PEER

PERFORMANCE EXCELLENCE IN ELECTRICITY RENEWAL

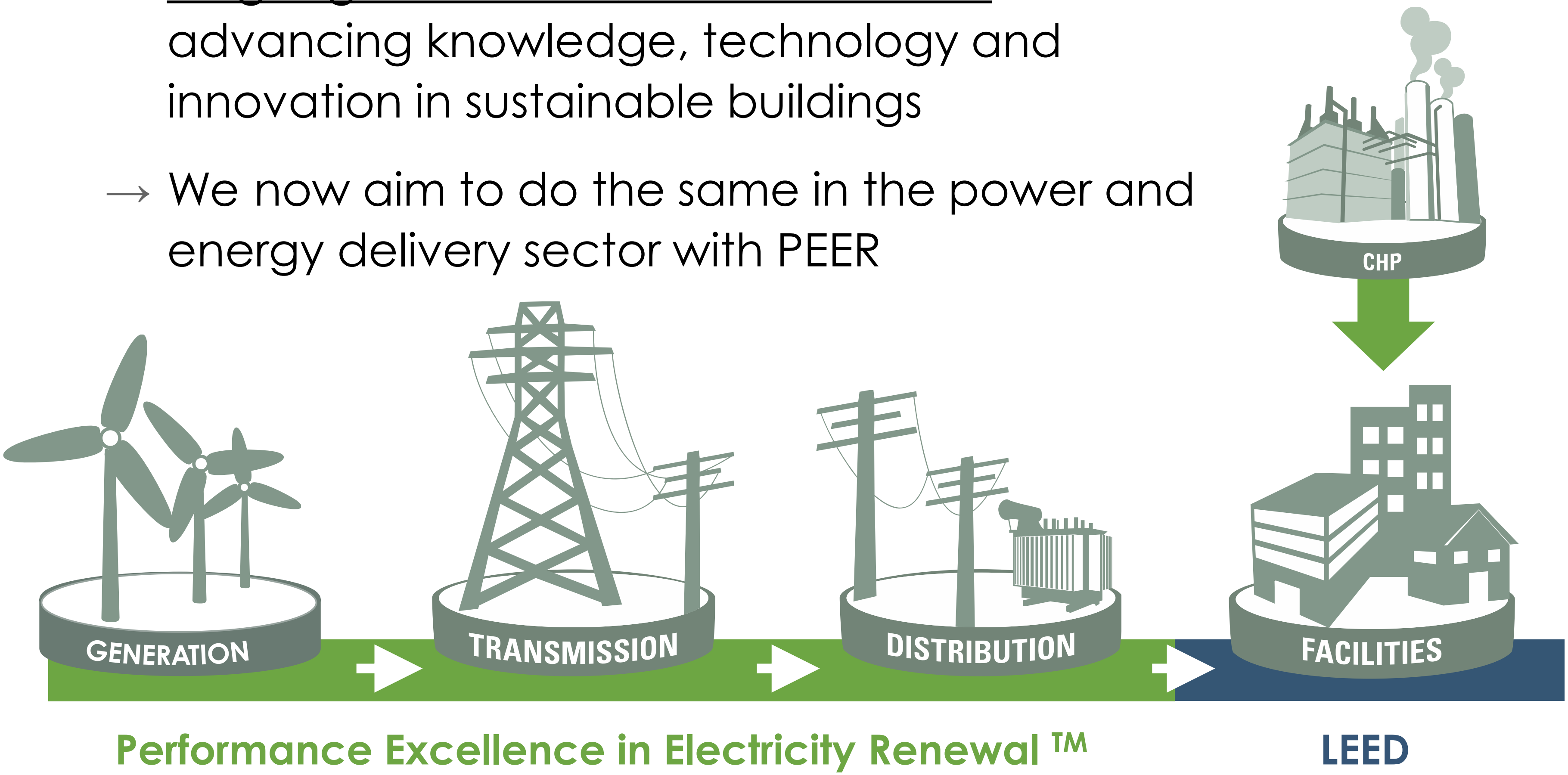
THE UNIVERSITY OF TEXAS AT AUSTIN

WHAT STARTS HERE CHANGES THE WORLD

PEER and LEED

→ Through LEED, USGBC created a common language, standard, and framework for advancing knowledge, technology and innovation in sustainable buildings

→ We now aim to do the same in the power and energy delivery sector with PEER



Four critical categories of power system performance

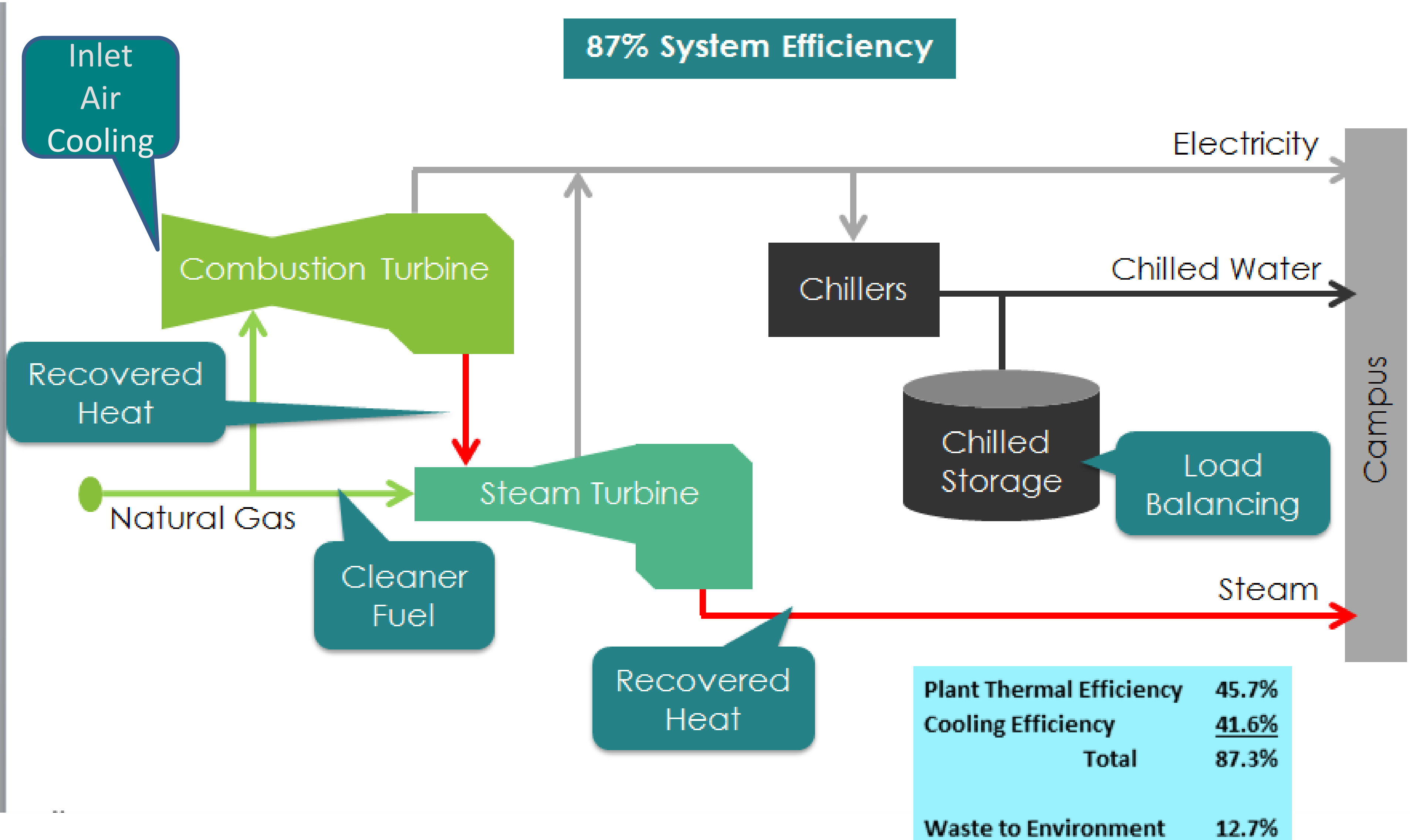
RELIABILITY, POWER QUALITY AND SAFETY

ENERGY EFFICIENCY AND ENVIRONMENT

OPERATIONAL EFFECTIVENESS

CUSTOMER ACTION

PEER is a learning system and continuous improvement process for designing and operating sustainable energy delievry systems

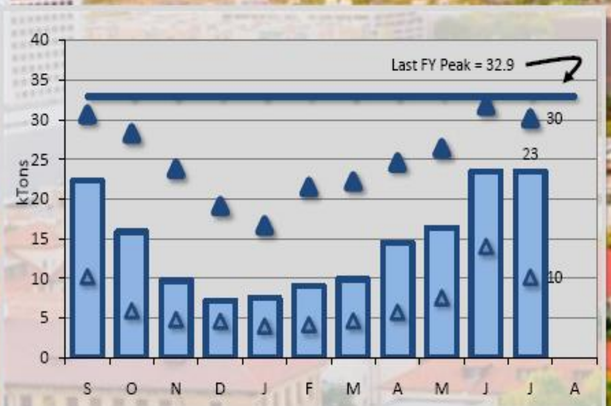

87% System Efficiency
Inlet Air Cooling
Combustion Turbine
Electricity
Chillers
Chilled Water
Recovered Heat
Chilled Storage
Load Balancing
Natural Gas
Steam Turbine
Campus
Cleaner Fuel
Steam
Recovered Heat
Plant Thermal Efficiency 45.7%
Cooling Efficiency 41.6%
Total 87.3%
Waste to Environment 12.7%

Utilities and Energy Management

Vital Signs

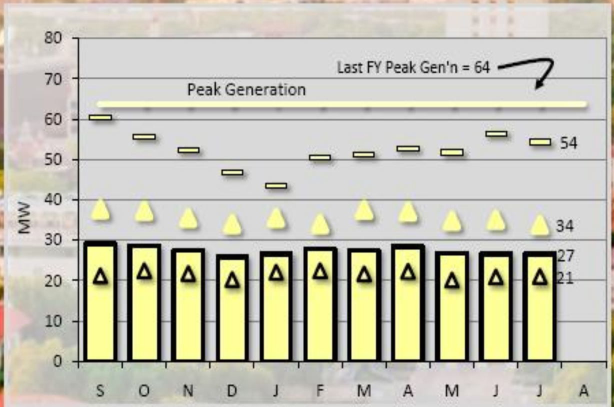
July, 2014

Campus Peak Energy Use



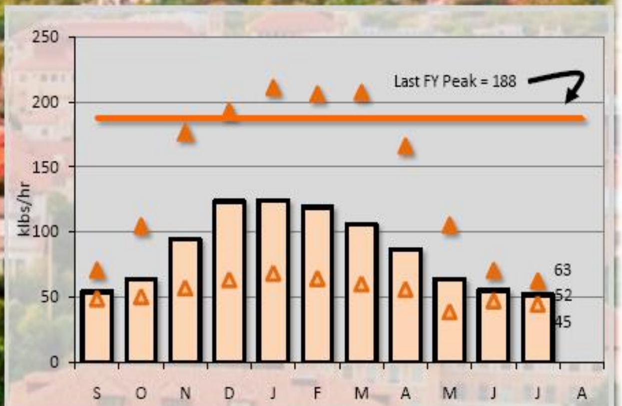
Chilled Water to Campus

Peak, Average, and Low



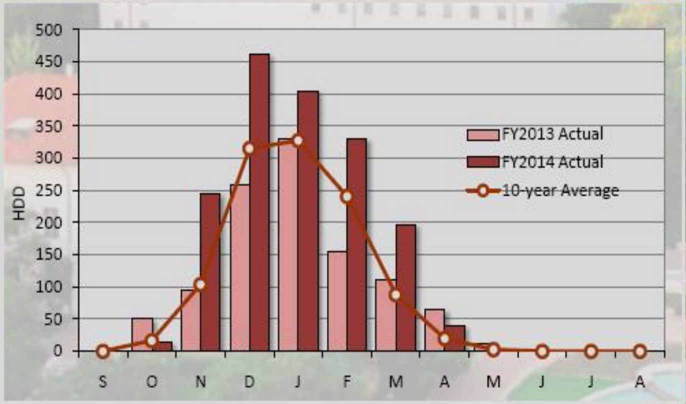
Electrical to Campus

Total Generation, Peak, Average, and Low



Steam to Campus

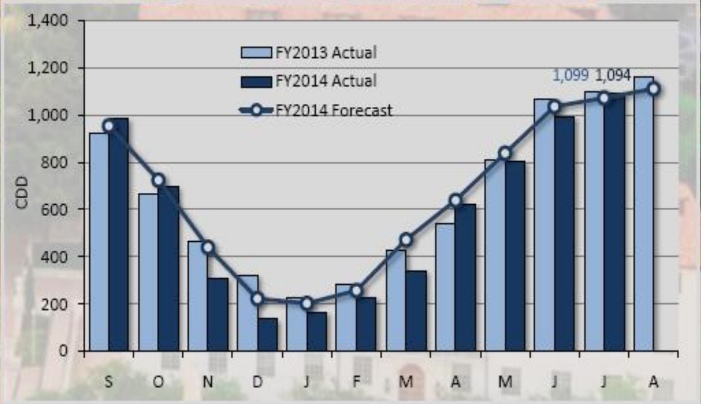
Peak, Average, and Low



Heating Degree Days

Weather

Degree-days compare the outdoor temperature to a standard temperature (65 degrees for the winter season and 50 degrees for the summer season). The more extreme the temperature, the higher the degree day number and the more energy required to cool or heat a building.



Cooling Degree Days

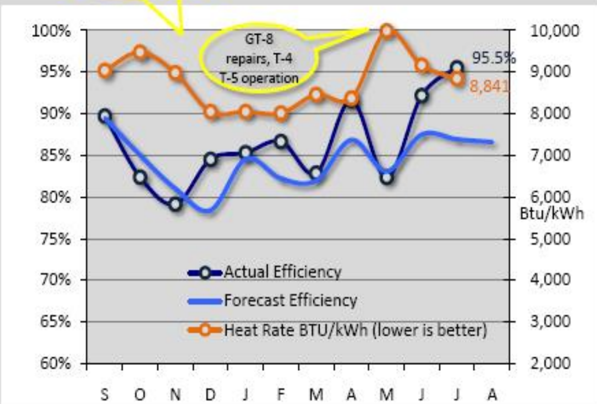
Utilities and Energy Management

Vital Signs

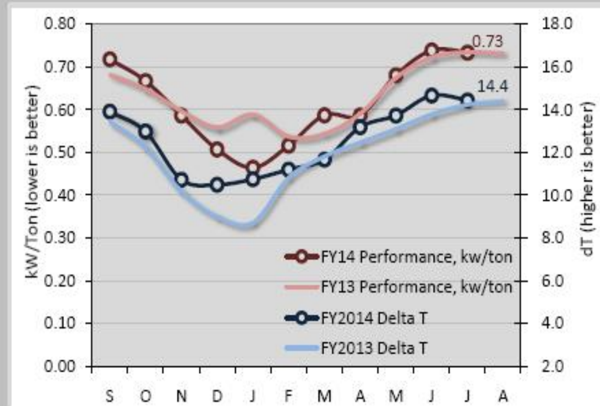
July, 2014

Plant Metrics

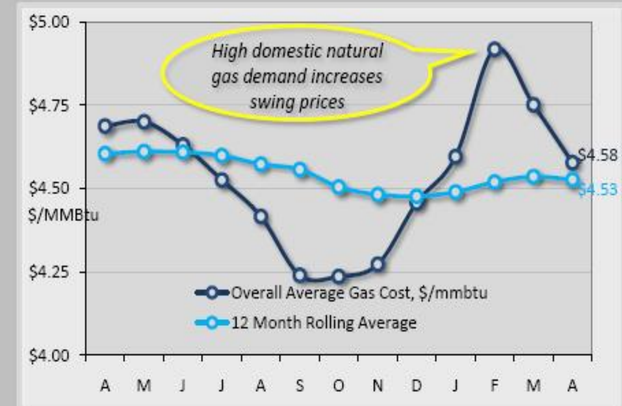
Efficiency, FYTD
86.7% Actual
84.3% Budget



Power Plant Efficiency

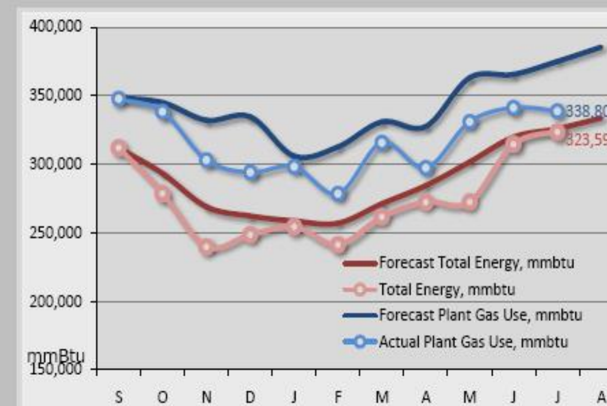


Chilling Station Efficiency



Gas Prices

Daily Gas Use
July, 2014



Monthly Energy

Utilities and Energy Management

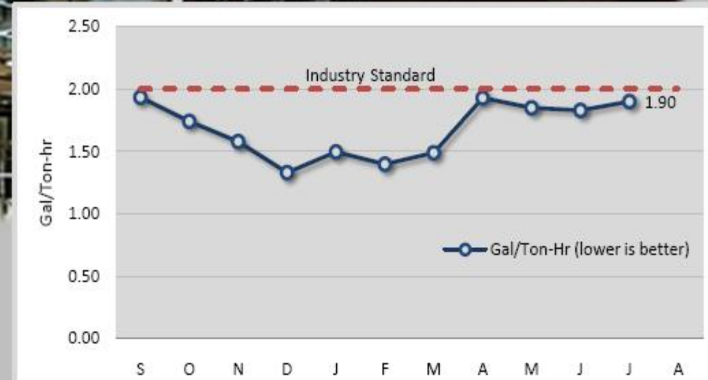
Vital Signs

July, 2014

Water Usage

Power Plant Water Usage per kWh

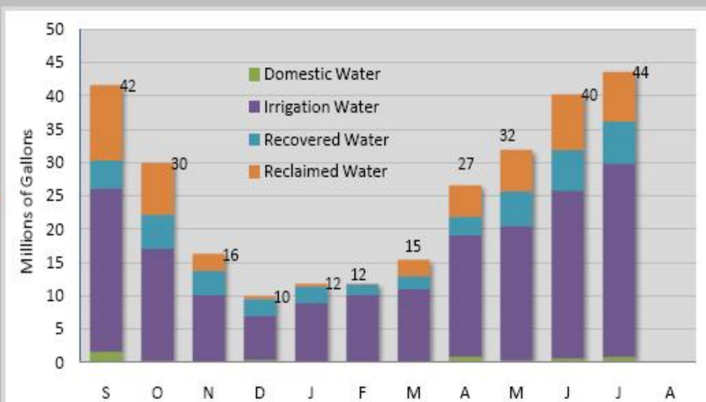
Industry Standards for water usage metrics are from U. S. Dept. of Energy's Argonne National Lab and the National Renewable Energy Lab (NREL).



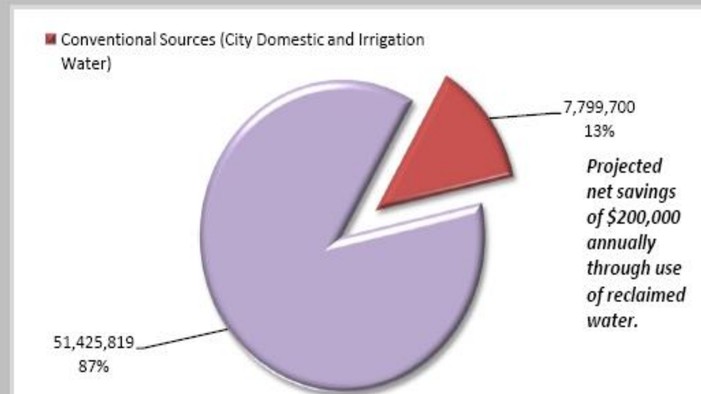
Chilling Station Water Usage per Ton-hr

Alternative water sources:

34% *FYTD*



Power Plant and Chilling Station Water Usage



Projected net savings of $200,000 annually through use of reclaimed water.

Chilling Station 5 Water Sources

Year to Date

SUSTAINABLE ENERGY DELIVERY FRAMEWORK

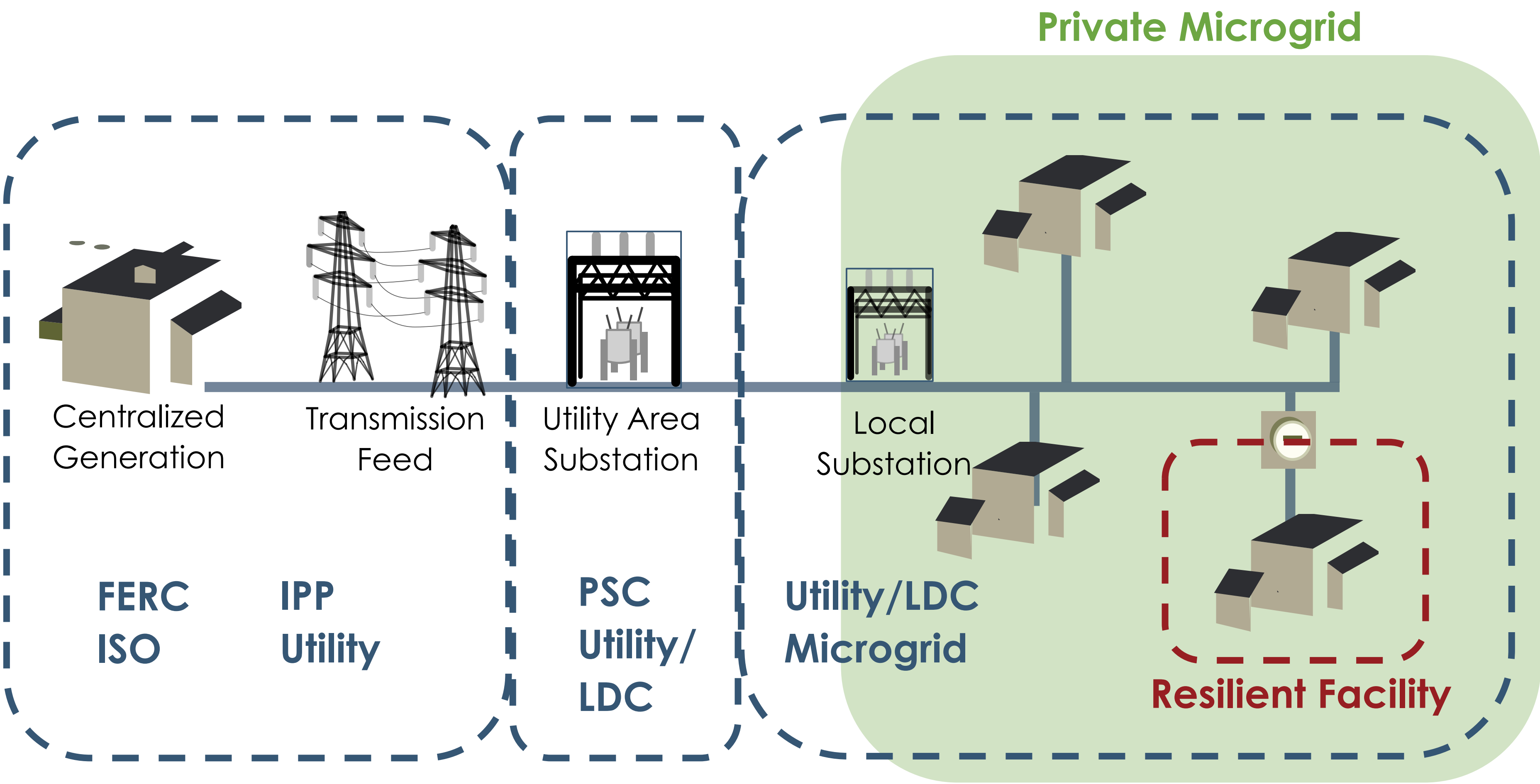
RELIABILITY, POWER QUALITY AND SAFETY

ENERGY EFFICIENCY AND ENVIRONMENT

OPERATIONAL EFFECTIVENESS

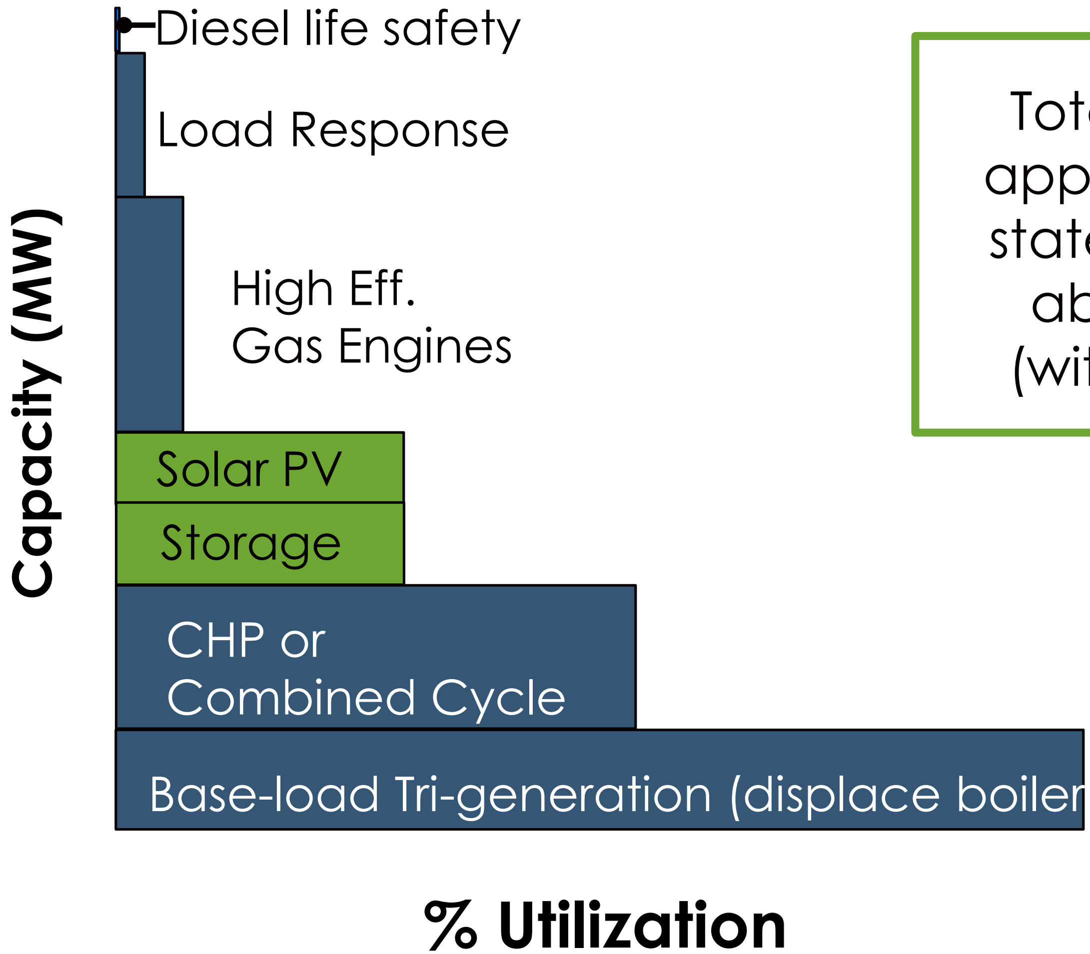
CUSTOMER ACTION

MICROGRID ARCHITECTURE



PRIVATE MICROGRID/RESILENT FACILITY

Technology Suite



Total CO_2 emissions can approach **300 lb./MWh** vs. state/regional average of about **~ 1,000 lb./MWh** (with methane leakage)

SYSTEM ENERGY EFFICIENCY OR INDEX (SEE)

$$SEE = \frac{\text{Metered Load, MMBtu}}{\text{Total Fuel Consumed, MMBtu}}$$

Performance Metric	Base Case	Cogen, 50%	District Energy	UT Austin 100%
Efficiency Gen	NA	52%/6.6	61%/5.6	46%/7.4
Electricity SEI, MMBtu/MWh	10.1	8.5	7.8	7.4
Cooling, kW/ton	1.3	1.3	1.0	0.75
SEE %	59%	68%	77%	86%
SEE Index	1.7	1.5	1.3	1.15

SEE Index = 1 / SEE

ENERGY EFFICIENCY AND ENVIRONMENT

Criteria	Metric/Basis	Max Points	UT Austin Points
CORE		**100**	**68**
Source Energy Intensity	7.4 MMBtu/MWh	50	35
CO2 Intensity	1,130lb./MWh	20	13
NOx Intensity	1.4 lb./MWh	10	0.0
SO2 Intensity	0 lb./MWh	10	10.0
Water Consumption	73 gal/MWh	5	5.0
Solid Waste Recycled	100%	5	5.0
BONUS		**15 Max**	**8.0**
Renewable Energy Credits	0.0%	10	0.0
District Energy	Checklist	2	2.0
Local Renewables	0.0%	2	0.0
Cogeneration / CHP	100.0%	2	2.0
Environmental Impacts	Checklist	5	4.4
Innovations		5	0
Subtotal		**100**	**76**

SAFETY, RELIABILITY, AND POWER QUALITY

Criteria	Methodology	Max Points	UT Austin Points
CORE		**100**	**67**
SAIDI – Downtime in minutes	9.7 minutes	1	1.0
SAIFI - Frequency	0.1 interruptions	1	1.0
Availability - Uptime	0.99998%	23	23.0
Damage and Exposure Prevention	Checklist	5	3.3
Alternative Sources of Supply	Site generation	5	5.0
Distribution Redundancy and Automated Restoration	44%	10	5.9
Island Capability	Checklist	20	20.0
Backup Power for Critical Loads	1%	10	0.1
Resiliency through Recovery	100%	5	5.0
Risk Mitigation	Checklist	20	3.0
Bonus		**15 max**	**13**
Power Quality Measurement	50%	5	3.7
Capabilities for Power Quality	Checklist	5	3.9
Momentary Outages	0.06 interruptions	10	3.0
Innovations		5	2.3
Subtotal		**100**	**80**

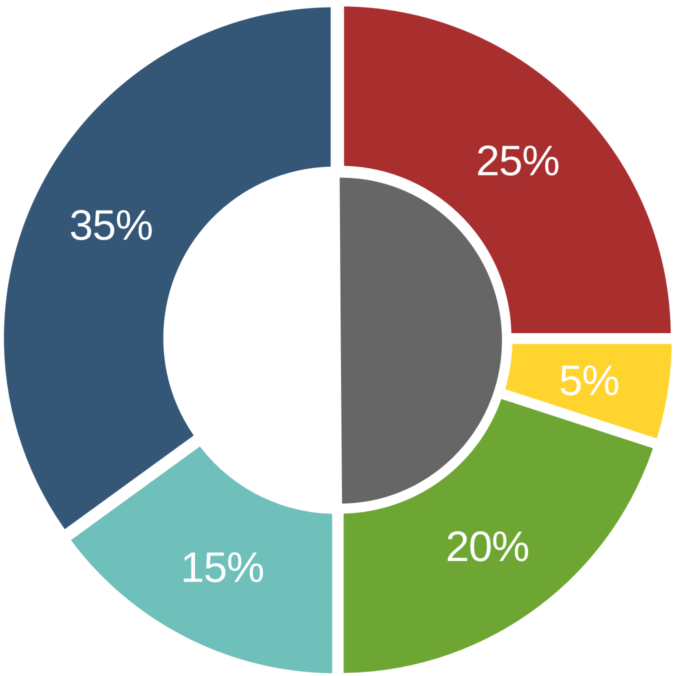
OPERATIONAL EFFECTIVENESS

Criteria	Metric/Basis	Max Points	UT Austin Points
CORE		**100**	**63.0**
Load Duration Curve	0%	20	10.0
Waste Identification and Elimination	Checklist	20	10.0
Failure Identification and Elimination	Checklist	20	3.0
Demand Response Capability	223%	20	20.0
Value Determination	$22 million	20	20
Innovations		**15 max**	**10.0**
System Energy Efficiency	87%	3	3.0
Gap Determination	$3,000,000	14	5
Innovations	Checklist	5	2.0
Subtotal		**100**	**73.0**

CUSTOMER ENGAGEMENT

Criteria	Max Points	UT Austin Points
Prerequisites		
Advanced Metering Infrastructure	Pass/Fail	Pass
Data Privacy/Cyber Security	Pass/Fail	Pass
Customer Engagement Programs	Pass/Fail	Pass
CORE	**100**	**62.5**
Local Renewable Capability	25	0.0
Local Cleaner Power Capability	30	30.0
Local Demand Response Capability	30	30.0
Access to Dynamic Pricing	5	0.0
Energy Management Systems	5	2.5
Electricity Supply Choice	5	0.0
Bonus	**12**	**12.0**
Innovations	12	12.0
Subtotal	**100**	**75**
Total	**400**	**304/76%**

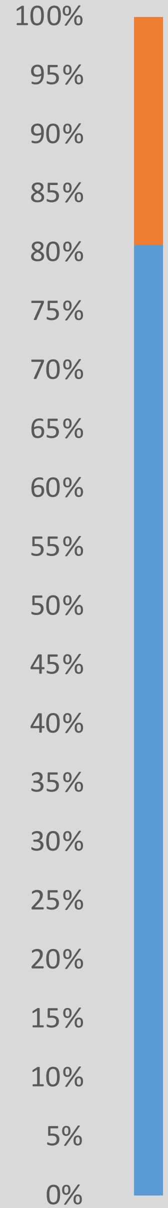
CLOSING THE POWER SUPPLY GAP



Fuel wasted to heat	25%
Emissions, water & waste	5%
System and capacity waste	20%
System and capacity costs	15%
Fuel to electricity	35%
Waste	~50%

	Baseline	Current	Upper Limit
Reliability and Power Quality			
SAIDI	60.7	9.67	0.0
SAIFI	0.77	0.10	0.00
ASAI	0.99988	0.99998	1.00000
Environmental and Efficiency			
SEI (mmBTU/MWh)	9.20	7.40	5.50
CO2I (lb/MWh)	1,560	1,130	750
NOxI (lb/MWh)	1.10	1.40	0.20
SO2I (lb/MWh)	2.20	0.00	0.00
Water (gal/MWh)	330	75	50
Waste (% Recycle)	43	100	100
Operations and Customer			
Demand % of Peak	71%	154%	0%
Demand Response %	0%	446%	446%
Cooling, kW/ton	1.2	0.8	0.7
Local Power %	0.0%	100.0%	100.0%
Energy Cost (000)	43,000	21,000	15,000

Upoper Limit



-	Electricity Cost OC, $
3,000,000	Electricity Energy Efficiency OC, $
-	Distribution OC, $
-	Demand Charge Reduction OC, $
-	Ancillary Service OC, $

TOTAL GAP, $

$3,000,000

Useage = 360,000 MWh

Peak = 60 MW

TOTAL VALUE, $

$22,240,000

6,000,000	Electricity Cost Savings
3,000,000	Electricity Energy Efficiency Savings
4,000,000	Chiller System Efficiency
9,000,000	Demand Charge Reduction Savings
240,000	Reliability and PQ Savings
-	Ancillary Service Savings

Baseline

USING PEER TOOLS TO IMPROVE PRIVATE MICROGRIDS