# *2017 TAC Meeting*

# Introduction

Turner Energy Storage to Micro Transactive Grid

From Clean Energy Fund I to Fund II

# Turner Energy Storage – Clean Energy Fund I

## Turner Energy Storage Project

- 1MW – 3.5 MWhr Vanadium Flow Battery
- Located Adjacent to SEL Manufacturing
- Economics of Scope Valuation
- Battery Operational Curves

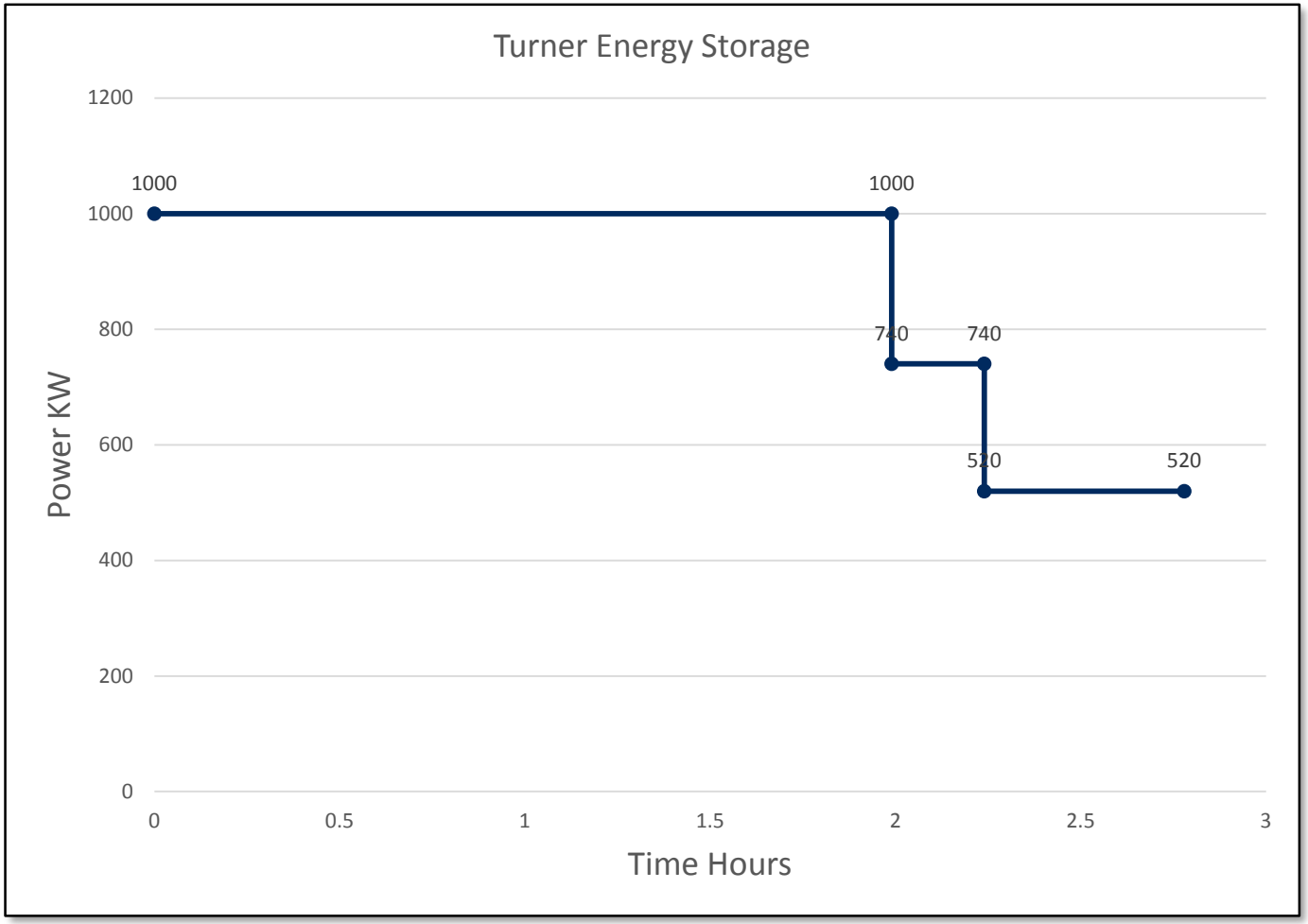
# Turner Energy Storage Use Case

| Use Case and application as described in PNNL Catalog | Avista | PSE | Sno – MESA1 | Sno – MESA2 | Sno - Controls Integration |
|---|---|---|---|---|---|
| **UC1: Energy Shifting** | | | | | |
| Energy shifting from peak to off-peak on a daily basis | Y | Y | Y | Y | |
| System capacity to meet adequacy requirements | Y | Y | Y | Y | |
| **UC2: Provide Grid Flexibility** | | | | | |
| Regulation services | Y | Y | | Y* | |
| Load following services | Y | Y | | Y* | |
| Real-world flexibility operation | Y | Y | | Y* | |
| **UC3: Improving Distribution Systems Efficiency** | | | | | |
| Volt/Var control with local and/or remote information | Y | | Y | Y | |
| Load-shaping service | Y | Y | Y | Y | |
| Deferment of distribution system upgrade | Y | Y | | | |
| **UC4: Outage Management of Critical Loads** | | Y | | | |
| **UC5: Enhanced Voltage Control** | | | | | |
| Volt/Var control with local and/or remote information and during enhanced CVR events | Y | | | | |
| **UC6: Grid-connected and islanded micro-grid operations** | | | | | |
| Black Start operation | Y | | | | |
| Micro-grid operation while grid-connected | Y | | | | |
| Micro-grid operation in islanded mode | Y | | | | |
| **UC7: Optimal Utilization of Energy Storage** | Y | Y | | | Y |

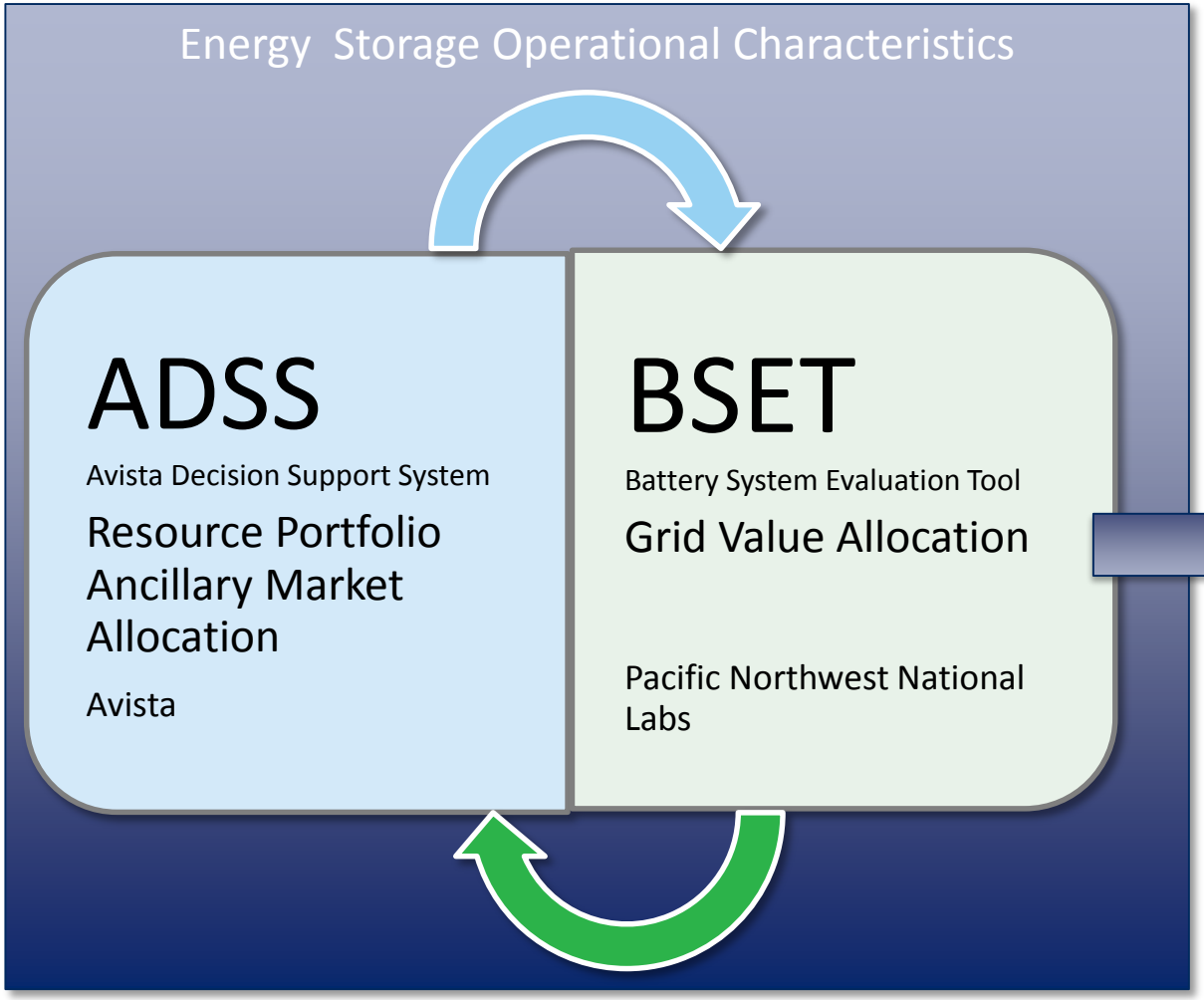
# Turner Energy Storage Project Operational Characteristics

- Flow Battery Energy Storage Systems (FBESS) performance depends on various factors
  - Operating mode – charge or discharge
  - Power
  - State of charge (SOC)
  - State of health
  - Operating temperature
- FBESS rating can be confusing
  - 1MW, 3.2 MWh is Uni Energy FBESS rating
  - However, at 1 MW, the energy obtained is ~ 2 MWh
  - To obtain the rated 3.2 MWh energy, the discharge power is 520 kW.
- Need to predict battery performance at various SOCs under different operating conditions
  - Battery SOC calculated by accounting for efficiency losses during charge and discharge

# Battery Operational Cycle



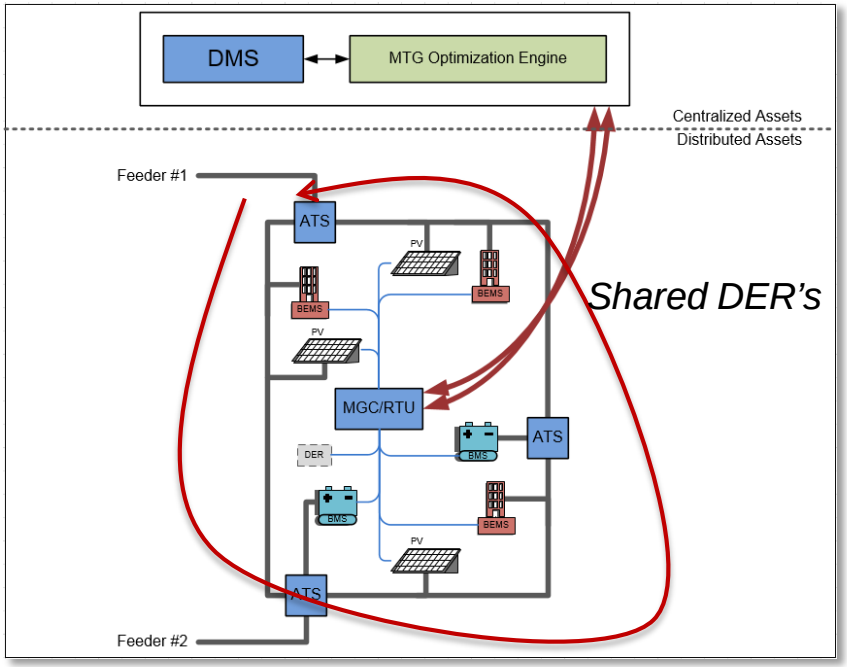
# Energy Storage Valuation




Annual Valuations

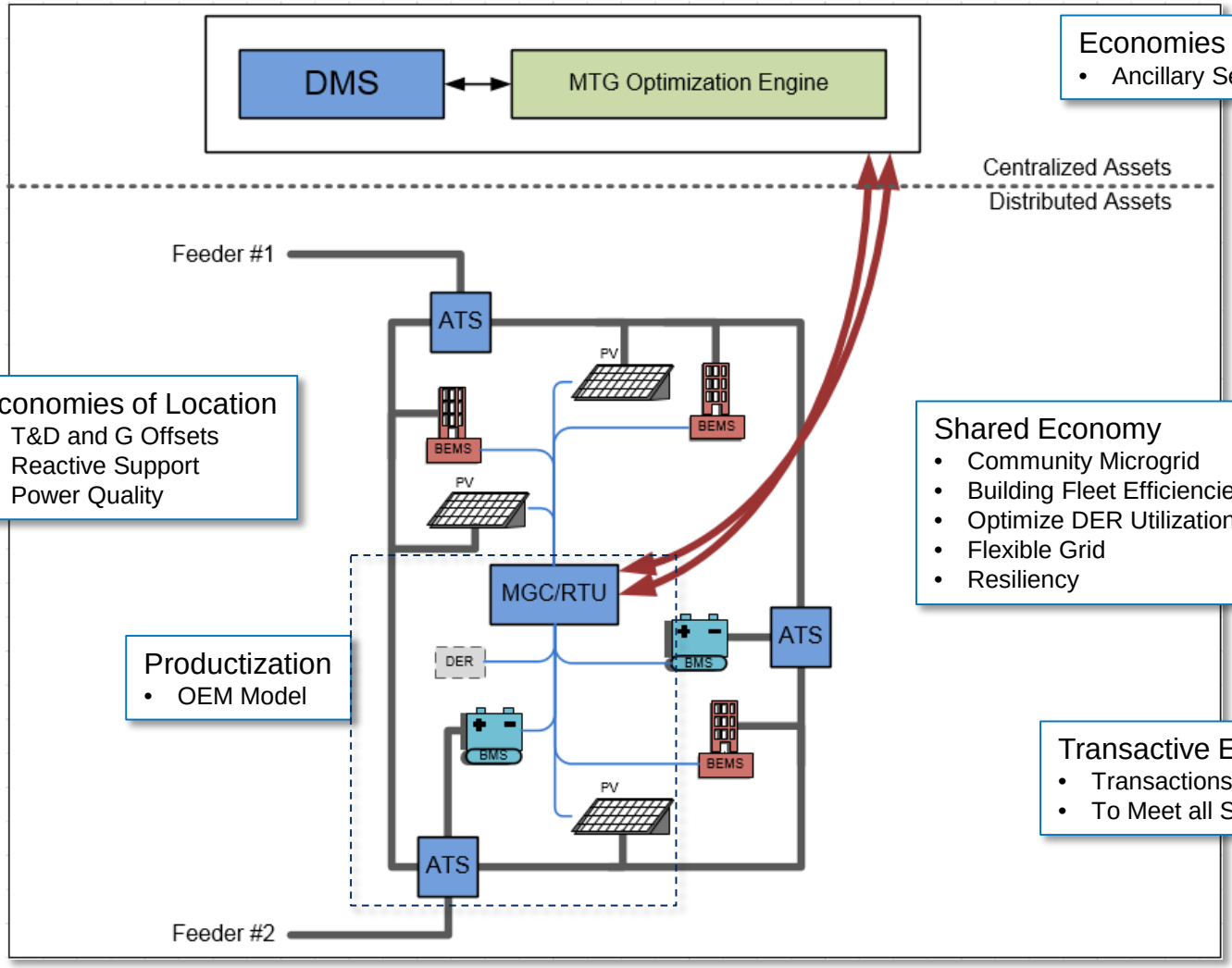
Storage Duty Cycles

# Micro Grid for the Shared Economy




| airbnb | Marriott | Expedia |
|---|---|---|
| Valuation: **$25 Billion** | Valuation: **$21 Billion** | Valuation: **$12 Billion** |
| Founded In: **2008** | Founded In: 1927 | Founded In: 1996 |
| **1 MM Locations** | 4,100 Hotels | 260,000 Listings |
| 190 Countries | *79 Countries* | 200+ Countries |
| **$0.9B Revenue** | $13.8B Revenue | $5.8B Revenue |

# Micro Transactive Grid Valuation




**Economies of Scope**
- Ancillary Services

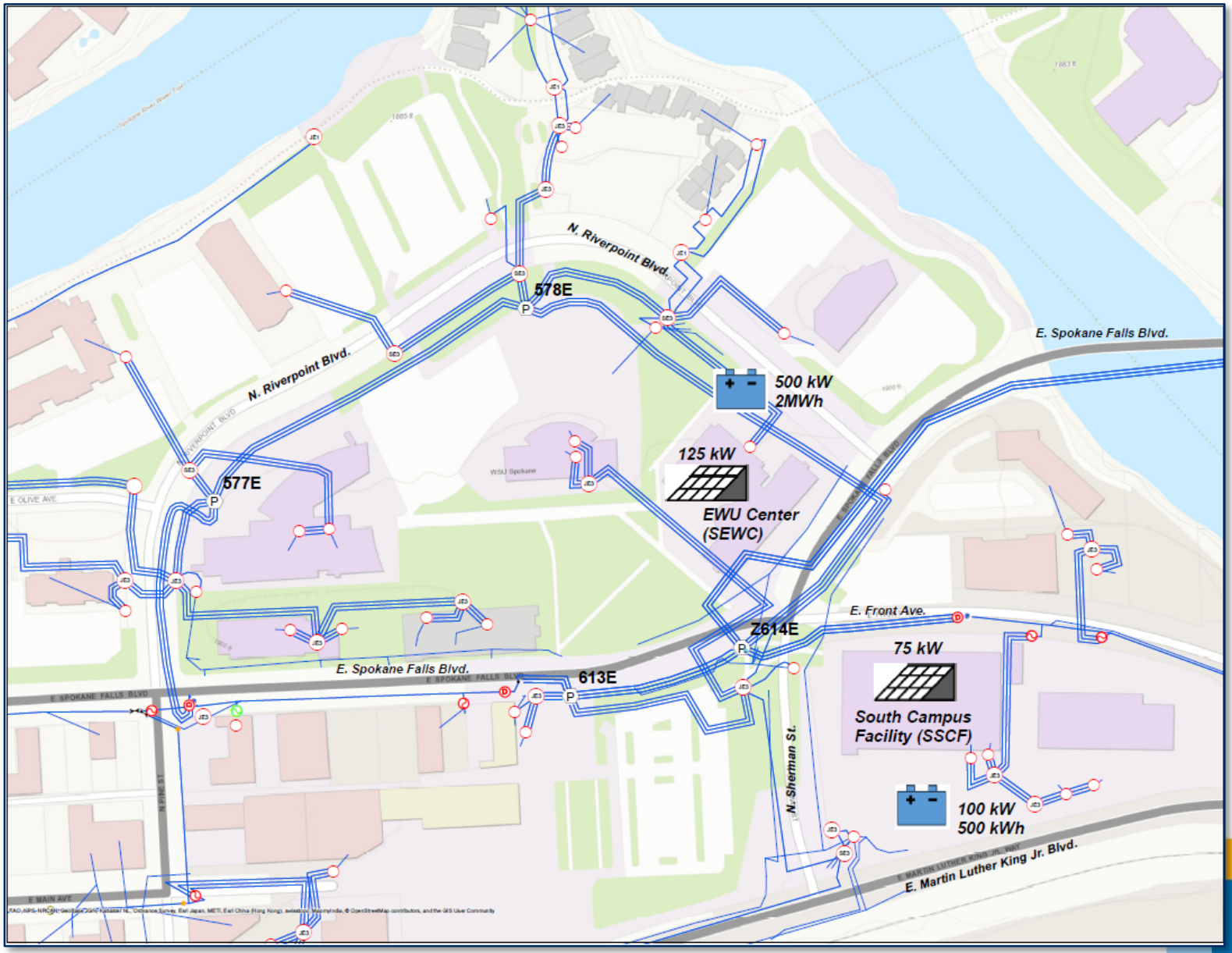
**Economies of Location**
- T&D and G Offsets
- Reactive Support
- Power Quality

**Shared Economy**
- Community Microgrid
- Building Fleet Efficiencies
- Optimize DER Utilization
- Flexible Grid
- Resiliency

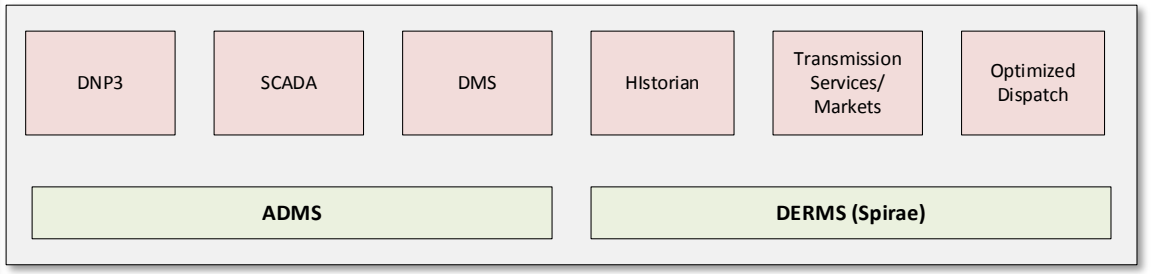
**Productization**
- OEM Model

**Transactive Economy**
- Transactions to Optimize Utilization of Assets
- To Meet all Stakeholders Needs

# Micro Transactive Grid



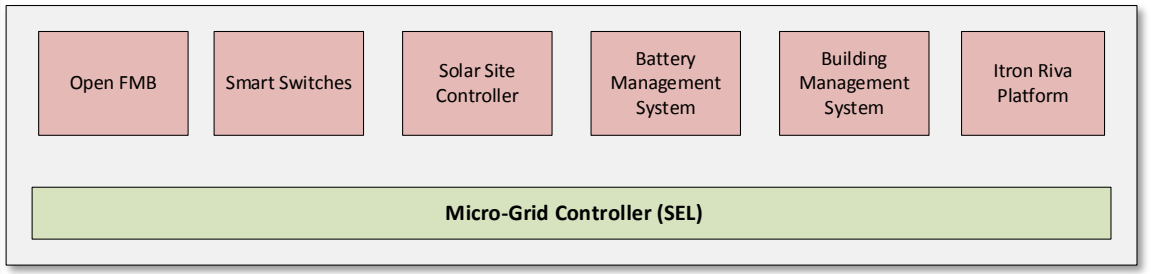
# Micro Transactive Grid Control Hierarchy




**Business Drivers**

- **Ancillary Services**
- Energy Price Arbitrage
- Load following services
- Voltage regulation services
- **Grid Services**
- Volt/Var control (IVVC and CVR) → DMS
- Load shaping
- Deferment of Distribution System Upgrades
- **Shared Economy**
- Modes of Operation
- Asset Optimization

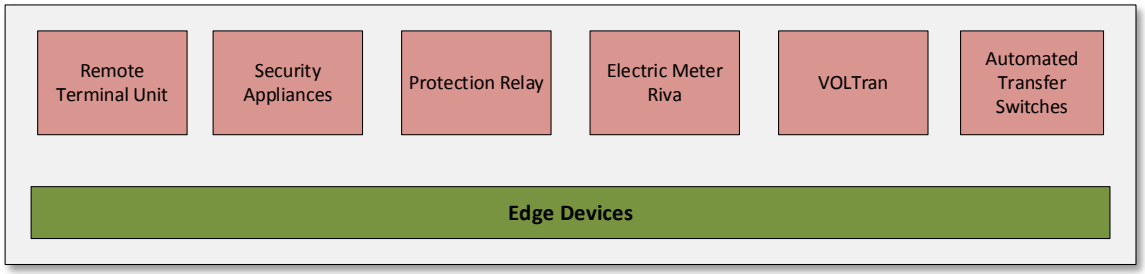
Centralized Controller




**Business Drivers**

- Data Aggregator
- Load Shedding
- Event Ride Through
- Islanding
- Load Balancing
- System Health Checks
- Mode of Operation
- Edge Analytics
- System Security

Site Controller

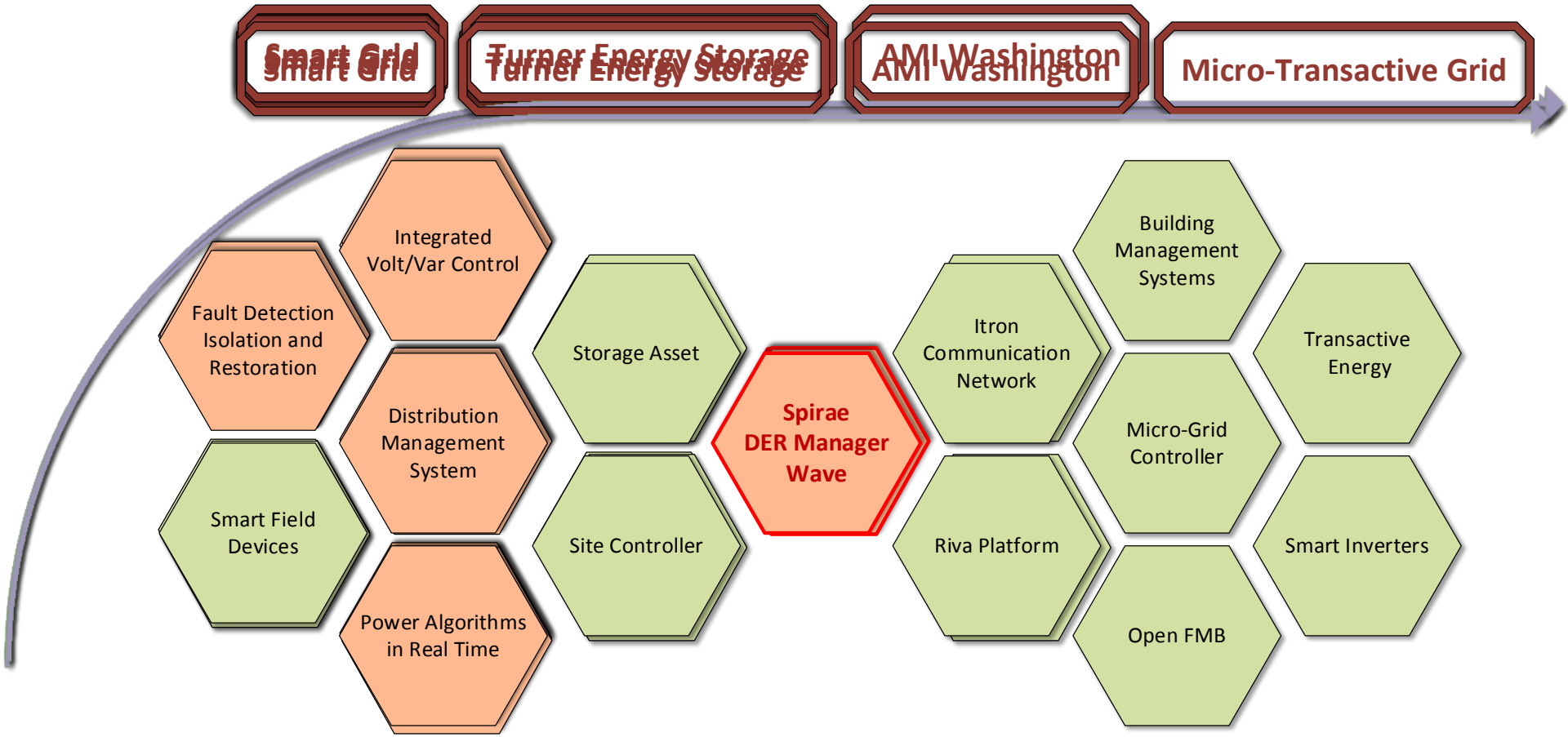



**Business Drivers**

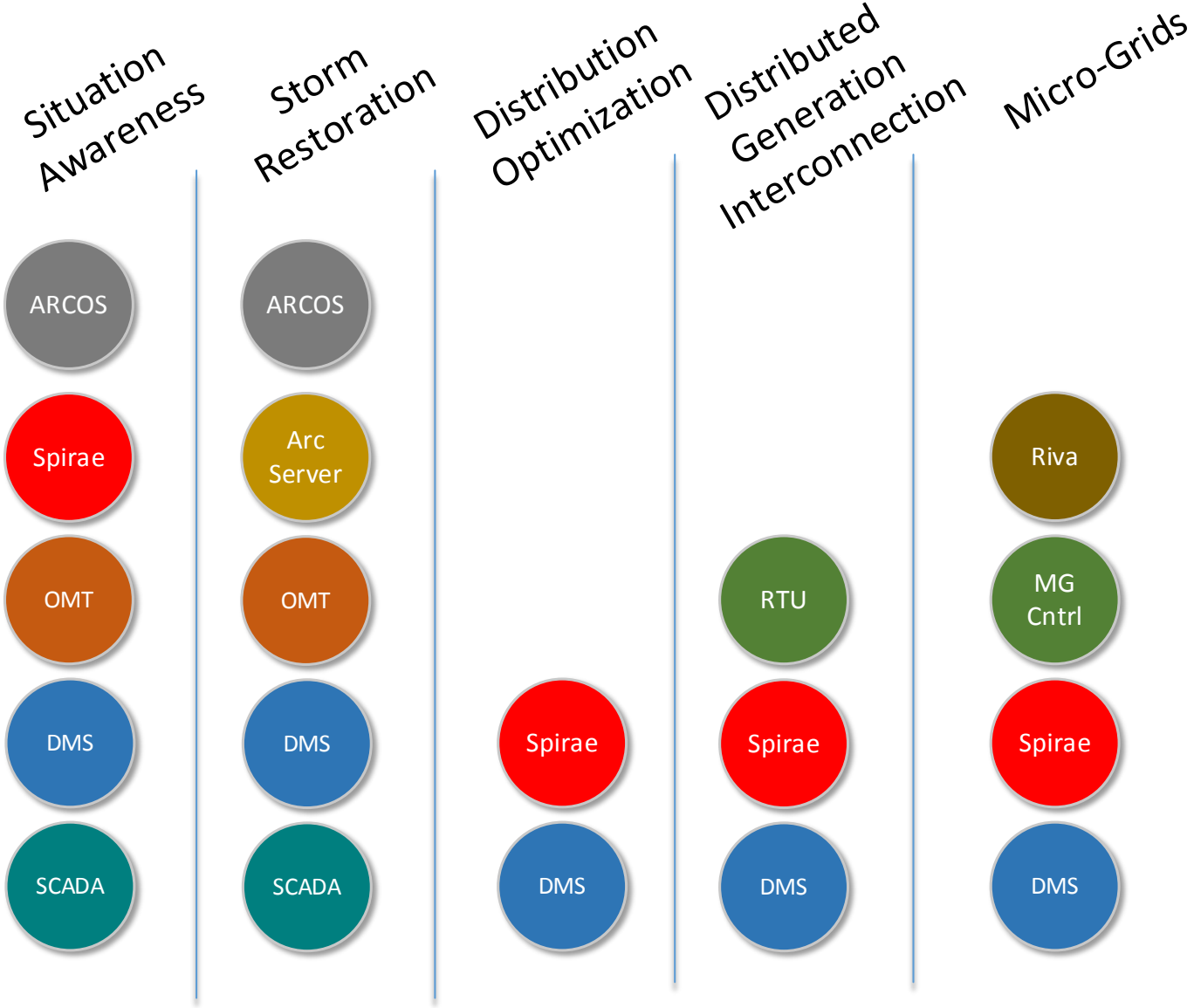
- Locational Services
- Load Disaggregation
- Autonomous Operation
- Protection System
- Edge Analytics
- Load Shedding
- System Operation with Communication Failure

Local Controller

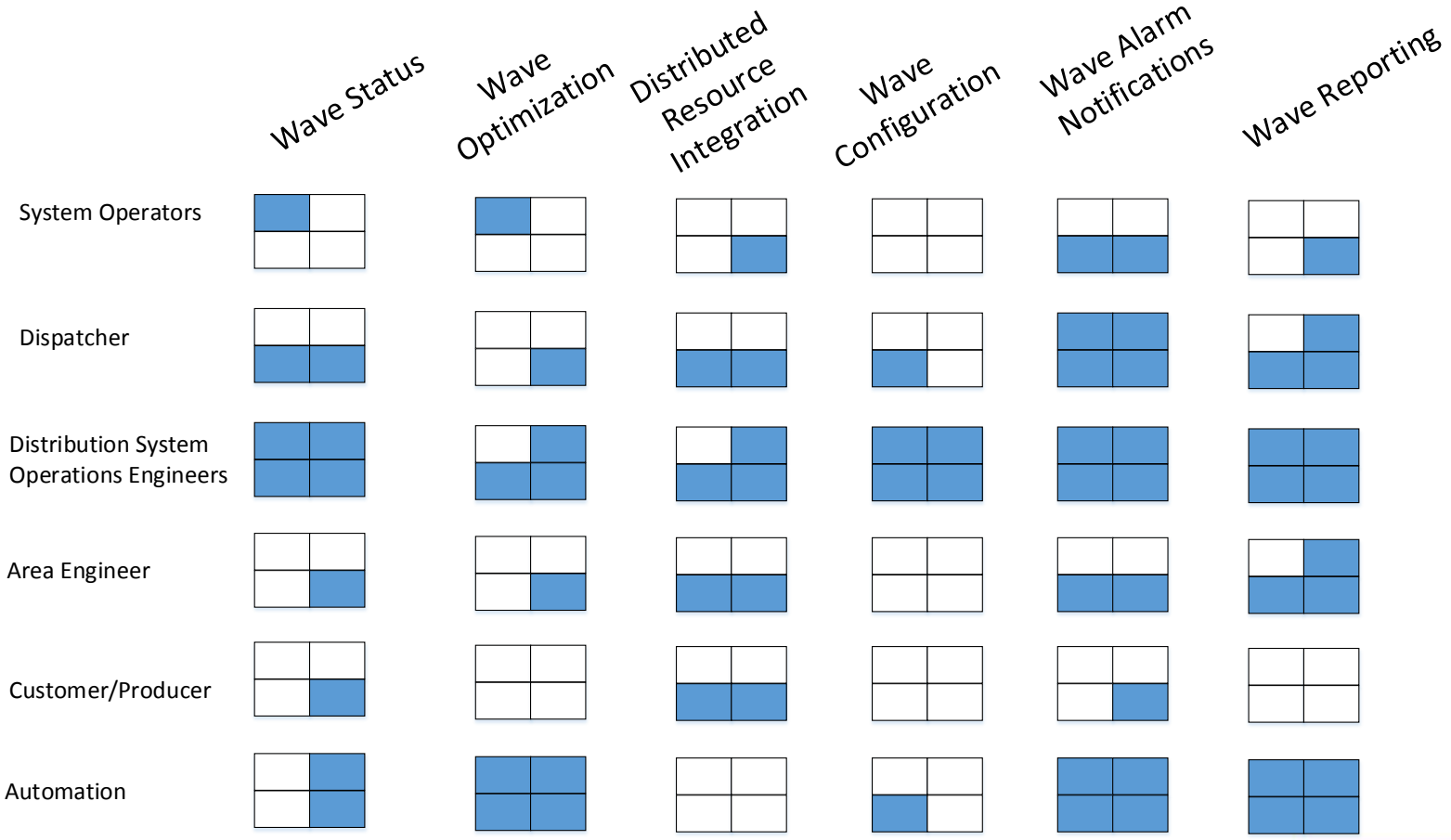
# Deploy - Building the Distribution System Platform



# Operate – Evolving Technology Platform



# Operate - Distributed Energy Resource Capability Matrix



# Questions

Industry for Regional-to-Global Impact
Panel session moderated by Jud Virden, Associate Laboratory Director, Energy & Environment, Pacific Northwest National Laboratory
Panelists:
Michael Atkinson
North American Region General Manager, GE Grid Solutions
Curtis Kirkeby
Curtis Kirkeby
Fellow Technology Strategy, Avista Utilities
Bert Van Hoof
Group Program Manager, Microsoft Corporation
Dave Cuthbert
Senior Solutions Architect, Amazon Web Services
Grid Solutions
AVISTA Utilities
Microsoft
amazon web services