



Managing Distributed Energy Resources

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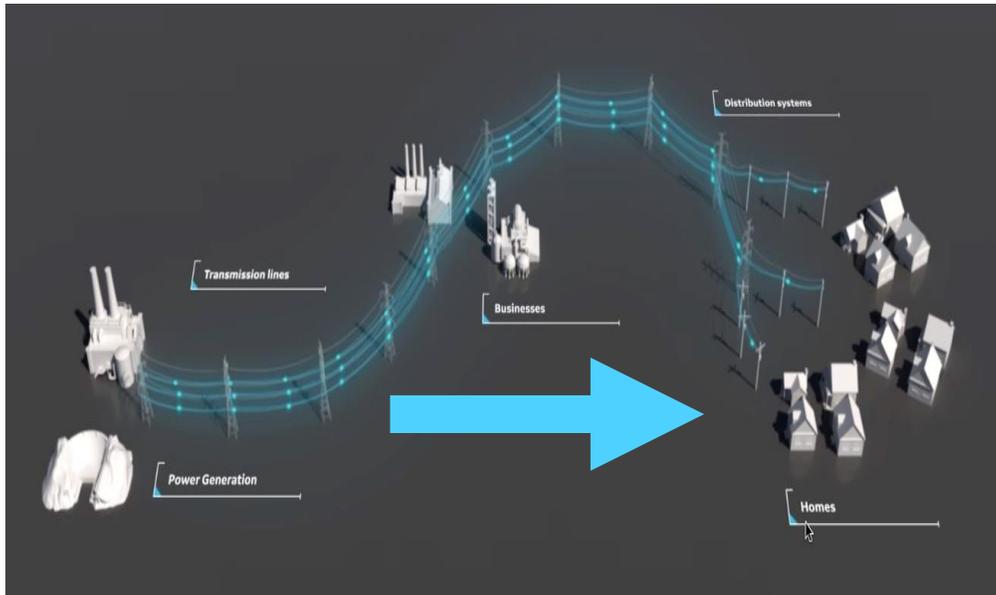
May 20, 2019

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Distributed Energy Resources

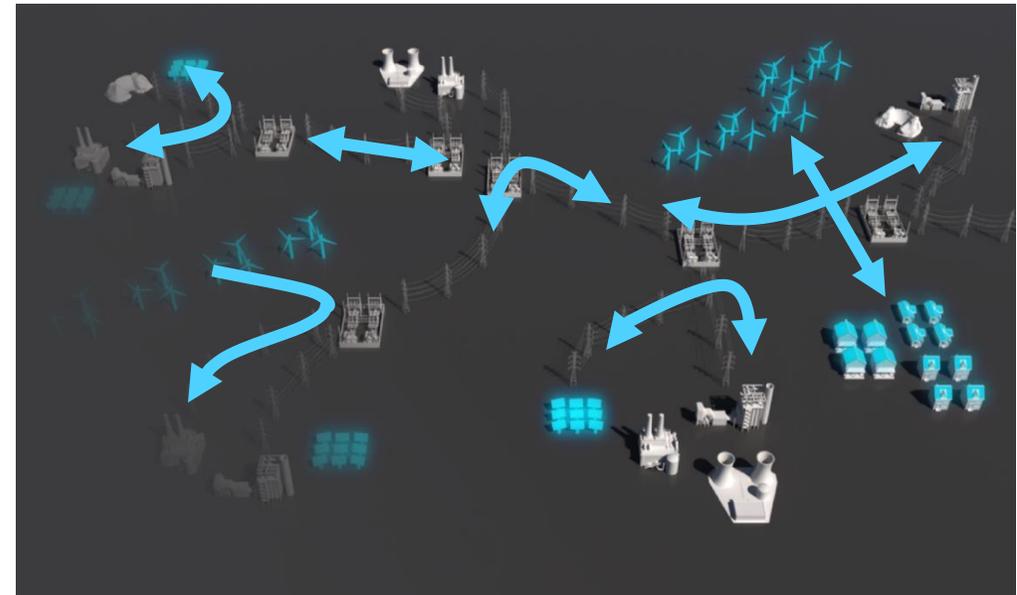
The Disruption of the Grid

Traditional Grids: One-way Flow



- Centralized generation
- Passive Customer consumes
- Only a portion of grid remotely managed: HV & MV
- Electrons flow down, revenue flows up

The DER Disruption: Multi-directional Exchanges



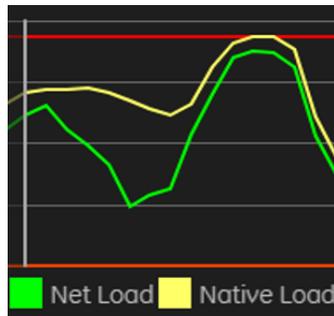
- Distributed generation, storage & flexible demand
- “Prosumer” generates, stores & steers consumption
- Need remote management of all wires length: Down to LV
- Microgrid/P2P threatens dependency on electric utility

Distributed Energy Resources (DERs)

Are your teams/tools/processes ready for New Paradigms?

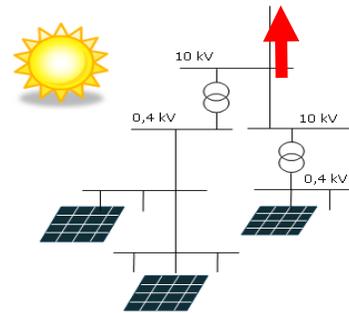
Awareness: what is the « load »?

Now need to be precise:
native consumption, « hidden » load,
or net load?

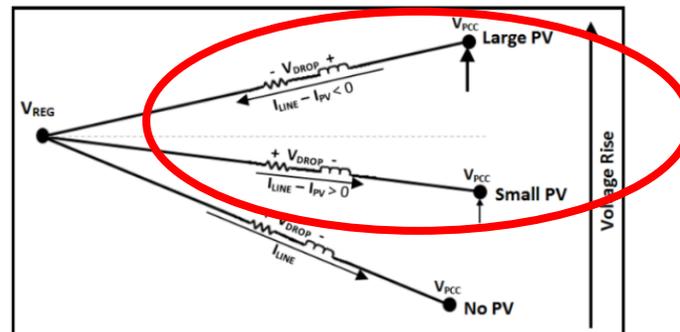


Powerflow: « Backfeeds »

Energy flow going up the Voltage levels
instead of going down

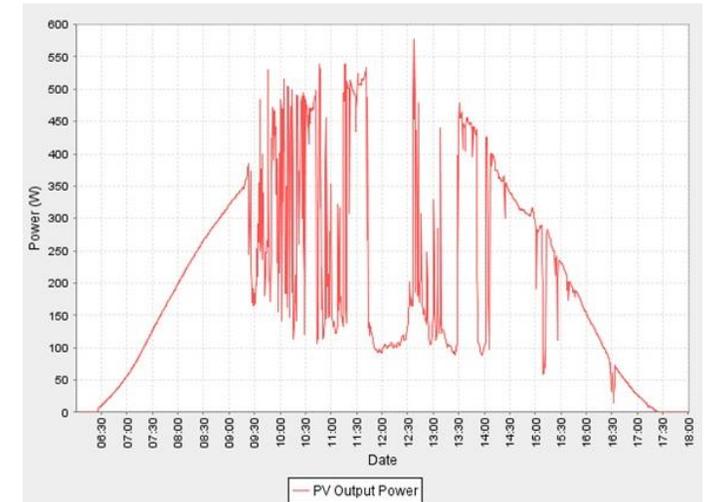


Voltage increasing (instead of decreasing)
alongside a feeder



X

Dynamics: Intermittency



Grid Operations before DERs

GIS - Planning



Grid Asset Manager/Planner

- Managing register of own Assets
- Accepting Y/N new load connections
- Planning investment (load growth scenario, APM strategy, etc.)

ADMS



D-grid Operator

- Operating the D-grid in Real-time

- Substation Automation. Protection, interlock



EMS



Look-Ahead

T-grid Operator

- Operating the T-grid in Real-time
- Operating the T-grid in Look-ahead
- Scheduling gen via Markets



Real-time

MMS



Market Operator

- Running the market for T

GMS



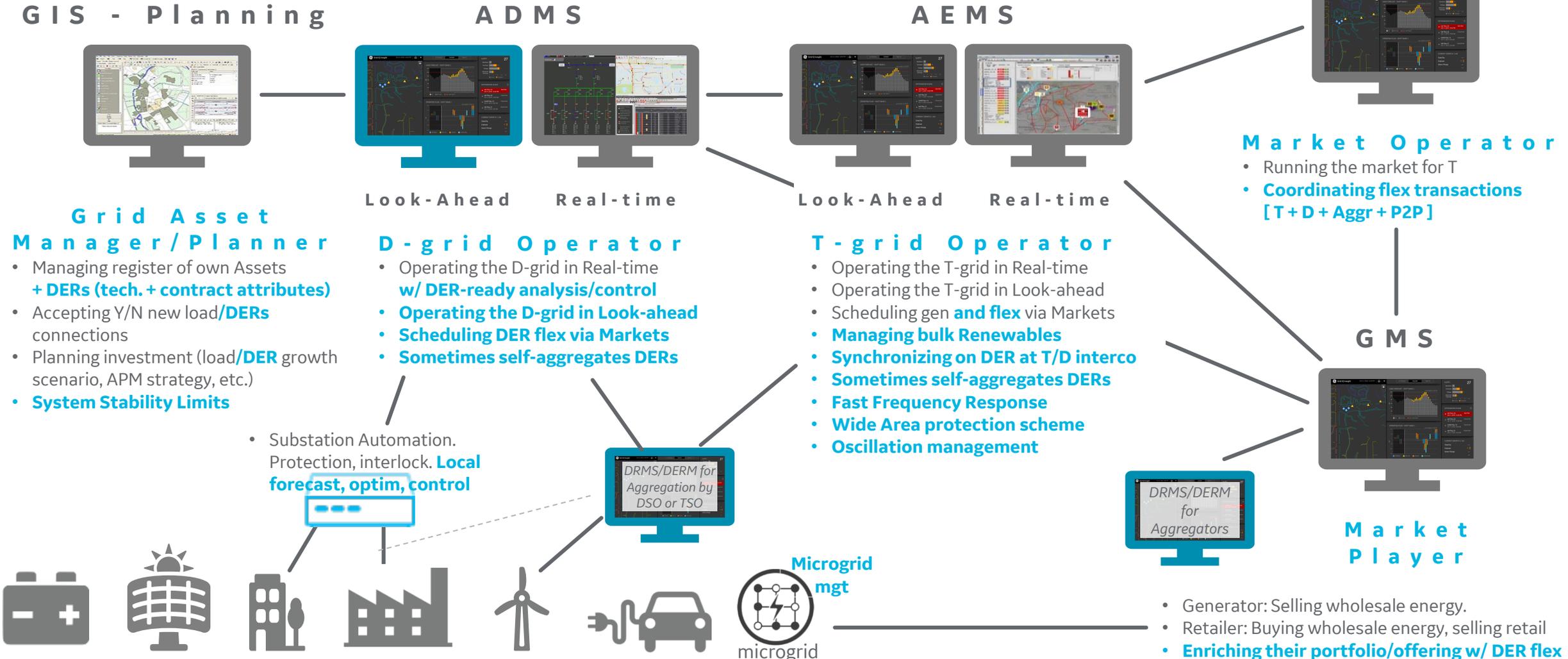
Market Player

- Generator: Selling wholesale energy.
- Retailer: Buying wholesale energy, selling retail



GE DIGITAL ENERGY

End-to-End DER Orchestration



GIS - Planning



Grid Asset Manager/Planner

- Managing register of own Assets + DERs (tech. + contract attributes)
- Accepting Y/N new load/DERs connections
- Planning investment (load/DER growth scenario, APM strategy, etc.)
- **System Stability Limits**

ADMS



Look-Ahead



Real-time

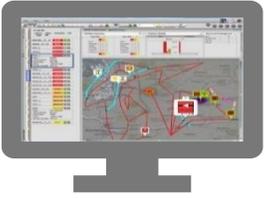
D-grid Operator

- Operating the D-grid in Real-time w/ DER-ready analysis/control
- **Operating the D-grid in Look-ahead**
- **Scheduling DER flex via Markets**
- **Sometimes self-aggregates DERs**

AEMS



Look-Ahead



Real-time

T-grid Operator

- Operating the T-grid in Real-time
- Operating the T-grid in Look-ahead
- Scheduling gen and flex via Markets
- **Managing bulk Renewables**
- **Synchronizing on DER at T/D interco**
- **Sometimes self-aggregates DERs**
- **Fast Frequency Response**
- **Wide Area protection scheme**
- **Oscillation management**

MMS



Market Operator

- Running the market for T
- **Coordinating flex transactions [T+D+Aggr+P2P]**

GMS

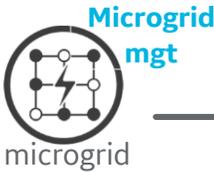


Market Player

- Generator: Selling wholesale energy.
- Retailer: Buying wholesale energy, selling retail
- **Enriching their portfolio/offering w/ DER flex**



Substation Automation. Protection, interlock. **Local forecast, optim, control**



DER Challenges & Solutions

End-to-end Product Capability

GE DER MGT SOLUTION = GIS+PLANNING+ADMS+EMS+MMS



DISTRIBUTED INTELLIGENCE

- What can we shouldn't we do on the edge?

OPTIMIZATION

- Which levers (DERs, others)? When?

FORECASTING & PLANNING

- What's at and behind the meter? What can I anticipate in the next hours?
- What more can I take where?

DER-AWARE GIS & ADMS

- Where are the DERs and how do they behave? Foundational.

Look-ahead Grid Operation – From Reactive to Predictive

Monitoring & Acting in Real-time is Not Enough Anymore – Need to Anticipate

ADMS or EMS



*Splitting their day between
managing today and
preparing for tomorrow*

Look-ahead Analysis – Principles

From Weather Forecast to Look-ahead Grid Reliability Study

What will the **weather** be like in the next 24 hours?



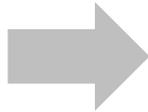
Weather Forecast
Weather History
Load History
Distributed Generation History

What will the **load and wind/PV generation** be like in the next 24 hours?



Load Forecast
Distributed Generation Forecast

Forecasting

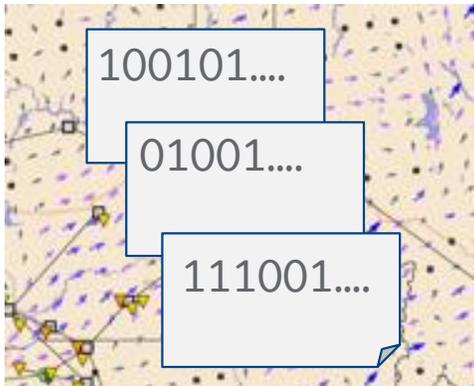


What will the **electrical flows** (W, VAr, V, Amps) be like in the next 24 hours?

Will I face violations?



Grid **Look-ahead Reliability Analysis**
(manually for one time slot in study-mode or automatically for a typical 24h look-ahead window)



DERM Experience

Active Network Management > Challenges of Renewable Generation Connection

Challenges

- Generators want to connect quickly



But

- Generators have highly variable output
- Stresses networks, risk of overloading/damaging assets

Solution: DSO offering Generators an alternative Connection scheme:

- Less connection delay
- Cheaper connection

Adaptive
Network
Management



vs

- Generators accept some curtailment when grid security requires it

Maximizing existing grid hosting capacity

Regulatory dependent (priority, compensation, reporting)

DERM > Why GE?

- **Experience delivering with Utilities pioneering DERs** (Hawaii, California, Ireland, Denmark, etc.) –both pilot and operational projects
- **Experience delivering on the full DER value chain** (DERM for DSOs, Renewables Management for TSOs, DRMS/DERM for aggregators, microgrids, DER integration grid planning, LV Management)
- **Best combination of Transmission and Distribution expertise, essential in DERM** where TSOs and DSOs need to collaborate, and where T level concepts migrate to D level (forecasting, look-ahead, scheduling, transactions/markets)
- **Modular Applications and Common Data layer strategy** -essential in DERM to address DER in all utility business processes and adapt to evolving regulatory regimes
- **Offerings and solid roadmap to manage DERs in an end-to-end fashion,** in and across GIS, planning, ADMS, EMS, MMS, at aggregator and microgrid level

GE booth #A0361

