Bloomenergy®

DIESEL ALTERNATIVES WORKSHOP

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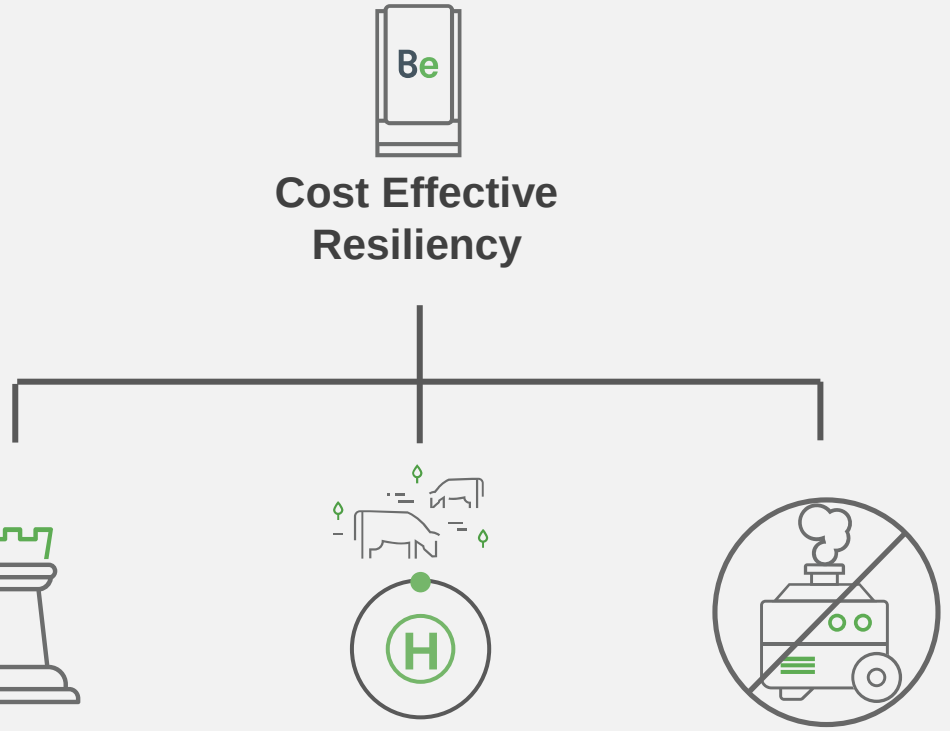
SUMMARY OF CHALLENGE STATEMENT

Does your solution replace diesel generators by supplying power to all customers at a substation level?	**YES**
Is solution portable or permanent?	**PROVEN IN BOTH**
Can your solution sustain islanding for 48 and/or 96 hours?	**YES**
Can your solution be ready for commercial operation by 2021 and can you execute a full-scale deployment?	**YES**
How many MW can your solution reasonably cover in 2021?	**300+ MW**

ENERGY PLATFORM
BUILT FOR PROTECTION



Cost Effective Resiliency

Long Duration Protection of Critical Infrastructure

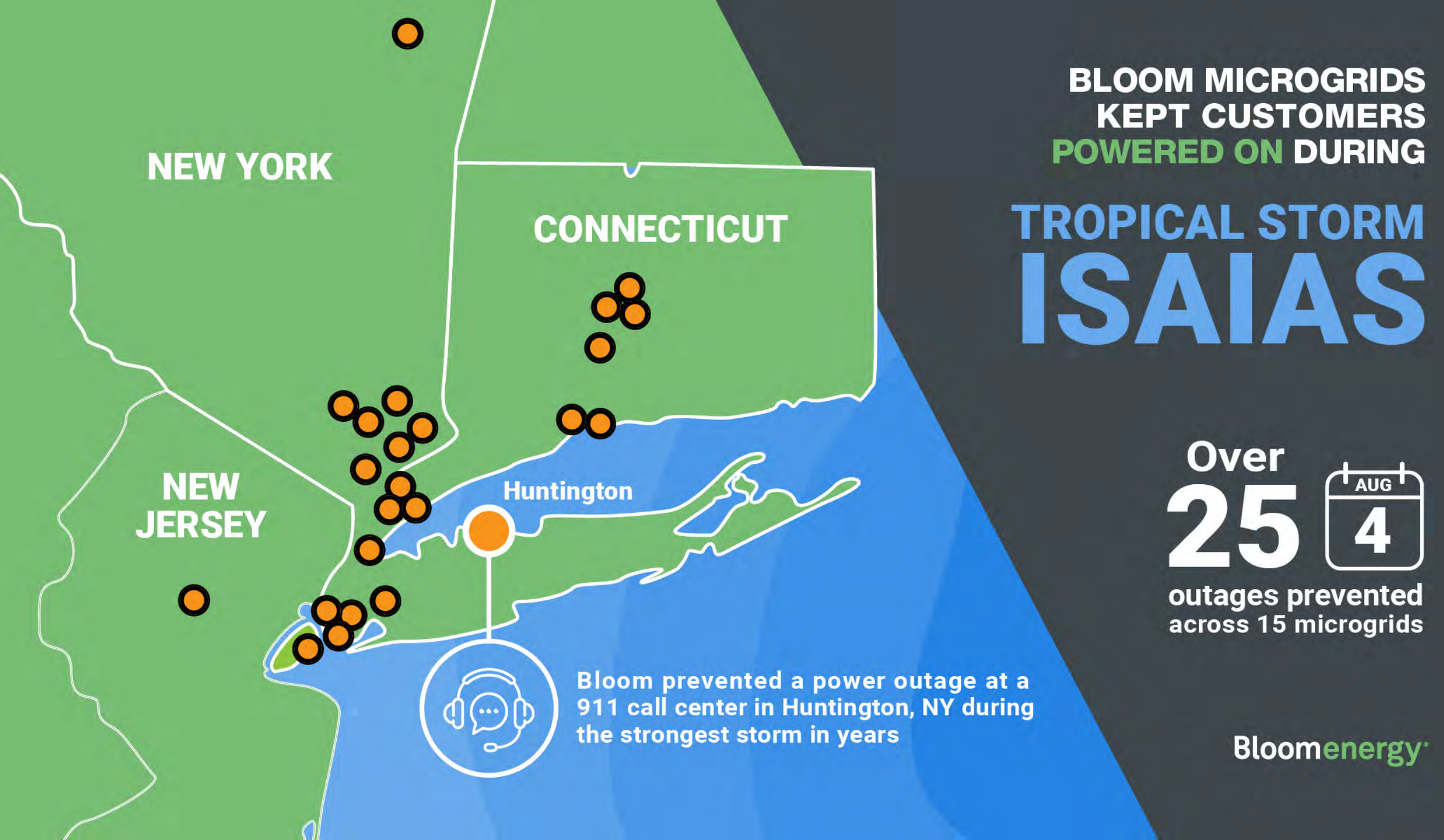
Capability to run on biogas or hydrogen

Virtually Zero NO_x, SO_2, Particulate Matter

HEADQUARTED AND KEY MANUFACTURING IN CALIFORNIA

OVER 700 SITES & 100 MICROGRIDS DEPLOYED

PROOF POINTS
PORTABLE, SCALABLE, RESILIENT & CLEAN



BLOOM MICROGRIDS KEPT CUSTOMERS POWERED ON DURING

TROPICAL STORM ISAIAS

Over **25** outages prevented across 15 microgrids

AUG 4

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SUBSTATION SOLUTIONS

Bloomenergy®

Substation	Microgrid Size	Utility Capacity Support	Application	Proof Point	Community Benefits	Utility Benefits
Alto	32 MW	38 MW	Stationary	Delmarva Substation	• Virtually zero local air pollutants • Very quiet • Energy dense	• Local capacity • Permanent transmission capacity benefit • Peaking capability
Covelo	2.65 MW	3.25 MW	Portable	Sleep Train Arena	• Virtually zero local air pollutants • Very quiet • Energy dense	• Ability to move to other substations

Modular, community-friendly technology enables solutions for various substation applications

Permanent solution can eliminate need for rolling black-outs deep in distribution system

2.65 MW SPECIFICATION
PARALLEL IN BLOCKS TO ANY SYSTEM SIZE

Output Rating	
Total System Generation Capacity	3250kW
System Generation Redundancy	N+1 Energy Server (250kW)
Grid Independent Load Support	2650kW/3000kVA @ N+2 MI5
Maximum grid independent step load	850KW or 1600kW (ie 30 or 60%)
Duration between max grid independent load step	100 seconds
Performance Specification	
Power Factor range	0.75-1.0(lead/lag)
Max crest factor	3:1
Nominal output voltage after transformer	480V AC (transformer provided per site voltage external to system)
Fault Current Capability	250% of Grid Independent Load Support
Phase Sequence	3ph-ABC
Configuration	3W
Waveform	Sine Wave
Voltage recovery	Meets ITIC, IEC 62040 Class 1
Accuracy to voltage set point	±0.5%
Static (steady state) voltage regulation	≤1% with resistive load
Transient (dynamic) voltage regulation	≤5% with resistive load
Voltage THD with 100% linear load	≤2%
Frequency setting	60Hz Fixed / Sync. To grid
Voltage THD with 100% linear load	≤2%
Inverter Certifications	UL1741/Rule 21 Compliant

KEY REQUIREMENTS CONFORMANCE

- All Equipment Provided will be commercial off the shelf
- 300+ MW of equipment can be supported by 10/2021 with decision by 10/2020
- Permanent solutions will need to be assessed to allow for permitting and utility requirements
- System capable of all power quality, paralleling, and protection requirements
- Paralleling system is standard Bloom Energy solution, no special testing required in the field.
- Can demonstrate performance on existing systems already operating at scale in California
- Portable solution deployable in <72 Hours

Technology Highlights

- Proven in PG&E technology for 12 years
- Existing Bloom Energy PG&E relationship supports standard communication and controls protocols
- Capable of running on renewable fuel today
- Virtually zero local air pollution
- Can run indefinitely
- Easily pairs with all other generation technologies

Other Key Challenge Statement Considerations

VENDOR COMPETENCE

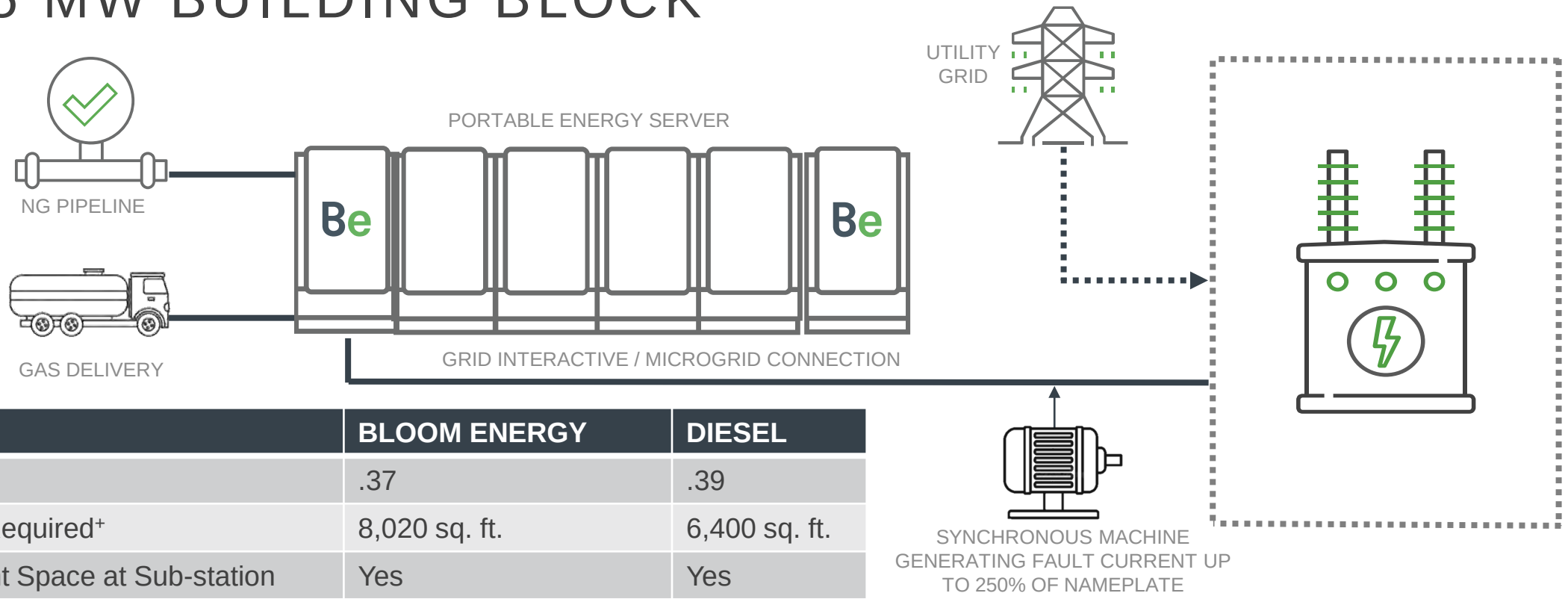
- Bloom Energy acts as primary vendor for project implementation
  - Will employ utility approved electrical partners to implement electrical systems on site
  - Will procure utility compliant switchgear and controls to integrate with the substation
  - Will develop proactive processes and procedures to conform to utility safety procedures
  - Already operating >265 MW with CA utilities in conformance with Rule 21 standards

SPECIFICATION CONCERNS

- 250% requirement drives overspend on components and paralleling equipment to support an avoidable condition for all proposed solutions. Given this is an emergency, interim microgrid response for a finite period of time, alternatives should be considered.
  - Modify downstream fault settings at key distribution points to be within available fault levels or enable inverter current clamp to disconnect distribution.
  - Energize the downstream MV distribution with inverter based voltage ramp control over 8 seconds limiting inrush demand

COVELO 2.5 MW APPLICATION*

2.65 MW BUILDING BLOCK



	BLOOM ENERGY	DIESEL
KW/SF	.37	.39
Space Required⁺	8,020 sq. ft.	6,400 sq. ft.
Sufficient Space at Sub-station	Yes	Yes
Community Friendly Generation	Yes	No
Permittable for permanent use	Yes	No
Island Duration Capability	Indefinite with pipeline or 96 hours at peak with live refuel capability	Unknown

⁺Includes temporary fuel tanks

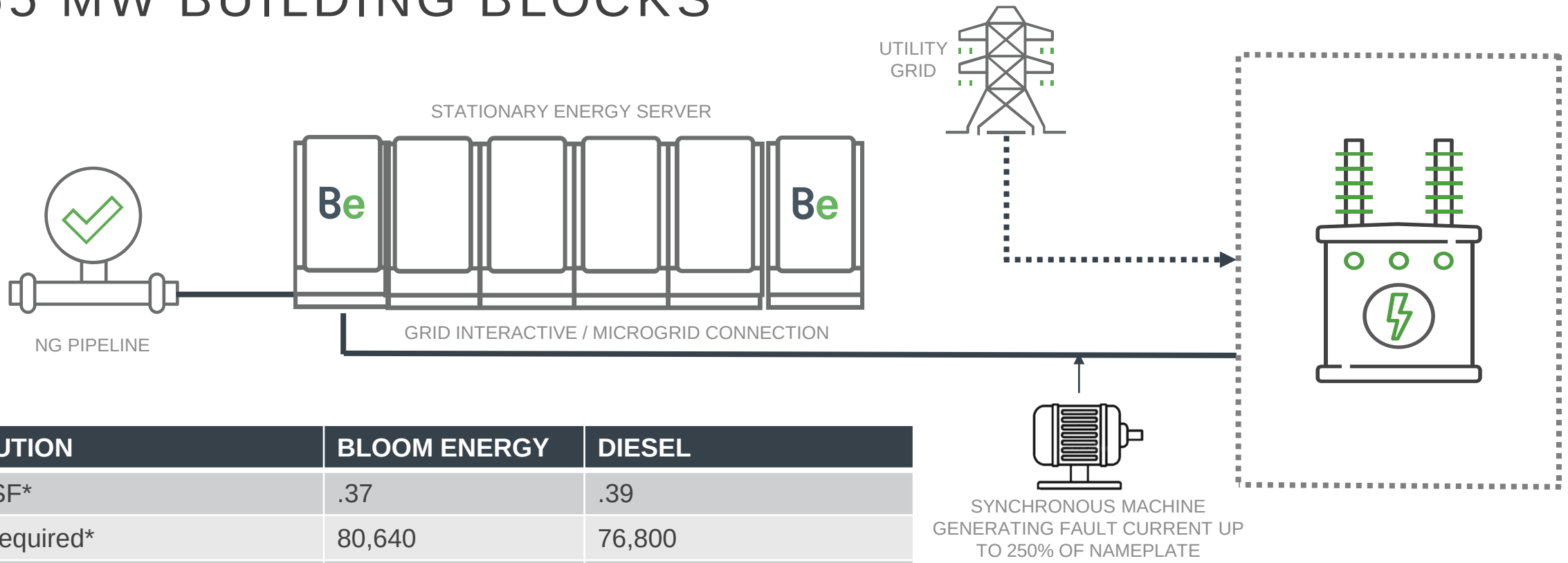
Recommendation:
Use 2.65 MW system to be deployed temporarily with temporary fuel

*Can be customized in 50kW increments

SPACE FOR TEMPORARY SOLUTION
COVELO SUBSTATION

ALTO 32 MW APPLICATION

2.65 MW BUILDING BLOCKS



SOLUTION	BLOOM ENERGY	DIESEL
KW/SF*	.37	.39
SF Required*	80,640	76,800
Sufficient Space at Sub-station	No	No
Community Friendly Generation	Yes	No
Permittable for permanent use	Yes	No
Island Duration Capability	Indefinitely	Unknown

*Adjusted for service access, clearance and all necessary equipment

Recommendation:

Permanently deploy as many MWs as possible at substation and deploy remainder strategically downstream to enable full capacity

SPACE CONSTRAINTS FOR A 30+ MW SOLUTION

ALTO SUBSTATION

ILLUSTRATIVE COST STRUCTURE
COVELO SUBSTATION – TEMPORARY SOLUTION

Cost Structure: Monthly rental, 6 month minimum

Cost Estimate: $250,000 – $320,000*/month

- *Nameplate capacity would be 3.25 MW to support 2.5 MW peak load*
- *Includes equipment, delivery, installation, comprehensive ongoing O&M and removal*
- *Pricing can be restructured as a fixed capacity charge with variable operational charges*

*Not inclusive of fuel

ILLUSTRATIVE COST STRUCTURE
ALTO SUBSTATION – PERMANENT SOLUTION

Cost Structure: 30-Year PPA

Cost Estimate: 6.5 - 8.5 cents per kWh

- *Includes equipment, delivery, installation, comprehensive ongoing O&M, and decommissioning*
- *Contracted tolling rate with 2% annual escalator*
- *24x7 output*

Fuel Costs: 2.2 – 2.5 cents per kWh

- *Commodity cost for PG&E Gate location*
- *Delivery cost to vary based on utility's strategy for distribution*

RENEWABLE FUEL READY

Bloomenergy

Bloom Energy Servers are capable of running on hydrogen blended with natural gas today and 100% pure hydrogen in the near future

Green hydrogen can be generated using otherwise curtailed renewables