CONSORTIUM FOR POWER EFFICIENCY

Briefing: Avoiding Electrical Upgrades with Power Efficient Design

What Decision-Makers Need to Know

This briefing outlines the importance of Power Efficient Design (PED) strategies to avoid unnecessary electrical upgrades in Canada's buildings. When supported by policies, codes, regulations, and programs, PED can accelerate electrification and enable density, while keeping costs low for Canadian homes and businesses.

What is Power Efficient Design?

Power efficient design (PED) refers to strategies to limit buildings' electricity use, ensuring that power demands stay within the limits of buildings' electrical services (i.e. their connections to the electrical grid) and other infrastructure. PED is an important strategy to enable a lower-cost transition to electric heating, cooling and electric vehicle (EV) charging. Likewise, PED can enable denser new development in existing neighbourhoods by avoiding higher-capacity, more expensive electrical services. This helps keep costs down for new construction while allowing more electrification.

Power Efficiency vs. Energy Efficiency: Power efficiency focuses on reducing the *instantaneous* use of electrical power to stay within electrical system constraints. Conversely, energy efficiency focuses on reducing the *overall* amount of electricity used over time. With good design, both power efficiency and energy efficiency can be achieved.

Table 1: Categories of PED

Optimize Load Calculations	Efficiency and Right-Sizing	Energy Management	Energy Storage
Calculate loads to better reflect true demand.	Save power through energy efficiency.	Monitor and control power to stay within capacity limits.	Store power for when it is most needed.

PED strategies fall into four broad categories:

- **Optimizing Load Calculations:** Updating how electricity needs are calculated, including by using historical energy data for these calculations where possible, can help better reflect actual energy use, making it easier to electrify buildings without unnecessary upgrades.
- **Building Efficiency and Right-Sizing Loads:** Peak electricity use can be reduced by improving the building envelope to reduce instantaneous heat losses and gains, and through efficient right-sized heating, cooling, ventilation, lighting and other building systems.
- **Energy Management Systems:** Energy management systems monitor and control electrical loads so as not to exceed capacity limits. They can temporarily reduce demands from flexible electrical loads (for example, EV chargers, hot water tanks, etc.) to stay within the limits of a building.
- **Energy Storage:** On-site storage, like batteries or thermal solutions (e.g., hot water storage), can supply energy during peak demand periods. These technologies are becoming more common as costs decline. In the future, energy storage could help avoid electrical service size increases, while offering other benefits like improved grid operations, resiliency, and lower utility bills.

The Consortium for Power Efficiency (the Consortium), convened by Dunsky Energy + Climate Advisors, is a partnership of utility, government, and non-profit partners that share the common goal of accelerating building decarbonization while minimizing costs for Canadians. Consortium funding partners have engaged Dunsky to lead several initiatives to support the adoption of PED strategies that can help avoid unnecessary electrical upgrades in both existing buildings and new construction.

Why Power Efficient Design?

Canadians are increasingly switching from fossil fuel systems to electric alternatives in homes, buildings, and vehicles. This **electrification** is driven by new technology, superior economics, consumer demand, and supportive policies. As a result, buildings are facing new electric demands from EV charging, heat pumps, and other electric appliances.

At the same time, many Canadian neighbourhoods are **densifying**. Notably, communities that were once mostly single-family homes are seeing more "missing middle" housing like multiplexes, townhomes, row houses, and small apartment buildings.

These energy transition and densification trends will reduce emissions and air pollution, make housing and transportation more affordable, drive economic development, and improve Canadians' quality of life.

However, electrification and densification are **increasingly leading to electrical service upgrades** to handle the increased demand, in both existing buildings and new construction. Often, larger electrical services bring significant costs for both customers and utilities. For example, upgrading existing services can mean significant architectural, electrical, civil and/or arboreal costs for existing buildings. Likewise, higher capacity electrical services often entails greater costs for developers and utilities. For example, an undergrounded 400A electrical service for a 3-unit multiplex can often cost homebuilders $30,000-$100,000+ more than the overhead 200A service typical for new single family homes.

How Power Efficient Design Can Help

PED can often avoid these expensive electrical upgrades. PED can allow full electrification – including EV chargers, heat pumps, and more – without upsizing electrical utility services, panels and other infrastructure. For example, a home with a 100A electrical panel can often fully electrify without a service upgrade. Likewise, a denser all-electric multiplex building can often an equivalent service to a new single-family home, when using PED.

Many PED strategies also lower buildings' contribution to utilities' system-wide peak electricity demand. This lowers costs for utilities and puts downward pressure on electricity rates. Energy management systems can enable grid-interactivity, further reducing strain on the broader system.

PED can be used in all building types and is a key tool for affordable, efficient electrification across Canada.

Barriers to Power Efficient Design

Some of the barriers to unlocking the benefits of PED include:

- **Codes:** Several PED strategies are not fully supported by current electrical codes. For example, in some case, electrical codes can have overly conservative load calculation assumptions and do not enable energy management for all applicable electrical loads. Additionally, inconsistent adoption and interpretation of codes across Canadian jurisdictions create further barriers.
- **Product certification & availability:** A lack of Canadian standards and certifications for PED technologies leads to uncertainty for electrical safety regulators, manufacturers, and contractors, and slows its adoption. Regional variation in approval processes also complicates the deployment of new technologies.
- **Industry and customer awareness**: Contractors, designers, and building owners are often unfamiliar with PED strategies.
- **Access to utility data:** It is often difficult to access accurate utility data, making it harder to use historical energy data for load calculations.

About the CE Code

The CE Code is a publication issued by CSA Group in several parts:

The CE Code, Part I, applies to all electrical work and electrical equipment in buildings, structures and premises on the consumer's side of a utility's electric service entrance. Every Canadian province and territory, as well as some cities with delegated authority from provinces, adopt electrical codes based on the CE Code, Part I, sometimes with amendments. It is these provincial, territorial or municipal codes that have legal effect. Different jurisdictions may adopt different versions of the CE Code, Part I, at different times.

The CE Code, Part II, consists of safety standards governing the construction, testing, and marking of electrical equipment, and includes general requirements that apply to all equipment.

How to Enable Power Efficient Design

CE Code Amendments

Amendments to the Canadian Electrical Code (CE Code) represent one of the most impactful ways to enable PED.

Several opportunities to update the CE Code to better enable PED have been identified. These include:

- **Energy Management Systems (EMS)**: Recognize and enable EMS technologies to dynamically control a variety of electrical loads beyond just EV chargers.
- **Load calculations:** Better enable load calculations for existing buildings based on historical metering data, and modernize lighting and plug-loads to reflect greater efficiency when constructed to modern practices.
- **Enable low power appliances:** Reflect the power efficiency of low-power electric ovens/ranges, and other low-power appliances.

Dunsky is currently drafting these and other CE Code amendment proposals on behalf of the Consortium.

Energy Management Standards

Energy Management Systems (EMS) can monitor and control electrical loads to stay within specified limits. There is a growing array of EMS technologies and providers.

However, Canada lacks a unified EMS standard for the purposes of PED and electrical codes' compliance. The standards landscape for these technologies is relatively fragmented and confusing. This complexity can discourage vendors from entering the Canadian market, create regulatory uncertainty, increase approvals time, create inconsistency between jurisdictions, and drive up costs.

Efforts are underway to address these challenges. CSA Group is finalizing a standard for Electric Vehicle Energy Management Systems (CSA C22.2 No. 343), which could streamline approvals for EV-specific EMS products once published. Additionally, the Consortium is preparing a report to identify opportunities to simplify and align EMS standards, with recommendations expected by March 2025.

Education and Capacity Building

Building industry knowledge and skills is critical to enabling PED strategies. Electrification and densification are relatively new trends, and technologies are evolving quickly. Many contractors, designers, and building owners are not yet familiar with these PED strategies, so there is a need to share best practices and provide practical tools and resources to help them understand and adopt these approaches.

To address this need, the Consortium is currently developing a **PED Guide for Electrification Retrofits** focused on single-family homes. This guide will help contractors and households apply PED strategies to avoid costly electrical service upgrades during retrofits.

Additionally, the Consortium is developing a **Power Efficient Electrification Calculator** (PEEC). This Excel-based tool will help homeowners and contractors plan for electrification, showing how to prioritize equipment upgrades while staying within electrical capacity limits.

Going forward, additional guides and calculators should be developed for other building types and applications, such as new buildings, multifamily units (e.g., apartments subject to Rule 8-202), and non-residential properties. Expanding these resources will empower industry stakeholders with the knowledge and tools to implement PED strategies effectively across a wider range of projects.

Optimizing Utility and Electrical Safety Authority Processes

There are several opportunities for provincial and municipal governments, safety authorities, regulators and utilities to better enable the determination of historical loads in existing facilities:

- **Historical Load Data:** Utilities should provide peak historical load data to customers with single meters, and establish automated systems to provide aggregated load data across multiple meters for multifamily and commercial facilities.
- **Upstream Infrastructure Capacity Data:** Utilities can share information on the available capacity of upstream electrical infrastructure to accommodate electrification.
- **Correction Factors:** Electrical safety authorities can establish correction factors to make less granular data – such as hourly readings – useful for load calculations. Additionally, new methods should be considered to simplify load aggregation for multiple dwellings, supporting electrification in multiplex homes as well as condominium and apartment buildings.
- **Customer Support:** Utilities should create teams to support stakeholders in accessing and interpreting historical data, as well as develop standardized guidance for load determination tailored to building types and electrification goals. This could include sharing PED guides for customers and contractors with a step-by-step approach, links to instructions for retrieving historical data, and jurisdiction-specific recommendations and considerations.

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