



# THE FUTURE OF MICROGRIDS

**How Energy Storage Systems Add Reliability and Efficiency**

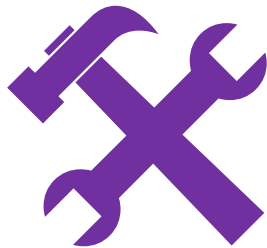
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Boston 11/8/17

# THERE ARE THREE MAIN DIMENSIONS TO MICROGRIDS

Requirements for a future energy system

## Reliability



- Reliability needs to be at least maintained
- Grid quality issues from high RE share need to be contained

## Cost-efficiency



- Reduction of fuel consumption
- Reduction on RE curtailment
- Reduction on O&M
- Increasing lifetime of all power equipment

## Sustainability



- Clean energy production
- Reduction of CO<sub>2</sub> emissions
- Paving the road towards high RE shares



Energy Storage is the cornerstone of renewable energy based microgrids

Resiliency is the ultimate revenue stacking option for grid-connected microgrids  
(and energy storage in general)

Reliability and Efficiency go hand in hand

# ENERGY STORAGE WILL BE THE CORNERSTONE FOR EFFICIENT ELECTRICITY SYSTEMS



## Decrease operating costs

- Allow gen-sets to operate in optimal range
- Increase gen-set efficiency
- Decrease cycling to reduce O&M

## Improve grid stability

- Act as back up power source to keep critical loads online
- Maintain high power quality with VAR support
- Avoid additional grid support equipment expenses
- Response time < 50 milliseconds

## Integrate more renewable resources

- Reduce strain on grid caused by intermittency
- Decrease diesel consumption through less curtailment of renewable resources
- Allow for 100% instantaneous RE penetration



# GRACIOSA: FULL-SCALE ISLAND MICRO-GRID WITH UP TO 65% RE SHARE

Commissioned Q1 2016  
2.8 MW/3.2 MWh Battery Storage  
4.5 MW Wind & 1.0 MWp PV  
RE limit without Battery Storage: 15%





# PROVEN FEASIBILITY BY A DEMONSTRATION SITE IN OUR TECHNOLOGY CENTER

## Layout Plan Technology Center

Inverters, Simulators (Wind, Sun)



1 MW/6 MWh NaS Battery



200 kW/200 kWh Li-Ion Battery



## Technology Center



14 km 15 kV Distribution Network (Medium Voltage)



Diesel Generator

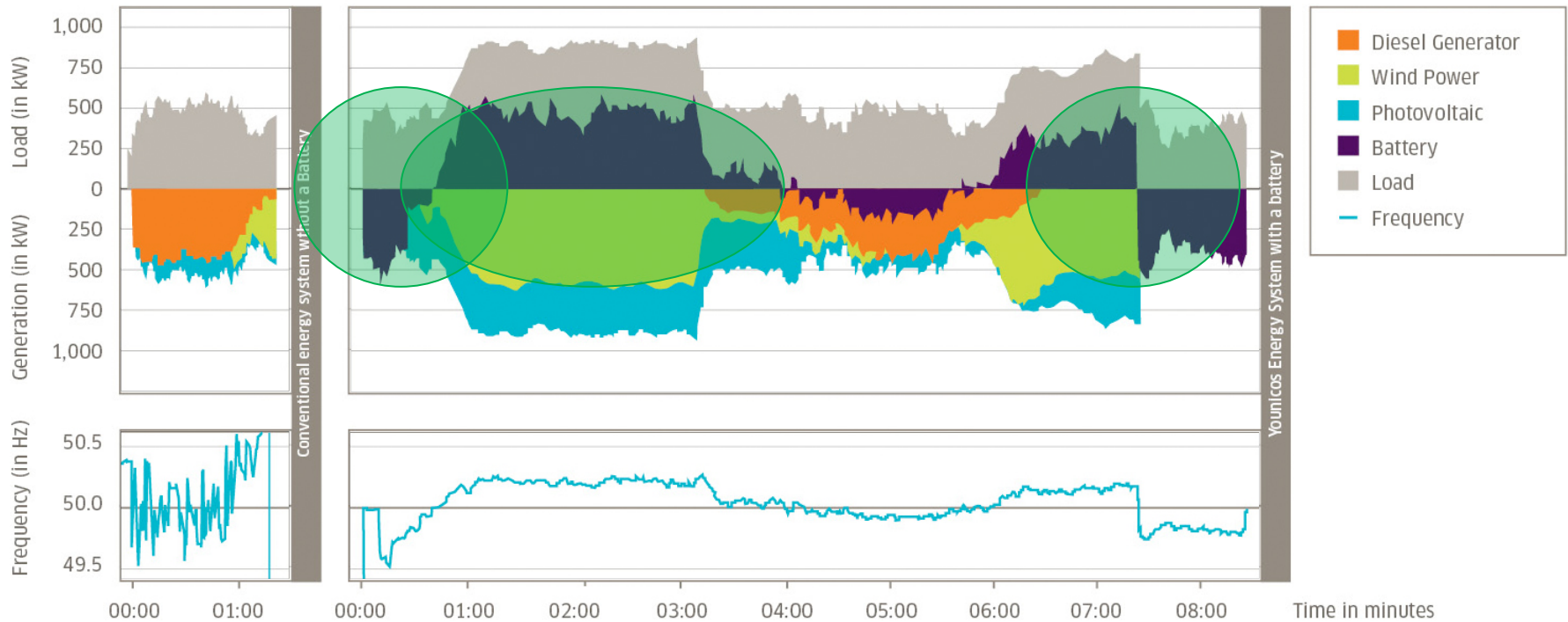
Island replica scale 1:3

- Demonstrate the functionalities of Younicos' technology
- Perform technical due diligences by local utilities or regulatory bodies
- Train local personnel in the operation and maintenance of such state of the art energy systems

We replicated a fully automated MW-scale island system in our headquarters in Berlin.



# Demonstration Results



# RESILIENCY AS REVENUE STACKING OPTION



Denver, Colorado, United States

## Panasonic Operations Hub

- 1 MW/120 min
- Lithium Ion
- 4 Y.Cubes
- Commissioning: Q1/2017
- Client:



**Panasonic**





# RESILIENCY AS REVENUE STACKING OPTION



## Multi-Use Storage for Greater Market Impact

Frequency Regulation

Solar Firming & Shifting

Peak Shaving

Energy Arbitrage

Back-up Power

capability to create islanded microgrid  
for 24/7 operation of the Panasonic  
NOC

Only needed when the other services  
cannot be provided (there is no grid)

New service for utilities

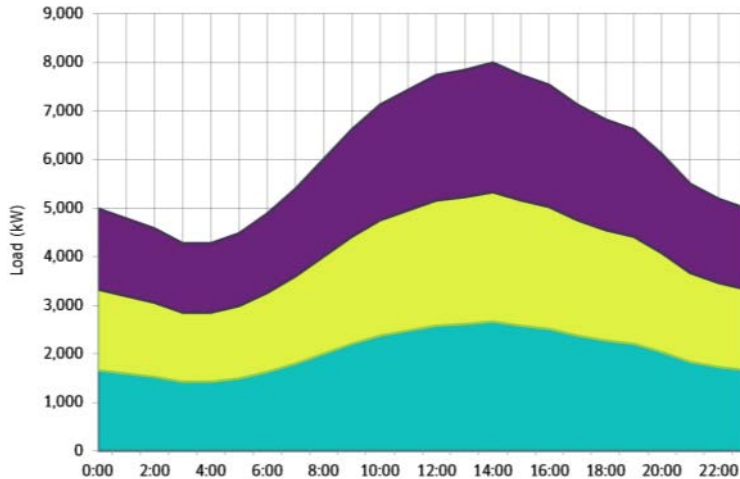




# EFFICIENCY AND RELIABILITY GO HAND IN HAND

## Operation without ESS

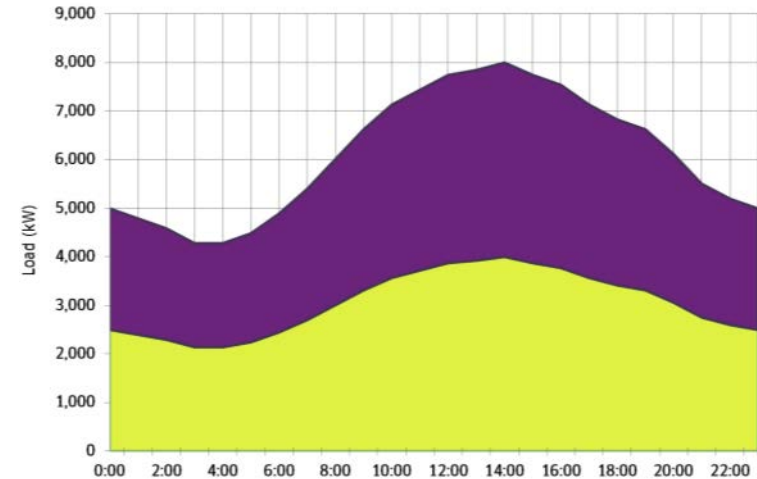
Existing Operation – Load Shared Across 3 Generators



- Load split evenly across 3 diesel generators
- Each DG acts as spinning reserves to keep serving load in case a single generator trips
- Operation at lower loading increases fuel consumption

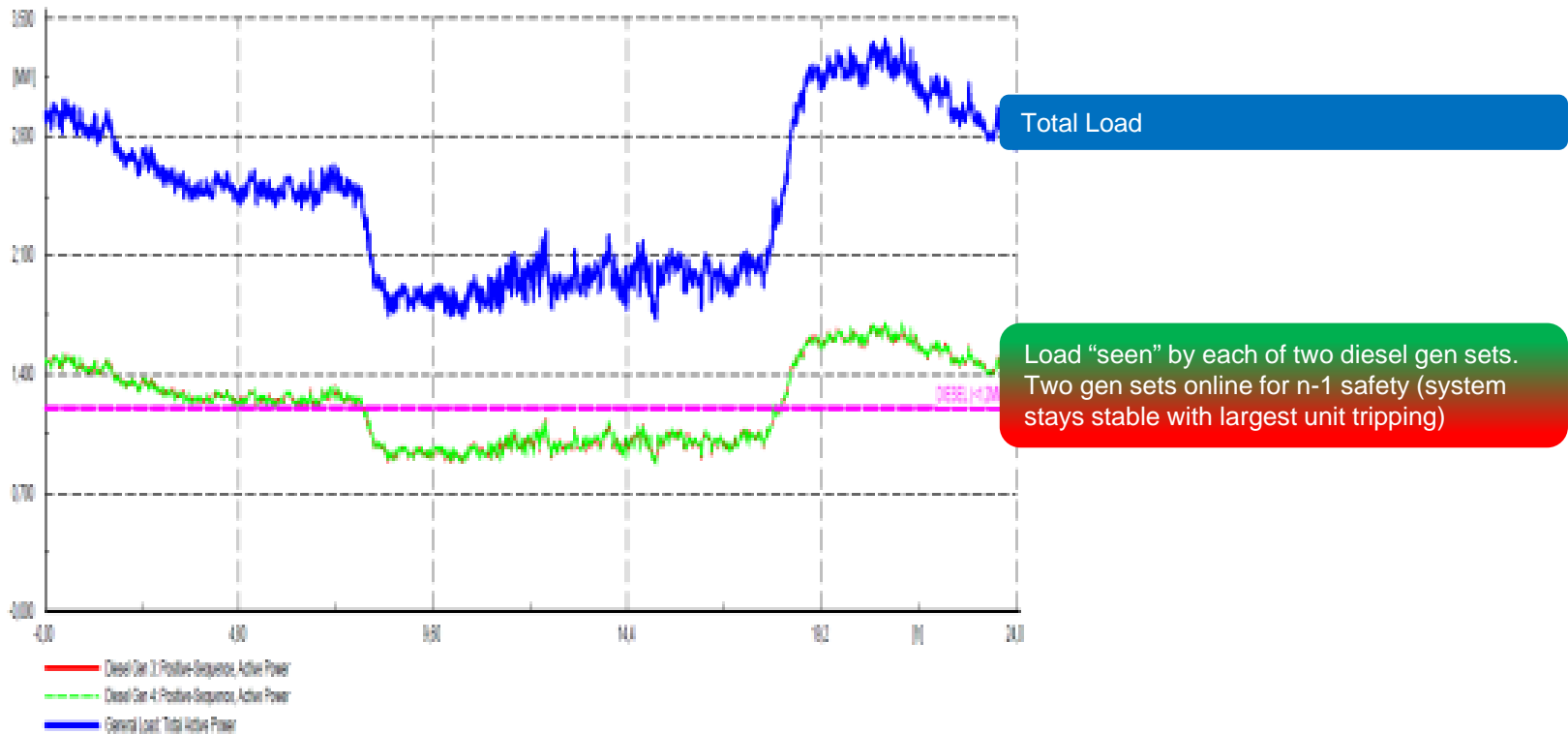
## Operation with ESS

Existing Operation – Load Shared Across 3 Generators

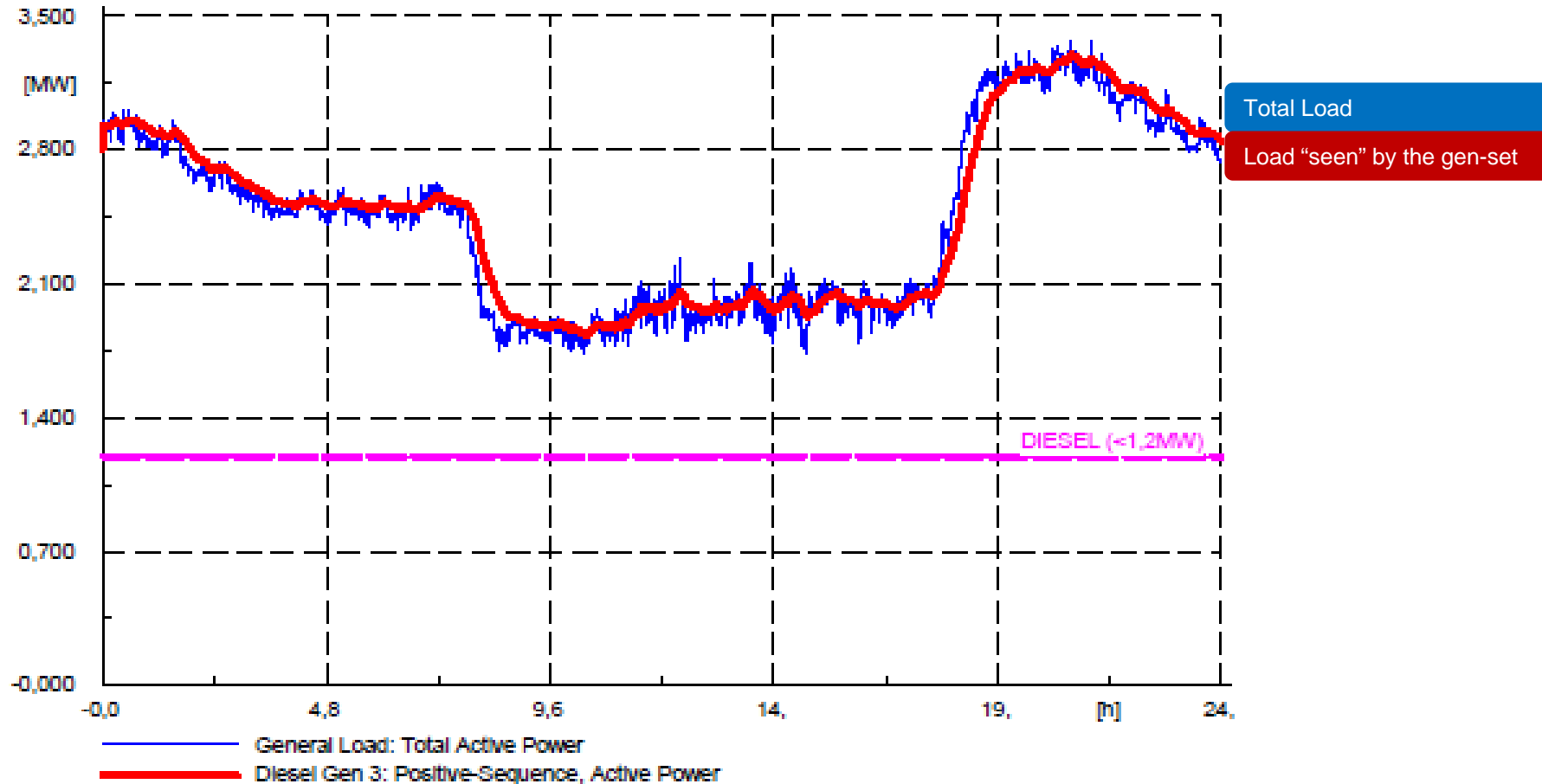


- Load split evenly across 2 diesel generators
- ESS provides spinning reserves while 3rd generator remains offline
- Operation at higher loading increases efficiency and reduces required O&M

# EFFICIENCY AND RELIABILITY GO HAND IN HAND



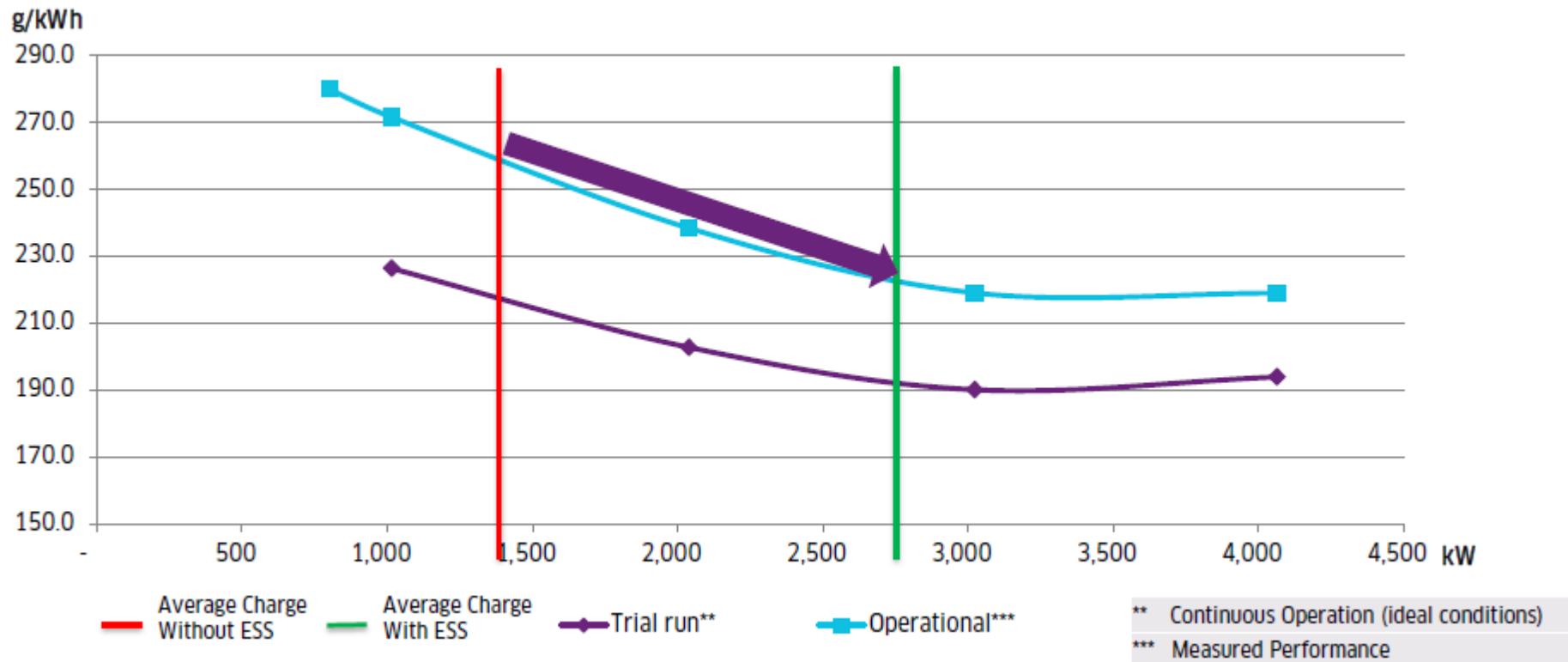
# EFFICIENCY AND RELIABILITY GO HAND IN HAND



# INCREASED EFFICIENCY DUE TO HIGHER GEN-SET LOADING



Specific Consumption on a Island Thermal Power Station

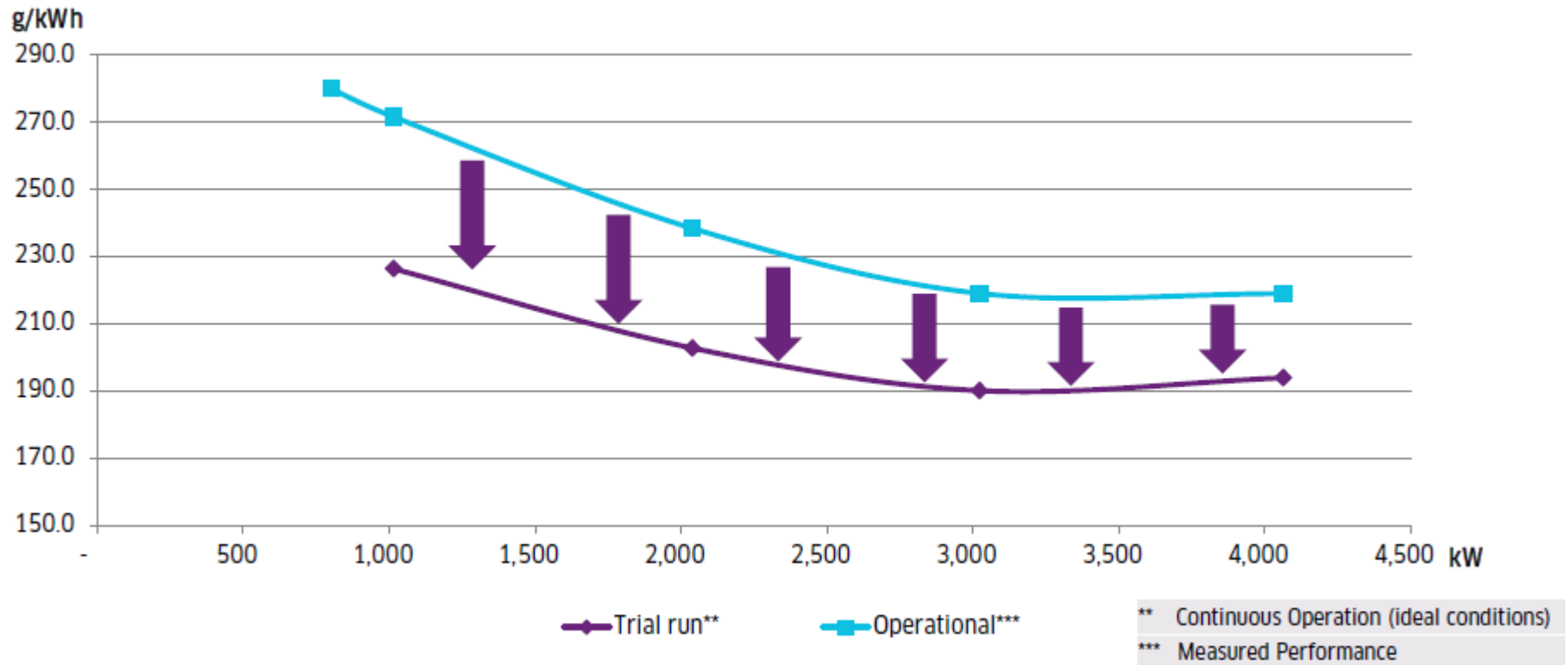




# INCREASED EFFICIENCY DUE TO SMOOTHER LOAD PROFILE



Specific Consumption on a Island Thermal Power Station



Additional advantages:

- Lower total run time hours
- Less strain on generators (reduction of load jumps)
- Reduction in O&M / oil consumption

# SUMMARY



- Fast and accurate energy storage systems can provide resiliency (especially in combination with renewable energy systems)
- (Electrochemical) Energy storage is inherently modular and has a very high reliability
- Reliability and microgrid capability are a potential new revenue stream for utilities
- System efficiency and reliability / resiliency can be tackled with the same solution

FURTHER QUESTIONS?  
WE ARE LOOKING FORWARD TO HEARING FROM  
YOU!

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