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OVERVIEW - INNOVARI
Industry Veterans with a global viewpoint as your partner

Executive Team Experience

Innovari Activity around the world

- Over 100 employees
- Deployments in 9 countries
- Over 80,000 sites under management representing over 3,000 MW
ITPL Project Locations - India

Company:
- Innovari Technologies Private Limited (ITPL), a wholly owned subsidiary of Innovari NL BV established in Nov 2014 with its corporate office in Gurgaon, Haryana
- ITPL established Technology Centre in Bangalore to support entire Asia market

ITPL Highlights:
- Successfully completed following projects:
  - 1 MW Reliance Infra (Mumbai)
  - 1.5 MW CESC (Kolkata)
- Signed 5MW pilot implementation with BESCOM (Bengaluru) in April’16
- Signed scale implementation contracts with:
  - Reliance Infra (Mumbai) – 100 MW
  - Tata Power (Delhi) – 50 MW
We are helping utilities enable the future grid now – through the seamless integration of edge-of-grid resources.
OVERVIEW – INTERACTIVE ENERGY PLATFORM (IEP)
We are **transforming** the traditional grid ...
... into an interactive, intelligent system.
By enabling the grid’s edge, we solve some of the world’s biggest energy challenges.

- Reduce Grid Losses, Fuel, and Carbon Emissions
- Solar and Wind Balance with Distributed Energy Resources (DER)
- Automated Demand Side Management (ADSM)
- Distributed Generation Integration
- Microgrid integration
- Storage and Grid Power Balancing
- EV Charge
- Reduce Peaker and T&D Upgrades
A Platform To Help Now And Enable The Future

INTERACTIVE ENERGY PLATFORM

- Manage DER with Building or Feeder loads
- Dispatchable Standby Generators
- Enable edge of grid technologies
- Manage PV Intermittency
- Control Energy Storage – optimize phase balance and feeder efficiency, and improves customer reliability

Utility has greater visibility deep into the grid, with advanced monitoring and analytics:
- Volt / VAR,
- Power Quality,
- DG & PV integration/monitoring
- Harmonics
- Digital Fault Recording
- Distribution level PMU

- 2-way, verifiable, closed loop control.
- Installed behind the meter
- Utility branded, owned and controlled
- Integrate with Building Management Systems (BacNet, Modbus, etc.)
- Direct control of facility lighting and HVAC loads
- Last Gasp Outage Notification
The Interactive Energy Platform™

Utility
Schedule, dispatch and monitor Events via a secure, real-time portal or integrated with your EMS, DMS, OMS or other control system.

Nexus: Utility benefits
Proprietary algorithms applied to aggregate capacity and provide real-time verification to the Utility.

Energy Agent™
Installed at Customer Sites. Provide additional controls for end-use customer. Tamper-resistant.

End-Use Customer
Customer Site Agreement with opt-out and lighting and HVAC scheduling capabilities.

Nexus: Customer benefits
Monitoring and control ensures guaranteed End-Use Customer’s building environment.

Grid Agent™
Advanced analytics for grid optimization.

DER Agent™
Edge-grid technologies.
Our platform is enabled by our **Energy Agent**, **Grid Agent**, and **Distributed Energy Resource (DER) Agent**.
Modest improvements in load management results in large improvements in the system utilization of all existing assets (generation, transmission, and distribution).

- Defers or eliminates costly T&D upgrades (feeder reconductors, substation retrofits, etc.).
- Helps improve total system reliability.
- Inclusion of load management is in line with regulatory requirements for DSM in IRP (where applicable).

Our Mission: Improving Overall System Utilization

Load Duration Curve Example

System Utilization Improvement

Increase of 19% in system utilization from 43% to 62% for 5% of hours; (438 hours)

Increase of 15% in system utilization from 43% to 58% for 2.5% of hours; (219 hours)

Traditional DR (40-60 hours)
A Business Model That Works For All Involved

Innovari’s Interactive Energy Platform™ connects utilities, their customers, and their communities to improve how the world uses energy.
We’re improving how the world uses energy.

We are the utility industry’s CAPACITY FOR CHANGE™

[Images of awards and recognitions]
CHALLENGES IN INTEGRATING AND BALANCING INTERMITTENT RENEWABLES (SOLAR)
Solar Impact on the Grid

- California CAISO analysis of Solar PV penetration creating the “Duck Curve”
- High Solar PV generation mid-day forces other generation to ramp-down; and when the solar subsides, then forces rapid generation ramp-up to serve the evening peak
- Hawaii is already seeing a high penetration of Solar PV significantly impacting grid operations, causing back-feed of energy at substations, seen above as the “Nessie Curve”

The Peak to Off Peak demand ratio is further worsened, system planners and operators have a significant challenge to manage
Avoid Turning OFF Solar PV

- Balancing to the intermittent changes of generation does not mean “turning off” the Solar PV arrays
  - The goal is to monitor, forecast, and respond to the variations in solar generation to optimize the use of this renewable resource
- Example: a building with Solar PV arrays on the roof and existing loads within the building
  - When sunny, the PV generation goes to first serve the building loads and the remainder goes to the grid
  - If PV generation suddenly decreases, as with the passage of cloud cover, the best response is to reduce loads immediately within the building – such as air conditioning

The IEP matches the demand to the generation and reduces the impact on the Grid
Control of DER
- Control the solar generation units entering the grid
- Control/alter the sequence of entry/exit from the grid based on certain characterizations

Control of Load
- “Sink Loads” - to bury excess power (Eg pre-cooling)
- “Controllable Loads” - to handle ramp up/ramp down of capacity

Creation of a real-time resource to handle the ramp up/down of capacity in a fully automated fashion to effectively keep the rate of change of grid-capacity within acceptable limits by altering BOTH supply and demand
Use Cases

1. Monitoring of distributed Solar PV arrays and reporting generation output for inclusion in NREL analysis by region
2. Monitor Solar PV output and coordinate the operation of loads within a common building (balancing on a site)
3. Coordinate the operation of loads on neighboring buildings in response to Solar output signals from an adjacent Solar PV array (balancing at the Feeder or Substation level)
4. Coordinate the operation of loads over a large array of buildings to coincide with a system-level solar generation forecast or signal as provided by NREL (balancing at the System level)
5. Where applicable, and multiple Solar PV arrays exist on one site, investigate the sequence of operations between multiple inverters to reduce the impact of sudden power changes due to cloud cover or other intermittency
Situation #1: Solar Production starts in Morning

IEP controls a set of loads and certain set of solar installations on a feeder or substation.

IEP monitors the state of these solar installations and will ramp their input into the grid and also start turning on controllable loads as and when output from solar peaks and in such a manner that the rate of change of solar addition could be met through demand and in the event of loss of the array, help buffer the effects of the loss of these solar resources.
Situation #2: Onset of cloud cover

IEP constantly monitors the output of set of solar installations.

When an unexpected decline in output is detected, IEP determines the extent of lost load from the solar arrays from the cloud cover and can immediately begin to manage controllable loads in a manner to help mute or control the loss of output. And just as importantly, the IEP can control the ramp of these resources coming back onto the grid.
Situation #3: Sudden boost in solar production - cloud cover gone

IEP has logged the net loss of many solar arrays in a specific area and recognizes it is likely they will all come back on in short order.

IEP can stagger the arrays coming back on instead of letting them turn on simultaneously.

IEP can activate “sink” loads to the extent required to help balance these loads if required.
CASE STUDY : RELIANCE
Reliance Project Summary

Project Overview

- **Objectives:**
  - Examine the Technical, Commercial & Regulatory feasibility of ADSM in India
  - Assess the potential of full scale deployment in RInfra license area

- **Capacity:** 1 MW (ADSM and DG)
  - Participants: Raghuleela Mall, ITC Hotel, Blue Dart, Marriott Hotel, & Reliance (2 own sites & Mobile DG)
  - Controllable Loads: Chillers, Lighting & DG
  - IEP used for > 200 hours

- **Uniqueness:** 1st utility in India to implement ADSM/DR

Benefits to Reliance:
- Avoid peak power purchase
- Reduce losses
- Defefer Feeder and Substation upgrades
- Improve System utilization
- Enable DG sets to feed power to grid

- Signed expansion contract of 100 MW in 2016
Office Building Test Event (Sample)

Meter data

Example TSTAT
First floor, Borivali

Set-point manually changed and reset mid-event by security guard. Loss of dispatched load monitored in RTCM

IES site level Real Time Capacity Monitoring (RTCM)
R-Infra Pilot Results

~250 Events called in last 20 Months

Reflects RInfra’s confidence

IEP used for >200 Hrs in last 20 Months

The duration of events range from 30 mins to 240 Mins
CASE STUDY : CESC
Objectives of the Pilot

- To determine Utility's end-use customers' willingness to participate, clearly understand the installation process, display advanced analytics, reduce load on specific feeders and test the functionality of the System which can:
  - Dynamically manage load in commercial & industrial facilities,
  - Obtain advanced analytics to help optimize the performance of Buyer's grid,
  - Enable integration with other Distributed Energy Resource ("DER") options including solar, battery storage, & generators
  - Helping to strengthen Utility's relationship with their end-use customers
C ESC Project Summary

Projects Overview

Capacity: 1.5 MW (ADSM and DG)

Participants: Tata Communication, Lake Mall, Super Diamond Mall, Mani Square Mall, Acropolis Mall, Park Hotel & Hotel Hindustan International

Controllable loads: Chillers, Lighting & DG

Uniqueness: 1st customer owned DG synchronously integrated with utility grid

Benefits to CESC:
- Avoid peak power purchase
- Reduce losses
- Defer Feeder and Substation upgrades
- Improve System utilization
- Enable customer owned DG sets to feed power to grid
- Reduce the impact of outages

100 MW expansion contract is in discussion
CESC Pilot Results (Sample)

**ADSM**

- Mon, Sep 5, 2016 at 13:00 0.1482MW shed for 30 mins

- Mon, Aug 29, 2016 at 14:00 0.2007MW shed for 60 mins

**DG**

- Mon, Sep 5, 2016 at 13:00 1.2MW shed for 30 mins

- Tue, Sep 6, 2016 at 13:30 1.29MW shed for 30 mins
IEP BENEFITS
Numerous Value Streams

- Each Utility can select their desired parameters and enter local data for decisions

Example:

- Wholesale Market
  - Capacity
  - Energy
- Ancillary Services
- Operating Improvement

- Peaker Generator Deferral
- Avoided Power Purchases
- Energy or Capacity Sales
- Return on Assets
- Substation Deferral
- Feeder Deferral
- Incorporation of Distributed Generators
- Integration and balancing of Renewables
- Lost Revenue Recovery
- Environmental CO2e Reduction
- Shoulder Month Savings
- Ancillary Services
- BMS Energy Efficiency Savings
- System Loss Savings
- Outage & Restoration
- Improving overall System Utilization
Thank You