

In this 21st century, we've begun an <mark>energy transition</mark> that is only comparable to the industrial revolution of the 19th century.

This transition is no longer driven by political choices to clean up our environment, but now by rational economic decisions of executives that see low-cost renewable sources of electricity as business opportunities.

All this creates a lot of turbulences for utilities. Let's try to see where this may have taken us by 2030.



The cost of electricity produced from utility-scale solar PV systems is dropping about 20% a year.

Looking at auction data for systems to be delivered in 2020, we can see that prices will soon be well below 3¢ per kWh for the best projects. That does not even pay for the coal to operate an existing coal plant.

But this is not the end.

- Solar is the renewable technology with the most patents, promising further improvements.
- The Chinese are driving it, with the most manufacturing, the best quality, and the largest installed base, and it is enshrined in their 5-year plan.
- Furthermore, the cost reductions are broad-based: solar panels, inverters, balanceof-system, installation, and operations have all seen cost reductions. At the same time, panel efficiency is getting better.

As disrupting as this is, it may not even be the most interesting story.



That was for utility-scale systems. A hundred MWs or so.

Commercial systems with just hundreds of kWs are just 2 years behind utility systems in terms of costs per watt. That is: the cost per watt of commercial systems today is the same as the cost of utility systems about 2 years ago.

Residential systems are just another 2 years behind.

Obviously, Canada does not get as much sun over the course of a year as, say, Arizona. Toronto, Halifax and Vancouver get 40% less than Arizona – but this is only 2 years worth of cost decline. If you are in Southern Alberta, you're in luck, as you're just a year behind Arizona.

In just a few years, your customers, starting with the commercial ones, will be able to produce energy for much, much less than what they can buy now.

And someone will take advantage of this. It could be you, or it could be someone else.



So, this should be your nightmare, or perhaps your fantasy, depending on what you want to do or who you work for.

Given how low-cost renewables and storage are advancing, before 2030, the traditional, centralized grid will have been transformed into a transactional grid of microgrids, with customer-owned distributed energy resources controlled by an array of energy service vendors.

- Customer expectations will be different.
- Customers will want choice, get together with their community, and share energy assets.
- They will redefine quality, as even short interruptions that throw distributed generation off-line will be unacceptable.
- Customer relationships will be different.

To succeed, utilities can learn from the lessons of other industries that went through deregulation and the introduction of competition, such as airlines and telephone companies.

Photo credit: ILIOTEC Solar GmbH, from WikiCommons, edited by B. Marcoux.



Who love their phone company here? Show your hand.

Not many. Well, nobody, actually.

Twenty years ago, an Angus-Reid survey put Bell Canada #2 among most admired corporations in Canada. Last year, Bell Canada ranked #291 in a University of Victoria brand trust survey.

• People love their Apple or Samsung phones, are addicted to Facebook to stay in touch with friends, and turn to Microsoft Skype to see remote family members, but they now mostly hate their phone company.

How did that happened?

20 or 30 years ago, phone utilities were highly regarded companies. Service was considered inflexible, but everyone could afford a local line, which was crosssubsidized by expensive long-distance calls and business lines.

• Like electric utilities, phone utilities had a duty for public service and provided lifelong employment to employees.

But, then, commercial customers revolted. Competition emerged, first for private networks sold to businesses. The local telephone service was unbundled from long-distance service in order to have retail competition and accelerate innovation.

Could customers turn against electric utilities too? Perhaps. When listening to renewable energy developers or commercial businesses, you already hear an undercurrent of dissatisfaction. You may think they're unreasonable, but that's what it is. Bell executive too thought that customers were unreasonable, and they turned

their attention to people that they thought really mattered: the regulators. See where this has taken them.



Well before 2030, customer-owned distributed energy resources will have pressured policy makers and regulators to unbundle energy retail from the wire business, as it's already the case in Alberta.

Unbundling and the ensuing retail competition will remove barriers for customers owning generation and controllable load, or their agents, to sell energy and services on open markets through the grid.

• Energy, in kWh or MWh, will be cheap, and customers and emerging energy service providers will be free to innovate.

Unbundling will also expose the capacity-driven cost of the distribution grid.

 Power, in kW or MW, will be very valuable, and wire utilities will innovate to reap the benefits.

In other words, the value chain will shift from energy generation assets to T&D wires.

This is similar to unbundling of local and long-distance telephone service in the 1990s. With competition forcing energy suppliers to keep price low, energy price regulation will be lightened, just like telephone regulations are much lighter now than they were 25 years ago.

Another example: you pay much more to telecom companies like Rogers Cable for Internet access than to content providers, like Netflix. Electricity will be the same.

*Photo credits: A pole in front of my house, 2009, B. Marcoux; Smart Meter, iStock, edited by B. Marcoux.* 



The new energy service providers will give more choices to customers, distributed generators and microgrid owners,

- removing complexity,
- providing financing and
- turning energy load and generation into commodity services.

This is already happening in Europe, where retail supply services are one of the most profitable segment of the industry – far more profitable than non-contracted generation.

Energy markets will evolve to <mark>ensure balancing, reliability, transparency, and efficiency at the lowest cost</mark>

- using distributed energy storage and demand management.
- New flexible uses will take advantage of inexpensive electrons when low prices occur at odd hours – an example may be hydrogen generation, storing it for use in fuel cells or feeding it into natural gas networks.
- Charging electric vehicles will be controlled to take advantage of low prices, perhaps even giving power back to the grid when prices are high enough.

All this is actually not more complicated than what is happening today in international banking, in the stock market or in telecom networks: market intermediaries will act automatically on behalf of distributed asset owners. Blockchain may help dealing with the sheer volume of automated energy transactions.

Photo credit: Costa Rica Rain Forest, 2011, B. Marcoux.



With unbundling, the traditional Canadian rate-of-return regulatory framework will not be suitable in 2030 to regulate the wire utilities.

The provincial regulatory regimes will have evolved toward a performance-based model. This new model will incentivize both lower costs and better reliability. Utilities will be freed to implement the innovative solutions they choose, including

- non-wire alternatives like virtual power plants to lower costs and
- new protection schemes that limit short interruptions that trip distributed generators offline.

Performance-based regulations are not new: for example, that's how it is in Alberta. In Great Britain, the regulator has implemented a regulatory framework called RIIO (Revenue = Incentives + Innovation + Outputs).

Utilities will have to develop new skills.

- They will become better technology integrators and project managers and
- they will partner more with technology vendors,
- while avoiding custom solutions.
- Utilities also need to lead better standardization and interoperability efforts in the industry. Get together, guys!

Some current electric hardware and software vendors may be unable to keep innovating while price are dropping. This happened in telecom too: Cisco System, a start-up in the 1980s, is now the largest networking company in the world, while many legacy telecom vendors, such as Nortel, went bankrupt.



Preparing for the future is essential for Canadian electric utilities and new players.

In an industry traditionally defined by centralized generation and rigid geographic boundaries between utilities, new linkages need to occur: utilities and customers, vendors and entrepreneurs, cities and businesses. We will need to cease the opportunities that didn't exist before and get ideas to market quickly.

The structure of the industry will emerge transformed, hopefully with Canadianowned service providers offering novel energy solutions in Canada, backed by a web of hardware, software, and professional service vendors.

Realizing this vision will increase competitiveness and opportunities for Canadians to export their energy, their expertise, and the fruit of their labor.

Thank you.

Photo credit: Dirt road in the Magdalene Islands, 1998, B. Marcoux.