PENNSYLVANIA GREEN ENERGY LOAN FUND

Procedures Manual for Quantifying Energy Savings

A. Introduction

A building project applying for a GELF energy loan must demonstrate that it will result in a reduction in energy consumption equal to the GELF savings goals, which differ for different project types. This reduction must be confirmed by an energy professional and be based on sound engineering principles for analyzing and estimating savings.

An "**energy professional**" is a registered architect, professional engineer, or individual with a current certification by the Building Performance Institute, the Association of Energy Engineers, the U.S. Green Building Council or comparable certification.

Each Applicant will need to submit a written energy analysis report. The contents of those reports depend on the specific type of project. As noted above, GELF recognizes four different categories of building projects likely to be interested in a GELF energy loan:

1. Projects involving limited energy retrofit measures or the replacement of equipment in an existing, occupied building.
2. Projects involving extensive energy retrofit measures in an existing, occupied building.
3. Projects involving the gut rehab of an existing building that is either currently unoccupied or will be renovated for a different usage.
4. Projects involving the new construction of a building or addition to a building.

Each of these categories of projects has a different approach for determining the energy reduction goal and for establishing that the proposed building project meets that goal. The contents of each energy analysis process and report for each project category will be discussed in the following sections.

For GELF applicants who are unable to provide the needed technical analysis of energy savings, GELF has contracted with Practical Energy Solutions ("**PES**") of West Chester, PA to provide such analysis. GELF will cover 75% of the cost of the analysis and the applicant covers 25% of the cost. PES will provide a proposal for the applicant that specifies the services to be performed and the 25% cost share of the applicant. Applicants should indicate their interest in applying for such a recoverable grant on the *GELF Initial Financing Request Form*.

The List of Energy Measures Spreadsheet

It is critical that the Applicant and Reinvestment Fund have a clear understanding about the specific energy measures (and their installed costs) that will be implemented with GELF financing. It is also critical that the actual measures installed be identical to the energy measures that were analyzed so the estimates of energy savings are accurate for the building at the conclusion of the project. Because the scope of work of a project often changes during the final design process and during construction, the Applicant is under a continuing duty to both update Reinvestment Fund as to the actual measures being installed and to submit revised energy analysis that reflects the actual energy measures being installed in the project. The project's final estimate of energy savings must be based on of the energy measures present in the building at the conclusion of construction. To help ensure this happens, an Applicant must complete and submit the *List of Energy Measures* spreadsheet as an exhibit to the *GELF Building Energy Loan Application* and must amend this form up through loan closing and construction. The *List of Energy Measures* spreadsheet is shown as Exhibit 1 on page 7 of this document and the Excel version is available on the GELF website (www.reinvestment.com/GELF).

While GELF is focused primarily on energy efficiency and conservation measures, it may also provide financing for distributed generation such as solar photovoltaic systems and combined-heat-and-power systems when such measures are part of a larger building energy conservation project. Please contact Reinvestment Fund for more information about financing these kinds of measures.

Review of the Applicant's Energy Analysis

DOE program guidelines require that all estimates of energy savings be reviewed and accepted by an independent energy expert. GELF has contracted with Practical Energy Solutions ("**PES**") of West Chester, PA to serve as Technical Reviewer for the energy analysis submitted by GELF applicants. PES will review the energy audits, energy modeling and other engineering analysis to confirm the energy savings estimates are reasonable. The Technical Reviewer will also review construction documents and specifications to ensure the energy audits, energy modeling and other engineering analysis accurately reflects the project that is to be constructed. Applicants' energy professionals must cooperate with the Technical Reviewer in answering questions and providing requested information and revisions. Acceptance of the energy savings estimates by the Technical Reviewer is a condition of the loan.

B. Limited Energy Retrofits in an Existing Occupied Building

Energy retrofits in existing occupied buildings can occur either when a piece of energy-consuming equipment reaches the end of its useful life or when a building owner decides to take a proactive approach to reducing the energy consumption of a building. In either case, the building owner replaces an existing piece of equipment or an energy system with a more energy-efficient model. Examples of energy retrofits covered by this project category could include replacement of HVAC equipment, lighting systems or other building systems. A more complete list of energy measures eligible for GELF financing is contained in the *List of Energy Measures* spreadsheet, available on the GELF website (www.reinvestment.com/GELF).

The distinction between "limited" energy retrofits and "extensive" energy retrofits (see the next section) is subjective, but in general, limited energy retrofits involve one or two separate Energy Conservation Measures ("**ECMs**") or pieces of equipment or energy systems. Three or more ECMs are considered an Extensive Energy Retrofit and are covered in the next section of the *Guidelines*.

For limited energy retrofits in an existing occupied building, the GELF energy savings requirement is that the energy consumption of the new equipment is **25%** less than the energy consumption of the existing equipment. When the Applicant is financing a limited energy retrofit, the energy consumption of the entire building need not be reduced by 25%, but only the energy consumption of the energy equipment or system being replaced.

To demonstrate compliance with the 25% reduction goal, GELF requires an energy professional to perform an energy analysis and submit a written report for each retrofit measure that addresses the following:

1. The description of the existing equipment/system.
2. The estimated annual energy consumption of the existing equipment/system (in units of energy - kW and kWh of electricity, ccf of natural gas, gallons of heating oil, etc.).
3. The description of the new proposed equipment/system or retrofit. Cut sheets of the equipment/ systems should be included as an attachment to the analysis.
4. The estimated total cost (both hardware and installation) of the new equipment/system or retrofit and any rebates, grants, tax credits or other financial incentives available.
5. The estimated annual energy consumption of the new equipment/system or retrofit (in units of energy, not costs).
6. The useful life of the new equipment/system or retrofit.
7. The estimated annual O&M cost savings or increase of the new equipment/system or retrofit.
8. The estimated annual and lifetime energy cost savings of the new equipment/system or retrofit (including any assumptions regarding future energy costs).

The energy professional must, as part of the written analysis, provide a description of and documentation for all tools used to perform energy use and energy savings estimates. Manual calculations should disclose essential data, assumptions, formulas, etc. so that a reviewer could replicate the calculations based on the data provided. All assumptions and estimates must be clearly identified.

As noted above, this energy savings analysis is subject to review and acceptance by GELF's Technical Reviewer.

C. Extensive Energy Retrofits in an Existing Occupied Building

As noted in the prior section, projects in an existing, occupied building involving three or more ECMs are considered an extensive energy retrofit.

For extensive energy retrofits in an existing occupied building, the GELF energy savings requirement is that the ECMs are predicted to reduce total annual energy consumption of the building by **25%** from historical usage. The necessary energy analysis needed to support the energy saving claims of comprehensive energy retrofits in existing buildings is a whole building energy audit report by an energy professional that addresses the following elements:

1. **Historic Energy and Water Consumption**:
   a) Compile energy and water usage and costs for the building for the 24 months prior to the audit. Provide the data showing monthly consumption and costs for electricity (show both kW and kWh), natural gas (ccf), fuel oil (gallons), steam (thousand pounds), propane (gallons), solid fuels (BTUs) and water (gallons). Show the billing meter readings that corroborate usage.
   b) Identify the utility rate schedule under which services are provided to each meter.
   c) Develop a load profile for each electric and natural gas account.

2. **Facility Description**
   a. Describe the building's size, age, construction type and features.
   b. Describe the building usage and occupancy profiles.

3. **Building Envelope**. Describe the building envelope (roof, exterior walls, windows, exterior doors). Assess the building's air tightness, U-values and solar reflectance.

4. **Systems and Equipment**. Analyze all the major electrical and mechanical systems at the building. The analysis shall address the loads, hours of operation, proper sizing, current condition, operating efficiencies and expected remaining life for the following building systems:
    a. HVAC system and controls (heating, air conditioning, ventilation).
    b. Lighting (interior and exterior).
    c. Water consumption end uses (such as restroom fixtures, kitchen equipment, laundry equipment, etc.) and water heating equipment.
    d. Plug loads (computers, office equipment, medical equipment, etc.).

5. **Energy Conservation Measures**: Identify and propose potential ECMs for installation or implementation at the building. For example, for lighting recommendations, for each area of each building, provide proposed fixture type, proposed lamp type, proposed lamp count, proposed ballast type, total watts per proposed fixture, projected energy savings, projected energy cost savings and before and after lighting levels. Similar detail should be provided for other measures. Clearly document the key assumptions made in analyzing each measure and describe the method of analysis. Provide the following for each recommended ECM:
    a. Description of the ECM.
    b. Estimated installation cost of the ECM and source of cost estimate.
    c. Life expectancy of the ECM.
    d. Estimated annual and lifetime energy savings of the ECM (kW, kWh, therms, etc.).
    e. Estimated annual and lifetime energy cost savings from the ECM (including any assumptions regarding future energy costs).
    f. Estimate of any rebates, grants, tax credits or other financial incentives available.
    g. Estimated annual and lifetime operating cost savings.
    h. Simple payback of the ECM.
    i. Estimated return on investment of the ECM.

The energy professional must, as part of the written analysis, provide a description of and documentation for all tools used to perform energy use and energy savings estimates. Manual calculations should disclose essential data, assumptions, formulas, etc. so that a reviewer could replicate the calculations based on the data provided. All assumptions and estimates must be clearly identified.

As noted above, the energy audit is subject to review and acceptance by GELF's Technical Reviewer.

D. Energy Measures in the Gut Rehab of an Existing Unoccupied Building

A full gut rehab generally involves the complete stripping of a building down to its walls and floors, followed by the rebuilding of the walls and roof and the installation of new HVAC systems, lighting and other energy systems.

For gut rehab projects, the GELF energy savings requirement is predicted energy use **10%** less that allowed under the applicable building code. For commercial buildings in Philadelphia, the applicable building code is the 2018 International Energy Conservation Code. For commercial buildings outside of Philadelphia, the applicable building code is the 2015 International Energy Conservation Code. For low-rise residential buildings throughout Pennsylvania, the applicable building code is the 2015 International Residential Code.

Once the correct building code has been identified, the second step is to show that the rehabbed building is designed to require 10% less total energy than the code-compliant project. GELF's process is modeled after the U.S. Green Building Council's Leadership in Energy and Environment Design ("**LEED**") process for deciding the number of

energy points a project earns, except that GELF focuses on BTU savings rather than dollar savings. There are three parts to showing the building will meet its energy goal:

1. The Applicant will need to identify the specific energy measures and systems that are to be included in the building. This is done by submitting the most current set of construction drawings that are available and by completing and submitting the *List of Energy Measures* spreadsheet that is available on the GELF website. GELF needs specific information about the high-performance energy systems and measures for the following:
    a. Building envelope (including air tightness, U-values, roof solar reflectance, windows and doors)
    b. HVAC system and controls (heating, air conditioning, ventilation)
    c. Lighting (interior and exterior)
    d. Water consumption end uses (such as restroom fixtures, kitchen equipment, laundry equipment, etc.) and water heating equipment
    e. Plug loads (appliances, computers, office equipment, medical equipment, etc.).

2. The Applicant must produce and submit an energy modeling report by a qualified energy consultant that estimates the building's total annual energy consumption with the energy systems and measures that will be used in the rehabbed building. The Applicant must also submit all input assumptions that were used in the modeling. The acceptable energy models include DOE-2.2, EnergyPlus, eQuest, HAP and Trace. The complete list of building energy modeling software accepted by the federal government for commercial building tax deductions is available at http://energy.gov/eere/buildings/qualified-software-calculating-commercial-building-tax-deductions.

3. The submitted energy model, construction drawings and supporting documents will be reviewed by GELF's Technical Reviewer. The Technical Reviewer will work with the applicant's design team to evaluate the project's energy savings and to recommend changes to the project design to improve energy performance.

Because the scope of work of a project often changes during the final design process and during construction, the Applicant is under a continuing duty to both update GELF as to the actual measures being installed and to submit revised energy modeling that reflects the actual energy measures being installed in the project. The project's final estimate of energy savings must be based on of the energy measures present in the building at the conclusion of construction.

E. Energy Measures in New Construction

GELF financing can be provided for new construction and on building additions.

For new construction projects, the GELF energy savings requirement is predicted energy use **15%** less that allowed under the applicable building code. For commercial buildings in Philadelphia, the applicable building code is the 2018 International Energy Conservation Code. For commercial buildings outside of Philadelphia, the applicable building code is the 2015 International Energy Conservation Code. For low-rise residential buildings throughout Pennsylvania, the applicable building code is the 2015 International Residential Code.

Once the correct building code has been identified, the second step is to show that the rehabbed building is designed to require 15% less total energy than the code-compliant project. GELF's process is modeled after the U.S. Green Building Council's Leadership in Energy and Environment Design ("**LEED**") process for deciding the number of energy points a project earns, except that GELF focuses on BTU savings rather than dollar savings. There are three parts to showing the building will meet its energy goal:

A GELF energy loan for new construction of a high-performance building or building addition will require a building energy simulation modeling report by a qualified energy professional that addresses the following three elements:

1. A brief narrative describing the high-performance energy systems and measures that will be installed in the building, including:
    a. Building envelop (including air tightness, U-values, roof solar reflectance, windows and exterior doors)
    b. HVAC system and controls (heating, air conditioning, ventilation)
    c. Lighting (interior and exterior)
    d. Water consumption end uses (such as restroom fixtures, kitchen equipment, laundry equipment, etc.) and water heating equipment
    e. Plug loads (computers, office equipment, medical equipment, etc.).
2. The building's predicted energy consumption on an annual basis were it built to applicable energy code.
3. The building's predicted energy consumption on an annual basis as designed with the higher-than-code energy systems and measures.

The Applicant must produce and submit an energy modeling report by a qualified energy consultant that uses recognized software to estimate the proposed building's total annual energy consumption - under the building code and as proposed. The acceptable energy models include DOE-2.2, EnergyPlus, eQuest, HAP and Trace. The complete list of building energy modeling software accepted by the federal government for commercial building tax deductions is available at http://energy.gov/eere/buildings/qualified-software-calculating-commercial-building-tax-deductions. The Applicant must also submit all input assumptions that were used in the modeling

As noted above, the energy model is subject to review and acceptance by GELF's Technical Reviewer.

Because the scope of work of a project often changes during the final design process and during construction, the applicant is under a continuing duty to both update GELF as to the actual measures being installed and to submit revised energy modeling that reflects the actual energy measures being installed in the project. The project's final estimate of energy savings must be based on of the energy measures present in the building at the conclusion of construction.

F. Reporting Energy Consumption Data with *Portfolio Manager*

All projects must also use ENERGY STAR's *Portfolio Manager*, a free, web-based benchmarking program, to report both the building's pre-retrofit Energy Performance Rating and an estimated post-retrofit Energy Performance Rating. Post-construction energy consumption data is required because GELF is required to report both the estimated energy savings and the actual energy savings realized by projects following their completion and occupancy.

Portfolio Manager is available at www.energystar.gov/benchmark. Practical Energy Solutions, GELF's Technical Reviewer, is available to help all GELF borrowers set up their Portfolio Manager accounts and to master the process for entering ongoing energy consumption data. GELF Borrowers must provide Reinvestment Fund and the Pennsylvania Department of Environmental Protection permission to access the *Portfolio Manager* account for the building.

Please refer to the *GELF Manual on Measurement and Verification*, available on the GELF website, for more information about Portfolio Manager and the tracking of utility data.

Exhibit 1

List of Energy Measures Spreadsheet

REINVESTMENT FUND

Pennsylvania Green Energy Loan Fund
List of Energy Measures

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Project Name:	
Project Address:	
Borrower:	

ENERGY MEASURE	DESCRIPTION / SPECIFICATIONS / MANUFACTURER / MODEL	TOTAL INSTALLED COST
Building Envelope		
Air Sealing		
Roof Insulation		
Exterior Wall Insulation		
ENERGY STAR certified roofing		
Windows		
Exterior Doors		
Exterior Shading Devices		
Other Building Envelope		
	Sub-Total:	*$0*
HVAC		
Heating Equipment		
Ventilation Equipment		
Cooling Equipment		
HVAC Distribution		
HVAC Control System		
Energy Recovery System		
Other HVAC		
	Sub-Total:	*$0*
Lighting		
Interior Lighting Fixtures		
Exterior Lighting Fixtures		
Lighting Controls		
Daylighting Measures		
Other Lighting		
	Sub-Total:	*$0*
Plumbing		
Domestic Hot Water Heater		
Low-Flow Plumbing Fixtures		
Hot water pipe insulation		
Other Plumbing		
	Sub-Total:	*$0*
Plug Loads		
Kitchen Appliances	ENERGY STAR dishwashers / refrigerators	
Laundry Appliances	ENERGY STAR clothes washers	
Office Equipment	ENERGY STAR office equipment	
Other Plug Loads		
	Sub-Total:	*$0*
Other Energy Measures		
Solar photovoltaics (PV)		
Combined Heat and Power (CHP)		
Energy Storage Systems		
Demand Response Systems		
3rd Party Building Commissioning		
Stormwater Retention Measures		
Other Energy Measures		
	Sub-Total:	*$0*
Energy Project Soft Costs		
Energy Audit or Modeling		
Other Energy Soft Costs		
	Sub-Total:	*$0*
	Grand Total:	**$0**