

# Committee on Water

ENERGY TECHNOLOGIES AREA

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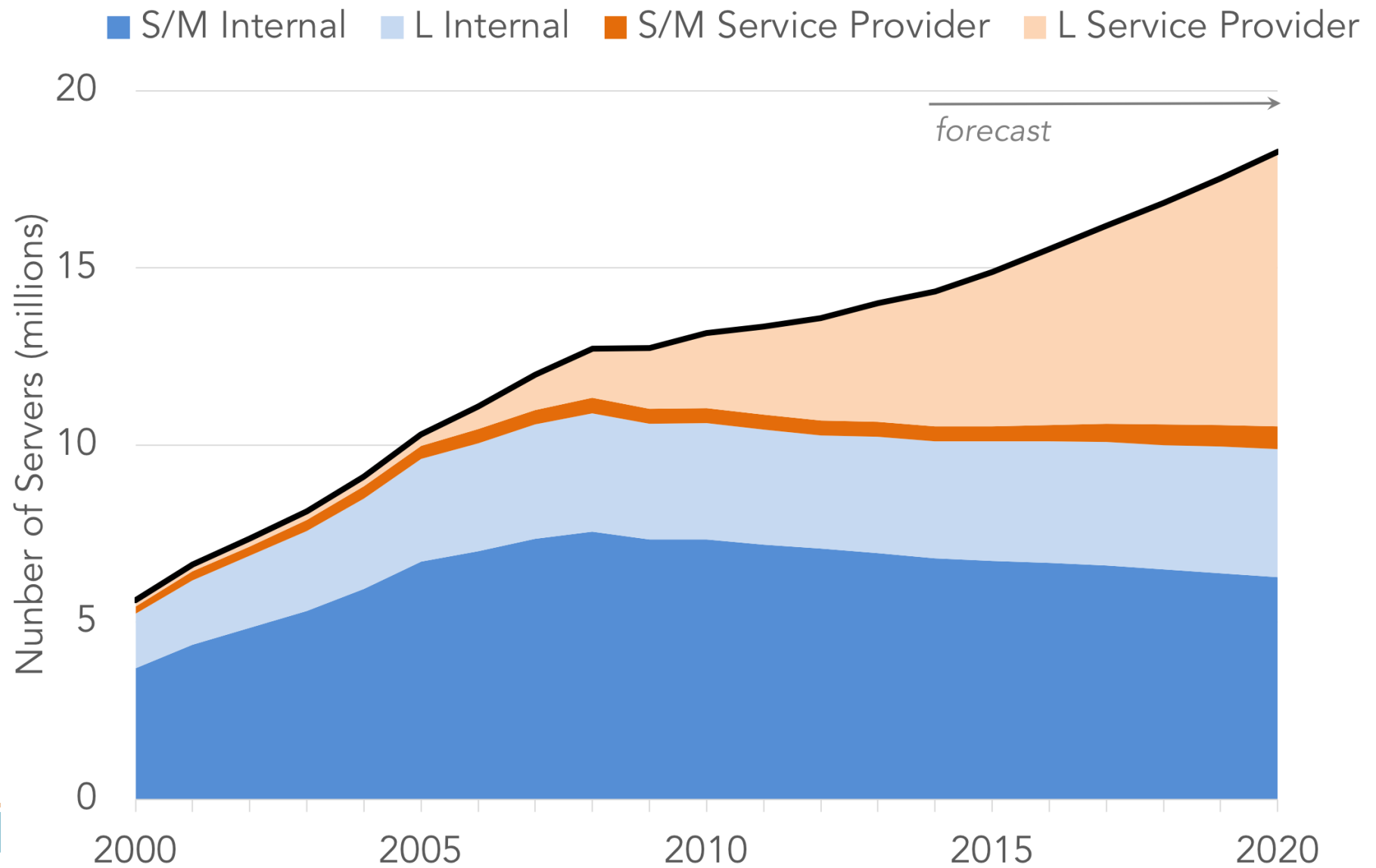
LAWRENCE BERKELEY NATIONAL LABORATORY

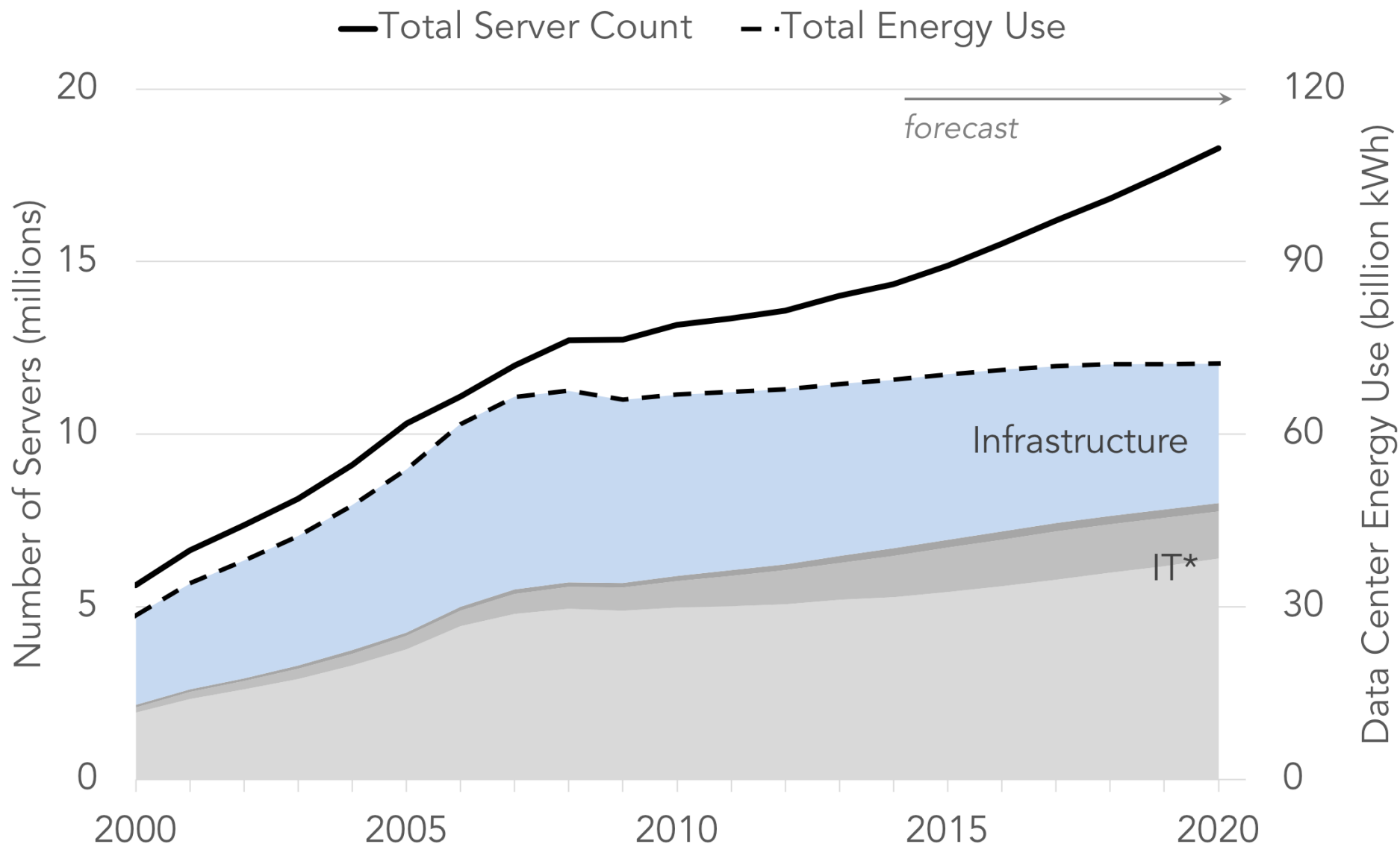
# NARUC Summer Conference

Phoenix, AZ / July 2018

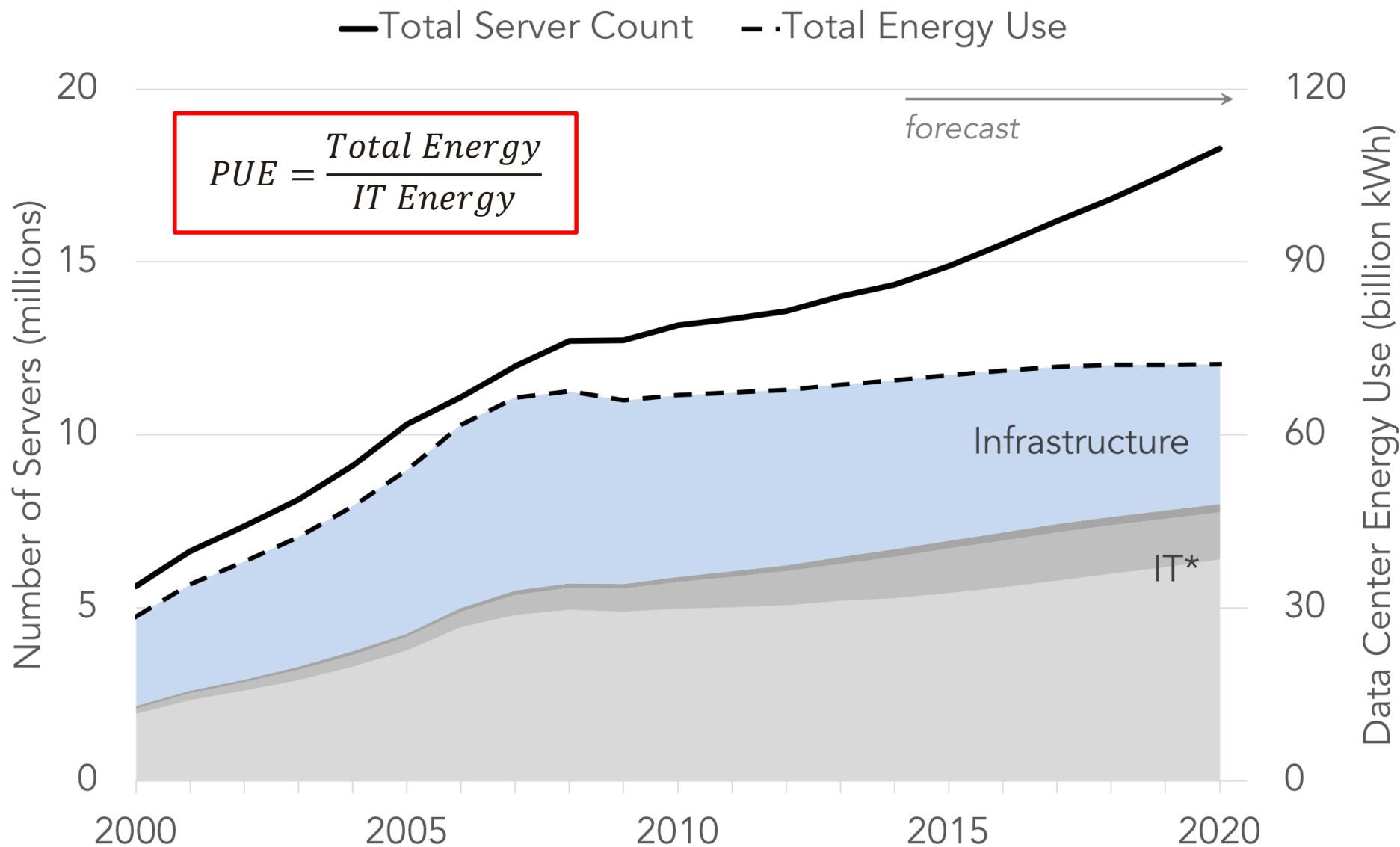
## Data Centers and the Utility

Sarah Josephine Smith, Senior Scientific Engineering Associate



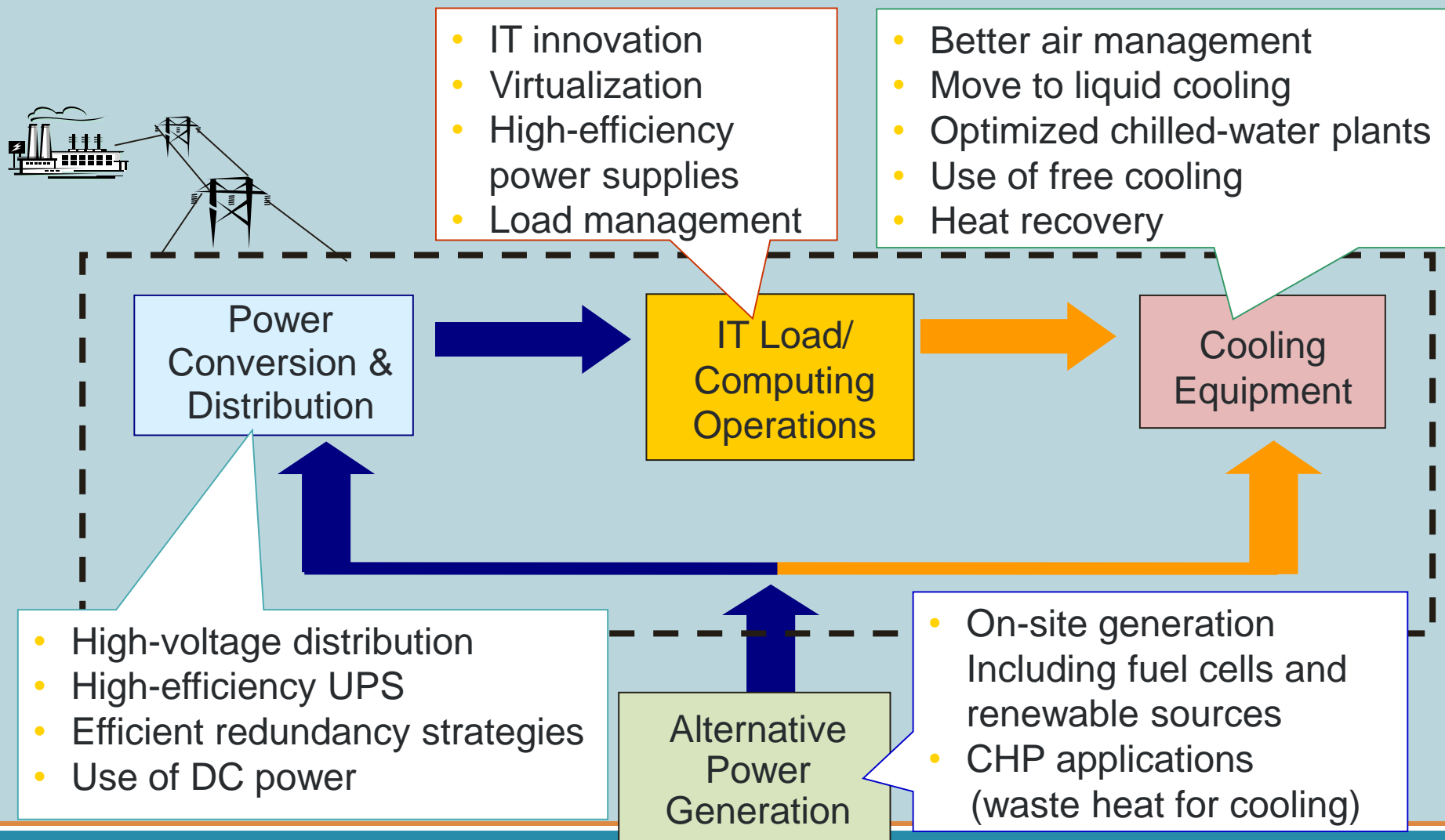


\* IT includes servers, storage, and networking equipment (grey shades, bottom-to-top)



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# ENERGY EFFICIENCY OPPORTUNITIES



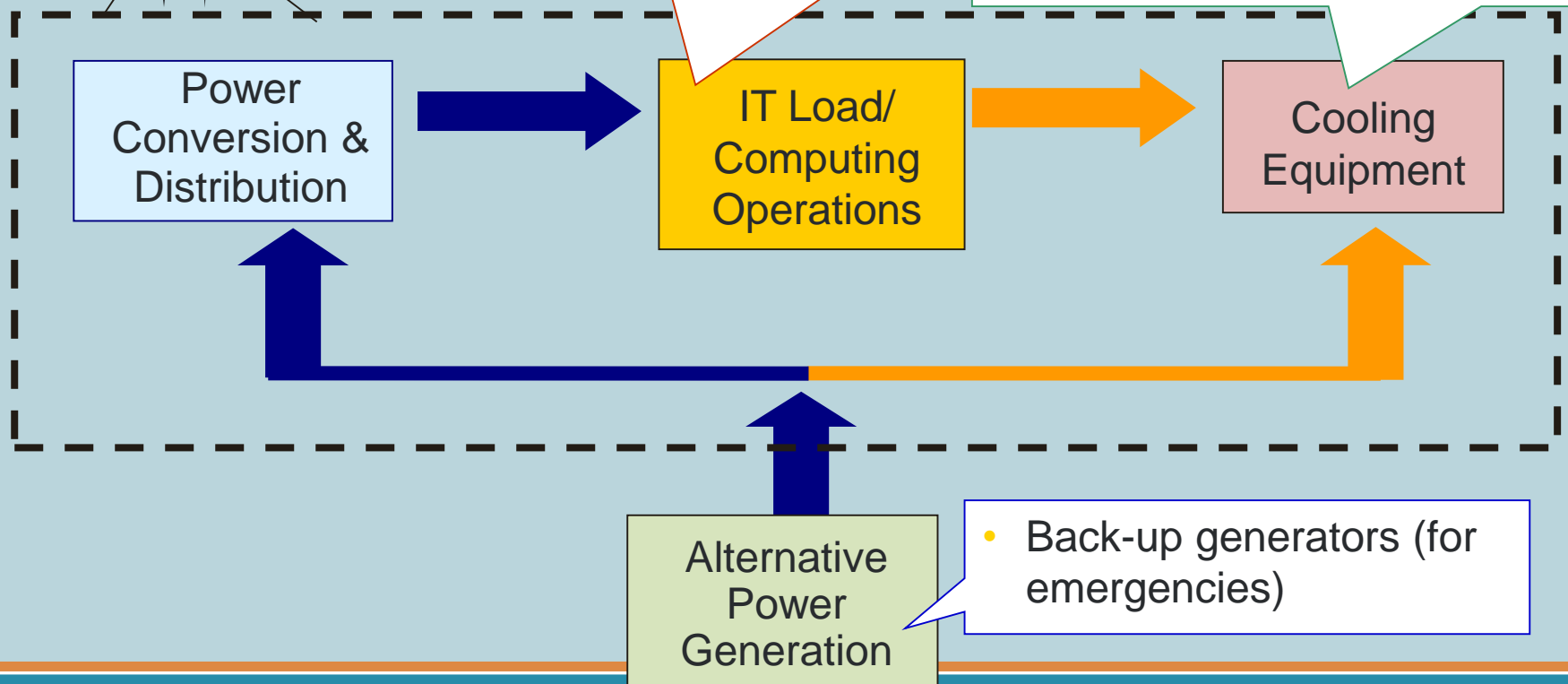
Graphic courtesy of Dale Sartor, LBNL

# DEMAND RESPONSE OPPORTUNITIES



- Load shifting or queuing jobs
- Load migration
- Shutdown of storage clusters
- Server shutdown

- CRAC unit shutdown
- Temperature set point adjustment
- Pre-cooling



# Thank you!

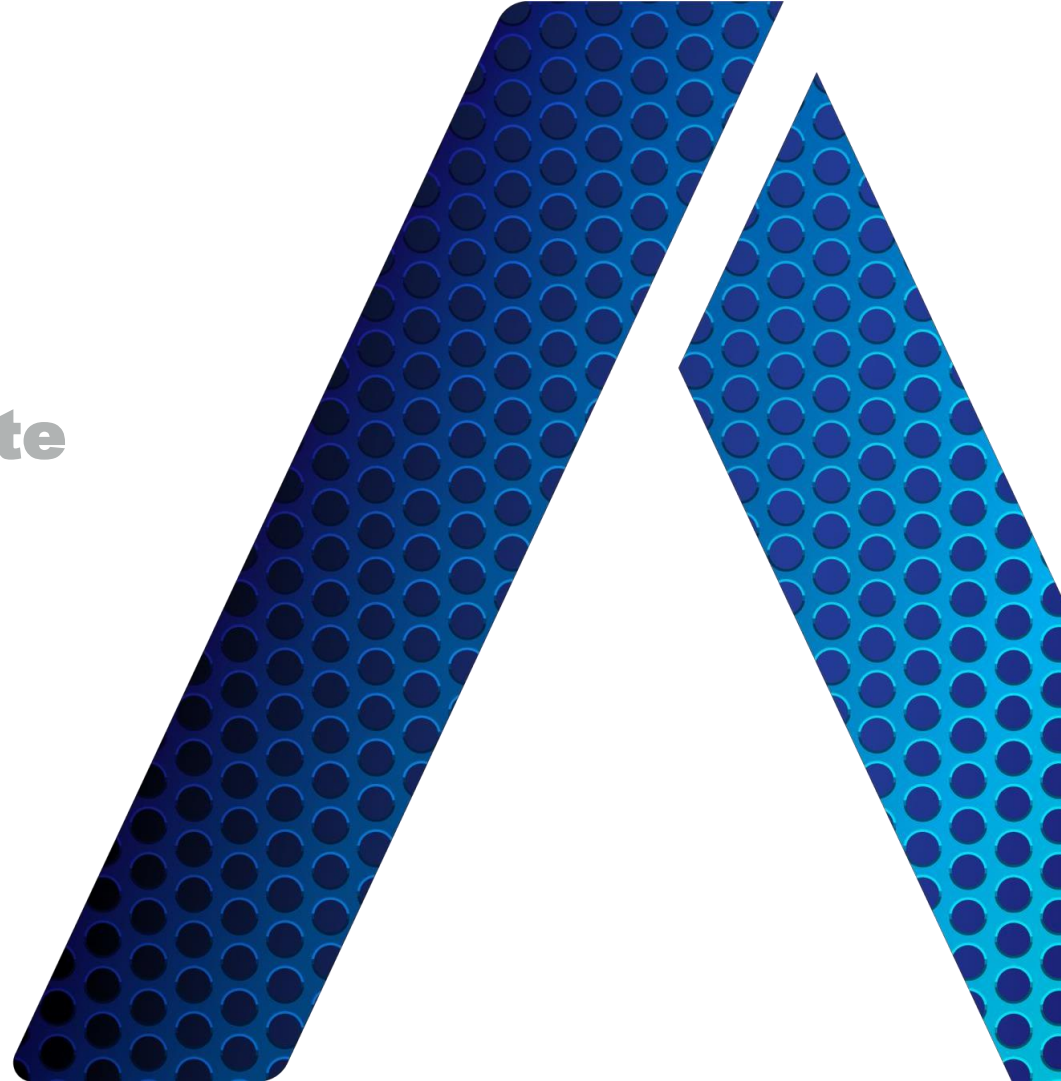
[sjsmith@lbl.gov](mailto:sjsmith@lbl.gov)

# Committee on Water

**Aligned**Energy

# Reducing Water Waste In Data Centers

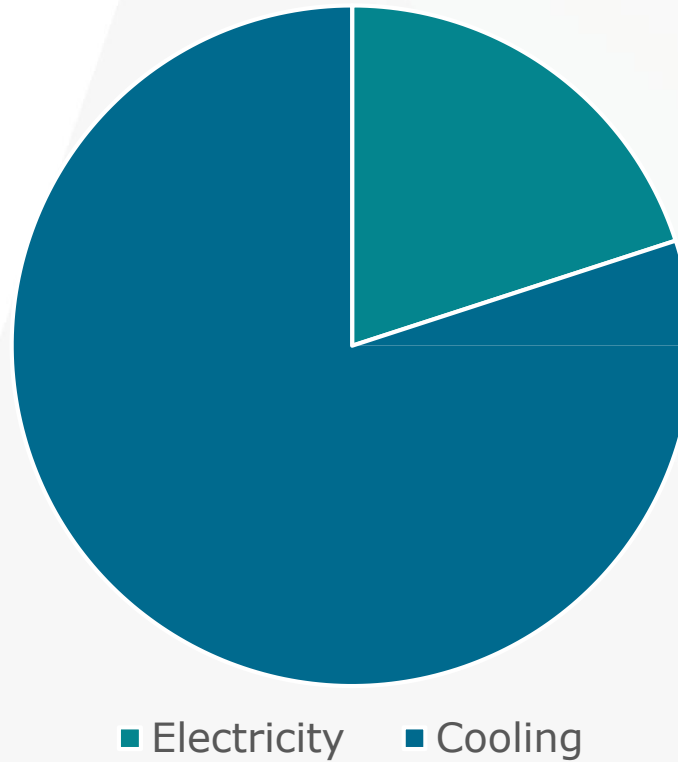
7.17.2018



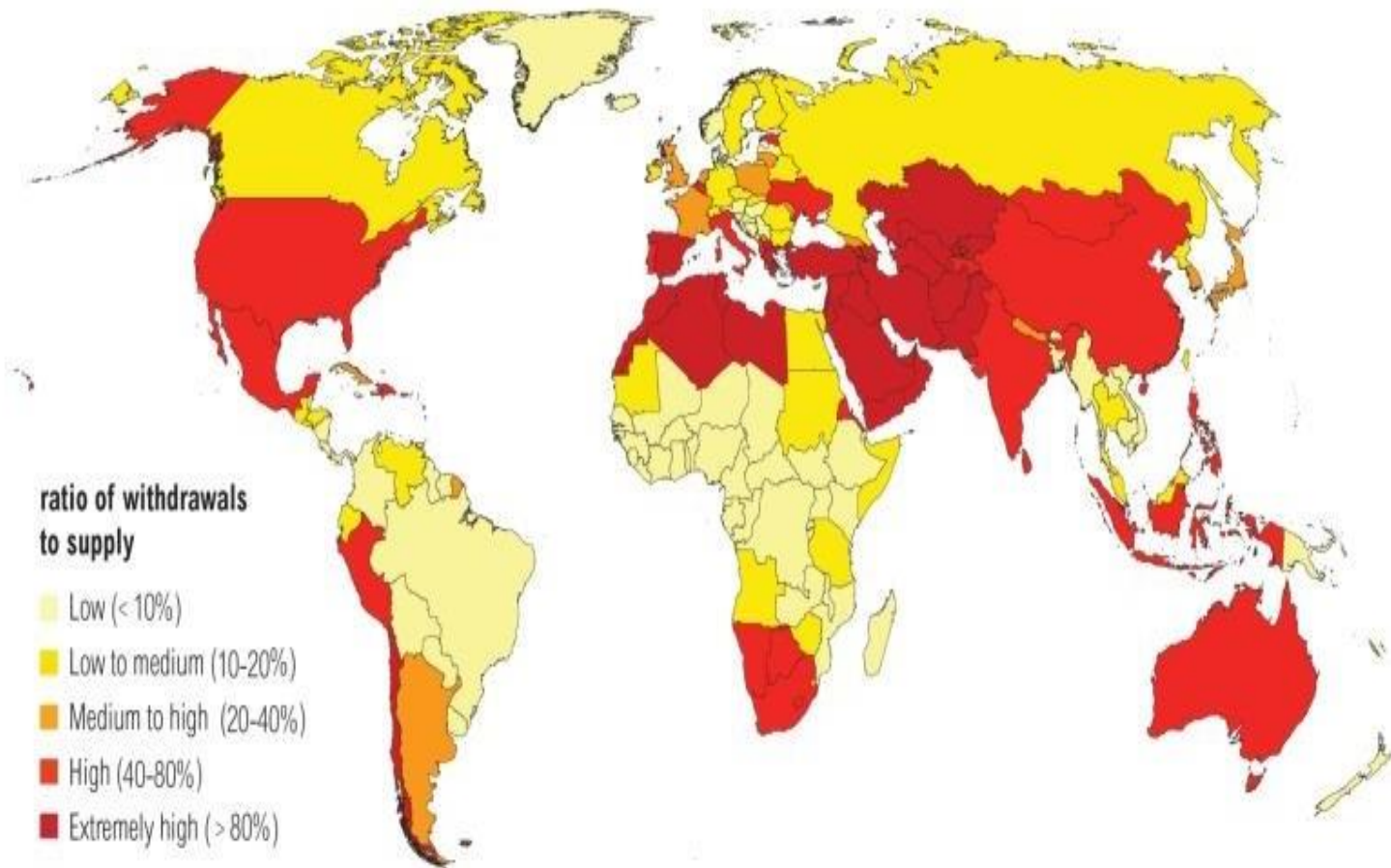
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## Water Use in Data Centers

**438 Million Gallons Per Year  
20 MW Data Center**



## Water Stress by Country: 2040

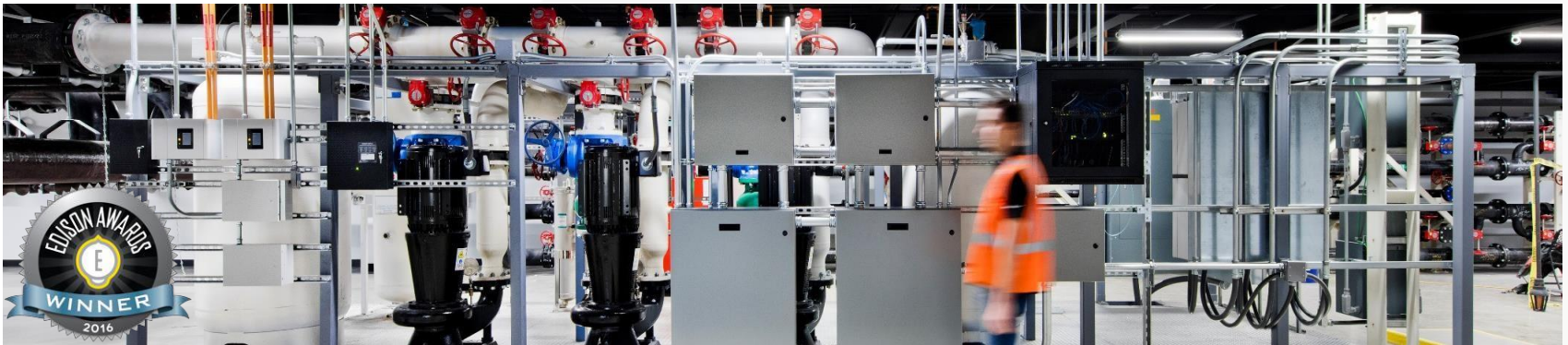


**NOTE:** Projections are based on a business-as-usual scenario using SSP2 and RCP8.5.

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## Aligned Energy Componentized & Pre-Manufactured Infrastructure

By engineering and constructing our solutions around standardized, pre-manufactured infrastructure components we reduce on-site construction time, increasing both capacity delivery velocity and overall systems reliability.



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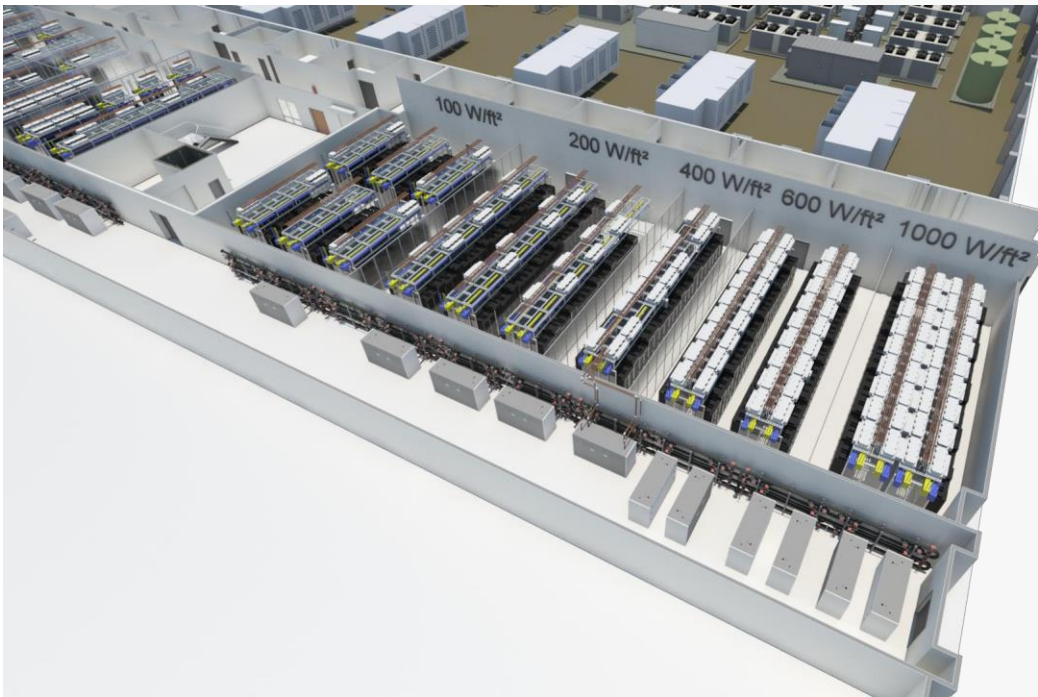
## Cactus Platform Delivers Flexible Density

Designed To Adjust to Any Environmental Condition

Efficient Optimization of Water and Power



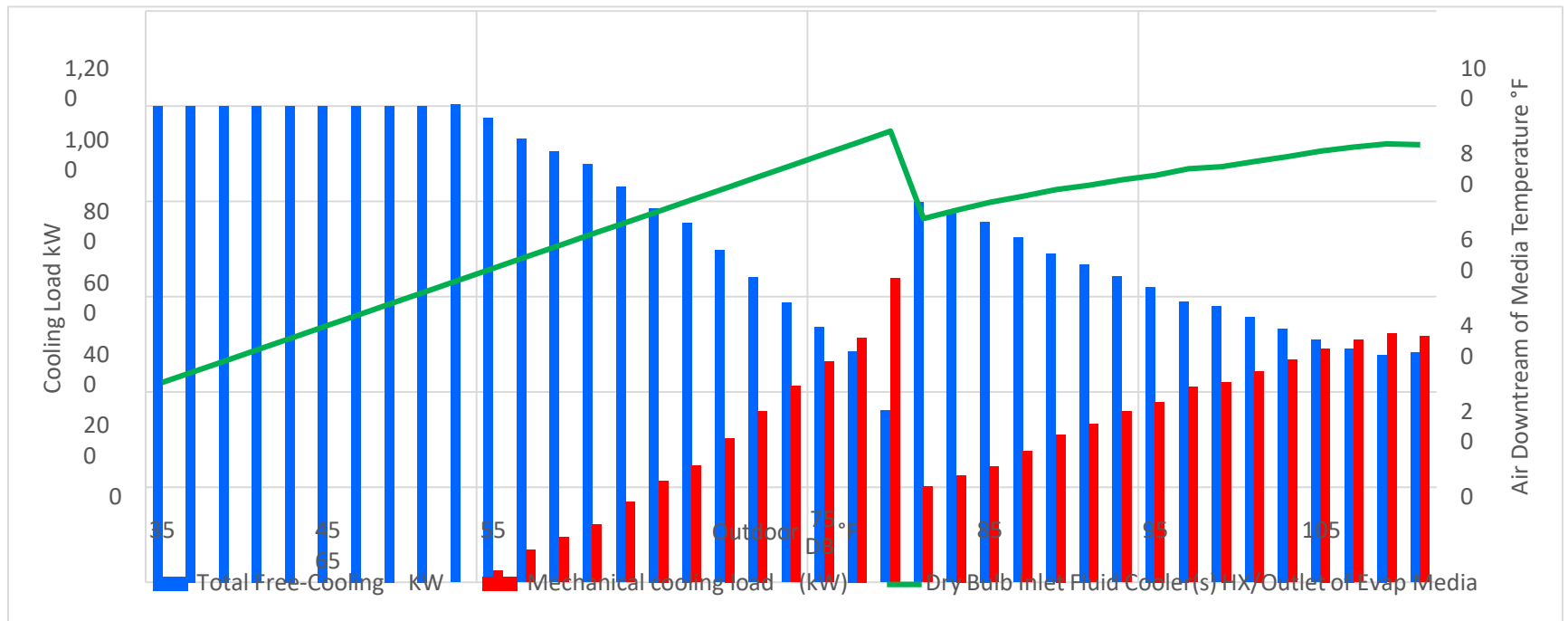
## Flexible Density



- Deploy Any Density On Demand
- Adjust Density From 30 Watts/Sqft to 2,000 Watts/Sqft

# Phoenix, AZ

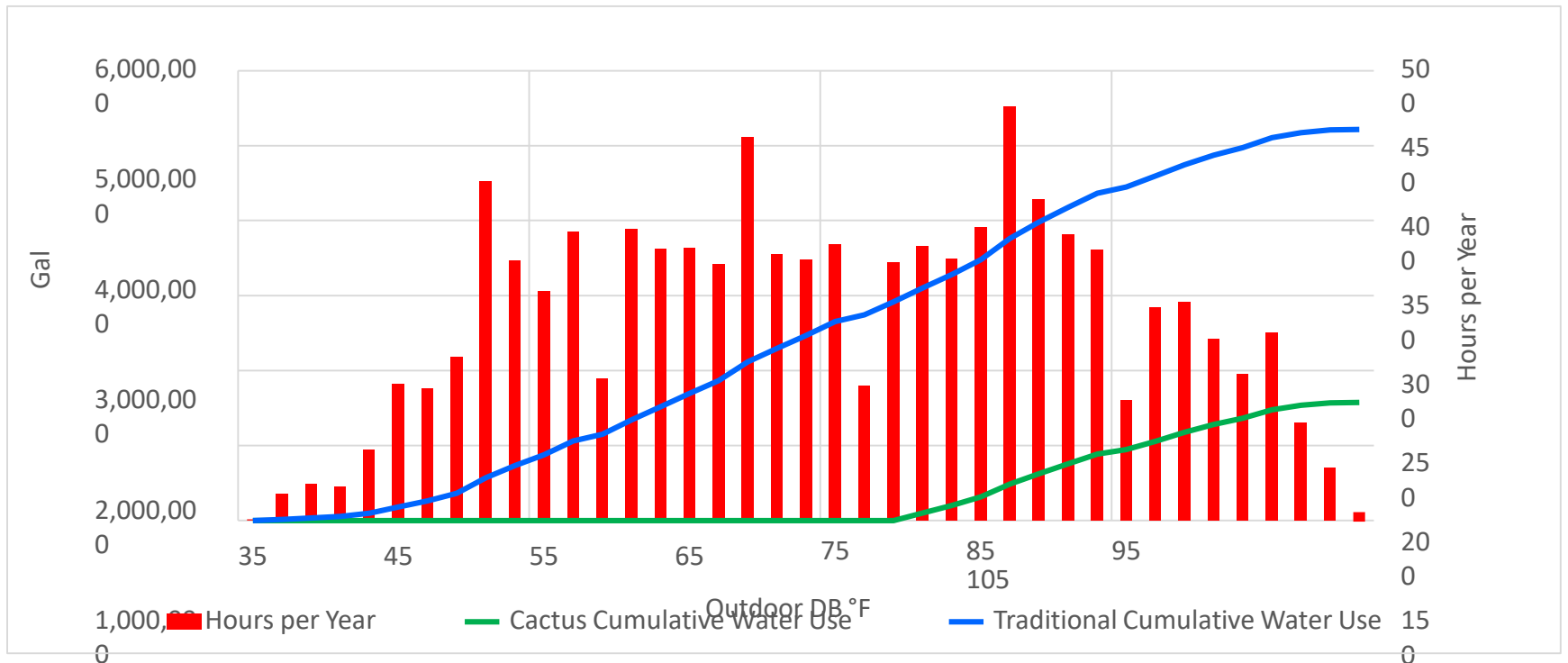
## Cooling Loads and Air Entering FC



# Water Use and Hours per Year versus Outdoor DB

## Phoenix, AZ

### 1 MW of Load



0

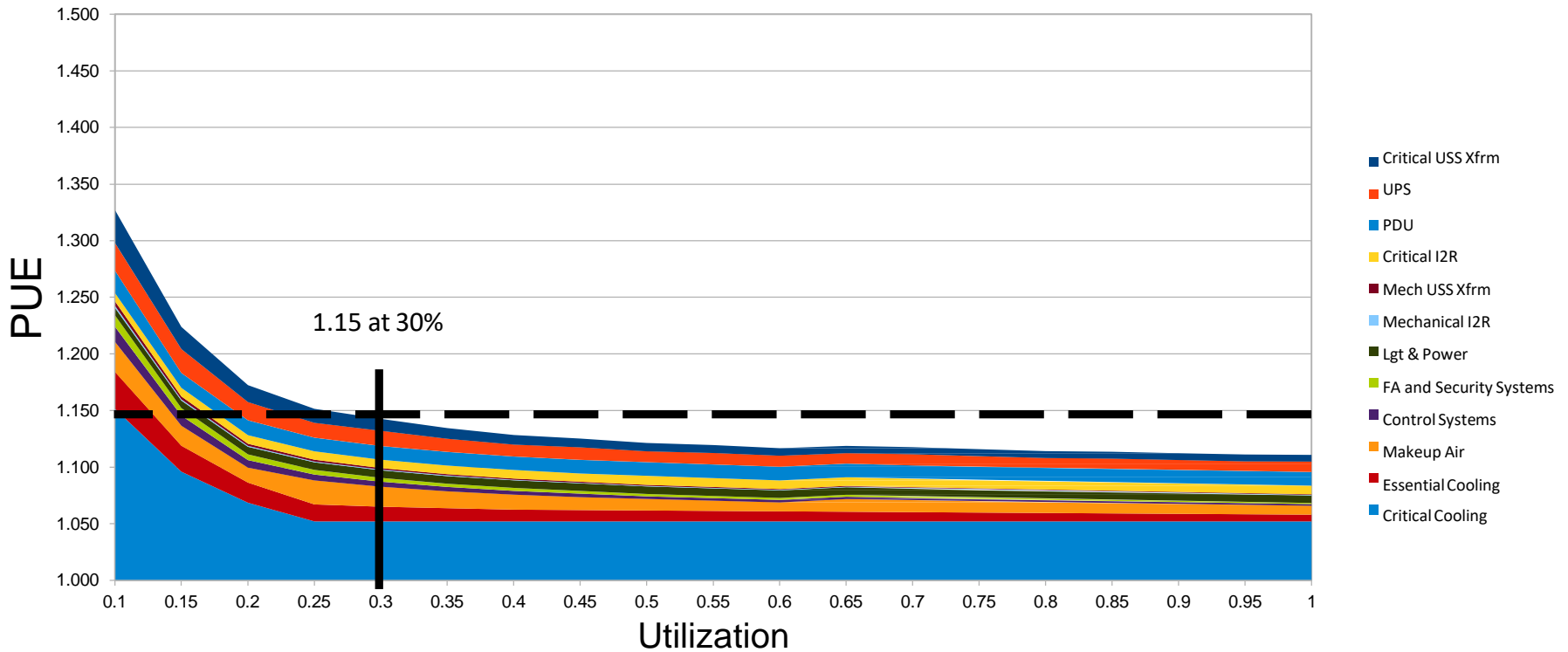
10

50

0

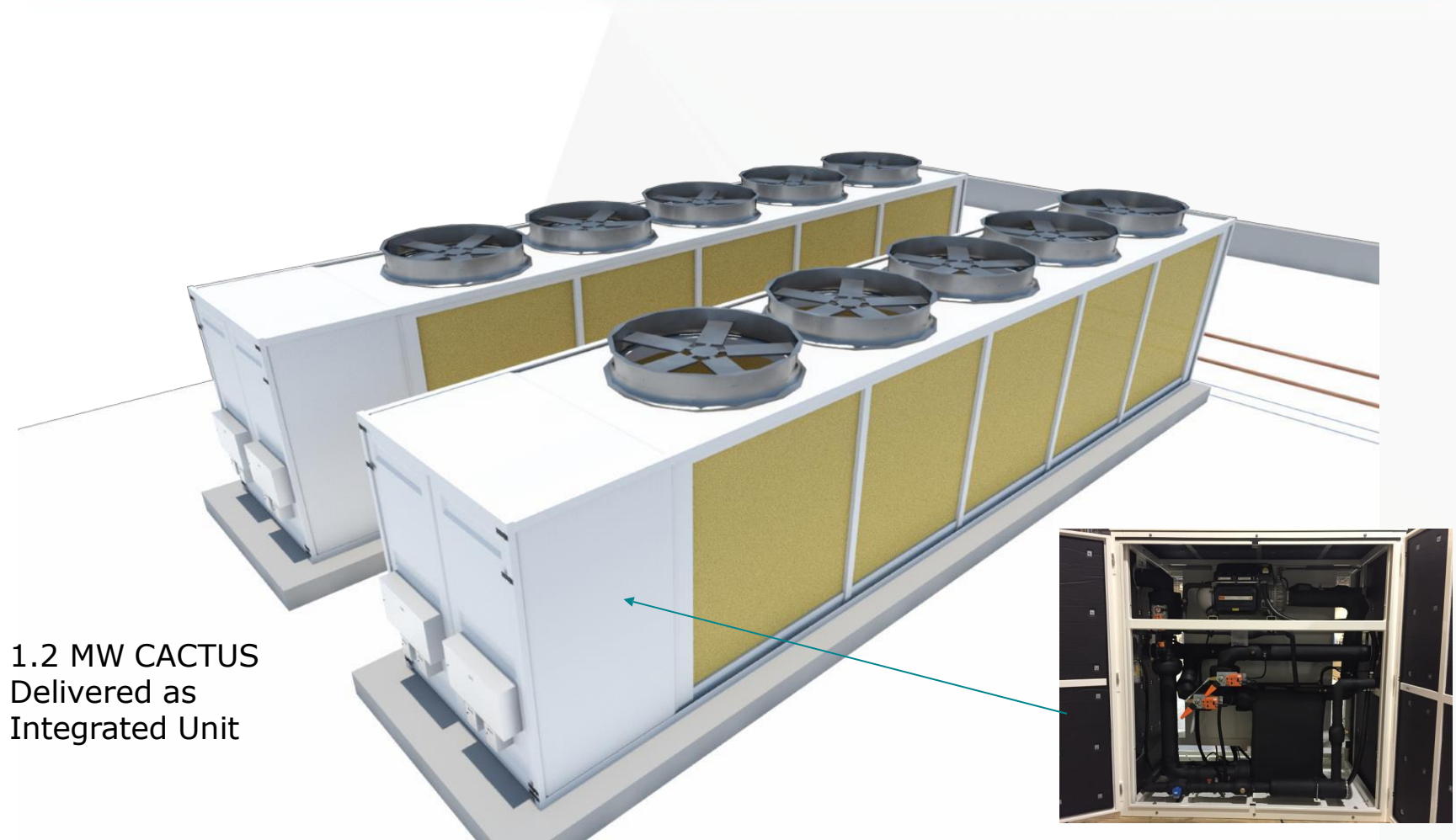
# Aligned Platform

## Phoenix, AZ Total PUE Load Curve



## Next Generation CACTUS Waterless Operation

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# Committee on Water

# Powering Big Data with the Sun

**Lisa Moerner, Director of Corporate Public Policy**



# Dominion Energy Profile

## Primary Operating Segments

### Power Delivery



#### Electric Transmission

- ❖ 6,600 miles of transmission lines
- ❖ Favorable regulatory environment

#### Electric Distribution

- ❖ 57,900 miles of distribution lines
- ❖ 2.6 million franchise retail customer accounts in VA and NC

### Power Generation



#### Utility Generation

- ❖ 22,327 MW of capacity
- ❖ Balanced, diverse fuel mix
- ❖ Favorable regulatory environment

#### Merchant Generation

- ❖ 3,710 MW of capacity, including nuclear, gas and renewable power
- ❖ Active hedging program for energy revenue/margins

### Gas Infrastructure



#### Gas Transmission

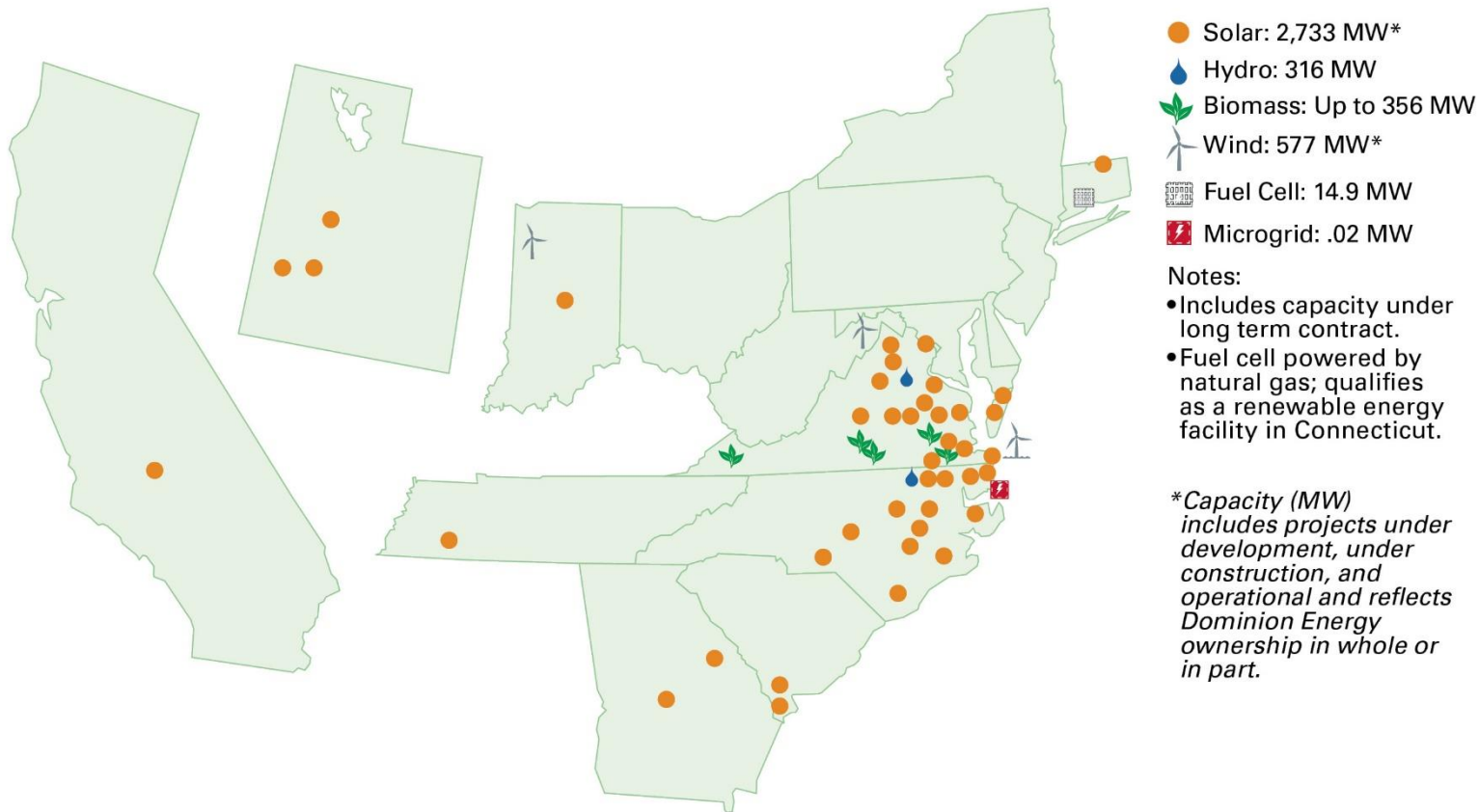
- ❖ Together with Gas Distribution, operates one of the largest natural gas storage systems in the U.S.
- ❖ 14,800 miles of pipeline in 11 states
- ❖ Cove Point LNG facility (bi-directional)
- ❖ Well positioned in Marcellus and Utica Shale regions

#### Gas Distribution

- ❖ 51,800 miles of distribution pipeline and 2.3 million natural gas customer accounts in five states

#### Dominion Energy Solutions

# Dominion Energy Nationwide Renewables Portfolio



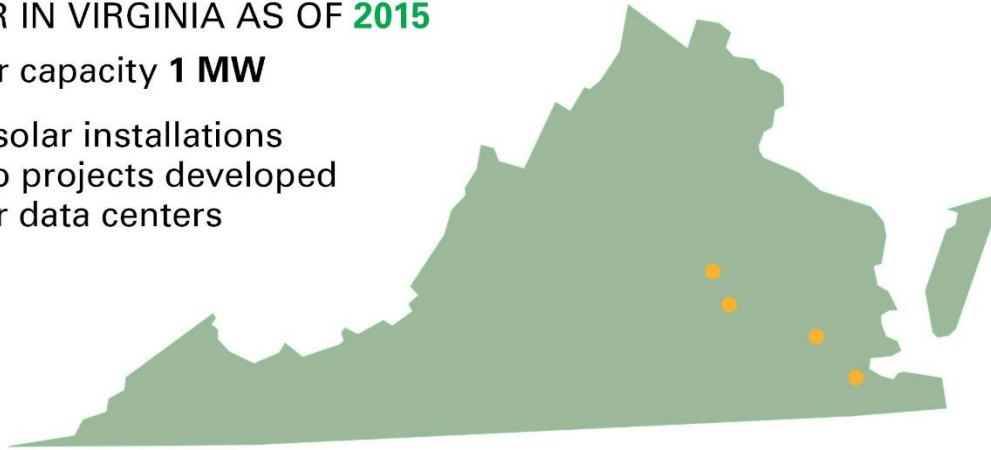
- 6<sup>th</sup> in the nation for solar ownership among utility holding companies.
- 2,700 MW+ of solar capacity in operation or under development across 9 states.
- 580 MW of solar in Virginia in partnership with data centers.

# Dominion Energy's Solar Portfolio – 2015 vs. 2018

## SOLAR IN VIRGINIA AS OF 2015

- Solar capacity **1 MW**

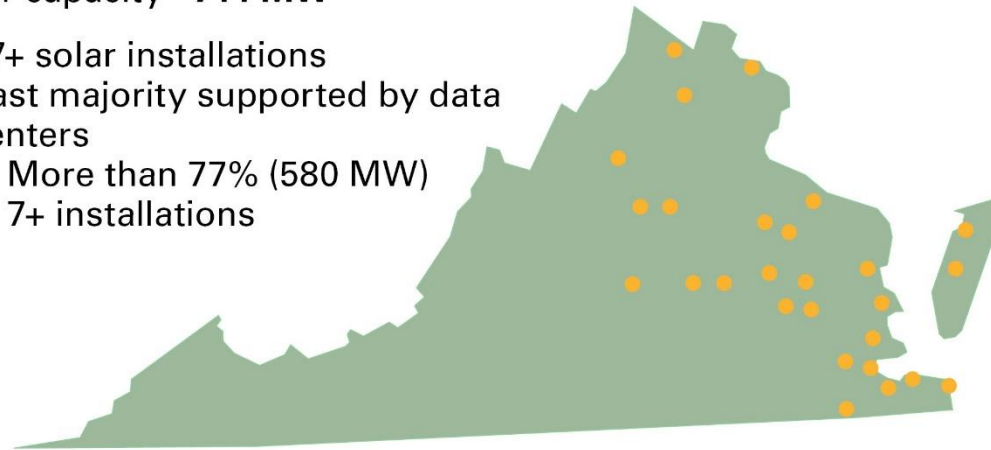
- 4 solar installations
- No projects developed for data centers



## SOLAR IN VIRGINIA AS OF 2018

- Solar capacity\* **744 MW**

- 27+ solar installations
- Vast majority supported by data centers
  - More than 77% (580 MW)
  - 7+ installations



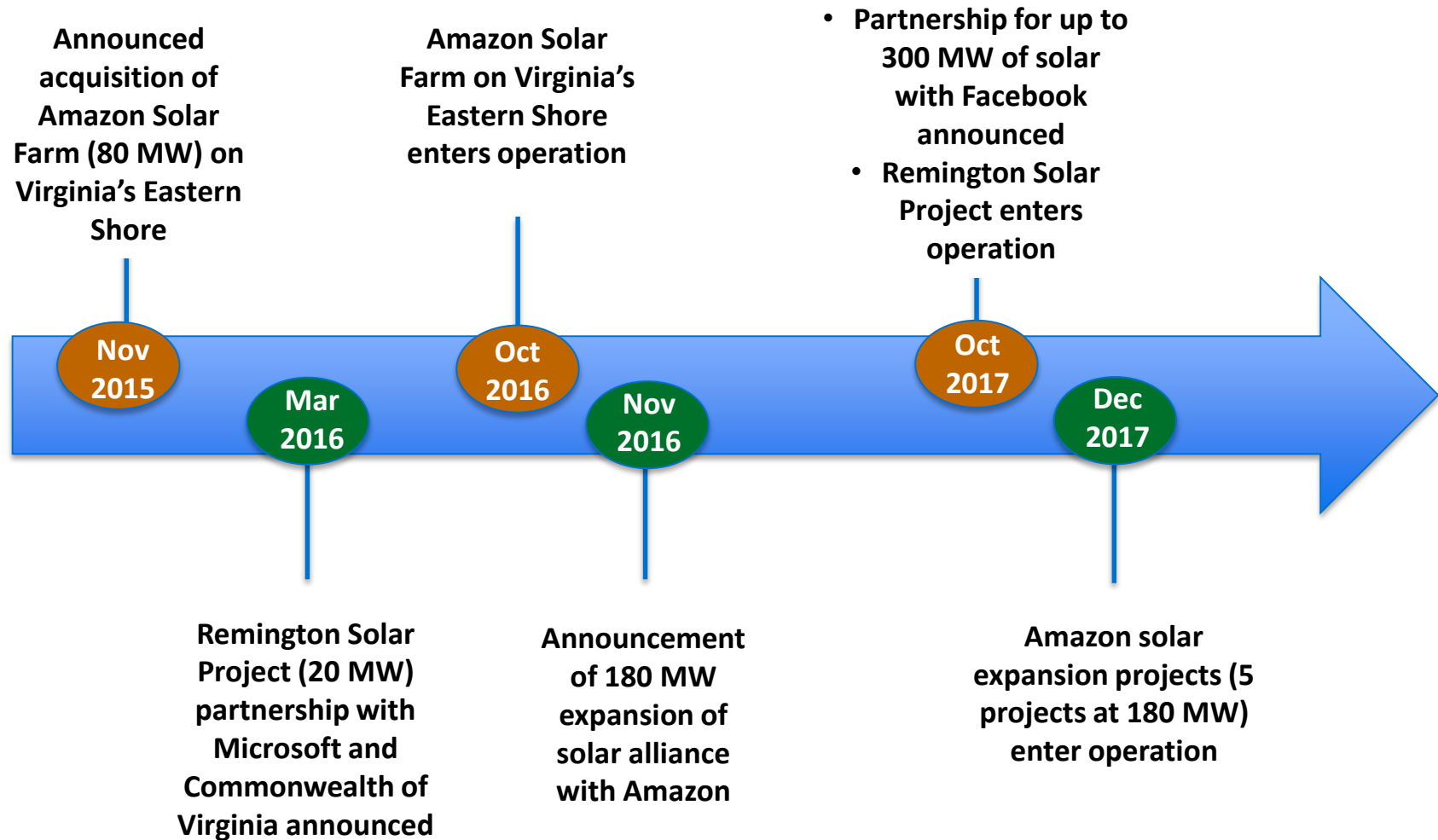
\* Operational or under development

# Dominion Energy Virginia: Renewable Options for Large Customers

File Year:	2018	2017		Current Offerings		
<b>Offering:</b>	Community Solar	Schedule CRG	Schedule RG	Schedule RF	Market Based w/Solar	Custom Offering
<b>Description:</b>	Purchase Subscriptions from solar facility	Purchase renewable energy 24x7; load following	Contract for Differences	Customer pays premium in exchange for renewable attributes	Purchase power at hourly market rate	Negotiable, PPAs, energy, RECs, dedicated solar, "Ring fence"
<b>Summary:</b>	Anchor for Residential	Greenest Solution	Choose up to 100% of load	True additionality	Pairs market with renewables	Customized
<b>Customers:</b>	Anchor Tenant	N/A	Walmart	Facebook	Amazon	Microsoft, Navy, UVA, Comm. of Virginia



# Timeline of Dominion Energy Solar Partnerships with Data Centers in Virginia



# Data Centers in Dominion Energy Virginia Territory

- Largest data center market in the world as of 2015\*
- Both Co-location and Enterprise Facilities
- Contribute 100 MW+ growth in demand per year
- Comprise 1 GW of actual electric load
- Data center efficiencies in electricity consumption being masked by aggregate data center growth
- Chip technology allowing operation at higher temperatures, leading to higher density of servers per facility
- New technologies advancing efficiencies in cooling, e.g. KyotoWheel, ambient air cooling



Photo credit: [Tqn.com](http://Tqn.com)

\*Northern Virginia Technology Council, *The Economic and Fiscal Contribution that Data Centers Make to Virginia*, February 2018

# Solar Alliance with Amazon Web Services

- Supports AWS's 100% renewable energy goal
- Project Details:
  - 260 MW of ground-mounted solar facilities
  - 6 projects
  - ~2,500 acres
- Dominion Energy crafted and received state regulatory approval for a Special Rate Contract (SCR):
  - Provides correlating retail bill with wholesale pricing for their renewable projects
  - Also available to other customers who want to achieve similar effort



Amazon Solar Farm U.S. East II – Buckingham County, Virginia

# Public-Private Partnership with Microsoft and Commonwealth of Virginia

- Supports Microsoft's sustainability goals
- Project Details:
  - 20 MW ground-mounted solar facility
  - ~125 acres
- Public-Private Partnership:
  - Dominion Energy constructs and owns facility
  - Commonwealth of Virginia purchases energy
  - Microsoft purchases RECs



Remington Solar – Fauquier County, Virginia

# Partnership with Facebook to Support More Solar on the Grid for Virginia Electric Utility Customers

- Supports Facebook's 100% renewable energy goal
- Data Center Project Details:
  - 970,000 Sq Ft on 328 acre site
  - Early 2019 operations date
  - \$750 million investment
- Solar Project Details:
  - Multiple projects, up to 300 MW
  - Facilitated by Schedule RF
    - Facebook pays premium in exchange for renewable attributes
    - Supports true additionality
    - Lowers cost of solar for all customers



Artist's Rendering – Facebook Data Center, Henrico County, Virginia

# Dominion Energy's Commitment to Reducing Water Usage in Power Generation

- Modern cooling systems that require no water for new fossil-fueled facilities
  - Advanced coal facility in Southwest VA uses air-cooled condenser instead of cooling water
  - Similar modern cooling systems installed at new natural gas facilities in Virginia
- Increasing water reuse, recycling, and conservation at generation facilities requiring water for cooling
  - Reuse of water from wastewater treatment plant in air emissions control equipment at fossil-fueled facility in Virginia
  - Variable speed drives to regulate water usage at nuclear facility in Connecticut
- Increasing use of solar to generate electricity which requires no water

## Dominion Energy Generation Water Reuse and Recycling

Water Reused/Recycled	2016	2015	2014	2013	2012
Million Liters	5,598	2,097	2,017	1,700	1,173
Million Liters/Net MWh	0.0000510	0.0000213	0.0000217	0.0000181	0.0000116

# Emerging Issues

- Rise of cryptocurrency mining companies
  - Operate like data centers
  - Pose unique challenges for utilities
- Land-use challenges with large-scale solar
  - 1 MW of solar could require as much as 10 acres of land
  - Competition with agricultural uses for arable land
  - Concerns about viewshed and historic sites

# Key Takeaways

- Data Centers are economic engines in the Commonwealth
- Aggregate data center electricity load continues to grow while individual data centers become increasingly efficient
  - Advanced cooling technologies reducing water usage
  - Advanced chip technologies allow operations at higher temperatures
- Data center renewable energy commitments have supported more than 77% of large-scale solar capacity either under development or in operation in Dominion Energy's Virginia service territory
- Dominion Energy continues to track and reduce water usage in power generation and other aspects of our business

**Thank you!**

# Committee on Water