

MICROGRID CASE STUDY

Case Studies in Peaking and Continuous Applications



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The Rolls-Royce vision

Rolls-Royce pioneers cutting-edge technologies that deliver the cleanest, safest and most competitive solutions to our planet's vital power needs.

Pioneering the power that matters





Core business areas

A world-class technology company, built on three strong and complimentary business units.



Civil Aerospace



35
types of commercial aircraft powered by us



13,000
engines in service around the world



25,600
of total employees



7,378m
underlying revenue

Defence



150
Customers in over 100 countries



16,000
engines in service around the world



10,400
of total employees



3,124m
underlying revenue

Power Systems



>40,000
customers in 13 different industries



20,000
Reciprocating engines sold per year



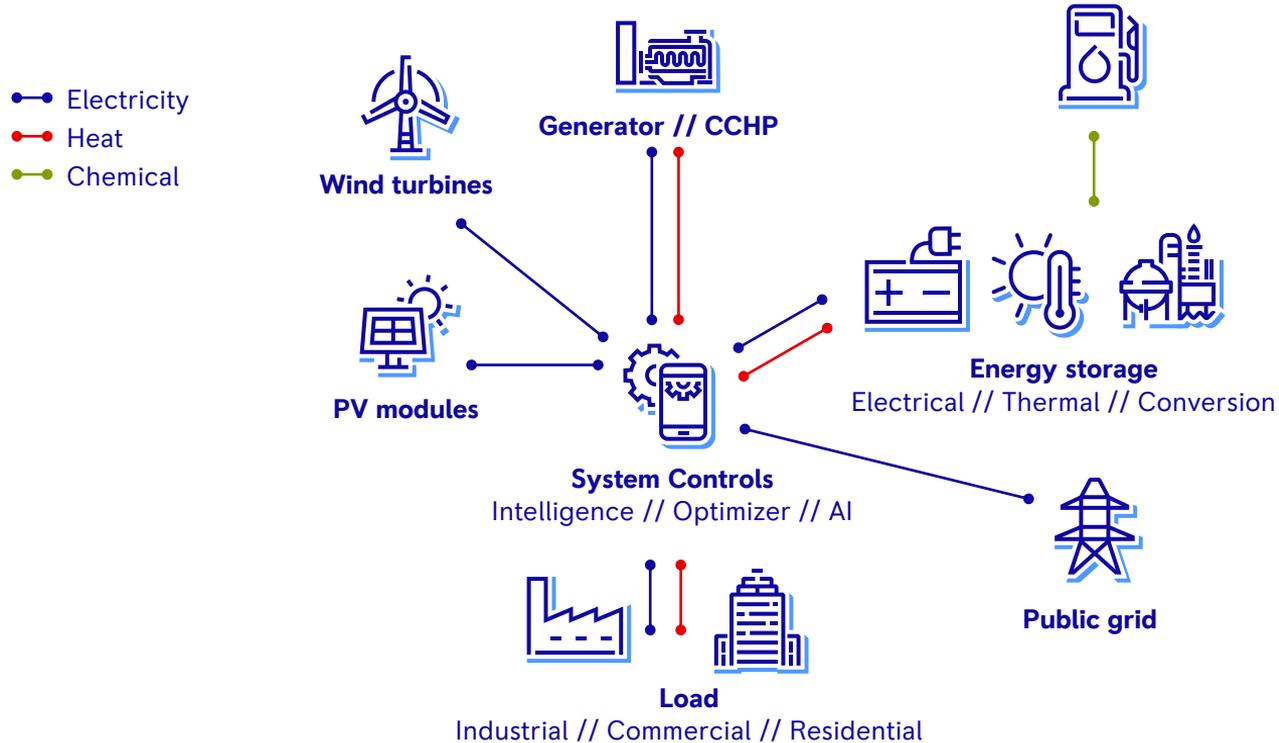
10,400
of total employees



3,550m
underlying revenue



Microgrids are one answer to global trends in the energy sector





PEAKING POWER

Customer:
Confidential

Location:
Southeastern USA



3 x 16V4000 GS – 6MW

**3 x 2MW/2MWh –
6MWh MTU Energy Pack**

18.7MW PV

- Industrial demand response project
- Industrial process with high peak electrical loads
- Controlling peak demand = \$100,000 monthly cost reduction in energy bill
- Microgrid controller to optimize all distributed generation assets



Energy Model Summary

Industrial User Peaking Application Distributed Generation Model

18.7MW - PV

6MW - Natural Gas Power Generation

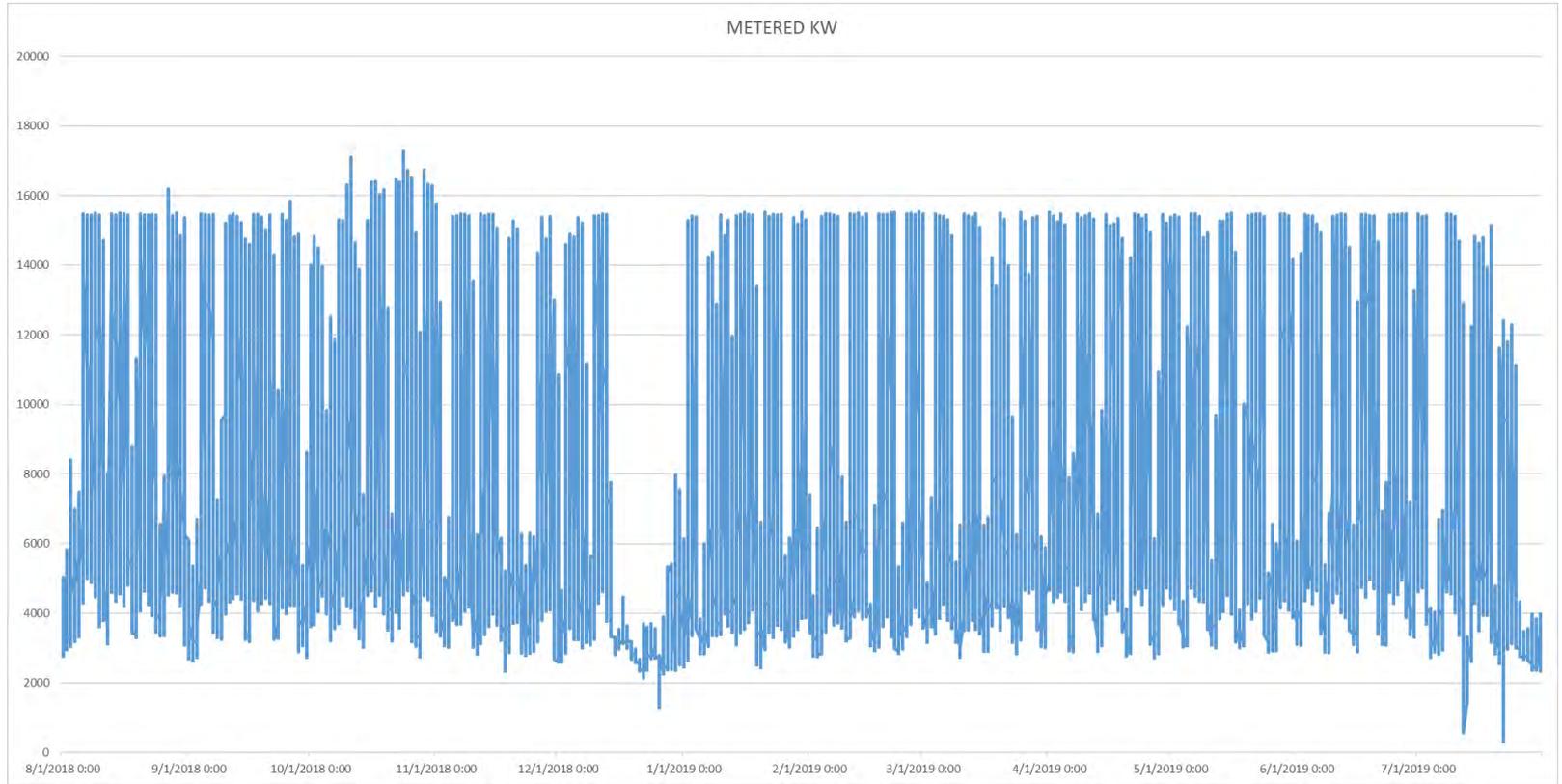
6MWhr – Battery Energy Storage

Project Overview

- Southeast USA
- Behind the meter distributed generation project combining
 - 18.7MW of PV
 - 6MW of gas generators
 - 6MWh of BESS
- All power used behind the meter for self-consumption, limited power sales back to the local utility
- Project goal is to keep the customer below their demand rate which triggers approx. \$100K monthly charges



Distributed Generation Model





Energy Data

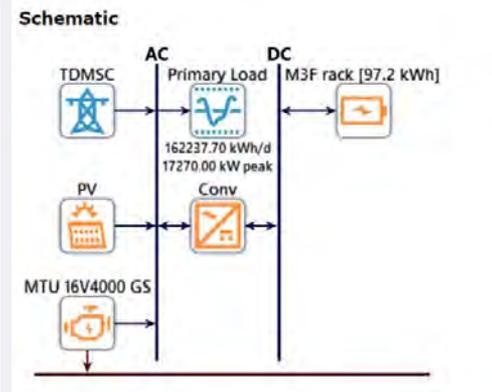
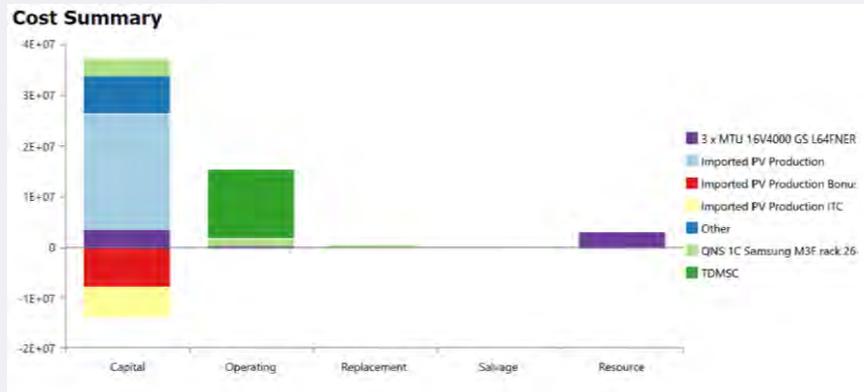
Distributed Generation Model





Distributed Generation Model

Energy Model Summary



System Architecture

Component	Name	Size	Unit
Generator	3 x MTU 16V4000 GS L64FNER Cont. NG 2014 kWe CHP	6,042	kW
PV	Imported PV Production	18,700	kW
Storage	QNS 1C Samsung M3F rack 264S1P [97.2 kWh] ASM	61	strings
System converter	Generic large, free converter	9,999,999	kW
Dispatch strategy	HOMER Peak Shaving		
Utility	TDMSC		



Distributed Generation Model

Energy Model Summary

Base Case Electric Bill

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Energy Charge	\$236,848	\$219,438	\$224,346	\$224,483	\$223,974	\$244,408	\$196,940	\$261,238	\$244,993	\$229,746	\$159,063	\$124,906	\$2.59M
Energy Purchased	5,311,099	4,844,278	5,120,453	5,198,436	5,225,976	5,089,075	4,024,613	5,529,365	5,161,588	5,514,084	4,729,477	3,468,318	59,216,762
Energy Sold	0	0	0	0	0	0	0	0	0	0	0	0	0
Demand Charge	\$169,544	\$169,031	\$169,457	\$167,525	\$167,495	\$179,924	\$179,901	\$186,675	\$184,131	\$200,677	\$169,063	\$168,831	\$2.11M
Peak Load	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed Charge	-\$47,407	-\$47,407	-\$47,407	-\$42,961	-\$42,961	-\$34,069	-\$34,069	-\$34,069	-\$34,069	-\$34,069	-\$34,069	-\$47,407	-\$479,964
Taxes	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total	\$358,985	\$341,061	\$346,395	\$349,047	\$348,508	\$390,263	\$342,772	\$413,844	\$395,054	\$396,354	\$294,058	\$246,330	\$4.22M



Distributed Generation Model

Energy Model Summary

Predicted Electric Bill

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Energy Charge	\$98,406	\$78,598	\$62,033	\$45,711	\$57,238	\$46,275	\$17,577	\$63,273	\$70,774	\$83,895	\$75,275	\$72,265	\$771,319
Energy Purchased	2,593,896	2,061,633	1,970,354	1,792,606	2,481,223	2,207,983	1,312,375	2,538,007	2,567,238	2,670,730	2,301,201	2,308,614	26,805,860
Energy Sold	310,016	429,617	895,708	1,313,263	1,509,039	1,438,500	1,750,253	1,226,787	956,365	664,919	599,261	726,415	11,820,145
Demand Charge	\$62,196	\$60,636	\$53,154	\$45,193	\$65,128	\$62,855	\$42,258	\$84,777	\$71,248	\$69,657	\$60,522	\$81,973	\$759,597
Peak Load	0	0	0	0	0	0	0	0	0	0	0	0	0
Fixed Charge	-\$47,407	-\$47,407	-\$47,407	-\$42,961	-\$42,961	-\$34,069	-\$34,069	-\$34,069	-\$34,069	-\$34,069	-\$34,069	-\$47,407	-\$479,964
Taxes	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total	\$113,195	\$91,827	\$67,779	\$47,943	\$79,405	\$75,062	\$25,766	\$113,980	\$107,953	\$119,482	\$101,728	\$106,831	\$1.05M

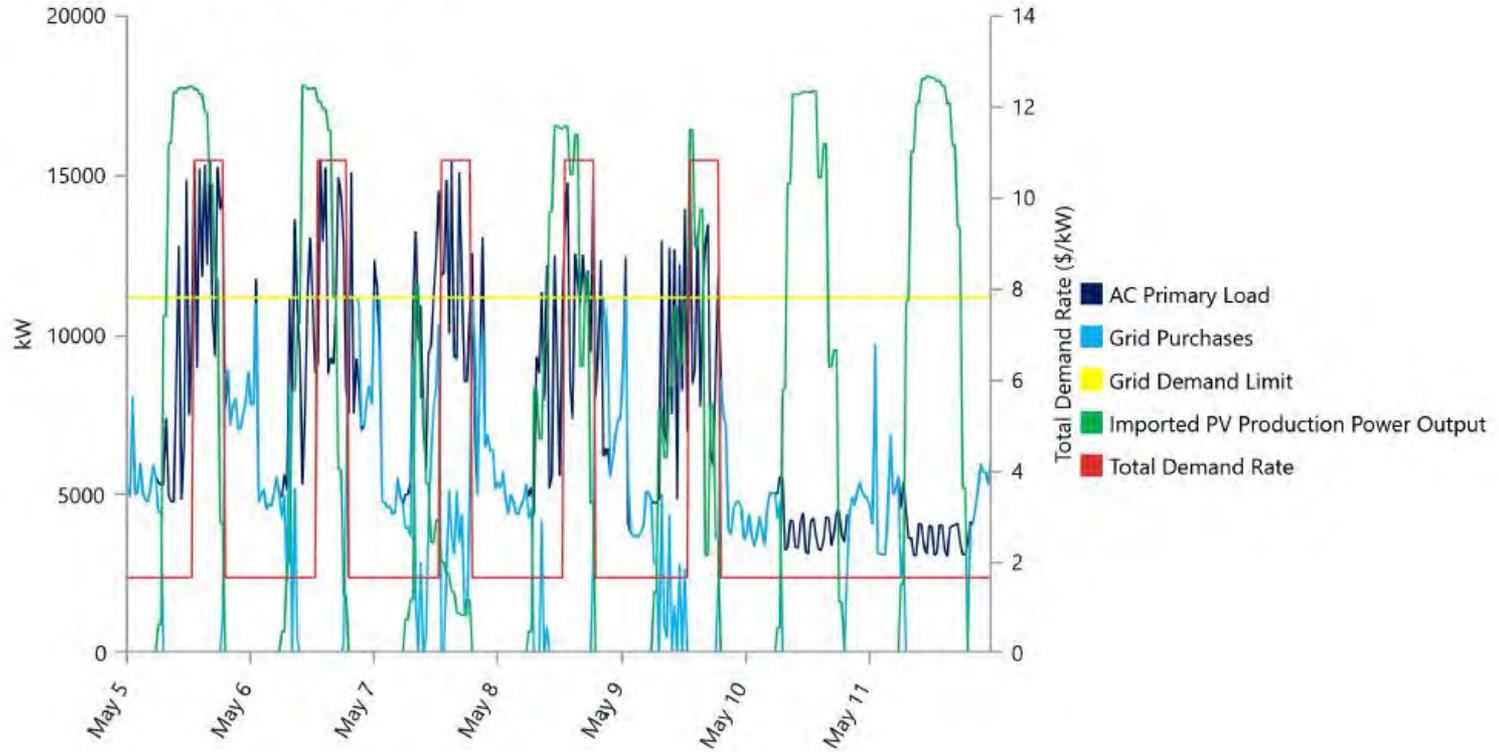
\$ 100K savings

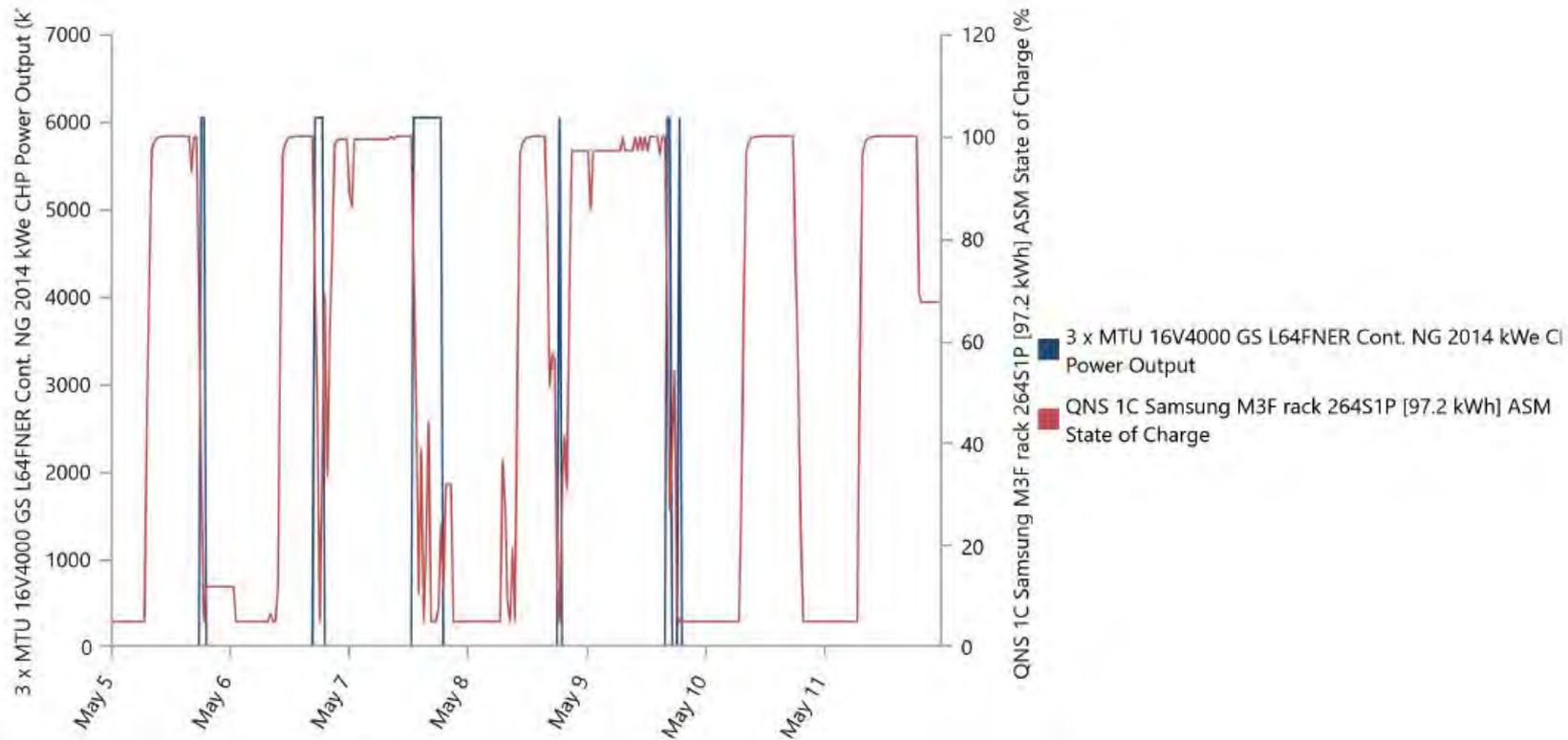
\$ 3M savings





Time series charts:







Distributed Generation Model

Compare Economics

IRR (%): **17.0**

Discounted payback (yr): **7.19**

Simple payback (yr): **5.73**

Annual utility bill savings: **\$3.17M**

	Base System	Proposed System
Net Present Cost	\$61.9M	\$42.2M
CAPEX	\$7.30M	\$23.3M
OPEX	\$4.22M	\$1.46M
Annual Demand Charge	\$2.11M	\$759,597
Annual Energy Charge	\$2.59M	\$771,319
LCOE (per kWh)	\$0.0808	\$0.0459
CO2 Emitted (kg/yr)	37,424,990	20,464,380
Fuel Consumption (L/yr)	0	1,843,545