gas prices are based on 2017-2019 utility CIPs and include a 4% annual escalation factor. As cost recovery is based on first-year energy savings, stakeholders requested that the scenario analysis consider how a change in gas prices may impact the financeable amount. To accommodate this request, a hypothetical scenario was developed that increased the first-year gas price by 50%. To avoid overly inflating gas prices, prices were held flat over time in this scenario and not inflated, as the objective of this scenario is only to demonstrate the impact of fluctuating gas prices on the financeable portion of an energy upgrade (which is a function of first-year energy savings rather than lifetime savings).

institutional partner, and a scenario where the weighted average of utility capital sources was utilized as a funding source.[12] The funding sources and costs of capital included in this analysis are described in Table 5.

Table 5. Funding Source and Cost of Capital Scenarios

Scenario	Source Cost of Capital	Cost of Capital Subsidy	Participant Cost of Capital	Reference Example
Market-Rate	4.99%	0.00%	4.99%	Minnesota Home Energy Loan Program
Zero-Interest	4.99%	4.99%	0.00%	Massachusetts HEAT Loan
Institutional Capital	2.50%	0.00%	2.50%	Stakeholder-suggested value[13]
Utility Commercial	9.05%	0.00%	9.05%	Utility pre-tax WACC

Across all scenarios, this analysis assumes that a program loss reserve of 1% is established to mitigate the risk of any potential customer charge-offs or missed payments, which is greater than the percentage of uncollectable investments reported by PAYS programs to date.[14] This analysis treats this loss reserve as a utility cost, though in some prior programs it has been incorporated into the tariffed cost recovery of program participants.

Measure Installation Assumptions

The measure screening analysis sought to identify measures and packages of measures that could be financed, in full or in part, through a TOB program. Generally, measure costs and savings estimates relied on utility CIPs and the Minnesota Technical Reference Manual (TRM)[15] to the greatest extent possible, supported by outside data as needed to fill gaps. However, as the analysis was conducted for five utilities located across the state, with inputs and assumptions drawn from multiple utility CIPs and from the TRM, it was not possible to fully replicate the inputs and assumptions of any single source. Additionally, at the request of the stakeholder working group, this analysis included assumptions that would be appropriate for poorly-insulated or high-consumption homes (as it is assumed that TOB financing would be particularly beneficial for these households) as well as average-consumption homes. As a result, the inputs used in this analysis are generally representative of Minnesota planning values,

[12] Participating utility stakeholders suggested that the pre-tax weighted average cost of capital (WACC) be used in this scenario.

[13] Stakeholder working group members advanced the possibility of partnering with the Saint Paul Port Authority or other governmental or institutional partners to provide low-cost sources of program capital, and suggested a range of 2% to 3% be used as the cost of capital in this scenario.

[14] Clean Energy Works and Energy Efficiency Institute, Inc. 2018 ACEEE Summer Study, available at: https://aceee.org/files/proceedings/2018/node_modules/pdfjs-dist-viewer-min/build/minified/web/viewer.html?file=../../../../../assets/attachments/0194_0286_000158.pdf

[15] As the utility planning assumptions provided for this analysis were from 2017-2019 CIPs, the corresponding TRM version was used in this analysis to maintain consistency.

but will not replicate CIP planning values exactly and are not intended to stand in the place of CIP planning assumptions.

The following planning assumptions were used for the measures included in this analysis. More detailed energy input assumptions (including energy savings, cost, and expected useful life metrics) are included along with sourcing assumptions in an accompanying analysis file that has been distributed to the stakeholder working group.

Table 6. Assumptions for Efficient and Baseline Installations

Measure	Efficient Installation Assumptions	Baseline Installation Assumptions
Attic/Ceiling Insulation + Air Sealing[16]	R-49 attic/ceiling insulation with ΔCFM50 of 513 (CenterPoint 2018 program average)	Existing R-17 insulation for average homes, and R-10 insulation for poorly insulated homes (plus R-2.37 for attic assembly)
Wall Insulation[17]	R-14 wall insulation	Existing R-5 insulation for average homes, and R-0.9 insulation for poorly insulated homes (plus R-2.37 for wall assembly)
Air Source Heat Pump[18]	10.5 HSPF / 19.2 SEER installation, consistent with NEEP cold climate ASHP database average;[19] assumed that system will use the existing heating system as backup	Displacing existing electric resistance heat or 80% AFUE furnace, and SEER 13 AC

[16] When evaluated as a stand-alone measure, envelope measure savings calculations assume a baseline of 13 SEER AC and either electric resistance heat or an 80% furnace depending on fuel type. When evaluated in as a measure package in combination with heating or cooling equipment measures, savings calculations reflect the efficiency of the installed equipment to account for interaction.

[17] Wall insulation was assessed as a standalone measure rather than in combination with air sealing for consistency with available utility program planning assumptions.

[18] This analysis assumes the installation of a cold climate ASHP in a home with existing ductwork. As the calculation of energy savings assumes that an ASHP would deliver the same amount of useful heat as the displaced equipment, it is necessary to apply a derating factor to an ASHP's heating efficiency that reflects Minnesota's cold climate. There is no such value included in the Minnesota TRM as the TRM only compares the energy savings of an efficient ASHP to the purchase of a baseline ASHP (which is not a relevant use case in this study). As a proxy and simplifying assumption, an adjustment factor of 63.53% (sourced from the New York TRM) is applied to the ASHP heating efficiency.

[19] As this assessment assumes the installation of an ASHP rated for cold-weather performance, unit efficiencies were based on the units meeting the NEEP cold-climate ASHP product specification. It should be noted that these efficiencies are greater than the efficiency values typically assumed in CIP planning, which assume a non-cold-climate ASHP replacing a standard efficiency ASHP (as discussed above, this analysis assumed the installation of a cold climate unit to allow for a more direct comparison of ASHP heating and thermal or electric resistance heating in Minnesota's climate). The average efficiency of NEEP-qualified units is used in this analysis, and 90% of listed NEEP-listed cold-climate ASHP units exceed 10 HSPF and 18 SEER. In practice based on the characteristics of the home, a lower-efficiency installation may be appropriate.

Measure	Efficient Installation Assumptions	Baseline Installation Assumptions
Ground Source Heat Pump[20]	4.15 COP / 23.3 EER GSHP (average of Massachusetts GSHP rebate data)	Replacing existing electric resistance heat or 80% AFUE furnace, and SEER 13 AC
Ductless Minisplit[21]	10.5 HSPF / 21.3 SEER installation, based on Xcel CIP assumptions; assumed that system will serve partial load only and use the existing heating system as backup	Displacing existing electric resistance heat or 80% AFUE furnace, and SEER 13 AC
Furnace	95% AFUE furnace	Replacing 80% AFUE furnace
Boiler	91% AFUE boiler	Replacing 80% AFUE boiler
Central Air Conditioner	16 SEER central air conditioner	13 (and 10) SEER central air conditioner[22]
Heat Pump Water Heater[23]	2.56 EF HPWH	Replacing 50-gallon tank water heater (calculated as 0.945 EF for electric and 0.575 EF for gas per MN TRM)
Gas Tank Water Heater	0.67 EF water heater	Replacing 50-gallon tank water heater (calculated as 0.575 EF per MN TRM)
Gas Tankless Water Heater	0.90 EF water heater	Assuming baseline tank water heater
Clothes Washer	ENERGY STAR unit	Standard unit
Clothes Dryer	ENERGY STAR unit	Standard unit
Refrigerator	ENERGY STAR unit	Standard unit
Solar Photovoltaic	5 kW rooftop system	No solar installation
Multifamily Whole Home Upgrade	Custom upgrade based on Xcel CIP planning assumptions	Average existing multifamily building

[20] GSHP COP and EER values are converted to seasonal factors using the factors provided in the Minnesota TRM.

[21] The heating efficiency of a ductless mini-split is de-rated in the same manner as an ASHP as described above.

[22] The analysis separately considered financing the full cost a new CAC with the energy savings relative to an existing 10 SEER unit (assumed to be a home's existing equipment) and financing the incremental cost of a new CAC with the energy savings relative to a new 13 SEER unit (assumed to be the baseline efficiency of a new CAC). Due to the short cooling season in Minnesota, the choice of baseline SEER had only a marginal impact on results, and so for simplicity this analysis only reports the variant with a 13 SEER baseline (chosen to align with utility planning assumptions).

[23] This analysis used EF rather than UEF as the basis for water heater efficiency to maintain consistency with utility planning assumptions available in 2017-2019 Triennial Plans. The methodology in the Minnesota TRM has since been updated to use UEF as the metric of water heater efficiency.

Measure	Efficient Installation Assumptions	Baseline Installation Assumptions
Small Measure Package[24]	Direct Install package of one low-flow showerhead, two faucet aerators, a water heater blanker, and four LED lights	N/A

To calculate energy cost savings, retail rates were developed from a range of sources. Natural gas retail rates were sourced from utility CIPs. Electricity retail rates were calculated for each affected end use based on utility tariff sheets. In cases where retail rates varied by season or consumption tier, a weighted average estimate was developed for each application using end-use specific hourly load profiles available from the US Department of Energy. Both Xcel and the City of Warren offer separate rates for customers with electric heat, and this was accounted for in the analysis of measures assessed in electric-heated homes.[25] Both gas and electric retail rates were adjusted to account for volumetric rate riders charged by each utility. Local taxes were not included in the retail rates as a conservative assumption, as it was assumed that tariffed cost recovery charges would be subject to these taxes as well.[26] Propane retail prices were sourced from US Energy Information Administration data.

Detailed Measure Screening Results

In the below tables, key output metrics are provided for measures across a range of modelling scenarios. These detailed tables are followed by a discussion of the results.

Each of the detailed output tables includes the following output metrics for a given measure and scenario, and additional detailed measure information is available in an accompanying analysis file that has been distributed to the stakeholder working group:

- **Post-Rebate Cost.** This value reflects the full installed cost of the measure or package of measures, minus the value of any available upfront rebates or tax incentives.
- **First-Year Savings.** This value reflects the total first-year bill savings that the customer is expected to experience. In the case of fuel-switching or multiple-fuel measures, this sums the energy savings of different customer fuels.
- **Financeable Amount.** This value presents the portion of the upfront cost that may be financed through a TOB program (based on cost recovery payments of up to 80% of energy savings over

[24] This analysis assumed that this small measure package would be installed directly by a program contractor and (consistent with most current utility programs) would be provided at no cost to customers, and therefore not included in the tariffed investment amount.

[25] Utility stakeholders noted that future rate designs for customers installing heat pumps for space or water heating may be developed on a Time of Use (TOU) basis. This analysis did not include such a TOU tariff, but as a simplifying assumption assumed that heat pump consumption would be billed by an electric utility at the rate currently charged to electric-heat customers.

[26] In such a case, a TOB participant may experience a negligible-to-minor reduction in taxes, which is not reflected in this analysis.

80% of the expected useful life of the measure). In the interest of space, this value is only presented for the financing scenario where market-rate capital is made available for a program. Outputs for additional scenarios are included in the detailed data file.

- **Customer Co-Payment.** This value reflects the resulting customer co-payment that may be required for a particular measure or package of measures, if any. As with the financeable amount, this value is only presented here for the financing scenario where market-rate capital is made available for a program. Outputs for additional scenarios are included in the detailed data file.
- **Percent of Net Cost Financeable.** These columns reflect the percent of the total upfront cost that could be financed through a TOB program, for each of the four cost of capital scenarios included in this analysis.
- **Percent of Incremental Cost Financeable.** This value reflects the percent of the incremental cost (net of baseline installation costs where relevant) that may be financed through a TOB program. This value is only shown here for the financing scenario where market-rate capital is made available for a program. Outputs for additional scenarios are included in the detailed data file.
- **Participant Cost Test Ratio.** This value shows the ratio of lifetime discounted[27] participant energy savings to upfront participant incremental costs (in a scenario without any financing), reflecting the general cost-effectiveness of a particular measure combination for utility customers.

[27] This refers to converting an annual stream of energy savings to an equivalent upfront value using a participant discount rate.

Table 7. Measure Screening: Attic/Ceiling Insulation + Air Sealing (Normal Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$1,771	$280	$1,771	$0	100%	100%	100%	100%	100%	3.24
	Gas (Current Price)	$1,771	$104	$899	$872	75%	61%	51%	39%	51%	1.35
	Gas (Inflated Price)	$1,771	$151	$1,308	$463	100%	89%	74%	56%	74%	1.96
	Propane	$2,221	$232	$2,010	$211	100%	100%	90%	69%	90%	1.93
CenterPoint	Gas (Current Price)	$1,721	$97	$845	$876	72%	59%	49%	38%	49%	1.30
	Gas (Inflated Price)	$1,721	$141	$1,227	$494	100%	86%	71%	54%	71%	1.90
Minnesota Power	Electric	$2,221	$516	$2,221	$0	100%	100%	100%	100%	100%	4.77
	Gas (Current Price)	$2,221	$109	$949	$1,272	63%	51%	43%	33%	43%	1.14
	Gas (Inflated Price)	$2,221	$161	$1,395	$826	93%	76%	63%	48%	63%	1.67
	Propane	$2,221	$254	$2,203	$18	100%	100%	99%	76%	99%	2.11
East Central Energy	Electric	$2,221	$398	$2,221	$0	100%	100%	100%	100%	100%	3.68
	Gas (Current Price)	$2,221	$110	$958	$1,263	64%	52%	43%	33%	43%	1.15
	Gas (Inflated Price)	$2,221	$162	$1,404	$817	93%	76%	63%	48%	63%	1.68
	Propane	$2,221	$255	$2,211	$10	100%	100%	100%	76%	100%	2.12
City of Warren	Electric	$1,721	$232	$1,721	$0	100%	100%	100%	89%	100%	2.76
	Gas (Current Price)	$2,221	$126	$1,090	$1,131	72%	59%	49%	37%	49%	1.31
	Gas (Inflated Price)	$2,221	$187	$1,618	$603	100%	88%	73%	56%	73%	1.95
	Propane	$2,221	$289	$2,221	$0	100%	100%	100%	86%	100%	2.40

In homes with normal levels of existing insulation, attic/ceiling insulation with air sealing can be fully financed in homes with electric and propane heat in most cases – though the higher cost of utility capital may present some limits. In homes with gas heat, which is substantially less expensive, a co-pay is generally required (though the measure still passes the PCT and is cost-effective overall). At current gas prices, roughly half of the cost of a normal attic/ceiling insulation with air sealing can be financed. This picture would improve slightly if gas prices were to increase by half, but the full amount could only be subsidized with zero-interest subsidized financing.

Table 8. Measure Screening: Attic/Ceiling Insulation + Air Sealing (Poor Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$1,771	$382	$1,771	$0	100%	100%	100%	100%	100%	4.42
	Gas (Current Price)	$1,771	$144	$1,247	$524	100%	85%	70%	54%	70%	1.87
	Gas (Inflated Price)	$1,771	$209	$1,771	$0	100%	100%	100%	78%	100%	2.72
	Propane	$2,221	$321	$2,221	$0	100%	100%	100%	96%	100%	2.68
CenterPoint	Gas (Current Price)	$1,721	$135	$1,172	$549	100%	82%	68%	52%	68%	1.80
	Gas (Inflated Price)	$1,721	$196	$1,701	$20	100%	100%	99%	76%	99%	2.63
Minnesota Power	Electric	$2,221	$703	$2,221	$0	100%	100%	100%	100%	100%	6.49
	Gas (Current Price)	$2,221	$152	$1,316	$905	87%	71%	59%	45%	59%	1.58
	Gas (Inflated Price)	$2,221	$223	$1,934	$287	100%	100%	87%	67%	87%	2.32
	Propane	$2,221	$352	$2,221	$0	100%	100%	100%	100%	100%	2.93
East Central Energy	Electric	$2,221	$542	$2,221	$0	100%	100%	100%	100%	100%	5.01
	Gas (Current Price)	$2,221	$153	$1,328	$893	88%	72%	60%	46%	60%	1.59
	Gas (Inflated Price)	$2,221	$224	$1,946	$275	100%	100%	88%	67%	88%	2.34
	Propane	$2,221	$353	$2,221	$0	100%	100%	100%	100%	100%	2.94
City of Warren	Electric	$1,721	$315	$1,721	$0	100%	100%	100%	100%	100%	3.76
	Gas (Current Price)	$2,221	$174	$1,511	$710	100%	82%	68%	52%	68%	1.82
	Gas (Inflated Price)	$2,221	$259	$2,221	$0	100%	100%	100%	77%	100%	2.70
	Propane	$2,221	$401	$2,221	$0	100%	100%	100%	100%	100%	3.33

In homes with poor existing insulation, the prospects for financing attic/ceiling insulation and air sealing are much improved. Installation costs can be fully financed in homes with electric or propane heat in all cases. With below-market interest rates, almost all of the cost can be financed depending on the price of gas.

Table 9. Measure Screening: Wall Insulation (Normal Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$2,448	$306	$2,448	$0	100%	100%	100%	83%	100%	2.56
	Gas (Current Price)	$2,448	$108	$941	$1,507	57%	46%	38%	29%	38%	1.02
	Gas (Inflated Price)	$2,448	$158	$1,368	$1,080	82%	67%	56%	43%	56%	1.49
	Propane	$2,898	$242	$2,102	$796	100%	87%	73%	55%	73%	1.55
CenterPoint	Gas (Current Price)	$2,398	$102	$885	$1,513	54%	44%	37%	28%	37%	0.98
	Gas (Inflated Price)	$2,398	$148	$1,283	$1,115	79%	64%	54%	41%	54%	1.42
Minnesota Power	Electric	$2,898	$564	$2,898	$0	100%	100%	100%	100%	100%	3.99
	Gas (Current Price)	$2,898	$114	$993	$1,905	51%	41%	34%	26%	34%	0.91
	Gas (Inflated Price)	$2,898	$168	$1,459	$1,439	74%	61%	50%	38%	50%	1.34
	Propane	$2,898	$265	$2,303	$595	100%	96%	79%	61%	79%	1.69
East Central Energy	Electric	$2,898	$435	$2,898	$0	100%	100%	100%	100%	100%	3.08
	Gas (Current Price)	$2,898	$116	$1,002	$1,896	51%	42%	35%	26%	35%	0.92
	Gas (Inflated Price)	$2,898	$169	$1,468	$1,430	75%	61%	51%	39%	51%	1.35
	Propane	$2,898	$266	$2,312	$586	100%	96%	80%	61%	80%	1.70
City of Warren	Electric	$2,398	$254	$2,207	$191	100%	100%	92%	70%	92%	2.18
	Gas (Current Price)	$2,898	$131	$1,139	$1,759	58%	47%	39%	30%	39%	1.05
	Gas (Inflated Price)	$2,898	$195	$1,692	$1,206	86%	70%	58%	45%	58%	1.56
	Propane	$2,898	$302	$2,622	$276	100%	100%	90%	69%	90%	1.92

Similar to attic/ceiling insulation, the prospects for financing normal levels of wall insulation are greatest in homes with electric or propane heat, and are generally consistent across utilities. In gas-heated homes, a copayment of more than $1,000 may be required regardless of retail price scenario.

Table 10. Measure Screening: Wall Insulation (Poor Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$2,448	$947	$2,448	$0	100%	100%	100%	100%	100%	7.94
	Gas (Current Price)	$2,448	$336	$2,448	$0	100%	100%	100%	91%	100%	3.16
	Gas (Inflated Price)	$2,448	$489	$2,448	$0	100%	100%	100%	100%	100%	4.61
	Propane	$2,898	$751	$2,898	$0	100%	100%	100%	100%	100%	4.79
CenterPoint	Gas (Current Price)	$2,398	$316	$2,398	$0	100%	100%	100%	87%	100%	3.03
	Gas (Inflated Price)	$2,398	$458	$2,398	$0	100%	100%	100%	100%	100%	4.41
Minnesota Power	Electric	$2,898	$1,749	$2,898	$0	100%	100%	100%	100%	100%	12.38
	Gas (Current Price)	$2,898	$355	$2,898	$0	100%	100%	100%	81%	100%	2.83
	Gas (Inflated Price)	$2,898	$521	$2,898	$0	100%	100%	100%	100%	100%	4.16
	Propane	$2,898	$823	$2,898	$0	100%	100%	100%	100%	100%	5.24
East Central Energy	Electric	$2,898	$1,349	$2,898	$0	100%	100%	100%	100%	100%	9.55
	Gas (Current Price)	$2,898	$358	$2,898	$0	100%	100%	100%	82%	100%	2.85
	Gas (Inflated Price)	$2,898	$524	$2,898	$0	100%	100%	100%	100%	100%	4.18
	Propane	$2,898	$826	$2,898	$0	100%	100%	100%	100%	100%	5.27
City of Warren	Electric	$2,398	$788	$2,398	$0	100%	100%	100%	100%	100%	6.75
	Gas (Current Price)	$2,898	$407	$2,898	$0	100%	100%	100%	93%	100%	3.25
	Gas (Inflated Price)	$2,898	$604	$2,898	$0	100%	100%	100%	100%	100%	4.84
	Propane	$2,898	$937	$2,898	$0	100%	100%	100%	100%	100%	5.96

Homes with poor levels of existing insulation offer the potential for significant energy savings (in CenterPoint's current rebate program, the average participant has a pre-insulation R-value of only 0.9). In nearly all cases, the full cost may be financed with ample savings remaining.

Table 11. Measure Screening: Air Source Heat Pump

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$7,796	$683	$5,410	$2,386	98%	82%	69%	54%	69%	1.61
	Gas (Current Price)	$7,796	-$216	$0	$7,796	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$7,796	$2	$17	$7,779	0%	0%	0%	0%	0%	0.26
	Propane	$7,796	$377	$2,989	$4,807	54%	45%	38%	30%	52%	0.89
CenterPoint[28]	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$7,246	$1,206	$7,246	$0	100%	100%	100%	100%	100%	3.07
	Gas (Current Price)	$7,246	-$724	$0	$7,246	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$7,246	-$491	$0	$7,246	0%	0%	0%	0%	0%	0.00
	Propane	$7,246	-$70	$0	$7,246	0%	0%	0%	0%	0%	0.00
East Central Energy	Electric	$7,616	$935	$7,410	$206	100%	100%	97%	76%	97%	2.26
	Gas (Current Price)	$7,616	-$456	$0	$7,616	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$7,616	-$224	$0	$7,616	0%	0%	0%	0%	0%	0.00
	Propane	$7,616	$198	$1,566	$6,050	29%	24%	21%	16%	28%	0.31
City of Warren	Electric	$7,446	$510	$4,038	$3,408	77%	64%	54%	43%	54%	1.26
	Gas (Current Price)	$8,246	-$4	$0	$8,246	0%	0%	0%	0%	0%	0.17
	Gas (Inflated Price)	$8,246	$256	$2,026	$6,220	35%	29%	25%	19%	32%	1.03
	Propane	$8,246	$692	$5,487	$2,759	94%	79%	67%	52%	88%	1.71

Air source heat pumps are most cost-effective when installed in homes with current electric heat. The financeable amount varies by utility, reflecting a range of electricity rate structures and climate zones. There may be some opportunities for fuel switching in propane-heated homes, but ASHPs are not expected to be cost-effective investments in gas-heated homes in most cases.

[28] This analysis did not include heat pump applications for a potential TOB program implemented by CenterPoint Energy (which has a gas-only service area in Minnesota), assuming that such a technology would be better suited for inclusion in a program operated by an electric utility.

Table 12. Measure Screening: Air Source Heat Pump w/ Small Measure Package

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$7,796	$805	$6,057	$1,739	100%	91%	78%	62%	78%	1.78
	Gas (Current Price)	$7,796	-$175	$0	$7,796	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$7,796	$59	$444	$7,352	8%	7%	6%	5%	8%	0.42
	Propane	$7,796	$462	$3,474	$4,322	62%	52%	45%	35%	60%	1.10
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$7,246	$1,378	$7,246	$0	100%	100%	100%	100%	100%	3.29
	Gas (Current Price)	$7,246	-$670	$0	$7,246	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$7,246	-$421	$0	$7,246	0%	0%	0%	0%	0%	0.00
	Propane	$7,246	$29	$217	$7,029	4%	3%	3%	2%	4%	0.00
East Central Energy	Electric	$7,616	$1,082	$7,616	$0	100%	100%	100%	85%	100%	2.46
	Gas (Current Price)	$7,616	-$410	$0	$7,616	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$7,616	-$162	$0	$7,616	0%	0%	0%	0%	0%	0.00
	Propane	$7,616	$288	$2,168	$5,448	39%	33%	28%	23%	39%	0.57
City of Warren	Electric	$7,446	$582	$4,378	$3,068	81%	69%	59%	47%	59%	1.36
	Gas (Current Price)	$8,246	$32	$237	$8,009	4%	3%	3%	2%	4%	0.27
	Gas (Inflated Price)	$8,246	$307	$2,310	$5,936	39%	33%	28%	22%	37%	1.13
	Propane	$8,246	$771	$5,801	$2,445	97%	82%	70%	56%	93%	1.85

Combining an air source heat pump with a suite of small measures does not dramatically alter the results relative to the installation of an air source heat pump alone.

Table 13. Measure Screening: Air Source Heat Pump w/ Small Measure Package and Envelope Upgrades (Normal Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$12,015	$1,125	$8,915	$3,100	100%	88%	74%	58%	74%	1.70
	Gas (Current Price)	$12,015	$83	$661	$11,354	8%	6%	6%	4%	7%	0.26
	Gas (Inflated Price)	$12,015	$336	$2,661	$9,354	31%	26%	22%	17%	27%	0.77
	Propane	$12,915	$770	$6,101	$6,814	67%	56%	47%	37%	56%	1.10
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$12,365	$1,962	$12,365	$0	100%	100%	100%	99%	100%	2.90
	Gas (Current Price)	$12,365	-$212	$0	$12,365	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$12,365	$56	$446	$11,919	5%	4%	4%	3%	4%	0.27
	Propane	$12,365	$542	$4,297	$8,068	49%	41%	35%	27%	42%	0.74
East Central Energy	Electric	$12,735	$1,534	$12,152	$583	100%	100%	95%	75%	95%	2.20
	Gas (Current Price)	$12,735	-$52	$0	$12,735	0%	0%	0%	0%	0%	0.02
	Gas (Inflated Price)	$12,735	$216	$1,710	$11,025	19%	16%	13%	11%	16%	0.53
	Propane	$12,735	$702	$5,562	$7,173	62%	52%	44%	34%	52%	0.99
City of Warren	Electric	$11,565	$843	$6,683	$4,882	82%	68%	58%	45%	58%	1.34
	Gas (Current Price)	$13,365	$261	$2,070	$11,295	22%	18%	15%	12%	18%	0.54
	Gas (Inflated Price)	$13,365	$560	$4,440	$8,925	47%	39%	33%	26%	39%	1.08
	Propane	$13,365	$1,064	$8,432	$4,933	89%	74%	63%	49%	74%	1.51

Including envelope improvements (attic and wall insulation and air sealing in a home with normal tightness) may conversely lead to an increase in customer copayment compared to an air source heat pump alone. This is because, due to interaction effects, the combined impact of envelope savings and heating efficiency savings is less than the sum of the envelope and heating efficiency savings if implemented individually. It is possible that additional cost savings may be provided through opportunities to right-size ASHP installations (reducing the tonnage and associated cost of an ASHP installation), though this is not considered in this analysis.

Table 14. Measure Screening: Air Source Heat Pump w/ Small Measure Package and Envelope Upgrades (Poor Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$12,015	$1,471	$11,658	$357	100%	100%	97%	76%	97%	2.29
	Gas (Current Price)	$12,015	$375	$2,973	$9,042	35%	29%	25%	19%	30%	0.83
	Gas (Inflated Price)	$12,015	$651	$5,155	$6,860	61%	51%	43%	34%	52%	1.40
	Propane	$12,915	$1,124	$8,906	$4,009	97%	81%	69%	54%	82%	1.72
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$12,365	$2,591	$12,365	$0	100%	100%	100%	100%	100%	3.94
	Gas (Current Price)	$12,365	$288	$2,281	$10,084	26%	22%	18%	14%	22%	0.65
	Gas (Inflated Price)	$12,365	$581	$4,602	$7,763	53%	44%	37%	29%	44%	1.25
	Propane	$12,365	$1,112	$8,812	$3,553	100%	84%	71%	56%	85%	1.77
East Central Energy	Electric	$12,735	$2,020	$12,735	$0	100%	100%	100%	99%	100%	2.98
	Gas (Current Price)	$12,735	$343	$2,718	$10,017	30%	25%	21%	17%	25%	0.72
	Gas (Inflated Price)	$12,735	$636	$5,039	$7,696	56%	47%	40%	31%	47%	1.30
	Propane	$12,735	$1,167	$9,249	$3,486	100%	86%	73%	57%	86%	1.81
City of Warren	Electric	$11,565	$1,121	$8,880	$2,685	100%	91%	77%	60%	77%	1.83
	Gas (Current Price)	$13,365	$517	$4,099	$9,266	43%	36%	31%	24%	36%	0.99
	Gas (Inflated Price)	$13,365	$846	$6,704	$6,661	71%	59%	50%	39%	59%	1.60
	Propane	$13,365	$1,400	$11,091	$2,274	100%	98%	83%	65%	98%	2.08

In a home with a poor building envelope, there may be some opportunities to combine an ASHP installation with small measures and an envelope package, though these appear to be limited to homes with electric resistance heat or cases with zero-percent financing and propane heat.

Table 15. Measure Screening: Ground Source Heat Pump

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$15,581	$1,171	$9,278	$6,303	84%	70%	60%	47%	60%	1.38
	Gas (Current Price)	$15,581	$88	$700	$14,881	6%	5%	4%	4%	5%	0.21
	Gas (Inflated Price)	$15,581	$357	$2,830	$12,751	26%	21%	18%	14%	21%	0.62
	Propane	$15,581	$819	$6,491	$9,090	59%	49%	42%	33%	48%	0.95
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$15,456	$2,082	$15,456	$0	100%	100%	100%	84%	100%	2.48
	Gas (Current Price)	$15,956	-$240	$0	$15,956	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$15,956	$46	$367	$15,589	3%	3%	2%	2%	3%	0.20
	Propane	$15,956	$566	$4,481	$11,475	40%	33%	28%	22%	32%	0.58
East Central Energy	Electric	$14,956	$1,611	$12,767	$2,189	100%	100%	85%	67%	85%	1.98
	Gas (Current Price)	$14,956	-$64	$0	$14,956	0%	0%	0%	0%	0%	0.01
	Gas (Inflated Price)	$14,956	$222	$1,763	$13,194	17%	14%	12%	9%	14%	0.46
	Propane	$14,956	$742	$5,876	$9,080	56%	46%	39%	31%	45%	0.87
City of Warren	Electric	$14,956	$881	$6,978	$7,978	66%	55%	47%	37%	47%	1.08
	Gas (Current Price)	$14,956	$270	$2,136	$12,820	20%	17%	14%	11%	17%	0.49
	Gas (Inflated Price)	$14,956	$589	$4,668	$10,288	44%	37%	31%	24%	36%	1.00
	Propane	$14,956	$1,127	$8,932	$6,024	84%	70%	60%	47%	69%	1.41

Due to the high cost of GSHP installations, a GSHP installation alone does not appear to be feasible for TOB in most cases, where even financing three quarters of the cost would result in a copayment of thousands of dollars. There may be some opportunities in homes with electric resistance heat, though some of this may be limited in utility jurisdictions (such as Xcel and the City of Warren) where low rates are provided to customers with electric heat.

Table 16. Measure Screening: Ductless Mini-Split

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$15,581	$1,171	$9,278	$6,303	84%	70%	60%	47%	60%	1.38
	Gas (Current Price)	$15,581	$88	$700	$14,881	6%	5%	4%	4%	5%	0.21
	Gas (Inflated Price)	$15,581	$357	$2,830	$12,751	26%	21%	18%	14%	21%	0.62
	Propane	$15,581	$819	$6,491	$9,090	59%	49%	42%	33%	48%	0.95
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$15,456	$2,082	$15,456	$0	100%	100%	100%	84%	100%	2.48
	Gas (Current Price)	$15,956	-$240	$0	$15,956	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$15,956	$46	$367	$15,589	3%	3%	2%	2%	3%	0.20
	Propane	$15,956	$566	$4,481	$11,475	40%	33%	28%	22%	32%	0.58
East Central Energy	Electric	$14,956	$1,611	$12,767	$2,189	100%	100%	85%	67%	85%	1.98
	Gas (Current Price)	$14,956	-$64	$0	$14,956	0%	0%	0%	0%	0%	0.01
	Gas (Inflated Price)	$14,956	$222	$1,763	$13,194	17%	14%	12%	9%	14%	0.46
	Propane	$14,956	$742	$5,876	$9,080	56%	46%	39%	31%	45%	0.87
City of Warren	Electric	$14,956	$881	$6,978	$7,978	66%	55%	47%	37%	47%	1.08
	Gas (Current Price)	$14,956	$270	$2,136	$12,820	20%	17%	14%	11%	17%	0.49
	Gas (Inflated Price)	$14,956	$589	$4,668	$10,288	44%	37%	31%	24%	36%	1.00
	Propane	$14,956	$1,127	$8,932	$6,024	84%	70%	60%	47%	69%	1.41

Ductless heat pumps are cost effective primarily in homes with existing electric heat (with some applicability against propane in northern Minnesota). As a standalone measure, the opportunity appears restricted to cases where utilities do not offer low rates for electric heat (such as in Minnesota Power and East Central Energy service territory).

Table 17. Measure Screening: Ductless Mini-Split w/ Small Measure Package

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$3,752	$538	$3,752	$0	100%	100%	100%	86%	100%	2.39
	Gas (Current Price)	$3,752	-$86	$0	$3,752	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$3,752	$61	$457	$3,295	17%	14%	12%	10%	12%	0.49
	Propane	$3,752	$314	$2,359	$1,393	87%	73%	63%	50%	63%	1.14
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$2,952	$899	$2,952	$0	100%	100%	100%	100%	100%	5.10
	Gas (Current Price)	$3,952	-$375	$0	$3,952	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$3,952	-$220	$0	$3,952	0%	0%	0%	0%	0%	0.00
	Propane	$3,952	$62	$467	$3,485	16%	14%	12%	9%	12%	0.00
East Central Energy	Electric	$3,652	$712	$3,652	$0	100%	100%	100%	100%	100%	3.26
	Gas (Current Price)	$3,652	-$224	$0	$3,652	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$3,652	-$69	$0	$3,652	0%	0%	0%	0%	0%	0.00
	Propane	$3,652	$212	$1,597	$2,055	60%	51%	44%	35%	44%	0.69
City of Warren	Electric	$3,472	$379	$2,853	$619	100%	96%	82%	65%	82%	1.84
	Gas (Current Price)	$3,952	$34	$252	$3,700	9%	7%	6%	5%	6%	0.31
	Gas (Inflated Price)	$3,952	$205	$1,545	$2,407	54%	46%	39%	31%	39%	1.13
	Propane	$3,952	$495	$3,722	$230	100%	100%	94%	75%	94%	1.83

When installed along with a suite of cost-effective small measures, financing for a ductless heat pump where the home heating fuel is electricity becomes attractive in most cases.

Table 18. Measure Screening: Ductless Mini-Split w/ Small Measure Package and Envelope Upgrades (Normal Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$7,971	$942	$7,467	$504	100%	100%	94%	73%	94%	2.17
	Gas (Current Price)	$7,971	$150	$1,191	$6,780	21%	18%	15%	12%	15%	0.45
	Gas (Inflated Price)	$7,971	$347	$2,747	$5,224	49%	41%	34%	27%	34%	0.96
	Propane	$8,871	$684	$5,424	$3,447	86%	72%	61%	48%	61%	1.24
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$8,071	$1,642	$8,071	$0	100%	100%	100%	100%	100%	3.75
	Gas (Current Price)	$9,071	-$9	$0	$9,071	0%	0%	0%	0%	0%	0.08
	Gas (Inflated Price)	$9,071	$200	$1,587	$7,484	25%	21%	17%	14%	17%	0.56
	Propane	$9,071	$580	$4,592	$4,479	72%	60%	51%	40%	51%	0.99
East Central Energy	Electric	$8,771	$1,285	$8,771	$0	100%	100%	100%	91%	100%	2.70
	Gas (Current Price)	$8,771	$79	$626	$8,145	10%	8%	7%	6%	7%	0.27
	Gas (Inflated Price)	$8,771	$288	$2,283	$6,488	37%	31%	26%	20%	26%	0.77
	Propane	$8,771	$667	$5,289	$3,482	85%	71%	60%	47%	60%	1.21
City of Warren	Electric	$7,591	$712	$5,639	$1,952	100%	88%	74%	58%	74%	1.74
	Gas (Current Price)	$9,071	$272	$2,156	$6,915	34%	28%	24%	19%	24%	0.67
	Gas (Inflated Price)	$9,071	$508	$4,025	$5,046	63%	52%	44%	35%	44%	1.22
	Propane	$9,071	$905	$7,172	$1,899	100%	93%	79%	62%	79%	1.64

Including envelope measures in a home with normal base levels of insulation may also provide some opportunities for cost-effective installation, though the interaction of HVAC and envelope savings may limit the additional benefit.

Table 19. Measure Screening: Ductless Mini-Split w/ Small Measure Package and Envelope Upgrades (Poor Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$7,971	$1,380	$7,971	$0	100%	100%	100%	100%	100%	3.30
	Gas (Current Price)	$7,971	$431	$3,412	$4,559	60%	51%	43%	34%	43%	1.18
	Gas (Inflated Price)	$7,971	$689	$5,462	$2,509	97%	81%	69%	54%	69%	1.88
	Propane	$8,871	$1,134	$8,871	$0	100%	100%	100%	79%	100%	2.19
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$8,071	$2,440	$8,071	$0	100%	100%	100%	100%	100%	5.78
	Gas (Current Price)	$9,071	$403	$3,197	$5,874	50%	42%	35%	28%	35%	1.00
	Gas (Inflated Price)	$9,071	$681	$5,393	$3,678	84%	70%	59%	47%	59%	1.66
	Propane	$9,071	$1,183	$9,071	$0	100%	100%	100%	81%	100%	2.23
East Central Energy	Electric	$8,771	$1,902	$8,771	$0	100%	100%	100%	100%	100%	4.14
	Gas (Current Price)	$8,771	$428	$3,395	$5,376	55%	46%	39%	30%	39%	1.09
	Gas (Inflated Price)	$8,771	$706	$5,591	$3,180	90%	75%	64%	50%	64%	1.77
	Propane	$8,771	$1,208	$8,771	$0	100%	100%	100%	86%	100%	2.36
City of Warren	Electric	$7,591	$1,064	$7,591	$0	100%	100%	100%	87%	100%	2.69
	Gas (Current Price)	$9,071	$554	$4,605	$4,466	73%	61%	51%	39%	51%	1.34
	Gas (Inflated Price)	$9,071	$871	$7,236	$1,835	100%	95%	80%	62%	80%	2.10
	Propane	$9,071	$1,404	$9,071	$0	100%	100%	100%	100%	100%	2.67

In a home with poor levels of existing insulation, however, a ductless mini-split may generally be financed where the heating fuel is electricity. It should be noted that, while the overall package of a ductless mini-split and envelope measures may be cost-effective, it may be viewed as desirable in the program design process to limit eligibility to cases where the ductless heat pump itself passes the participant cost test as a standalone measure.

Table 20. Measure Screening: Furnace

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$3,249	$172	$1,427	$1,822	63%	52%	44%	34%	100%	2.88
	Gas (Inflated Price)	$3,249	$217	$1,799	$1,450	80%	66%	55%	43%	100%	3.67
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$3,149	$166	$1,378	$1,771	63%	52%	44%	34%	100%	3.02
	Gas (Inflated Price)	$3,149	$208	$1,725	$1,424	79%	65%	55%	42%	100%	3.83
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$3,349	$179	$1,487	$1,862	64%	53%	44%	34%	100%	2.83
	Gas (Inflated Price)	$3,349	$233	$1,938	$1,411	84%	69%	58%	45%	100%	3.73
	Propane	.	.	.	.	.	.	.	.	.	.

Furnaces, which are only evaluated in gas-heated homes, are expected to require a co-payment when installed on a standalone basis regardless of the utility or cost of capital. However, the incremental cost of a furnace may be financed in many cases. This indicates that there may be potential to use TOB financing as a means to encourage the purchase of efficient equipment in cases where a home's heating equipment has failed and a customer must purchase a new furnace regardless.

Table 21. Measure Screening: Furnace w/ Small Measure Package

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$3,249	$219	$1,648	$1,601	70%	59%	51%	40%	100%	3.22
	Gas (Inflated Price)	$3,249	$280	$2,107	$1,142	90%	76%	65%	52%	100%	4.16
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$3,149	$211	$1,588	$1,561	70%	59%	50%	40%	100%	3.37
	Gas (Inflated Price)	$3,149	$268	$2,015	$1,134	89%	75%	64%	51%	100%	4.32
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$3,349	$224	$1,688	$1,661	70%	59%	50%	40%	100%	3.15
	Gas (Inflated Price)	$3,349	$295	$2,218	$1,131	92%	77%	66%	53%	100%	4.17
	Propane	.	.	.	.	.	.	.	.	.	.

Combining a furnace with a suite of small measures does not dramatically alter the results compared to a furnace as a standalone measure.

Table 22. Measure Screening: Furnace w/ Small Measure Package and Envelope Upgrades (Normal Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$7,468	$395	$3,280	$4,188	63%	52%	44%	34%	60%	1.52
	Gas (Inflated Price)	$7,468	$534	$4,436	$3,032	86%	71%	59%	46%	81%	2.07
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$7,268	$376	$3,126	$4,142	62%	51%	43%	33%	59%	1.50
	Gas (Inflated Price)	$7,268	$506	$4,206	$3,062	84%	69%	58%	45%	80%	2.04
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$8,468	$434	$3,609	$4,859	62%	51%	43%	33%	56%	1.44
	Gas (Inflated Price)	$8,468	$606	$5,036	$3,432	86%	71%	59%	46%	78%	2.03
	Propane	.	.	.	.	.	.	.	.	.	.

Including envelope measures in a home with normal existing insulation also does not dramatically alter the results compared to installing a furnace as a standalone measure, and may in fact detract from the potential to finance the incremental cost of a furnace. This stands to reason as, as shown above, envelope measures alone are not expected to be fully financeable in a gas-heated home with normal levels of insulation.

Table 23. Measure Screening: Furnace w/ Small Measure Package and Envelope Upgrades (Poor Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$7,468	$615	$5,111	$2,357	99%	82%	68%	53%	94%	2.45
	Gas (Inflated Price)	$7,468	$853	$7,087	$381	100%	100%	95%	73%	100%	3.42
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$7,268	$584	$4,849	$2,419	96%	80%	67%	52%	92%	2.41
	Gas (Inflated Price)	$7,268	$806	$6,694	$574	100%	100%	92%	71%	100%	3.35
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$8,468	$699	$5,805	$2,663	99%	82%	69%	53%	90%	2.39
	Gas (Inflated Price)	$8,468	$998	$8,295	$173	100%	100%	98%	76%	100%	3.44
	Propane	.	.	.	.	.	.	.	.	.	.

In homes with poor existing insulation, however, there may be opportunities to finance a package of furnaces and envelope measures in gas-heated homes. TOB financing could potentially be attractive in financing the incremental cost of a measure, at subsidized interest rates, or with increased gas prices. At non-subsidized rates and current gas prices, however, this package would still require a copayment.

Table 24. Measure Screening: Boiler

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$7,468	$615	$5,111	$2,357	99%	82%	68%	53%	94%	2.45
	Gas (Inflated Price)	$7,468	$853	$7,087	$381	100%	100%	95%	73%	100%	3.42
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$7,268	$584	$4,849	$2,419	96%	80%	67%	52%	92%	2.41
	Gas (Inflated Price)	$7,268	$806	$6,694	$574	100%	100%	92%	71%	100%	3.35
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$8,468	$699	$5,805	$2,663	99%	82%	69%	53%	90%	2.39
	Gas (Inflated Price)	$8,468	$998	$8,295	$173	100%	100%	98%	76%	100%	3.44
	Propane	.	.	.	.	.	.	.	.	.	.

TOB financing could potentially be attractive for a boiler as a standalone measure in gas homes if used to address most of the incremental cost over a standard replacement in cases of failed heating equipment. At subsidized interest rates or with increased gas prices, financing may become attractive as a means to capitalize the full cost of a boiler.

Table 25. Measure Screening: Central Air Conditioner

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$3,139	$31	$246	$2,892	11%	9%	8%	6%	56%	1.29
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$3,589	$20	$160	$3,429	6%	5%	4%	3%	18%	0.42
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	$3,589	$23	$183	$3,405	7%	6%	5%	4%	21%	0.48
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	$3,589	$10	$80	$3,509	3%	3%	2%	2%	9%	0.21
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.

Air conditioning is not expected to be a suitable application for TOB financing in Minnesota due to the short cooling season. The results above demonstrate results when compared against a 13 SEER baseline, but the interpretation of results does not change when a 10 SEER baseline is assessed. EEtility has reported that in existing PAYS programs even in warmer climates it is not typical for CACs to be installed as a standalone measure.

Table 26. Measure Screening: Heat Pump Water Heater

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$1,907	$189	$1,171	$736	79%	70%	61%	51%	100%	2.48
	Gas (Current Price)	$2,907	-$13	$0	$2,907	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$2,907	$49	$303	$2,604	13%	12%	10%	9%	19%	0.54
	Propane	$2,907	$155	$960	$1,947	43%	37%	33%	27%	60%	1.12
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$1,857	$275	$1,697	$160	100%	100%	91%	76%	100%	3.78
	Gas (Current Price)	$2,857	-$73	$0	$2,857	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$2,857	-$10	$0	$2,857	0%	0%	0%	0%	0%	0.05
	Propane	$2,857	$103	$639	$2,218	29%	25%	22%	19%	41%	0.70
East Central Energy	Electric	$1,907	$234	$1,446	$461	98%	86%	76%	63%	100%	3.06
	Gas (Current Price)	$2,907	-$43	$0	$2,907	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$2,907	$19	$118	$2,789	5%	5%	4%	3%	7%	0.29
	Propane	$2,907	$133	$819	$2,088	36%	32%	28%	23%	51%	0.92
City of Warren	Electric	$1,907	$120	$744	$1,163	51%	44%	39%	32%	74%	1.57
	Gas (Current Price)	$2,907	$47	$288	$2,619	13%	11%	10%	8%	18%	0.48
	Gas (Inflated Price)	$2,907	$113	$700	$2,207	31%	27%	24%	20%	44%	1.08
	Propane	$2,907	$225	$1,393	$1,514	62%	54%	48%	40%	87%	1.68

The applicability for HPWHs as a standalone measure appears limited to homes with electric heat, where financing may be attractive with low interest rates or as a means to financing the incremental cost in cases of equipment failure. Opportunities may currently be limited in the City of Warren, where homes with electric heat have particularly low retail rates.

Table 27. Measure Screening: Heat Pump Water Heater w/ Small Measure Package

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$1,907	$312	$1,776	$131	100%	100%	93%	78%	100%	3.71
	Gas (Current Price)	$2,907	$30	$172	$2,735	7%	7%	6%	5%	11%	0.33
	Gas (Inflated Price)	$2,907	$108	$616	$2,291	27%	24%	21%	18%	38%	0.98
	Propane	$2,907	$242	$1,378	$1,529	60%	53%	47%	40%	86%	1.69
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$1,857	$446	$1,857	$0	100%	100%	100%	100%	100%	5.58
	Gas (Current Price)	$2,857	-$21	$0	$2,857	0%	0%	0%	0%	0%	0.00
	Gas (Inflated Price)	$2,857	$57	$325	$2,532	14%	13%	11%	10%	21%	0.61
	Propane	$2,857	$199	$1,134	$1,723	50%	44%	40%	33%	73%	1.39
East Central Energy	Electric	$1,907	$381	$1,907	$0	100%	100%	100%	96%	100%	4.53
	Gas (Current Price)	$2,907	$3	$19	$2,888	1%	1%	1%	1%	1%	0.12
	Gas (Inflated Price)	$2,907	$82	$465	$2,442	20%	18%	16%	13%	29%	0.78
	Propane	$2,907	$224	$1,274	$1,633	55%	49%	44%	37%	80%	1.54
City of Warren	Electric	$1,907	$193	$1,099	$808	73%	65%	58%	48%	100%	2.30
	Gas (Current Price)	$2,907	$82	$468	$2,439	20%	18%	16%	14%	29%	0.74
	Gas (Inflated Price)	$2,907	$165	$939	$1,968	41%	36%	32%	27%	59%	1.44
	Propane	$2,907	$305	$1,734	$1,173	75%	67%	60%	50%	100%	2.16

Including a package of small measures may make financing for a HPWH more attractive for homes with electric heat.

Table 28. Measure Screening: Heat Pump Water Heater w/ Small Measure Package and Envelope Upgrades (Normal Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$6,126	$846	$6,126	$0	100%	100%	100%	83%	100%	2.84
	Gas (Current Price)	$7,126	$235	$1,769	$5,357	34%	29%	25%	20%	30%	0.82
	Gas (Inflated Price)	$7,126	$409	$3,079	$4,047	60%	50%	43%	34%	53%	1.39
	Propane	$8,026	$709	$5,332	$2,694	92%	78%	66%	53%	79%	1.64
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$6,976	$1,428	$6,976	$0	100%	100%	100%	100%	100%	4.16
	Gas (Current Price)	$7,976	$207	$1,558	$6,418	27%	23%	20%	16%	23%	0.65
	Gas (Inflated Price)	$7,976	$391	$2,937	$5,039	51%	43%	37%	29%	44%	1.19
	Propane	$7,976	$723	$5,438	$2,538	94%	80%	68%	54%	82%	1.69
East Central Energy	Electric	$7,026	$1,138	$7,026	$0	100%	100%	100%	97%	100%	3.29
	Gas (Current Price)	$8,026	$227	$1,704	$6,322	29%	25%	21%	17%	25%	0.70
	Gas (Inflated Price)	$8,026	$410	$3,083	$4,943	53%	45%	38%	31%	46%	1.23
	Propane	$8,026	$743	$5,584	$2,442	96%	81%	70%	55%	83%	1.73
City of Warren	Electric	$6,026	$632	$5,009	$1,017	100%	98%	83%	65%	98%	2.21
	Gas (Current Price)	$8,026	$334	$2,511	$5,515	43%	37%	31%	25%	37%	1.00
	Gas (Inflated Price)	$8,026	$541	$4,071	$3,955	70%	59%	51%	40%	61%	1.61
	Propane	$8,026	$891	$6,700	$1,326	100%	98%	83%	66%	100%	2.11

Similarly, including envelope upgrades in a home with standard insulation levels would be attractive in electric-heated homes in some cases, and propane-heated homes in limited cases.

Table 29. Measure Screening: Heat Pump Water Heater w/ Small Measure Package and Envelope Upgrades (Poor Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$6,126	$1,424	$6,126	$0	100%	100%	100%	100%	100%	5.11
	Gas (Current Price)	$7,126	$495	$3,919	$3,207	78%	65%	55%	43%	67%	1.82
	Gas (Inflated Price)	$7,126	$790	$6,263	$863	100%	100%	88%	69%	100%	2.89
	Propane	$8,026	$1,299	$8,026	$0	100%	100%	100%	100%	100%	3.25
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$6,976	$2,483	$6,976	$0	100%	100%	100%	100%	100%	7.71
	Gas (Current Price)	$7,976	$493	$3,910	$4,066	69%	58%	49%	38%	59%	1.61
	Gas (Inflated Price)	$7,976	$809	$6,413	$1,563	100%	95%	80%	63%	96%	2.61
	Propane	$7,976	$1,382	$7,976	$0	100%	100%	100%	100%	100%	3.49
East Central Energy	Electric	$7,026	$1,953	$7,026	$0	100%	100%	100%	100%	100%	6.02
	Gas (Current Price)	$8,026	$508	$4,023	$4,003	71%	59%	50%	39%	60%	1.64
	Gas (Inflated Price)	$8,026	$824	$6,527	$1,499	100%	96%	81%	64%	97%	2.63
	Propane	$8,026	$1,397	$8,026	$0	100%	100%	100%	100%	100%	3.50
City of Warren	Electric	$6,026	$1,098	$6,026	$0	100%	100%	100%	100%	100%	4.07
	Gas (Current Price)	$8,026	$652	$5,165	$2,861	91%	76%	64%	50%	77%	2.09
	Gas (Inflated Price)	$8,026	$1,017	$8,026	$0	100%	100%	100%	79%	100%	3.25
	Propane	$8,026	$1,631	$8,026	$0	100%	100%	100%	100%	100%	4.14

Due to the large savings presented by envelope upgrades in homes with poor insulation, a package with a HPWH may prove attractive.

Table 30. Measure Screening: Gas Tank Water Heater

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$1,777	$21	$146	$1,631	11%	9%	8%	7%	31%	0.74
	Gas (Inflated Price)	$1,777	$31	$218	$1,559	17%	14%	12%	10%	47%	1.10
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$1,602	$19	$136	$1,466	11%	10%	8%	7%	46%	1.10
	Gas (Inflated Price)	$1,602	$29	$204	$1,398	17%	15%	13%	10%	69%	1.64
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$1,852	$22	$157	$1,695	11%	10%	8%	7%	29%	0.68
	Gas (Inflated Price)	$1,852	$33	$235	$1,617	17%	15%	13%	10%	43%	1.03
	Propane	.	.	.	.	.	.	.	.	.	.

There appears to be little opportunity to finance gas tank water heaters on a standalone basis.

Table 31. Measure Screening: Gas Tank Water Heater w/ Small Measure Package

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$1,777	$68	$387	$1,390	28%	24%	22%	18%	82%	1.85
	Gas (Inflated Price)	$1,777	$94	$537	$1,240	38%	34%	30%	25%	100%	2.58
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$1,602	$64	$367	$1,235	29%	26%	23%	19%	100%	2.80
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$1,852	$68	$384	$1,468	26%	23%	21%	17%	71%	1.60
	Gas (Inflated Price)	$1,852	$95	$540	$1,312	37%	33%	29%	25%	99%	2.26
	Propane	.	.	.	.	.	.	.	.	.	.

When combined with a package of small measures, the incremental cost of a gas tank water heater may be financeable. This could be applicable in cases where a home's water heat has failed. The full post-rebate cost likely cannot be financed.

Table 32. Measure Screening: Gas Tank Water Heater w/ Small Measure Package and Envelope Upgrades (Normal Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$5,996	$280	$2,215	$3,781	52%	44%	37%	29%	47%	1.23
	Gas (Inflated Price)	$5,996	$402	$3,187	$2,809	75%	63%	53%	42%	68%	1.77
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$5,721	$263	$2,086	$3,635	52%	43%	36%	29%	47%	1.23
	Gas (Inflated Price)	$5,721	$378	$2,994	$2,727	74%	62%	52%	41%	68%	1.77
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$6,971	$324	$2,569	$4,402	52%	43%	37%	29%	45%	1.21
	Gas (Inflated Price)	$6,971	$476	$3,773	$3,198	77%	64%	54%	42%	67%	1.78
	Propane	.	.	.	.	.	.	.	.	.	.

Packaging a gas water heater with envelope measures in a normal home does not appear to yield an attractive financing package. As shown above, these envelope measures cannot be fully financed in a gas-heated home in homes with normal levels of insulation.

Table 33. Measure Screening: Gas Tank Water Heater w/ Small Measure Package and Envelope Upgrades (Poor Insulation Baseline)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$5,996	$545	$4,532	$1,464	100%	90%	76%	58%	97%	2.53
	Gas (Inflated Price)	$5,996	$790	$5,996	$0	100%	100%	100%	85%	100%	3.68
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$5,721	$513	$4,263	$1,458	100%	89%	75%	58%	97%	2.53
	Gas (Inflated Price)	$5,721	$741	$5,721	$0	100%	100%	100%	83%	100%	3.67
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$6,971	$648	$5,381	$1,590	100%	92%	77%	60%	95%	2.53
	Gas (Inflated Price)	$6,971	$957	$6,971	$0	100%	100%	100%	88%	100%	3.75
	Propane	.	.	.	.	.	.	.	.	.	.

Packaging a gas water heater with envelope measures in a poorly insulated home may yield an attractive package where the cost of capital is subsidized, or in scenarios with high gas prices. This bundle of measures could also be used to finance the incremental cost of the package of measures against the cost of a baseline water heater (in the case of equipment failure).

Table 34. Measure Screening: Gas Tankless Water Heater

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$3,826	$52	$454	$3,372	17%	14%	12%	9%	54%	1.44
	Gas (Inflated Price)	$3,826	$78	$680	$3,145	26%	21%	18%	14%	80%	2.15
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$3,826	$49	$423	$3,402	16%	13%	11%	8%	50%	1.34
	Gas (Inflated Price)	$3,826	$73	$635	$3,190	24%	20%	17%	13%	75%	2.01
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$4,076	$56	$489	$3,587	18%	14%	12%	9%	45%	1.19
	Gas (Inflated Price)	$4,076	$85	$733	$3,342	27%	22%	18%	14%	67%	1.79
	Propane	.	.	.	.	.	.	.	.	.	.

Similar to tank water heaters, there appears to be little opportunity to finance gas tankless water heaters on a standalone basis.

Table 35. Measure Screening: Clothes Washer

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$697	$3	$18	$679	3%	3%	3%	2%	88%	1.90
	Gas (Current Price)	$697	$2	$9	$688	2%	1%	1%	1%	43%	0.97
	Gas (Inflated Price)	$697	$2	$11	$686	2%	2%	2%	1%	54%	1.23
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$682	$2	$8	$673	2%	1%	1%	1%	100%	3.74
	Gas (Inflated Price)	$682	$2	$10	$671	2%	2%	2%	1%	100%	4.71
Minnesota Power	Electric	$707	$5	$25	$682	4%	4%	4%	3%	82%	1.78
	Gas (Current Price)	$707	$2	$9	$698	2%	1%	1%	1%	29%	0.65
	Gas (Inflated Price)	$707	$2	$11	$696	2%	2%	2%	1%	37%	0.82
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	$707	$4	$21	$685	4%	3%	3%	3%	70%	1.52
	Gas (Current Price)	$707	$2	$9	$698	2%	1%	1%	1%	29%	0.64
	Gas (Inflated Price)	$707	$2	$11	$696	2%	2%	2%	1%	36%	0.81
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	$682	$2	$10	$671	2%	2%	2%	1%	100%	4.52
	Gas (Current Price)	$682	$2	$8	$673	1%	1%	1%	1%	100%	3.64
	Gas (Inflated Price)	$682	$2	$10	$671	2%	2%	2%	1%	100%	4.68
	Propane	.	.	.	.	.	.	.	.	.	.

Utility planning assumptions indicate only a small amount of energy savings from an ENERGY STAR clothes washer compared to a standard unit, as well as only a small incremental cost difference between a standard and efficient unit. While the resulting energy savings are technically adequate to finance the (small) incremental cost of a clothes washer, this measure is likely not a good candidate for TOB financing.

Table 36. Measure Screening: Clothes Dryer

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$851	$17	$98	$753	15%	13%	12%	10%	56%	1.20
	Gas (Current Price)	$897	$5	$27	$870	4%	3%	3%	3%	12%	0.28
	Gas (Inflated Price)	$897	$7	$38	$859	5%	5%	4%	4%	17%	0.39
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$872	$5	$26	$846	4%	3%	3%	2%	13%	0.30
	Gas (Inflated Price)	$872	$6	$36	$836	5%	5%	4%	3%	18%	0.42
Minnesota Power	Electric	$901	$24	$138	$763	19%	17%	15%	13%	61%	1.32
	Gas (Current Price)	$947	$5	$27	$920	4%	3%	3%	2%	10%	0.23
	Gas (Inflated Price)	$947	$7	$37	$909	5%	4%	4%	3%	14%	0.32
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	$901	$21	$118	$784	17%	15%	13%	11%	52%	1.12
	Gas (Current Price)	$947	$5	$27	$920	4%	3%	3%	2%	10%	0.22
	Gas (Inflated Price)	$947	$7	$37	$909	5%	4%	4%	3%	14%	0.31
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	$876	$10	$58	$818	8%	7%	7%	6%	29%	0.63
	Gas (Current Price)	$922	$5	$26	$895	4%	3%	3%	2%	11%	0.25
	Gas (Inflated Price)	$922	$7	$37	$884	5%	5%	4%	3%	15%	0.35
	Propane	.	.	.	.	.	.	.	.	.	.

Similarly, utility planning assumptions indicate minimal savings from an ENERGY STAR clothes dryer, and as a result this measure is likely not a good candidate for TOB financing.

Table 37. Measure Screening: Refrigerator

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$674	$76	$603	$71	100%	100%	89%	70%	100%	127.01
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$659	$80	$630	$29	100%	100%	96%	75%	100%	99.00
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	$689	$77	$608	$81	100%	100%	88%	69%	100%	54.31
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	$639	$65	$516	$123	100%	95%	81%	63%	100%	99.00
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.

A refrigerator may be a good candidate for financing, except in scenarios where the cost of capital is high. Utility planning assumptions indicate a minimal incremental cost for refrigerators, and so financing is best considered as it would address the full cost of the appliance.

Table 38. Measure Screening: Solar PV (With Tax Credit)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$12,950	$873	$7,573	$5,377	86%	70%	58%	45%	58%	1.38
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$7,757	$865	$7,506	$251	100%	100%	97%	74%	97%	2.29
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	$12,950	$874	$7,581	$5,369	86%	70%	59%	45%	59%	1.38
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	$12,950	$688	$5,973	$6,977	68%	56%	46%	35%	46%	1.09
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.

Including the federal investment tax credit (26% of the installed cost in 2020), solar PV may be a cost-effective investment for residents. This is particularly attractive for Minnesota Power customers, where solar PV installations receive a considerable rebate and nearly all of the remaining cost may be financed at a market cost of capital. For other utilities, even partial financing of a solar investment that a customer wishes to pursue anyways may prove attractive, though this is likely to appeal primarily to homeowners with ready access to capital.

Table 39. Measure Screening: Solar PV (Without Tax Credit)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$17,500	$873	$7,573	$9,927	64%	52%	43%	33%	43%	1.02
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	$12,307	$865	$7,506	$4,801	90%	73%	61%	47%	61%	1.44
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	$17,500	$874	$7,581	$9,919	64%	52%	43%	33%	43%	1.02
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	$17,500	$688	$5,973	$11,527	50%	41%	34%	26%	34%	0.81
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.

After federal tax credits sunset in 2022, the cost-effectiveness of solar will decline (unless installation costs see a corresponding decrease) but may still be attractive for consumers. TOB financing could still be an attractive option for some homeowners with access to capital for a copayment.

Table 40. Measure Screening: Solar PV (Low-Income Qualified)

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	$7,500	$873	$7,500	$0	100%	100%	100%	77%	100%	2.39
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	.	.	.	.	.	.	.	.	.	.
	Gas (Inflated Price)	.	.	.	.	.	.	.	.	.	.
	Propane	.	.	.	.	.	.	.	.	.	.

This scenario considers only Xcel energy customers that meet income-based criteria to receive an upfront rebate for solar energy through Xcel's Solar Rewards program. It is assumed that customers with incomes low enough to qualify would not be able to take advantage of the federal tax credit. For these customers, the remaining upfront cost of a solar PV installation could be met via TOB financing in all but the highest-capital-cost scenario.

Table 41. Measure Screening: Multifamily Whole-Home Custom

Utility	Heating Fuel	Post-Rebate Cost	First-Year Savings	Financeable Amount (Market Rate)	Customer Co-Pay (Market Rate)	Pct. of Net Cost Financed by Cost of Capital				Pct. of Incremental Cost Financed (Market Rate)	PCT Ratio
						Zero Interest	Inst. Capital	Market Rate	Utility Capital		
Xcel	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$31,489	$2,024	$17,558	$13,931	82%	67%	56%	43%	100%	99.00
	Gas (Inflated Price)	$31,489	$2,381	$20,657	$10,832	97%	79%	66%	50%	100%	99.00
	Propane	.	.	.	.	.	.	.	.	.	.
CenterPoint	Gas (Current Price)	$31,489	$1,976	$17,148	$14,341	80%	66%	54%	42%	100%	99.00
	Gas (Inflated Price)	$31,489	$2,310	$20,041	$11,448	94%	77%	64%	49%	100%	99.00
Minnesota Power	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$31,489	$1,866	$16,190	$15,298	76%	62%	51%	39%	100%	99.00
	Gas (Inflated Price)	$31,489	$2,216	$19,229	$12,260	90%	74%	61%	47%	100%	99.00
	Propane	.	.	.	.	.	.	.	.	.	.
East Central Energy	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$31,489	$2,040	$17,696	$13,792	83%	68%	56%	43%	100%	99.00
	Gas (Inflated Price)	$31,489	$2,390	$20,734	$10,754	97%	79%	66%	50%	100%	99.00
	Propane	.	.	.	.	.	.	.	.	.	.
City of Warren	Electric	.	.	.	.	.	.	.	.	.	.
	Gas (Current Price)	$31,489	$1,758	$15,257	$16,232	71%	58%	48%	37%	100%	99.00
	Gas (Inflated Price)	$31,489	$2,118	$18,379	$13,110	86%	70%	58%	45%	100%	99.00
	Propane	.	.	.	.	.	.	.	.	.	.

Xcel's planning assumptions for custom upgrades in its joint multi-family building efficiency program with CenterPoint indicate a highly cost-effective program for participants (where rebate levels are nearly equal to incremental costs). However, it is unlikely that the full installed cost can be financed using TOB given the low cost of gas heat, though partial financing may still be attractive for multi-family building owners.

Summary of Results

Comparing screening results across the above home energy upgrades reveals clear trends in the types of measures that are good candidates for TOB financing. Several key points that reveal trends in these results are discussed below. Table 42 provides a simplified and illustrative characterization of measure suitability that illustrates the general relative participant economic feasibility of financing different energy efficiency upgrades through TOB (noting that the cost-effectiveness of a particular measure would depend on the characteristics of a home and existing heating efficiencies and envelope tightness, as well as any bundling strategy).

Table 42. Illustrative Suitability by Measure and Existing Heating Fuel

Measure	Electric	Gas	Propane
Attic/Ceiling Insulation + Air Sealing	Strong	Okay	Strong
Wall Insulation	Strong	Okay	Strong
Air Source Heat Pump	Limited	Poor	Poor
Ground Source Heat Pump	Limited	Poor	Poor
Ductless Minisplit	Okay	Poor	Limited
Furnace	N/A	Okay	N/A
Boiler	N/A	Limited	N/A
Central Air Conditioner	Poor	N/A	N/A
Heat Pump Water Heater	Okay	Poor	Limited
Gas Tank Water Heater	N/A	Limited	N/A
Gas Tankless Water Heater	N/A	Poor	N/A
Clothes Washer	Poor	Poor	N/A
Clothes Dryer	Poor	Poor	N/A
Refrigerator	Okay	N/A	N/A
Solar Photovoltaic	Okay	N/A	N/A
Multifamily Whole Home Upgrade	N/A	Okay	N/A

Key takeaways from this assessment include:

- **The greatest opportunity for TOB financing is in envelope measures.** This is consistent with participation records from prior PAYS programs, where envelope improvements have accounted for the bulk of program participation. In homes heated by electricity or propane, financing for envelope improvements is attractive in a home with standard insulation levels, and dramatically so in a home with poor insulation levels. The low cost of gas heat makes applicability more difficult, but there are still ample opportunities for financing envelope improvements (especially wall insulation in poorly insulated homes). In several cases, envelope improvements may be combined with other measures that are cost effective but not fully financeable to develop an attractive financing package. It should be noted that there is a wide range in the costs and savings of home envelope measures, which is demonstrated in program data from current utility CIPs, and so evaluating the specific opportunity for cost-effective energy improvements in a given home is critical.

- **Opportunities to finance HVAC improvements must be considered on a case-by-case basis.** It may be difficult to fully finance HVAC equipment on a standalone basis in many cases, though there are several opportunities to do either in specific circumstances or in combination with measure packages. In electric-heated homes, ductless mini-splits may be an attractive candidate for financing given their modular nature and relatively low cost, especially when combined with envelope measures or used as a partial heating source. Opportunities to finance heating systems in gas-heated homes are more limited but do exist. TOB may be an attractive tool to drive the purchase of efficient furnaces, for example, in cases when an existing heating system has failed and the homeowner must purchase a new furnace regardless, with financing being used to cover the incremental cost of a more efficient system.
- **Other discrete potential applications for TOB financing are available.** For example, financing HPWHs in homes with electric water heaters may be a viable option, as well as financing refrigerators or rooftop solar systems (especially in the case of customers that qualify for existing solar rebates such as Xcel's income-based Solar Rewards incentive). TOB financing may also be an attractive tool to support the joint Xcel-CenterPoint Multi-Family Building Efficiency program by addressing a large portion of the cost of a complex building upgrade.

It should be noted that, in existing TOB financing programs, opportunities for financing are not evaluated on a prescriptive measure-level basis using average building performance characteristics as they have been here, but rather on a home-by-home basis with the aim of identifying a financeable package of upgrades (relying primarily on building envelope improvements and small cost-effective measures) that would not require a copayment. Based on the particular characteristics of a home, different measures may be cost-effective (varying, for instance, based on the efficiency of existing equipment or on the opportunity to right-size HVAC equipment in tandem with home envelope improvements). As indicated above, there is likely to be such an opportunity to develop a package of financeable measures in many targeted households in Minnesota, particularly those with electric heat or poor existing levels of insulation or building tightness.

Program Benchmarking

This section considers data from prior on-bill programs (both tariff-based and loan based) to benchmark potential participation rates and program costs. Three of the five utilities included in this assessment are IOUs, for which there is more limited prior program data available for comparison.[29] Therefore, prior programs available for benchmarking include:

- Prior TOB programs (using the PAYS system) implemented by rural electric cooperatives, which generally have smaller service areas than the IOUs included in this assessment.
- Prior loan-based on-bill financing programs implemented by investor-owned utilities.

The reference data for this discussion is based primarily on two PAYS programs implemented in Arkansas and North Carolina, and the On-Bill Recovery program in development in Minnesota by CenterPoint Energy.[30] As neither of these data sources is fully analogous to a large-scale TOB program implemented by an IOU in Minnesota, the participation and administrative costs projections in this section must be interpreted as being subject to a degree of uncertainty.

Program Participation Rates

Previous PAYS programs implemented by rural electric cooperatives have demonstrated participation rates of approximately 5% of residential meters within 3 years. EEtility, a PAYS program implementer, provides a rule of thumb estimate of 1%-1.5% participation in the first year of program operation in the first year and 2%-2.5% in subsequent years. Within the first three years of operation, the HELP PAYS® program operated in Arkansas has just reached 520 installations (6.1% of the residential meters served by Ouachita Electric Cooperative). Most utilities that have implemented TOB programs for residential energy upgrades serve less than 50,000 residential meters.

The On-Bill Recovery Program currently in development by CenterPoint Energy in Minnesota targets an annual participation rate of 500 participants. If this participation rate were maintained over a five-year period, the resulting 2,500 participants would represent 0.3% of CenterPoint's residential meters.

This targeted rate of participation is considerably less than the assumed participation in rebate-based programs in Minnesota. CenterPoint's 2017-2019 CIP targeted the installation of roughly 13,000 furnace or boiler improvements and approximately 1,300 attic or wall insulation participants per year. CenterPoint's dedicated low-income programs target an additional 200 furnace or boiler improvements and 600 attic or wall insulation participants per year. Xcel's 2017-2019 CIP targeted around 7,300 furnace or boiler rebates, 250 heat pump rebates, and 900 attic or wall attic or wall insulation

[29] To date, the only existing example of an IOU TOB program is the SolarSaver program operated by Hawaiian Electric Company, which offered tariffed financing for solar hot water systems. In July 2019, the Georgia Public Service Commission approved a pilot PAYS program operated by Georgia Power, the primary IOU in the state.

[30] This program is an on-bill loan repayment program.

participants (roughly 150 of which are expected from low-income programs and are provided at no cost to program participants) per year.

Program Implementation and Administration Costs

Similar to program participation rates, there is a wide range in program implementation and administration costs available from prior references programs.

In discussions with utility cooperatives that have implemented TOB programs, cooperative leaders have noted that program administration tends to require less than one Full-Time Employee (FTE) to operate,[31] and have incurred minimal costs to adjust billing software or conduct marketing and outreach. EEtility, an experienced PAYS program implementer, reports that in its current pricing it offers program implementation and delivery for a fee of roughly $1,130 per participating home, which covers the direct cost of audit and test-out procedures, data management, and administration and other overhead costs. Typically, the majority of this (roughly two thirds) is funded by the implementing utility and reflects the cost of audits and other program costs. Program participants are responsible for covering certain costs that are specific to their project site, and a portion of this implementation and delivery fee (just under $400) is incorporated into the tariffed cost recovery payments made by the program participant. A similar administrative cost structure has been used in other PAYS programs, such as the How$martKY program operated in Kentucky. Based on discussions with EEtility about program set-up costs, Cadmus estimates an additional program set-up cost to the utility of roughly $26,000, covering software optimization, contractor training, and other costs for a program operating on a scale that serves approximately 200 households per year or less.

In comparison to these relatively streamlined costs for TOB programs reaching approximately 200 households per year or less, the costs of the On-Bill Recovery program proposed by CenterPoint to reach 500 households per year are substantially higher, reflecting the larger scale and complexity of an IOU-based program. CenterPoint's CIP estimated first-year costs of $1.1 million to develop, launch, and implement a program reaching 500 participants per year, with subsequent annual costs of $625,000 to $650,000 after the initial year.[32] The bulk of this cost is from project delivery, which includes implementation partner fees, utility CIP labor, and additional billing and customer service costs. In addition, CenterPoint generally anticipates incurring $75,000 annually in utility program administration costs, $25,000 annually in advertising and promotions, and $25,000 annually (post-launch) in evaluation.

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[31] As a general rule of thumb, PAYS program developers recommend budgeting one full-time employee to implement a program serving 200 participants per year. See the *Decision Tool for Utility Managers* developed by the Energy Efficiency Institute, Inc., available at: https://roanokeelectric.com/sites/roanokeec2/files/PDF/Pay%20as%20you%20Save/Decision%20Tool%20for%20Utility%20Managers%20v14.pdf

[32] These costs were revised in a 2018 budget modification request to reflect revised budget estimates and a delayed timeline, though overall annual costs remained broadly similar.

Roughly interpreting CenterPoint's project delivery budget, program start-up costs are expected to amount to roughly $425,000, and subsequent annual project delivery costs are projected at $525,000. On a per-participant basis, project delivery would amount to $1,050 per participant, roughly in line with the per-participant costs of a cooperative-run PAYS program. This comparison is intended for illustrative purposes only, and CenterPoint has cautioned that its program costs are not intended to be extrapolated on a per-participant basis. While the program cost projections for the CenterPoint OBR program were used here as the best local estimate of IOU on-bill financing program costs, stakeholders noted that these costs may not be appropriate for use in a TOB program as well. For example, stakeholders noted that the CenterPoint loan program budget was developed anticipating that quality assurance checks would be conducted for a subset of participants, not all participants, and that associated costs could increase if such checks were to be conducted for all participants and be funded by the utility.

Analysis Assumptions

As there is not a directly comparable state-wide or IOU-operated TOB program for residential energy from which to draw assumptions, there is a degree of uncertainty in projecting participation and administrative cost assumptions in this analysis.

Cadmus developed two scenarios for program participation and administrative costs, which were utilized in the subsequent benefit-cost analysis. The first is a relatively conservative base scenario, grounded primarily on CenterPoint's OBR estimates for IOUs (and assuming a simplified start-up process for non-IOUs based on past TOB programs). [33] At stakeholder working group request, Cadmus also included a scenario with higher participation rates that targeted 1% participation over five years. This higher penetration level represents a substantial increase in the participation rate compared to CenterPoint's OBR program assumptions, but falls below the rates typically seen in TOB programs implemented in smaller jurisdictions.[34]

As noted above, in several existing TOB programs, a portion of project delivery costs are recovered from program participants through fees that are incorporated into tariffed payments. However, based on stakeholder working group feedback, and to be consistent with the proposed CenterPoint OBR programs, this analysis assumed that program implementation and delivery costs (as well as the loss

[33] Participation and cost estimates were not developed for East Central Energy, as they were not able to share utility cost information and so were not included in the benefit-cost analysis portion of this assessment.

[34] The participation scenario should be viewed as illustrative and is used to provide an indicative understanding of the impact of higher participation on benefit-cost results. This scenario was included to respond to stakeholder working group requests and is not based on data from prior IOU financing programs. While existing TOB programs implemented by small rural utilities have yielded significantly higher participation rates (on a percentage basis) than this, these were not replicated directly in this analysis as these utilities were not considered an appropriate benchmark for a larger IOU-implemented program and the resulting participation rates would far eclipse participation rates in existing low-income programs in Minnesota.

reserve) would be borne entirely by the program without any allocation of project costs (beyond the direct cost of installed equipment) to program participants.

Table 43. Participation and Program Cost Assumptions Used in Benefit-Cost Analysis

Utility		Xcel	CenterPoint	Minnesota Power	City of Warren
Total Residential Meters		1,140,536	782,021	122,295	767
Base Scenario	Participants/Yr [a]	729	500	78	10
	% of Res. Meters (5 years)	0.3%	0.3%	0.3%	6.5%
	Start-Up Costs [b]	$475,000	$475,000	$475,000	$25,000
	Annual Program Costs [c]	$947,700	$650,000	$101,400	$35,200
Increased Participation Scenario	Participants/Yr [d]	2,281	1,564	245	20
	% of Res. Meters (5 years)	1.0%	1.0%	1.0%	13.0%
	Start-Up Costs [b]	$475,000	$475,000	$475,000	$25,000
	Annual Program Costs [c]	$2,965,300	$2,033,200	$318,500	$45,400

[a] Base participation for IOUs based on CenterPoint OBR program assumption for IOUs and pro-rated by total residential meters. Assumed flat rate of 10 participants per year in City of Warren given its small size (with an annual participation rate that is roughly in line with prior TOB programs).

[b] Start-up costs applied in first year only, based on CenterPoint OBR program assumption for IOUs and PAYS program implementer discussions for City of Warren.

[c] Annual program costs (inclusive of both administrative overhead and program implementation and delivery) incurred in each year (and added to start-up costs in first year), based on CenterPoint OBR program assumptions for IOUs, pro-rated by participation. City of Warren per-participant costs based on PAYS program implementer discussions and include fixed cost of part-time program administrator.

[d] These increased participation rates reflect simple assumptions of 1% of residential meters participating over five years for IOUs, and 20 participants per year for City of Warren.

Benefit-Cost Analysis

Overview

To demonstrate the potential program-level cost-effectiveness of TOB financing, this section assesses a series of hypothetical TOB programs using traditional energy efficiency benefit-cost tests (detail on the specific cost and benefits components that are included in each test is provided in Table 45): [35]

- **Societal Cost Test (SCT).** This test evaluates the overall cost-effectiveness of a program without adopting the perspective of a particular actor. The lifetime discounted benefits of wholesale energy reductions and environmental impacts are compared to the lifetime discounted installation and program costs.
- **Participant Cost Test (PCT).** This test considers the perspective of program participants, comparing lifetime energy savings to upfront and ongoing participant costs.
- **Utility Cost Test (UCT).** This test considers the utility perspective, and compares the lifetime benefits of avoided energy and capacity costs to the lifetime costs of administering a program.
- **Ratepayer Impact Measure (RIM).** Finally, this test considers utility ratepayers, comparing the benefit of utility energy cost savings (which puts downward pressure on rates) against utility program costs and lost revenues from decreased retail sales (which puts upward pressure on rates). For energy efficiency programs, it is common for the RIM to fail, as participant energy savings leads the utility to recover fixed costs across a smaller number of retail sales.

For all of these tests, lifetime benefits and costs are tallied and discounted on a net present value basis. Lifetime discounted benefits are divided by lifetime discounted costs to yield a benefit-cost ratio. If the B-C ratio is greater than one, the program is considered to pass that particular test. This analysis utilized the discount rates shown below:

Table 44. Discount Rates

Cost Test	Discount Rate	Source
SCT	2.55%	Xcel CIP
PCT	2.55%	Xcel CIP
UCT/RIM - Xcel	7.04%	Xcel CIP
UCT/RIM - CenterPoint	6.44%	CenterPoint CIP
UCT/RIM – Minn. Power	6.74%	None provided, average of Xcel/ CenterPoint
UCT/RIM - City of Warren	5.00%	None provided, based on past municipal utility analyses

Avoided energy costs, escalation factors, environmental damages, and line losses were based on utility CIPs. For the purposes of evaluating TOB financing, Cadmus defined the benefit-cost tests as having the following components:

[35] Additional information on these standard cost-effectiveness tests and their calculation is available in the US EPA resource *Understanding Cost-Effectiveness of Energy Efficiency Programs,* available at: https://www.epa.gov/sites/production/files/2015-08/documents/cost-effectiveness.pdf

Table 45. Overview of Costs and Benefits Included in Analysis of a TOB Program

BCA Category	Description	SCT	PCT	UCT	RIM
Avoided Electric Energy Costs[36]	*Avoided utility volumetric electricity purchases that result from participant energy savings.*	Benefit		Benefit	Benefit
Avoided Electric Capacity Costs	*Avoided utility volumetric electricity capacity reservations that result from participant energy savings.*	Benefit		Benefit	Benefit
Avoided Gas Energy Costs	*Avoided utility volumetric gas purchases that result from participant energy savings.*	Benefit		Benefit	Benefit
Avoided Gas Capacity Costs	*Avoided utility volumetric gas capacity reservations that result from participant energy savings.*	Benefit		Benefit	Benefit
Retail Electric Savings	*Reduced participant retail electricity costs*		Benefit		Cost
Retail Gas Savings	*Reduced participant retail gas costs*		Benefit		Cost
Retail Propane Savings[37]	*Reduced participant retail propane costs*	Benefit	Benefit		
Environmental Benefits	*Reduced environmental damages associated with energy savings.*	Benefit			
Incremental Measure Costs[38]	*Additional cost of installing energy efficiency measures compared to baseline measures (less federal tax credits)*	Cost			
Rebates[39]	*Rebates offered for installation of efficiency measures*			Cost	Cost
Incremental Co-Payment	*Upfront payment required of a TOB customer to meet any non-financeable upfront costs*		Cost		
Cost Recovery Payments[40]	*Monthly tariffed cost recovery payments made by TOB participant*		Cost		
Loss Reserve[41]	*Cost of funding program loss reserve fund*			Cost	Cost
Cost of Capital Subsidy[42]	*Socialized incentive applied to program cost of capital*			Cost	Cost
Program Costs	*Program costs incurred by a utility or other program implementer*	Cost		Cost	Cost

[36] In the UCT and RIM tests, avoided electric and gas costs are only applied if the relevant utility provides that fuel.

[37] In lieu of avoided costs, propane savings are included in the SCT at the retail level.

[38] Measures costs are typically included as a participant cost, but are not in this case as they would be financed through a TOB program (save for any customer co-payment, which is included in the PCT).

[39] Rebates are typically included as a participant benefit, but are not in this case as it assumed that any available rebates are accounted for in the tariffed amount.

[40] Tariffed investment and cost recovery are not included in the UCT and RIM test as it is assumed that program capital is sourced from an outside partner or, in the case of utility capital, that it is recovered at the utility's cost of capital for a net neutral impact.

[41] This analysis assumes that a 1% loss reserve is included in a TOB program, which is funded as a program implementation cost. This analysis assumes that any charge-offs are paid out of the loss reserve, and charge-offs are not otherwise tracked.

[42] Cost of capital subsidies only apply to the zero-interest financing scenario, which assumes that subsidy funds would be made available to offer zero-percent financing to TOB program participants.

This analysis does not consider any potential double-counting or allocation of savings that may occur between TOB programs and existing rebate programs. For the purposes of this analysis, rebates that are paid to program participants are counted as a utility cost, and the full amount of energy savings is attributed to the TOB program.

Cadmus conducted a benefit-cost analysis for each utility and on a state-wide aggregate basis. A benefit-cost analysis was not conducted for a program operated by East Central Energy, as the utility was unable to share avoided energy cost data as part of this analysis. Eight scenarios were assessed, reflecting four different potential cost of capital scenarios, and both the Base and Increased program participation rates described above.

Given the broad number of scenarios, Cadmus used a simplified process for determining the measure mix of a TOB program for benefit-cost purposes: for each installation measure or combination that passes a series of screening criteria, an even share of program participation was allocated.[43] Potential energy improvements that met the following criteria were included in the assumed mix of measures for the purposes of benefit-cost analysis:

- The measure must pass the Participant Cost Test without financing. That is, in a scenario where no financing is offered, the measure must represent a cost-effective investment for participants.
- An adequate portion of the measure cost must be financeable. For this purpose, financing was considered adequate if it could address at least 70% of the post-rebate upfront cost and result in a co-payment of less than $1,000, or if it could address at least 80% of the incremental measure cost and result in a co-payment of less than $200.

In addition, potential energy improvements that met the following criteria were excluded in the assumed mix of measures for the purposes of the benefit-cost analysis:[44]

- Fuel-switching measures (i.e. heat pumps replacing gas or propane consumption) were excluded, as were applications where the space heating is not provided by the relevant utility (e.g. an electric utility installing envelope measures for gas-heated or propane-heated homes). These screening factors were included to maintain consistency with current Minnesota CIP practices, and are not conditions of a TOB program.

[43] There are clear weaknesses in this approach, as it assumes even participation within a scenario regardless of measure type, as well as even participation across scenarios regardless of the program cost of capital (as logically, participation would be greater if a lower program cost of capital were made available to participants). However, as the participant adoption analysis required to develop a more detailed participation projection is beyond the scope of this effort and as this exercise is intended to provide an indicative assessment of potential program cost-effectiveness, this simplified approach was used.

[44] These screening factors do not necessarily reflect the financial or programmatic feasibility of the excluded measures within a TOB program, but were used as simplifying assumptions to provide greater clarity in the results of this analysis.

- For gas measures, only the Current Price scenario (rather than Inflated Price scenario) for retail gas prices was considered.
- Solar photovoltaic installations were not included as these are not part of utility CIPs and are not typically evaluated using energy efficiency benefit-cost tests.
- Whole-home custom multifamily installations were not included as the sheer size of these projects would skew the program-level results.

Results

The tables below display the results for each of the eight BCA scenarios, followed by a summary table of the aggregated BCA ratio for all utilities combined across each scenario.

Table 46. BCA Results – Base Participation Scenario, Zero-Interest Capital, 5 Year Program

Test	Input	Xcel	CenterPoint	Minnesota Power	City of Warren	Aggregate
Societal Cost Test	Benefits	$24,912,170	$15,525,408	$2,967,268	$633,105	$44,037,950
	Cost	$22,484,716	$10,075,780	$3,361,069	$395,472	$36,317,036
	Net	$2,427,454	$5,449,628	-$393,801	$237,633	$7,720,914
	BC Ratio	1.11	1.54	0.88	1.60	1.21
Participant Cost Test	Benefits	$40,377,996	$12,194,454	$9,341,507	$439,215	$62,353,173
	Cost	$12,675,183	$3,975,395	$1,825,506	$144,538	$18,620,622
	Net	$27,702,813	$8,219,059	$7,516,001	$294,677	$43,732,550
	BC Ratio	3.19	3.07	5.12	3.04	3.35
Utility Cost Test	Benefits	$10,624,620	$7,401,691	$1,209,448	$390,245	$19,626,004
	Cost	$10,585,537	$6,362,338	$1,677,460	$265,571	$18,890,907
	Net	$39,082	$1,039,353	-$468,012	$124,674	$735,097
	BC Ratio	1.00	1.16	0.72	1.47	1.04
Ratepayer Impact Measure	Benefits	$10,624,620	$7,401,691	$1,209,448	$390,245	$19,626,004
	Cost	$35,739,917	$12,769,363	$7,684,970	$599,841	$56,794,091
	Net	-$25,115,297	-$5,367,673	-$6,475,522	-$209,595	-$37,168,087
	BC Ratio	0.30	0.58	0.16	0.65	0.35

Table 47. BCA Results – Base Participation Scenario, Institutional Capital, 5 Year Program

Test	Input	Xcel	CenterPoint	Minnesota Power	City of Warren	Aggregate
Societal Cost Test	Benefits	$25,019,024	$18,145,607	$2,967,268	$601,751	$46,733,651
	Cost	$20,890,326	$10,677,668	$3,361,069	$375,622	$35,304,685
	Net	$4,128,699	$7,467,939	-$393,801	$226,129	$11,428,966
	BC Ratio	1.20	1.70	0.88	1.60	1.32
Participant Cost Test	Benefits	$40,286,930	$14,372,322	$9,341,507	$423,517	$64,424,277
	Cost	$13,882,594	$5,592,150	$2,197,833	$158,660	$21,831,237
	Net	$26,404,336	$8,780,172	$7,143,675	$264,857	$42,593,040
	BC Ratio	2.90	2.57	4.25	2.67	2.95
Utility Cost Test	Benefits	$10,693,239	$8,609,117	$1,209,448	$370,041	$20,881,845
	Cost	$6,583,435	$4,806,042	$1,126,475	$209,434	$12,725,386
	Net	$4,109,804	$3,803,075	$82,972	$160,608	$8,156,459
	BC Ratio	1.62	1.79	1.07	1.77	1.64
Ratepayer Impact Measure	Benefits	$10,693,239	$8,609,117	$1,209,448	$370,041	$20,881,845
	Cost	$31,659,832	$12,258,236	$7,133,985	$531,695	$51,583,749
	Net	-$20,966,593	-$3,649,119	-$5,924,538	-$161,654	-$30,701,904
	BC Ratio	0.34	0.70	0.17	0.70	0.40

Table 48. BCA Results – Base Participation Scenario, Market-Rate Capital, 5 Year Program

Test	Input	Xcel	CenterPoint	Minnesota Power	City of Warren	Aggregate
Societal Cost Test	Benefits	$23,143,458	$15,852,950	$2,967,268	$620,708	$42,584,384
	Cost	$19,724,908	$9,326,094	$3,361,069	$361,171	$32,773,241
	Net	$3,418,551	$6,526,856	-$393,801	$259,537	$9,811,143
	BC Ratio	1.17	1.70	0.88	1.72	1.30
Participant Cost Test	Benefits	$39,464,025	$12,616,785	$9,341,507	$441,670	$61,863,987
	Cost	$15,189,738	$5,397,651	$2,604,253	$169,545	$23,361,188
	Net	$24,274,287	$7,219,133	$6,737,254	$272,125	$38,502,799
	BC Ratio	2.60	2.34	3.59	2.61	2.65
Utility Cost Test	Benefits	$9,676,364	$7,570,255	$1,209,448	$378,688	$18,834,755
	Cost	$6,477,053	$4,551,011	$1,126,443	$210,681	$12,365,188
	Net	$3,199,311	$3,019,244	$83,005	$168,007	$6,469,567
	BC Ratio	1.49	1.66	1.07	1.80	1.52
Ratepayer Impact Measure	Benefits	$9,676,364	$7,570,255	$1,209,448	$378,688	$18,834,755
	Cost	$31,039,586	$11,103,949	$7,133,953	$546,850	$49,824,338
	Net	-$21,363,222	-$3,533,694	-$5,924,505	-$168,162	-$30,989,583
	BC Ratio	0.31	0.68	0.17	0.69	0.38

Table 49. BCA Results – Base Participation Scenario, Utility Capital, 5 Year Program

Test	Input	Xcel	CenterPoint	Minnesota Power	City of Warren	Aggregate
Societal Cost Test	Benefits	$21,608,588	$10,746,532	$2,871,437	$612,479	$35,839,035
	Cost	$16,606,286	$7,373,581	$3,141,231	$346,554	$27,467,653
	Net	$5,002,301	$3,372,951	-$269,794	$265,924	$8,371,382
	BC Ratio	1.30	1.46	0.91	1.77	1.30
Participant Cost Test	Benefits	$36,720,435	$9,130,171	$9,035,646	$445,752	$55,332,005
	Cost	$15,034,498	$4,461,870	$3,003,685	$195,671	$22,695,723
	Net	$21,685,937	$4,668,301	$6,031,962	$250,081	$32,636,281
	BC Ratio	2.44	2.05	3.01	2.28	2.44
Utility Cost Test	Benefits	$9,051,164	$5,015,752	$1,170,001	$370,817	$15,607,734
	Cost	$6,196,489	$4,128,655	$1,125,064	$208,228	$11,658,437
	Net	$2,854,675	$887,096	$44,937	$162,588	$3,949,296
	BC Ratio	1.46	1.21	1.04	1.78	1.34
Ratepayer Impact Measure	Benefits	$9,051,164	$5,015,752	$1,170,001	$370,817	$15,607,734
	Cost	$29,035,138	$8,470,373	$6,933,906	$546,290	$44,985,707
	Net	-$19,983,974	-$3,454,621	-$5,763,905	-$175,473	-$29,377,973
	BC Ratio	0.31	0.59	0.17	0.68	0.35

Table 50. BCA Results – Increased Participation Scenario, Zero-Interest Capital, 5 Year Program

Test	Input	Xcel	CenterPoint	Minnesota Power	City of Warren	Aggregate
Societal Cost Test	Benefits	$77,948,778	$48,563,476	$9,320,264	$1,266,210	$137,098,727
	Cost	$69,342,163	$30,506,239	$9,540,216	$647,007	$110,035,625
	Net	$8,606,615	$18,057,237	-$219,952	$619,203	$27,063,102
	BC Ratio	1.12	1.59	0.98	1.96	1.25
Participant Cost Test	Benefits	$126,340,478	$38,144,252	$29,341,914	$878,431	$194,705,075
	Cost	$39,659,933	$12,435,037	$5,733,962	$289,076	$58,118,008
	Net	$86,680,544	$25,709,216	$23,607,952	$589,355	$136,587,067
	BC Ratio	3.19	3.07	5.12	3.04	3.35
Utility Cost Test	Benefits	$33,243,838	$23,152,488	$3,798,906	$780,491	$60,975,723
	Cost	$32,110,303	$18,890,593	$4,251,958	$392,494	$55,645,347
	Net	$1,133,535	$4,261,896	-$453,051	$387,997	$5,330,376
	BC Ratio	1.04	1.23	0.89	1.99	1.10
Ratepayer Impact Measure	Benefits	$33,243,838	$23,152,488	$3,798,906	$780,491	$60,975,723
	Cost	$110,816,941	$38,931,768	$23,121,701	$1,061,033	$173,931,443
	Net	-$77,573,103	-$15,779,280	-$19,322,794	-$280,542	-$112,955,720
	BC Ratio	0.30	0.59	0.16	0.74	0.35

Table 51. BCA Results – Increased Participation Scenario, Institutional Capital, 5 Year Program

Test	Input	Xcel	CenterPoint	Minnesota Power	City of Warren	Aggregate
Societal Cost Test	Benefits	$78,283,120	$56,759,460	$9,320,264	$1,203,503	$145,566,347
	Cost	$64,353,406	$32,388,947	$9,540,216	$607,308	$106,889,876
	Net	$13,929,715	$24,370,513	-$219,952	$596,194	$38,676,471
	BC Ratio	1.22	1.75	0.98	1.98	1.36
Participant Cost Test	Benefits	$126,055,537	$44,956,624	$29,341,914	$847,035	$201,201,110
	Cost	$43,437,856	$17,492,246	$6,903,449	$317,320	$68,150,871
	Net	$82,617,681	$27,464,378	$22,438,466	$529,715	$133,050,239
	BC Ratio	2.90	2.57	4.25	2.67	2.95
Utility Cost Test	Benefits	$33,458,544	$26,929,319	$3,798,906	$740,083	$64,926,852
	Cost	$19,587,950	$14,022,500	$2,521,301	$280,219	$36,411,969
	Net	$13,870,593	$12,906,819	$1,277,606	$459,864	$28,514,882
	BC Ratio	1.71	1.92	1.51	2.64	1.78
Ratepayer Impact Measure	Benefits	$33,458,544	$26,929,319	$3,798,906	$740,083	$64,926,852
	Cost	$98,050,587	$37,332,962	$21,391,044	$924,742	$157,699,335
	Net	-$64,592,043	-$10,403,643	-$17,592,137	-$184,659	-$92,772,483
	BC Ratio	0.34	0.72	0.18	0.80	0.41

Table 52. BCA Results – Increased Participation Scenario, Market-Rate Capital, 5 Year Program

Test	Input	Xcel	CenterPoint	Minnesota Power	City of Warren	Aggregate
Societal Cost Test	Benefits	$72,414,580	$49,588,026	$9,320,264	$1,241,417	$132,564,287
	Cost	$60,706,878	$28,161,221	$9,540,216	$578,407	$98,986,722
	Net	$11,707,702	$21,426,805	-$219,952	$663,010	$33,577,565
	BC Ratio	1.19	1.76	0.98	2.15	1.34
Participant Cost Test	Benefits	$123,480,715	$39,465,302	$29,341,914	$883,339	$193,171,271
	Cost	$47,527,837	$16,883,854	$8,180,026	$339,090	$72,930,806
	Net	$75,952,878	$22,581,449	$21,161,889	$544,250	$120,240,466
	BC Ratio	2.60	2.34	3.59	2.61	2.65
Utility Cost Test	Benefits	$30,276,799	$23,679,758	$3,798,906	$757,376	$58,512,840
	Cost	$19,255,087	$13,224,764	$2,521,199	$282,713	$35,283,763
	Net	$11,021,712	$10,454,995	$1,277,708	$474,663	$23,229,077
	BC Ratio	1.57	1.79	1.51	2.68	1.66
Ratepayer Impact Measure	Benefits	$30,276,799	$23,679,758	$3,798,906	$757,376	$58,512,840
	Cost	$96,109,871	$33,722,353	$21,390,942	$955,051	$152,178,217
	Net	-$65,833,072	-$10,042,595	-$17,592,035	-$197,675	-$93,665,377
	BC Ratio	0.32	0.70	0.18	0.79	0.38

Table 53. BCA Results – Increased Participation Scenario, Utility Capital, 5 Year Program

Test	Input	Xcel	CenterPoint	Minnesota Power	City of Warren	Aggregate
Societal Cost Test	Benefits	$67,612,055	$33,615,151	$9,019,258	$1,224,957	$111,471,421
	Cost	$50,948,888	$22,053,761	$8,849,701	$549,173	$82,401,523
	Net	$16,663,167	$11,561,390	$169,557	$675,784	$29,069,898
	BC Ratio	1.33	1.52	1.02	2.23	1.35
Participant Cost Test	Benefits	$114,896,176	$28,559,176	$28,381,197	$891,504	$172,728,053
	Cost	$47,042,097	$13,956,730	$9,434,650	$391,342	$70,824,819
	Net	$67,854,078	$14,602,446	$18,946,547	$500,162	$101,903,233
	BC Ratio	2.44	2.05	3.01	2.28	2.44
Utility Cost Test	Benefits	$28,320,584	$15,689,271	$3,675,004	$741,633	$48,426,492
	Cost	$18,377,219	$11,903,634	$2,516,868	$277,808	$33,075,529
	Net	$9,943,365	$3,785,637	$1,158,136	$463,825	$15,350,963
	BC Ratio	1.54	1.32	1.46	2.67	1.46
Ratepayer Impact Measure	Benefits	$28,320,584	$15,689,271	$3,675,004	$741,633	$48,426,492
	Cost	$89,838,067	$25,484,526	$20,762,589	$953,931	$137,039,113
	Net	-$61,517,483	-$9,795,255	-$17,087,585	-$212,298	-$88,612,621
	BC Ratio	0.32	0.62	0.18	0.78	0.35

Table 54. Summary of BCA Results Aggregated Across All Utilities for Each Scenario

Participation Scenario	Cost of Capital	SCT	PCT	UCT	RIM
Base Participation	Zero-Interest	1.21	3.35	1.04	0.35
Base Participation	Institutional Capital	1.32	2.95	1.64	0.40
Base Participation	Market-Rate	1.30	2.65	1.52	0.38
Base Participation	Utility Capital	1.30	2.44	1.34	0.35
Increased Participation	Zero-Interest	1.25	3.35	1.10	0.35
Increased Participation	Institutional Capital	1.36	2.95	1.78	0.41
Increased Participation	Market-Rate	1.34	2.65	1.66	0.38
Increased Participation	Utility Capital	1.35	2.44	1.46	0.35

Comparing the results across scenarios, several key findings emerge:

- All scenarios pass the Societal Cost Test in aggregate state-wide. This test does not pass in most cases for Minnesota Power, which is due primarily to a greater presence of air and ground source heat pumps (which have high installed costs) in that utility's portfolio compared to others.
- The Utility Cost Test generally passes, but it is comparatively lower in the scenario in which the cost of capital provided to participants is subsidized (i.e. zero interest scenarios), as utility net benefits are reduced by the cost of capital buy-down (which for simplicity is included as a cost in the UCT in this analysis regardless of whether utility funds are ultimately the source of a cost of capital buy-down)[45]. The Minnesota Power program fails the UCT in this subsidized zero-interest scenario (and Xcel's is marginal). In non-subsidized instances, the Utility Cost Test generally passes.
- All scenarios pass the Participant Cost Test, because the measure screening process for the BCA ratio analysis only included the measures that individually passed the PCT. The PCT is strongly impacted by the program cost of capital, with lower costs of capital increasing participant cost-effectiveness.
- The BCA ratio for the Ratepayer Impact Measure is below 1 in all cases. This is generally true in energy efficiency programs, which often lead to ratepayer impacts due to decreased retail sales.
- The Increased Participation scenario has minimal impact on BCA results compared to the Base scenario. This indicates that base projections for program participation provide sufficient volume to justify fixed program costs. However, should participation levels be decreased below the Base level, or should program costs increase, this would reduce program cost-effectiveness among the SCT, UCT, and RIM tests.

[45] Alternately, if subsidies in the cost of capital were provided by outside partners (such as philanthropic funding), these would not count as a utility cost.

Policy and Program Design Considerations

Throughout this study period, stakeholder discussions have identified several program design considerations that must be addressed in any program implementation process. These considerations include:

- **Incorporation of fuel switching measures.** At stakeholder request, this analysis included fuel switching measures (i.e. installing an electric heat pump for space or water heating in a home heated by natural gas or non-utility fuels) in the measure screening assessment (though these were excluded from the benefit-cost analysis). Fuel switching applications are not currently included in the Minnesota TRM or utility CIPs. If these applications are included in a TOB program, the approach should be coordinated and reconciled with utility CIPs.
- **Inclusion of non-utility fuels.** Households heated by non-utility fuels (e.g. fuel oil and propane) have been eligible for some existing TOB programs. In Minnesota, while propane serves a minority of households, this heating fuel is likely disproportionately common in rural areas, and may be attractive to include in a program to allow these communities to participate in a TOB program. Non-utility savings are not included in the Minnesota TRM, and including these in a TOB program may require coordination with CIP programs. Additionally, a program design that includes non-utility fuels must consider the approach for estimating and tracking energy savings from non-utility fuels, which are not metered on a regular basis as electricity and natural gas are.
- **Identification of a program capital source.** As noted in this analysis, several scenarios for program funding and cost of capital have been discussed by the stakeholder group, including private capital, a partnership with an institutional partner (such as the Saint Paul Port Authority), or utility capital. The identification of a capital funding source will be a key consideration in the development of a TOB program.
- **Inclusion of new construction.** This analysis was limited to efficiency measures in existing buildings. Stakeholders raised the question of whether new construction measures could be included in a TOB program as well.
- **Overlap with existing efficiency programs serving low-income households.** Several stakeholders have noted that TOB financing may be intended to serve low-income households that are currently eligible for low- or no-cost upgrades. For example, Xcel Energy's CIP programs include the Home Energy Savings program, which provides free insulation and HVAC upgrades to income-qualified households, with additional offerings available to qualifying multi-family buildings. These programs may be more robust than comparable offerings in cooperative utility jurisdictions that have previously implemented TOB financing. However, the income eligibility thresholds for existing low-income programs (e.g. 50% of the state median income or double the federal poverty level) may exclude a broad swath of moderate-income customers that face barriers in accessing capital but that are not eligible for existing programs.
- **Aligning TOB energy savings assumptions with CIP planning values.** Utility stakeholders noted that, in the CIP process, energy efficiency savings are typically tracked and accounted for using deemed savings values. As a TOB program would instead develop household-specific estimates

of energy savings for each participant, this could lead to two different sets of program impact metrics for the program, which must be addressed.

- **Program delivery mechanism for multi-family and rental homes.** In implementing a TOB program that targets multifamily and rental properties, a program design must consider the perspectives and roles of tenants and property owners alike. For building-level improvements to multifamily properties (such as with the Xcel/CenterPoint multi-family building efficiency program), a program design must include a mechanism to allocate cost recovery obligations across multiple utility meters in the case of common improvements to individually-metered multifamily housing.
- **List of Eligible Measures.** Several stakeholders have noted that, in addition to the set of measures evaluation in this assessment, a TOB program could potentially cover smart thermostats, water heater controls, or electric vehicle charging equipment.
- **Inclusion of Loss Reserve.** This analysis has included a 1% loss reserve as a program cost as a strategy for mitigating the impact of any program charge-offs or missed payments. The design of a TOB program should consider the means of addressing participant non-payment, which could include the development of a loss reserve (or participation in existing offerings such as the Energy Solutions Reserve Fund developed by the North Carolina Sustainable Energy Association).
- **Measure Cost-Effectiveness Requirements.** As shown in the above measure screening assessment, it may be viable to package a measure that does not pass the participant cost test as a standalone measure with a suite of cost-effective small measures and envelope measures to develop a combined package that passes that test. A program design may consider whether such a strategy should be permitted (as it maximizes the amount of potential energy savings in a home) or restricted (as it includes individual measures that do not provide lifetime economic benefits to participants).
- **Consumer Protection.** Stakeholders have also raised several questions regarding potential consumer protections. This has included questions of what disclosure requirements are necessary upon the sale or lease of a household that is participating in the program, whether any steps are necessary ensure that low-income customers (who may qualify for grant-based programs) would receive the optimal program, whether program fees are required (and if so whether they should be subsidized for certain customer classes), and what rules should govern potential utility disconnection related to non-payment.
- **Regulatory and Legal Approval.** Finally, stakeholders have raised the question of what regulatory approvals or enabling legislation might be needed for a program or pilot to move forward.

Conclusions

Opportunities for Tariffed OBF

Of the measures included in the assessment, the most robust and compelling economic opportunity for participants in a TOB program would be building envelope upgrades such as insulation and air sealing. This is particularly true in homes with electric heat and in homes with below-average levels of existing insulation. By contrast, homes with natural gas heat present the lowest opportunity, though TOB envelope upgrades are still expected to be viable in gas-heated homes with poor levels of insulation and tightness. While envelope improvements are expected to be the most widespread opportunity for TOB in Minnesota, there are other intriguing opportunities as well, such as financing for ductless mini-splits in electric-heated homes, targeting the incremental cost of gas furnace upgrades, and financing the remaining post-incentive cost of solar PV installations.

The economic opportunities identified in this assessment are broadly consistent with the data from prior TOB programs. While there are important differences between TOB economic feasibility in Minnesota and past TOB programs in the Southeast (such as reduced opportunities for cooling measures and less ASHP suitability due to the colder climate), the general finding that the greatest opportunity lies in homes with electric heat and poor building envelopes is consistent with the emphasis in past programs on building envelope measures in high-consumption homes. While a majority of homes in Minnesota and the targeted LMI and rental household customer segments are heated by natural gas, electric heat is disproportionately common among these customer segments.

Impact of Cost of Capital

There are a variety of potential sources of capital that could be deployed in a TOB program, which have a range of potential costs of capital. Clearly, program participants would benefit from a low cost of capital, as shown in the above measure screening and benefit-cost analysis. In most cases the difference between costs of capital is incremental rather than dramatic, though the high cost of capital associated with the utility weighted average cost of capital was shown to be a limiting factor in many cases. The benefit-cost analysis indicates that a subsidized cost of capital may be a burden on utility cost-effectiveness tests. Therefore, the optimal source of capital for a TOB program may be a partnership with an institutional partner that is able to access low-cost financing and deploy it for a TOB program without the need for a subsidy.

Program Cost-Effectiveness

As shown in the section on benefit-cost analysis, a TOB program can be expected to satisfy program cost-effectiveness requirements, but results will depend on several factors. Chief among these is the mix of measures included in a program – this analysis purposefully identified and selected measures based on participant cost-effectiveness for average homes and homes with poor insulation, with the result of a highly cost-effective program.

Additionally, participation levels and program administration costs will be a key determinant of program cost-effectiveness. Based on this analysis, a TOB program achieving participation levels in line with

CenterPoint OBR program assumptions would provide adequate scale to justify fixed program development costs. However, should participation levels fall below these levels or program administrative costs exceed them, utility cost effectiveness may be harmed.

As noted above, the cost of the capital deployed in a TOB program would be a key determinant of participant cost-effectiveness. If the cost of capital were subsidized, this could be expected to improve participant cost-effectiveness, but to erode utility cost-effectiveness.

Program Planning Considerations

As noted in the program benchmarking discussion, a Minnesota TOB program, particularly one implemented in the Twin Cities, would be among the first TOB programs targeting residential energy upgrades developed at the scale of an investor-owned utility. As such, there is uncertainty regarding program cost and participation rates due to lack of direct precedent. For that reason, this assessment attempts to bound this uncertainty by drawing on reference data from prior non-IOU TOB programs as well as loan-based on-bill recovery program assumptions developed previously in Minnesota.

Additionally, while this assessment focuses primarily on the economic and financial feasibility of TOB financing, it has provided an opportunity for stakeholders to raise a series of important program design considerations. While this analysis does not attempt to resolve these program design and implementation issues, they are catalogued in the Policy and Program Design Considerations section of this report for reference by stakeholders in subsequent discussions.

Appendix 1: Advisory Working Group Participants

The Energy Transition Lab facilitated the study process and convened the Advisory Committee.

Facilitators	Title	Organization
Ellen Anderson	Executive Director	UMN Energy Transition Lab
Aaron Hanson	Energy Program Associate	UMN Energy Transition Lab
Consultants	**Title**	**Organization**
Ryan Cook	Senior Associate	The Cadmus Group
Kelly Kneeland	Senior Analyst	The Cadmus Group
Advisory Committee	**Title**	**Organization**
Alice Madden	Community Power Staff	Community Power
Ben Passer	Director, Energy Access and Equity	Fresh Energy
Bridget Dockter	Manager, Outreach & Policy	Xcel Energy
Carmen Carruthers	Outreach Director	Citizens Utility Board
Chris Duffrin	President	Center for Energy & Environment
Emma Schoppe	Local Energy Policy Manager	CenterPoint Energy
Gabe Chan	Assistant Professor	UMN Humphrey School of Public Affairs
Jamez Staples	President	Renewable Energy Partners
Jodi Slick	CEO	Ecolibrium 3
Joe Musolf	Interim Housing Director	City of St. Paul
John Farrell	Director, Energy Democracy Initiative	Institute for Local Self-Reliance
John Scicchitano	Director	NYSERDA
Jonathan Sewall	State Program Administrator	Minnesota Department of Commerce
Justin Jahnz	Manager, Energy Services and Strategic Projects	East Central Energy
Katherine Teiken	Energy Efficiency Fellow, Multifamily Division	Minnesota Housing
Kim Havey	Manager, Division of Sustainability	City of Minneapolis
Lisa Beckner	Data Analyst II	Minnesota Power
Lissa Pawlisch	Director	UMN Clean Energy Resource Teams
Liz Kutschke	Research Fellow	UMN Center for Sustainable Building Research
Marcus Mills	Board Member	Marcy Holmes Neighborhood Association
Pam Marshall	Executive Director	Energy Cents Coalition
Pat Huelman	Associate Extension Professor	UMN Cold Climate Housing Program
Ron Elwood	Supervising Attorney	Legal Services Advocacy Project
Shannon Mortenson	City Administrator/Clerk-Treasurer	City of Warren
Stephen Katz	Consultant	Consulting Engineers Group
Contributors	**Title**	**Organization**
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Ethan Warner	Regulatory Analyst	CenterPoint Energy
Nick VanDuzee	Energy Efficiency Engineer	CenterPoint Energy

Appendix 2: Policy and Law Considerations

Separately from the above economic and financial feasibility assessment of TOB financing, the Energy Transition Lab and Minnesota Department of Commerce requested that Cadmus conduct a review of several elements of Minnesota law that have been highlighted by stakeholders as relevant for the implementation of a TOB program in Minnesota. The resulting summary of this review is provided below.

CADMUS

Memorandum

To: Ellen Anderson, ellena@umn.edu

From: The Cadmus Group

Subject: Research Regarding Tariffed On-Bill Finance Under Minnesota Law

Date: May 31, 2019

Introduction

Tariffed On-Bill Finance ("TOBF") refers to a program in which energy efficiency measures and/or solar installations are made available to residential customers by a utility offer that pays for upgrades under the terms of a new, additional tariff. The investment is tied to the meter at the property where the upgrades are installed. The tariff includes a cost recovery charge on the bill such that the customer pays a monthly rate that is less than the rate they would have been charged without the efficiency measures and/or solar but more than the estimated savings generated by the measures, until the utility's investment cost is recovered. These models are often known as Inclusive Financing or Pay As You Save ("PAYS")©.

The question has been raised whether Minnesota statutes and rules authorize this model and whether any legislative or regulatory changes would have to be made for this program to be instituted by a Minnesota public utility. The Minneapolis Clean Energy Partnership ("CEP"), involving the city, Xcel Energy, and CenterPoint Energy, has been evaluating the opportunity for this type of program. CenterPoint, the gas utility, has raised the issue and circulated a document to the CEP suggesting that legislative or Public Utility Commission ("PUC") action would be needed in order to enable such a program. Community Power, a local nonprofit group, sponsored an additional analysis of the same issues that reached the opposite conclusion. The University of Minnesota has requested that the Cadmus Group provide this assessment[46] regarding these conflicting opinions in response to the below series of questions as a neutral third party.

[46] This memorandum is for informational purposes only and not for the purpose of providing legal, business, or tax advice or soliciting legal business. You should contact your attorney and/or tax advisor to obtain advice with respect to any particular issue or problem. Use of and access to this memorandum or any of the materials referenced or contained within the memorandum do not create an attorney client relationship between Cadmus Group LLC and the user. The Cadmus Group LLC is not a law firm and does not provide legal, financial, or tax advice. The opinions expressed at or through this memorandum are the opinions of the individual author(s) and may not reflect the opinions of The Cadmus Group LLC, or the firm's consulting clients.

Analysis

1. Is Minn. Stat. § 216B.03 direct authorization for the TOBF system to be approved following the standard ratemaking and rate changing processes applied to public utilities? Does Minn. Stat. § 216B.02 support that? Does it need explicit statutory authority as in CIP statute Minn. Stat. § 216B.241, Subd. 5d?

Minn. Stat. § 216B.03 states that public utility rates must be just and reasonable, must not be unreasonably discriminatory, and should encourage energy conservation and renewable energy use to the maximum reasonable extent.[47] On its face, this statute seems to support the idea of a TOBF system because such a system would support the state's energy planning and conservation goals, so long as the rate is determined to be just and reasonable. The authority to implement a TOBF system likely hinges on the interpretation of the definitions provided in Minn. Stat. § 216B.02 for "rates" and "service." These definitions are discussed in more detailed in response to question 2, below.

It is unclear whether the TOBF system would need explicit statutory authority such as the authority that has been provided for on-bill loan programs in the Energy Conservation Improvement statute ("CIP").[48] Minnesota's Energy Savings Policy Goal states that "it is the policy of the State of Minnesota to achieve annual energy savings equal to at least 1.5 percent of the annual retail energy sales of electricity and natural gas through cost-effective energy conservation improvement programs and rate design… and other efforts to promote energy efficiency and energy conservation."[49] Energy conservation improvement is defined as "a project that results in energy efficiency or energy conservation."[50] The state policy and definition of energy conservation seem to be inclusive of TOBF, but the CIP statute provides additional details and requirements that make TOBF's potential status unclear.

The CIP requires public utilities to invest in energy conservation in specific amounts to achieve the 1.5 percent annual energy savings target set forth in Minn. Stat. § 216B.2401,[51] authorizes the commissioner to regulate such programs,[52] and requires the public utilities to submit an energy conservation improvement plan to the commission that "*may* include… energy savings from electric

[47] Minn. Stat. § 216B.03

[48] Minn. Stat. § 216B.241, Subd. 5d

[49] Minn. Stat. § 216B.2401

[50] Minn. Stat. § 216B.241, Subd. 1, paragraph (e).

[51] Minn. Stat. § 216B.241, Subd. 1a.

[52] See e.g., Minn. Stat. § 216B.241, Subd. 2. The commissioner may also "explicitly se[t] forth the interest rates, prices, and terms under which the improvements must be offered to customers" for these energy conservation programs.

utility infrastructure projects approved by the commission,… or waste heat recovery converted into electricity projects that may count as energy savings."[53] Notably, the statute requires programs to provide energy savings, be cost effective, and be just and reasonable. The statute also specifically calls out energy infrastructure projects and waste heat projects as projects that may be approved by the commission, but is silent as to the additional specific components of the plan that could also be acceptable.[54] While TOBF isn't explicitly authorized, use of the word "may" could be interpreted as starting a non-exhaustive list in which TOBF would be permissible. The On-bill repayment programs' enabling statute (Minn. Stat. § 216.241, Subd. 5d) seems like an appropriate section of the Minnesota Statutes to include TOBF, but an "on-bill repayment program" is defined as a "program in which a utility collects on a customer's bill repayment of a loan to the customer by an eligible lender to finance the customer's investment in eligible energy conservation or renewable energy projects, and remits loan repayments to the lender."[55] This definition describes a loan program with a third party lender rather than an on-bill tariff for an incentive provided by the utility.

TOBF seems to fit within the purpose of CIP and could meet a broad interpretation of such a program. However, because specific provisions for a similar program do exist, legislation specifically enabling TOBF might be preferable or necessary under a narrow interpretation.

2. Is a TOBF program a "service" that may be offered by a public utility?

a. Is it consistent with definition of public utility "service" in Minn. Stat. § 216B.02, Subd. 6?

A public utility "service" as defined in Minn. Stat. § 216B.02, Subd. 6 is "natural, manufactured, or mixed gas and electricity; the installation, removal, or repair of equipment or facilities for delivering or measuring such gas and electricity."[56] It remains unclear whether a TOBF program meets this definition. The Minnesota Court of Appeals found that energy conservation improvements required of certain public utilities are not a "service" within the meaning of the statute, but instead are the purchase or installation of any device, method or material that increases efficiency in use of electricity or natural gas.[57] In regards to the solar installation component of TOBF, it is possible that solar installations would be considered a "service" because a PV system could be considered to be electricity or facilities that deliver electricity. It is also unclear whether the financing component of the program would be read as consistent with the definition of a "service."

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[53] Minn. Stat. § 216B.241, Subd. 1c, paragraph (d), emphasis added.

[54] *See* Minn. Stat. § 216B.241, Subd. 2, paragraph (e).

[55] Minn. Stat. § 216B.241, Subd. 5d, paragraph (a)(2)

[56] Minn. Stat. § 216B.02, Subd. 6

[57] In the Matter of Implementation of Utility Energy Conservation Improvement Programs and the Establishment of a Utility Renewable Resources Pilot Program, 368 N.W. 2d 308, 313. Minn. Ct. of Appeals, May 28, 1985.

b. *Is it a rule, practice, or contract under definition of "rate" in Minn. Stat. § 216B.02, Subd. 5?*

A "rate" is defined in Minn. Stat. § 216B.02, Subd. 5 as "every compensation, charge, fare, toll, tariff, rental, and classification, or any of them, demanded, observed, charged, or collected by any public utility for any service and any rules, practices, or contracts affecting such compensation, charge, fare, toll, rental, tariff, or classification." Based on this definition, it appears that a "rate" includes a tariff charged and collected by a public utility for any service. The question remains whether the word "service" in this statute has a definition broader than how "service" is defined in Minn. Stat. § 216B.02, Subd. 6.

In its memo, CenterPoint found that if the program in question is not a service, a rate cannot be charged absent specific authorization, and presumably interprets "any rules, practices or contracts affecting such compensation…" to be limited by the question of "service." In contrast, Apparatus' memo states that "service" is not the limiting factor, and that "any rules, practice, or contracts affecting any such compensation" should be broadly interpreted to include any practices that have a bearing on the charge for a service. This point of disagreement has not been clarified, and thus the interpretation remains open to a potential legal challenge. If the charge must be for a service, then it reasonably follows that any rule or practice related to the charge would also be related to a service, which may exclude TOBF.

There is additional nuance for potential solar photovoltaic installations included in a TOBF offer. In these cases, TOBF would be a financing mechanism that supports solar installations, and could therefore be considered a rule or practice with a "bearing on the charge for a service." Under the existing law, this could be interpreted as providing more leeway for TOBF for renewable energy generating services because renewable energy generating services could be interpreted as satisfying the definition of a service (as discussed in section 2a, above).

c. *Does the explicit authority related to energy conservation improvements in Minn. Stat. § 216B.16, Subd. 6b authorize TOBF?*

As has been discussed in the response to question 1, it is unclear whether TOBF is authorized under the CIP statute (Minn. Stat. § 241). Additionally, as is discussed in the response to 2d below, Minn. Stat. § 216B.16, Subd. 6b explicitly authorizes the PUC to include programs authorized under CIP in normal ratemaking activities, even though such programs are not technically utility services. Because Minn. Stat. § 216B.16, Subd. 6b does not make specific mention of an TOBF program and is tied to projects as defined in the CIP statute, its applicability to TOBF remains uncertain. However, it should be noted that if TOBF were authorized or included under CIP, a public utility implementing TOBF would be able to recover costs related to the program under normal ratemaking under Minn. Stat. § 216B.16, Subd. 6b.

d. *Does Minn. Stat. § 216B.16 authority for the PUC to set and adjust rates include the authority to allow for cost recovery? See Minn. Stat. § 216B.16, Subds. 6 and 6b.*

Minn. Stat. § 216B.16 explicitly authorizes the PUC to set and adjust rates that allow for cost recovery. Under Subd. 6, the commission shall "give due consideration to the need of the public utility for revenue

sufficient to enable it to meet the cost of furnishing service, of furnishing the service, including adequate provision for depreciation of its utility property used and useful in rendering service to the public, and to earn a fair and reasonable return upon the investment in such property."[58]

Minn. Stat. § 216B.16 also explicitly extends that authority to recover costs for energy conservation improvement projects. Under Subd. 6b, "all investments and expenses of a public utility as defined in section 216B.241, Subd. 1, paragraph (h), incurred in connection with energy conservation improvements shall be recognized and included by the commission in the determination of just and reasonable rates as if the investments and expenses were directly made or incurred by the utility in furnishing utility service."[59]

3. Do the rules in the Conservation Improvement Program (CIP) apply to TOBF?

As discussed in the response to question 1, it is unclear whether TOBF is authorized by Minn. Stat. §§ 216B.03 or 216B.241. However, based on the purpose and definitions within CIP, and the existence of the on-bill loan program ("on-bill repayment program") within the CIP, it seems reasonable for TOBF to be subject to the rules in the CIP if authorized by either law. If that were the case, TOBF would likely be subject to Minn. Stat. § 216B.241 Subd. 3.

a. Does the CIP statute require ownership of energy efficiency improvements to remain with the property owner, with certain exceptions, rather than the meter? See Minn. Stat. § 216B.241, Subd.3.

Minn. Stat. § 216B.241 Subd. 3 states that "[a]n energy conservation improvement made to or installed in a building in accordance with this section, except systems owned by the utility and designed to turn off, limit, or vary the delivery of energy, are the exclusive property of the owner of the building except to the extent that the improvement is subjected to a security interest in favor of the utility in case of a loan to the building owner."[60] Based on the statute, it seems that under most circumstances, the ownership of CIP energy efficiency improvements remain with the property owner. However, if the improvement is financed by the utility through a loan and the loan is outstanding, an exception applies, and the building owner is not the exclusive owner of the improvement. If TOBF is determined to be authorized by law, and the on-bill tariff is interpreted to be a loan, then TOBF would likely fall under the exception in Minn. Stat. § 216B.241 Subd. 3. However, if TOBF is not interpreted to be a loan, this exception would likely not apply, and explicit language regarding a tariffed energy improvement is not present in the CIP statute.

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[58] Minn. Stat. § 216B.16, Subd. 6.

[59] Minn. Stat. § 216B.16, Subd. 6b, paragraph (a).

[60] Minn. Stat. § 216B.241 Subd. 3

4. Would disconnection of utility services for nonpayment be permissible? See Minn. Admin. R. 7820.1300; Minn. Stat. § 216B.241, Subd. 5d(g).

Based on Minn. Admin. R. 7820.1300 and Minn. Stat. § 216B.241, Subd. 5d(g), disconnection of utility services for nonpayment may be permissible under some circumstances, and would not be permissible under a variety of other circumstances. As has been discussed above but is worth noting again, it is possible that a loan provided under CIP (the "on-bill repayment program")[61] would not be considered a utility "service,"[62] and it is not permissible to disconnect utility services for nonpayment of a loan.[63] Therefore, the issue is whether it would be permissible to disconnect utility service for nonpayment of a tariff (as distinct from a loan program) that includes TOBF. Whether this is permissible depends on whether TOBF is determined to be an integral part of utility service, because Minn. Admin. R. 7820.1300 states that "a utility may not disconnect service to any customer for … failure to pay for merchandise, appliances, or services not approved by the commission as an integral part of the utility service."[64]

If TOBF were considered to be a part of integral utility service, the restriction in the administrative rules would probably not apply, and disconnection of services for nonpayment of the tariff would be permissible. If TOBF were not considered to be part of integral utility service, then a party could argue that nonpayment of the TOBF portion of the tariff would not be a permissible reason to disconnect service under Minn. Admin. R. 7820.1300(B) or could even contend that the TOBF portion of the tariff is a loan in effect and would fall under the restriction in Minn. Stat. § 216B.241, Subd. 5d(g).

Recommendations

The following recommendations and concluding thoughts are based on the analysis in this memo, and take into consideration specific issues that the University of Minnesota highlighted for review:

- *Whether some aspects of the TOBF program could move forward even if other aspects could be limited, and whether a pilot program could be authorized (with certain x y z elements) and/or be permitted under existing regulation for a partial approach.*
- *What, if any, legislative changes would be needed to support a TOBF program that meets the criteria described herein?*

Based on our findings, it is apparent that uncertainty regarding the legality of tariffed on-bill finance under Minnesota law remains. If the State were to move forward with the TOBF program as defined

[61] Minn. Stat. § 216B.241, Subd. 5d(g)

[62] See Minn. Stat. § 216B.02, Subd.6

[63] Minn. Stat. § 216B.241, Subd. 5d(g)

[64] Minn. Admin. R. 7820.1300(B)

under the existing framework, it is possible that the program would prevail if challenged, but it is also possible that it would not.

The purpose of the State's energy goals, precedent set by enabling various other renewable energy generation and energy efficiency initiatives, and the existence of an on-bill loan program may indicate that the State is willing and interested in engaging in a variety of programs to improve energy efficiency and reduce usage of non-renewable energy sources. If the State were to proceed with the program under the existing legal framework, it is possible if challenged, a judge could interpret the statutes and rules to permit the program.

However, it is also possible that the various statutes and definitions discussed above could be interpreted to exclude TOBF as a permissible program. For example, an interpretation of the term "service" could plausibly exclude TOBF, and thus TOBF would not be able to be regulated by the PUC under normal rate-making proceedings unless specifically provided for (as other CIP programs are, like on-bill loans, community solar gardens, or performance-based regulation[65]). Additionally, where "rates" relate to TOBF for efficiency improvements, it is possible that a judge could interpret energy efficiency improvements to not be a "service" for which the financing component could support. Moreover, if the program is determined to fit within the purpose of CIP, it may be limited by existing provisions therein, such as the ownership requirement in Minn. Stat. § 216B.241 Subd. 3 (depending on interpretation of whether TOBF is a loan), and the limitations around permissible reasons to disconnect service for nonpayment (depending on interpretation of whether TOBF is an integral utility service, or whether it is effectively a loan).

To avoid some of the potential limitations of full implementation of the TOBF program, the State could consider a partial implementation that focuses on solar installations rather than efficiency measures, either as a true program or a pilot project. TOBF does seem to fit within the purpose of the State's energy goals, and the statutes may favor TOBF where the tariff supports renewable energy generation. In the analysis of "rate" in section 2(b) above, the financing component of the TOBF program could be separated as a supporting rule to the solar installation components of the program, because a solar installation could be interpreted as a "service." Based on this interpretation, it is possible that TOBF could move forward as a tariff for solar installations with a lower risk of challenge because it would qualify as a "rate," potentially avoiding both the "service" issue and issues related to CIP.

The State could also seek to authorize TOBF as currently contemplated by enacting new legislation that specifically provides for such a program. There is precedent for this with the on-bill (loan) repayment program, which is authorized by Minn. Stat. § 216B.241 Subd. 5d and incorporated as part of normal ratemaking by Minn. Stat. § 216B.16 Subd. 6b. Additionally, the program could be interpreted as fulfilling State energy goals. Although there is some time and risk involved in creating new legislation,

[65] See e.g., Minn. Stat. §§ 216B.241, Subd. 5g, 216B.1641, 216B.1675.

such an act would help to remove the uncertainty that exists in the current legal framework and would conclusively authorize TOBF.

Conclusion

There are several points of uncertainty in the applicability of current Minnesota Law to a TOBF program that make such a potential program vulnerable to challenge. Based on this analysis, a TOBF program that more narrowly focuses on solar photovoltaic installations may have a greater ability to withstand such challenges in the near-term. The vulnerability of a TOBF program to challenge could be addressed via legislation that explicitly authorizes such as program, as has been done for on-bill repayment programs.