

Re-Inventing Wires: The Future of Landlines and Networks



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Climate Change and Energy Transformation FESTIVAL DES TECHNOLOGIES VERTES *Montreal—April 21-22, 2023*

Re-Inventing Elecetricity

Talking Points—2023-04-22 University of Colorado, Boulder

Tim Schoechle, PhD—303-443-5490 <u>—timothy@schoechle.org</u>; and <u>—schoechle@Colorado.edu</u>

National Institute for Science, Law and Public Policy Washington, DC — Boulder, CO



FESTIVAL DES TECHNOLOGIES VERTES Re-Inventing Electricity:

Decentralization with solar-plus-storage and microgrids for sustainability and resilience

Part 3 of a 3-part series

• Part 1: Climate change

An overview of climate warming and its consequences

- Part 2: Energy transformation
 - Structural transformation of energy and electricity
- Part 3: Re-Inventing electricity

Decentralization with solar-plus-storage and microgrids

- Not only a "transition"
 - But a <u>structural transformation</u>
 - From centralized to decentralized—to distributed energy
 - Renewable/sustainable solar PV for self-consumption
 - Resilient: electricity when the main grid fails
- Inverting the "grid" a bottom-up view
 - Starting at home
 - Premises architecture of solar-plus-storage and resilience
 - Generate electricity as close as possible to where it will be used
 - EMMA—the missing piece: local control (<u>Schoechle, 2020</u>)
- Electrification—the new new thing!
 - But... don't run electrification on coal—nor natural gas, oil, or diesel!
 - Old vs new: technologies, structures and paradigms

- Old structure/technology (top-down view) c. 1900
 - Centralized flow
 - Generation to transmission to distribution to customer
 - Capital intensive technology
 - Coal, natural gas, nuclear, big hydro
 - Big economies of scale
- But the technology has advanced
- New structure/technology (bottom-up view) c. 2000
 - Decentralized and localized
 - Inexpensive mass-market consumer electronics
 - Solar PV, inverters, batteries, "smarter" appliances
 - Scalable—no economies of scale

- An alternative path
 - But compatible with the existing grid
 - Starting with individual homes and buildings
 - Solar community microgrids with storage
- Available and inexpensive
 - Solar PV, batteries, inverters, smart appliances
 - <u>But</u> has been lacking a standardized premises control system
 - A way to balance premises use, generation, and storage
 - A generic home energy management system (HEMS)
 - Now offered by EMMA

Re-Inventing Electricity Localization with solar, storage and microgrids

- Smart meters are not the "Smart Grid"
 - Do not manage energy
 - Do not benefit consumers
- Smart meters add unnecessary risks
 - Safety risk
 - Security risk
 - Privacy risk
 - EMF radiation exposure risk
- Smart meters add unnecessary costs
 - Only to eliminate jobs and add to capital cost recovery for utility
 - Do not integrate renewable energy
 - A substitute for truly smarter energy

Getting Smarter About the Smart Grid

Why are federal government stimulus programs underwriting billions of dollars of 'dumb' smart meters for utility companies-with taxpayer dollars-meters that will soon be obsolete and not integrate with, or enable, the 'smart grid' of the future on which U.S. energy sustainability depends?



Authored by a veteran communications technology expert, in collaboration with the National Institute for Science, Law & Public Policy, "Getting Smarter About the Smart Grid" offers a roadmap to a truly "smart" decentralized electricity grid capable of integrating "distributed" power generation and renewable energy sources without the privacy, security, reliability, economic, or potential public health impacts of our present 20th centralized and wasteful utility infrastructure investment approach.

National Institute for Science, Law & Public Policy

November 2012

- EMMA standardized modular home energy management
 - "Energy Management and Measurement Application"
 - ISO/IEC open standards based
 - Open source software: Linux[™], Raspberry Pi[™], Arduino[™], etc.
 - Mass market, grid compatible, enabling incremental change
 - Next generation, EMMA replaces the "smart meter"
 - No dependency on wireless, nor on cloud services
 - Enables microgrids
 - semi-autonomous operation
 - Sharing power within the community
 - Augments utility services—with or without solar PV
 - can provide grid backup and load shifting (duck curve problem)
 - Can implement utility demand response services and protocols
 - Can charge batteries and manage/optimize energy appliances
 - Can manage EV charging

Localization with Solar, storage, and microgrids



The solar "Duck Curve" problem

Re-Inventing Electricity Localization with solar, storage, and microgrids



Transitional hybrid grid: combined centralized and solar microgrid

2023-04-22

Tim Schoechle PhD

Localization with solar, storage, and microgrids



Conventional premises general architecture, with solar PV (no storage)

Localization with solar, storage, and microgrids



HES/EMMA premises architecture, with solar-plus-storage

- EMMA functionality—Energy Management and Measurement Application
- Energy Management Functions
 - Load balancing (appliance control)
 - Inverter management and monitoring
 - EV charging management
 - Grid condition (state) management for the home
 - Normal grid-connected state
 - Grid disconnected state—energy conservation scenario management
 - Microgrid state—electricity sharing management
 - Demand response for utility (fiber preferred)
 - Microgrid management (via fiber)
- Energy Measurement Functions
 - AMI metering for utility (via fiber)
 - Solar production
 - Battery status
 - Power quality measurement (real time)
 - Power factor monitoring
 - Harmonic emissions monitoring (aka "dirty electricity")

- Inverting the "grid" a bottom-up view
 - Starting at home
 - Premises architecture of solar-plus-storage and resilience
 - Generate electricity as close as possible to where it will be used
 - EMMA—the missing piece: local control –*Schoechle, 2020*
- Electrification—the new new thing!
 - But... don't run it on fossil fuels (coal, natural gas, oil or diesel)!
 - Old vs new: technologies, structures and paradigms
 - Consumer electronics replaces industrial economies of scale
 - "Sustainability" and "resilience"—on your roof
- Electric vehicle charging
 - The 2x factor
- Munis and coops can do it!
 - Utilities that are owned by the customers!
 - Optical fiber—enables microgrids, and enhances community resilience
 - Energy democracy vs. the parasitic IOU/PUC symbiosis
 - DDD: Decarbonization, Decentralization, Democratization
- Hundreds of millions of people still don't have electricity

localization with solar, storage, and microgrids

References

- Schoechle (2012). <u>Getting Smarter About the Smart</u>
 <u>Grid</u>. National Institute for Science, Law & Public Policy.
- Schoechle (2020). "<u>Intelligent Energy: Solar Homes and</u> <u>Microgrids of the Future</u>." *Solar Today* (Fall).
- Schoechle (2021). "<u>Hidden in Plain Sight: Ready or Not</u>" Solar Today (Summer).
- Schoechle (2021a). "<u>Power Struggle : The Hundred-Year</u> <u>War Over Electricity.</u>" (review). *Solar Today* (Winter)

- Questions?
- Comments?



Home Operation Schedule Partners FAQ What's new?



Québec's first microgrid - A source of pride

Following the July 2013 rail disaster, Lac-Mégantic and its citizens decided to move away from fossil fuels, choosing instead to rally around a forward-looking project in collaboration with Hydro-Québec: Québec's first electric microgrid, built to serve the heart of the city and inaugurated in 2021. This facility produces clean and renewable energy locally to meet the community's needs. Thanks to the human energy invested in the Lac-Mégantic microgrid and responsible energy use, the project can serve as an example. An example of the energy transition, of cooperation and resiliency.



- · There are nine municipal power utilities and one electricity cooperative in Quebec.
- Together, the AREO members serve some 168 000 customers mostly from the residential sector, representing about 3.5% of clients in Quebec;
- Their combined maximum peak power demand in winter is over 1000 MW;
- Each year. AREQ members purchase approximately 5.8 TWh from Hydro-Quebec, amounting to a total bill of about \$330 M.
- · Four of these power utilities operate their own production stations: Coaticook, Magog, Saguenay, and Sherbrooker.
- · AREO members rely on 15 small production stations totalling 43 MW of installed capacity.

Other informations

Utility	Subscribers	Area	Number of municipalities	
ALMA	5.532	25 km²		
AMOS	2.955	6.x km²	1	
BAIE-COMEAU	4 (94)	153 km²	4	
COATICOOK	4140	29 km²	3	
JOLIETTE	9.537	0.3 km²	3	
MAGOG	10.557	20 km²	3	
WESTHOUNT	10.275	4 km ²	4	
SAGUENAY	25 698	220 km²	2	
SHERBROOKE	909.10	500 km²	sa -	
ST-JEAN BAPT.	0.027	400 km ⁴	15	
TOTAL	167 828	1 434.5km²	41	

To sign up : renoclimat.ca



Helping you save energy and make your home more comfortable

We want to help Canadians make where they live more energy efficient. The Canada Greener Homes Initiative will help homeowners save money, create new jobs across Canada for energy advisors and fight climate change. NOTE: This information is for applicants residing in: Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Northwest Territories, Prince Edward Island, Saskatchewan and Yukon.

- Ontario applicants
- Quebec applicants



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Search the website



MENU 🛩

Canada.ca > Natural Resources Canada > Energy Efficiency > Energy Efficiency for Homes > Canada Greener Homes Initiative

Canada Greener Homes Grant > Canada Greener Homes Grant > How the grant process works

Eligible retrofits and grant amounts

As part of the Canada Greener Homes Initiative, you have access to:

Grants from \$125 to \$5,000

To get a part of your costs back for eligible home retrofits

Up to \$600

As a maximum contribution toward the total costs of your pre- and post-retrofit EnerGuide evaluations

 Interest-free loans of up to \$40,000, with a repayment term of 10 years to help you undertake major home retrofits

Ineligible retrofits

Before you start, check that your desired retrofit is eligible through the initiative.

▶ Retrofits that are not eligible

Special measures for northern and off-grid communities

We recognize that Canadians living in northern and off-grid communities face specific challenges when it comes to completing home retrofits, including higher equipment and labour costs.

Eligible retrofits

Home insulation Upgrade your eligible attic, cathedral ceiling, flat roof, exterior wall, exposed floor, basement and crawl space.	Up to \$5,000
Air-sealing Perform air sealing to improve the airtightness of your home to achieve the air-change rate target.	Up to \$1,000
Windows and doors Replace your doors, windows or sliding glass doors with ENERGY STAR® certified models.	Up to \$5,000
Thermostat Add a smart thermostat to help improve your comfort and save money on your energy bill (must be combined with another energy efficiency retrofit).	Up to \$50
Space and water heating Make the switch to more energy-efficient space heating or water heating equipment to save on your utility bill and reduce your carbon footprint.	Up to \$5,000
Renewable energy Install a solar photovoltaic system to convert sunlight energy into electricity.	Up to \$5,000
Resiliency measures Implement measures to protect your home and family from environmental damages (must be combined with another energy efficiency retrofit).	Up to \$2,625
Low rise multi-unit residential buildings (MURBs) Learn more about how to multiply your incentives if you live in a multi-unit residential building.	

To sign up : renoclimat.ca

Resiliency measures

Climate change and its effects often hit close to home. Many environmental factors related to climate change can have an impact on your home, causing fire, flooding, wind and loss of power. Your home and its location can help you identify your specific vulnerabilities to climate change.

If you are in the process of making upgrades to your home, consider additional retrofits that could help protect your home and your family from environmental damages at the same time.

The resiliency measures detailed below must be combined with an energy efficiency retrofit from the Canadian Greener Homes Grant initiative.

- Batteries connected to photovoltaic (PV) systems.
- Roofing Membrane Self-adhering roofing underlayment applied to entire roof
- Basement Wall Waterproofing
- Moisture Proofing Crawl Space Floor, Walls and Headers