

Combined Heat and Power (“CHP”) Program

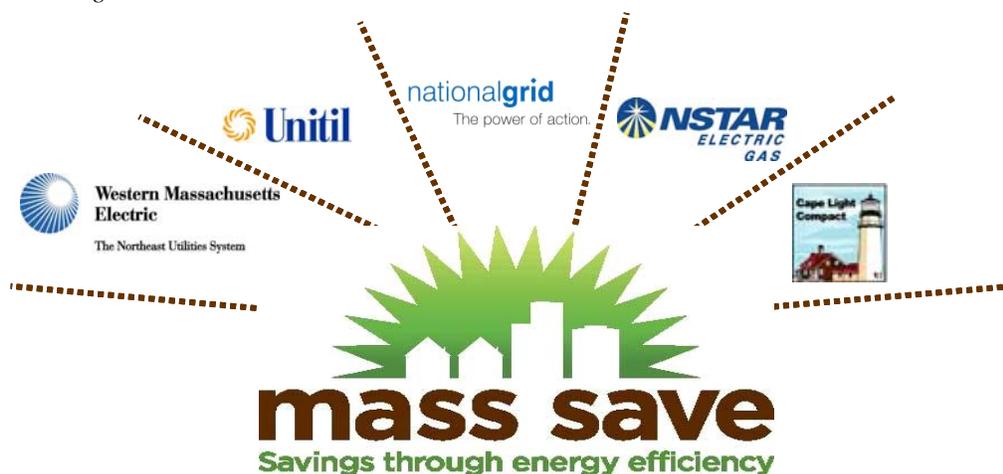
Guidebook for Submitting CHP Applications for an Energy Efficiency Incentive in Massachusetts

Version: November 18, 2010

Disclaimer:

Please note that as a relatively new program, some items described in this document are in a state of flux. This is especially true for metering requirements. Please acquire and review the latest version of this document before submitting a project for an incentive pre-approval.

There may be circumstances where additional requirements are necessary for the customer to receive an incentive. Similarly, there may be projects where some of these listed requirements can be waived by the Program Administrator. Ongoing consultation with the applicable Program Administrator during development of the project is essential to maximize the chances for receiving an incentive. Please note that for the reasons discussed within the document, an incentive pre-approval letter should be received prior to initiating the purchase of a CHP system. Projects which proceed prior to receiving an incentive pre-approval letter may be disqualified from receiving an incentive.



Contents

PURPOSE OF THIS GUIDEBOOK	2
INTRODUCTION	2
WHAT IS CHP?	2
CHP APPLICATIONS	3
CHP PROGRAM DESCRIPTION.....	3
EQUIPMENT ELIGIBLE FOR CHP FUNDING.....	3
QUALIFYING CRITERIA	4
INCENTIVE LEVELS.....	6
CHP APPLICATION FORM	7
TYPICAL APPROVAL PATH	9
ENERGY BENEFITS.....	10
CO-FUNDING OF ENGINEERING TECHNICAL ASSESSMENTS	10
POST INSTALLATION REQUIREMENTS TO RECEIVE INCENTIVE FUNDS:	11
• <i>Installation</i>	11
• <i>Metering Requirements</i>	11
POST OPERATIONAL ASSESSMENT.....	13
POST INSTALLATION REGULATORY EVALUATION ACTIVITIES	14
SUGGESTIONS FOR SUBMITTING A CHP INCENTIVE APPLICATION.....	15
OBJECTIVE.....	15
AUTHORIZATION TO SHARE CUSTOMER DATA	15
ATTRIBUTES OF A SUCCESSFUL PROJECT	15
EARLY ENGAGEMENT WITH THE PROGRAM ADMINISTRATOR	17
INTERCONNECTION APPROVAL.....	18
APPENDIX	19
FIGURE 1 – TYPICAL CHP APPROVAL PATH.....	20
FIGURE 2 – COMBINED HEAT AND POWER (“CHP”) TECHNICAL ASSESSMENTS	21
FIGURE 3 – CUSTOM APPLICATION FORM.....	22
FIGURE 4 – EXAMPLE OF HOURLY SUMMARY DETAILS TO BE INCLUDED WITH CUSTOM APPLICATION	23
FIGURE 5 – REQUEST FOR HOURLY ELECTRIC INTERVAL DATA.....	24
FIGURE 6 – CUSTOMER AUTHORIZATION TO RELEASE DATA TO THIRD PARTIES	28
FIGURE 7 - LINKS TO INTERCONNECTION REQUIREMENTS	29

Purpose of this Guidebook

The purpose of this document is to describe Massachusetts' Combined Heat and Power Program ("CHP") including available incentive amounts, application process, and requirements for post installation inspection/operational assessments and regulatory evaluations. This document offers the reader suggestions to maximize the chance of receiving an incentive.

The incentive levels for successful project submissions are very attractive. However, to achieve the objectives of the CHP program and to comply with regulatory requirements, the application process for receiving these incentives is extensive. CHP developers and engineers who are assisting customers in preparing the application will find the first one to be fairly time consuming. However, after becoming familiar with the process, subsequent submittals should be much more straightforward. The goal for this document is to shorten the learning curve in order to expedite the process.

Introduction

As a result of the Green Communities Act of 2008, Combined Heat and Power Projects are now eligible for funding as an electric energy efficiency measure by Electric Program Administrators ("PA") in Massachusetts. The Program Administrators who are responsible for administering incentives for CHP Programs are shown below:

- NSTAR
- National Grid
- Western Massachusetts Electric Company
- Unitil
- Cape Light Compact

What is CHP?

Combined Heat and Power is the simultaneous generation of electric and thermal energy from a single fuel source such as natural gas. As an example, a natural gas fired engine when coupled with a generator produces electric energy. The engine produces waste heat via hot exhaust gas as well as heat rejected through the radiator to keep the engine and the lubricant at the optimal temperature. This normally wasted heat can be captured to produce steam or hot water for space heating, domestic hot water, or manufacturing processes. The steam or hot water produced by the CHP unit will lower the fuel otherwise used in the facility boiler for domestic hot water, space heating etc. The overall efficiency of a CHP system can be 80-85% which exceeds the combined efficiency of power generation, transmission and distribution system of a central power plant of an electric utility (typically 35 to 40% electric efficiency) along with on-site production of thermal energy in a boiler.

The increased efficiency of CHP also leads to a lower carbon foot-print because of reduced greenhouse gas emissions such as CO₂ and other greenhouse gas production.

Other significant benefits of the CHP system may include standby power capability at the facility, and better control of power factor depending on type of generator deployed by the CHP system.

CHP Applications

In order to derive the maximum benefit from a CHP installation, the thermal energy generated by the CHP unit needs to be utilized by the facility. To obtain the optimum return on the incremental cost of installing a CHP system, the best applications are typically those with high annual hours of operation with near full utilization of the thermal output. The facilities with considerable coincidence of electrical and thermal loads are the ideal applications for CHP.¹ Some examples of such applications include process industry (24/7) operation, as well commercial applications such as hotels, hospitals, nursing homes, schools, colleges, laundries, health facilities, and multi-unit apartments.

CHP Program Description

Equipment Eligible for CHP Funding

Generally, equipment qualifying for CHP incentives include reciprocating engines, gas turbines (also commonly referred to as combustion turbines), and back pressure steam turbines which recover waste heat for useful purposes. It is important to note that for the purposes of receiving an incentive under this program, a CHP system must directly produce electricity and not simply offset the use of electricity. An example of equipment excluded from this definition would be a gas-fired engine directly coupled to a compressor which indirectly reduces electricity by reducing or eliminating the use of a motor to drive a compressor. The CHP system can use any fuel type.

¹ Coincidence is defined as occurring during the ISO-NE defined peak periods which result in a decrease in demand for the New England region.

Qualifying Criteria

Qualifying equipment needs to meet the following criteria:

1) Minimum Efficiency Test

CHP equipment must have an annual combined electric and thermal efficiency greater than or equal to 60% with fuel input being expressed on a Higher Heating Value (“HHV”) basis.

- a) Electrical Efficiency = kW (nameplate) X 3,412 Btu/kWh ÷ Fuel Input (Btu/Hr), HHV
- b) Thermal Efficiency = Btu/hr useful thermal energy ÷ Fuel Input (Btu/Hr), HHV
- c) Combined Efficiency = a) + b)

Please be aware that many engines used for CHP applications are rated on a Lower Heating Value Basis. For natural gas, Higher Heating Value Fuel Input = 1.11 x Lower Heating Value Fuel Input. Other fuel types have different conversion factors.

2) The CHP equipment must undergo a utility benefit cost analysis utilizing a methodology prescribed by the Department of Public Utilities (“DPU”). This methodology considers the kW output of the CHP system (net of any incremental parasitic load to operate the CHP system’s auxiliary equipment), the annual net kWh generated, installed cost of the equipment, ongoing annual maintenance costs, quantity of fuel and type of fuel being fired to and displaced by the CHP system. Also, the timing of the power production, such as winter/summer and peak- versus off-peak are also inputs in the Benefit/Cost model to determine the Benefit/Cost Ratio (“BCR”). In order to receive incentive funding for CHP projects, the lifetime benefits must exceed the lifetime cost. In other words, the BCR must be greater than or equal to 1.0. Customers with functional CHP systems with remaining service life who seek to expand the capacity of their CHP system may be eligible for incentive funding on an incremental basis.² Customers with CHP systems which are past their life expectancy may also be eligible for funding based on the total kW (rather than just an incremental) for a replacement CHP system.

3) It is important to understand that the Benefit/Cost model which is used to determine whether a project is eligible for incentive funding by the PA is a different methodology than the analysis a customer would perform to determine whether the project economics are attractive enough to move forward with the project. Some of the key differences are as follows:

- a. The utility Benefit/Cost model utilizes marginal values of fuel and electricity as well as the value of deferred transmission and distribution. Also, the value of capacity used in the Benefit/Cost model is determined according to the ISO-New England Peak Period definitions.
- b. In contrast, a customer’s economic model will utilize retail costs for fuel and electric power. Also, a customer will consider the value of avoided electric

² Where incremental cost and benefits are considered as part of the analysis.

demand charges determined according to the periods defined in the rate tariffs (instead of the ISO-NE period definitions).

Because there are differences in the economic modeling methodology between the two perspectives, a CHP project may make economic sense for the customer but not be eligible for an incentive because it fails the BCR test.

It is important to note that in most situations, the BCR analysis will determine whether a CHP project will qualify for an incentive as opposed to whether it reaches the 60 % minimum efficiency requirement. In other words, projects which just barely exceed the 60% minimum efficiency criteria are unlikely to have a BCR ratio > 1.0.

Qualifying Federal Tax Credits and Federal Grants which effectively reduce the installed cost of the CHP system are allowed to be figured as a reduction in installed cost of the CHP system. This provides a boost to the BCR. Sufficient documentation will need to be provided for the availability of these grants or tax credits (to the extent consideration of these grants and tax credits are essential to achieving the required BCR ratio). When providing the Program Administrator with the total cost of the system, a breakdown of overall installed cost, equipment cost, and federal tax credits/federal grants should be provided.³ Providing this level of detail is advantageous to the submitter as some of the listed costs may not necessarily be attributable to the incremental costs of the CHP project. This will allow the PA to cull out those costs which can be excluded. This will result in a greater likelihood of the project having a BCR greater than or equal to 1.0 and being approved for an incentive.

Tax credits and grants which are specific to Massachusetts are not permitted to be figured into a reduction in installed costs for BCR analysis purposes. Similarly, the value of a customer's participation in the Alternative Portfolio Standard ("APS") produced from monetizing Alternative Energy Certificates ("AECs") are not allowed to be used as a reduction in customer costs for the BCR analysis. The total cost paid of the system (without regard to the incentive amount offered by the PA) is used as an input into the BCR model.⁴

- 4) Customers who have already placed an order for a CHP system may be denied an incentive offer if there is a strong likelihood they would be considered a free rider⁵. Customers who are relying on an incentive for a CHP system to meet their financial rate of return requirements should defer ordering a CHP system until receiving a pre-approval letter for an incentive.
- 5) Please note that for a purchased or leased CHP system, another requirement of the program is for a maintenance agreement to be in place which covers a minimum (3) three year period. Customers who are purchasing the output of the CHP system (i.e. "purchased power and thermal agreement") from another entity who owns the system will

³ At a minimum, the breakdown between material and labor costs must be provided.

⁴ Cost being used in this regard is the amount that the customer will pay plus incentives to be received.

⁵ In other words, the customer would have moved forward with the CHP project even without an incentive.

be required to maintain the equipment for the duration of the contract (which must exceed 3 years).⁶

Incentive Levels

Assuming a project qualifies for a CHP incentive (as discussed in the preceding section), the specific incentive award will vary depending on the size of a project and certain other project attributes (as described in more detail below).

For projects which are 150 kW or less, the incentive amount is:

Incentive Amount: \$750 per kW X kW Size⁷

For example, a 100 kW CHP system would be eligible for a \$75,000 incentive.

For systems larger than 150 kW, the specific amount is determined by the Program Administrator.

A building or a process which is materially lacking in implementation of cost-effective energy efficiency may be ineligible to receive ANY CHP incentive payment. Specific requirements are determined by the applicable Program Administrator. In any case, the incentive will be capped at 50% of the total installed cost of the CHP system.

On average, non-CHP energy efficiency measures have a higher BCR than CHP and should be implemented as the first choice. This is especially significant given that interactions may exist between other building energy efficiency measures and operation of the CHP system. For instance, if a customer is replacing an older boiler with a more efficient one, the thermal benefit resulting from CHP will be reduced than if the existing boiler were to remain in place.⁸

Also, CHP systems which are sized without taking into account available electrical and thermal energy efficiency measures may ultimately end up being oversized relative to the eventual building electric and thermal load (if standard building energy efficiency measures are implemented after a CHP system is installed).

A particular PA may have funding limitations which may affect the amount available for an incentive.

⁶ In the event the customer has an option to purchase the CHP system prior to the expiration of such a “purchased power and thermal agreement,” ideally, there should be a provision for the customer to acquire a maintenance agreement covering a minimum 3 year term.

⁷ Where kW is the nameplate of the equipment based on standard conditions and without reduction for parasitic losses.

⁸ This is not to suggest that a customer should retain the existing less efficient boiler. On an overall basis, it may be beneficial to do both projects. Rather the quantification of the benefits from CHP needs to consider the movement of the baseline conditions if the boiler were to be replaced with a more efficient one. This will avoid overstating the thermal efficiency benefits from the CHP project.

CHP Application Form

Applications for CHP incentives are submitted on the Custom Application form. There is a separate custom form for retrofit versus new construction projects. [Figure 3](#) shows the links to obtain the forms. Although it is an NSTAR link, the same form is used throughout Massachusetts. Most of the information on the form is self explanatory. However, the following points are discussed further.

[Page 1](#) of the application seeks information from the customer and requires the customer's signature. Please note that the customer is defined as the entity responsible for paying the electric utility bill (and whose name is on the electric bills with the listed account number). In some cases, the customer may not actually own the CHP equipment. In particular, the equipment may be owned by a third party and the customer simply purchases the electric and thermal output from the system. The customer may receive the incentive payment directly (either in the form of a check or a credit on their electric bill) or they may choose to assign the incentive payment to the vendor who is installing the CHP system. The entity (be it the customer or the vendor) who will receive the incentive payment will list their Tax ID number on the form.

[Page 4](#) of the custom form includes the key summary information which is essential for being able to perform the utility BCR analysis. In particular, Table 1 of the form summarizes the electric energy (kWh) and demand reductions (kW) according to the time periods defined on the application. Please note that the time periods for peak- and off-peak periods are different from those defined in a customer's rate tariff. Table 2 defines the cost information for the project. For retrofit projects, the cost data is the total costs of installing the CHP system. For new construction projects, the cost data is incremental cost above and beyond the baseline case (which would be the system without the CHP system being installed). Table 3 defines the Non-Electric Benefits Summary Table. For CHP projects, the relevant lines are the Gas or Oil (MMBTU) and the O&M (\$/year). In the vast majority of projects, these items are a net cost increase rather than a net benefit and will be entered as negative values. Generally, the MMBTU impact in this table is the Fuel Fired to the CHP system reduced by the boiler fuel savings where $\text{Annual boiler fuel savings} = \text{Annual CHP therms utilized} \div \text{Annual boiler efficiency}$.

The application needs to support the values in these Tables by providing the necessary summary information (discussed in the below paragraph) along with the calculations (presented in a spreadsheet format) demonstrating how these values are determined.

[Figure 4](#) shows an Example of Hourly Summary Detail to be included with Custom Application. Because electric and thermal loads for most facilities can vary widely seasonally and daily, it is essential that a simulation be performed to determine how the CHP unit is expected to perform (i.e. fuel fired to the CHP unit, net kWh generation, thermal energy recovered for use and resulting reduction in boiler fuel) for each hour of the year. The detailed simulation model used to determine these values will need to be included as part of the project submission.

Please note that electric interval data is available for time of use customers to establish the baseline conditions (before any further adjustments for weather normalization) or other contemplated changes (i.e. for building energy efficiency) to a facility's load. The data is available in either 15 minute or hourly increments. **Please refer to Figure 5 for the form to request such electric interval data.** In some instances, gas interval data may also be available to provide assistance in establishing the quantity and profile of gas being consumed for the facility prior to the installation of a CHP system. Please consult with the applicable natural gas utility account executive to determine if gas interval data is available and how to obtain it. If there are other gas appliances on the meter which have loads which cannot be offset from the thermal output of a CHP system, additional analysis will be necessary. In particular, either direct thermal measurement of the loads which are available for off-set by a CHP system, or a well supported engineering calculation to estimate the actual thermal load which can be met through a CHP system is necessary. The applicable PA will determine the acceptable methodology for estimating thermal loads which can be offset by a CHP system. Generally, pre-installation thermal metering will be required on larger systems. For smaller systems, engineering estimation methodology may be acceptable in lieu of such pre-installation thermal metering.

For retrofit applications with historical billing records, columns A and B of this figure represents the pre-CHP purchased electricity and fuel requirements to meet the facility loads. This represents the baseline conditions. Col C and D simply describe the facility's requirement for useful thermal data (steam and hot water). Please note that it may be necessary to adjust these values for the installation of building energy efficiency measures (electric and/or thermal energy), or if historical weather conditions vary from normal. If so, insert additional columns to show the adjustments to the baseline. Columns E to N describe the performance of the CHP system and the incremental impact that operation of the system will have on electric and thermal loads in the facility. Columns O and P describe the purchased electric and fuel requirements following completion of the CHP system. In the attached example, this CHP system produces both hot water and steam. Many applications will produce either hot water or steam for the thermal energy. Please note that this attached Figure 4 is simply an example to illustrate the types of information which need to be modeled and summarized for the CHP application process. There will be some variation depending on the particular project. The key takeaway of this figure is to demonstrate the appropriate level of detail necessary to support the incentive application. The simulation model supporting this Figure 4 summary will also need to be provided with the application. Some projects may use some of the thermal output from a CHP system to drive an absorption chiller. In those instances, additional columns will be needed to show how this impacts the electric chiller's kW and kWh consumption.

For new construction projects, the baseline conditions in columns A and B should be determined by using an approved⁹ Building Simulation Model (including all energy efficiency measures – absent the CHP project). A building simulation model SHOULD NOT be used to mimic the baseline conditions for a retrofit project as it is very unlikely to reconcile with existing (normalized) bills.

⁹ By the applicable Program Administrator.

Typical Approval Path

Refer to [Figure 1](#) for a flow chart which shows a typical approval path for a customer to receive a pre-approval letter for a CHP incentive. One of the first steps in the process is to determine the extent that building energy efficiency measures have already been implemented. This is for the reasons discussed in the preceding paragraphs. The next question is to determine whether or not a CHP provider is already engaged in discussions with the customer. For purposes of this flowchart, a CHP Provider refers to a turn-key installation contractor or an engineer who is studying a CHP system's feasibility or designing the CHP system. If a customer is not currently discussing CHP with a provider, then a list of approved CHP vendors will be provided (assuming that a customer's facility is of a type which has a good likelihood of being able to benefit from installation of a CHP system). **Various tools are available from the Program Administrators to assist in performing preliminary feasibility analysis including performing the essential hourly simulations.** Contact your applicable PA for more information.

A CHP incentive offer from a Program Administrator can be made with or without a CHP installation contractor's proposal. If a customer is engaged with an engineer who is studying the feasibility of a CHP system, referred to as a "CHP Technical Assessment," the production of the study results (in accordance with all requirements listed in [Figure 2](#) including the completion of a Minimum Requirements Document ("MRD") is sufficient to offer a CHP incentive (providing it meets all qualifying requirements for a CHP incentive). This situation may occur if the customer desires to receive a commitment from the Program Administrator regarding the availability of funding before spending additional time and resources for detailed engineering design work and/or contracting with a developer.

As long as the project design and operation is in compliance with the MRD, no additional approvals are necessary prior to receiving the incentive payment. Please refer to the Custom Application Form for the specific submittal requirements and to receive examples of Minimum Requirements Documents for CHP systems.

If the customer has not decided on a specific CHP engine, then the MRD should be written in a manner which provides the flexibility for a customer to solicit bids for various engines under consideration. It is essential that the proposed MRD include both the minimum annual electric and thermal efficiency (individually rather than the two combined), the minimum and maximum kW size being proposed, an estimate of the installed cost for each kW system range being considered along with the maintenance costs. As discussed in preceding paragraphs, these are essential inputs which are necessary to determine the BCR of the proposed project.

The MRD can be issued specific to a particular Make/Model CHP system. However, the downside of this approach is that the CHP pre-approval offer for an incentive may lock the customer into actually installing this particular system. If the customer later decides to go out to bid after the incentive letter is received, it may be necessary for the customer to reapply for the incentive (because the system would not be in compliance with the MRD). There is a risk that a different system may not achieve the required BCR either because the system is

less efficient or because the prescribed Benefit/Cost methodology has been changed. Thus, the MRD should avoid being tied to a specific make/model equipment unless the customer is sure that will be the product which will be installed.

Energy Benefits

Other than the energy cost savings realized by the Customer, the Program Administrator is entitled to 100% of the benefits and rights associated with the CHP installation. This is described in Section 19 of the Terms and Conditions with the Custom Application form.

However, despite these Terms and Conditions, the Customer may elect to pursue and retain APS Generation Attributes associated with the Massachusetts Alternative Energy Portfolio Standard (“APS”). Upon request, the Program Administrator will waive the rights to the APS value. The customer shall be solely responsible for all costs associated with reporting requirements of the APS. The APS program is administered by the Commonwealth of Massachusetts. This is an optional program and participation is not required to receive a CHP incentive from a PA. Please click on the below link for more information. Please contact DOER for more information.

http://www.mass.gov/?pageID=eoeeterminal&L=5&L0=Home&L1=Energy%2C+Utilities+%26+Clean+Technologies&L2=Renewable+Energy&L3=Renewable+Energy+Portfolio+Standard+%26+Alternative+Energy+Portfolio+Standard+Programs&L4=RPS+and+APS+Statement+of+Qualification+Applications&sid=Eoeea&b=terminalcontent&f=doer_rps_aps_aps_sqa&csid=Eoeea

Co-funding of Engineering Technical Assessments

As described above, in order to facilitate the analysis of a potential CHP project, Program Administrators offer co-payment of engineering “Technical Assessment” Services that provide a study in accordance with the deliverables outlined in Figure 2 of the Appendix.

The requirements for co-funding of technical assessment services for CHP are as follows:

1. General co-funding requirements for CHP Engineering Services

Co-funding of Engineering Services for CHP studies is limited purely to the identified Technical Assessment Study requirements. The cost of performing design work to actually install the CHP system is NOT a cost which is eligible for co-funding by the Program Administrator. Co-funding is limited to 50% of the reasonable costs of performing the study (as determined solely by the Program Administrator). Except as specified in paragraph 3 below, the proposed work shall include the deliverables and be in accordance with the terms and conditions as further described under the Technical Assessment Services. Please contact the applicable PA to obtain the necessary forms for requesting co-payment of a Technical Assessment Study.

Co-funding of Engineering Services performed by or under the supervision of a proposing contractor (or affiliate of the proposing contractor) for the sales or installation of any

equipment used in the CHP program is NOT eligible for co-funding. If a company who performs a Technical Assessment Study receives co-funding from the PA and later becomes an equipment supplier or vendor performing a turn-key CHP installation, then the CHP incentive offered to the customer will be reduced by the co-payment paid for the Technical Assessment

2. The organization or person performing the technical assessment engineering services is NOT precluded from performing the design work if the customer decides to install a CHP system. No deduction for the cost of the Technical Assessment will apply under this situation.

3. A more limited scope for co-funding of engineering services than described under item #1 may be approved under certain circumstances.

An example of this more limited scope would be to provide assistance to a customer for obtaining pre-metering data to more accurately establish the thermal load profile which may be available for offset by a CHP system. This may occur if the customer plans on using the services of an installation contractor who is otherwise capable of delivering a CHP proposal with all other required supporting data and analysis but lacks the equipment or expertise to conduct such pre-metering services.

Post installation requirements to receive incentive funds:

- **Installation**

Installation of the CHP system will comply with all the local, state and federal requirements and satisfy the permitting requirements of all regulatory requirements including but not limited to air emissions. To the extent that meters for natural gas, electric power, and utilized thermal energy is installed by the customer and/or CHP contractor, the Program Administrator will need to obtain, at no extra cost to the PA, access to this information for evaluation purposes. Refer to the discussion on post-evaluation activities for more detail.

Meters are installed in compliance with the MRD to monitor fuel fired to the CHP unit, electric power production, and thermal energy used by the facility.

- **Metering Requirements**

For any meters which are planned for installation as part of the project, the system needs to capture 15 min interval data for control inputs and outputs, electricity produced, and thermal energy recovered. The installation should provide hourly trends for gas input and engine run hours. For larger CHP systems, collection of data regarding consumption of auxiliary equipment such as secondary pumps, radiator fans etc., supporting the CHP plant should also be collected. From a cost standpoint, it may not be practical to collect continuous data for all auxiliary equipment. Other means of approximating these loads, such as engineering estimates or spot measurements may be more appropriate.

For customers planning to participate in the APS program, the CHP plant will need to meet the requirements of the Section III.2.C. and Appendix C of the Massachusetts APS Statement of Qualification Application Form dated October 5, 2009. During post inspection, confirmation that the agreed data collection system is properly installed including being connected to proper metering, calibrated, reporting and archiving data. As described in a subsequent section, Regulatory Evaluation activities may require that additional metering be installed which surpasses what the customer would feel is essential to meet their needs. Please contact the applicable Program Administrator for more information.

The following table provides a general illustration of the types of hardware and information collected from installed meters. This table shows information for a single reciprocating-engine unit providing hot water to a customer’s space heating and domestic hot water systems. This is a straightforward example and may not be indicative of the requirements for more complicated systems.

Sample Metering Requirements for Illustration Purposes

Equipment	Data gathered	Used to calculate
4 Smart Temperature Probes	Temperatures, T1, T2, T3, T4	Percentage of recovered heat that serves DHW, Building Heat, or is rejected
BTU meter (using ultrasonic flow and delta-T) with pulse adapter	Total BTU/hr of heat recovery (includes rejected heat) by time-of-use	Heat produced
Three phase electric meter with pulse adapter	Generator Electricity Output by time-of-use	Electricity generated, system efficiency
Natural gas meter with pulse adapter	Natural Gas flow rate by time-of-use	Uncorrected Natural Gas input to system
1 Gas Pressure Gauge	Natural Gas inlet pressure	Conversion to actual natural gas flow rate and energy input
4 Current Transducers	Current draw of CHP system components	Parasitic Pump/Fan Loads

Post Operational Assessment

In general, the documentation listed below should be available during commissioning and post operational assessment. These requirements would be listed in the MRD. The listed items DO NOT need to be received prior to the PA issuing an incentive pre-approval letter. The below items are more typical of larger projects. Smaller projects may have significantly reduced requirements. The requested information will generally be limited to those items which are integral to the design and operation of the system and are produced by the installing contractor(s) and/or engineer(s) in the course of their normal activities.

1. Design datasheets and O&M manuals for the following equipment:
 - a. Engine Generator Set
 - b. Primary Water Circuit Pump, Secondary Hot Water Pumps
 - c. Electric Motors and Variable Frequency Drives (“VFD”)
 - d. Heat Exchangers – Exhaust Gas, Primary Water/Hot Water
 - e. Metering Equipment
2. Plant layout drawings, flow and PID diagrams.
3. Controls Drawings, Final Sequence of Operations programming, O&M Manuals, Instrumentation List and Datasheets
4. Ability to provide CHP plant performance data for one hour intervals.
 - a. Gross and Net kW output after parasitic loads are deducted
 - b. Cumulative net kWh generated; Cumulative Heat Input to CHP; and Cumulative heat utilization to measure seasonal and annual overall plant efficiency.
 - c. Fuel input to CHP plant
 - d. Heat energy exported from CHP plant
 - e. Heat energy provided to process hot water system
 - f. Pump status, VFD status, speed input/output etc if used in the CHP plant
 - g. Any other points that are necessary to determine parasitic loads to determine the net plant efficiency based on the final plant design.
5. Provide ability to export weekly data electronically to third party via email during the Commissioning process.
6. Commissioning process will require start-up functional testing of the CHP and the thermal and electrical interface to the buildings, a minimum 2 weeks of concurrent 15min interval data for all points noted above. If equipment fails to meet expected sequences of

operations and corrections are needed, an additional 2 weeks of trend data shall be provided. To confirm any seasonal changes in operation, PA may require two additional 2 week periods of operational trend data after completion of initial Commissioning process such that trends are captured during summer, winter and spring/fall in the first year of operation.

7. Provide meter calibration data and provide Testing and Balancing (“TAB”) reports.

Post Installation Regulatory Evaluation Activities

Program Administrators are required by regulation to evaluate all of their energy efficiency programs to determine the percentage of predicted energy savings which are actually realized and to utilize those results to make program improvements.

Typically, evaluations of such energy efficiency projects are performed on a subset of projects each year. However, because the CHP program is a new program, the PAs desire to perform evaluations on nearly all of the early projects. This will provide valuable feedback in the early stages of operation to assist in improving the program.

For most facilities, hourly thermal loads will vary widely throughout the day. For loads supplying space heating, there will be additional seasonal variations. Thus, CHP production of kWhs, fuel fired, and thermal energy produced and recovered will vary accordingly. Thus, a full (or nearly a full) year of data is often needed to perform a meaningful evaluation.

Many planned CHP systems are being designed which already include the necessary meters to gather some or all of the essential data for performing regulatory evaluations. This is especially the case for the following projects: 1) where systems are being installed on a performance basis; 2) where the customer plans to participate in the APS program (most typically systems exceeding 150 kW in size), or 3) where a third party will own and operate the equipment and sell the electric and thermal outputs to the customer. To the extent that such meters are already planned for installation which meet the requirements for regulatory evaluation, the customer (or a contractor working on behalf of the customer) must provide, at no cost, such metered data. In those few instances, where metered data is not being collected for all of the necessary inputs and outputs (or is of insufficient precision) from the CHP system, then the PA will subsidize the cost of equipment and/or installation services. These would typically be small CHP projects where the vendor sells the CHP system directly to the customer on a non performance basis for which the customer does not desire to pay a premium for these meters.¹⁰

¹⁰ More so than virtually any other EE measure, CHP systems usually have a dramatic impact on a facility’s purchased fuel and electric power. Through billing analysis, such customers usually have a strong sense as to whether the net benefits they are receiving from a CHP system are in alignment with expectations (even though such a billing analysis may be insufficient for regulatory evaluation purposes).

It should be noted that customers and vendors should not forgo the installation of meters they would ordinarily install with the plan of having the PA pick up the cost. Meters installed for evaluation purposes may only be in place on a temporary basis and may have different specifications from ones ordinarily utilized by the CHP vendor.

Prior to the issuance of a pre-approval incentive letter, the PA (in consultation with a third party evaluation consultant), will discuss the specific metering requirements and what party is responsible for equipment and/or installation costs. **Please note that this is an evolving process so specific metering requirements are not listed within the current version of this document.**

As more experience is gained with CHP, it is expected that the metering requirements for evaluation may be reduced, but similar requirements for commissioning may still be required. Please contact the applicable Program Administrator with any questions.

Suggestions for Submitting a CHP Incentive Application

Objective

Provide to end users, engineers and CHP developers suggestions for a project to successfully pass the electric utility benefit-cost-ratio (BCR) test.

Authorization to Share Customer Data

Because there are usually multiple parties involved in the analysis and implementation of a CHP system, it is essential for a customer to give permission to share data with third parties involved in the development of the project. [Figure 6](#) is a form to be completed by the customer to grant permission for the utility or third party energy suppliers to share this data with other listed entities.

Attributes of a Successful Project

Even the best CHP applications marginally pass the BCR test. Because there is little margin for error, the project must be examined rigorously to determine whether it meets the necessary requirements for receiving an incentive.

A successful CHP project typically utilizes nearly all of the thermal energy being produced by the system and uses a prime mover with an attractive heat rate and with minimal parasitic load (less than or equal to 5%). CHP projects with substantial thermal dumping of the load, high parasitic requirements, and few thermal following run hours are far less likely to achieve an acceptable BCR. Use of thermal storage (especially for domestic hot water) to more evenly spread the thermal load over a greater numbers of hours may boost the BCR and increase the chances for being awarded an incentive. Because the BCR test relies on a great number of inputs to determine the result, it is difficult to establish a bright line standard. If a project uses

a reciprocating engine as the prime mover and the electric and thermal outputs of the system can be utilized simultaneously within the facility for at least 5,000 hours, there is a good chance (but no guarantee) that it will pass the BCR test. There are projects with more than 5,000 hours that have failed the test and other ones which have passed with somewhat less than 5,000 hours. Projects using combustion turbines usually require substantially more than 5,000 hours. This is because turbine installations are more typically more expensive than reciprocating engines and have a lower electrical efficiency. However, maintenance costs are typically lower for turbines than reciprocating engines which provide some offset to the higher installed cost and lower turbine electrical efficiency. It is unlikely that a building that has minimal summertime thermal use would pass the BCR test as it would not have enough run hours to justify the capital expenditure. Thus, office buildings are unlikely to qualify.

Care should be taken not to propose an oversized system. An oversized system will cost more to install than a properly sized system. It will also result in a reduced number of equivalent full load operating hours compared to a correctly sized system. Such oversized systems will substantially reduce the likelihood of the project qualifying for an incentive.

Please refer to the table on the next page for comparisons between prime mover types.

The table below summarizes relative comparisons between prime mover types:

PRIME-MOVER	PROSPECT	REMARKS
Reciprocating engine generator	More likely	Highest electric efficiency; lower installed cost; higher maintenance cost
Gas turbine generator	Less likely	Booster compressor increases parasitic load which reduces net CHP kWh production; potential use of a duct burner for increased thermal efficiency and thermal production; higher installed cost but lower maintenance cost
Microturbine generator	Less likely	Booster compressor increases parasitic load which reduces net CHP kWh production; higher installed cost but lower maintenance cost
Back pressure steam turbine	Most likely	Efficiencies depend on the specific design; lower maintenance; with availability of HP steam typically has the lowest installed cost.
Fuel cell	Least likely	Least efficient, low grade recovered waste heat

Early Engagement with the Program Administrator

It is highly recommended that the customer establish a dialogue with the PA during the early stages of developing a CHP project. By doing so, feedback can be given to the customer in the early stages of the development process regarding the likely cost-effectiveness of the proposed project. If one or more configurations for a CHP are NOT going to meet the minimum criteria for an incentive, it's best for everyone involved to receive early feedback on this result.

A critical path item that should be determined early in the process is to affirm that the electric utility circuit is compatible with a CHP project (i.e. not on an area network). Please note that a circuit compatibility check is not the same as receiving approval to interconnect a CHP project with the electric utility. Please contact the applicable electric account executive to determine compatibility.

For systems firing natural gas, confirmation should be received that sufficient gas volume and pressure is available to supply a facility's total gas requirements for the proposed CHP system and other existing or new gas appliances. Some early study work may be necessary to determine the range of systems being considered and the gas firing rate for each CHP option under consideration.

Interconnection Approval

Please note that approval of an incentive payment for CHP does not constitute approval of a project from an interconnection standpoint. There is a separate application process for receiving approval to interconnect a CHP system with the local electric utility. Please contact the interconnection department for the applicable utility for details on how to apply for an interconnection. Figure 7 lists the links to the various utilities for the interconnection process.

Appendix

Figure 1 – Typical CHP Approval Path

Figure 2 – Combined Heat and Power Technical Assessments

Figure 3 – Custom Application Form

Figure 4 – Example of Hourly Summary Detail to be included with Custom Application

Please note that the Detailed Simulation Model supporting the Hourly Summary Detail is required to be included with the application. An example of an hourly simulation will be provided upon request.

Figure 5 – Request for Hourly Electric Interval Data

Figure 6 - Customer Authorization to Release Data to Third Parties

Figure 7 – Links to Interconnection Requirements

Figure 1 – Typical CHP Approval Path

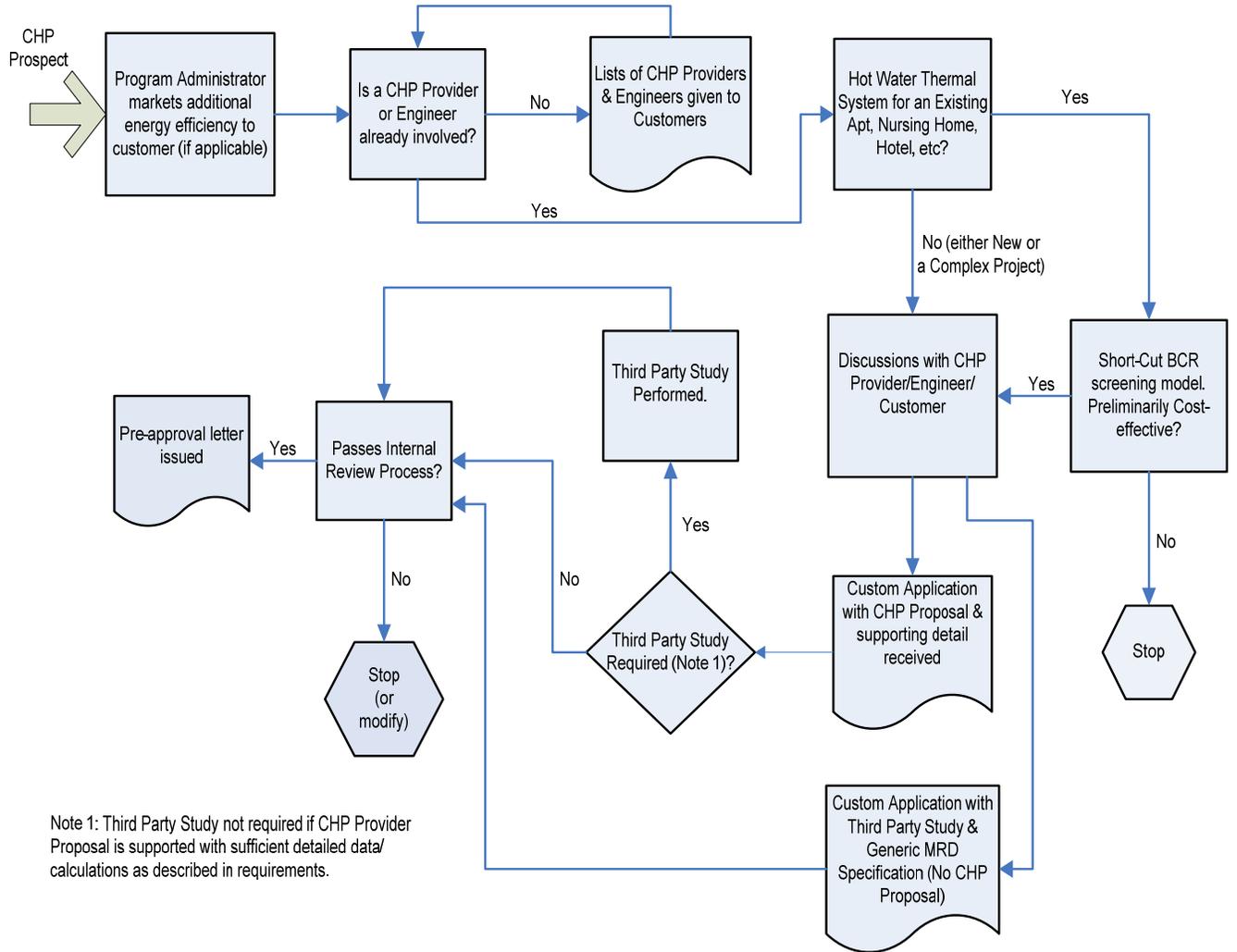


Figure 2 – Combined Heat and Power (“CHP”) Technical Assessments

The general requirements should be included in a technical assessment (provided by a third party engineer or the developer proposing the project):

- A description of the facility and mechanical equipment for the existing facility.
- All relevant electric and fuel data including consumption and billing information.
- A narrative description of the proposed CHP system.
- Description of existing processes.
- Pre-metering data of existing electric and thermal loads to the extent feasible or if not feasible alternative means to estimate.
- Proposed CHP system being considered including manufacturers performance specification data (i.e. cut-sheets).
- A Minimum Requirements Document for the proposed CHP system and sequence of operations.
- Estimate of parasitic loads incremental to the CHP system.
- Confirmation of available gas supply and pressure requirements.
- Description of methodology used to estimate the expected performance of the CHP system including a list of all assumptions and support of such assumptions.
- Hourly model showing the expected performance of the CHP system detailing fuel requirements, electric and thermal production by hour showing what electricity thermal energy is consumed on-site versus being exported or dumped.
- Profile showing facility kWh, kW, and thermal needs prior to and after the installation of a CHP system summarized monthly and annually according to peak- and off-peak periods.
- Detailed cost estimates for the CHP system for installation and routine and major maintenance.
- Customer financial analysis considering all variables which impact economics.
- Walkthrough identification of cost and estimated savings of building energy efficiency measurements which can be cost-effectively implemented.
- Completed custom application form (ready for a customer’s signature).

Figure 3 – Custom Application Form

Refer to the below links for the retrofit or new construction custom application form. Please note that this same form is used for all the Massachusetts Program Administrators.

http://www.nstar.com/docs3/application_forms/retro-custom.pdf

http://www.nstar.com/docs3/application_forms/new-custom.pdf

Figure 4 – Example of Hourly Summary Details to be included with Custom Application

Figure 4
CHP Incentive Application - Hourly Summary Detail to be included with Custom Application (Note 1)
 Note 1: Include excel model showing all assumptions and formulas which produces this summary.

Month	Day	Hour	Total Facility Pre-CHP				CHP System										Total Facility Post CHP	
			A kWh	B Fuel (Btus)	C Steam (Btus)	D Hot Water (Btus)	E Fuel Fired to CHP (Btus)	F kWh produced net of parasitics	G Steam Produced (Btus)	H Steam Energy Used (Btus)	I = G - H Steam Energy Dumped (Btus)	J Hot Water Energy Produced (Btus)	K Hot Water Used (Btus)	L = J - K Hot Water Energy Dumped (Btus)	M = (H + K) / Boiler Efficiency Boiler Fuel Saved (Btus)	N = E - M Incremental Facility Fuel Increase (Btus)	O = A - F kWh	P = B + N Fuel (Btus)
Jan	1	1																
Jan	1	2																
Jan	1	3																
Jan	1	4																
Jan	1	5																
Jan	1	6																
Jan	1	7																
Jan	1	8																
Jan	1	9																
Jan	1	10																
Jan	1	11																
Jan	1	12																
Jan	1	13																
Jan	1	14																
Jan	1	15																
Jan	1	16																
Jan	1	17																
Jan	1	18																
Jan	1	19																
Jan	1	20																
Jan	1	21																
Jan	1	22																
Jan	1	23																
Jan	1	24																
Jan	2	1																
Jan	2	2																
Jan	2	3																
Jan	2	4																
Jan	2	5																
Jan	2	6																
Jan	2	7																
Jan	2	8																
Jan	2	9																
Jan	2	10																
Jan	2	11																
Jan	2	12																
Jan	2	13																
Jan	2	14																
Jan	2	15																
Jan	2	16																
Jan	2	17																
Jan	2	18																
Jan	2	19																
Jan	2	20																
Jan	2	21																
Jan	2	22																
Jan	2	23																
Jan	2	24																

Repeat for each hour of each day for all months

Figure 5 – Request for Hourly Electric Interval Data

Please refer to the next three pages for a form to obtain Electric Interval Data from the Electric Utility for the specified customer.

Please note that the Supplier/Broker is any third party. The customer must sign this document to authorize releasing the interval data to a third party. The customer can also request this data directly without the involvement of a third party.

Interval Data is available for Time of Use Accounts. Although the information is not on the form, please specify whether 1 hour or 15 minute interval data is requested and the time periods which are being requested.

Some natural gas utilities may also use this same form for requesting natural gas hourly interval data. Contact your applicable natural gas account executive to determine whether such hourly gas interval data is available and the mechanism for requesting this data.

MASSACHUSETTS INTERVAL DATA REQUEST FORM

This is to be completed by the Supplier/Broker

Distribution Company (circle one): **NGRID** **NSTAR** **UNITIL**
WMECO

• Customer Name (as it appears on the bill): _____

Account Number	Service Address	Billing Name	Billing Address	City/State/Zip

Please attach additional accounts as needed, and reference accordingly in the table above with “see attached”.

• Supplier/Broker Name: _____

• Supplier/Broker Contact: _____

• Supplier/Broker Contact Telephone Number: _____

• Supplier/Broker Contact Email Address: _____

***CHECK ONE Invoice the customer OR Invoice the supplier/broker as follows:

(Not applicable to NSTAR)

Supplier/Broker Signature: _____ Date: _____

Supplier Billing Address

This section is to be completed by the Customer

I authorize the above distribution company to share my interval data with the above supplier/broker until I or my supplier/broker notifies you otherwise¹¹. The tariff allows for one request per account per calendar year for historical data at no charge. I understand that a fee will be assessed for any subsequent request made within the calendar year. Please accept this request for information under the authority of this form as if the request was made directly to you. You are permitted to accept this form as

¹¹ Signatures for historical requests are only valid for one year after the sign date.

authentic whether it is the original executed document or a copy thereof. My signature affirms that I have the authority to make and sign this request on behalf of my company.

*Customer Signature _____
 *Printed Name _____
 *Title _____
 *Company Name _____
 *Date _____

Massachusetts tariff allows for one request per account per calendar year for historical data at no charge. If available, I would like to exercise that option now: YES NO

*****SEE ATTACHED FEE SCHEDULE*****

NGRID Please scan the completed form into PDF format and email

to: IntervalDataRequests@us.ngrid.com

Historical request for Interval Data:

• Initial Request – covering a single calendar year No Charge

Subsequent historical request within same calendar year

• Single Retail delivery service account \$83.00

• Additional retail delivery service account – requested at same time
 \$6.41 per account x # of accounts (_____) _____

Subscription Service for Interval Data over the Internet:

• Single retail delivery service account \$154.00

• Additional retail delivery service account – requested at same time
 \$76.89 per account x # of accounts (_____) _____

***CIRCLE ONE 1 Year Contract OR Automatic Yearly Renewal
Total Charges \$ _____

NSTAR Please attach as a pdf in the Issue Tracker or Fax To Interval Data Services (781) 441-3690

NSTAR will invoice the supplier/broker only, not the customer.

Historical request for Interval Data:

• Initial Request – covering a single calendar year No Charge ***

Subsequent historical request within same calendar year

• \$36.64 per account x # of accounts (_____) _____

Subscription Service for Interval Data over the Internet:

• \$161.64 per account x # of accounts (_____) _____

Automatic Yearly Renewal
Total Charges \$ _____

WMECO Submit requests to NU Meter Operations Support by fax 860-665-2069, or by pdf to metersvcs@nu.com.

WMECO/CL&P will provide interval meter data via an access-protected web site. The service period begins the first business day after email notification of the availability of the EPO service. WMECO or CL&P may, at our discretion, cancel this agreement and return the unused pro-rated portion of fees received.

Historical request, \$50 per account

All interval data available at the time of the request will be provided online. Data will not be updated. The user id and password will expire 30 days after the start of the service.

Annual subscription, \$300 per account per year

All interval data available at the time of the request will be provided online. For phone-accessed meters, data will be updated

daily. For manually-read meters, data will be updated approximately once a month. The subscription automatically renews each year. Refunds are not issued for early cancellation.

UNITIL Fax To (603) 227-4543

Historical request for Interval Data:

Initial Request – covering a single calendar year

No Charge

Subsequent historical request within same calendar year

Single Retail delivery service account

\$49.26 per meter

Additional retail delivery service account

(Please attach list of accounts)

\$49.26 per meter x # of accounts

\$ _____

Annual Subscription

Single retail delivery service account

\$346.92 per meter

Total Charges

\$ _____

Figure 6 – Customer Authorization to Release Data to Third Parties

I authorize the following utilities and/or energy suppliers to release billing information and other data being collected regarding my facility to third parties in order to determine the feasibility of a potential energy efficiency measure and/or to facilitate the preparation of an energy efficiency incentive application.

Name: _____ Title: _____

Signature: _____ Date: _____

Utility or Energy Supplier Name	Account Number	Billing Name	Service Address

Please indicate the third parties which are allowed to receive this information:

Third Party Allowed to Receive Data	Contact Person	Email Address	Telephone Number

After completing this form, please forward to the applicable utility or energy supplier with a copy to the third party requesting such data).

Figure 7 - Links to Interconnection Requirements

NSTAR:

http://www.nstar.com/business/rates_tariffs/interconnections/

NGRID:

http://www.nationalgridus.com/masselectric/business/energyeff/4_interconnect.asp

Western Mass:

<http://www.wmeco.com/Business/UnderstandBill/RatesRules/DistribGenRequirements.aspx>

Unitil:

http://services.unitil.com/mass/gen_req_proc.asp