

Heating Electrification without Peak?
A Unique Electric-Gas Collaboration Shows a Third Way is Possible
Jean-Philippe Hardy, Dunsky Energy + Climate Advisors
Philippe Dunsky, Dunsky Energy + Climate Advisors

ABSTRACT

Achieving climate goals requires dramatic reductions in fossil fuel use, and for cold climates, that poses a unique challenge: winter peaks, and the sometimes colossal costs they can engender.

This paper presents an unprecedented collaboration between competing utilities – one gas, one electric – designed to achieve climate goals at the lowest cost. The collaboration involves the gas utility promoting electric heat pumps to its customers, the electric utility paying the gas utility for peak shaving services, and customers being offered incentives and a special dual-energy rate. It also involves government support, and a regulator challenging itself to break down traditional silos in the interests of the climate.

The paper discusses the context for this unique collaboration, the main characteristics of the approach designed by the utilities, and its projected impacts on energy use, rates, and GHG emissions. It also discusses areas where the approach has the potential to accelerate the much-needed energy transition, but also opportunities for improvement, and thoughts on the applicability of this model to other regions. It further discusses other options for decarbonizing heating while accounting for the interests of consumers, utilities, and society.

Introduction

Climate change is arguably the greatest challenge facing humanity. Québec, with its unique energy context and clean electricity, has undeniable assets to play a leadership role in the transition to a low-carbon economy. Accordingly, the Quebec government adopted a legislated target of reducing greenhouse gas (GHG) emissions by 37.5% by 2030 compared to 1990 levels (Gouvernement du Québec, 2021a), and achieving net zero by 2050 (Gouvernement du Québec, 2021a).

The Government's *2030 Plan for a Green Economy* (“Plan pour une Économie Verte 2030” or “PEV 2030”), unveiled on November 16, 2020, charts a course towards decarbonization of the economy by focusing on electrification, renewable energy (including biomass, Renewable Natural Gas or RNG, other bioenergy and H₂), energy efficiency, and measures to better manage demand during peak periods.

Meanwhile Hydro-Québec, the province’s vertically-integrated public utility, and Énergir, the province’s primary gas utility, recently developed an unprecedented deal focused on promoting dual-energy systems. The deal is intended to encourage the partial decarbonization of buildings, by switching most gas heating to electric, while retaining gas for the coldest hours of the year to minimize peak demand impacts.

This paper outlines the agreement between Hydro-Québec and Énergir, the context that led to this agreement, our analysis of the advantages and disadvantages as well as some thoughts on the applicability to other jurisdictions.

Context

Presentation of Hydro-Québec and Énergir

Hydro-Québec is the public utility responsible for managing the generation, transmission, and distribution of electricity in the province of Québec (Canada). Hydro-Québec is one of the largest hydropower producers in the world, and operates about 60 hydroelectric generating stations, producing approximately 190 TWh for its domestic and export markets (Hydro-Québec, 2019). Hydro-Québec also owns and operates about 34,000 km of high-voltage transmission lines and about 260,000 km of electricity distribution lines (Hydro-Québec, 2022a).

Énergir is an energy company with activities in Québec and northeastern United States. It is by far the largest gas utility in Québec, supplying approximately 97% of the gas used in the province, to about 205,000 customers. Énergir has several subsidiaries active in Québec and the United States, including Vermont Gas Systems and Green Mountain Power, the largest gas and electricity utilities in Vermont. Énergir is also active in natural gas transportation, wind and solar electricity generation, gas storage, and liquified natural gas.

The challenges of decarbonization for Hydro-Québec and Énergir

For a variety of reasons, including low electricity rates and low capital cost of electric resistance heating systems, electricity is widely used in heating systems in Québec, especially in the residential and small commercial sectors. For this reason, the electrical network experiences its peak demand periods in winter, during periods of extreme cold, as illustrated in Figure 1.

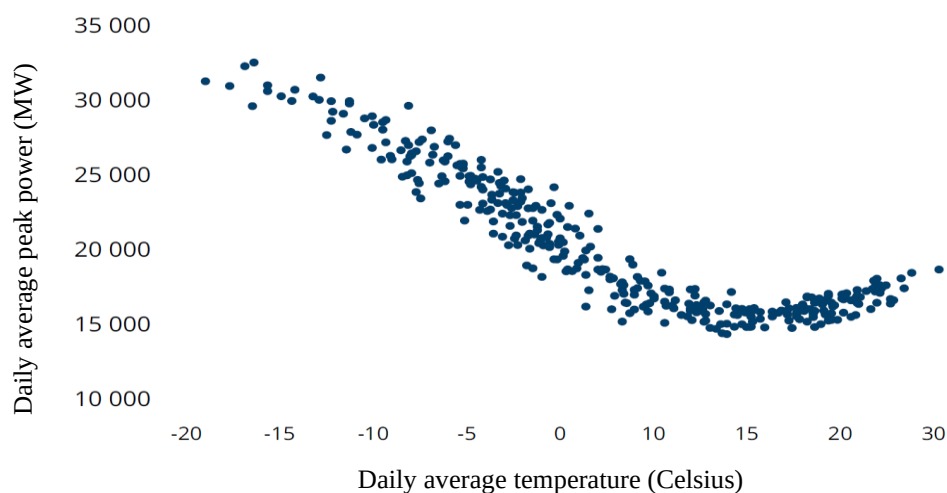


Figure 1: Hydro-Québec's 2020 load profile (each dot represents a day). *Source:* Whitmore and Pineau 2022.

Therefore, in a scenario where Énergir's customers are fully electrified, Hydro-Québec would have to incur significant costs for additional generation capacity, transmission, and

distribution infrastructures to meet the increased winter peak demand, resulting in increased rates for customers.

For the gas utility, the situation is quite different because, under a full electrification scenario, it would experience a significant reduction in sales of gas sold each year. With lower sales to generate the level of revenue required by Énergir to run its network, important increases in gas rates would be needed. Table 1 below summarizes the 2030 cumulative and annual rate increases for both utilities in a scenario where all buildings targeted by the dual-energy offer are fully electrified when their existing gas equipment reaches the end of its useful life.

Table 1. Projected rate increases under a full electrification scenario

	2030 Cumulative	Annual average
Electricity	3.0%	0.27%
Natural Gas	5.6%	0.68%

Baseline is 2019 for electricity and 2022 for natural gas. Numbers assume 100% of the available replace-on-burnout market in the targeted buildings is fully electrified each year until 2030. Source: Hydro-Québec and Énergir, 2021a

Québec's Green Economy Plan

With its 2030 Green Economy Plan, the Québec government announced its intent to make the province a leader in the green economy, in large part by relying heavily on its clean power to electrify Québec's economy. The Government reiterated its commitment to reduce GHG emissions by 37.5% by 2030 compared to 1990 levels and set out the province's path to carbon neutrality by 2050.

The government of Québec mandated Dunskey Energy + Climate Advisors to determine the least-cost path to achieving the province's 2030 (-37.5%) and 2050 (net zero) targets. Using economy-wide optimization modeling, that report specified the detailed, sector- and segment-level changes – both in emissions and technology adoption – required to achieve the targets (Dunskey Energy + Climate, 2019).

The Dunskey study results provided guidance for the province's key energy and GHG policies. For the buildings sector, government set a target of reducing GHG emissions from space and water heating by 50% by 2030, compared to 1990 levels, while maximizing economic benefits and minimizing costs for customers.

Wary of the potential impact on rates of the full electrification of buildings, due to increased peak electricity demand and a significant reduction in gas use, the two utilities and government agreed to an alternative solution that rests on the complementary use of the electricity and gas networks. While the deal still requires regulatory approval, the government adopted a decree instructing the province's utilities regulator to take into account the multiple benefits of the negotiated approach (Gouvernement du Québec, 2021). In so doing, it instructed the regulator to consider a previously unheard-of solution: that one utility compensates the other for the value of peak avoidance, in effect offsetting a part of its lost sales revenue and, ultimately, sharing in the net cost of this decarbonization solution.

The Dual Fuel Deal

The Hydro-Québec and Énergir offer that was presented to the provincial energy regulator in October 2021 aims to encourage the conversion of gas heating systems in residential, commercial, and institutional buildings to dual-energy systems. These systems will use electricity as the main source of energy for heating and gas will be used as a secondary source during limited periods when temperatures fall below a predetermined switchover temperature. Depending on the switchover temperature¹, dual-energy systems will reduce GHG emissions of heating systems by 65% to 75%. The offer promotes a complementary use of both energy sources in order to significantly reduce GHG emissions while managing peak electricity demand and rate increases for electricity and gas customers in the province, and potentially reducing societal costs. This new offer includes 3 main items:

- A mechanism where Hydro-Québec compensates Énergir for a portion of its loss of gas sales due to the conversion of a portion of Énergir's customers to dual-energy systems, in order to balance the rate increases between the two utilities;
- Commercial offers to promote the installation of energy-efficient dual-energy systems in targeted buildings, in collaboration with the SITE, a Québec government organization running various programs to reduce GHG emissions;
- Dual-energy rate options that promote the conversion of space heating loads to dual-energy systems by improving their cost-effectiveness for home and building owners.²

Targeted buildings and end-uses

The utilities, through their initial offer filed with the regulator, aim to convert a portion of Énergir's residential customers for space and water heating to dual-energy systems. New constructions will also be eligible. If the first phase is approved by the regulator, the two utilities intend to extend the offer to a portion of Énergir's commercial and institutional clients (phase 2 of the offer).

The extended offer targets a portion of Énergir's residential, commercial and institutional customers who use gas for space or water heating and whose gas equipment will need to be replaced in the near future. If customers use gas for water heating, the intention of the offer is to fully convert water heating to electricity, while only a portion of the gas used for space heating will be converted to electricity using a dual-energy system. The offer doesn't target other gas-fired equipment, such as fireplaces and stoves, that will therefore keep using gas. New homes and buildings will also be targeted by the utilities. The targeted buildings are established based on their annual gas consumption, as follows:

- Residential and commercial buildings: annual use of 15,000 cubic meters or less;
- Institutional buildings: 500,000 cubic meters or less.

¹ The switchover temperature in Hydro-Québec's existing residential dual-energy rate (rate DT) is -12C, except for Northern regions of Québec where the switchover temperature is -15C. The numbers presented by Énergir and Hydro-Québec in their regulatory filing assume a switchover temperature of -12C for the residential sector and -9C for the commercial and institutional sectors.

² For residential customers, the utilities rely on the existing dual-energy rate offered by Hydro-Québec and the current natural gas rates. Dual-energy rates for commercial and institutional buildings do not currently exist and will be part of the next phase of the utilities' offer that will be filed with the regulator.

The targeted buildings and end-uses have been determined by the utilities based on the volumes that need to be converted to dual-energy so the government can achieve its GHG emission reduction targets set in the province's Green Economy Plan 2030.³ For the institutional sector, the threshold is higher to take into account the government's lead-by-example policy, which aims to reduce the GHG emissions of its building stock by 60% by 2030.

The targeted buildings and end-uses described above represent 178,000 clients and 729 million cubic meters of natural gas per year. Table 2 presents the breakdown of clients and sales per sector.

Table 2. Number of targeted clients and associated gas sales, per sector

		Residential	Commercial	Institutional	Total
Number of clients (thousands)	Total	142	48	7	197
	Targeted	136	35	6	178
	%	96%	72%	98%	90%
Natural gas sales (Mm³)	Total	597	1,057	577	2,231
	Targeted	260	165	304	729
	%	44%	16%	53%	33%

Source: Hydro-Québec and Énergir, 2021a

It can be noted that the vast majority of residential, commercial, and institutional clients – 90% – are targeted by the offer but because the largest customers aren't,⁴ the percentage of the associated gas sales drops to 33%. The utilities also applied a market growth factor and broke down the gas sales by end-use to determine what sales could be converted to electricity through the dual-energy offer. The following table summarizes the sales per sector and end-use, after the inclusion of the growth factor:

³ It should be noted that the projected GHG emission reductions, costs, energy impacts, additional and lost revenues, etc. presented in the regulatory filing assume that 1/15th of the targeted markets will convert to dual-energy systems each year until 2030, which roughly represents an adoption level of 100% of the available replace-on-burnout market each year.

⁴ Customers that are not targeted are: residential and commercial buildings using more than 15,000 m³ per year, institutional buildings using more than 500,000 m³ per year, and all industrial buildings.

Table 3. Sales of targeted clients, per end-use (millions of cubic meters per year)

	Residential	Commercial	Institutional	Total
Space heating	178	170	235	584
Hot water	50	19	10	79
Other equipment (stoves, fireplaces, etc.)	18	26	37	80
Total	246	215	282	743

Source: Hydro-Québec and Énergir, 2021a

Decarbonization potential, energy, and peak demand impacts

Assuming full electric conversion of hot water and partial conversion of space heating⁵, the resulting sales that can be converted to electricity and therefore almost fully decarbonized are presented in the following table:

Table 4. Potential reductions in natural gas sales scenario (millions of cubic meters per year)

	Residential	Commercial	Institutional	Total
Space heating	131	111	153	395
Hot water	50	19	10	79
Other equipment (stoves, fireplaces, etc.)	0	0	0	0
Total	181	130	163	474

Figures represent the total technical potential for the targeted buildings and end-uses. Source: Hydro-Québec and Énergir, 2021a

The following graph compares potential conversion volumes with the total consumption of each sector, and with the total consumption of targeted buildings and of targeted end-uses in those buildings.

⁵ A conversion level of 75% of space heating was assumed for the residential sector, corresponding to a switchover temperature of approx. -12C. For the commercial and institutional sectors, the assumed conversion level is 65%, corresponding to a switchover temperature of approx. -9C.

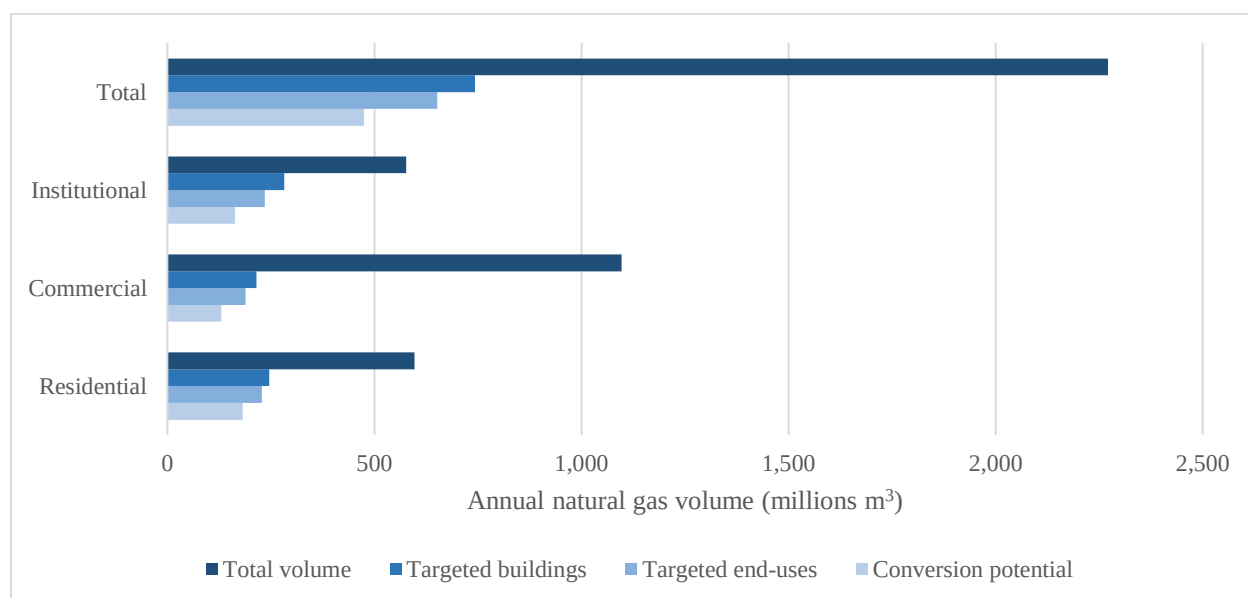


Figure 2. Targeted natural gas sales and conversion potential, per sector. *Source:* Hydro-Québec and Énergir 2021.

From this data, we can calculate the percentage of decarbonization that can potentially be achieved under the dual-energy approach put forward by the utilities, as shown in this next table.

Table 5. Potential decarbonization levels

	Residential	Commercial	Institutional	Total
% of targeted building sales	74%	60%	58%	64%
% of sector's sales	30%	12%	28%	21%

Source: Hydro-Québec and Énergir, 2021a

It appears from the previous table that the dual-energy offer has the potential to significantly decarbonize the targeted buildings and has further room to grow as the province proceeds towards its target of net-zero carbon by 2050. Importantly, the dual-energy offer allows to achieve those levels of decarbonization with minimal impact on the electricity peak demand, thus reducing the need for costly electrical infrastructures. To illustrate this benefit, the utilities presented two scenarios to the regulator: one where all targeted buildings are fully electrified and another where buildings take the dual-energy approach. Impacts on energy use and peak demand in 2030 are presented in the following table.

Table 6. Comparative 2030 energy use impact of full electrification and dual-energy scenarios

	Full electrification	Dual-energy	Difference
Natural gas sale (Mm ³)	-401	-287	-28%
Electrical energy (GWh)	2,957	1,837	-38%
Peak electrical demand (MW)	2,070	63	-97%

Figures represent the total 2030 technical potential for replace-on-burnout in the targeted buildings and end-uses, assuming an available market of 1/15th of the total market each year. *Source:* Hydro-Québec and Énergir, 2021a

Interestingly, while a dual-energy approach generates 28% fewer reductions in gas use, it achieves those reductions with an almost negligible impact on the peak electrical demand.⁶ Also, since natural gas is only used when outside temperatures are very low, and therefore when the efficiency and capacity of air-source heat pumps are lower, the average efficiency of the conversion process is higher, which means that on average, less electrical energy is necessary to convert each unit of natural gas.

Costs and rate impacts

The main purpose of the dual-energy approach put forward by Énergir and Hydro-Québec is to achieve a high level of decarbonization while limiting the impact on electricity and gas rates. For the electric utility, the reduced peak demand of dual-energy systems compared to fully electrified systems reduces the need for additional electricity generation, transmission, and distribution infrastructure. Under the cost-of-service rate-setting approach used in Québec, those cost reductions translate to lower rates for customers. Furthermore, increased electricity sales from the conversion of gas to electricity create a downward pressure on rates as costs-of-service can be spread over a larger volume of energy.

For gas, however, the dual-energy approach means less natural gas is sold each year by the utility. It also means an increased imbalance in the profile of gas distribution, with similar sales of gas distributed in very cold weather but significantly smaller sales outside of those periods. Without significant reductions in the utilities fixed costs, the costs-of-service needed to operate and maintain the gas distribution network has to be distributed over fewer cubic meters of gas, creating an important upward pressure on rates. Contrarily to what we see for the electricity rates, the difference in gas rates between the full electric and dual-energy scenarios isn't very large, since both scenarios significantly reduce gas use. The following table summarizes the 2030 rate impacts of both scenarios, assuming the full replace-on-burnout technical potential is achieved each year in the targeted markets.

⁶ The peak demand impact is associated with the full electric conversion of hot water production. No peak demand impact is generated by the partial electric conversion of space heating since space heating systems are only using natural gas during periods of peak demand.

Table 7. Comparative 2030 rate impact of full electrification and dual-energy scenarios

		Full electrification	Dual-energy	Difference
Natural gas rates	Cumulative	+5.6%	+4.8%	-14%
	Annual average	+0.68%	+0.59%	
Electricity rates	Cumulative	+3.0%	+0.9%	-70%
	Annual average	+0.27%	+0.08%	

Baseline is 2019 for electricity and 2022 for natural gas. *Source:* Hydro-Québec and Énergir, 2021a

It appears from the previous table that there is an important imbalance between the rate impacts of the dual-energy approach on the two utilities. To correct this imbalance, Hydro-Québec and Énergir came up with a highly unusual and innovative collaboration mechanism, where Hydro-Québec compensates Énergir for its reduced sales. Even though under a dual-energy approach, the gas network can be seen as providing peak shaving services to the electric utility, the compensation mechanism is based on the GHG reductions that are achieved by substituting fossil gas use with clean electricity from Hydro-Québec's grid. Without going into all the details of the mechanism, here are its main characteristics (Hydro-Québec and Énergir, 2021):

- The mechanism was designed so that the total compensation amount in the year 2030 equals \$85M, assuming the levels of conversion to dual-energy are as planned.⁷
- The compensation amount is based on the actual sale of natural gas that is converted to electricity. For each customer that installs a dual-energy system and subscribes to Hydro-Québec's dual-energy rate, the two utilities will, each year, jointly calculate the actual reduction in gas consumption and use it to calculate the compensation.
- The compensation amount is based on a degressive rate, to reflect Énergir's revenue losses associated with its degressive distribution rates.
- Compensations will be given by Hydro-Québec to Énergir for 15 years after a client subscribes to the dual-energy rate. The client has to remain on the dual-energy rate for compensations to occur.

Using this compensation mechanism, the utilities calculated the new rate impacts. The following table describes those impacts, with and without the compensation mechanism.

⁷ Since the planned levels of conversion to dual-energy assume 100% replace-on-burnout adoption in the available markets, a total compensation of \$85M is highly improbable. However, this was a theoretical exercise to determine the rates of compensation that will be applied to the actual levels of conversion that will be calculated each year.

Table 7. Comparative 2030 rate impact of dual-energy scenario, with and without compensation

		Dual-energy without compensation	Dual-energy with compensation	Difference
Natural gas rates	Cumulative	+4.8%	+0.9%	-81%
	Annual average	+0.59%	+0.11%	
Electricity rates	Cumulative	+0.9%	+1.4%	+56%
	Annual average	+0.08%	+0.13%	

Baseline is 2019 for electricity and 2022 for natural gas. Rate impacts assume 100% of the replace-on-burnout technical potential is achieved each year in the targeted markets. *Source:* Hydro-Québec and Énergir, 2021a

Using this mechanism, the utilities were able to redistribute more evenly the benefits and costs of the dual-energy approach, thus creating a more balanced rate impact between electricity and natural gas consumers. In the following graph, we compare the cumulative 2030 rate impacts of the three scenarios that were presented to the regulator: full electrification, dual-energy without compensation, and dual-energy with compensation.

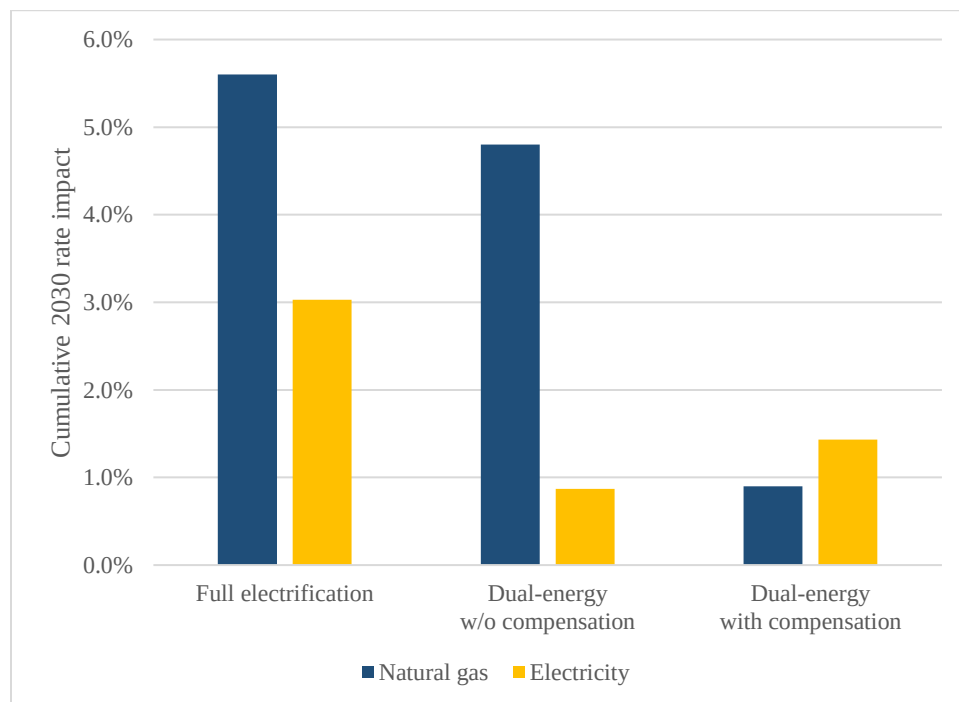


Figure 3. Cumulative 2030 rate impact of the three scenarios presented to the energy regulator. Rate impacts assume 100% of the replace-on-burnout technical potential is achieved each year in the targeted markets. *Source:* Hydro-Québec and Énergir 2021.

Driving Sales: The Old and the New

Some incentives already exist to help reduce the capital and operation costs for customers who decide to install a dual-energy system. In the residential sector, a dual-energy rate has been offered by Hydro-Québec for many years. Under this rate, residential customers benefit from a reduced kWh rate whenever the outside temperature is above -12°C ⁸, allowing average savings of approximately \$500 per year for an average-sized single-family home in Montréal, compared to using only electricity for heating (Hydro-Québec, 2022b). For residential customers, Hydro-Québec offers incentives to customers who install a heat pump while Énergir incentivizes the installation or replacement of gas furnaces and boilers. No incentive is currently offered by the provincial government to support the transition from gas to electricity in the residential sector.

In the commercial and institutional sectors, a wider array of incentives are available to building owners, from the two utilities and the provincial government, allowing to offset a significant portion of the capital costs of installing a dual-energy system. However, no dual-energy rate currently exists for those customers, leaving them out of the deal and compensation mechanisms until the next phase of the offer is approved by the regulator.

Given this background, the utilities have agreed to actively promote the offer through their regular marketing tools (e.g., customer service, website, advertising campaign, social media, etc.), and to inform their clients of the different support programs that are offered by the utilities and provincial government to facilitate the purchase, installation, and upgrade of heating appliances (Hydro-Québec and Énergir, 2021b).

Énergir also agrees to encourage the partners in its trade ally network (“certified natural gas partners”) to promote dual-energy systems to Énergir’s current and future customers and to promptly provide Hydro-Québec with the contact information of its customers who wish to install a dual-energy system. For its part, Hydro-Québec also proposes to waive any electric service upgrade fees that would be required for a residential customer to install a dual-energy system (Hydro-Québec and Énergir, 2021b).

The above-mentioned incentives and strategies, plus new ones that could be offered by the utilities or government, will be key in achieving a high level of adoption of dual-energy systems within Énergir’s existing and future clientele. In their request to the regulator, the utilities calculate that incentives should cover at least 80% of the incremental cost, in order to achieve a simple payback period of 5 years or less for participants (Hydro-Québec and Énergir, 2021a).

Analysis

The dual-energy offer described in this paper is interesting at many levels. It creates the framework for a unique collaboration between competing utilities to reduce the GHG emissions of the buildings sector. Although it was pushed by the provincial government to help it achieve its 2030 climate goals, this type of cooperation could play an important role in the future, especially as both electricity grids and gas supplies are decarbonized. For the specific approach under consideration here, we identified different areas that show great promise and others where we see opportunities for improvement.

⁸ Or -15°C in the northern regions of Québec.

Reducing the Societal Costs of Decarbonization

Using its HEATTM model, Dunskey Energy + Climate Advisors conducted a study in 2020 for Énergir to determine the optimal path – for society, ratepayers and the utility – to reach its new GHG reduction targets.

The study included the analysis of 18,000+ combinations of building archetypes, baseline natural gas and air-conditioning equipment, energy sources, low-carbon technologies, and equipment operating modes to determine the optimal decarbonization solution for each market segment, looking at the societal cost of decarbonization, the potential decarbonization levels, and the participant cost-effectiveness.

The assessment found that a dual-energy system yields the lowest societal abatement cost of carbon for a significant number of market segments – representing a large share of gas sold by Énergir -- for buildings in the residential, commercial, and institutional sectors (Dunskey Energy + Climate Advisors 2020).

However, one key conclusion of this study was that dual-energy systems weren't optimal for new construction, because of several factors, including the additional costs of hooking up the buildings to the gas network and the lower incremental cost of low carbon technologies in new buildings compared to existing ones. Based on this study's results, we believe the vast majority of new buildings built in Québec should rely solely on clean electricity as an energy source and should have some level of critical peak demand management capabilities.⁹

It's also worth noting that the aforementioned study didn't consider the potential peak demand benefits of emerging storage and controls technologies, such as electric thermal storage, batteries, and utilities-controlled thermostats, which have the potential to significantly reduce the societal carbon abatement costs of full electrification. (The HEAT model, which is being used to determine optimal decarbonization solutions for utilities and governments across the U.S. and Canada, has since incorporated those technologies and more.)

Gas' Shifting Role: from Commodity (Primary Heating Source) to Value-Add (Peak Management) Service

As shown previously, dual-energy systems in winter peaking grids greatly reduce the need for additional electricity infrastructure because dual-energy systems switch entirely off electricity during peak demand periods (i.e., during the coldest days of winter). When compared to a scenario where buildings are fully electrified without taking advantage of peak demand reduction measures or programs (e.g., storage, controls, ground-source heat pumps, time-of-use rates, etc.), partial electrification using a dual-energy approach can reduce peak demand dramatically.

To an electric utility that is facing a short-term need for new capacity, as is the case for Hydro-Québec¹⁰, this potentially means reduced infrastructure costs and, as a corollary, a slower increase in rates.

⁹ Understanding that some buildings like healthcare facilities and buildings used as emergency shelters should also possess fossil fuel-powered equipment as a back-up in case of emergency.

¹⁰ Hydro-Québec projects that it will need new additional capacity starting in the winter of 2026-2027 (Hydro-Québec, 2020).

On the other hand, for gas utilities dual energy in and of itself means a slump in sales, a higher imbalance between summer and winter use, and ultimately higher rates. This is where the Hydro-Québec - Énergir agreement is unique: in creating a commercial transaction that values the peak savings generated by gas' more limited – but higher value – role.

In effect, under this agreement, natural gas moves from being a primary heating source to providing a peak management service to the electric utility, in the process enabling more rapid decarbonization, at least in the short-term.

Accelerating or Decelerating GHG Savings?

Helping a gas utility to maintain low rates when there is scientific consensus about the need for swift reductions in gas use raises valid concerns.

Yet is this a classic situation where “perfect might be the enemy of good”? While it is true that the proposed dual-energy approach will “only” reduce the GHG emissions of targeted buildings by 65-75%, it could prove a more effective strategy than full electrification *if* it results in faster and/or higher rates of adoption, while also keeping power rates competitive against fossil fuels for other uses. We note valid points on both sides of the debate:

- On the one hand, it is clear to us that a coordinated approach – one in which *both* utilities (and government) work hand-in-hand to encourage market adoption of partial electrification – provides a greater likelihood of market adoption than the counterfactual: one in which *both* utilities, for different reasons, resist or actively oppose electrification. Under the agreement, both utilities will use their sales forces to offer lower-cost energy rates, generous incentives, and strong enabling mechanisms, all within a well-coordinated communications campaign.
- Similarly, maintaining the competitiveness of power rates – by avoiding higher-than-needed, peak-related decarbonization costs – can be crucial to the broader decarbonization effort. The opposite – burdening electricity with higher-than-needed decarbonization costs – runs the risk of limiting the scale of electrification across the board, whether for buildings, vehicles or industry.
- On the other hand, the scale of the current agreement is arguably limited. In terms of the offer itself, utilities are essentially relying on existing residential dual-energy rates and incentive programs. What the provincial government and utilities will add to the offer (e.g., a dual-energy rate for commercial customers, additional incentives) in the coming months will be a determining factor in the pace of adoption, i.e. in the success or failure of the proposed approach to reach the province's GHG target for the buildings sector.
- Similarly, the current plan does not address the full market, being limited for now to replace-on-burnout opportunities. To speed up the pace, the plan could be adapted to target existing gas heating systems as well. This would involve the same suite of measures – a dual energy rate combined with incentives on heat pumps and requisite controls – and could apply to the vast majority of the market (old buildings with high-temperature steam systems would be an exception).
- Finally, we note that a regulatory approach that requires the conversion of existing gas systems to dual-energy at the end of their useful life may be necessary to ensure a pace of adoption needed to achieve the province's GHG reduction target for buildings.

Looking Forward: A Transitional Approach

The dual-energy strategy put forward by Quebec's gas and electric utilities could potentially achieve important GHG reductions more rapidly than other solutions could, because of more favorable customer economics and because of the collaborative approach. In the next 5 to 10 years, this solution could prove to be an important driver of GHG reductions in Québec's buildings sector. Nevertheless, we believe this approach should be seen as a transition one, for two main reasons.

First, considering the province's target to reach carbon neutrality by 2050, it is likely that other types of solutions will have to be prioritized after 2030 to allow for the full decarbonization of buildings. As bioenergy such as renewable natural gas, biodiesel, and green hydrogen will be in high demand in hard-to-electrify sectors (e.g., industry, some freight transport, air travel), there will be more pressure and a better business case for the full electrification of buildings. Since most types of gas heating equipment have a useful life of 15 to 25 years, installing new ones after 2030 may mean they will have to be replaced while still functional, with the associated financial impacts.

For new constructions, there are two important additional risks. The first one is the risk of creating new stranded assets as the new buildings for which the gas network was expanded move towards full electrification. The other is the risk that new buildings are designed to optimize dual-energy systems, making them less suitable for full electrification using highly efficient heat pumps.¹¹

Second, the fast evolution of peak demand management technologies could render the dual-fuel approach obsolete for some building types at some point within the next decade. In the residential sector, Hydro-Québec is running a promising pilot program to replace existing furnaces with electric thermal storage systems. Hilo, a Hydro-Québec subsidiary, recently began offering turnkey installation of a variety of demand response (DR) enabled technologies (from smart thermostats to connected appliances), in exchange for a commitment to participating in DR events. Hydro-Québec is also piloting several new critical peak pricing and critical peak rebates for residential, commercial, and institutional buildings.

The scaling of those innovative programs, business models, and rates, combined with the emergence of more cost-effective thermal and electric storage and control technologies, has the potential to tip the scale in favor of full electrification for most building types.

Applicability to other jurisdictions

When considering a similar approach in other jurisdictions, the following factors should be carefully considered:

- 1. The value of a dual energy approach is limited to winter peaking regions.** While that would seem to exclude most regions of North America, we note that as electrification

¹¹ For example, this could happen if a building is designed with a high-temperature (160-180F) hot water loop for space heating, which is a reasonably good solution for a dual-fuel system but a poor solution when using heat pumps.

takes hold, many electric grids in northern regions can expect to shift – in the absence of aggressive measures such as this – from summer to winter peaking. Electric utilities with a much larger summer peak compared to their winter peak will not benefit in the short term from a dual-energy approach.

2. **The value of a dual energy approach is tied to the harshness of its winters** (put inversely, the value declines the more a region's winter is temperate). The colder the climate, the larger the impact of heating electrification on the electricity grid, and the more beneficial a dual-energy approach. Also, as outside air temperature drops, the efficiency and capacity of air-source heat pumps decrease significantly, requiring more input from the electric resistance backup and increasing peak electrical demand.¹²
3. **Agreement between competing electric and gas utilities requires strong leadership and trust.** Developing a common strategy, partnership, dual-energy rates, incentive programs, and other support mechanisms requires significant effort. Since the immediate benefits for gas utilities aren't necessarily obvious and in fact run contrary to traditional business models, the development of an electricity-gas dual-energy approach requires the willingness to think outside the box. Strong, forward-thinking leadership is essential to enable fruitful negotiations in situations where distinct energy utilities (i.e. ones that sell electricity or gas, but not both) have built varying degrees of institutionalized distrust over the years.

Conclusion

The collaboration model presented in this paper shows how critical value can emerge when leaders of good will choose to step outside the proverbial box, challenge traditional ways of doing things, dare to break down silos, and allow for creative problem-solving to address the unprecedented challenge of climate change.

The dual-energy approach put forward by two competing utilities has the potential to accelerate, at least in the short term, GHG reductions in buildings, while reducing the need for costly upgrades to the electricity grid and limiting rate increases for both electricity and gas users.

To create a material dent in the building sector's GHG emissions and a real chance of reaching the province's climate goals, the dual-energy offer should be expanded to more market segments and, potentially, to customers whose gas systems have not yet come to the end of their useful lives. Other improvements could also go a long way to maximizing the impact of this innovative agreement.

Ultimately, we find this agreement to be an important step towards accelerated decarbonization of space and water heating in the near-term, with the potential for greater impact still possible. Going forward, it is imperative to track adoption closely; periodically re-assess the cost-effectiveness of different decarbonization solutions; and be ready to pivot toward alternative solutions – including thermal and electrical storage – as their performance and price points continue to evolve.

¹² One way to mitigate this issue is to install ground-source heat pumps instead of air-source heat pumps. Ground-source heat pump's efficiency and capacity are not directly dependent on outside air temperature.

References

- Dunsky Energy + Climate Advisors. 2019. *Trajectoires de réduction d'émissions de GES du Québec – Horizons 2030 et 2050*. Montréal, QC: Dunsky Energy + Climate Advisors. https://www.dunsky.com/wp-content/uploads/2021/09/Rapport_Final_Trajectoires_QC_2021.pdf
- Dunsky Energy + Climate Advisors. 2020. Confidential report.
- Gouvernement du Québec. 2021a. *Plan pour une économie verte 2030*. <https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/environnement/publications-adm/plan-economie-verte/plan-economie-verte-2030.pdf?1605549736>
- Gouvernement du Québec. 2021b. Decree 874-2021 (passed June 23 2021).
- Hydro-Québec. 2019. *Plan d'approvisionnement 2020-2029*. http://publicsde.regie-energie.qc.ca/projets/529/DocPrj/R-4110-2019-B-0005-Demande-Piece-2019_11_01.pdf
- Hydro-Québec. 2020. *État d'avancement 2020 du plan d'approvisionnement 2020-2029*. http://publicsde.regie-energie.qc.ca/projets/529/DocPrj/R-4110-2019-B-0106-Demande-PieceRev-2020_11_16.pdf
- Hydro-Québec. 2022a. *Our mission and activities*. Accessed March. <https://www.hydroquebec.com/about/mission-activities.html>
- Hydro-Québec. 2022b. *Rate DT – Dual Energy for residential and agricultural customers*. Accessed March. <https://www.hydroquebec.com/residential/customer-space/rates/rate-dt.html>
- Hydro-Québec and Énergir. 2021a. *Offre d'Hydro-Québec distribution et d'Énergir en réponse aux objectifs de décarbonation du chauffage des bâtiments énoncés dans le Plan pour une Économie Verte 2030*. http://publicsde.regie-energie.qc.ca/projets/597/DocPrj/R-4169-2021-B-0026-DemAmend-PieceRev-2021_11_09.pdf
- Hydro-Québec and Énergir. 2021b. *Mesures de soutien à la décarbonation du chauffage des bâtiments d'Hydro-Québec Distribution*. http://publicsde.regie-energie.qc.ca/projets/597/DocPrj/R-4169-2021-B-0006-Demande-Piece-2021_09_16.pdf
- Énergir. 2022. *Our energies*. Accessed March. <https://www.Énergir.com/en/about/>
- Whitmore, J. and Pineau, P.-O., 2022. *État de l'énergie au Québec 2022*, Montréal, QC : HEC Montréal. https://energie.hec.ca/wp-content/uploads/2022/02/EEQ2022_web.pdf