An Introduction to Distributed Generation (DG) Applications

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Meet your panelists

Cummins presenters:

Scott Miller
Product Manager
Cummins Inc.

Dave Matuseski
Customer Engineering Director
Cummins Inc.

Cummins facilitator:

Michael Sanford
Technical Marketing Specialist
Cummins Inc.

Your local Cummins contacts:

- Western Canada: Ian Lindquist (ian.lindquist@cummins.com), Western Canada Region
- Eastern Canada: Melvin Nicholas (melvin.nichols@cummins.com), Eastern Canada Region
- AZ, ID, NM: Carl Knapp (carl.knapp@cummins.com), Rocky Mountain Region
- CO, MT, ND, UT, WY: Chris Scott (chris.scott@cummins.com), Rocky Mountain Region
- Northern IL, IA: John Kilinskis (john.a.kilinskis@cummins.com), Central Region
- UP of MI, MN, East ND, WI: Michael Munson (michael.s.munson@cummins.com), Central Region
- NE, SD, West MO, KS: Earnest Glaser (earnest.a.glaser@cummins.com), Central Region
- TX, OK, AR, LA, MS, AL, Western TN: Scott Thomas (m.scott.thomas@cummins.com), Gulf Region
- FL, GA, NC, SC, Eastern TN: Robert Kelly (robert.kelly@cummins.com), South Region
- NY, NJ, CT, PA, MD: Charles Attisani (charles.attisani@cummins.com), East Region
- CA, HI: Brian E Pumphrey (brian.pumphrey@cummins.com), Pacific Region
- WA, OR, AK: Tom Tomlinson (tom.tomlinson@cummins.com), Pacific Region
- For other states and territories, email powergenchannel@cummins.com or visit http://power.cummins.com/sales-service-locator
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Course Objectives

An Introduction to Distributed Generation (DG) Applications

The evolution of the electricity markets has changed….Distributed Generation is a broad category and although there are some more apparent applications of the concept; some applications may not be top of mind when customers are considering their approach to an energy strategy or inquiring about on-site generation.

This course will provide an approach to categorizing these distributed generation (DG) uses and explain a few of these opportunities in greater detail.

After completing this course, participants will be able to:

• Describe energy ecosystem trends and the needs driving the evolution of DG
• Identify the categories of DG applications (Use Cases) and components of the system
• Define possible DG approaches to customer energy needs.
What is “Distributed Generation?”
The Evolution of Power Markets

The traditional top-down flow of electricity has been experiencing disruptive forces over the last several years.
Power Markets Evolution

The traditional top-down flow of electricity has been experiencing disruptive forces over the last several years.

De-carbonization driving regs & policy
Electricity Generation in the US

Sources of U.S. electricity generation, 2018

- Total = 4.18 trillion kilowatthours
- renewables 17%
- petroleum 1%
- nuclear 19%
- coal 27%
- natural gas 35%
- hydro 7%
- wind 6%
- solar 1.6%
- biomass 1.5%
- geothermal 0.4%

Note: Electricity generation from utility-scale facilities.
Electricity Generation in the US

Sources of U.S. electricity generation, 2018

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Note: Electricity generation from utility-scale facilities.
Electricity Generation in the US

U.S. electricity generation by major energy source, 1950-2018

- **2018**
  - petroleum and other: 44 billion kilowatthours
  - renewables: 713 billion kilowatthours
  - nuclear: 807 billion kilowatthours
  - natural gas: 1,468 billion kilowatthours
  - coal: 1,146 billion kilowatthours

Note: Electricity generation from utility-scale facilities.
Power Markets Evolution

The traditional top-down flow of electricity has been experiencing disruptive forces over the last several years.

De-carbonization driving regs & policy

Technology availability & cost decline
Power Markets Evolution

Solar (PV) Cost Decline

Source: IRENA.org
Power Markets Evolution

The traditional top-down flow of electricity has been experiencing disruptive forces over the last several years.

- De-carbonization driving regs & policy
- Technology availability & cost decline
- Customer expectations / demand

Power markets of the past: A top-down flow from supply to demand.
Power Markets Evolution

The traditional top-down flow of electricity has been experiencing disruptive forces over the last several years.

- De-carbonization driving regs & policy
- Technology availability & cost decline
- Customer expectations / demand

Power markets of the past
A TOP-DOWN FLOW FROM SUPPLY TO DEMAND

- Central Generation
- Transmission
- Distribution
- Utility Meter
- Customer Load

Utilities deferring large transmission investments
Power Markets Evolution

The traditional top-down flow of electricity has been experiencing disruptive forces over the last several years.

- **De-carbonization** driving regs & policy
- **Technology availability & cost decline**
- **Customer expectations / demand**

Power markets of the past
A TOP-DOWN FLOW FROM SUPPLY TO DEMAND

- **Utilities deferring large transmission investments**
- **De-Regulation of markets**
Power Markets Evolution
Regulated and De-Regulated Markets

**Wholesale Market** – Sale of electricity among utilities and electricity traders

**Retail Market** – Sale of electricity to the end consumer
Power Markets Evolution
Regulated and De-Regulated Markets

-- Sale of electricity among utilities and electricity traders
Retail Market – Sale of electricity to the end consumer
Power Markets Today

- Central Generation
- Transmission
- Distribution
- Utility Meter
- Customer Load
Power Markets Today

Defining the Customers
Power Markets Today
Defining the Customers
Power Markets Today

Defining the Customers
Power Markets Today
Defining the Customers

Power market today
 BI-DIRECTIONAL ENERGY NETWORKS
 WITH ACTORS ACROSS THE VALUE
 CHAIN SHAPING PLANNING,
 INVESTMENT AND OPERATION

FRONT OF METER

CENTRAL GENERATION → TRANSMISSION → DISTRIBUTION → UTILITY METER → CUSTOMER LOAD
Power Markets Today
Defining the Customers

Alternatives to major transmission infrastructure are enabling power providers to leverage power generation closer to the demand.
Energy consumers have the option to be in control of the source and cost of their power.
Customers with weak or no grid infrastructure have options to produce their own reliable power.
Power Markets Today

Customer Profiles

Power Providers
- Utilities
Power Markets Today

Customer Profiles

Power Providers
- Utilities

Power Consumers
- Larger C&I
- Hospitals
- Hotels
- Data Centers
- Also residential scale
Power Markets Today

Customer Profiles

Power Providers
- Utilities

Power Consumers
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- Hospitals
- Hotels
- Data Centers
- Also residential scale

Producers / Consumers
- Islands
- Rural growth areas
- Mining Operations
Power Markets Today

Customer Profiles

VARYING PURCHASE MOTIVATORS
- Capital Expense
- Operating Expense
- Resiliency / Reliability
- Carbon Footprint / Renewable Integration
- Regulatory Pressures
Concept Check

The evolution of power markets is all driven by the transition from coal and nuclear central generation.

a) True
b) False
The evolution of power markets is all driven by the transition from coal and nuclear central generation.

a) True
b) False
Power Markets Evolution

The traditional top-down flow of electricity has been experiencing disruptive forces over the last several years.

- **De-carbonization** driving regs & policy
- **Technology** availability & cost decline
- **Customer expectations / demand**

*Power markets of the past*
*A TOP-DOWN FLOW FROM SUPPLY TO DEMAND*

- Central Generation
- Transmission
- Distribution
- Utility Meter
- Customer Load

*Utilities deferring large transmission investments*
*De-Regulation of markets*
Power Markets Today

Customer Use Cases

How is DG used by these customers?
Power Markets Today

Customer Use Cases

GRID FIRMING

- Frequency and Voltage Regulation
- Balancing the intermittency of Renewable Sources
- Additional Capacity
Power Markets Today
Customer Use Cases

ENERGY MANAGEMENT

- Demand Response
- Balancing the intermittency of Renewable Sources
- Leverage multiple right-sized assets in a system (microgrid)
- Energy Resiliency
Power Markets Today

Customer Use Cases

Customers are billed for their energy in numerous ways, sometimes a mix of different charges. Understanding the rate structure of the utility bill can uncover opportunities for cost savings through self-generation.

<table>
<thead>
<tr>
<th>Total Amount Due</th>
<th>$7,707.49</th>
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</thead>
<tbody>
<tr>
<td><strong>Total Charges for Electricity</strong></td>
<td></td>
</tr>
<tr>
<td>Supplier</td>
<td></td>
</tr>
<tr>
<td>Generation Service Charge</td>
<td>34400 kWh X 0.2473</td>
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<tr>
<td>Subtotal Supplier Services</td>
<td>$4,290.71</td>
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<tr>
<td><strong>Delivery (Rate B2-LARGE GENERAL-SECONDARY)</strong></td>
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<tr>
<td>Customer Charge</td>
<td>$18.00</td>
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<tr>
<td>Distribution Demand Charge</td>
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<tr>
<td>1st 10</td>
<td>No Charge</td>
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<tr>
<td>Over 10</td>
<td>108.4 KW X 9.65</td>
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<tr>
<td>Transmission Demand Charge</td>
<td></td>
</tr>
<tr>
<td>1st 10</td>
<td>No Charge</td>
</tr>
<tr>
<td>Over 10</td>
<td>108.4 KW X 7.54</td>
</tr>
<tr>
<td>Distribution Charge</td>
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</tr>
<tr>
<td>1st 2000</td>
<td>2000 kWh X 0.03136</td>
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<tr>
<td>Next 17760</td>
<td>17760 kWh X 0.02619</td>
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<tr>
<td>Over 19760</td>
<td>14640 kWh X 0.02428</td>
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<td>Transition Charge</td>
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<td>Revenue Decoupling Charge</td>
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<td>34400 kWh X -0.0041</td>
<td>-$14.10</td>
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<tr>
<td>Distributed Solar Charge</td>
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<tr>
<td>34400 kWh X 0.0063</td>
<td>$21.67</td>
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<tr>
<td>Renewable Energy Charge</td>
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<tr>
<td>34400 kWh X 0.0050</td>
<td>$17.20</td>
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<tr>
<td>Energy Efficiency</td>
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</tr>
<tr>
<td>34400 kWh X 0.0108</td>
<td>$377.02</td>
</tr>
<tr>
<td>Subtotal Delivery Services</td>
<td>$3,148.61</td>
</tr>
</tbody>
</table>
Power Markets Today

Customer Use Cases

GRID FIRMING

- Frequency and Voltage Regulation
- Balancing the intermittency of Renewable Sources
- Additional Capacity

ENERGY MANAGEMENT

- Demand Response
- Balancing the intermittency of Renewable Sources
- Leverage multiple right-sized assets in a system (microgrid)
- Energy Resiliency
Multi-Asset Power System
Multi-Asset Power System
Multi-Asset Power System
Multi-Asset Power System
Multi-Asset Power System

Continuous Dispatchable Power
Multi-Asset Power System

Switchgear and Controls
Multi-Asset Power System

World Wide Connection
Power System Case Study

Johannesburg Solar Integration
Power System Case Study
Johannesburg Solar Integration

- Total annual PV output is estimated to be 1,065 MWH
- This results in 1,081 metric tons of reduction in greenhouse gas per year
Help customers understand their energy system needs by asking leading questions...

Many customers might not come to you specifically looking for a distributed generation system.

These customers may have…

• reliable grid power
• no expertise to figure out the cost/benefit of self generation
• initial interest in backup generation only
Distributed Generation Applications
Customer Application Considerations

Site Location
Are they in a deregulated Utility Market?

Monetization opportunities
Can they monetize their onsite power generation source now or in the future?

Renewable Integration
Do they have (or want to have) renewables as part of their energy system?

Sustainability Drivers
Are there company carbon or sustainability goals in play?

Financing Options
Did you know that there are investors willing to carry the capital costs of the onsite generation?
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Distributed Generation Applications

Customer Application Considerations

Site Location

Monetization opportunities

Renewable Integration

Facilities & Operations
Improve eco-efficiency at all Cummins and JV sites. Our goals are to:

- Reduce energy use intensity by 25% and greenhouse gas emissions 27%
- Reduce direct water use intensity by 33% and achieve water neutrality at 15 sites
- Increase recycling rate to 95% and achieve zero disposal at 30 sites

Sustainability Drivers
Are there company carbon or sustainability goals in play?

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Are there company carbon or sustainability goals in play?

Financing Options
Did you know that there are investors willing to carry the capital costs of the onsite generation?
Concept Check

Customers need to have an environmental sustainability goal in order to leverage a distributed generation system.

a) TRUE
b) FALSE
Concept Check

Customers need to have an environmental sustainability goal in order to leverage a distributed generation system.

a) TRUE
b) FALSE
Course Summary

An Introduction to Distributed Generation (DG) Applications
• Describe energy ecosystem trends and the needs driving the evolution of DG
• Identify the categories of DG applications (Use Cases) and components of the system
• Define possible DG approaches to customer energy needs.
Additional Resources

Cummins White Papers

- The Latest Evolution Of Distributed Energy Resources: Opportunity For Business Within The PJM
- An introduction to the Smart Grid
- Utilizing Flare Gas to Generate Power for the Oil and Gas Sector
- Evaluating cogeneration for your facility: A look at the potential energy-efficiency, economic and environmental benefits

Cummins On-Demand Webinars

- Functions and Features of Generator Set Control Based Paralleling
- Specifying Gaseous Generator Sets
- Paralleling Power System Design Considerations and System Level Control
Q&A

Type your questions, comments, feedback in the WebEx Q&A box. We will get to as many questions as we can. 

We will publish consolidated FAQ along with presentation and webinar recording on powersuite.cummins.com

Your local Cummins contacts:

- Western Canada: Ian Lindquist (ian.Lindquist@cummins.com), Western Canada Region
- Eastern Canada: Melvin Nicholas (melvin.nichols@cummins.com), Eastern Canada Region
- AZ, ID, NM, NV: Carl Knapp (carl.knapp@cummins.com), Rocky Mountain Region
- CO, MT, ND, UT, WY: Chris Scott (chris.scott@cummins.com), Rocky Mountain Region
- Northern IL, IA: John Kilinskis (john.a.kilinskis@cummins.com), Central Region
- UP of MI, MN, East ND, WI: Michael Munson (michael.s.munson@cummins.com), Central Region
- NB, SD, West MO, KS: Earnest Glaser (earnest.a.glaser@cummins.com), Central Region
- South IL, East MO: Jeff Yates (Jeffery.yates@cummins.com), Central Region
- TX: Scott Thomas (m.scott.thomas@cummins.com), Gulf Region
- FL, GA, SC, NC and Eastern TN: Robert Kelly (robert.kelly@cummins.com), South Region
- NY, NJ, CT, PA, MD: Charles Attisani (charles.attisani@cummins.com), East Region
- CA, HI: Brian E Pumphrey (brian.Pumphrey@cummins.com), Pacific Region
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- For other states and territories, email powegenchannel@cummins.com or visit http://power.cummins.com/sales-service-locator
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Cummins Distributed Generation Informational Contact:
DGinfo@cummins.com

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• February 2020 – Systems Design Advantages of a Right-Sized Automatic Transfer Switch

Please contact Mohammed Gulam if you have any questions related to the PowerHour webinar (mohammed.gulam@cummins.com)