



Transactive Energy in the Northwest – An Avista Utility Perspective

Presented by:

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Who is Avista Utilities?



- Founded in 1889 as Washington Water Power Company
- Changed name in 1999
- Celebrated 125th Anniversary in 2014



- Investor-owned, regulated gas and electric utility
- Headquarters in Spokane, WA
- 1,680 employees
- 369,000 Electric customers
- 329,000 Natural Gas customers
- Serves Washington, Idaho and Oregon

Avista's 126 Year History of Innovation

The Itron logo features the word "Itron" in a bold, red, italicized sans-serif font. A yellow lightning bolt graphic is positioned above the letter 'o'.

1903 Longest transmission line in the world
1910 Automatic control for electric range
1911 Automatic electric water heater
1915 Largest dam in the world with largest generator
1977 Established Itron

The ReliOn logo consists of the words "Reli" and "On" in a bold, black, sans-serif font, separated by a vertical blue line. Below the line are two blue circles containing white plus and minus signs, respectively, with a registered trademark symbol to the right.

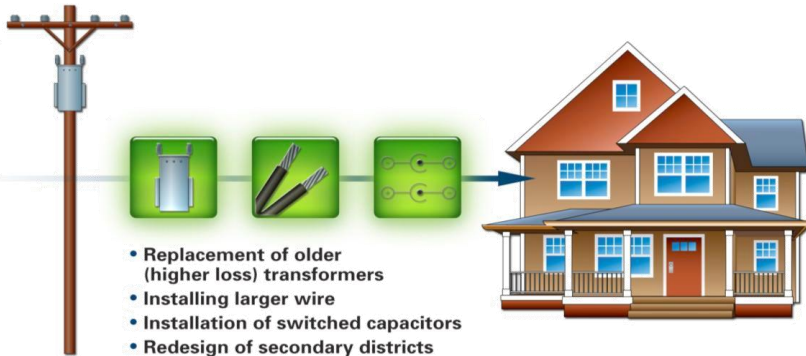
1983 First bio-mass plant in the world
1991 Developed first client-server CIS
1995 Established Ecova (sold to GDF Suez)
1996 Established Reli-On fuel cell company (sold to Plug Power)

The ecova logo features the word "ecova" in a lowercase, blue, sans-serif font with a registered trademark symbol.

2001 Developed the first GIS based OMS
2009-2013 Three ARRA smart grid grants
2015 Largest vanadium flow battery in north America and Europe
2015 Largest community solar in WA state

Pacific Northwest Smart Grid Demonstration Project

Smart Grid Investment Grant



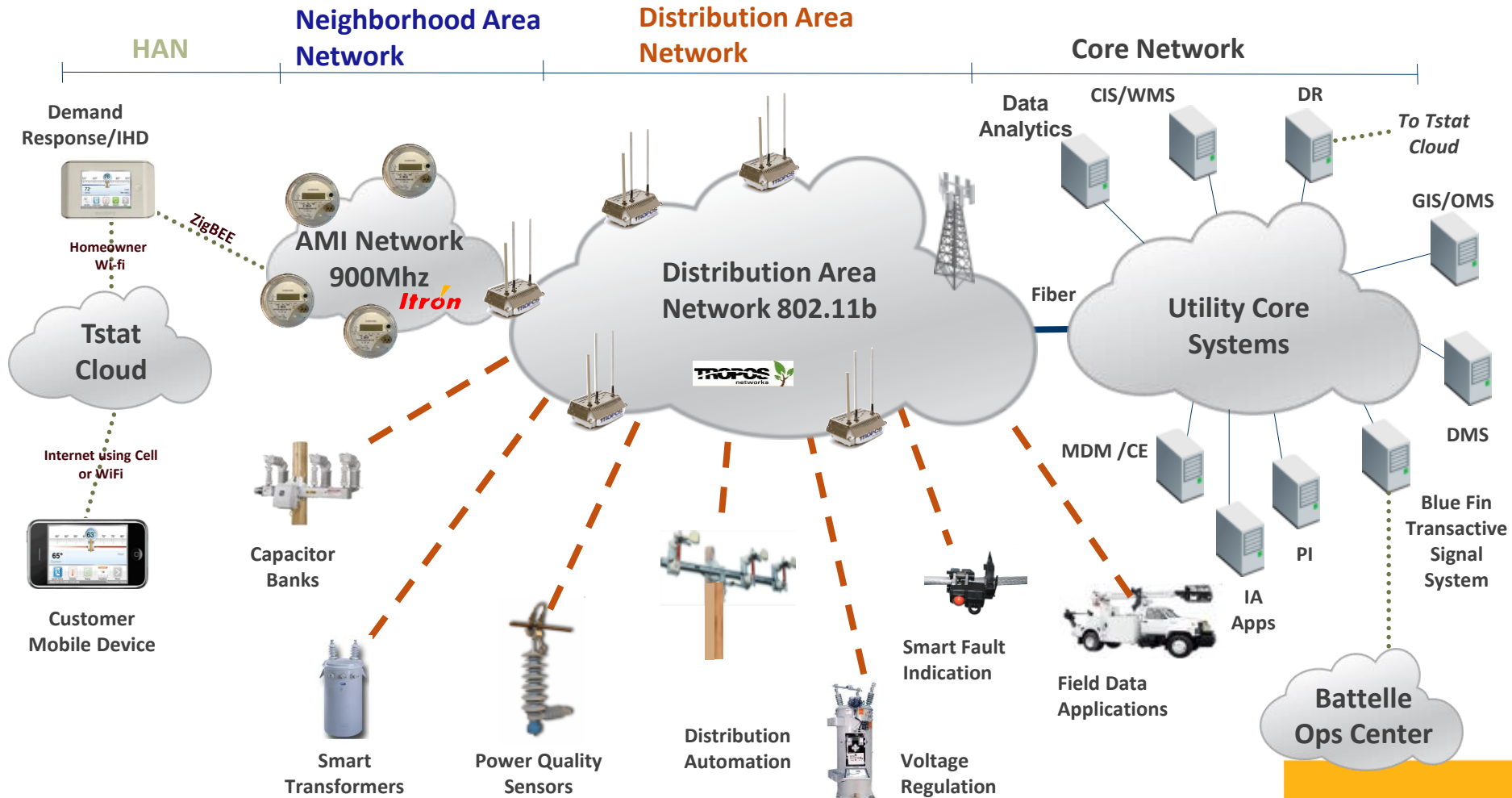
Smart Grid Workforce Training Grant



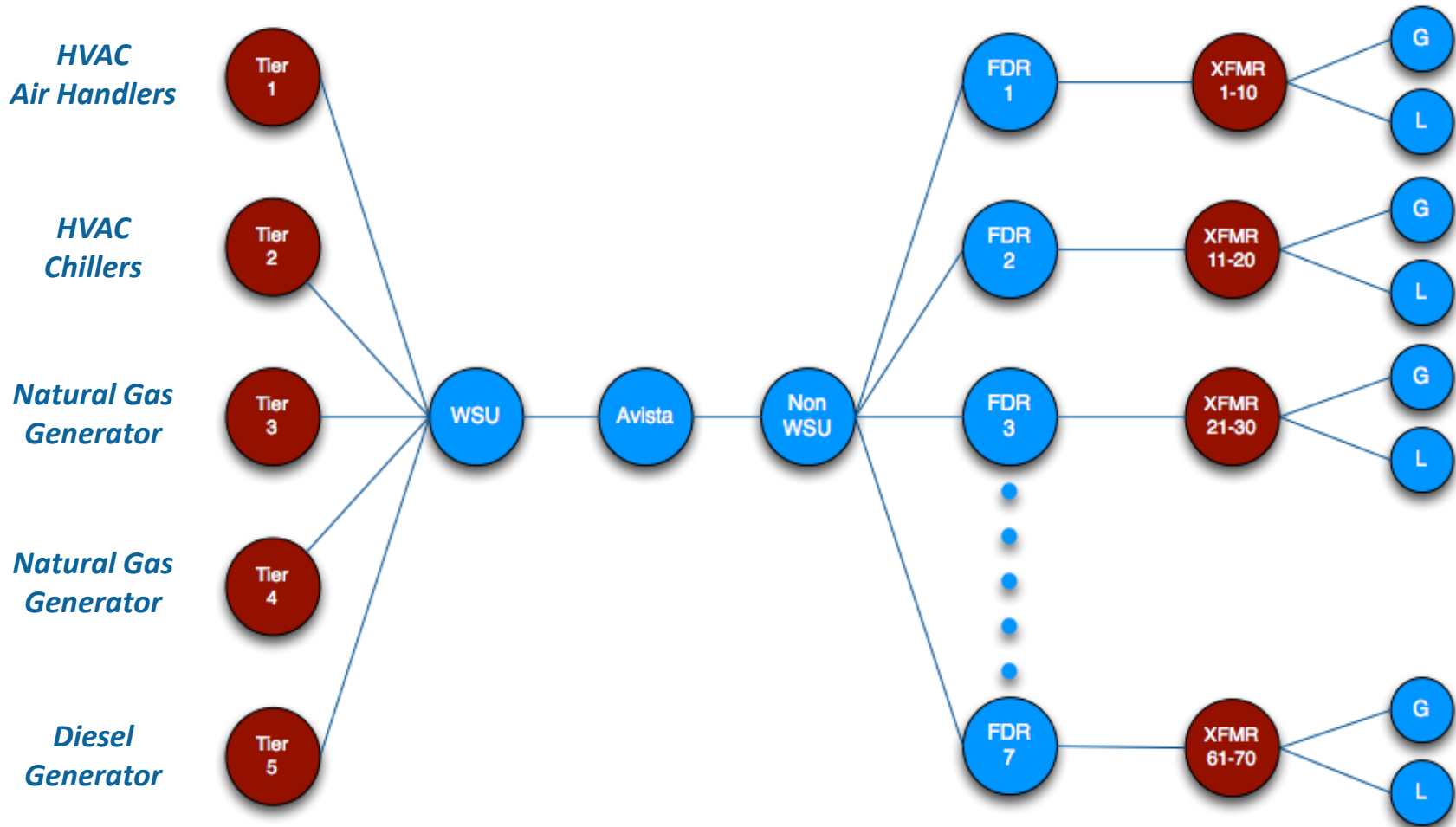
Smart Grid Demonstration Project



Smart Grid Infrastructure



Transactive Heirarchy

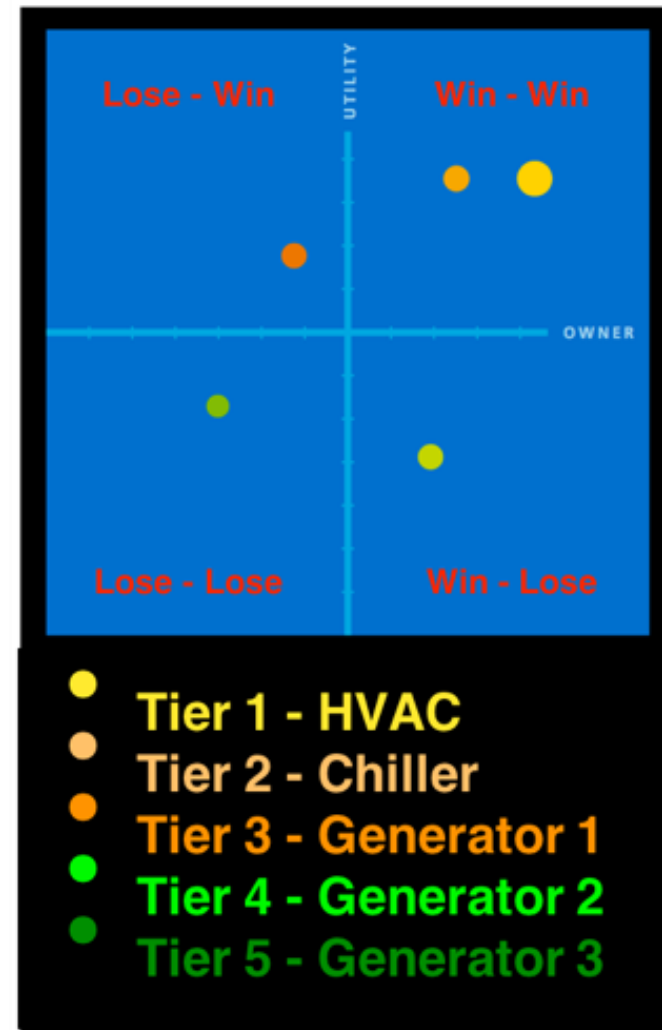


Localized Marginal Value (LMV)

Localized Marginal Cost (LMC)

Four Quadrant Valuation

- Five WSU Tiers
- Multiple Thermostat Tiers
- Leverages Forward Prediction, Real-Time Adjustment of Prediction
- Achieved Automated Prediction of Quantity and Value
- Achieved Manual Scheduling, with Full Automation Desired (5 minute intervals)



Avista's Energy Storage Project

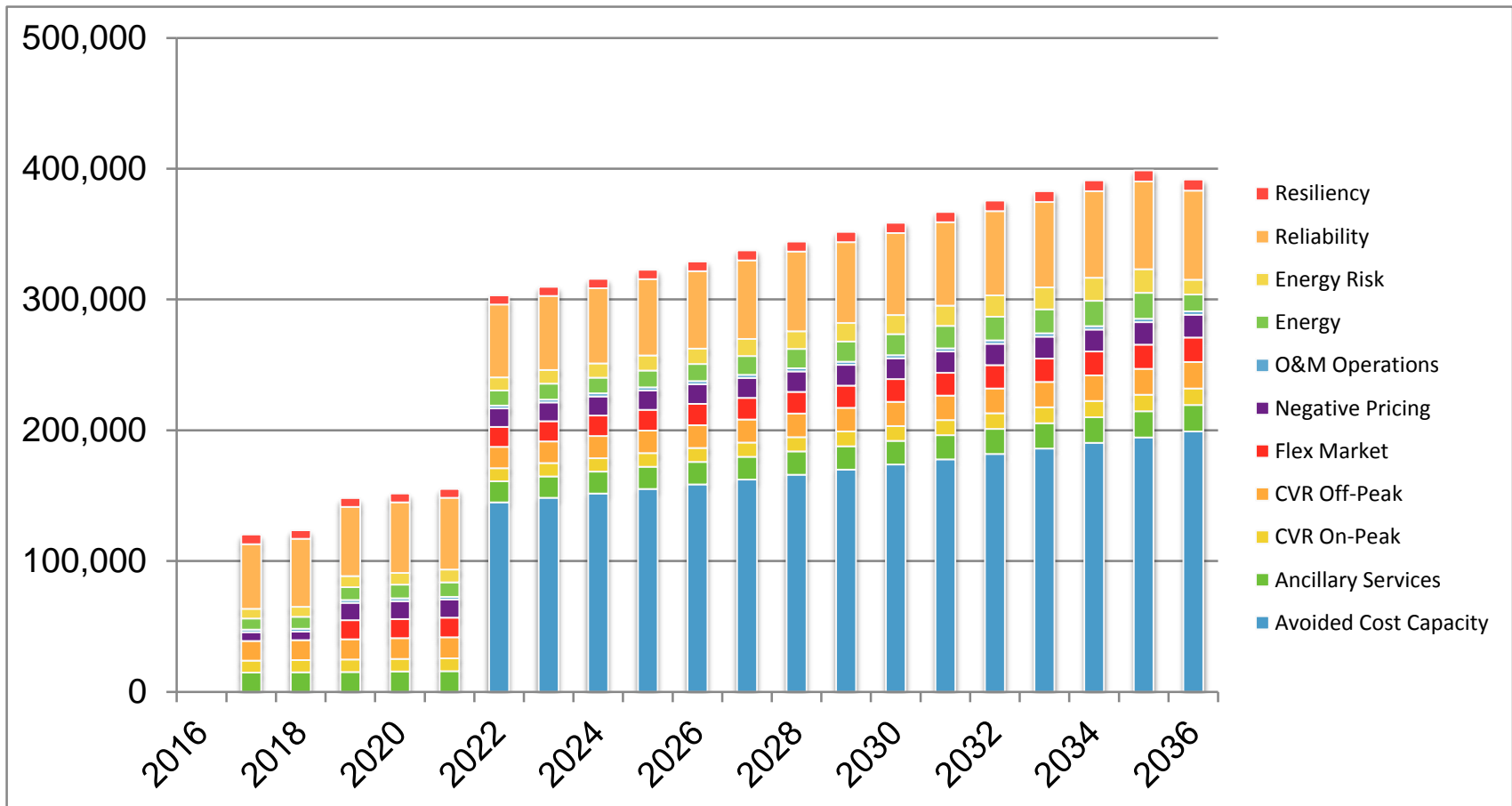
Explore how energy storage can help deliver stacked values for the electrical grid and customers; more **flexible, reliable and resilient**

- 1MW, 3.2MWh battery storage system
- \$7M project
 - \$3.2M Clean Energy Fund
 - \$3.8M Avista matching
- Operating since April 2015 in Pullman, WA



Stacking & Optimizing Values

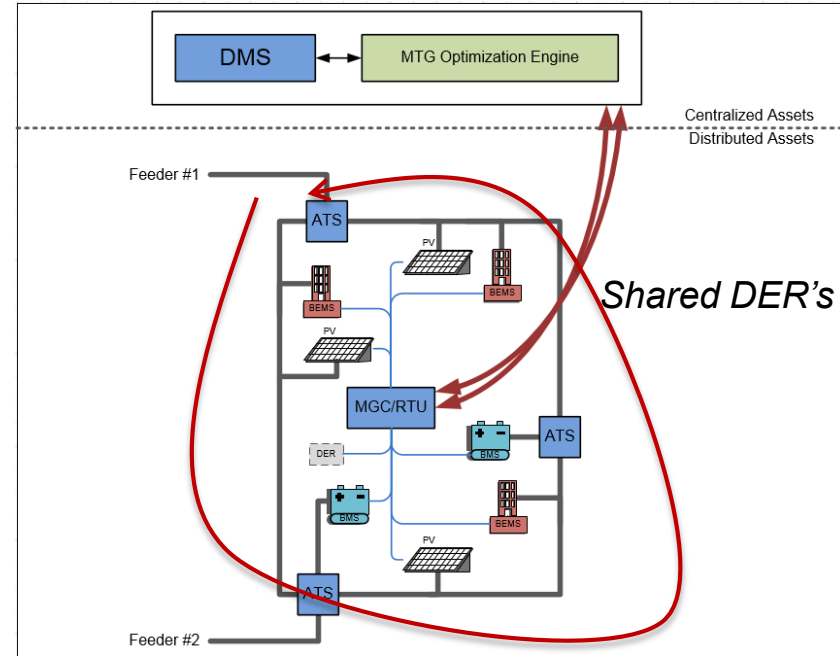
Stacked Values in \$/Year



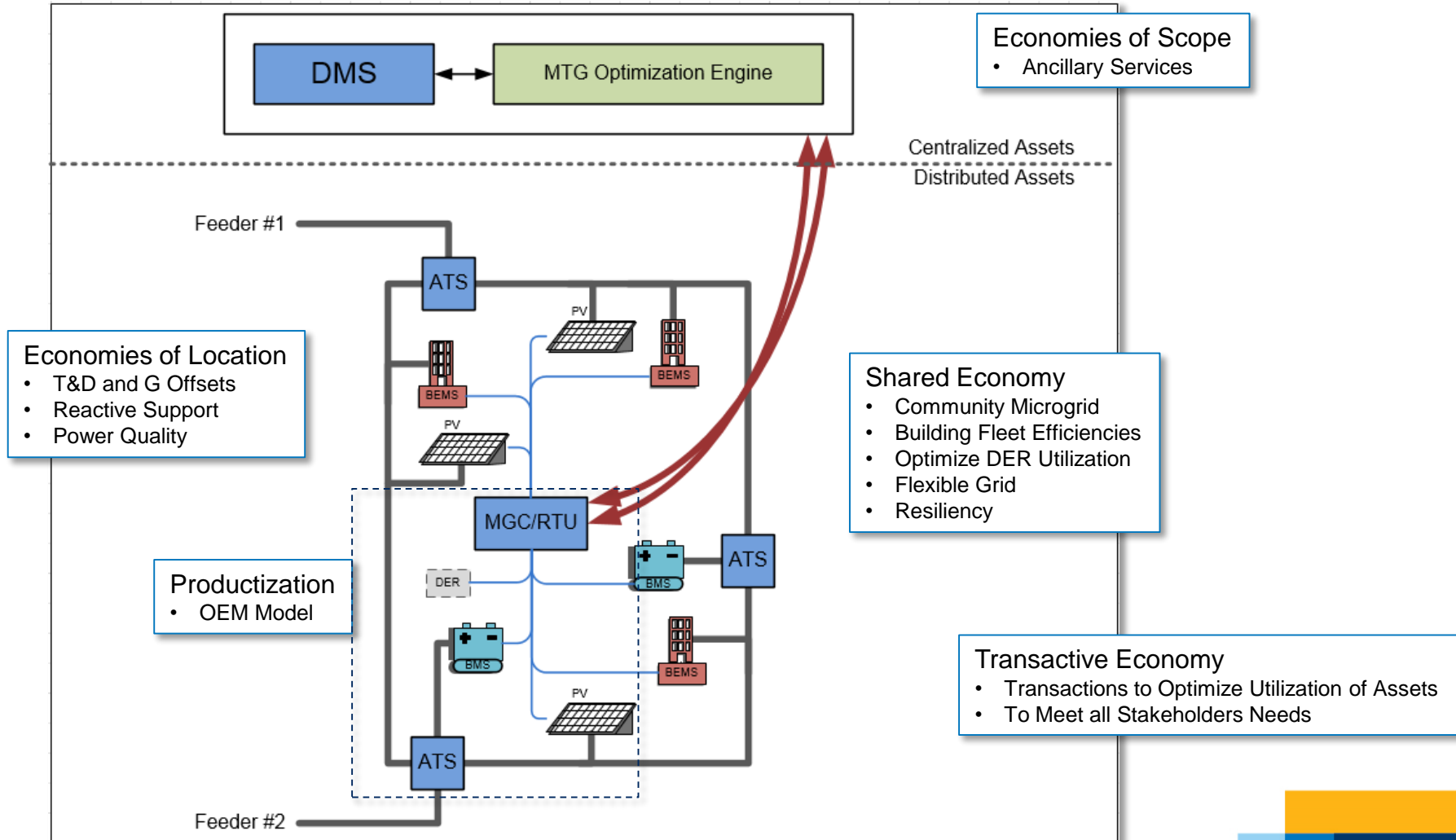
MicroGrids Enable the Shared Economy



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

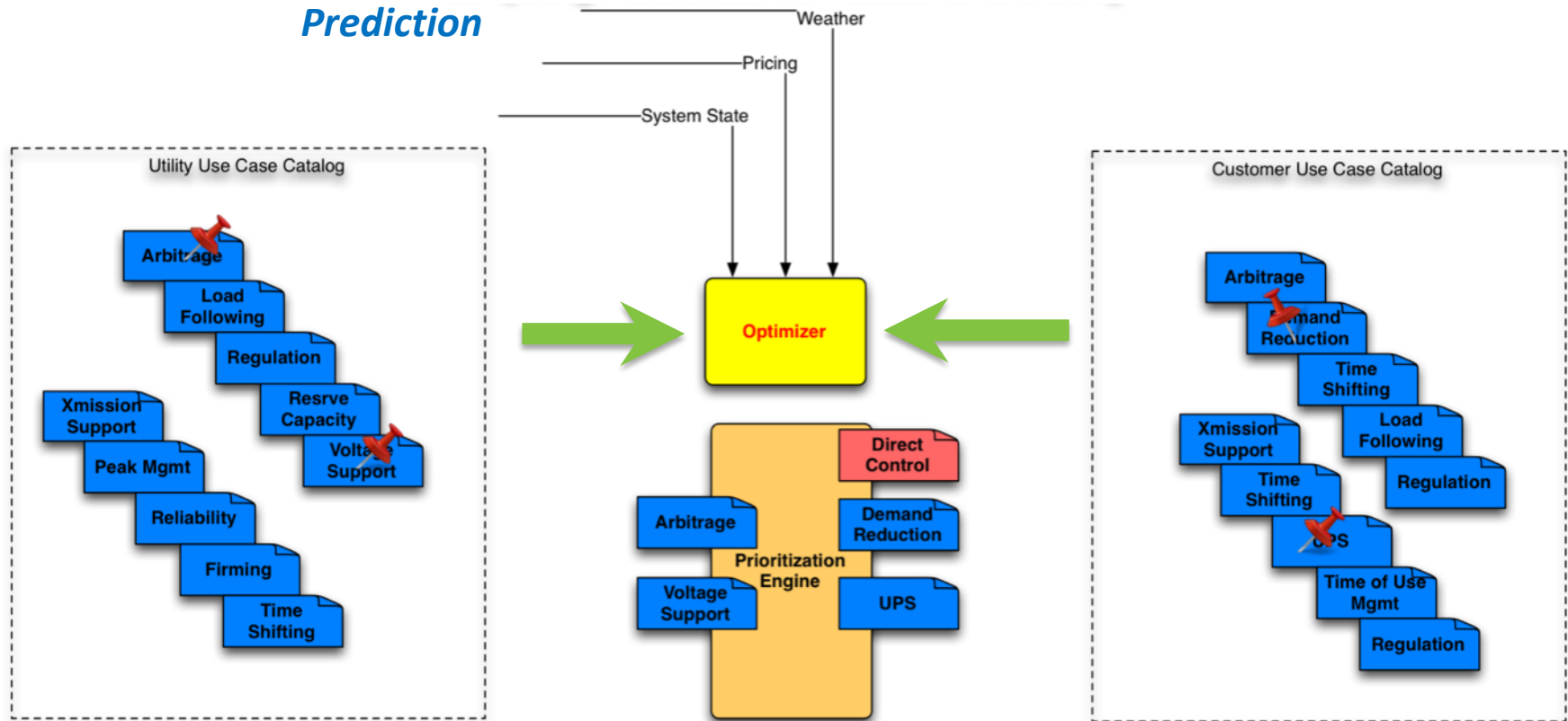


The Vision: A Micro Transactive Grid



Economic & Grid Use Cases Optimized for Maximum Value Transactions

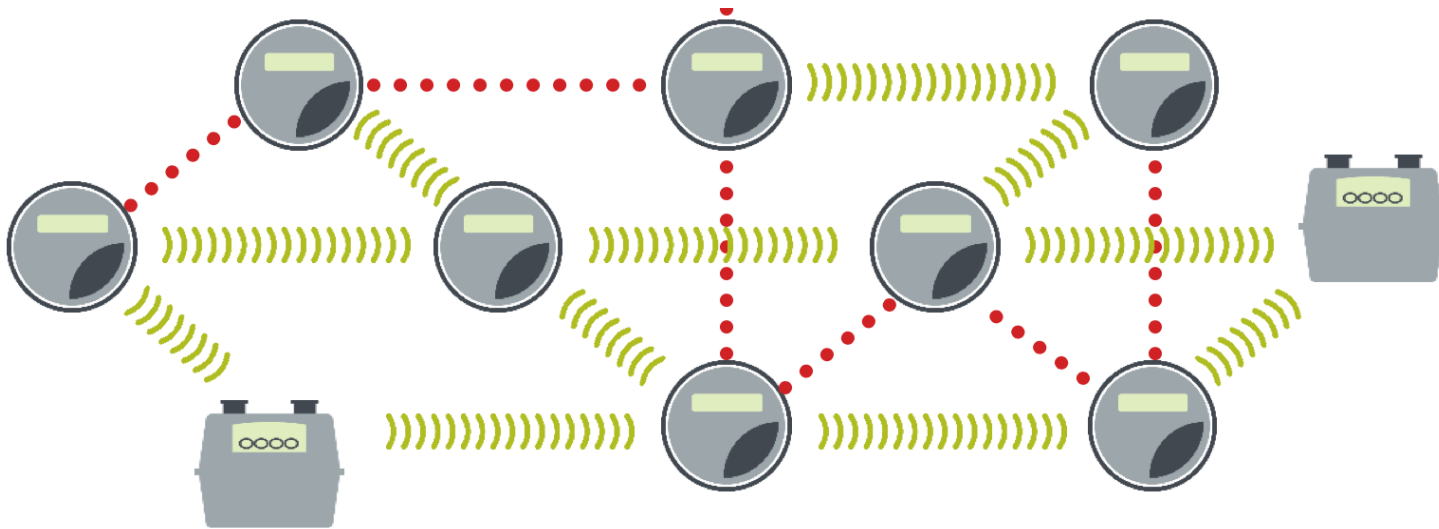
Prediction



Intelligence at the Edge

Taking the Vision to the Edge

- Intelligent Grid Edge Agents
- Peer-to-Peer Transactions
- Peer-to-Peer Control
- Resiliency Services
- Electrical Locational Awareness
- Power Quality Assessment
- Forecasting & Optimization



Questions?