Microgrid Service Solution (MSS)

“The zero net energy concept: 24 hr RENEWABLE-POWERED”

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5 Disruptive Trends and Technologies

(1) Decarbonization
(2) Decentralization
(3) Electrification
(4) Digitalization
(5) Deregulation

4D1E model

Grid for today

Grid for tomorrow
Increasing of energy consumption (Oil, Gas and Electricity)

Lead to

How to reduced?


Source: https://virta.global/blog/decarbonisation
Decentralization

SGtech School of Renewable Energy and Smart Grid Technology
Naresuan University

4D1E model

DERs: (PV-intermittent supply + BESS-firm) with grid parity

1. Increasing of DERs with low cost of the energy units (kWh) implementation
2. Change from centralize to decentralize and two-way power flow (upstream gen.)
3. Rapidly development of Lithium-ion and “COE decreasing of battery lithium-ion”

The Plummeting Cost of Solar
300x cheaper over 40 years
($/watt)

Lithium-ion battery price outlook

Source: BloombergNEF
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Distributed EV + DERs -> VPP with aggregator model

Source: https://www.teslarati.com/automakers-come-acceptance-ev-revolution-begun

**4D1E model**

- **Distributed EV + DERs**
- **VPP with aggregator model**

**June**
- India – expect all electric by 2030, official policy expected in Dec
- Netherlands – lower house passes motion to ban petrol vehicle sales by 2025 (March 2016)
- Norway – Norway discussing ban of petrol vehicles by 2025 (June 2016)
- Germany – passes resolution seeking to approve ZEV only by 2030 (October 2016)

**July**
- China – EV mandates lobbied against
- Norway – updates: to use a mix of incentives and fees to reach goal of no petrol vehicles sold by 2025. June 2017

**Aug**
- UK – to ban petrol vehicle sales by 2040
- France – to ban petrol vehicle sales by 2040

**Sept**
- Scotland – government pledges to phase out petrol vehicle sales by 2032
- China – “New energy vehicles” requirements published

**Electrification**

- 30 new BEVs by 2025, 20-25% of sales (2016)
- EVs to be 15-25% of sales by 2025 (March 2017)
- 7 new electrified vehicles announced, $700M to upgrade factory (January 2017)
- $560M battery plant, $11B to bring 10 EVs by 2022, 15-25% of sales by 2025

**Model 3 production starts**
- Model 3 production starts
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production

**July 18**
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production

**Aug 12**
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production

**Sept 18**
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production

**Oct 18**
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production
- Model 3 production

- 12 BEVs by 2025 + 13 electrified
- $1B refit USA plant for EV, reiterates $10B for EVs and $1B for batteries
- All new models electrified by 2020
- $84B investment to bring 300 EVs to market by 2030
- New BEV concepts
- Evokes China sales to be EV by 2030
- $2.7 Billion in batteries and EVs

- Team Edison to make BEVs, reiterates 13 new electrified vehicles by 2020, $4.5B in investments + reallocating 1/3 of combustion investment

**Source:** https://www.teslarati.com/automakers-come-acceptance-ev-revolution-begun

**Dynamics demand with EV penetrations**

**BEV** = Battery Electric Vehicle
**PEV** = Plug-in Electric Vehicle
**ZEV** = Zero Emission Vehicle
**EV** = Electric Vehicle
**“electrified”** = hybrid, plug-in hybrid, or BEV
Digitalization

Key technologies
- 5G Board Band Cellular Network
- IOT with M2M communication
- Quantum Computing Technology
- Business Innovation for Energy sector

4D1E with Energy Sector ???
(Decentralized Digital Platform)

Source: http://www.iwaytrack.com/iwaytrack-blog2.html
Microgrid Service Solution (MSS)

(Net Zero Import Energy from the Grid)

Key driving force: COE of PV & BESS

Micro-Grid (Low Voltage)
- Distributed Generation (DG)
- Customer Electrification (Prosumer)
- Almost PV on ground and rooftop (< 1 MW)
- Microgrid, Prosumer and P2P: Utilities, Private and Customer

Community Grid (Medium Voltage)
- Small Power Producer transmission
- Community Electrification (IPP, SPP and VSPP)
- PV and Wind farm, Waste to Energy Biomass Gasification (1 – 90 MW)
- ESB, DR and VPP: Utilities and Private

National Grid (High Voltage)
- High Capacity transmission
- Nation balance of supply & Demand
- Centralize Generation (> 100 MW)
- Enhanced Single Buyer (ESB)
Microgrid Service Solution (MSS)
(RE100 Future Model)

Smart Grid Technology Implementation:
DERs-DR-IEC61850-P2P ETP with V2G + BESS -> VPP

SGtech-Smart Grid Data Utilization Platform

Solar PV + BESS with Grid Parity
Energy-as-a-services

Carbon Neutrality & Net Zero Concept
Smart Grid Technology Showcase

24 hr RENEWABLE-POWERED supply to communities (SGtech, NU)
Supply Side
Campus power project
PV Rooftop 50 kWp

Supply Side
Campus power project
PV Rooftop 3 kWp

Supply Side
PV Rooftop 3 kWp

Supply Side
PV Rooftop 50 kWp

Supply Side
NEDO MG project
120 kWp

Supply Side
PV Rooftop 3 kWp

Flixible Side
BESS 200 kW/200 kWh

PV Capacity = 530 kWp
Peak Demand = 250 kW
1. Microgrid-NEDO
   - PV: 120 kW on ground
   - Diesel Generator: 100 kW

2. PV Campus Power
   - PV: 350 kW on ground
   - PV: 50 kW rooftop

3. Automated Demand Response (DLC function)

4. BESS for Microgrid-ZNE
   - BESS: 200 kW / 200 kWh
   - LiFePO4 Technology

SGtech Disruptive Technology
DERs (Solar + BESS + DR + EV )

EV with V2G charging station (Optional)
MG-ZNE Architectural Design

**BUSINESS & FUNCTION LAYER**

**INFORMATION LAYER**

**COMMUNICATION LAYER**

POWER FLOW CONTROL (PV & BESS, EV)

POWER FLOW CONTROL (Load)

**COMPONENTS LAYER**

- PV (INV/Controller)
- BESS, EV (INV/Controller)
- Load (DLC & Protection & Relay)
- Smart Meter

**Energy Management System (EMS) + Energy Trading Platform (ETP)**

- BIG DATA / ANALYTICS / BLOCKCHAIN / AI FORECASTING / POWER FLOW CONTROL
- Multi-protocol / CIM / Standard Data (Json)
Microgrid-EMS Platform

MG Zero Net Energy Concept

**Key Point:** Monitoring, Protection and Control (Stability)

Net zero import energy from the grid

1. RE and Load Forecasting
2. Dispatch Efficiency (Daily Scheduling & Planning)
3. Daytime (PV+BESS) and Nighttime (BESS+EV)
4. Cost optimization with Reserve Capacity (DR+VPP)
5. P2P Energy Trading Platform with blockchain technology

**Microgrid Concept Design**

- Distributed Generation (DG+BEss+EV)
- IEC61850
  - Intelligent Electronic Devices (IED)
  - POC (Grid-Islanding Mode)
- Energy Consumption (DR)
- Smart Grid Technology
- Microgrid Controller (MGC)
- ESS-VPP-Signal
- MG_mode Signal
- DR-Signal

**POC (Grid-Islanding Mode)**
Microgrid ZNE concept < Grid parity with Merit order

Next project (2022-23)
Virtual Power Plant (VPP)
From NU (Dome) ~ 1 MW of PV Rooftop
(External Source: Other MG with Private PPA)

BESS Applications: Power Quality (4-Quadrant) / Balancing + Load Following / Peak Shaving / Spinning Reserve (100%)
SGtech Microgrid

PV Capacity = 530 kWp
Peak Demand = 250 kW

LCOE: 3.25 – 3.75 Baht/kWh with merit order (LMP Concept)

Priority 1: Supply & Demand Ratio (DERs) (3.25 - 3.75 Baht/kWh) -> Self Consumption
Priority 2: BESS / V2G (Optional) (Peak & Nighttime) ~ 3.80 Bath/kWh -> Dispatch Efficiency
Priority 3: DR / VPP (Operating Reserve) ~ 3.85 Bath/kWh -> Reserve Capacity
Priority 4: PEA Utility Grid (External sources) ~ 4.00 Bath/kWh

4.72 Baht/kWh (Last update)
Thailand: 0.13 $/kWh
Germany: 0.35 $/kWh

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Full Demonstrate of SGtech P2P ETP Platform with Blockchain Technology
Year 2022: Microgrid Service Solution (MSS)
The completely microgrid functional implementation system in Thailand

“Net Zero import energy from the grid”
All areas of smart grid technology implementation
Thank you