



Celtic-Plus

Online Idea Pitch Session



28th June 2018,

Pitch of the Project Proposal

Power & Energy eXchange (PEX™) Communications
Cybersecure & Ultrafast Blockchain Networks Providing Enhanced
Frequency Response Services to Distributed Energy Resources

TSI-ECO.com

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**Teaser: Blockchain Smart Contracts In Ultrafast & Cybersecure Utilities Network,
 Artificial Intelligence For Machine Learning In DER Modules
 Simulation Testbed For Validation Of Microgrid To Grid Operation,
 Traceability Of Energy Consumed For Voluntary Carbon Credits Incentives.**



Transactions Data ledgers are shared distributed machines (set of sensors to react to it, meter it, and bill for it instantly. Cost/transaction is near zéro.

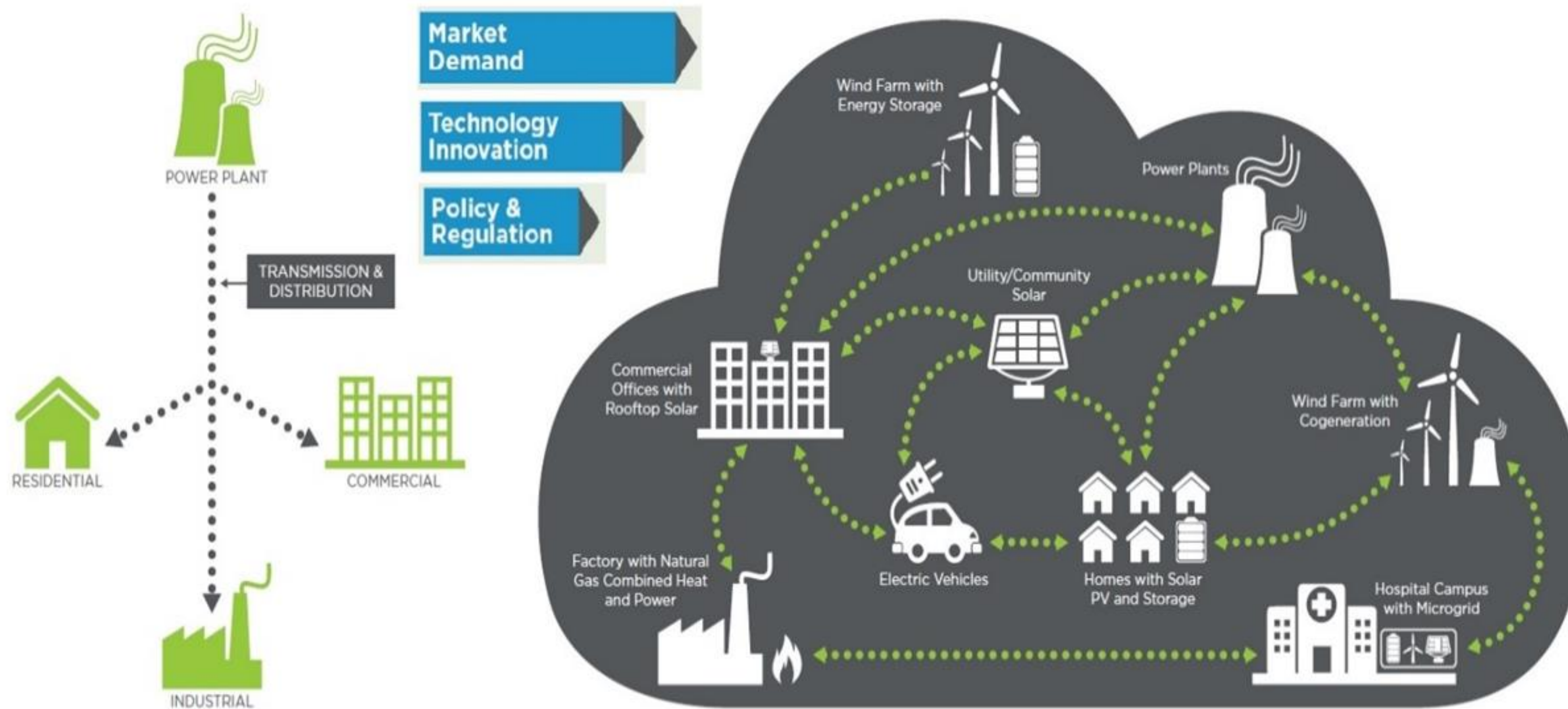
Centralised transactions telecom networks are too slow, too expensive, exclusive and vulnerable to attacks launched from low-cost IoT endpoint devices, without incentive to incur the cost of a security stack.

New Communications technologies must enable pervasive Blockchain connectivity and cybersecurity to IoT: Wireless 5G, Gbps Wi-Fi, new controls, virtual beacon, and low power, long distance radio frequency to be tested

Figure 2.1 The Emerging Energy Cloud

TODAY: ONE-WAY POWER SYSTEM

EMERGING: THE ENERGY CLOUD



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Canadian Organisation Profile



TSI-eco founded in 2012 in Canada based on Telecom Services International –TSI since 1981 who developed and operated Real-Time Digital Telecom eXchanges in Canada, Australia & Europe. It leads the Canadian Electric Grid Innovators (CEGI) Consortium in 2017, experts in real-time simulation with telecom, energy, grid & microgrids, power electronics and artificial intelligence (AI). Participants:

www.groupesm.com/en/services-and-solutions/energy/,

www.opal-rt.com/power-electronics-overview/

www.aisupplychains.ca supercluster -now funded CAD 200 M\$- enables CEGI to pitch the PEX™ to match the contributory funding by its large participating prosumers, utility grid stakeholders & Universities: How will AI + Blockchain collaborative innovation enable the energy supply chain infrastructure.

Canada's effective Free Trade Agreement with the European Union applies to Eureka Projects.

Mission: *to develop transactive energy exchange with ultrafast communications between machines that manage the Grid to Microgrids at independent producers and Prosumers to advance renewable and cleantech for energy flexibility, improve security & resiliency of grids, reliability of prosumers and incentivize more integration in electric grid, reduce the operating costs for stakeholders.*

Now seek European participation for integrating electrons and communications exchange flows solving global and practical solutions to the energy via the Grids.

IoE + 5G Project: Outcomes, Impact



Blockchain to get consensus for enhanced frequency response service to the Grid and new income by Prosumers.

IoE transactions decentralised stakeholders, producers & electric grid need machine2machine communications

5G Real-Time Communications for ultrafast and cybersecure deployment, lower latency, reduced latency, higher availability with no need for back-up power/site, multiple links for failure tolerance, fast deployment via mobility devices,

eXchanges” Smart Contracts: MW, MWh, Enhanced Real-time Unit Commitment (ERUC), Carbon Credit Mechanisms

Benefits:

- Transparent price of smart contracts for real-time enhanced frequency services and ERUC Demand Response
- Cost-effectively deployment of non-emitting generators preferably in advanced microgrids
- Manage Energy Efficiency and Conservation plus shedding of non-critical loads at low state of charge
- Load Serving Entities, Independent Producers & Prosumers could trade energy-as-a-service contracts
- Enhanced the cybersecurity starting with the communication and addressing each module
- Enhanced the resiliency of the electric grids by reducing brownouts and blackouts and ensure survivability,
- Cost reductions for the grid operators translates in rate reductions for the consumers of electricity, and ,
- Voluntary Carbon Credits GREEN token may be the incentive to reduce GHG for producer & Prosumer’s
- Induce co-investments by producers, Prosumers and Load Servicing Entities
- Many jobs for Highly Qualified Positions.

Proposal Development

Blockchain Architecture for Stakeholders & Benefits for each



STAKEHOLDERS BENEFITS:

PROSUMER shortens Payback in co-Investing with LSE in Adv. Microgrids that are able of EFR Service to the Power Grid, benefits :

- UPS,
- Savings from Peak Power Demand Mgmt (shaving of internal power surges)
- Cleaner power as PF = 1
- Co-managed Reserve of Energy,
- Carbon Credit Mechanism Incentives
- MWh AI-traced to Non-Emitting Gens
- Monetizes EFR & EMS Responsive DR

LOAD SERVING ENTITY (LSE) sells the above more cost-effective Energy as a Service (EaaS) managing the savings provided to Prosumer,

DISTRIBUTED SERVICE OPERATOR gains: Grid's Resilient & More Cost-effective Grid Operations with Time-of-Use pricing

ISO/RTO buys smart contracts to accurately predict Demand Response, reduce Frequency Regulation charges and costs to Subscribers

DISTRIBUTED SERVICE OPERATOR

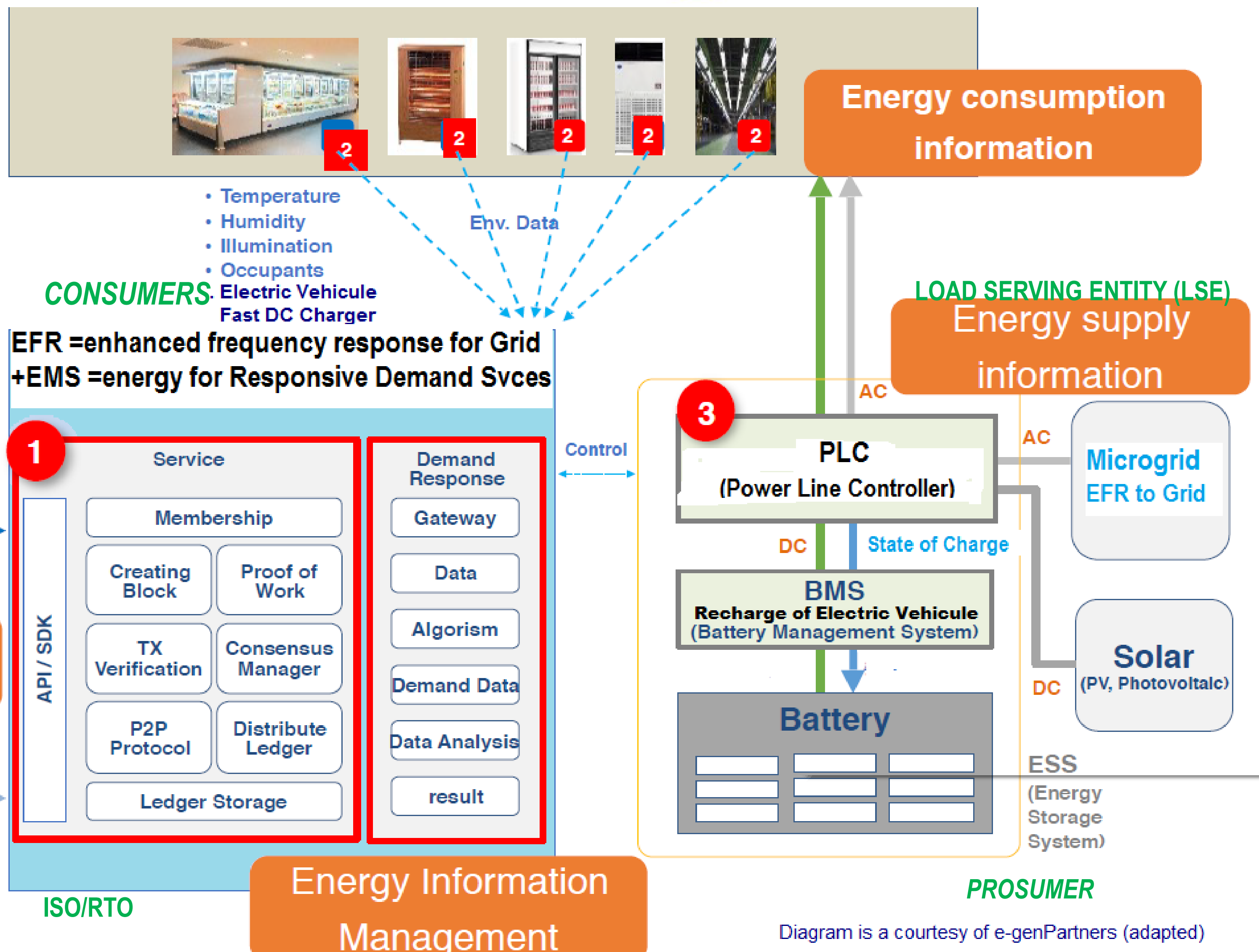
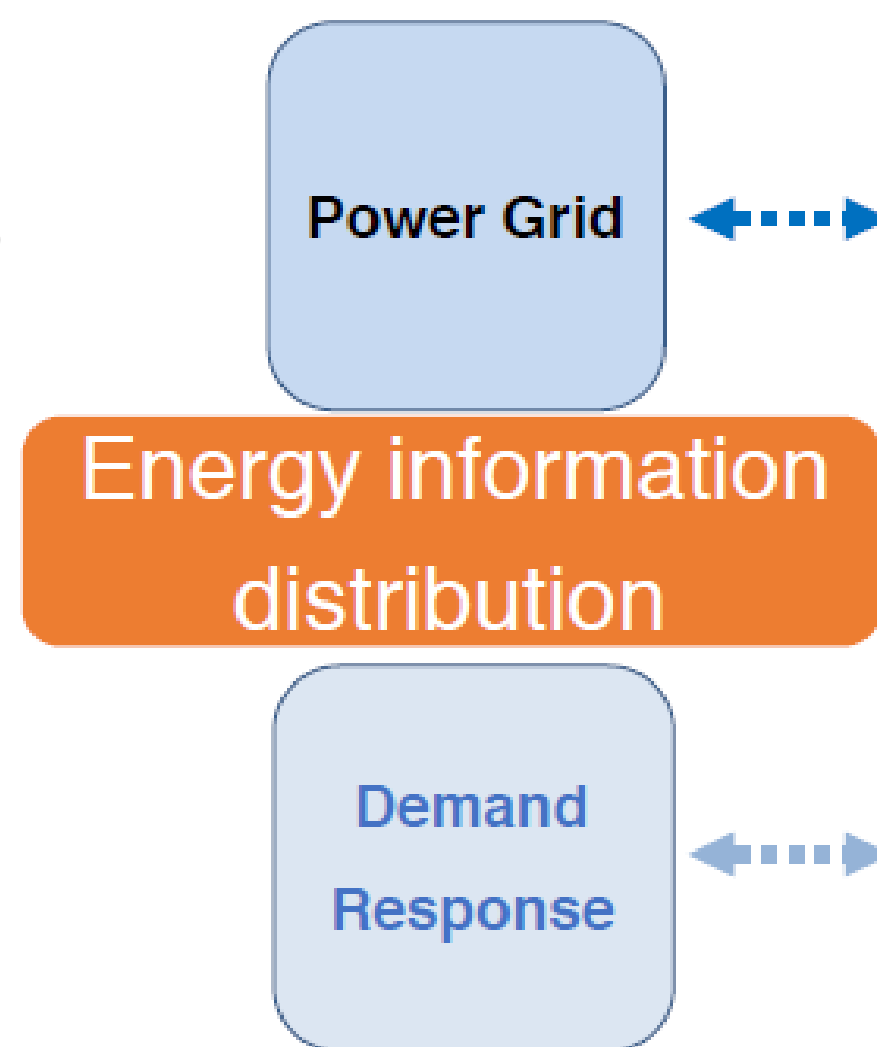
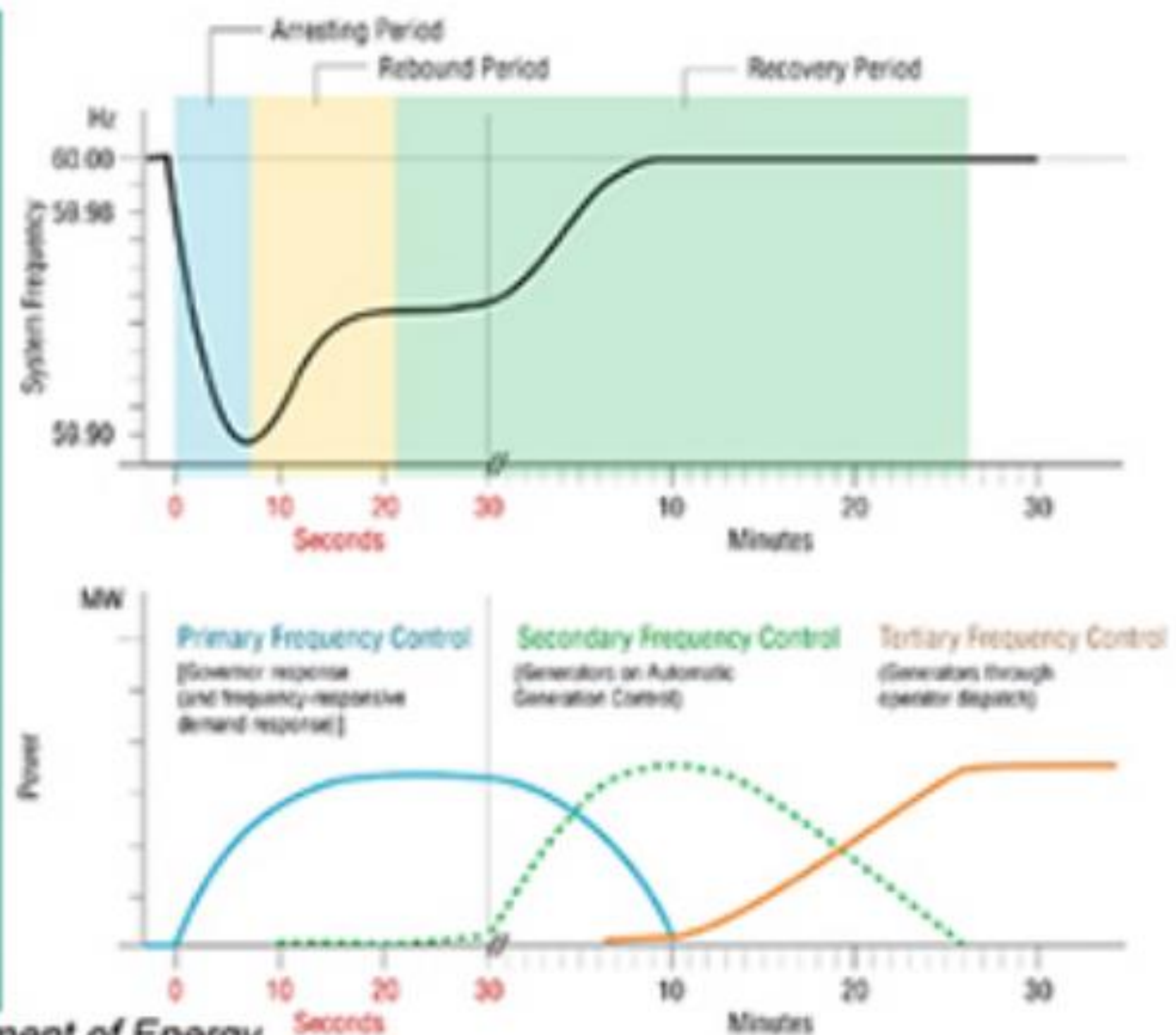
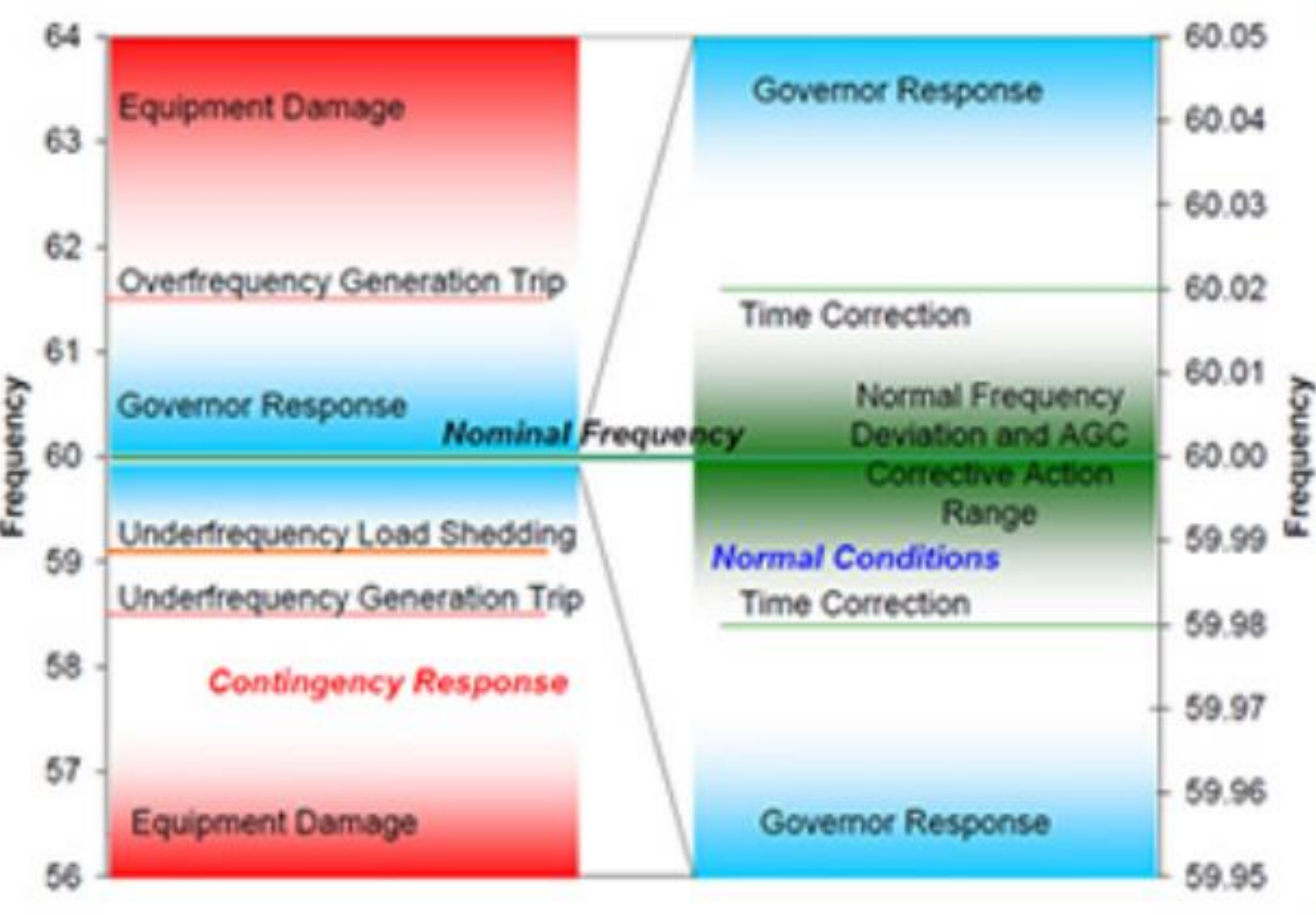


Diagram is a courtesy of e-genPartners (adapted)

Frequency Regulation @60 Hz takes up to 10 Mins to recover

Frequency Response Metrics to Assess the Planning & Operating

Reliable Integration of Variable Renewable Generation



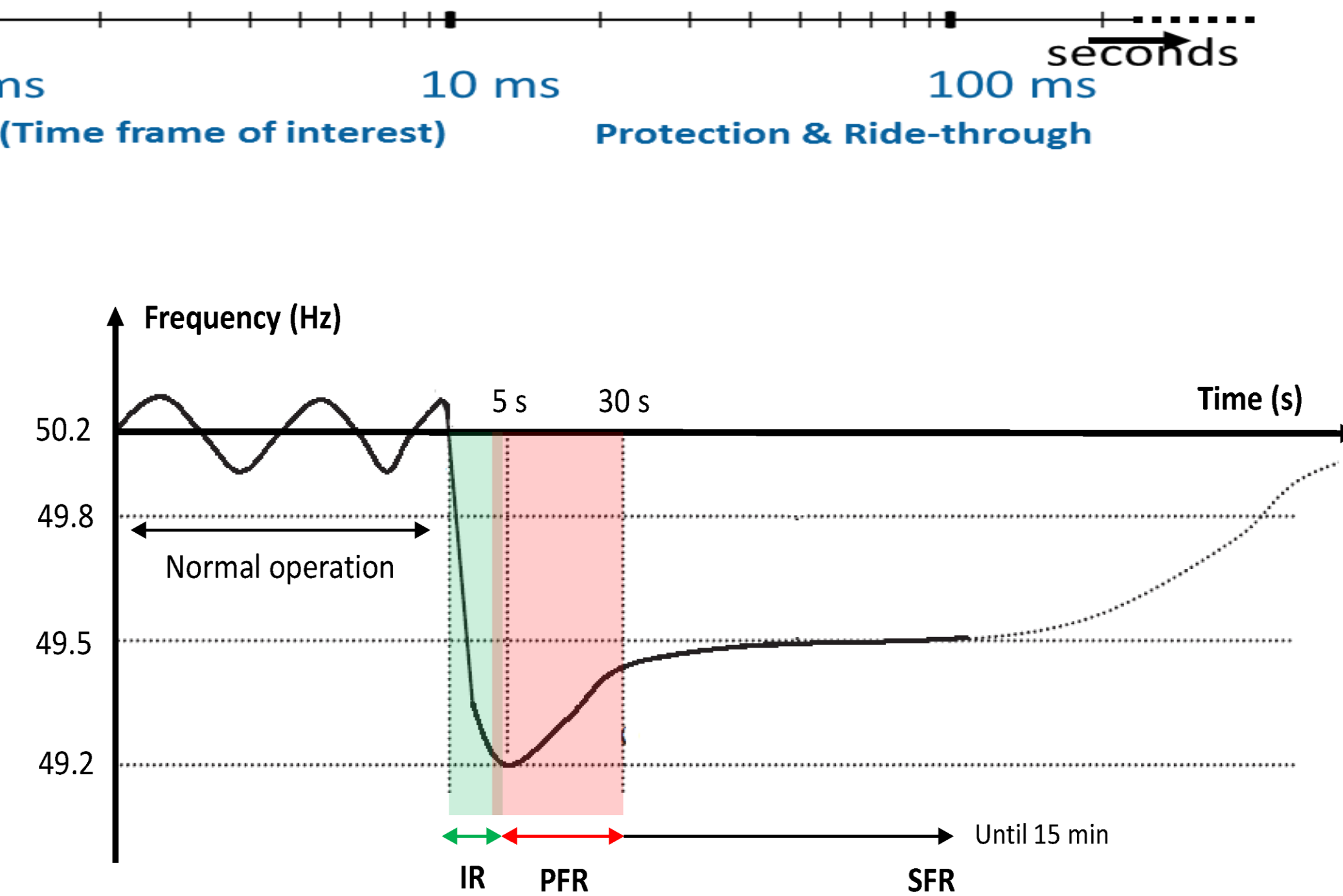
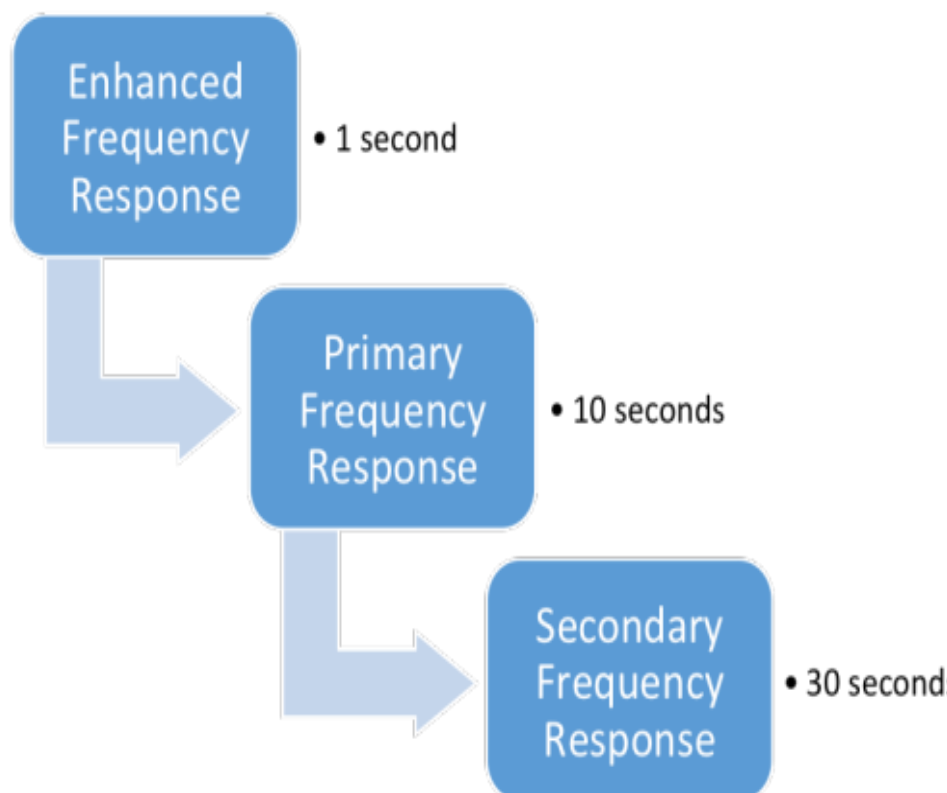
Source: Department of Energy

IoE +5G Project Use: Real-time Blockchain for EFRS & SFRS + Ultra-Fast Communications Architecture



First 5G demo in moving vehicle at 1.6 Gbps throughput achieved in 100MHz TDD spectrum 5 ms latency is within timeframe of interest, but for delays to get Consensus?

Computational velocity for AI plus ultra fast communications system enable the Real-Time validation of the grid's stability @50 Hz by: Inertial response (IR), primary frequency response service (PFRS), secondary frequency response Service (SFRS).



PEX™ Adv. Microgrids execute smart contracts after Consensus by stakeholders concerned, if no validation Test Bench:

- 1) Dispatch high power capacity to each local grid (after valuation) as required to correct the frequency excursion event (FEE)?
- 2) Microgrid auto-detects the FEE, posts a smart contract to sell an enhanced frequency response (EFR) for 1-30 secs.
- 3) Distributed Service Operators (DSO) &/or Wholesale Grid Operators' machines buy the Smart contract by consensus.
- 4) Compensates prosumer for exporting capacity Power & energy, i.e. self-healing grid from brownout &/or blackout events?
- 5) Microgrids controls the amplitude/duration of DER's reverse power flows and duration of load sheds based on state of charge.

Enhanced Frequency Response Services (PFRS & SFRS) @60 Hz by 4 DERs

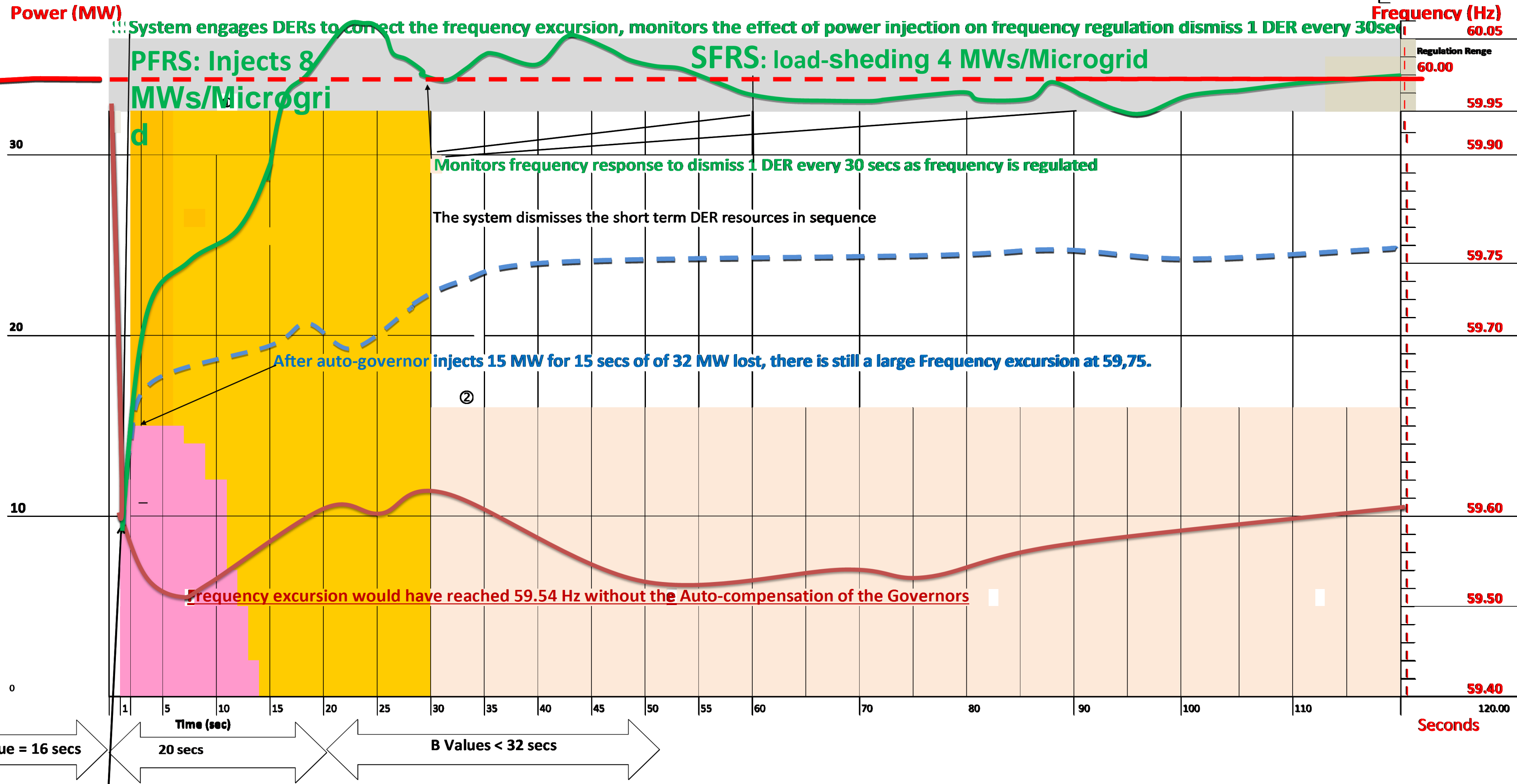
Distributed Energy Resources (DER) with Blinkless Microgrid offer the PEX™'s Enhanced Frequency Response (EFR) Service

HOW: Each microgrid detects and corrects the frequency excursion (FE) + injects into the grid twice its nominal power for 30 seconds, while maintaining critical loads.

This self-healing microgrid auto-reverses its power flow when the grid's FE < 59.70 Hz, reverses power to the grid still in connected mode until the FE > 60.05 Hz

Primary FR= each of 4 DERs of 4 MWs auto injects twice its nominal the nominal Power of each is 4 MW/DER, the EFT impact is 8 MW/DER for 30 secs

Secondary response: each Microgrid now load sheds 4 MW for 30 secs(16 MWs) until the grid's frequency is regulated or the SOC of Battery is critical



PEX™ Blockchain Smart Contracts:

① **PFRS**, 4 Microgrids DERs react to large FE < 59,7 Hz each auto-dispatches its DERs within 17 msecs, so this Primary Frequency Response **32 MWs** instantly injected in 17 msecs stabilizes the grid's power loss for 30 msecs;

② **SFRS**: each 4 Microgrid DERs now to load-shed **4 MWs** (16 MWs total) to replenish the grid's energy until frequency is very fast brought within regulation within the regulation range for 90 secs.

The price of this **EFR self-healing grid service smart contract** eliminates the brownout to be but cannot to be compensated by the insignificant amount of energy contributed for 120 secs.

Developments of TEST BENCH



Grid to Microgrid Validation of EFRS with AI Needs UltraFast IoE Communications

- *Test Bench with Real-time simulator of electrical ultrafast networks and electrical equipment of various manufacturing partners, allowing testing of local equipment controllers (faster algorithms) intelligent controllers for IoE transactions, power management and stability control of power grids.*
- *control algorithms with "Deep Learning" methods or other artificial intelligence algorithms.*
- *simulator makes it possible to train the machine learning algorithms, allowing multiple scenarios, with learning which ensures a high reliability of the solution offered before its implementation on site.*
- *also test algorithms and behavior of the solution offered in critical scenarios such as network faults, provide a complete proof of concept and make the necessary adjustments for the integration of the technologies in the network.*

Partners



Existing: Canadian Electric Grid Innovators (CEGI) Consortium with large Canadian partners covering all the Grid's technologies.

Involved countries: Canada, Sweden/Finland, Germany, France, Israel and Turkey.

Looking for partners:(Eurogia 2020 & Celtic-Plus) clusters for joint development of enhanced frequency response services with expertise in their country's best grid situation and cybersecure capabilities to implement blockchain & AI in the PEX™

- Grid's resiliency, Prosumer's reliability, Demand Response, Peak Shaving,
- Familiarity with Intermittency BrownOut/BlackOut facts in their grid.

Partners: Grid suppliers IPP, ISO/TSO, EPEX Spot Market and DSOs.

- 5G real-time communication (msec) and simulation

Partners: 5G vendors, operators and developers.

- AI Developers within 5G, machine2machine and Blockchain Smart Contracts
- Investors and ICOs professionals

Contact Info



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