

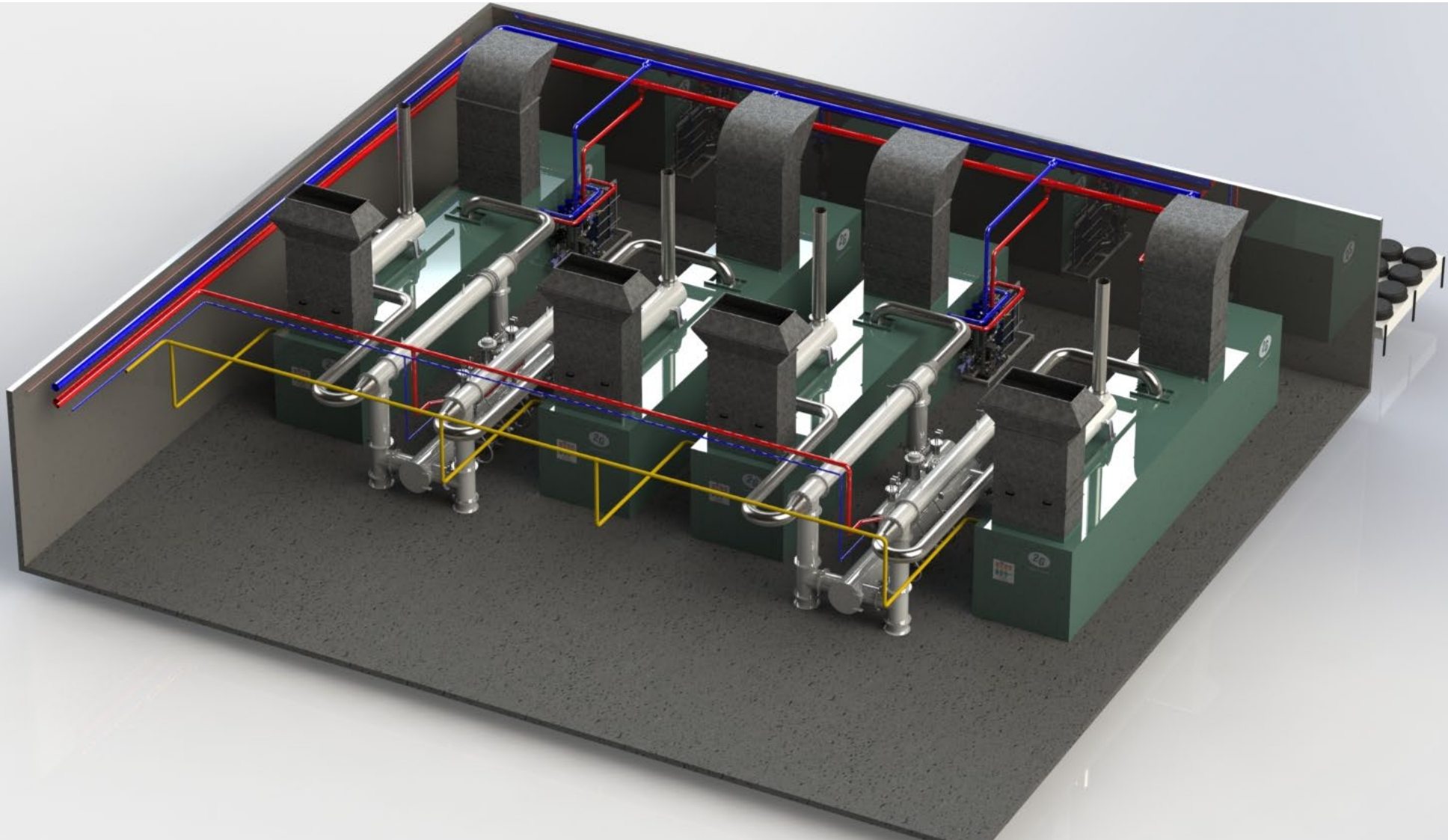
ADVANCED ENERGY **101**

HOSTED BY TAEBC AND SEVEN STATES POWER CORPORATION



**White Harvest
Energy**

Erlanger Case Study

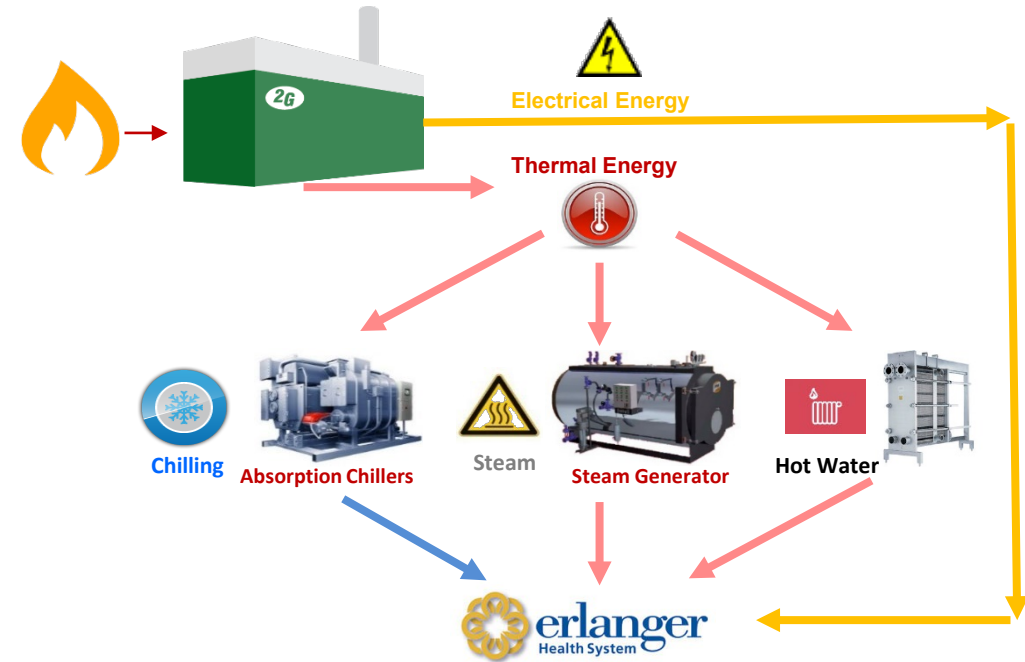




Project Description

Installation of 4 x 2,000
kW CHP facility
producing:

- 52,000 MWh electricity
- 12,000 lb/hr 115psi steam
- 14,000 MBtu/hr hot water
- 600-800 tons chilled water (potential)





Project Description

Packaged Containers:

- 4 x 2MW NG Engine Gensets (**MWM – CAT**)
- 2 x 6,000 lb/hr Exhaust Gas HRSGs (**Hering**)
- (Future) Hot water heat recovery for laundry and FW preheating
- (Future) 600-800 ton absorption chiller
- (Future) Battery ESS
- (Future) Island Mode completion





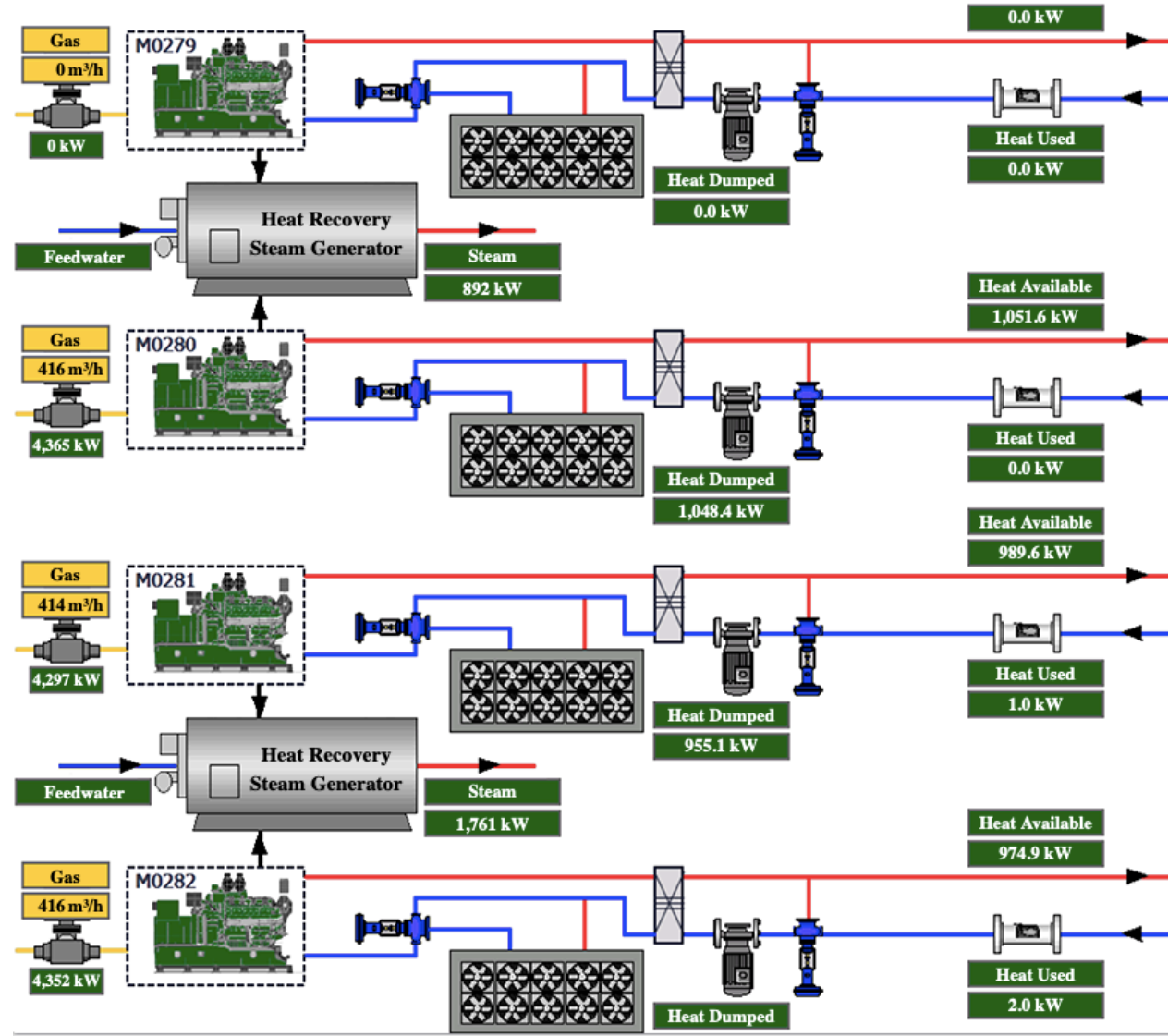
Project Description

- Medium voltage 12.47kV - paralleled
- Common bus with hospital supply
- Main-tie-main with grid
- Island mode capable (automatic)
- Load shedding capability
- Seamless transition with automated resync to grid





Layout





Benefits

- More efficient use of gas
- Electricity generation (reduces purchased energy)
- Steam as a by product
- Electric load reduction

- Reduced CO₂ due to increased efficiency
- Technology is capable of using renewable gas so it can be 100% renewable energy



- Outstanding current grid service
- Ability to serve load in event of outage
- Maintain primary with backup generation – (Business Continuity)
- Blackstart capable
- Can run as long as natural gas is available



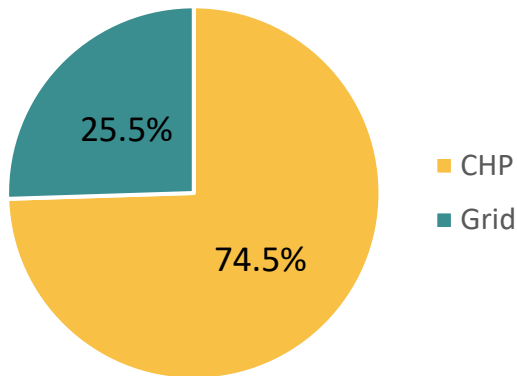
Performance

- Startup – April 1, 2019
- kWh's generated vs purchased (~75% offset)
- CO₂ reduction to date
- Cost Savings
- "Best" Performance
 - **Best Month – Availability – August**
 - **Best Month – Savings – June**
 - **Best Month – Least Power Purchased – December**

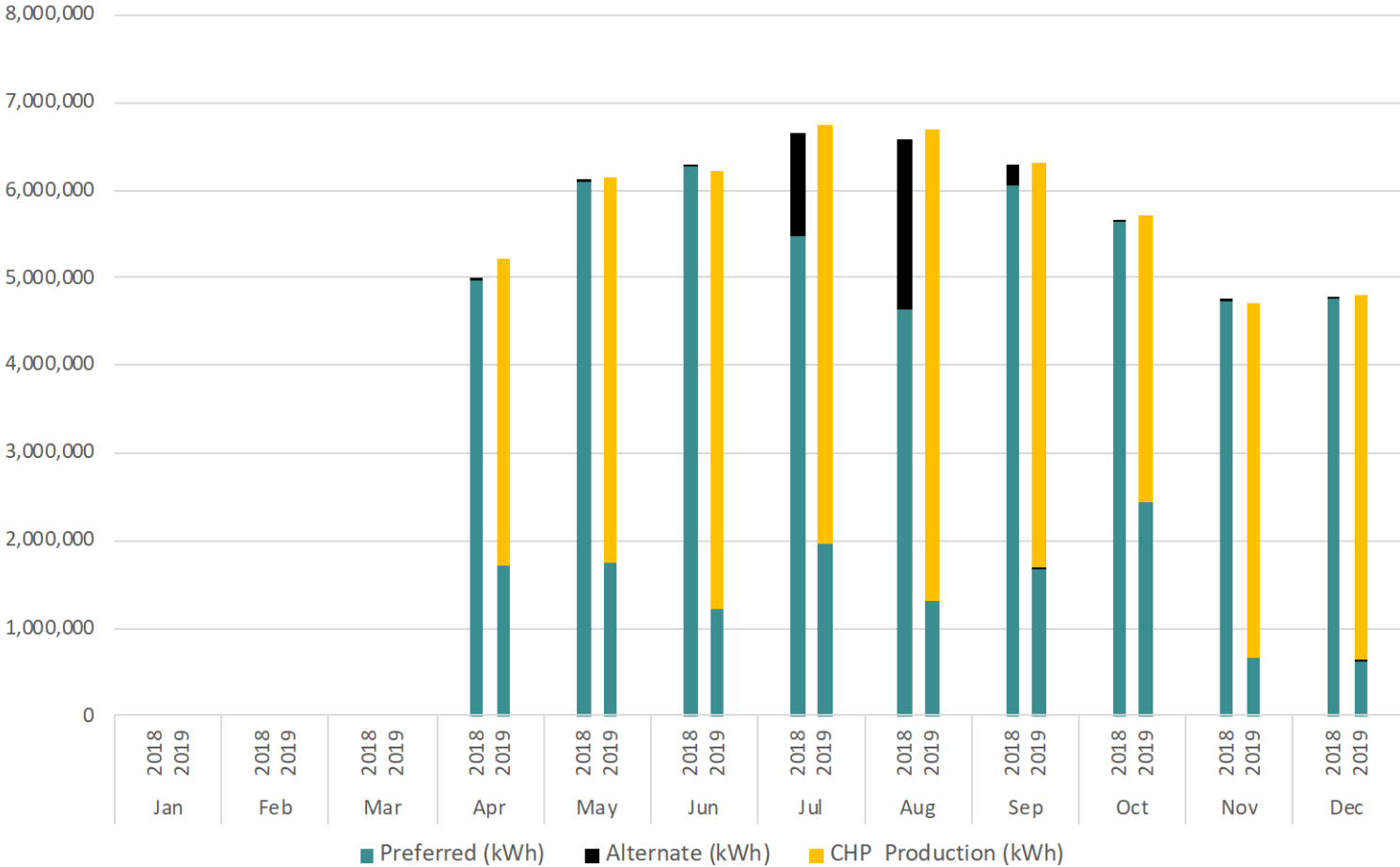


Performance

2019 Totals:
CHP Generated
39,136,664 kWh
Grid Imported
13,396,196 kWh



Electrical Consumption
Erlanger Hospital - 975 East Third Street
Historical Comparison





Performance

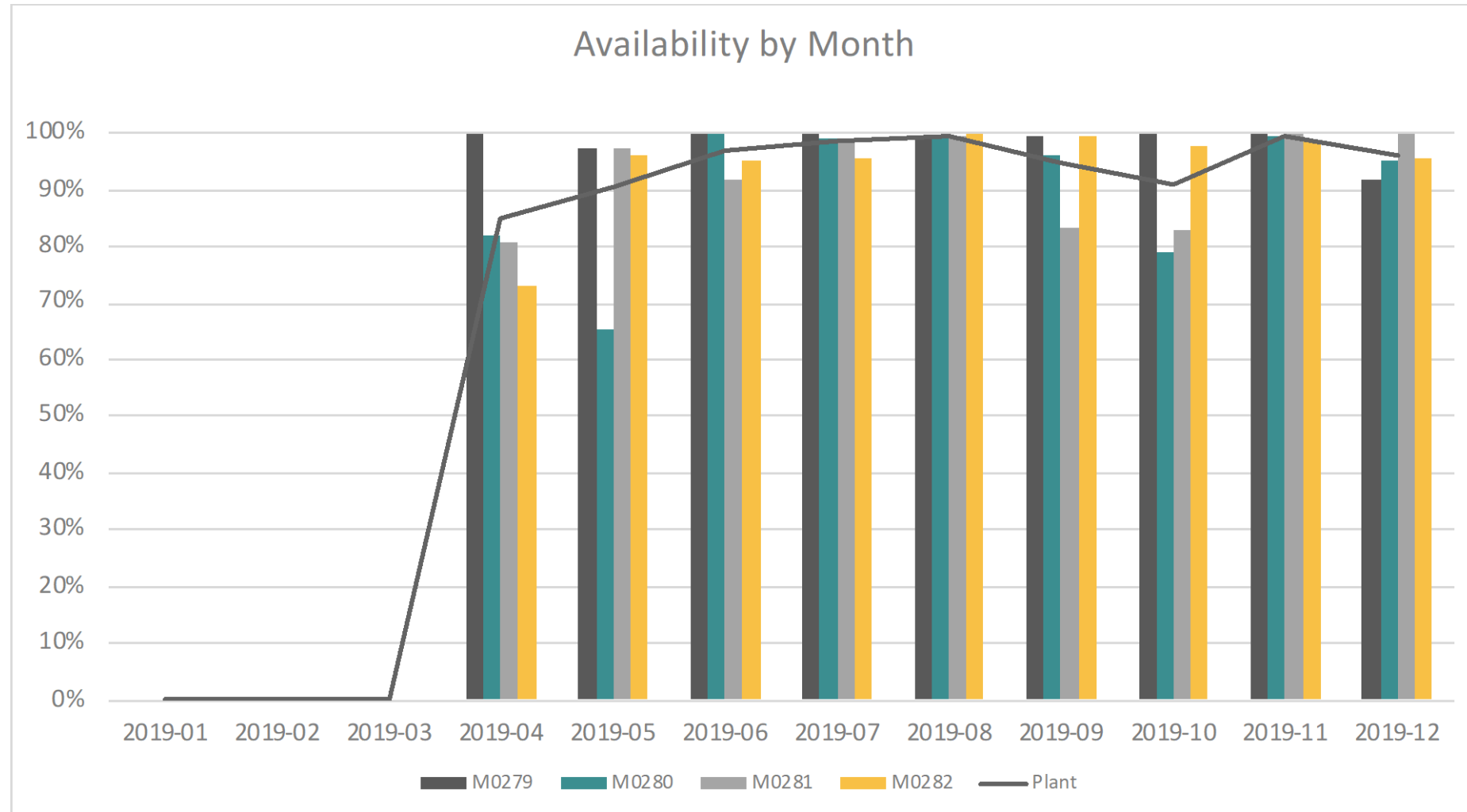
2019 Availability

94.8% (Apr to Dec)

96.7% (Jun to Dec)

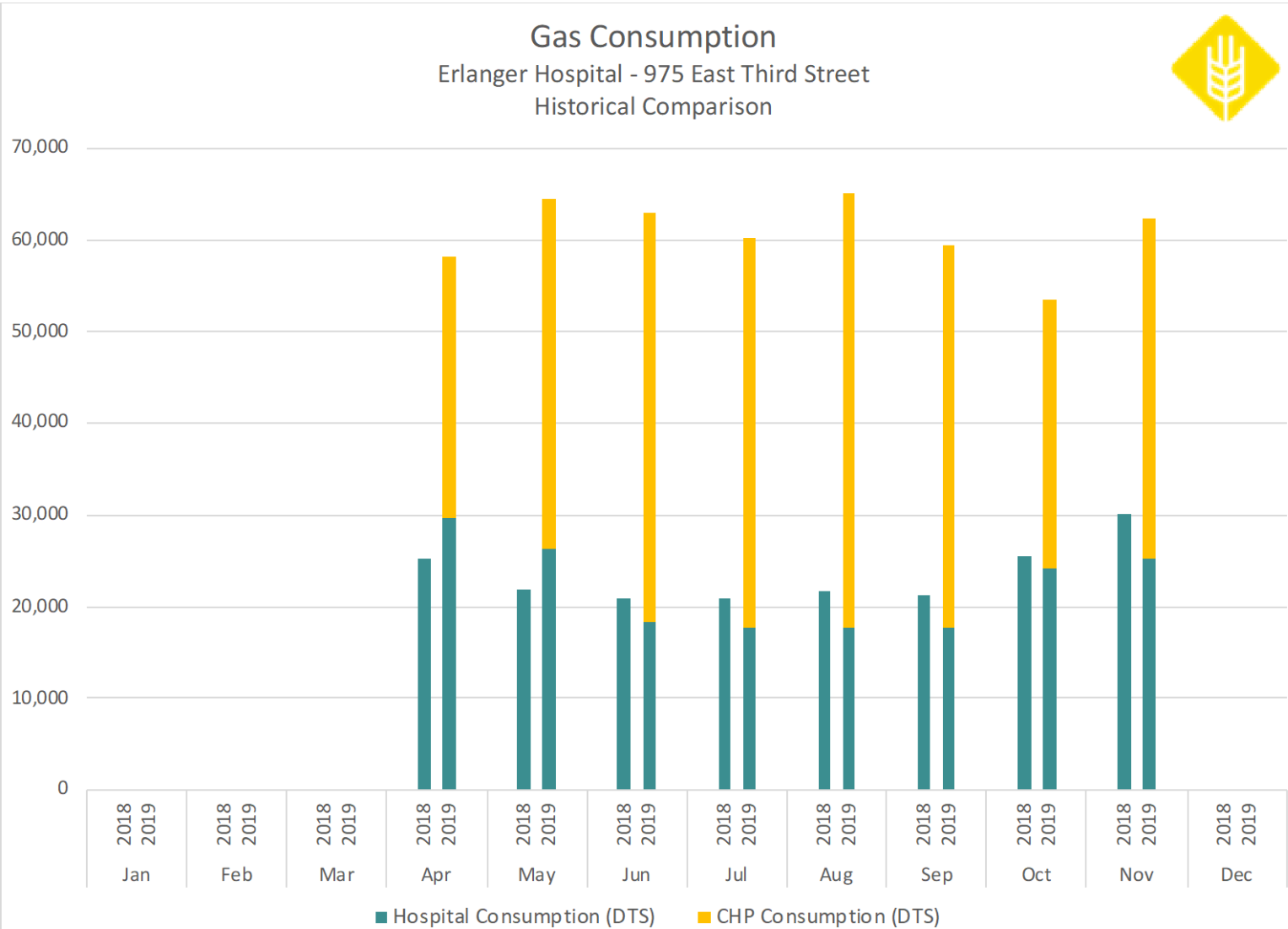
Best Month

99.5% (Aug)



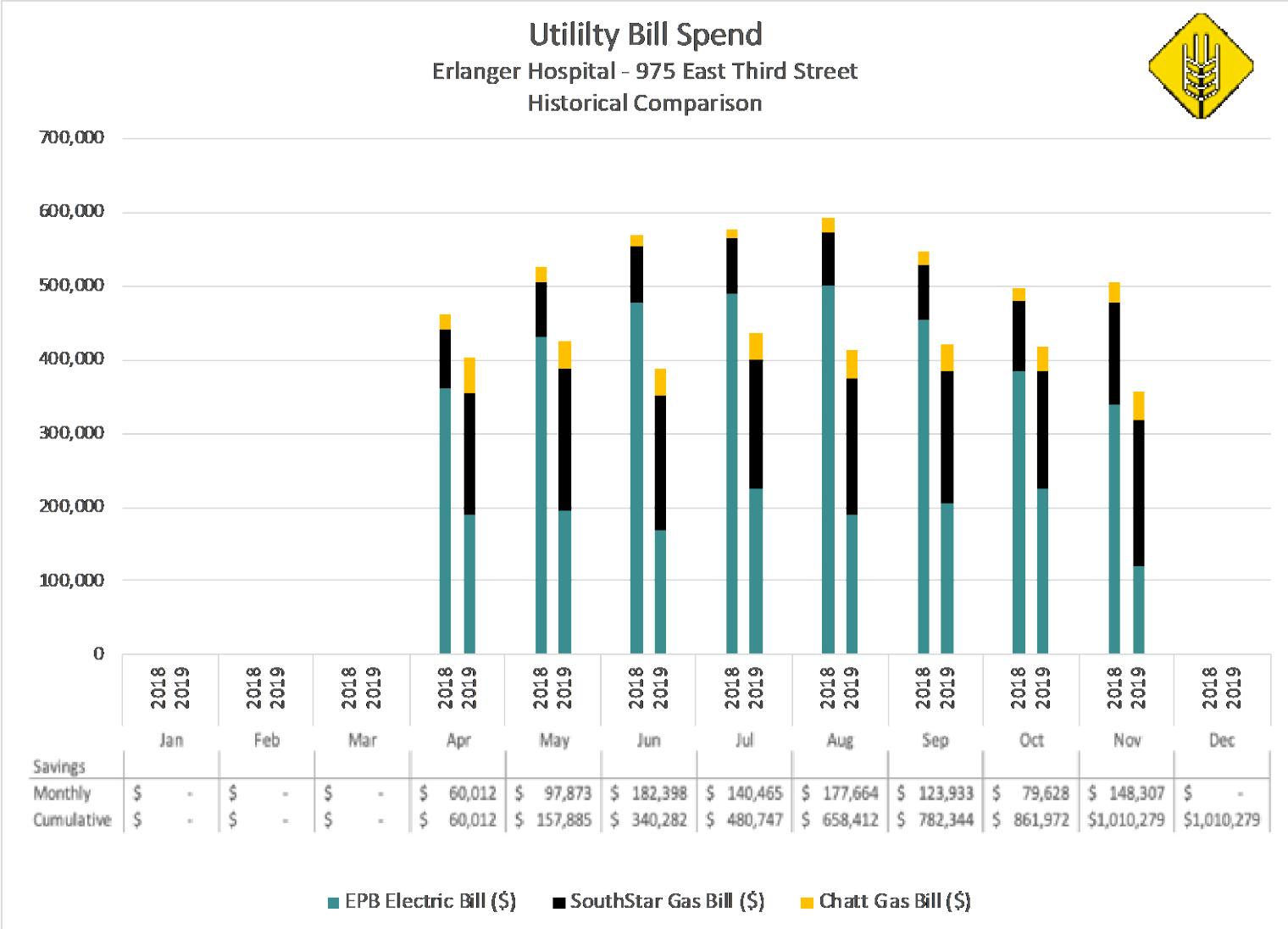


Performance





Performance





- Reduced CO₂ due to increased efficiency
 - **2019: 11,015 tons of CO₂ avoided**
 - **2020: 14,000 tons of CO₂ avoided (target)**

Removing 2,339 passenger vehicles from the road for a year

CO₂ Emissions from:

1,865 homes' electricity use for a year

1.4 billion smart phones charged

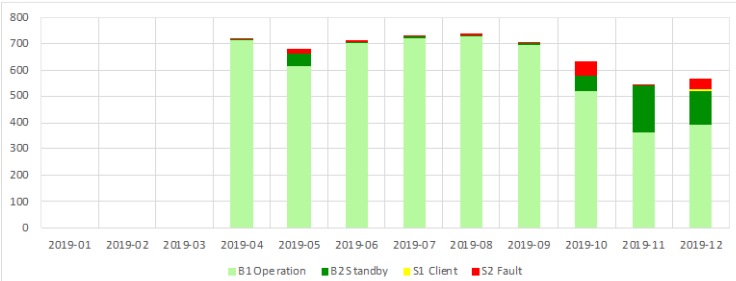
GHG Avoided by 2.4 wind turbines running for a year

Carbon sequestered by 14,385 acres of US forests in one year

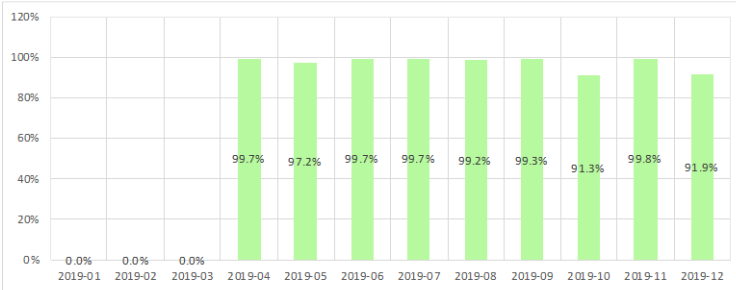


Plant ID M0279 (Unit 1)
Location Erlanger Health System, 975 East Third St, Chattanooga, TN
First Time Operation Oct 28, 2018 12:00AM
Model Number Avus 2000c
Fuel Natural Gas
Electric Cap. [kW] 2000
Thermal Cap [kW] 1977
Reporting Period 2019-01 to 2019-12 **Total Operating Hours since COD** 5443

Hour Meter



Availability according to VDI 4680
$$= \frac{(B1 + B2 + S1)}{(B1 + B2 + S1 + S2)} \times 100\%$$



Executive Summary for EHS

Plant ID M0279, M0280, M0281, M0282
Location Erlanger Health System, 975 E. Third St, Chattanooga, TN
Model Num(s) Fox Avus 2000c
Reporting Period August 2019

Plant Availability for Period

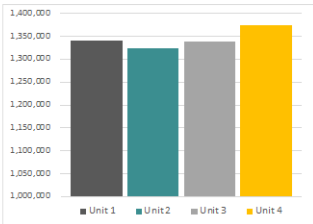


* All costs and savings are ONLY ESTIMATES until material
interval data becomes available.
** All data starts from April 1, 2019

Summary

TOTAL MONTHLY ELEC [kWh]
5,376,761
TOTAL MONTHLY STEAM [MMBtu]
9,058
TOTAL MONTHLY SAVINGS
\$117,840
TOTAL INVENTORY VALUE ON SITE
\$235,400

Electrical Generation for Period



Estimated Utilities without CHP

ITEM	AMOUNT
Electric	\$477,075
CHP Gas Only	\$0
CHP Steam	\$0
Operations	\$0
Period Total	\$477,075
TYM Total	\$2,167,733
Cumulative Total	\$2,167,733

Actual Utilities with CHP

ITEM	AMOUNT
Electric	\$215,308
CHP Gas Only	\$170,455
CHP Steam	(\$52,889)
Operations	\$57,250
Period Total	\$359,224
TYM Total	\$1,253,389
Cumulative Total	\$1,253,389

Estimated Monthly Savings (Cost)

ITEM	AMOUNT
Electric	\$271,756
CHP Gas Only	(\$170,455)
CHP Steam	\$52,889
Operations	(\$57,250)
Period Total	\$137,840
TYM Total	\$413,384
Cumulative Total	\$413,384

Performance	OP HOURS		AVAILABILITY		ELECTRICAL GENERATION		
	PERIOD	TOTAL	PERIOD	TYM	PERIOD	TYM	TOTAL
M0279 Unit 1	726	5475	99.2%	99.1%	1,359,205	6,520,993	6,520,993
M0279 Unit 2	725	2867	99.5%	98.9%	1,354,868	5,310,862	5,310,862
M0279 Unit 3	726	5253	99.5%	98.1%	1,357,659	6,022,579	6,022,579
M0279 Unit 4	746	2754	100.0%	92.9%	1,357,659	5,172,705	5,172,705
Total	2923	12327	99.5%	97.0%	5,376,761	23,035,339	23,035,339

Upcoming Maintenance Events

All Units: 640 Maintenance due at 4,000 op hours; unit outages required
All Units: HRSG feedwater valve exchange upcoming; Island Mode testing upcoming; Software update upcoming (full plant outage required)

Major Outages during Period

M0279 Unit 1	No major outages; minor excessive heat outages
M0280 Unit 2	No major outages; minor excessive heat outages
M0281 Unit 3	No major outages; minor excessive heat outages
M0282 Unit 4	None
Other	None

Parts Replaced/Installed during Period

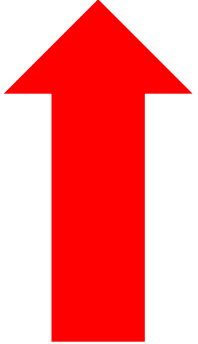
M0279 Unit 1	Air Filter replaced
M0280 Unit 2	Battery charger and Flywheel sensor replaced
M0281 Unit 3	Air Filter replaced
M0282 Unit 4	Air Filter replaced
Other	None



LPC Changes

- How would I change this project if LPC-owned?
 - **Make it bigger**

Summer:



Electric Use



Heat Use

Winter:



Electric Use



Heat Use



Lessons Learned & Issues

- Scheduled “E40” Maintenance
- Bearing Replacements
- Grid Issues – 4 Outages since April
- 1 Total plant outage for boiler inspection
- Island Mode Challenges
- Boiler Feedwater Pump Skids



Summary & Questions

- Less complicated design & installation due to packaged product
- Drivers for the project included:
 - **Energy savings,**
 - **Risk mitigation &**
 - **Carbon reduction**
- Talented project team collaborated and executed well resulting in industry leading \$/kW installed cost