ONTARIO POWER AUTHORITY

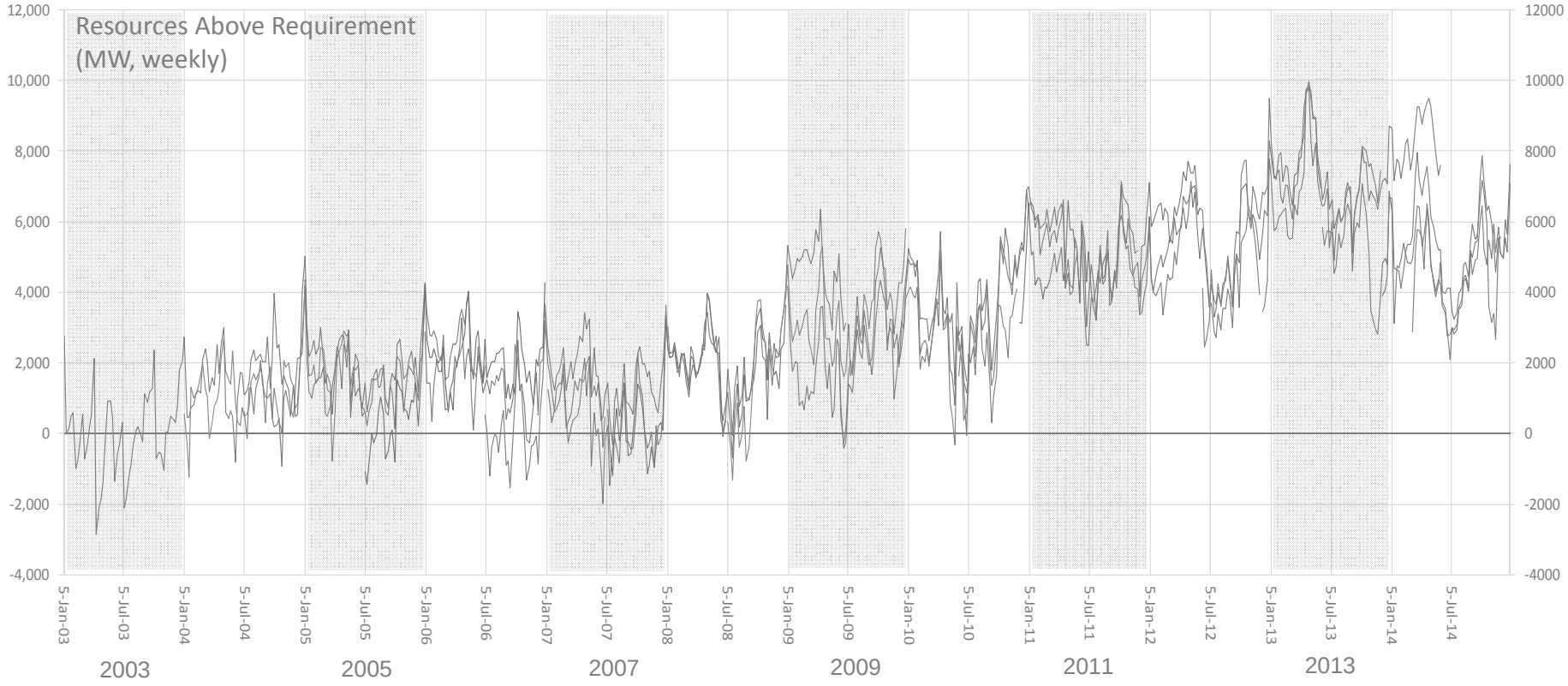
Considerations of the Role of Natural Gas-Fired Generation in Ontario's Evolving Electricity Supply Mix

Prepared for Discussion at the OEB Natural Gas Market Review

Power System Planning

November 27, 2014

Ontario has seen net growth in electricity supply in recent years. Electricity demand has not grown within the same period. Strong generation capacity margins have been the result.



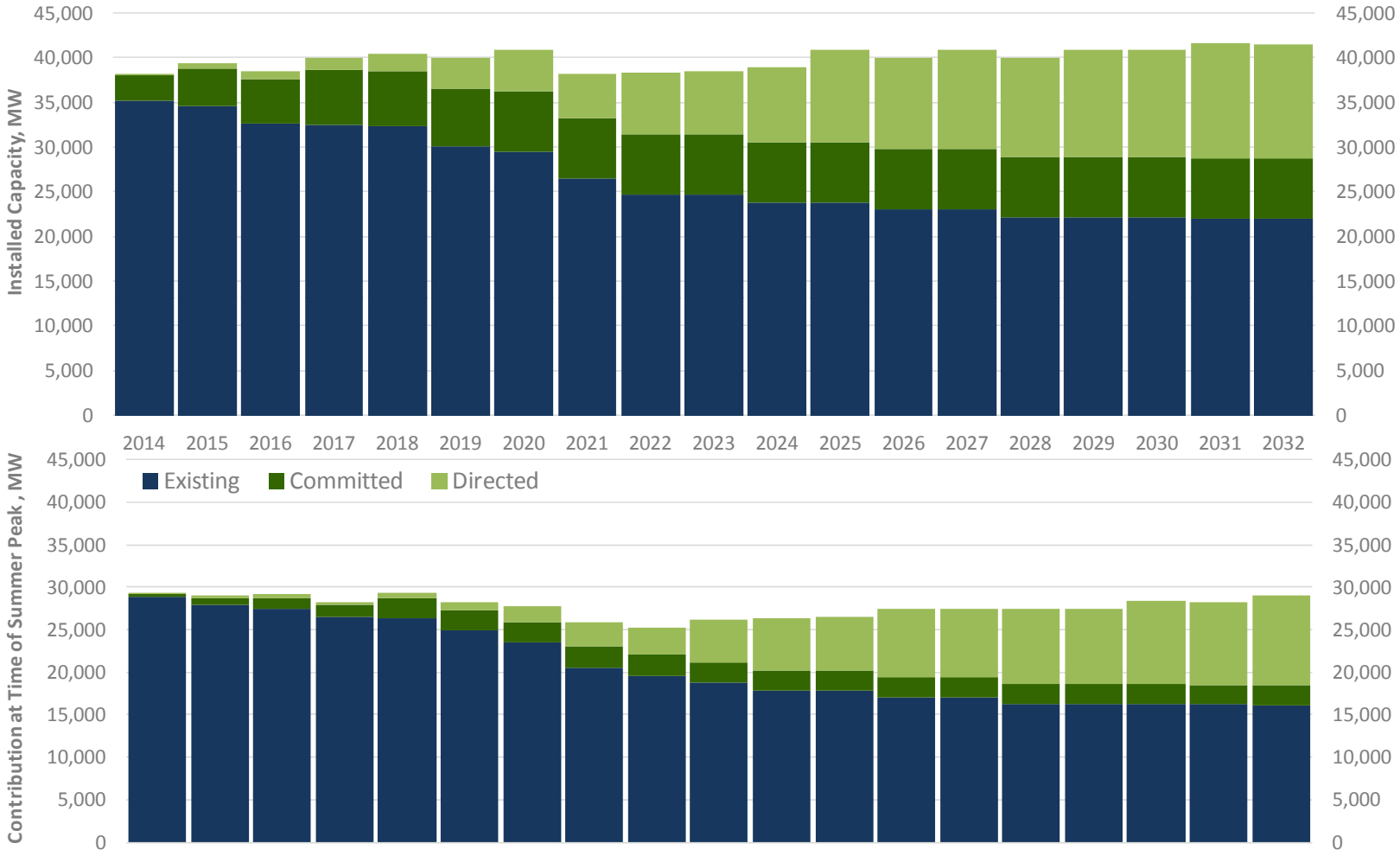
ONTARIO POWER AUTHORITY

Future net demand growth will remain moderate, the role of conservation will be significant

Peak demand savings are from codes & standards, energy efficiency programs and time of use. Demand response is not shown.

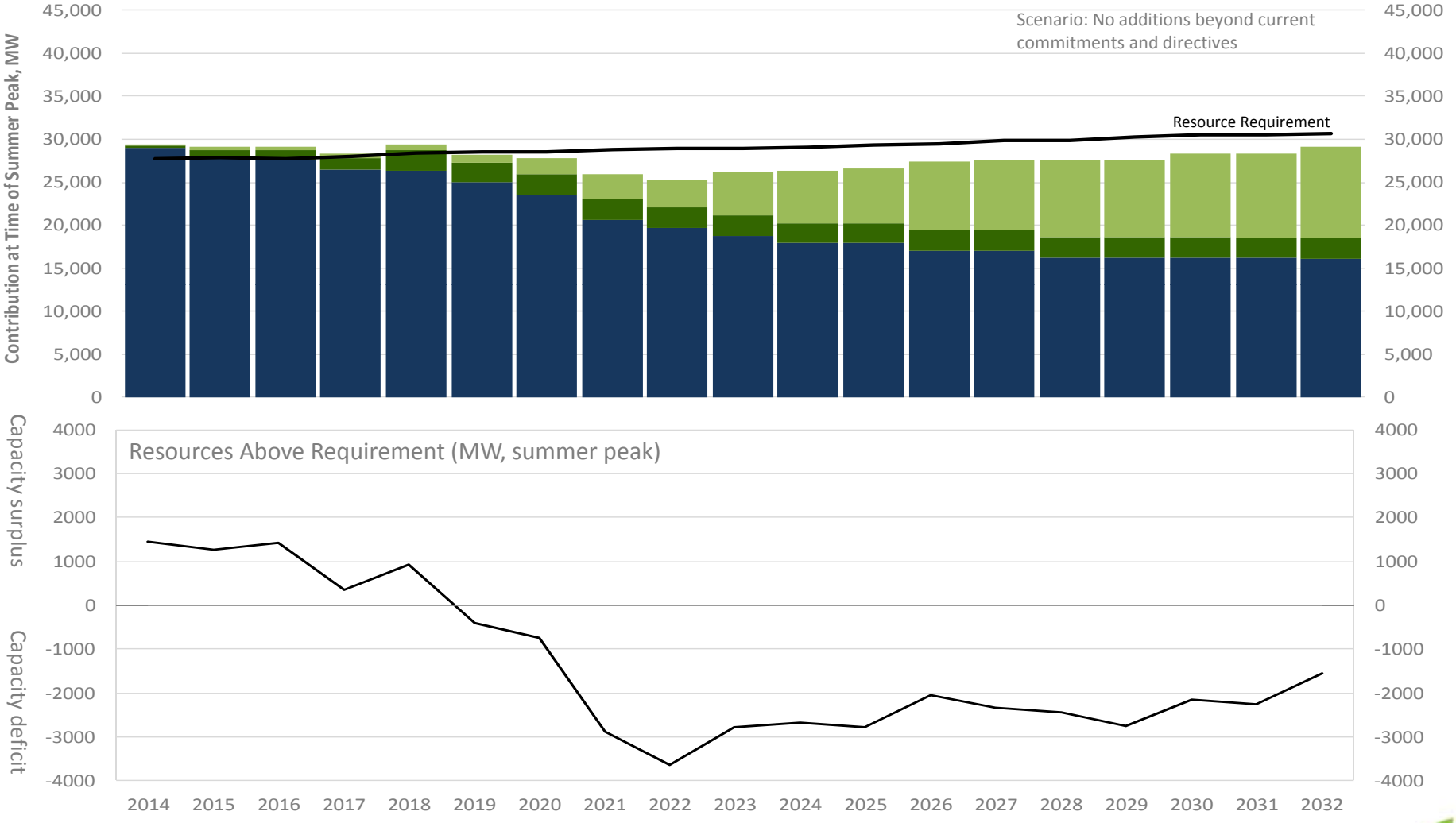
ONTARIO POWER AUTHORITY

More supply is in the pipe, but existing supply will diminish over time. Reductions will eventually outstrip currently committed and directed additions.



ONTARIO POWER AUTHORITY

Existing, committed and directed resources will provide adequate supply for the next few years, after which time additional resources will be required



ONTARIO POWER AUTHORITY

On the need for additional resources: timing, size & characteristics

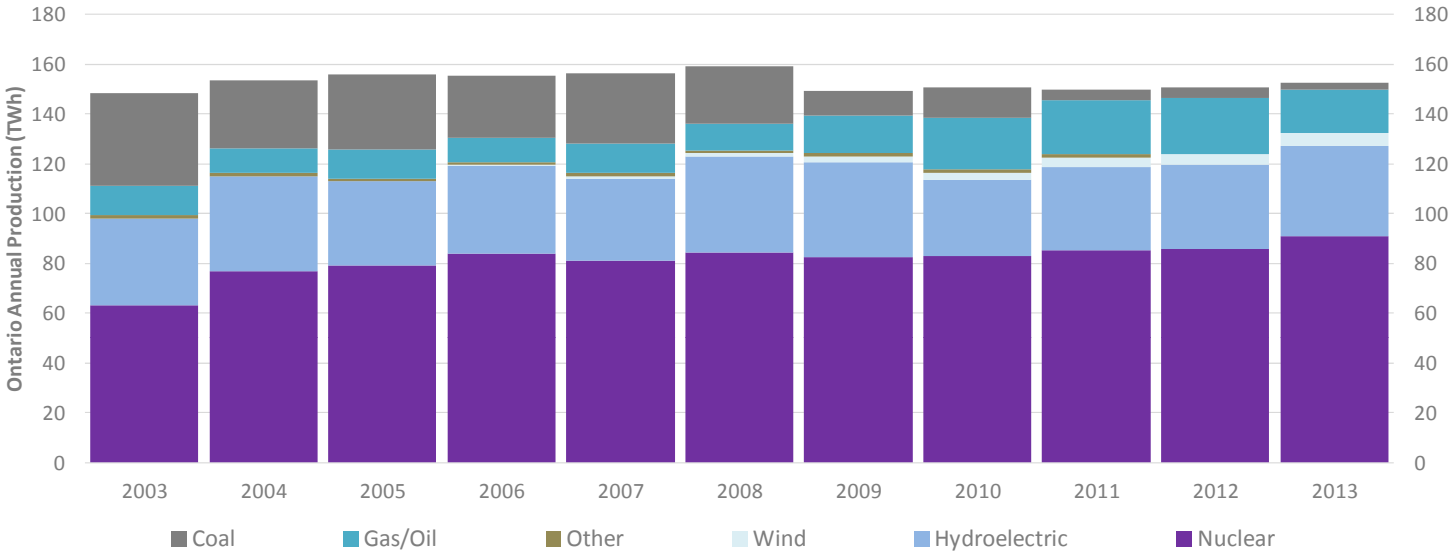
- The additional need can vary/change as it is driven by factors that are in motion:
  - Pickering retirement (3,000 MW)
  - Refurbishment outages at Bruce and Darlington (2,000 MW at a time)
  - Potential retirement of Non-Utility Generation as existing contracts expire (1,000 MW)
  - Moderate growth in resource requirement due to demand growth (1,000 – 2,000 MW)

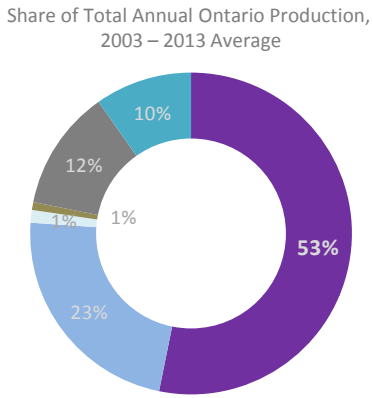
- The nature of the need:
  - Capacity in the summer when demand is higher and capability is lower
  - Flexibility all year round to complement solar/wind resources
  - Regional planning initiatives under way point to deliverability to GTA and other load centres as a companion key requirement
  - Infrastructure security/resiliency and response to weather events

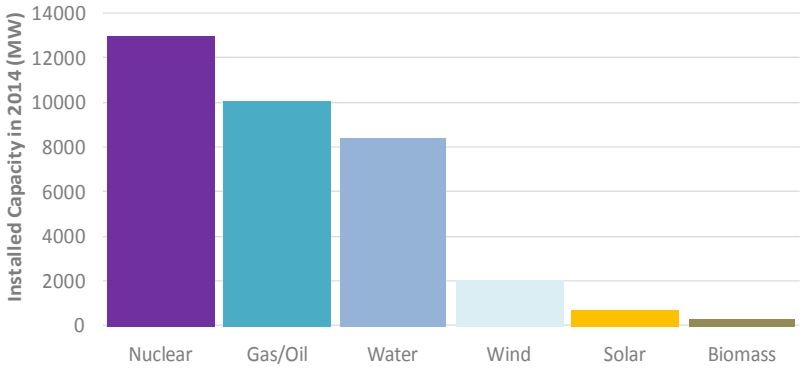
- The amount and timing of the need:
  - 3,000 MW, give or take
  - 2019, give or take

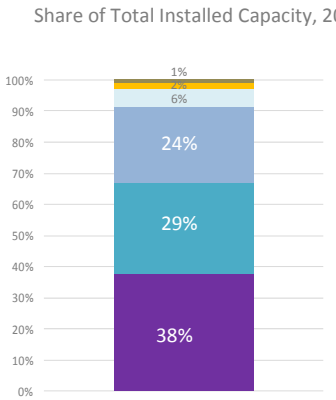
ONTARIO POWER AUTHORITY

For context as we think of the future: Ontario's supply mix has evolved over the past decade

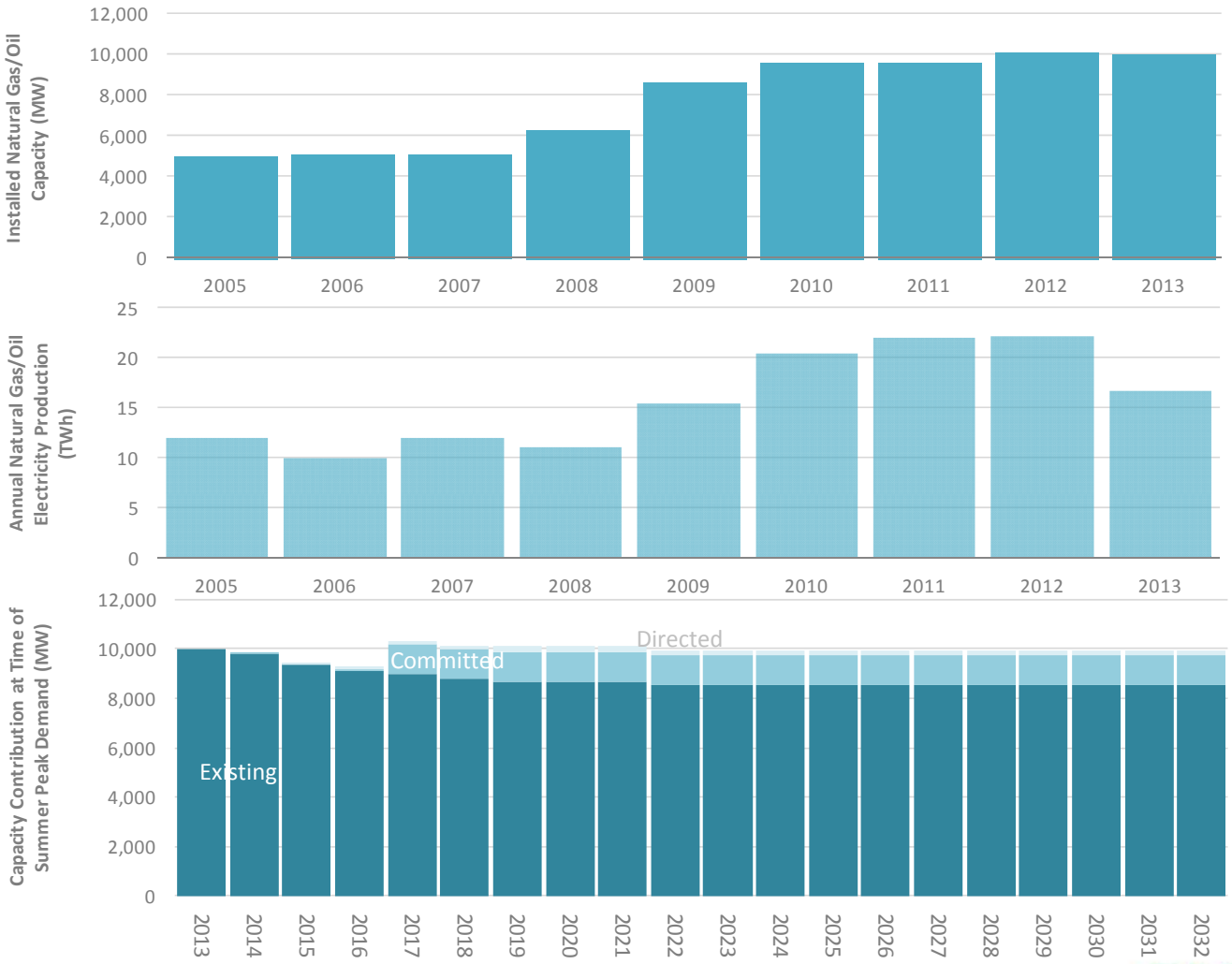




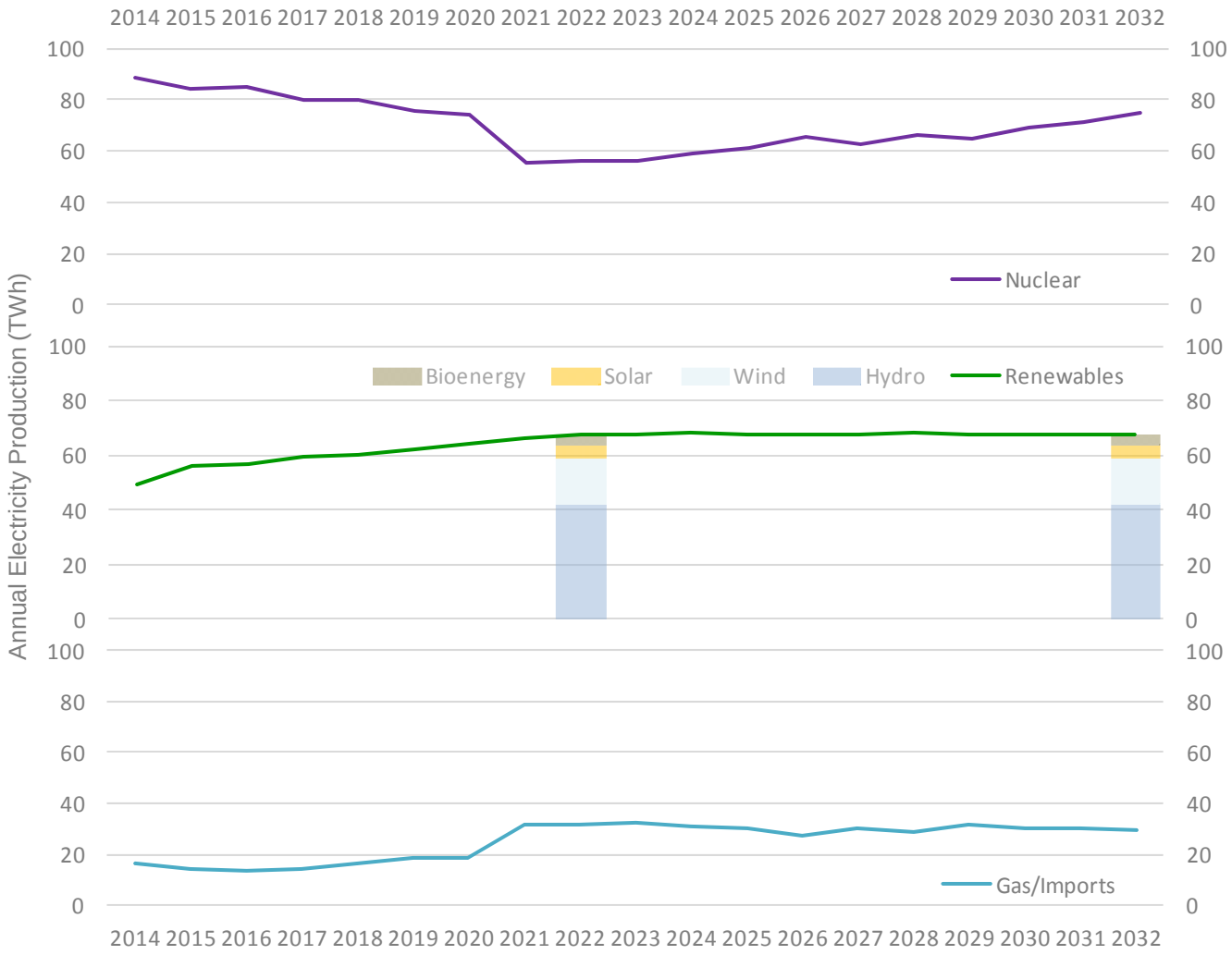


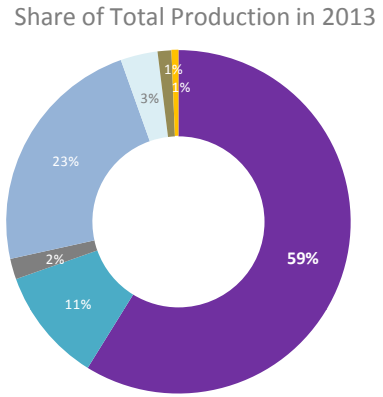


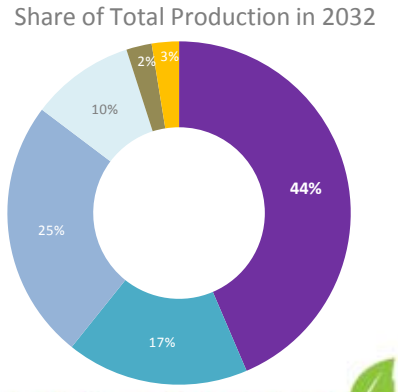
Natural gas has played an increasingly prominent role in Ontario's electricity supply mix in recent years



Indicative outlook for energy production to 2032: less nuclear, more renewables and gas







ONTARIO POWER AUTHORITY

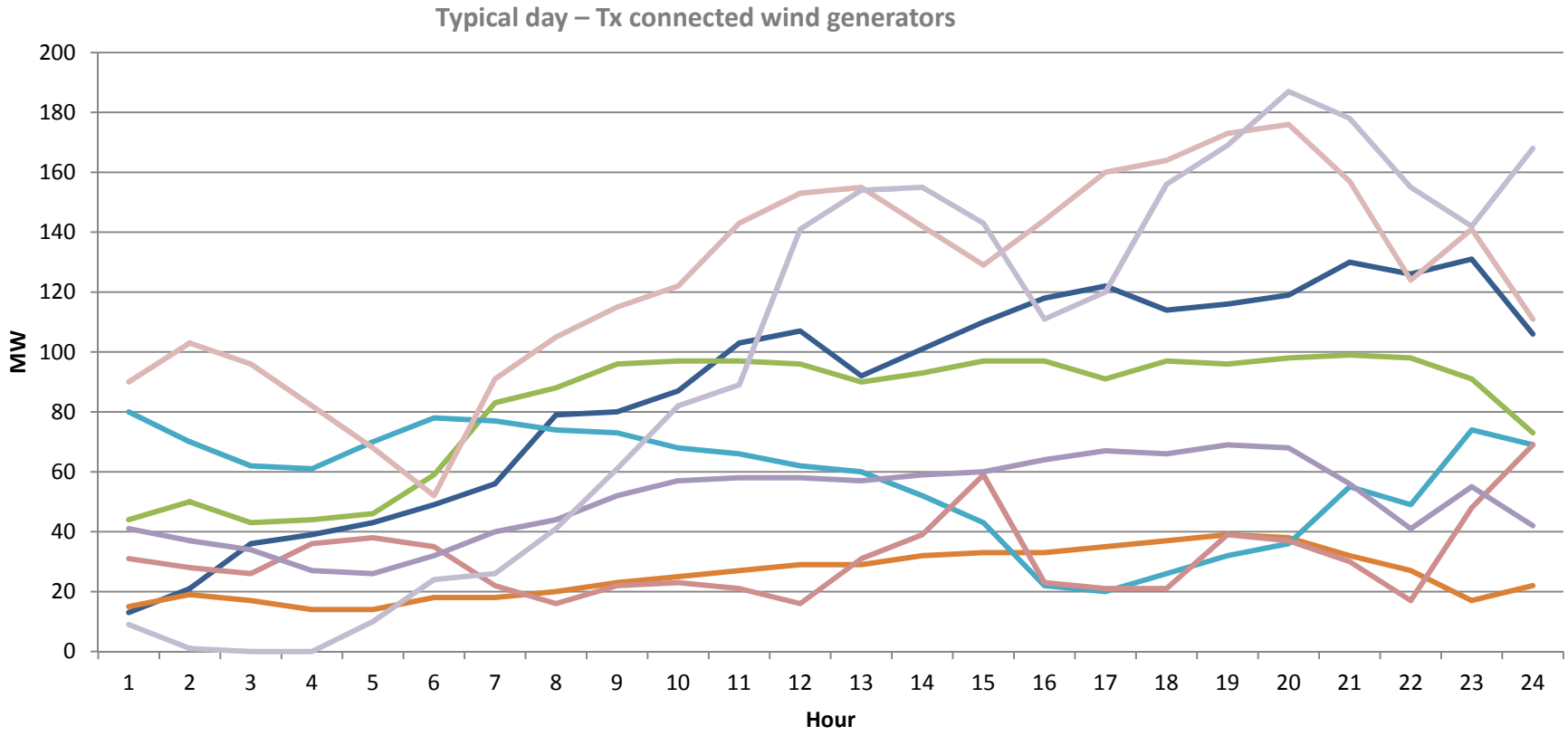
Some of the challenges as the supply mix evolves

- System Volatility
- Availability of flexible resources
- Reliability
- Costs
- Environmental Impacts
- Risks

ONTARIO POWER AUTHORITY

Snapshot of 2010 – wind output

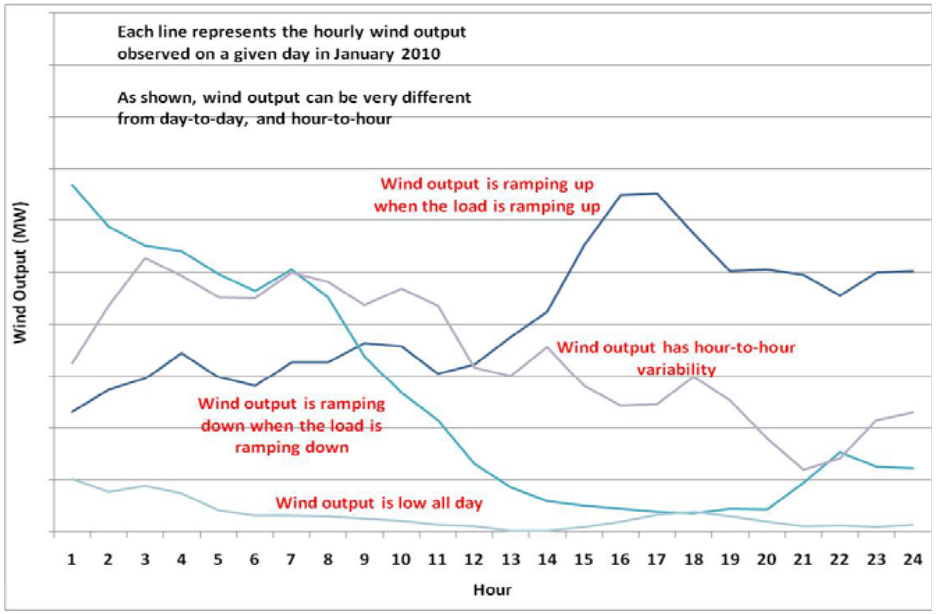
A typical day of **wind** generation. Wind generation is variable but there wasn't much on the grid yet.



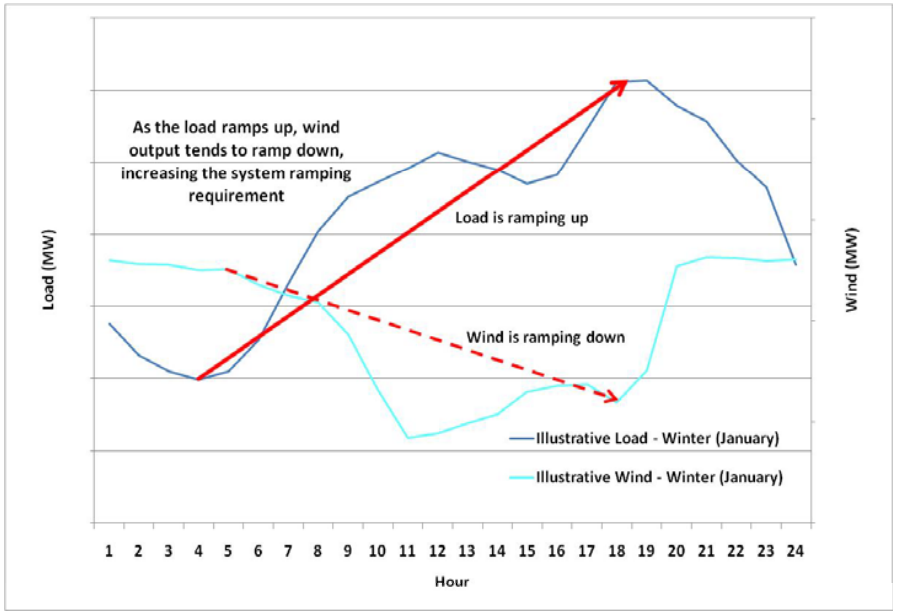
ONTARIO POWER AUTHORITY

General wind output patterns

Renewable output can be intermittent and highly variable; it also follows daily and seasonal patterns that can challenge system operations



Day-to-day wind profile in winter varies significantly – this can create a range of impacts on the system

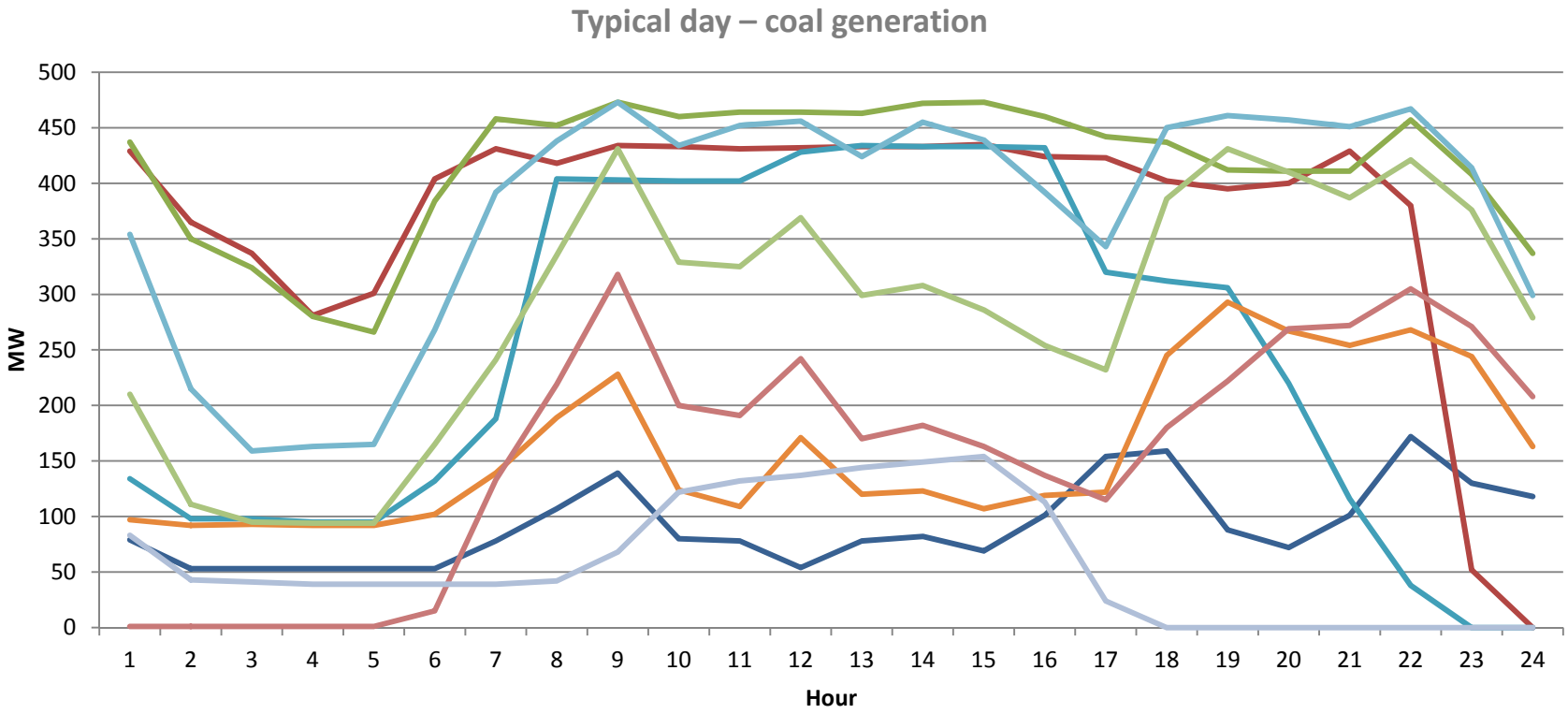


Average wind profile in winter tends to increase ramping requirement

ONTARIO POWER AUTHORITY

Snapshot of 2010 – coal output

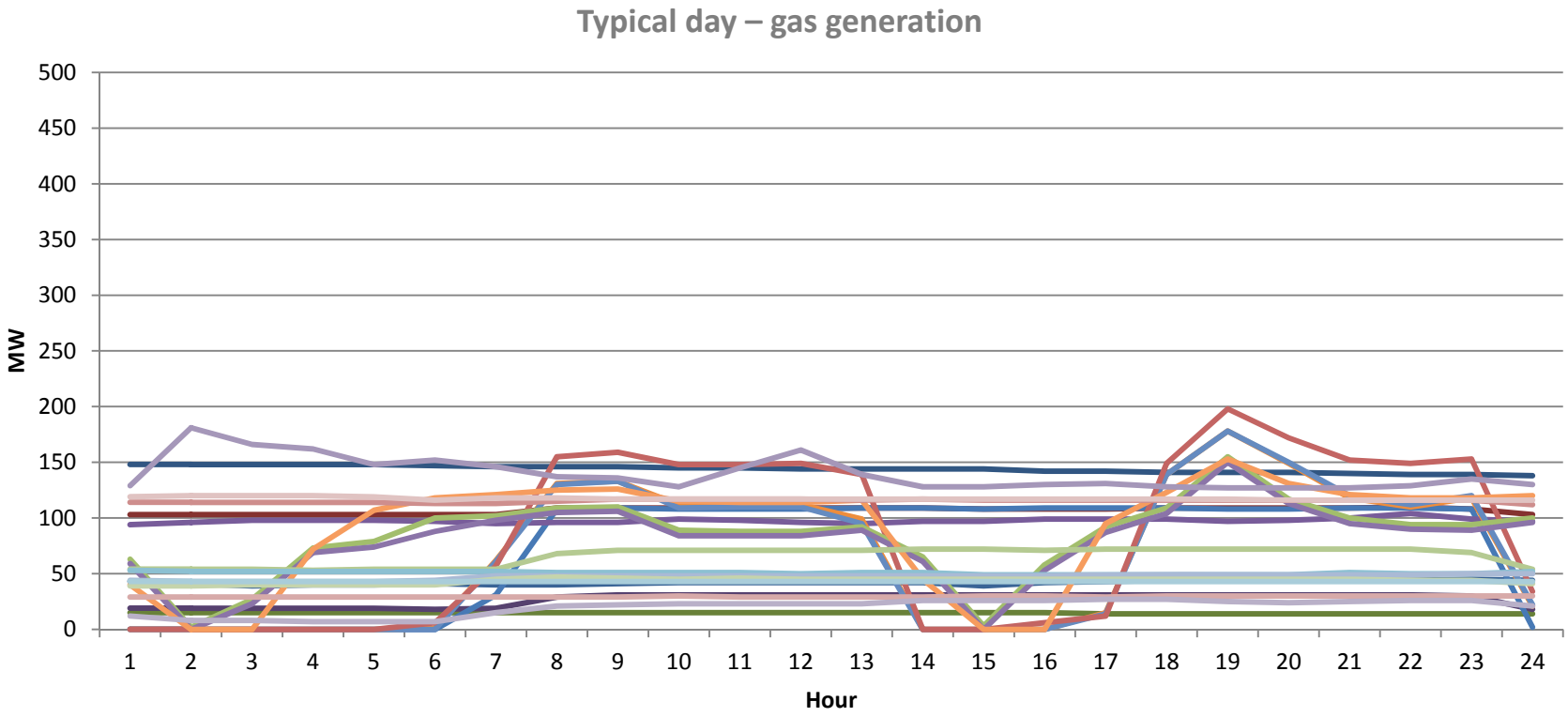
The same day's **coal** output. The variable behaviour of wind generation was compensated by the flexibility (ramping/low minimum loading point) of coal. I.e. Coal was used to absorb the variability of wind and load.



ONTARIO POWER AUTHORITY

Snapshot of 2010 – gas output

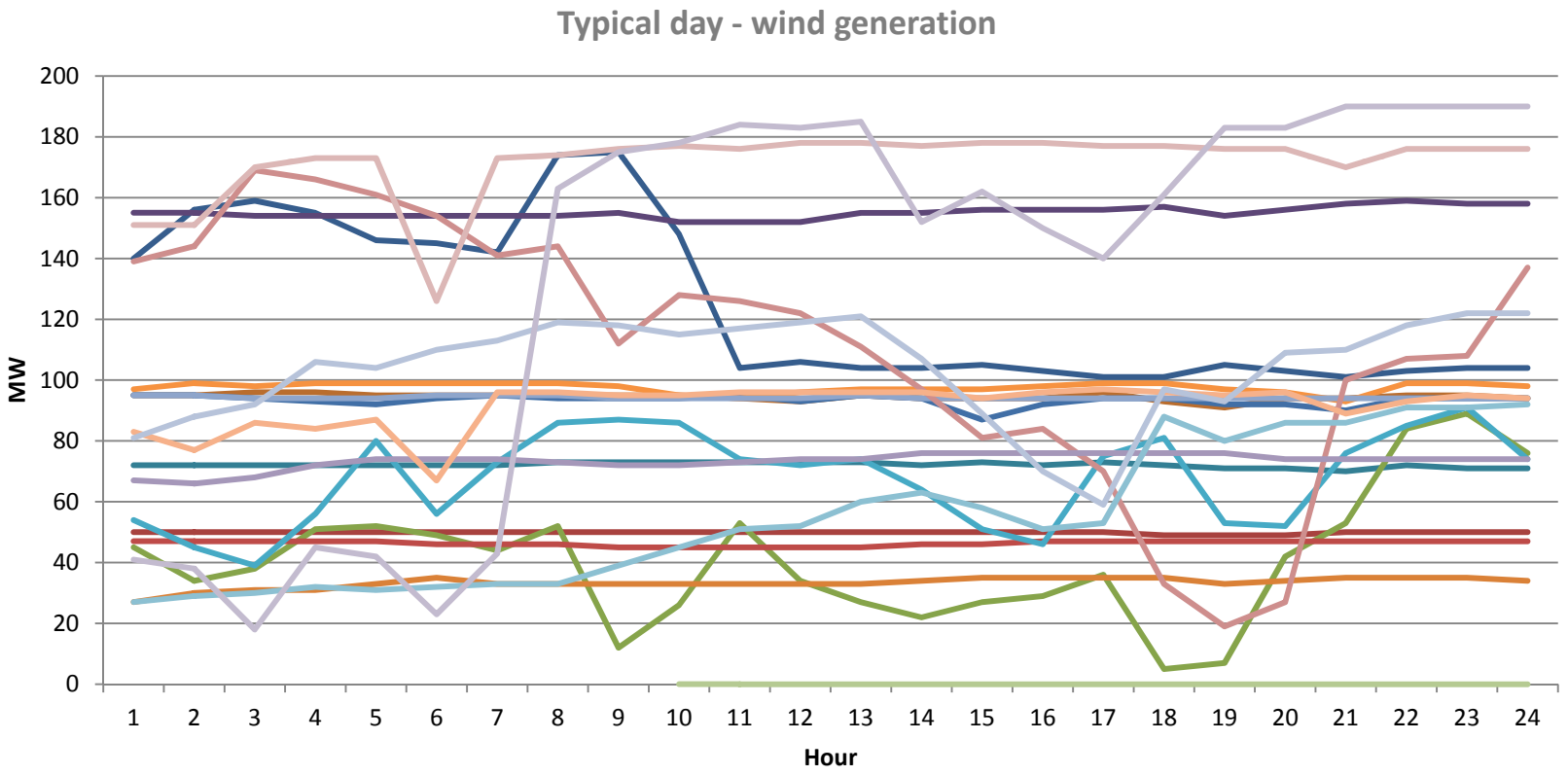
The same day's **gas** output. Gas-fired generators did not need to ramp the same way that coal-fired generators did.



ONTARIO POWER AUTHORITY

Snapshot of 2014 – wind output

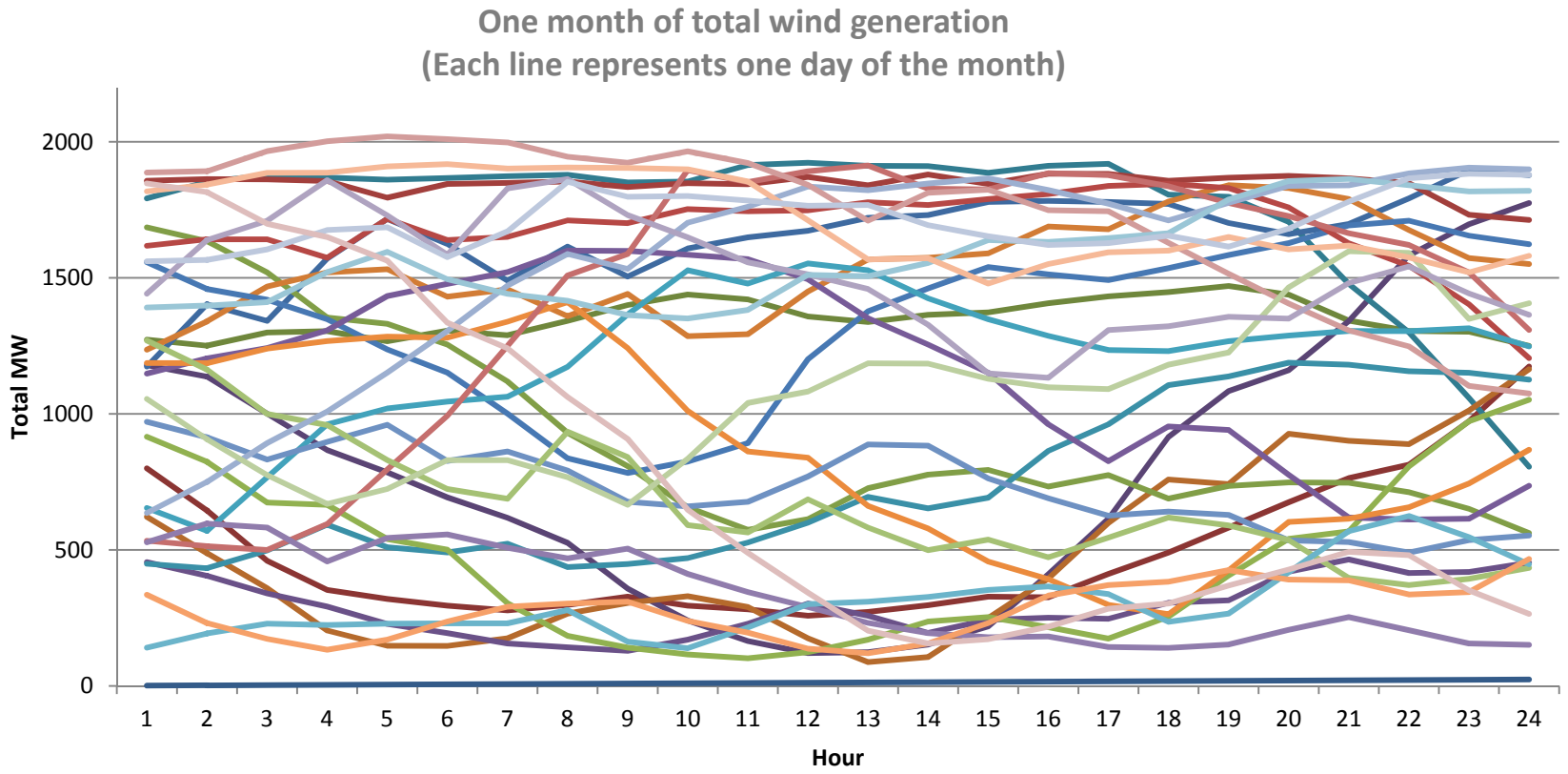
The situation has changed. We have more wind generation (still highly variable) and no coal generation to compensate.



ONTARIO POWER AUTHORITY

Snapshot of 2014 – one month of wind output

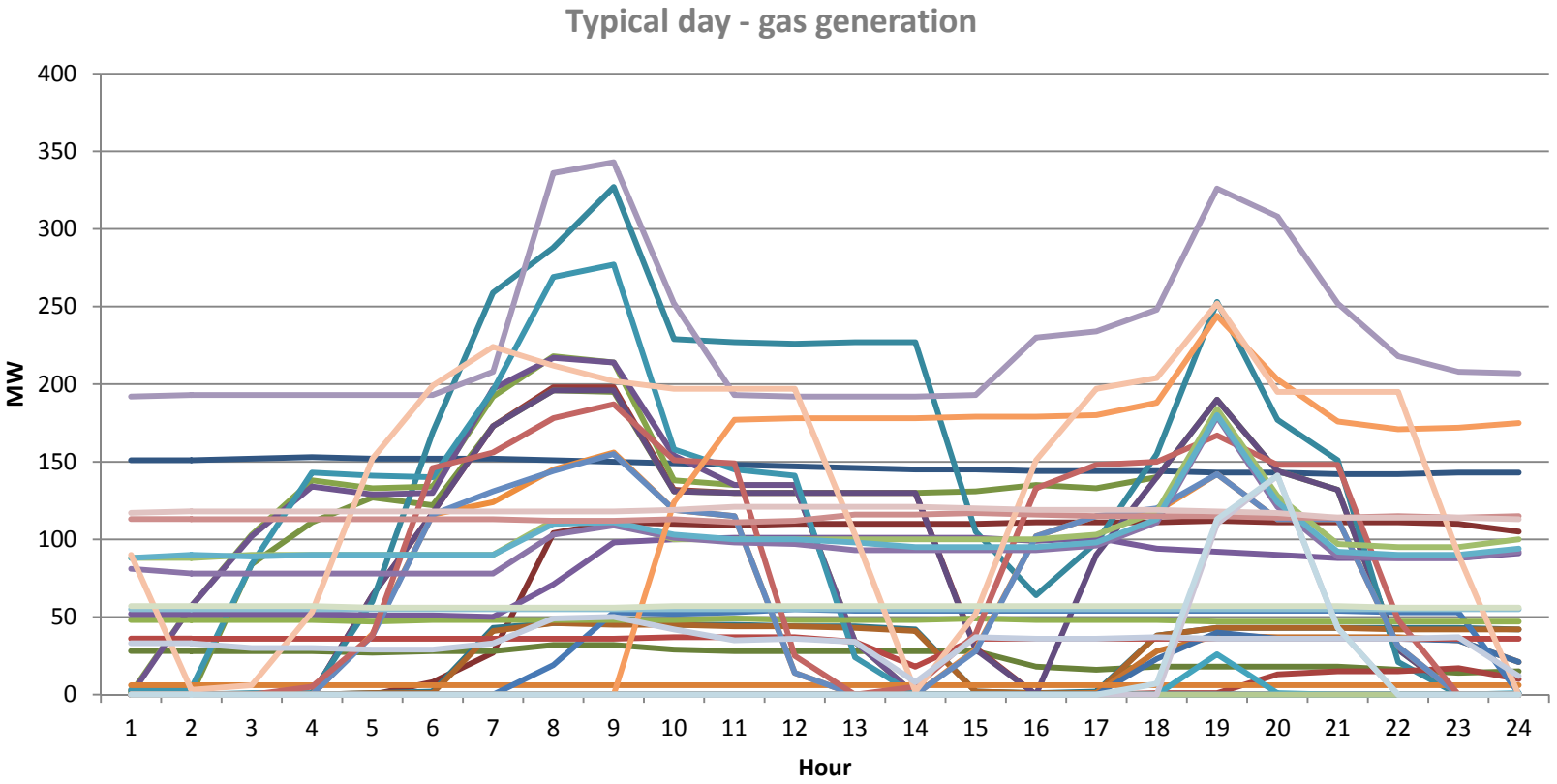
Not only does wind generation vary by individual facilities, even total wind output varies significantly on any given day.



ONTARIO POWER AUTHORITY

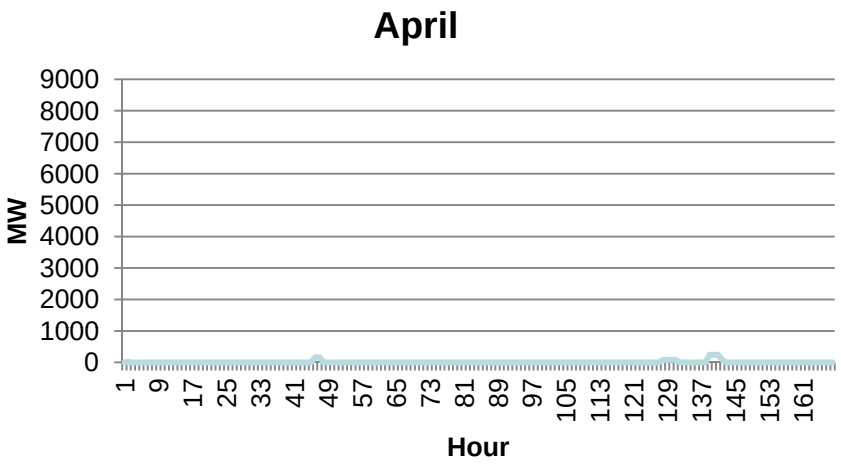
Snapshot of 2014 – gas output

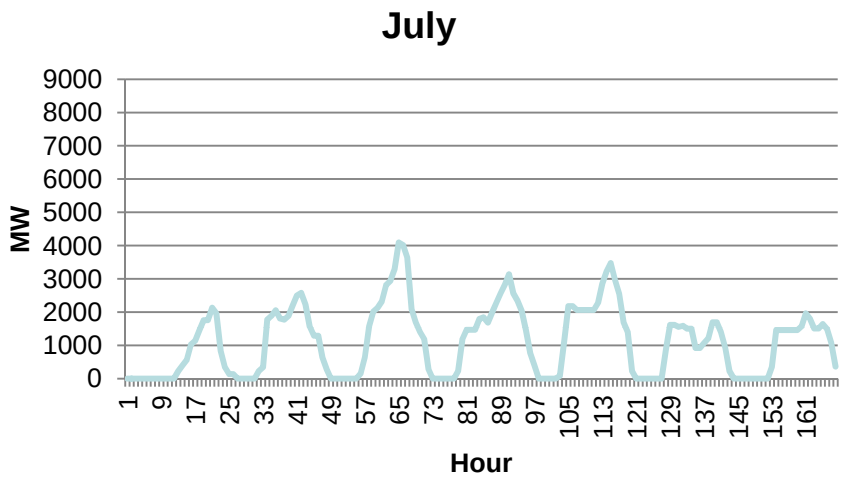
As a result, gas-fired generators are now required to compensate for wind generation's intermittency.

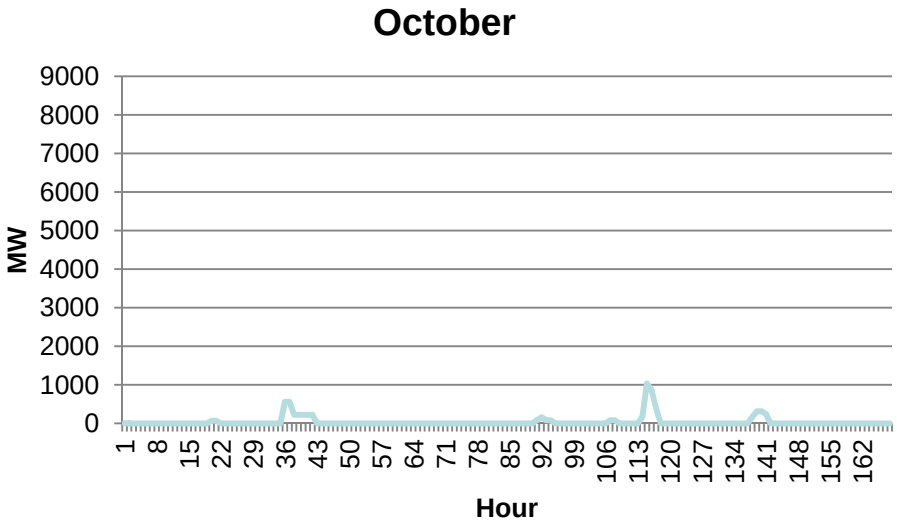


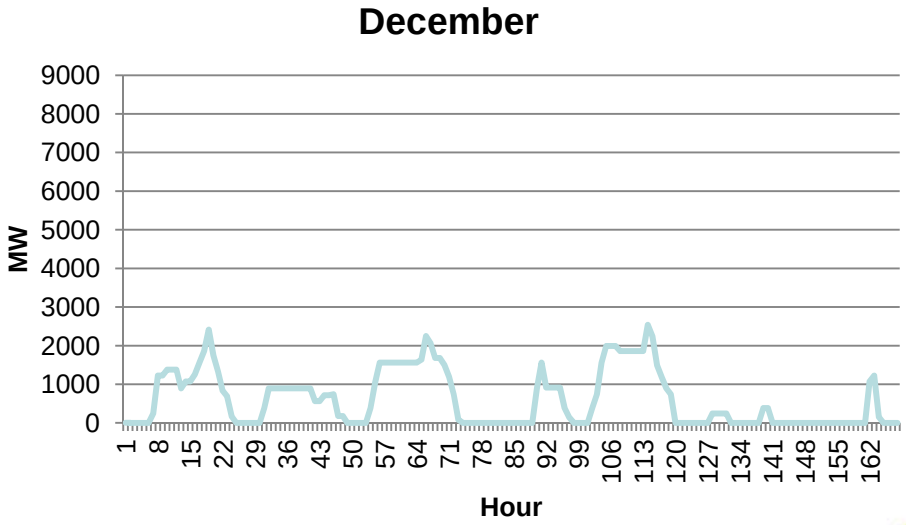
ONTARIO POWER AUTHORITY

Gas production – typical weeks in 2017



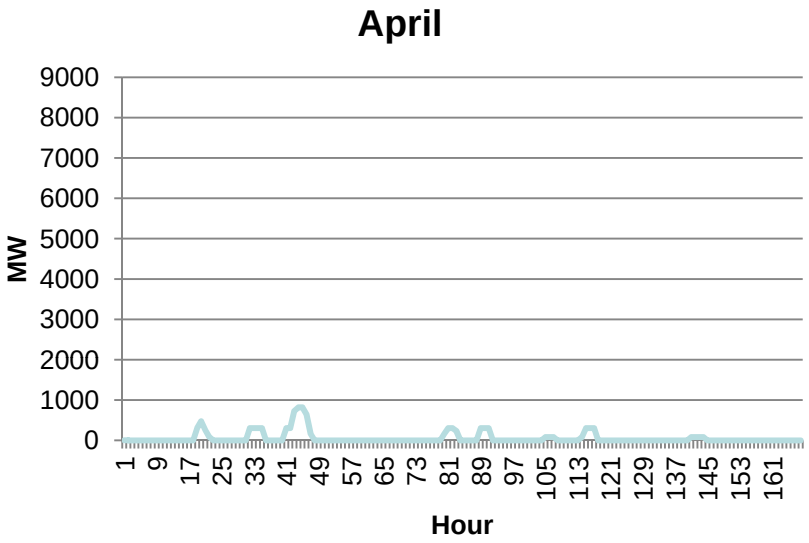


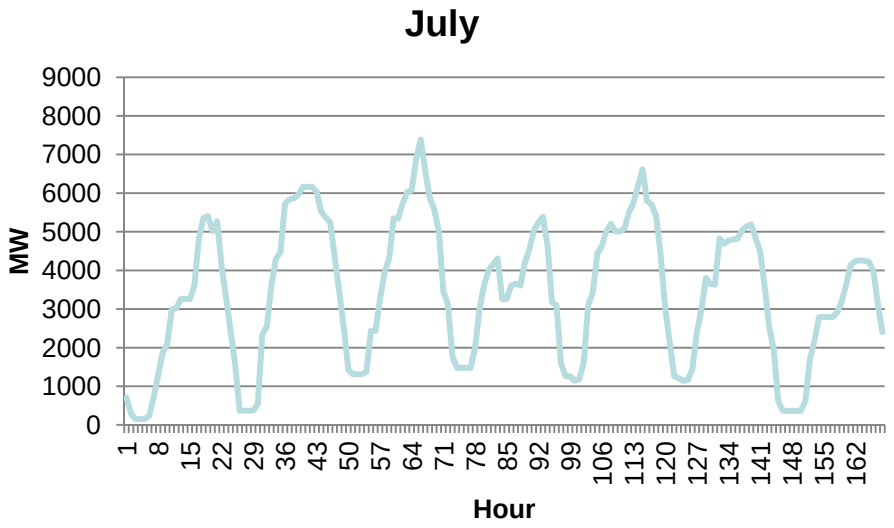


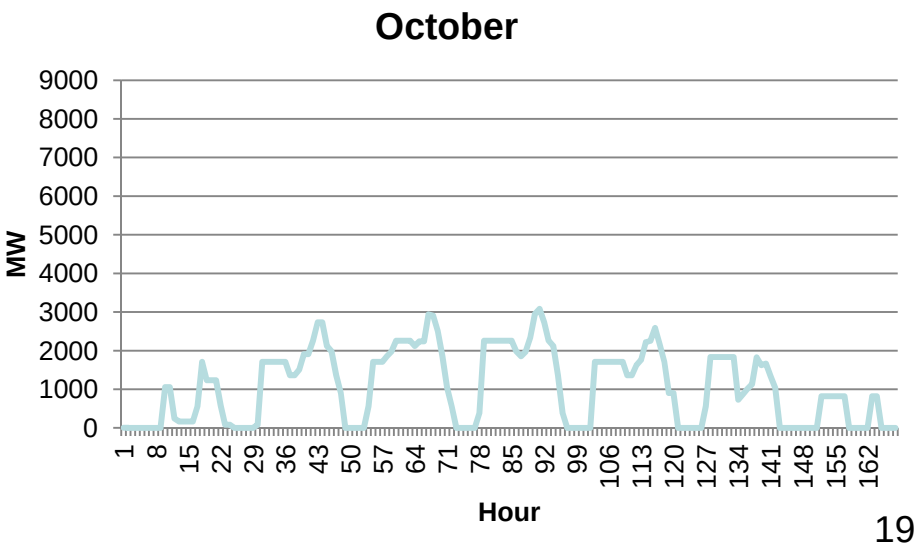


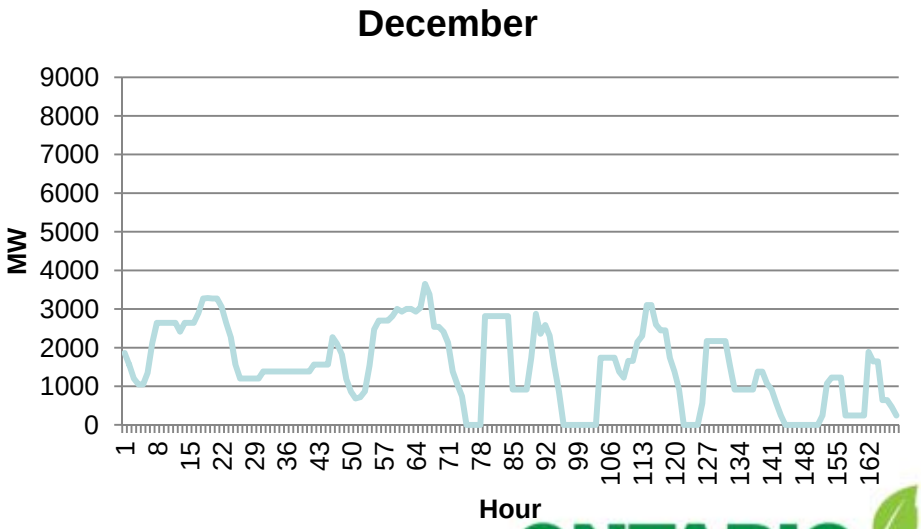
ONTARIO POWER AUTHORITY

Gas production – typical weeks in 2021









ONTARIO POWER AUTHORITY

Will this trend continue?

YES!

• Coal has been phased out and remaining resources will need to provide fast ramping and generation flexibility to compensate for wind

• Further, Ontario's commitment to renewable generation means that even more wind (and other intermittent resources) will be coming online soon

• Gas-fired generators will need to become more flexible as they take the place of coal generation in terms of compensating for intermittent generation

ONTARIO POWER AUTHORITY

Gas plant characteristics

Capability	Need
Hi Minimum Load	As Low Min. Load Point as Possible
Limited Partial Load	More Flexible Partial Load
Good Ramping	Better Ramping
Good Starts	Faster Starts
Good Efficiency	Better Efficiency

The system will be more **volatile** = Gas resources will need to be more **flexible**

Issues with gas supply:

- Nomination windows (more flexibility)
- Availability of gas Management services at reasonable cost
- Effects of new gas sources and impact on pipelines, supplies, costs
- Polar Vortex effects (gas worth more than electricity)
- Reliability of the gas delivery system & impact on electricity production
- ETC