

Presentation to The Ontario Smart Grid Forum

DG Integration Key to Smart Grid

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Smart Grid Mantra

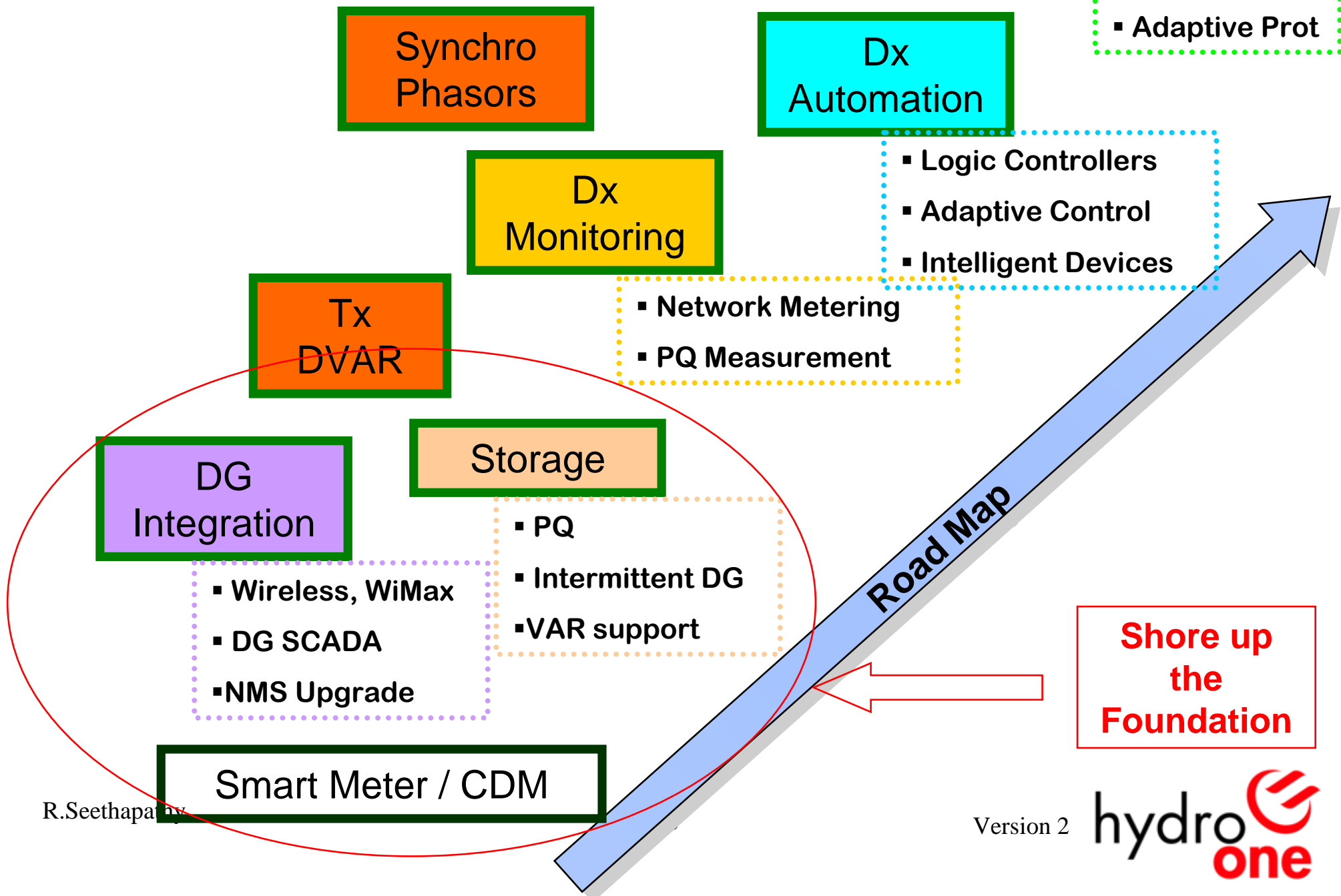
- **Requires transformation of T&D**

- Break down T&D barriers; Optimize network
- ➡ ▪ **Maximize use of low-cost DERs**
- Enable distributed diagnosis and decision support

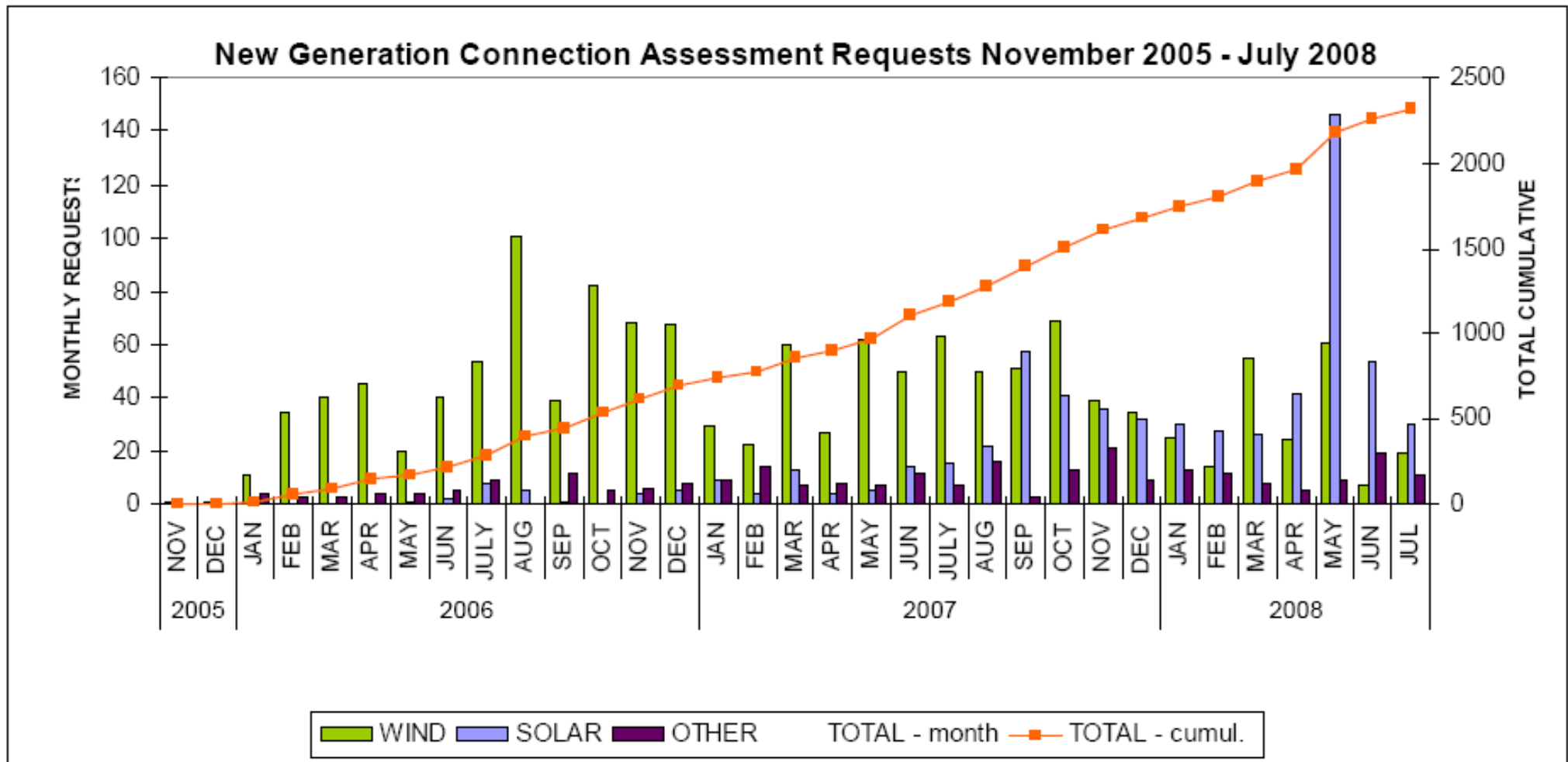
- **Objective – To further improve grid performance**

- Efficiency, Reliability, Power Quality, Safety
- Faster decision making and isolation/restoration
- Balancing power delivery and use

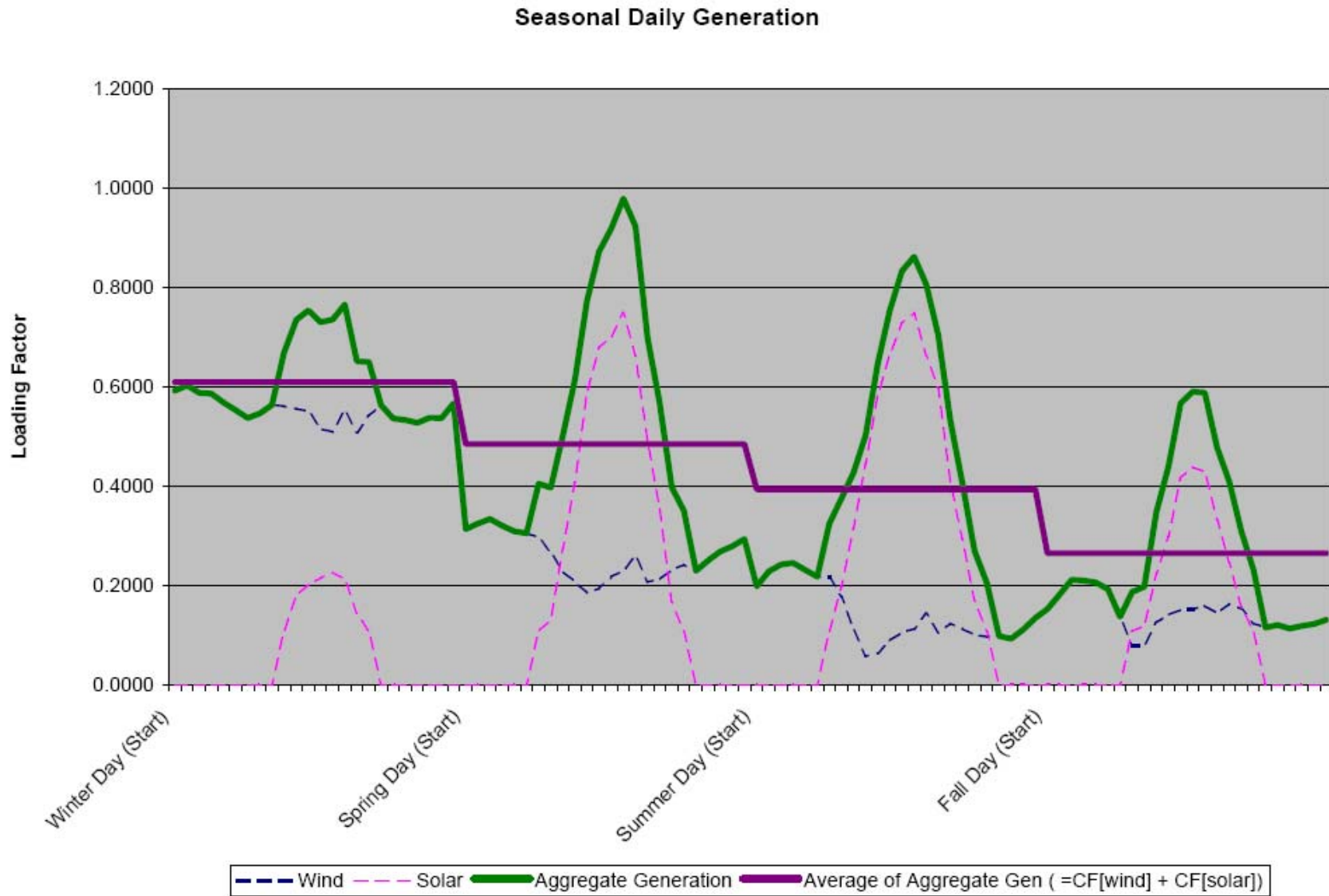
Smart Grid - Milestones



Hydro One - Application Request Status



Benefits of Fuel Mix



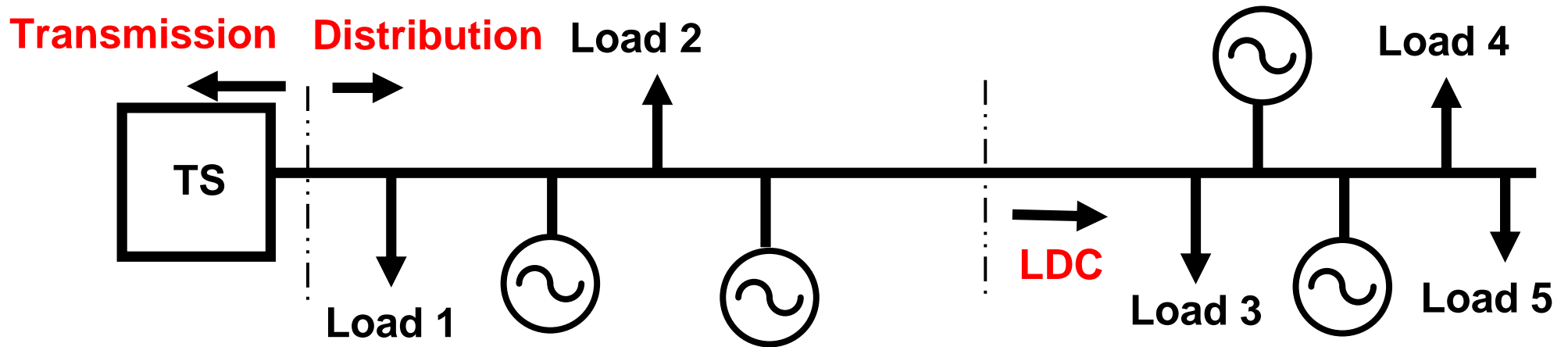
Ontario's Opportunity to Shape DG growth

- **High take interest in applications**
 - Across all RFPs
- **High Renewable energy component**
 - Wind, solar, biodigester

Provides a good foundation for a green Ontario

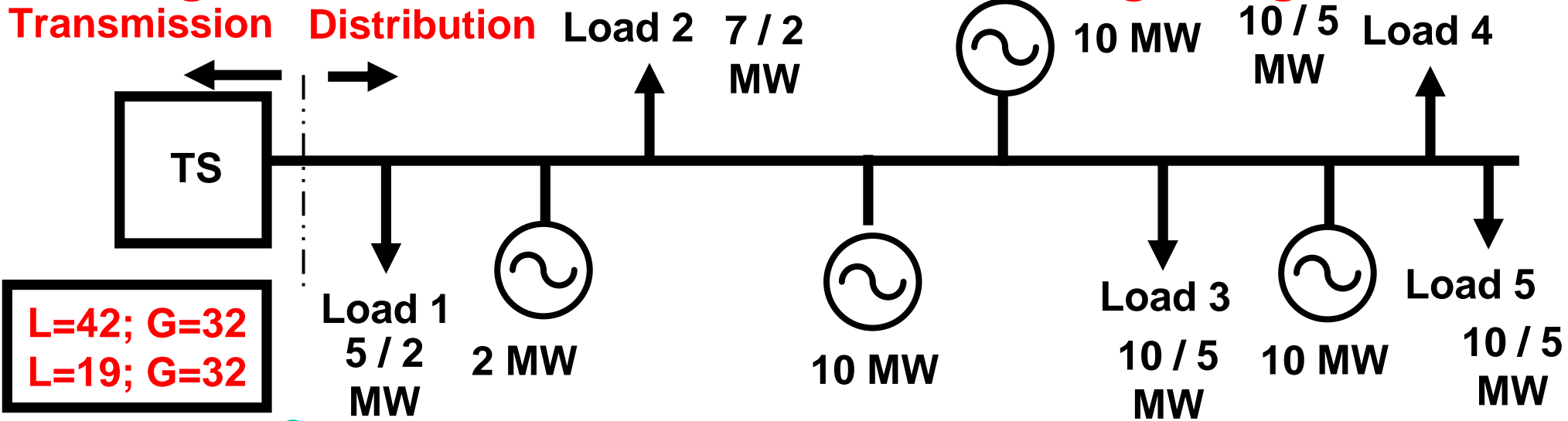
But we need to shape it and integrate it well in our wires.....

System Aspects to Integrating DGs

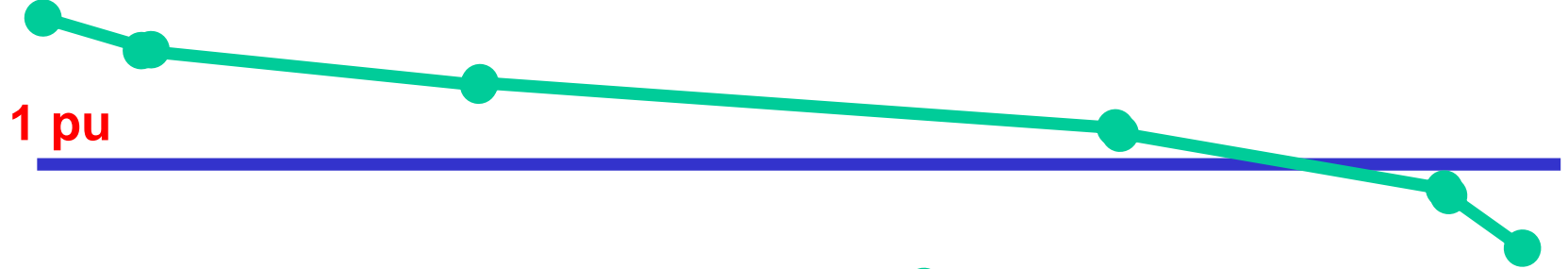


<u>Operations</u>		<u>Customers</u>	
<u>Op. Control</u>	<u>Personnel Safety</u>	<u>Reliability</u>	<u>Power Quality</u>
Voltage Control	▪ Back-feed	▪ Dependability	▪ Voltage
Protect Equip.	▪ Isolation / WP	▪ Security	▪ Sys vs DG hunt
Thermal/Overload	▪ Safe restoration	▪ Restoration	▪ Harmonics
Contingency Mgt			▪ Flicker
Load following			

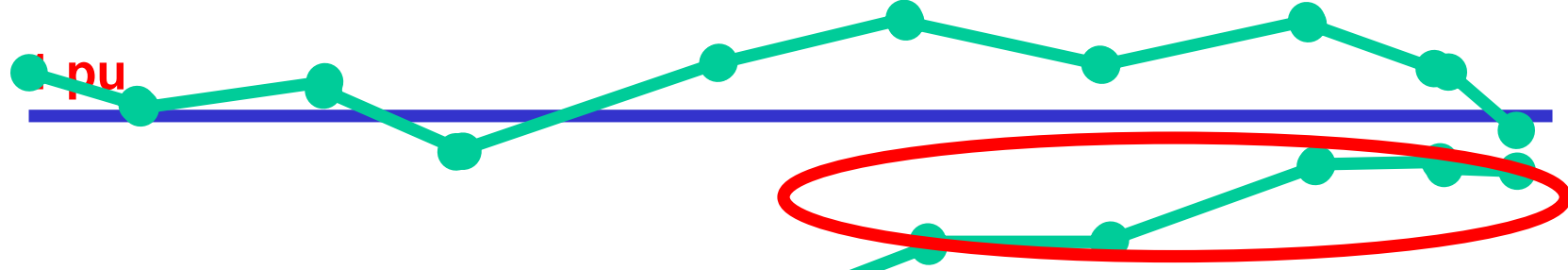
Mixing Generation With Load - Voltage Mgmt



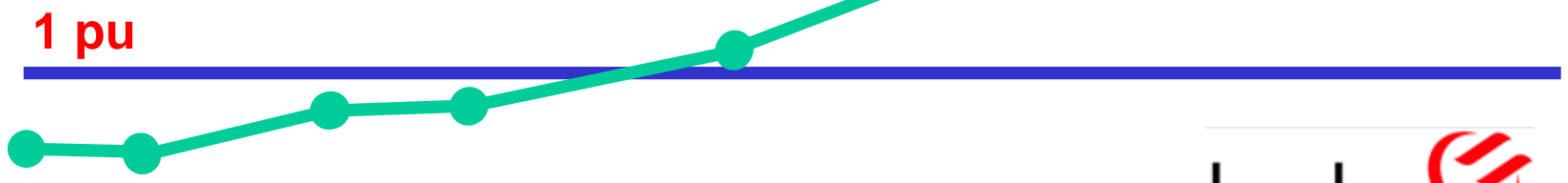
No Gen



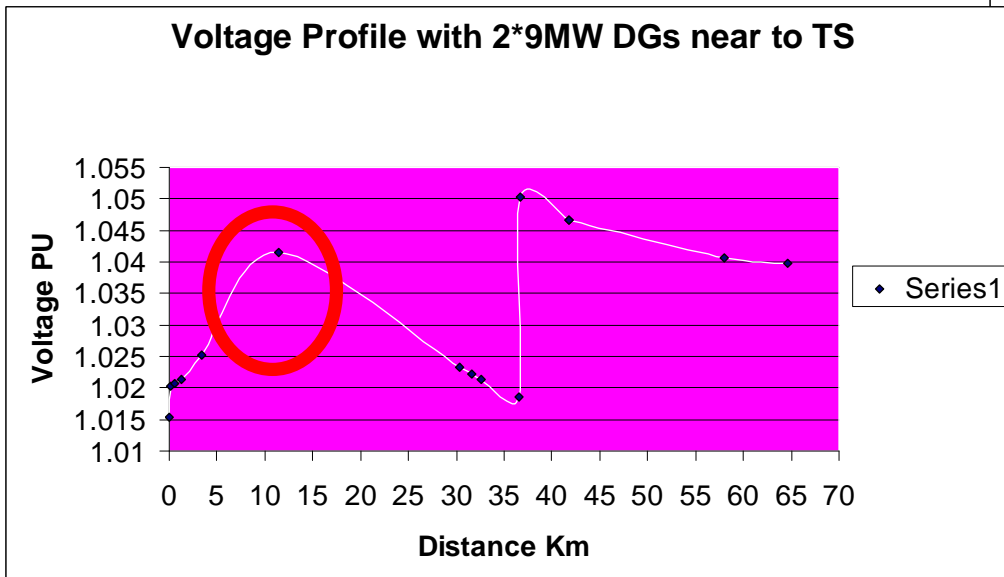
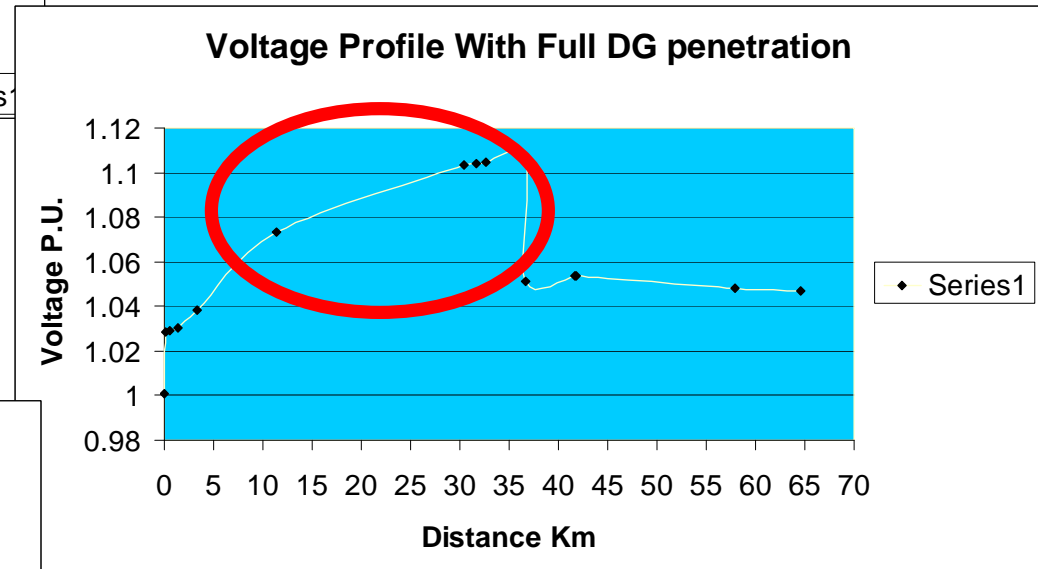
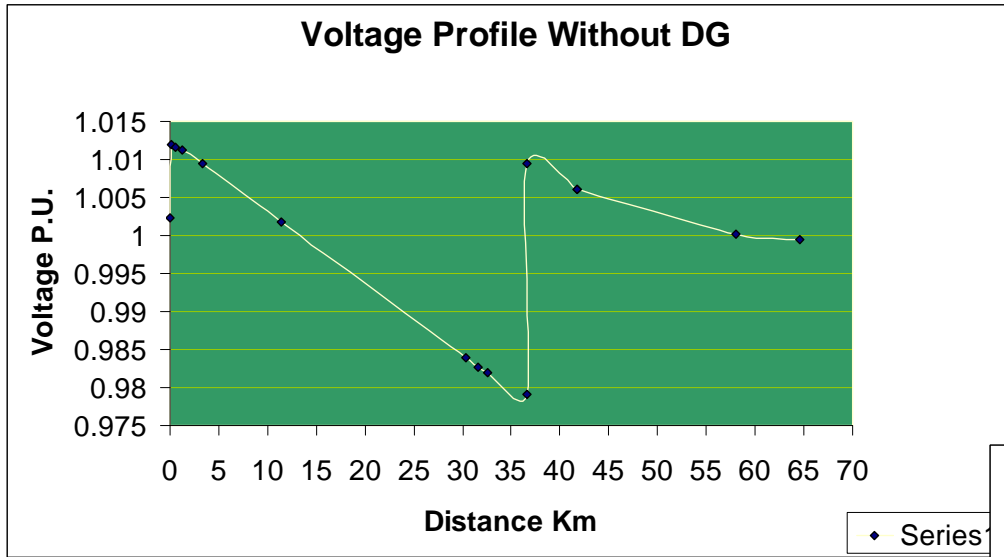
Max Gen @
Max Load



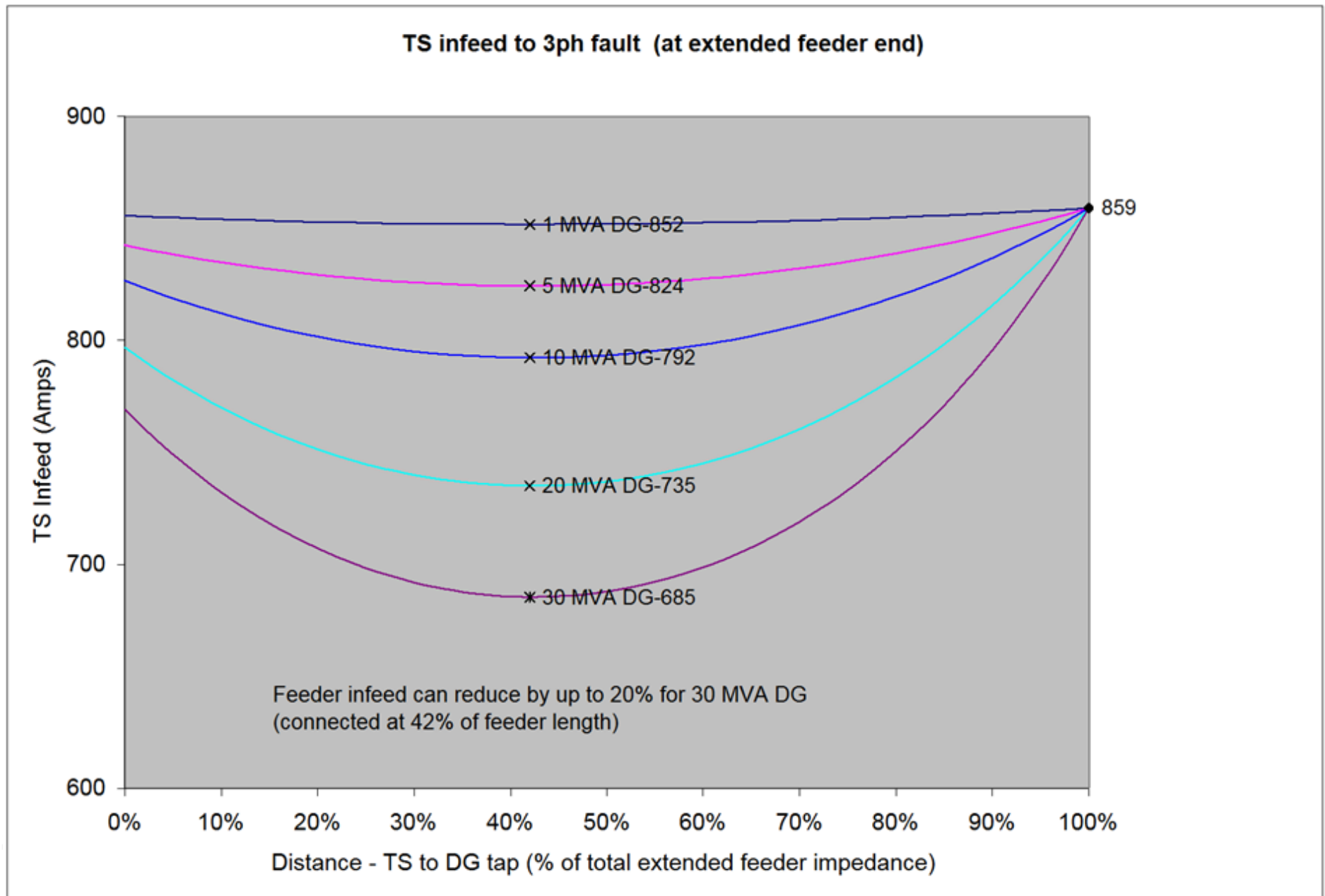
Max Gen @
Min Load



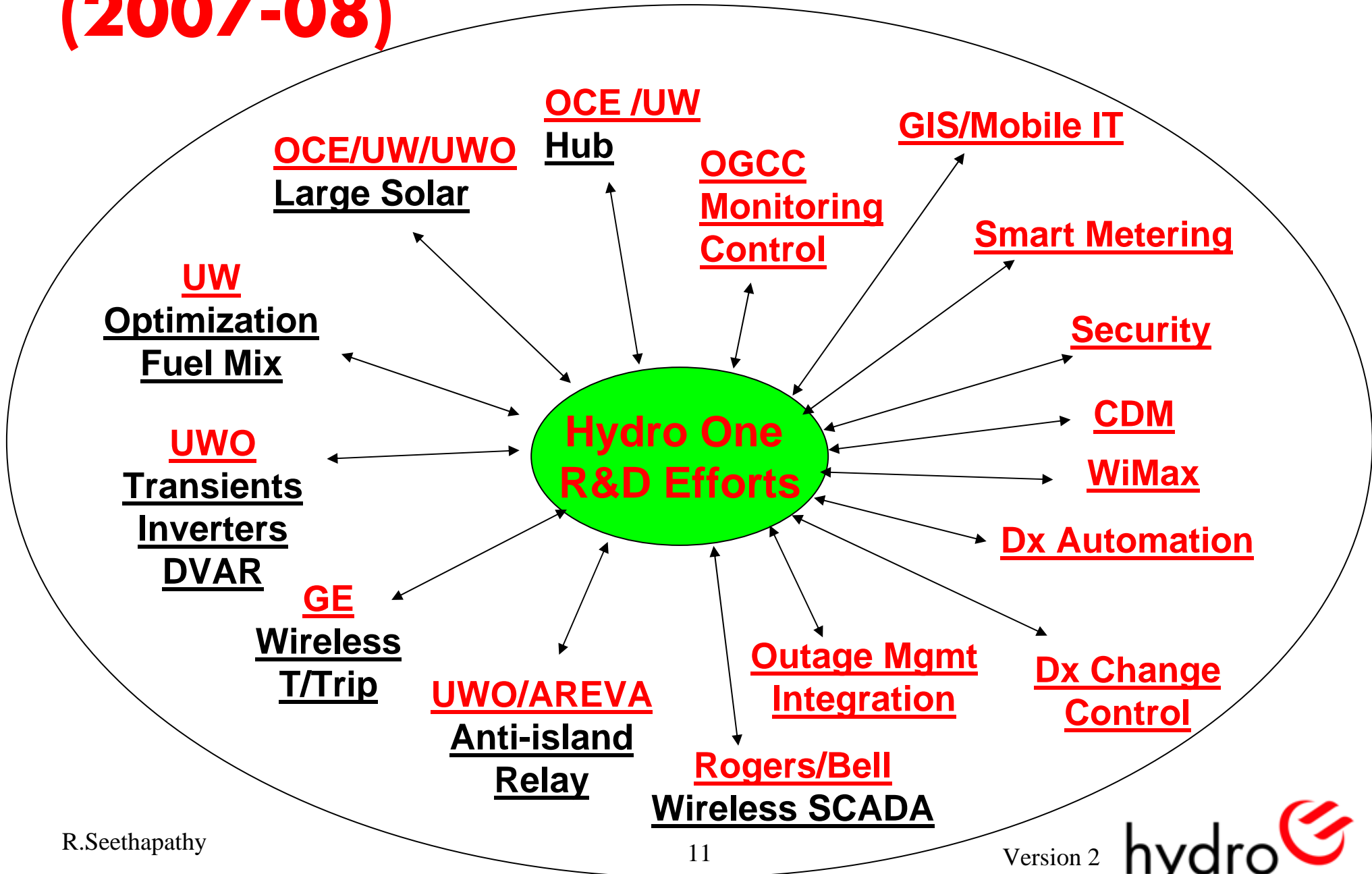
DG Influence on Feeder Voltage Profiles during light loads



Feeder Protections – DG Apparent Impedance on Long Feeders



Hydro One – Studies/Pilots (2007-08)



Rural Network Challenges

- **Radial system** – Little or no network backup capability
- **Load Factor** - Rural/Farm - Night load much lower than day high
- **Rural Feeders** – “long, weak, light”
 - Low stiffness, low short circuit, poor voltage control; 50% 1-Ph
- **Technical Limits** - Complex technical limits relative to Urban Dx
- **Model & Tools** - Current tools do not have dynamic DG models

Rural Networks are not ideal for high DG penetration

- **Future Challenges**
 - Increased investment to “shore” up the weak network
 - Poor power quality – voltage management

Planning Issues

- **Network optimization**

- Location, DG size, Fuel Mix, Load Displacement
- Line Loss Reduction
- Not impede ability to perform load transfers
- Otherwise – collect DG power through enabler lines to Tx directly

All DGs do not provide same value to the network

- **Future Challenges**

- Mismatch due to load reductions; DGs have firm contract
- Restricted ability to perform load transfers with DGs
- Possible curtailment of DGs based on load levels

Operations Issues

- **Visibility to Dx network elements**
 - Little or no visibility to network elements except at stations
 - Nodal voltage management
 - Power Quality monitoring
 - Wide daily fluctuations in power factor based on gen-load balance
 - Dynamic management of real-time DG operations

Need investments in Dx Monitoring & Control

- **Future Challenges as DG Penetration increases**
 - LDC has no DG output regulating authority
 - Need DVAR support to manage DG dynamics/transients

Tx-Dx Coupling

- **Transmission Constraints**
 - Back-feed into Tx (likely 27 TS will backfeed)
 - VAR support for DGs
- **Tx/Dx Code overlap**
 - If DGs impact Tx, then both DSC & TSC apply
 - DSC and TSC - different in “socialization” of network costs

Build Tx enabler lines for High DG cluster areas
- **Future Challenges**
 - Further Tx-Dx integration as DG penetration increases in Dx
 - All Tx “stiffness” are not same; Regional impact on Dx/DGs
 - Tx ancillary enhancements to support/manage Dx needs

DG Management

- **Supply Reliability (Firm Power vs Energy)**
 - Intermittent power, possible tandem variability (Wind, Solar)
 - No local backup i.e. CHP or storage
 - Control issues:
 - Non dispatched with little view from the system operator
 - DGs not manned 24/7

Need storage devices to smooth intermittent energy

- **Future Challenges as DG penetration increases**
 - DG management & Regulation Policy/Authority
 - IESO, LDC, Other ??
 - Local Dx based criteria for DG control
 - Also weather related control support
 - Need a DG control center for Ontario

Enabling DGs - Food for Thought

- **DG size, Location, Fuel Mix - important to Dx architecture**
 - Leverage wires investment - Maximize overall DG capacity factor
 - Emphasize load displacement over pure generation
 - Invest in telecom and electrical storage devices
- **DG Management & Regulation Policy/Authority**
 - IESO, LDC, Other ??
 - Local Dx based criteria for DG control
 - Need a DG control center for Ontario
- **Other**
 - Storage – whose tool is it – Generator or LDC or both?
 - Local Dx based criteria for DG control
 - Need a DG control center for Ontario
 - Need VAR support from Tx

THANK YOU!