EM&I Engineering

Guideline – Social Housing Energy Savings Program (SH-ESP) Feasibility Study

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1 List of Acronyms

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

DR – Demand Response

EE – Energy Efficiency

EM&I – Energy Management and Innovation

FS - Feasibility Study

GHG – Greenhouse Gas

HP – Heat Pump

LD – Load Displacement

LCE – Low Carbon Electrification

SH-ESP – Social Housing Energy Savings Program

LCE – Low Carbon Electrification

OA – Opportunity Assessment

2 Introduction.

This guideline is intended to support consulting engineers as they evaluate the feasibility of implementing energy measures through the Social Housing Energy Savings Program (SH-ESP). Consultants are expected to prepare proposals considering the scope of work as defined in this guideline. Consultants are expected to apply this guideline when completing the scope of work as defined in the SH-ESP Feasibility Study Funding Agreement between the customer and BC Hydro. Refer to section 4.

A feasibility study is intended to go beyond an opportunity assessment (OA) or traditional energy audit focusing on a conceptual or pre-schematic design recommendation by including additional detail on the feasibility of the proposed recommended measures. The consultant should undertake sufficient investigation and analysis to have confidence that the recommended measures are practical and feasible in the building and site conditions, and that the equipment recommendations and cost provided have either accounted for all major foreseeable technical and cost barriers, or at least flag those foreseeable items so the participant can continue with the project understanding the risks.

The scope of the Feasibility Study will involve energy efficiency (EE) measures. While this study does not primarily focus on demand response (DR) or load displacement (LD) measures, they can also be studied where applicable.

The consultant must be a BC Hydro approved consultant. The customer may choose an energy consultant from a list supplied by BC Hydro Alliance; or may, subject to BC Hydro's prior approval of the consultant's qualifications, use an energy consultant of their choosing.

3 Purpose.

A BC Hydro funded SH-ESP Feasibility Study helps customers make decisions on implementing EM by providing key information for a business case including:

- energy impacts (kWh/year)
- demand impacts (kW)
- project cost estimates including equipment, materials and labour ($)
- energy cost impact ($/yr., $/kWh)
- simple payback (yr.)
- non-electrical benefits and impacts
- highlighting equipment, building, site and installation considerations that impact the feasibility, costs and timeline of the proposed EM(s); such as, equipment location, structural upgrades, electrical capacity upgrades, hazardous materials and permit

4 Scope of Work.

The Feasibility Study scope of work is outlined in this guideline and will be stated in the Feasibility Study Funding Agreement with BC Hydro. A pre-proposal meeting may be scheduled to agree on the system(s) and boundary(ies), which EM measures are in scope, what key project and business information is required, and how the impacts will be evaluated: individually or using an integrated approach.

Consultant proposals must be submitted via a populated SH-ESP Feasibility Study Proposal Template. Proposal fees are to be developed in compliance with the scope of work and methodology outlined within this guideline.

The measures to be studied may be informed by a previously completed SH-ESP Opportunity Assessment (OA), customer site inspection or studies completed outside of the SH-ESP. Measures will be categorized as follows:

- Rebate Measure – Common equipment addition or replacements with predictable savings potential, not requiring custom energy impact calculations.
- Custom Measure – Complex retrofits involving detailed analysis and custom energy impact calculations.

The criteria for each are discussed in Section 4.2 and 4.3 respectively.

Note also that the Feasibility Study work must:

- Only begin after the customer has signed and returned a copy of the SH-ESP Feasibility Study Funding Agreement.
- Follow industry accepted energy engineering practices.
- Be complete within six months of the Feasibility Study Funding Agreement signing date.

4.1 Deliverables:

The consultant must deliver the following:

- Feasibility Study Report (signed and sealed by a Professional Engineer) with contents per section 5.8.
- Supporting files and engineering calculations used in conducting the study and analysis.
- Completed SH-ESP Workbook tabs, depending on whether custom and/or rebate measures were studied.

Note: If the Feasibility Study includes lighting re-design, a completed BC Hydro (or approved) lighting calculator shall be submitted as a part of the Feasibility Study Report. Relevant lighting drawings and specifications may be submitted to describe existing systems and proposed lighting measures. If the scope is for lighting re-design only then only the lighting calculator is required, the SH-ESP Workbook is not required.

4.2 Rebate Pathway

The rebate pathway is a streamlined approach to rebates suitable for equipment additions or replacements without significant re-design. An SH-ESP Workbook (In-suite, Lighting and/or Mechanical tabs) is to be populated with basic information on the existing system and proposed measures, upon which eligible rebate amounts and associated energy impacts are immediately calculated. Custom energy impact calculations are not required. Rebate measure can apply for rebates without a Feasibility Study; However, measures can still be studied at the customer's discretion.

A list of qualified Rebate Measures is listed below:

1. Domestic hot water
   1.1. Central air source HP water heater, NEEA Tier 2 or 3**
   1.2. In-suite all-in-one air source HP water heater with supplemental electricity*
2. HVAC
   2.1. Cold climate air source HP (mini-split)*
   2.2. Cold climate air source HP (multi-split)*
   2.3. Central cold climate air source HP (multi-split or variable refrigerant flow, outdoor unit located in common area serving multiple suites)
   2.4. Rooftop HP MUA with supplemental electric heating
   2.5. Low ambient rooftop HP MUA with electric preheat (HP operational down to -12°C with electric preheat)
3. Envelope
   3.1. Glazing (for electrically heated building, existing system must be single glazed or double glazed with non thermally broken frames)
4. Mechanical
   4.1. Parkade CO - HVAC controls
   4.2. Variable speed drive for motors
5. Lighting
   5.1. Like-for-like lighting replacements
   5.2. Lighting controls
6. In-suite measures
   6.1. In-suite lighting*
   6.2. In-suite fridge*

* Must cover a substantial portion of the building suites. This offer is not for individual, in-suite upgrades.
** Central heat pump water heating systems with supplemental gas-fired heating are not accepted.

4.3 Custom Pathway

The custom pathway is reserved for complex measures in which a Feasibility Study will need to be completed first to define the project scope, energy impacts and costs prior to rebate application. Measures pursued through this pathway will require custom engineering calculations to determine energy impacts as outlined in section 5.3 to 5.5. A SH-ESP Workbook

(Custom tab) is to be populated with basic information on the existing system and proposed measures.

Measure(s) are considered as custom if they are not a rebate measure. In general, custom measures may meet any of the following criteria:

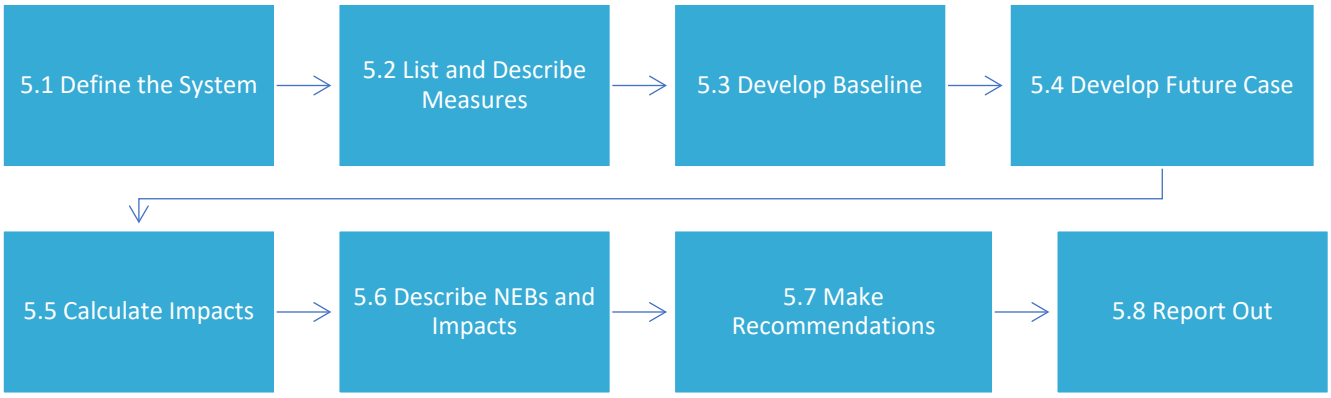
1. Any building envelope upgrades other than glazing-only retrofits.
2. Installation of through-wall packaged terminal heat pumps*.
3. Central hydronic or domestic hot water heat pumps with custom supplemental electrical resistance heating (supplemental gas fired heating is not accepted).
4. Central heat recovery: Includes heat recovery from sewage or wastewater or exhaust air heat recovery.
5. Central hydronic or domestic hot water heating that is electric resistance only.
6. Heat pumps that aren't air-to-air systems, i.e. they're water-to-air, air-to-water, or water-to-water.
7. Lighting redesign that includes changes to the light quantity and/or mounting locations, or projects that add a networked lighting control system.

* Through-wall packaged terminal heat pumps will only be accepted if all other heat pump options (mini-split and multi-splits) are not feasible. Commentary for this justification must be included in the Feasibility Study report. EM&I Engineering requires a Professional Engineer to be involved in design and site reviews of installations.

5 Methodology.

The consulting engineer is expected to adopt a logical and transparent approach and document all assumptions and conclusions. Some studies may require a modified methodology. If there is uncertainty in how best to proceed, please discuss any proposed modifications with EM&I Engineering before proceeding. The default methodology for a feasibility study is presented in Figure 1 and the sections below.

Figure 1: Default Feasibility Study Methodology



5.1 Define System.

Identify and describe the system being assessed. The description should include:

- Annual energy consumption for electricity, natural gas, and other fuels.
- Annual peak demand profile.
- System description with equipment efficiencies and capacities, where applicable; and,

5.2 List and Describe the Measures.

Using observations as well as any available opportunity assessments, past studies or customer site inspection, list and describe the in-scope measures. Each measure may follow either the rebate or custom pathway as described in Section 4.2 and 4.3. Measures may include updates, replacements, and operational enhancements of existing systems as well as new equipment and systems.

For each measure, develop pre-schematic design with sufficient analysis to present a feasible solution given building and site conditions, as well as customer requirements. This includes documentation of the basis of design used in developing the proposed EM (future case). Information in this section should include, but not limited to:

- Description of the existing and proposed systems, as well as the measure scope
- Design and equipment pre-selection to demonstrate measure intent, such as:
    - Equipment sizing supported engineering calculations or existing building data
    - Performance specifications (capacity, flows, demand, efficiencies, etc.)
    - Electrical specifications
    - Make and model used for calculation and cost estimates
    - Reference to cut sheets for major equipment attached as appendices
    - System schematics
- Identify and verify feasible equipment location(s) and their implications on cost estimates provided
- Identification of project safety and operational risks, such as:
    - structural upgrades
    - hazardous material abatement
    - electrical capacity and connections (implications of connecting to suite vs. common area service) per CEC
    - proper condensate drainage
    - water ingress, airtightness and seals for envelope penetrations
    - noise and vibration issues
    - occupant training needs
- Recommended solutions to address known risks which may include the following:
    - involving registered professional engineers in design and/or post installation inspections with signed and sealed letter of assurance
    - hazardous material testing
    - additional commissioning requirements or functional testing
    - measurement and verification

- Permit considerations (installation requirements may trigger additional permit requirements)

5.3 Develop Baseline.

This section is not a requirement for rebate measures, baseline values can be determined using the SH-ESP Workbook.

Determine the baseline values for the system and each custom measure listed in section 5.2:

- Fossil fuel consumption (GJ)
- Electricity consumption (kWh)[1]
- Average load (kW)
- Peak demand (kW)
- Building load profiles (kW: hourly, weekly, monthly)
- Energy Costs ($)[2]
- Capital Costs ($)[3]
- Operations and Maintenance (O&M) Costs ($)

The report must provide the source and assumptions for each value, where applicable.

5.4 Develop Future Case.

This section is not a requirement for rebate measures, future case values can be determined using the SH-ESP Workbook.

Determine the future case values for the system and each custom measure listed in section 5.2:

- Fossil fuel consumption (GJ)
- Electricity consumption (kWh)
- Average load (kW)
- Peak demand (kW)
- Building load profiles (kW: hourly, weekly, monthly)
- Energy Costs ($)[4]
- Capital Costs ($)[5]
- Operations and Maintenance (O&M) Costs ($)

The report must provide the source and assumptions for each value.

[1] Note the electrical rate schedule for suites and common areas
[2] The estimate of electricity cost ($/yr) should use Tier 2 of the customer's rate schedule and applicable riders.
[3] If the baseline conditions are for an existing system, the baseline capital cost estimates may be $0. If the system is considered end of life the baseline capital cost used must meet the current ASHRAE Standard 90.1 or local building by-laws. For lighting measures, baseline cost is assumed to be $0.
[4] Assume inflation at 2% per year.
[5] Include and breakout costs for consulting, design, permitting, material, labour, commissioning, and any electrical infrastructure upgrade costs, where applicable. Include metering installation costs as separate line items. Exclude taxes and contingencies.

5.5 Calculate Impacts.

This section is not a requirement for rebate measures, impact values can be determined using the SH-ESP Workbook.

For custom measures, determine the incremental values for the system and each custom measure listed in section 5.2 by subtracting the future case value from the baseline value.

- Fossil fuel consumption (GJ)
- Electricity consumption (kWh)
- Average load (kW)
- Peak demand (kW)
- Building load profiles (kW: hourly, weekly, monthly)
- Energy Costs ($)
- Capital Costs ($)
- Operations and Maintenance (O&M) Costs ($)
- Simple Payback (years)

The integrated net impact, accounting for all secondary benefits and interactive effects, must be considered as defined by the scope of work. The report must describe the methodology used and detail the analysis by providing measurement data collected, instruments used in the analysis, detailed calculations, and assumptions, where available. An unprotected excel spreadsheet that includes all data and calculations should be provided.

Accuracy requirements are stated in section 6.

5.6 Describe Non-Electrical Benefits and Impacts.

For measures listed in section 5.2 comment on changes to safety, comfort, operations, reliability, and/or serviceability.

5.7 Make Recommendations.

Propose an implementation strategy for recommended bundle of measures with a hypothetical schedule. This bundle should not include measures that are options to one another (or measures that are mutually exclusive). The strategy and schedule must account for customer priorities and constraints and any constraints, as applicable. Identify and describe other potential technical and cost barriers and recommend how to overcome them. Where possible, identify other potential incentives or tax credits.

The details of a measure must not be so specific that they exclude all vendors and manufacturers but one. Recommendations must not contain references to specific manufacturers or equipment vendors or service providers, unless:

- the customer has requested a quotation from a specific vendor, manufacturer, or service provider, or

- an opportunity requires equipment or service that can only be provided by one source.

Use Table 1 to summarize recommendations.

Table 1: Summary of Opportunities

Opportunity Name	Peak Demand Reduction (kW)	Energy Change (kWh, GJ)	GHG Emissions Reduction (tCO2e)	Energy Cost ($) Savings	Opportunity Cost ($)	Incremental Cost ($)	Simple Payback (years)

5.8 Report Out.

The Feasibility Study Report should be developed using the methodology in section 5 to report out on the scope of work detailed in section 4 in the following sections:

1) Executive Summary
   a) Include Table 1: Summary of Opportunities
2) Background Information
   a) Include site address and contact details
   b) Include the contact information for the author of the report, Engineer of Record and Customer's Technical Representative.
   c) Reference any previous studies or assessments.
3) System Definition
4) Opportunities Considered
5) Baseline
6) Energy Impact
7) Cost Impacts
8) Non-Electrical Energy Benefits and Impacts
9) Recommendations

6 Accuracy.

The confidence intervals for energy and emissions impacts and cost estimates for all opportunities must be provided. The expected accuracy for electrical energy impacts is (+/-10%) and implementation costs is (+/-30%)[6].

If meeting the accuracy requirements outlined above is not feasible, the application should provide supporting information and rationale.

7 BC Hydro EM&I Engineering Review.

The Feasibility Study will be reviewed by the BC Hydro EM&I Engineering team. The reviewer will look for reasonable assumptions, appropriate methodology and results that are consistent with sound engineering judgement and similar project experience. If opportunities for significant improvement come to light the consultant will be informed and given every opportunity to revise the report.

EM&I Engineering will not analyse reported results in enough detail to verify all calculations.

The consultant retains all responsibility for the analysis and report.

[6] Association for Advancement of Cost Engineering International, Recommended Practice No. 18R-97. www.aacei.org.

Appendix I – Definitions

Energy Efficiency (EE) is the use of less energy to perform the same task or produce the same result.

Load Displacement (LD) describes customer-based electricity generation, behind the electricity meter, whose main purpose is to displace the electrical load normally supplied from the grid, and results in no net increase in GHG emissions.

LD technologies must be categorized as simple cycle, combined cycle, combined heat and power, or renewable (solar, wind, hydro, geothermal, biomass).

Low Carbon Electrification (LCE) is the reduction of GHG emissions using clean electricity instead of GHG emitting forms of energy such as natural gas, diesel, propane, and gasoline.

Disclaimer