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Use of BTM Storage for Grid Services – Economics and Operations

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What is Behind the Meter?

Traditional Power Supply System

- Supply power to the grid
- Through network, it reaches consumers' meters
- Is consumed **after** passing the meter

Behind-the-Meter (BTM) Power Supply System

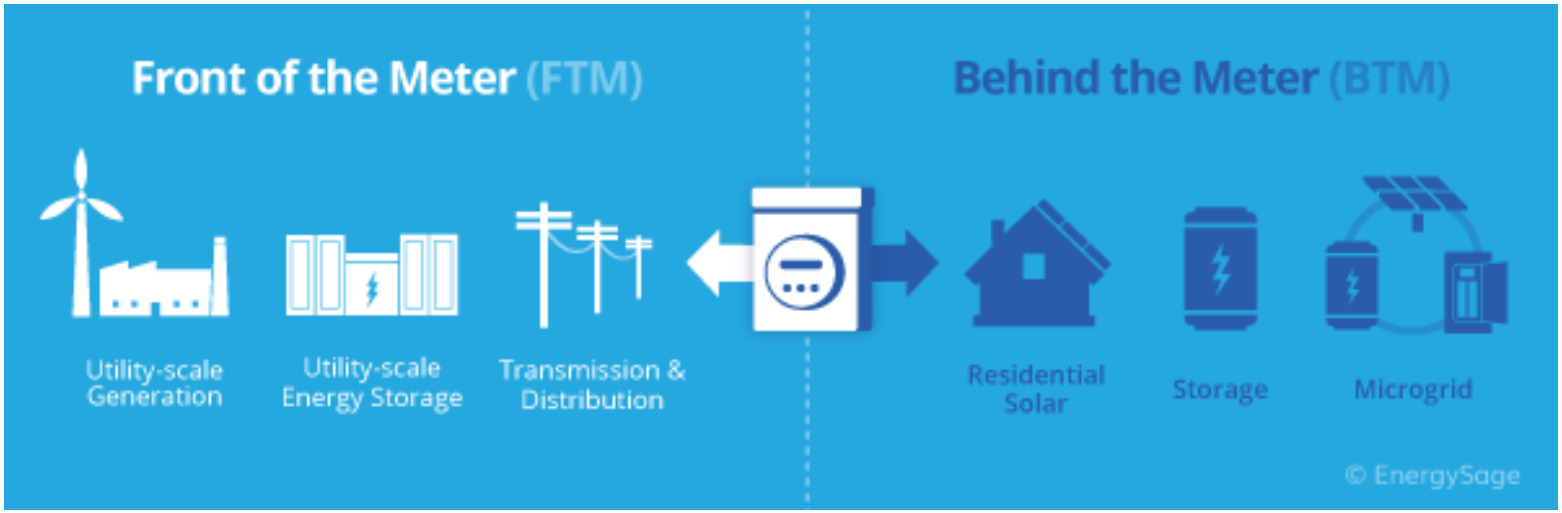
- Located "behind" consumers' meters
- The power consumed does not pass through the meter
- Is consumed **before** passing the meter

What is Included in Behind the Meter?

The BTM energy systems may comprise of;

- On-site generation (most commonly RTS)
- Controlling system (grid tie inverter and synchronizer)
- Storage (batteries, compressed air, etc.)
- But NOT the power consuming appliances

What is Behind the Meter?



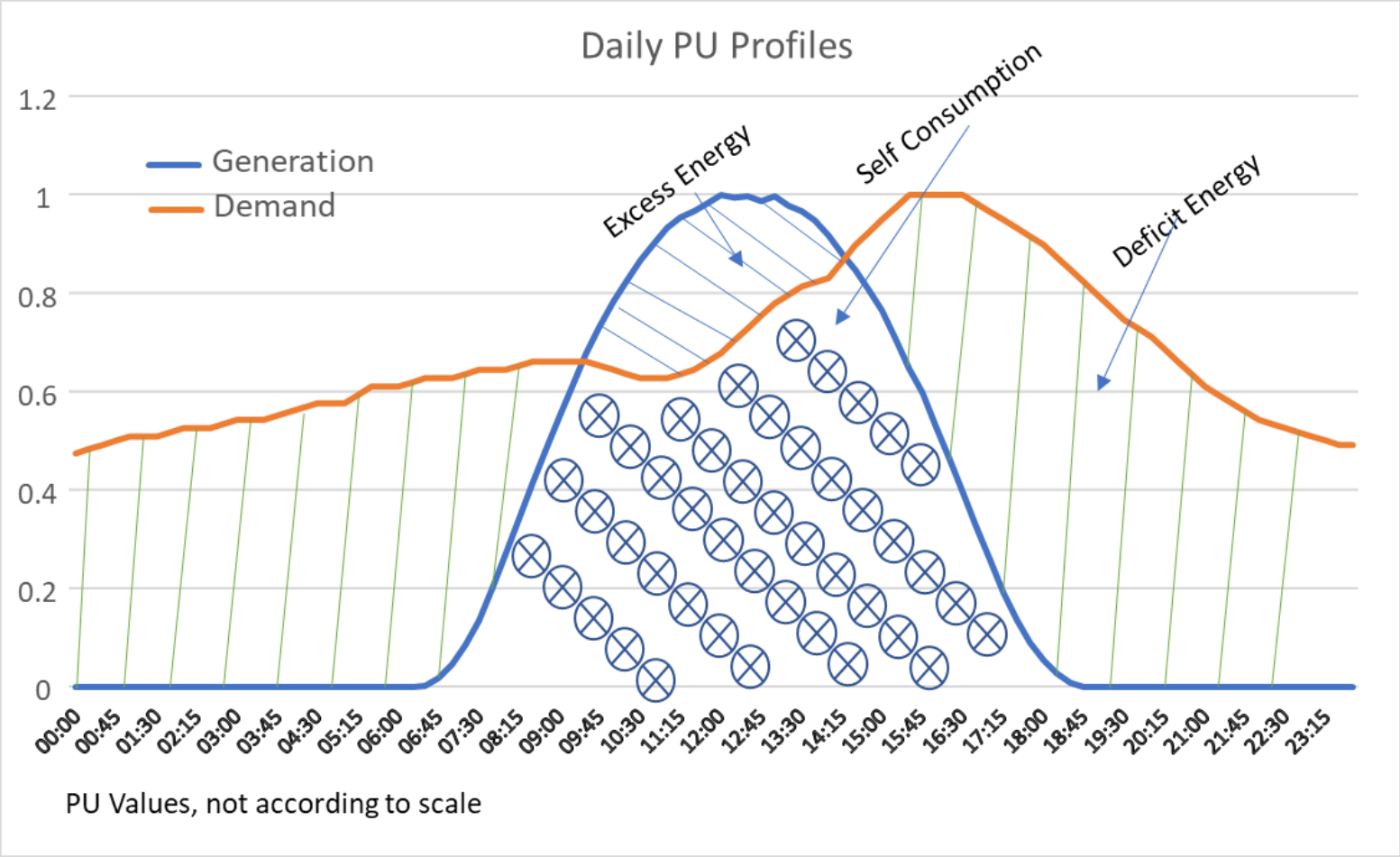
Emerging Definition of BTM?

Meets 100% energy requirements;

- While technically not correct, becoming more acceptable definition of BTM
- Technically, a facility with BTM can import and export energy
- For this presentation;
  - RTS = Simple Rooftop Solar with no batteries
  - BTM = RTS + Batteries meets 100% power requirement of owner

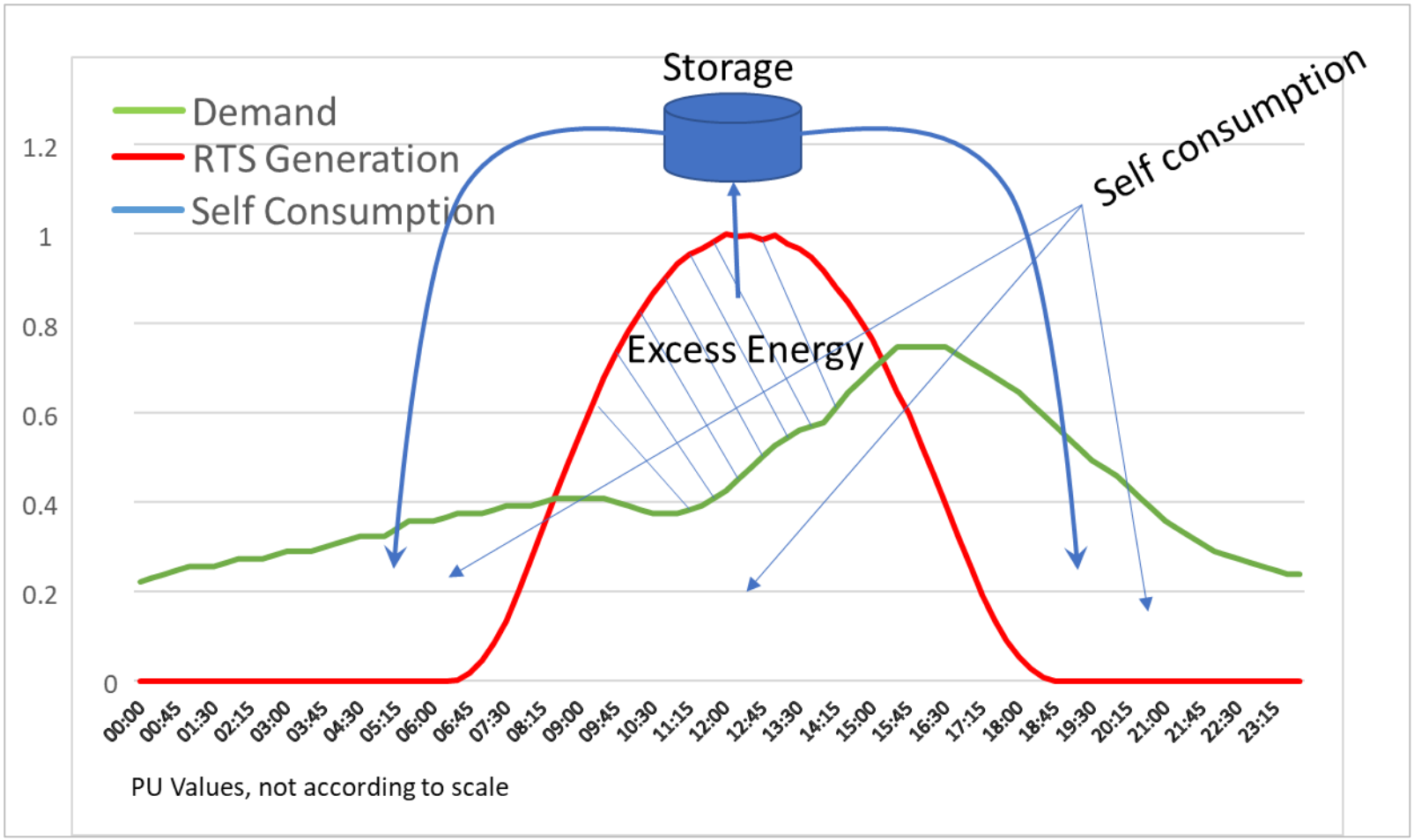
Simple RTS Vs BTM

Disbalance between Generation and Demand



Simple RTS Vs BTM

Self consume excess energy using storage



Feasibility Assessment Model - RTS

- GIZ developed a model to simulate and assess various RTS policy options
- Feasibility assessed for customers and utility, based on;
  - Customer Demand Profile
  - Utility Load Profile
  - RTS Generation profile
  - RTS installed capacity
  - LCOE based on RTS fixed and variable cost components over life
  - Weighted average tariff for customer class
  - Proposed FIT rates and other monetary incentives
- Used the model to assess feasibility of BTM

Simulation Results - BTM

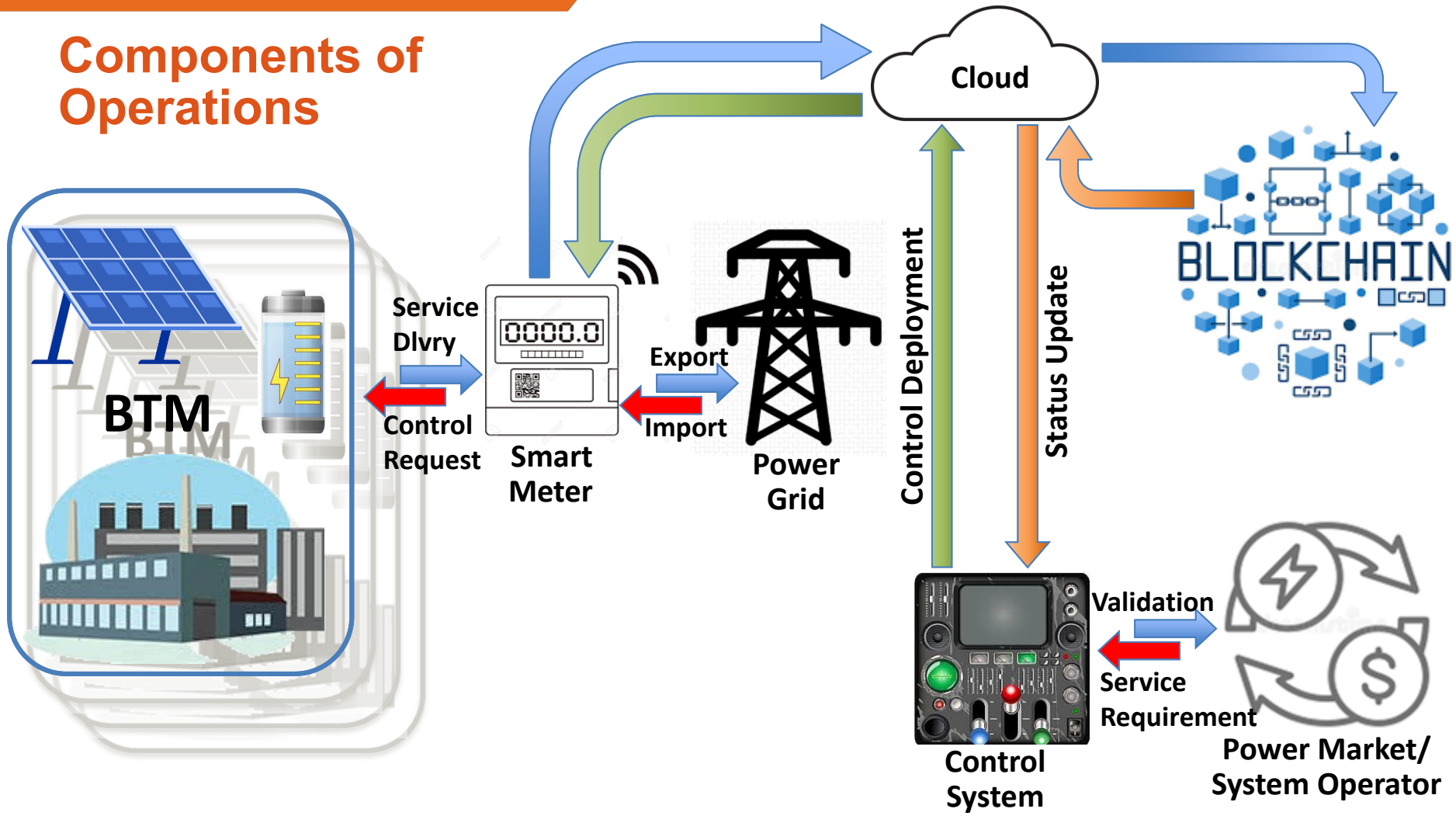
- Larger size, lower LCOE, lower tariff, more feasible RTS
- LCOE 42% less than average tariff for large industrial customers
- LCOE 65% less than average tariff for large commercial customers
- Self-consumption of RTS varies from 45% to 54%
- LCOE increases more than 270% with inclusion of batteries
- Payment for use of batteries for grid services can turn this around
- Win-win situation for customer, system/market operator, utilities, government
- Might require financial subsidies or even system operator financing batteries at large BTM systems

Components of Operations

- Customer meter must be certified/calibrated with ability to measure;
  - State-of-charge (SOC) of battery
  - Total facility load
  - Under smart grid, AI based non-intrusive appliance monitoring
- Meter should have cloud connectivity to transmit real time data
- Meter data is logged at a blockchain register
- The blockchain register data is linked to smart control system(s)
- In the event of requirement for grid services;
  - Real time assessment, aggregation and deployment of batteries based on SOC and facility loads
  - AI based decision to supply to grid or disconnect facility or individual loads
  - Block chain record of participation of individual facilities
  - Settlement based on grid services market bids/offers

Operational

Components of Operations



Operational

Considerations

- Grid services may include:
  - Export of energy as Virtual Power Plant (VPP)
  - Voltage and frequency control (additional supply or reduced demand)
  - Spinning (instantaneous) Reserve
- Other services may include:
  - Market balancing participation as aggregated load
  - Demand Response
- A customer may participate in more than one service program
- Grid services requirements and compensation must provide reasonable compensation
- BTM battery becomes a common asset for system operator/customer
- As such common investment sharing model should be considered
- Use of Blockchain register may be exploitted to settle in digital currency
- Offers great potential for use of AI and ML for real time control

Thank You

Questions/ Remarks/ Feedback

- Now

OR

- Later through shahab@sq-associates.com