Electricity in Southern Ontario: Historical Perspectives
Ontario

- Has some large hydro-electric schemes but
  - Lacks the massive hydro electric potential of Quebec
  - Lacks hydrocarbon fuels
Ontario

• After a period of private-sector electrical generation, Ontario developed public hydro-electric systems to supply power at cost to boost the manufacturing economy
• Added major coal, nuclear stations
• Re-privatised hydro when the debts on the public electrical system became unsustainable
  • Mainly a consequence of the debt-costs of nuclear power
Private Beginnings

• From 1880s industry began producing electricity from steam, water power
• Main use: lighting
Yonge St Arcade 1885
Toronto 1880s

- Experimental electric street lighting systems set up in Toronto: arc lights
- Toronto Electric Light Co [TELco] begins in the engine room of a mattress factory
1880s

• Two competing companies, both direct current [DC]:
  • TELco: overhead cables
  • Incandescent Light Co [ILCo]: underground conduits, 2-wire Edison system
• TELco sets up its main station on Scott St
  • Imports cheap soft coal by steam barge
• ILCo sets up on Bay St
TELCO coal barge Van Allen
1890

- TELco arc light
- Horse-drawn streetcars
1890s

• Toronto streetcar system electrified around 1893, 500V DC system
• Needs a major steam generation plant
• Generating so much current that the water and gas mains on Front St corrode prematurely
1901 Arc lights and electric streetcars
1900s

- Modest steam-powered electric generation in Toronto for street lighting, commercial buildings downtown, DC current
- TELco stingy on electric supply to factories, not supplying homes
  - Most factories generate their own electricity
1890s-1900s

- Small water power sites across Ontario being turned into small privately-owned hydro-electric schemes
- Supply the local town, village
- Use DC current
1894 Bracebridge ON sets up 74KW system
1890s-1900s

• Private hydro is developed at Niagara Falls
• Requires long-distance transmission, therefore uses Alternating Current [AC]
  • Key users are urban streetcar systems which still require DC
  • Niagara set to 25 cycle AC to allow easy conversion to DC
1900s

• Private sector hydro power reaches Toronto from Niagara Falls c 1907
• Arrives the “green line” NW hydro corridor
• Ontario’s largest switching yard at Huron St
• Rotary converters change AC to DC for streetcars
This cut shows the locations of the system for Niagara power under the station at Queen and Bathurst. B. 54,000 v., the 11,050 v., terminal station, and the three 18,700 v., 22,000 v., distributing stations of the transmission Poplar Plains road. A. distributing Alhambra and Blool.
1900s-1910s

• Arrival of hydro power does not eliminate steam generation
• Hydro transmission lines vulnerable to storms
  • TELco steam backup still needed
• Not enough Niagara power allocated to Toronto’s streetcar system
  • Has to generate from steam during rush hours
1900s

- 1906 Ontario creates Hydro Electric Power Commission of Ontario [HEPCo]
- Publicly-owned HEPCo develops its own Niagara power
- Brings it into Toronto via the waterfront
- Publicly-owned, delivers power at cost
  - Allows manufacturing to benefit from cheap power
Sunnyside 1920s
1910s

- Toronto Hydro takes over street lighting from TELco in 1911
  - Brings electricity to ordinary homes, businesses
  - The Hydro Light
- Factories convert to electricity, begin to abandon steam
Bay & Temperance 1912
Bloor & Dufferin 1912
1900s-1910s

- Small private hydro schemes running in suburbs
- Hydro dams at Lambton, Erindale, supply power to Toronto’s western suburbs
Erindale ON

- Small (5MW) hydro dam built 1905-1910 on Credit River
- Powered Streetsville, Etobicoke lakeshore 1910-1923
Market Penetration

Domestic electric use became universal in Toronto in the 1910s

<table>
<thead>
<tr>
<th>Year</th>
<th>Toronto Hydro Customers</th>
<th>Electric meters per household</th>
</tr>
</thead>
<tbody>
<tr>
<td>1911</td>
<td>4000</td>
<td>1 in 15</td>
</tr>
<tr>
<td>1921</td>
<td>82000</td>
<td>1 in 1.3</td>
</tr>
<tr>
<td>1931</td>
<td>182000</td>
<td>1 in 0.7</td>
</tr>
</tbody>
</table>
Toronto: Total Electrical Consumption (MWH)
World War 1

• Most households now using electricity
• Available Niagara Power all being used by 1918
• TELco has to resume steam generation
• Brown-outs
1921 Clean-Up Deal

- Province keen to reduce the cost of power, make it more widely used
- Public take-over of private electrical companies [TELco etc.,], streetcars, radial railways
- HEPCo becomes the largest electrical utility in the world
- 1921 clean-up deal creates TTC, augments Toronto Hydro, Ontario Hydro etc.,
Domestic Power Use

• 1920s: Typical large Toronto suburban house goes through 20 KWH/month
• 2019: typical large Toronto suburban house goes through 21 KWH/day
1920s-1940s

• Ontario Hydro expands power generation at Niagara Falls, develops Ottawa River hydro in 1920s
• Takes over Abitibi hydro dam 1930s
• HEPCo creates a reliable, integrated electricity system based on hydro power
  • Steam generation decommissioned
  • HEPCo builds major transmission lines
• But system capacity reached in 1940s
Post-War changes

- Post-war boom marred by severe hydro shortages in later 1940s, early 1950s
- Need to alter Toronto region from 25 cycle AC to 60 cycle
1950s

- Ontario Hydro plans to add hydro from the St Lawrence Seaway scheme
- But knows that demand will outstrip hydro supply
1950s

• So Ontario Hydro creates new coal-fired plants to meet peak daily demand
  • Hearn Generating Station on Toronto waterfront
• Single integrated grid system expanded with interconnections to US electrical grids
Toronto: Total Electrical Consumption (MWH)
1950s

• Electric demand continues to grow
• HEPCo commits to coal-fired generation
• Hearn TGS runs full-time, expands
  • Eventually generates 10% of Ontario’s electricity
  • Consumes 3 million tons coal/year by the mid-1960s
• Hearn TGS burns more coal than the entire city in the 1930s
  • Becomes a major polluter
1 Nov 1967
1965 Blackout

- Much of southern Ontario blacked out by an integrated grid failure
1960s

- HEPCo adds Lakeview TGS
  - Plans Nanticoke TGS
- Commits to nuclear power, based on CANDU reactor
  - Bruce, Pickering, Darlington
  - Assumes a massive debt load to pay for them
- HEPCo becomes a massive electrical utility
Nanticoke
TGS 1980
Hearn TGS 1972

- Tries to reduce pollution in the 1970s
- Converts to natural gas
Lakeview TGS 1992
Oct 1982 smog

Breathe easy, winds expected to clear smog tonight

By Bob Hepburn

Social aid spared as $1.1 billion shifted to jobs, homes, railways

By Bob Hepburn

The federal government will shift $1.1 billion to create new jobs. Stimulate the housing industry and expand Western rail programs and tax rebates.
What a mess! This thick cloud of smog that descended upon Metro in October, 1982, prompted six local industries to cut back emissions. Reader says if countries pooled their knowledge to undertake cleaning up the mess and put the billions of dollars spent on weapons into a combined effort of world survival, the problem could be solved before it's too late.
1970s

• HEPCo becomes Ontario Hydro in 1974
• A major publicly-owned integrated electricity provider
• Developing an electrical future heavily dependent on nuclear power
  • Incurring a major debt-load
Bruce NGS

- Announced 1968
- Goes online 1975
- The largest nuclear generating station in the world by 2011
Pickering NGS 1971
1971

- Ontario Hydro commits to an $83 billion nuclear power expansion
  - Equivalent to $550 billion today
- Adds Pickering B, Bruce B
1980s

• Delays and cost overruns on the nuclear programme
• Darlington and Pickering are glitchy, expensive
• Ontario Hydro carrying a $26 Billion debt by 1999
• De-industrialization begins to soften electric demand from industry
1990s

• Ontario 40% nuclear by 1990s
• Nuclear stations expensive, aging, waste cycle unsolved
• Nuclear stations need continuous load, no good for spikes/troughs in demand
• Use hydro, coal stations for surge demand
  • Adds to the considerable smog problem
• Repair of aging nuclear stations precipitates debt crisis for Ontario Hydro
Jul 1988 smog

146 missing as explosion turns North Sea rig into fireball

SMOG LAYER SHROUDS METRO

Free trade wins key vote in Commons

Opposition sings O Canada

Workers lay siege to Yugoslav parliament

Angry PM tells Tories "Chaplin's tomb"
Conservatives 1990s

- Began to privatise Ontario Hydro 1998
- Separates the generation and transmission functions, breaks Ontario Hydro into 5 companies
- Allows private generation, renewables
- Adds flexibility, some market discipline
- But adds a profit motive
- Make electricity consumers pay off the $19 billion Ontario Hydro debt
2003 Blackout

- A legacy of big, interconnected electric utilities
- Plus years of poor maintenance
- At peak summer daily demand a falling tree branch in Ohio shorted out the power to 50 million people
Aug 2003 blackout
Hydro Systems

• Ernie Eaves conservative government foundered after 2003 blackout
  • Old electrical infrastructure
  • Ontario’s dependence on nuclear, delayed the grid re-start
  • Nuclear stations have no black-start capability
  • Takes them weeks to come back on line
2003 Blackout

Ontario Demand: August 14 - 18, 2003

14-Aug-03 15:45, 24,072 MW
14-Aug-03 16:20, 2,544 MW
Hydro Systems

• Renewing hydro infrastructure proves costly
• McGuinty government embarked on a $39 BN scheme to renew nuclear capacity, decommission coal-fired stations, grow renewables, add gas-fired plants
Nanticoke TGS

• Ontario’s largest coal-fired station, operating by early 1970s
• Ontario’s largest point source of greenhouse gases
  • 17 million tonnes of CO2/year
• Produced 8-16% of Ontario’s power
• Closed 2014
Toronto: Portlands Energy Centre Jul 2012
Gas Fired Plants Scandal

• Semi-privatised hydro system fails to perform public consultations on new gas-fired plants
  • Toronto gets the gas-fired Portlands Energy Centre
• Liberals forced to cancel projected plants in Oakville and Mississauga when they need to win an election
  • Huge cancellation penalties, embarrassing cover-up
• Conservative critics who demanded the plants be cancelled then complain about the cost of cancellation
Hydro Systems

- Ontario electricity costs rising
- Critics blame renewables, gas plant cancellations, but nuclear renewal is a big part of the increased costs
- Eaves, Wynne, Ford governments borrow money to subsidise electricity to consumers
- Ontarians not paying what their consumption habits truly cost
  - 18c/kWh in Ontario vs 42c/kWh in Germany
- Need to cut use, increased costs would help
Hydro Systems

- Renewables starting to change the possibilities
- Renewables at grid scale cheaper than coal
- Development of home electrical generation (wind, solar) with grid-tie
- Home battery storage systems, fleets of electric cars, utility battery systems allow public power storage
  - Now getting grid-scale battery storage
- May force re-think of grid systems: will we need big provincially-scaled electrical generation, distribution?
Oxford County, ON Aug 2017
Erie Shores Windfarm, ON, Aug 2017
Blenheim ON, Aug 2014
Partnerships

• Quebec: most homes, domestic hot water heated by hydro
  • Quebec runs short of power in winter
• Ontario: surplus generating capacity in winter
  • Runs short in hot summer weather
• Ontario and Quebec agreed to share power seasonally
  • Ontario supplies Quebec in winter
  • Quebec supplies Ontario in summer
• Cuts costs, greenhouse gas emissions