## Ontario Renewable Capacity as of Dec 31, 2018

<table>
<thead>
<tr>
<th></th>
<th>Transmission (MW)</th>
<th>Distribution (MW)</th>
<th>Total (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>4,505</td>
<td>604</td>
<td>5,109</td>
</tr>
<tr>
<td>Solar</td>
<td>479</td>
<td>1,412</td>
<td>1,891</td>
</tr>
</tbody>
</table>

**Ontario Peak Demand**

<table>
<thead>
<tr>
<th>Year</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>27,005 (Aug.1, all time peak)</td>
</tr>
<tr>
<td>2018</td>
<td>23,456 (July 5)</td>
</tr>
</tbody>
</table>
Data Collections

- PQ meters for DGs > 250kW, at coupling transformers (U-DER only)
- Waveform records to verify ride-through performance after major events
- Shake-off issue is typical in installations under old standard, due to various reasons
Example — 500kV Bus SLG Fault in Toronto Area

44kV 30+MW solar

230kV 50MW solar

44kV 30MW solar

44kV 27MW solar

44kV 30MW solar

115kV 50MW solar

28kV 10MW wind
Vendor 1 - U/V without delay (Type-3 wind 44kV)

Before — 230kV fault

100ms time delay

After — 500kV fault
Vendor 2 – Limited vs. Full Grid Support (Solar 44kV)

Limited Support— 500kV fault  Control mode  Full Support— 500kV fault
Vendor 3 – Insufficient delay—Type 4 wind 28kV

U/V with 50ms delay—230kV fault
Vendor 4 – Negative sequence current instantaneous trip—Type 3 wind 44kV

67Q1T no delay, 500kV fault
Transient over-voltage may cause multiple IBR trips (solar or Type 4 wind) --- Capacitor switching

Before  No MC  After
Discussions

• DER interruptions under external disturbances are not uncommon for installations under old standard
• Only U-DERs are monitored in HONI. In some regions U-DER may be equally important as R-DER
• Worked with vendors and GOs to mitigate. Instantaneous protections and MC are typical causes. Most mitigations are through software change, some remotely
• Less interruptions after multiple fixes