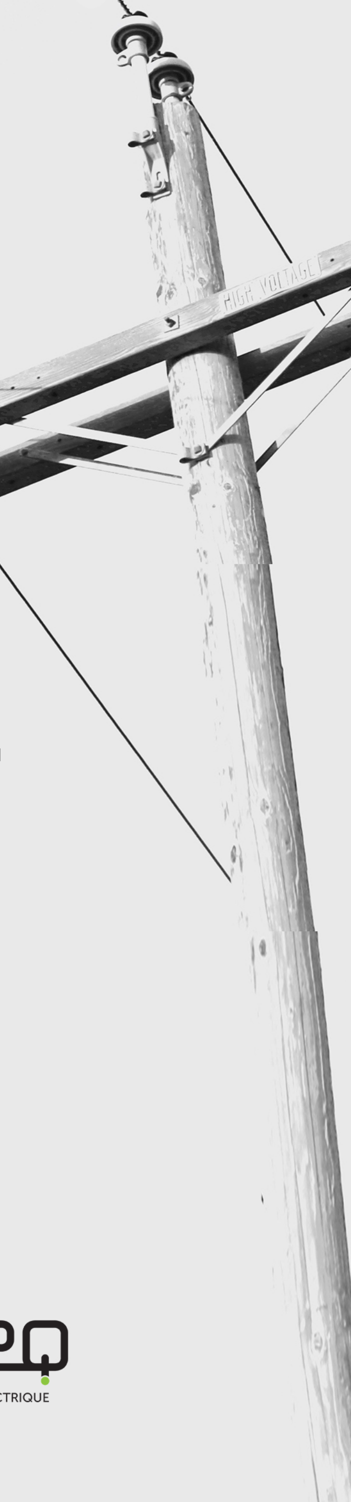
INSTITUT DE L'ÉNERGIE TROTTIER

Synthesis Report

Worshop | January 24, 2019

THE GRID OF THE FUTURE

How to make it good enough?



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About the Institut de l'énergie Trottier

The IET was created in 2013 thanks to a generous donation from the Trottier Family Foundation. Its mission is to train a new generation of engineers and scientists with a systemic and trans-disciplinary understanding of energy issues, to support the search for sustainable solutions to help achieve the necessary transition, to disseminate knowledge, and to contribute to societal dialogue on energy issues. Based at Polytechnique Montréal, the IET team includes professor-researchers from HEC, Polytechnique and Université de Montréal. This diversity of expertise allows IET to assemble work teams that are trans-disciplinary, an aspect that is vital to a systemic understanding of energy issues in the context of combating climate change.

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Executive summary

Under the leadership of the Institut de l'énergie Trottier at Polytechnique Montréal, in collaboration with InnovÉÉ, IGEE and AIEQ, a day-long workshop was held in Montreal in January 2019. Together, academics, industry and utilities representatives, and other stakeholders from Quebec and Ontario had high-level discussions on how to address the all-out challenge of creating the Grid of the Future.

For the first time in its history, the electricity grid is facing a combination of disruptive innovations and pressures that challenge its business-as-usual practices. These perturbations are impacting the grid at all levels: from its day-to-day operation to planning its expansion, from its business model to its regulatory framework. The workshop allowed to discuss around some of those impacts, as summarized below.

- **Distributed energy resources** becoming cost competitive, not only more of those will be integrated to the grid, increasing its complexity, but many of them will be operated by new players, like aggregators and prosumers. Those being motivated by objectives that are not necessarily compatible with utilities obligations towards system reliability.
- **Demand patterns** are also expected to change in ways still uncertain as new loads will appear on the grid at varying places and times – think electric vehicles – and as behind-the-meter installations will be more wide spread.
- Variable renewable capacity coupled with less predictable demand patterns calls for **new balancing mechanisms**, like demand response and storage, for which the economic models and the implementation strategies are to be defined. What are the proper incentives for demand responses? What storage capacity adds value, where?
- Those will be best defined if it is possible to **put a value on the various services that the grid offers**. Knowing what those services are worth to customers is equally important as knowing what they cost to the utilities. Those would also serve at **redefining the quality indicators** to better monitor the grid's evolution as the actual ones may be based on parameters of no direct importance to customers or of no value to future grid management.
- This then raises the question of the current **regulatory framework** adequacy and how to build in it the flexibility and responsiveness required to manage this transformation period filled with uncertainties and unknowns.
- Among those unknowns are what **new business models** to adopt. Should it still be based on selling energy or could it be based on selling services? Since customers can play an active role on the grid, should they have contractual obligations related to reliability? Could decentralized system operation, delegated to non-traditional actors, be part of a viable business model?

All those foreseen impacts draw the picture of a sector evolving toward a new ecosystem in which new stakeholders will appear, with roles and responsibilities still to be defined. To limit disruption, it would be essential to rapidly develop a shared understanding, a common vision, of what should be the future grid.

Even with a common vision, there will still be many unknowns and uncertainties, too many to make any definitive design decisions up front. Resiliency must thus be an integral part of the process of creating that grid of the future. This is best assured if all stakeholders

are collaborating in a concerted manner, in as many steps of the process as possible. Among some worth mentioning:

- **Modelling initiatives** – to help reduce uncertainties, expand capacities to include emerging trends, and identify new pathways
- **Innovation sandboxes** – in which could be tested new grid operation and management strategies, where lie many unknowns.
- **Regulatory framework overhaul** – to build in it the flexibility and responsiveness needed to cope with the system rapid evolution.

Shaping the future of the grid is among the biggest challenge our society will face over the next decades. From this multi-stakeholder conversation, some action paths were identified to carry on the work it entails:

- **Raise awareness** by creating didactic material on transition
- **Catalyze the transformation** through production of white papers
- **Animate the conversation** via thematic workshops or groups of interest

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1 Introduction

One of the greatest modern engineering achievements, barely unchanged since its invention a century ago, the electricity grid is facing a combination of disruptive innovations and pressures that challenge its business-as-usual practices. These perturbations are impacting the grid at all levels: from its day-to-day operation to planning its expansion, from its business model to its regulatory framework. It has entered a period of transition to become what many call the smart grid, **a complex combination of technological innovations** putting the electricity industry is in the midst of a revolution in the way it plans, operates and manages the grid in a world where its role and function are expected to be transformed.

Maintaining the quality and reliability of service in this evolving grid could easily make smart grid implementation cost prohibitive, compromising its realization. However, if the design of the smart grid is only driven by cost, there is a risk of not achieving the grid's minimum functional requirement: to meet end user's demand for electricity. The crucial question then is **how to design the grid to be good enough?**

This is the key question that triggered the organisation of this workshop, to which were convened academics, industry and utilities representatives, and other stakeholders from Quebec and Ontario to start **a multi-stakeholders conversation on how to address the all-out challenge of creating the Grid of the Future**, a grid that can embrace the changes of today and that will adapt easily to the changes of the future.

This report serves as a synthesis of the conversations and exchanges that occurred during that day long workshop.

2 The current situation

Key takeaways

The grid sees its operation getting more complex with penetration of new technologies.

Those new technologies are rendering business-as-usual practices obsolete and challenge current business model, calling for an overhaul of the regulatory framework.

- The grid is a **complex combination of various technologies**, mixing legacy elements with newer technologies – some of them still emerging – on both the production and the consumer sides.
- It's an infrastructure that needs to be maintained and constantly adapted in order to fulfill its primarily function: deliver an energy service to its customers.
- Its operation is getting more complex as new technologies change not only how electricity is generated, but also how it is consumed, making the **business-as-usual approach unsuited for future planning activities**.
- Those new technologies not only affect demand patterns, but also the utilities revenue stream.
- Being a rather conservative regulated industry – and for good historical reasons – , it has a natural inertia that, at best, slows down its transformation to those new realities, or at worst, can lead regulators to take some short-sighted, ill-informed, unilateral, poor decisions.
- Lacking a clear comprehensive understanding of how the electricity system will evolve makes it difficult to define new regulations that would ease the grid's evolution, create profitable revenue streams, and ensure its maintenance.

3 What is already happening?

Key takeaways

Distributed generation and behind-the-meter installations increase system operation complexity with unknown impact on its reliability.

Part of their penetration is driven by new actors in the ecosystem whose motivations, conflicting with utilities' obligations, may compromise system reliability as they have no bounding contractual obligations.

Future demand patterns are uncertain as new dynamic loads will appear on the grid, possibly leading to higher, longer, displaced peak demand.

Distributed Energy Resources (DER)

- Capacity increase will be mostly coming from DER generation as prices are still expected to drop. If this predicts that the grid of the future will not have energy issues, it certainly poses **a threat to utilities business model**.
- Those capacities will vary in size and location; some of them (mostly photovoltaic cells) will be installed **behind the meter**, out of reach for control by system operators, adding **complexity to the grid operation** (like the management of inverted power flow).
- The multiplication of such capacities, sometimes driven by aggregators, may affect system reliability, as their right to produce is not assorted with any duty or commitment regarding system balancing, let alone **system reliability**.

Uncertainties in demand evolution

- Historically, electricity demand forecasts having often been wrong; there is no reason to believe that this will be different from now on. That being said, with the **rapid transformation in distributed generation**, it becomes more difficult to justify the construction of large infrastructures.
- The only thing that seems sure is that **future demand patterns are uncertain at this time as new dynamic loads will appear on the grid** (like electric vehicles and smart devices, to name a few).
- Those new loads will most likely **not be equally distributed both in space and time**; moreover, some of these loads could lead to a **higher peak demand**, to extended or displaced peak periods, or to a demand concentration in specific grid nodes.

The boundaries of the system

- The meter is not the system boundary anymore; it is mainly a contractual boundary.
- There will be an increasing number of **behind-the-meter smart devices** that will affect the grid – they already do – and for which there are **no system integration strategies**.

- Most of those devices are out of reach from utilities (for technological or regulatory reasons). Still, they offer the capability of creating a **virtual, parallel network** that could be controlled by non-energy actors with **objectives conflicting with those of utilities**.

New actors

- The two most prominent new actors identified are the **prosumers** and the **aggregators**. The multiplication of new smart devices gives them a control over their demand, affecting net load – hence utility revenues – but without imposing them any **obligations or commitment towards system reliability**.
- Other less prominent actors are the new **big-data players**. Not present in the field much yet, they will **find their way between consumers and utilities**, affecting energy consumption patterns. Their relationship with utilities is yet to be determined.

4 Where are the biggest uncertainties?

Key takeaways

The proper incentives may not be identified yet for demand response mechanisms to be effective at balancing the system.

It is not clear where and how to integrate storage so that it can efficiently balance the system and possibly play a role in demand peak mitigation.

The quality indicators of the grid must evolve with the grid's transformation; there is no evidence as to how customers value the quality of the grid and what is that value worth for them.

There is not a clear proposition on how to manage the evolution of standards and regulations over the grid transition period given that some flexibility may be required during that period.

How active of a role will consumers play?

- There is a lot of **expectation on demand response mechanisms** to maintain system equilibrium. Those mechanisms could benefit from smart devices, **given that consumers accept to comply**, which is far from guaranteed.
- Prosumers will likely be looking at maximizing the use of their generation capacity, further modifying final demand patterns to the expense of utilities.
- What would be the **proper incentives** that would create value for customer while contributing to system reliability and utility revenue?

What role will storage play and how?

- Storage will certainly be required, primarily to help balancing a grid with increasing amount of intermittent capacity. It could also be a solution to **mitigate demand peaks**, given that it is properly located and sized.
- Storage adds to the grid complexity, affecting its operation in a manner still unknown, especially as **it is not yet clear where the storage will reside**: at the consumer level, between consumer and utilities, managed by utilities or by the energy producer?
- This leads to two fundamental interrogations: what and where will be the value of storage in the grid?

Which criteria should be used to monitor grid evolution?

- Grid operation procedures have been designed in order to meet some specific quality criteria. **As the nature of the grid is evolving, those quality criteria definition needs to be revisited** for two reasons: simplify grid operations and prevent overinvesting in unnecessary solutions.
    - Power quality: as more and more loads are in DC, are power quality requirements still that important?

    - System reliability: could more local storage in the system change the definition of reliability?
    - System resiliency: what will be considered acceptable in a more decentralized system exposed to cybersecurity threats?
- Quality criteria definition must also take into consideration their **perceived value by customers**: what are they willing to pay for reliability? For resiliency? For power quality?

How to adapt standards and regulations to new and future realities?

- Current system operations are dictated by standards and regulations that may be ill-suited for the grid of the future, but system actors are legally bounded to comply with them.
- How can regulatory bodies manage a transition and how various stakeholders participate in this transition?
- Certainly, this raises a governance issue: can the system allow transitory regulations to validate some of the proposed new regulations?
- What could speed up the definition and the adoption of new adapted standards and regulations?

5 What could/should most likely happen?

Key takeaways

There is a need to move from business models based on pricing the energy delivered to pricing the services provided; establishing what those services are, and what is their value, is not trivial.

Customers playing an active role on the grid should have contractual obligations or constraints towards system reliability and resiliency.

Increased grid complexity may call for a more decentralized approach to system operation, and some of that can be assumed by non traditional actors.

A redefinition of the utility-customer relation

- As system boundary are not as clear as they used to be, with behind-the-meter active element, **the customer now has the possibility to play an active role in the system**. Not being limited to passively consume energy anymore, this new role is affecting system operation and utility revenue.
- To mitigate the impact on system operation, network-active customer should have **contractual obligations/constraints towards system reliability and resiliency**.
- The question of utility revenue calls for a new pricing model, not only based on delivered energy.
    - How to put a value on the provided service?
    - Should pricing take into account a system added value on a per customer basis?
    - Can it be as simple as pricing power instead of energy?
- Could moving toward Energy Service Companies (ESCOs) help address both issues (operation and revenue)?

Business model based on system value

- To keep the grid working, utilities must generate enough revenue to, at minimum, cover maintenance and operation costs.
- Currently, some subsidized components are added to the grid without a proper evaluation of the value they add to it.
- Establishing the proper system value of the various grid component would help:
    - Redefine various incentives and subsidies
    - Establish where to best integrate DGs
    - Establish ideal size and location for storage

Decentralized system operation

- As the grid is evolving to more communication capable components, the amount of information to process will increase significantly. That information will be paramount to balancing an ever more complex grid.

- That complexity will most likely call for **a more decentralize approach to system operation**; the objective is to bring “the right information at the right level”.
- As a decentralized approach is probably key to system flexibility, it could be extended to other part of overall operations. Could reliability and resiliency related responsibilities be delegated? If so, to what level?
- Any delegated responsibility would have to be contractually bounding and part of a revisited regulatory framework.
- **Various actors could assume those decentralized responsibilities**: prosumers, ESCO, distribution companies, non-wire services, aggregators, etc.

6 What is required to make it happen?

Key takeaways

There is a need to develop a shared understanding of what the grid should be in order to define new roles and responsibilities for stakeholders.

A sandbox approach would help test innovations, mainly on the operation and management side of things, where lie most of the unknown.

The regulatory framework must be made flexible and responsive to cope with the pace of technological innovation and the evolution of consumption habits.

If more modelling efforts would help reduce uncertainty, some more are also needed to either expand models or develop new ones, reflecting emerging trends. This to further reduce uncertainties or identify new pathways.

A global, high-level vision

- The goal here is not to define a plan or a roadmap, but rather a vision of what the grid should be.
- This exercise would force the stakeholders to a) establish a common glossary to define the grid, and b) define its high-level requirements.
- This would also help define roles and responsibilities for stakeholders.

Innovation sandboxes

- There is a need for **safe spaces** where industries and utilities, with the support of regulators, can **test innovations at a broader scale**.
- Not knowing how technology will evolve, the focus should be more **on system operation and management** rather than on technology integration alone.
- This should allow for an iterative approach for both technology integration and system operation procedure.
- It could also be extended towards involving customers – residential and industrial – as a mean to test new business models.

An overhaul of the regulatory framework

- No matter what direction the grid takes, any of the envisioned evolution highlights the necessity of adapting/changing the current regulatory framework.
- With the pace of technological innovation, coupled with electricity consumption habits evolution**, there is a need that flexibility and responsiveness be built in the regulation**.
- The new regulation should also help defining:
    - Proper incentives;
    - Business models;
    - Reliability, resiliency, power quality requirements;
    - Rights and responsibilities of each stakeholders.

Intensified modelling initiatives

- With so many uncertainties regarding the grid of the future, modelling is often presented as the obvious solution for reducing risks – technological, operational or financial.
- There is certainly a need for more sustained modelling initiatives, at all levels and stages of the grid evolution, from policy design to real time system operation, while not forgetting capacity expansion and system planning models.
- Most of those questions can be answered with existing models, but **most have to be updated to integrate emerging trends** (like load profile evolution, reaction to demand response, etc.).

7 Proposed next steps

Raising awareness

- Didactic material on the transition
    - Create series of short texts or videos explaining **what the different aspects of the transition mean for the industry**, technologically but also structurally, for how business will be transformed.
    - Having domain experts participating would help make this a good education and communication tool specifically directed at a Canadian industry audience with its known weaknesses, issues and challenges.
    - Part of this initiative would call for establishing a glossary, a common set of definitions, a list of known problems, challenges and issues, etc.
    - It would also help at defining the requirements for the grid of the future.

Catalyzing the transformation

- A white paper on the need for **innovation sandboxes**
    - This white paper should serve to **build the case** to have utilities, industries and regulators working together to create those innovation spaces.
- A white paper on cybersecurity and smart technologies
    - A broader conversation on this issue is needed as it is mostly fueled with arguments for the consumers (and not all valid).
    - Before too many of those technologies are deployed, discuss the actions to be taken to **limit negative impacts and minimize risks**.

Animating the conversation

- Hold future workshops focused on specific topics, such as:
    - Industrial electrification
    - Load management mechanism
    - EVs impact and integration strategies
    - Electricity pricing model and market reform
- Create groups of interest to:
    - Identify research project, help identifying partners and find funding
    - Discuss the socioeconomic of the transformation, especially the utility-customer relation that is to be redefined
    - Stay informed and share new knowledge

Appendix A – Questionnaire results

In preparation to the workshop, a questionnaire has been submitted to all the participants; 25 of them completed it. Below is a summary of their responses.

The biggest challenges	• Find new **business models and market structure** to keep it profitable, coupled with the penetration rate of Variable Renewable Energy (VRE) and Distributed Generation (DG). • Reliability and resiliency in presence of an **increasing number of actors** and cyber security breaches.
Most mentioned risks	• Cybersecurity • Reliability • Instability induced by grid complexity • Active loads and demand peaks • Inadequate revenue • Management
Most mentioned challenges	• Demand-side management • Costs and storage for VER • Load satisfaction • Business models • Governance, including policies and incentives
Behaviours identified as most disruptive on the demand	• EVs • Energy storage • Power needs • Prosumers
Identified demand drivers	• Thermal comfort • EVs • Electrification of processes and from additional and new devices
Obstacles to the evolution of the grid	• Communication and social acceptability • Governance • Inertia at many levels • Investment, revenue, business model • Technology maturity and planning
Behaviors identified as disruptive to planning, operation and management	• Growth of distributed and behind-the-meter generation • EVs and storage • Prosumers and aggregators as service providers • Grid complexity
Foreseen business models	• Energy storage operator • Energy retail company • Independent grid • P2P inside distribution grid • ESCO

Appendix B – Scoping paper

The following text was originally sent along with the invitation to serve as an introduction and set the context for the workshop.

The Grid of the Future – How to make it good enough?

By: Magdy Salama, professor, University of Waterloo
Louis Beaumier, executive director, Institut de l'énergie Trottier
Normand Mousseau, academic director, Institut de l'énergie Trottier

Electricity grid is one of the greatest modern achievements, affecting the life of billions of people across the world since its invention. Barely unchanged for a century, the grid is entering a period of transition, taking a new form for the 21st century. Motivated by the global commitment for decarbonisation, the electricity industry is in the midst of a revolution in the way we plan, operate and manage the modern electric power systems.

These new systems are characterized by a steady growth in **distributed energy resources**, the increasing connections of **variable renewable energy source** (RES), the emergence of the "**prosumer**" (the producer-consumer), the advent of **aggregators** operating as service providers, the expected substantial penetration of **electric vehicles**, the deployment of **energy storage** and the updating of **grid connection codes** to ensure better participation of the new technologies into modern power systems. Their implantation in a world where electricity is expected to play an ever-increasing role represents an enormous undertaking that requires serious research and breakthrough innovations and is expected to transform almost completely the role and function of the electric grid.

In the face of these radical changes, the future grid will still be required to guarantee the quality and reliability of service, a task made more complex as it will also provide consumers with more opportunities to control their electricity use and adjust their consumption. It will have to maintain the delivery of power with a good level of quality and yet operate the system in an open network mode to facilitate an active and dynamic exchange of information as well as power.

Integrating these changes into the existing electric grid is a monumental challenge for the power industry. It demands the grid to become open to new stakeholders, technical innovations and novel business models. It requires the electric grid to transform from a mostly passive and reasonably well understood network of consumers into an active network of generators and consumers. Not content with transporting energy, the future electric grid will become a communication system, coordinating and automating the flow of electricity, in order to ensure the flexibility, security, reliability, efficiency and safety of the system. The future electric grid is to become what many call the smart grid.

Encompassing all these characteristics can easily make smart grid implementation cost prohibitive, compromising its realization. However, if the design of the smart grid is only driven by cost, there is a risk of not achieving **the grid's minimum functional requirement: to meet end user's demand for electricity**.

The crucial question then is **how to design the grid to be good enough?** Answering this key question requires first to understand and acknowledge the main challenges associated with implementing it.

A first implementing challenge is defining **business models and market structures** for the operation of the future grid. These models should be designed to encourage and facilitate the growth of distributed energy resources (DER), the high penetration of renewable energy generation (REG) and the wide spread of central energy storage systems (CESS). Such models will embrace the shift from energy consumers to prosumers. The market structure for this grid should acknowledge and consider the emergence of aggregators operating as service providers at the distribution system level. The future grid market structure should be designed as a self-sustained system that does not need or rely on government or public subsidies and yet allows and encourages private investors to participate and play a vital role in the future grid operation. Location specific (bus-wise) incentives for DER and REG, improvement-based reward CESS integration, value-stream approach for system resources, and competitive demand side management are among the new mechanisms that are now available for the future grid business models and market structure.

The second important challenge is the **evolution of the demand**. In the grid of the future, the nature and the composition of loads will be more complex than in the traditional grid. Reliable models of loads and system components must first be constructed to fulfill the requirements and constraints of the smart grid environment. The main challenge here is to develop proper models that allow the examining and the investigation of the salient features of smart system components and the emerging new harmonic sources, including EV charging stations. These models should represent thoroughly the smart grid system components and accurately map the relationship between the power requirements and the voltage and frequency. Unlike the traditional demand models, these new constructed models should have the capability to tackle efficiently the decentralized weakly meshed systems of the future grid and incorporate seamlessly its control actions. These models should, for example, help address the uncertainty of the electric vehicle loads due to driving behaviors, battery capacities, states of charge and trip purpose.

The **intermittent nature of RESs** renders existing planning models ineffective and inaccurate as a basis for the design decisions of the future grid. This fact constitutes the third challenge for the implementation of smart grid. Designing of qualitative probabilistic planning models that incorporate the stochastic output of distributed RES and the vulnerability of the associated spinning reserve is at the core of this challenge. Planners' experience and the bus-wise cost-benefit analysis should be the cornerstones in determining the optimal feasible distributed generation (DG) capacity investment plan for the future grid.

The demand pattern coupled with the intermittent nature of the renewable energy sources, discussed in the previous sections, will affect adversely the flexible generation capacity and will reduce the spinning reserve of the future grid and this may lead to frequency and voltage variations for the entire grid. Therefore, the fourth factor challenging the deployment of smart grid is the ability to maintain **adequate spinning reserve** at all times and under varying operating conditions. Employing renewable energy sources equipped with advanced power electronics to act like spinning generators to arrest the changes in frequency is the focal issue in this challenge. Demand response and energy storage can also play a vital role in stabilizing the frequency of the smart grid.

The traditional grid enjoys high level of reliability because of proper grid design and many years of operation experience. For the future grid to **maintain high reliability levels**, with so many actors, it will have to possess **self-healing capabilities**. This is the fifth challenge for implementing the future grid. What performance indices would best reflect future system reliability, given the new grid structure, the integration of new system components, the existence of varying generation and the connectivity of mobile loads, in order to meet these challenges?

The grid of the future will evolve as a response to a mixture of market forces and emerging trends in power industry. At the same time, this grid will be transforming the way we plan, generate, and deliver electricity. **It is up to us now to create the grid that can embrace the changes of today and that will adapt easily to the changes of the future.**

Appendix C – List of participants

Following is the list of people who, by their participation to the various discussions at the workshop, contributed to the creation of this reports.

Last name	First name	Title	Organization
Alva	Sergio	Field Engineer	Schweitzer Engineering Lab (SEL)
Bakke	Gretchen	Visiting Professor	Humboldt University, Berlin
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Blachère	Jonathan	Business Development and Account Manager, Digital Grid	Siemens Canada
Boucher	Dan	CEO	Vadimus
Bouffard	François	Professor	McGill University
Carlson	Richard	Director, Energy Policy and Energy Exchange	Pollution Probe
Chartrand	Denis	CEO	Distribution Smart Network
Djenane	Gaétan	Responsable marketing et ingénierie	Schneider Electric
Dy	Norbert	Analyst	AQPER
El Chehaly	Mohamed	Manager, Grid Solution	SNC Lavalin
El-Samahy	Ismael	Design Supervisor, Capacity Integration	IESO
Farthing	Greg	VP Strategic Initiatives	ABB
Forcione	Alain	Chef - Scénarios et vision technologique	IREQ
Fréchet	Pierre	Chef de division gestion énergétique et électrométrie	Ville de Sherbrooke
Gagnon	Richard	Directeur partenariats stratégiques	Transition énergétique Québec (TEQ)
Langlois-Bertrand	Simon	Assistant Professor	Concordia University
Lopes	Luiz A.C.	Professor	Concordia University
Marcoux	Benoît	Directeur	Consultant
Martin	Yanique	R&D Director	Opal-RT
Maurice	Jean-Claude	National business development director	WSP
Moeini	Ali	Chercheur, Simulation et évolution des réseaux	IREQ
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Okou	Francis	Professor	Royal Military College of Canada
Paquin	Jean-Nicolas	Division Manager - Application eXpertise and Electrical Simulation (AXES)	Opal-RT

Last name	First name	Title	Organization
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Perreault	Christian	Esstalion	IREQ
Pineau	Pierre-Olivier	Professor	HEC Montréal
Prieur	Alexandre	Project Engineer, Smart Grid	CanmetENERGY
Salama	Magdy	Professor	University of Waterloo
Sayegh	Alain	Directeur, intégration nouvelles technologies	Hydro-Québec Distribution
Toussaint	François	Analyst	AIEQ
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Tremblay	Désirée	Partnerships	TM4
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