Software for Grid-Connected Energy Storage

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The Grid Needs Batteries

Origin of MESA

CES

- 25 kWh Li-ion battery
- ~$100k

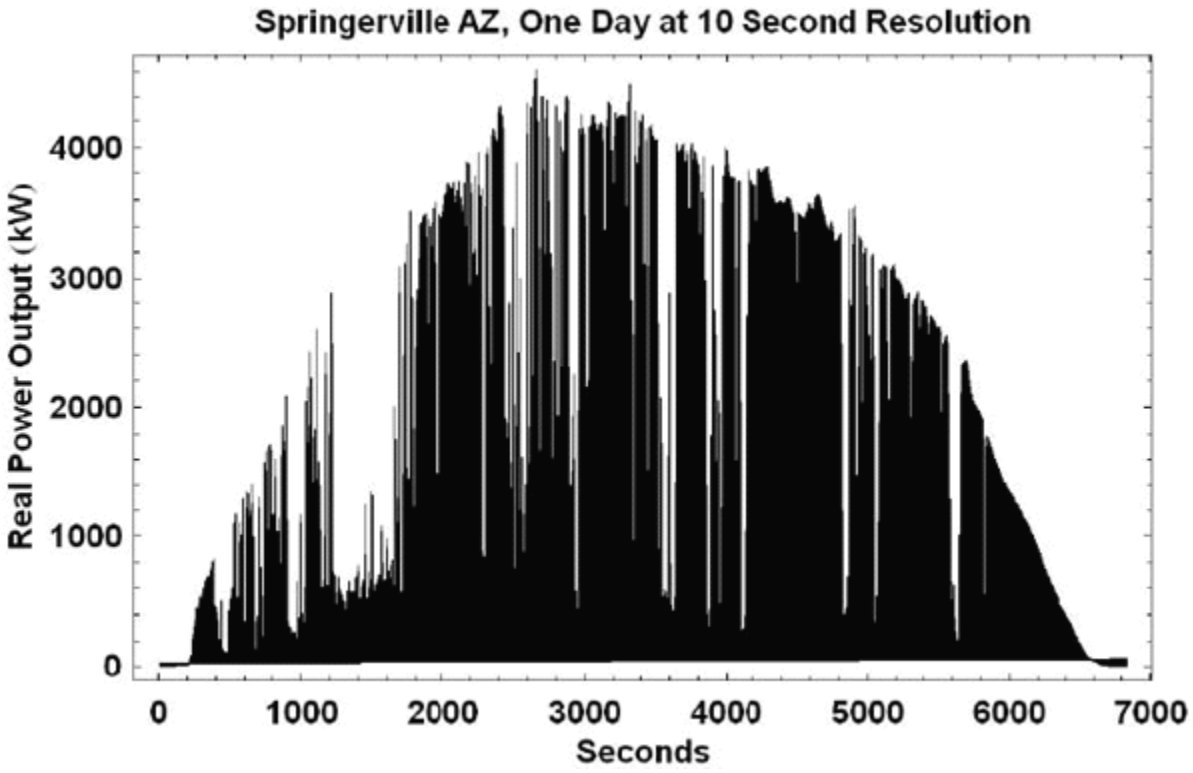
One-off Projects

Nissan Leaf

- 24 kWh Li-ion battery
- $35k
- Plus a car

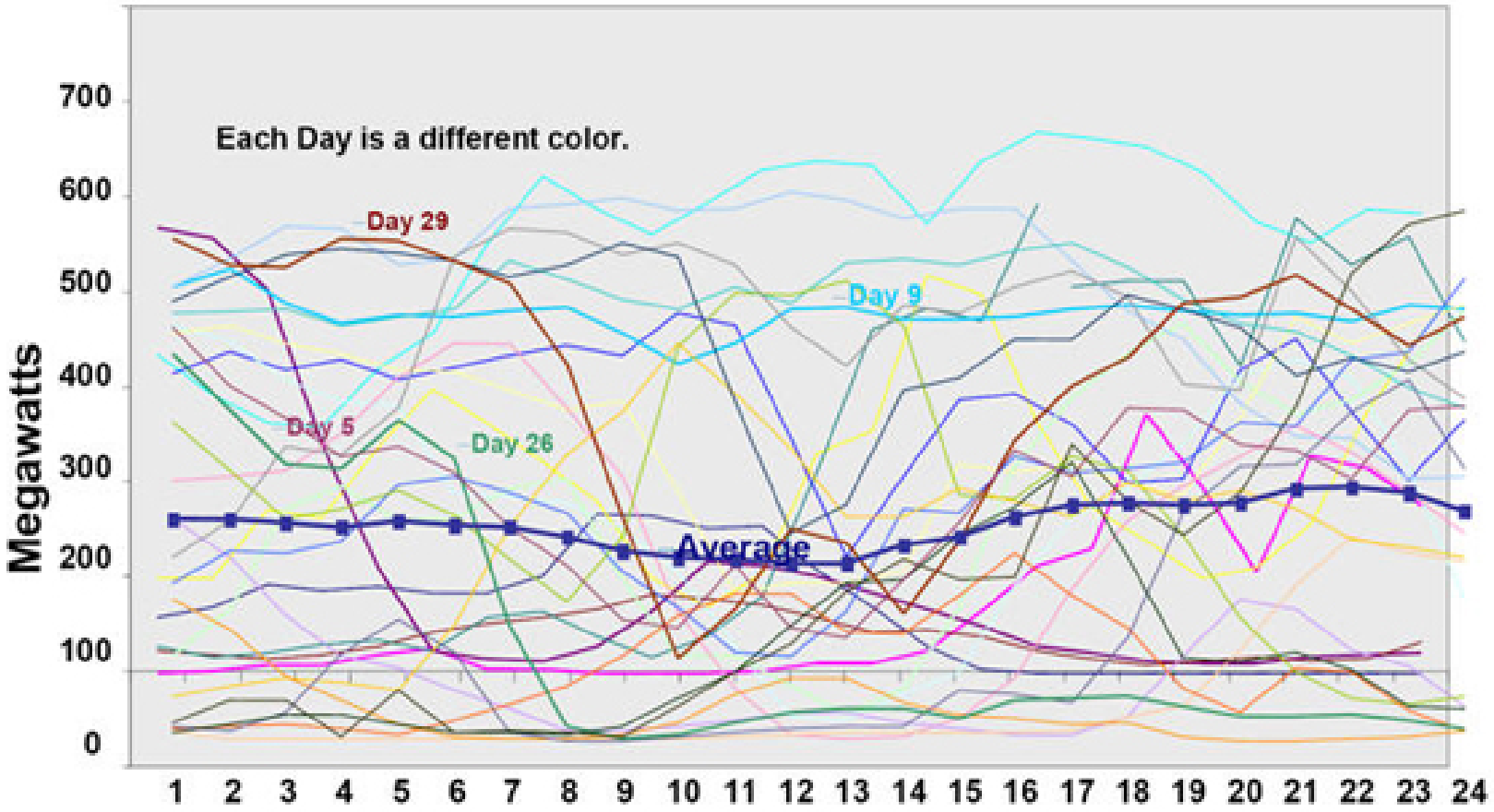
Engineered for Scale

Clean, but Intermittent
(solar)



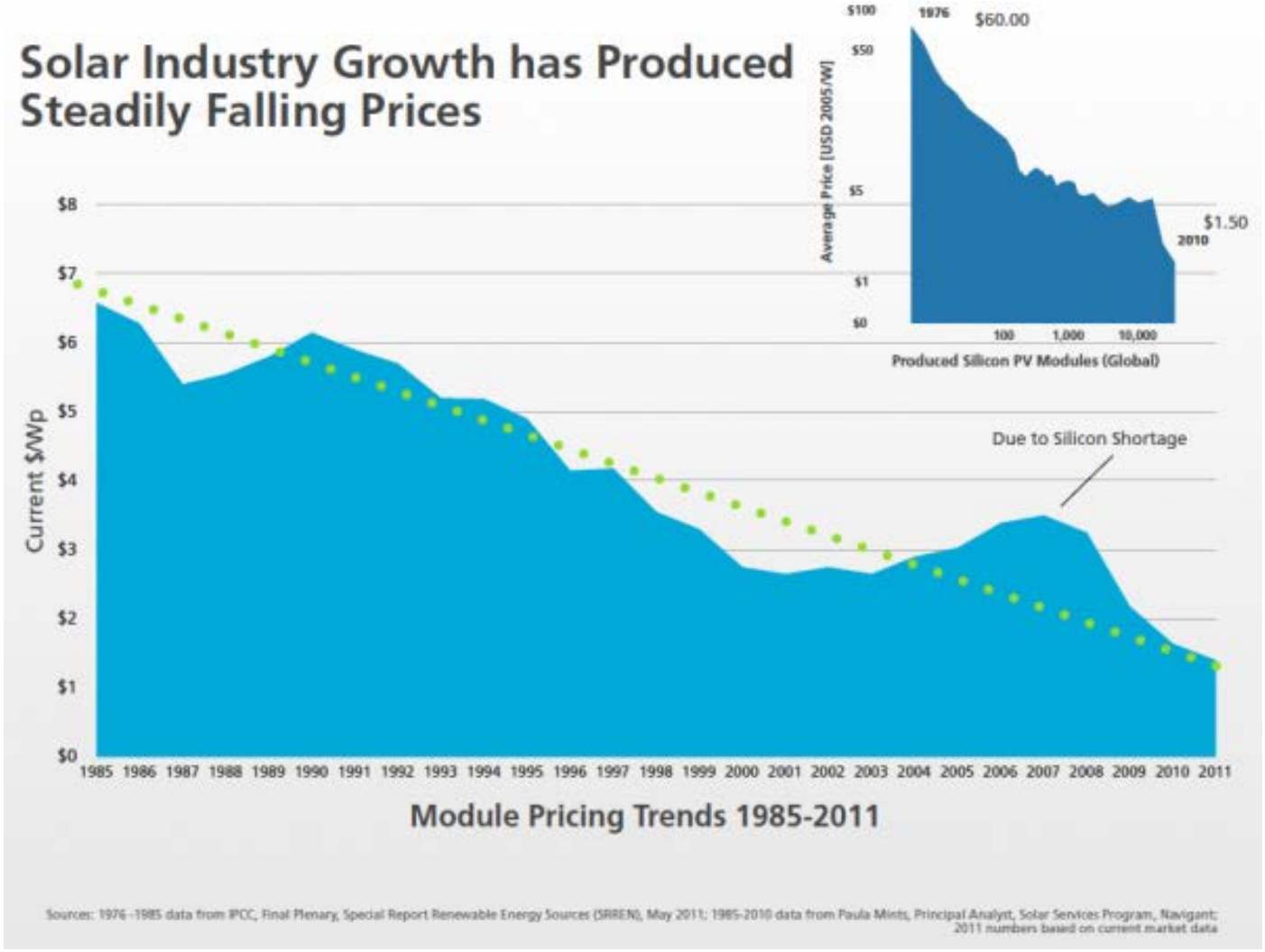
Source: Carnegie Mellon Electricity Industry Center (CEIC)

Clean, but Variable
(wind)



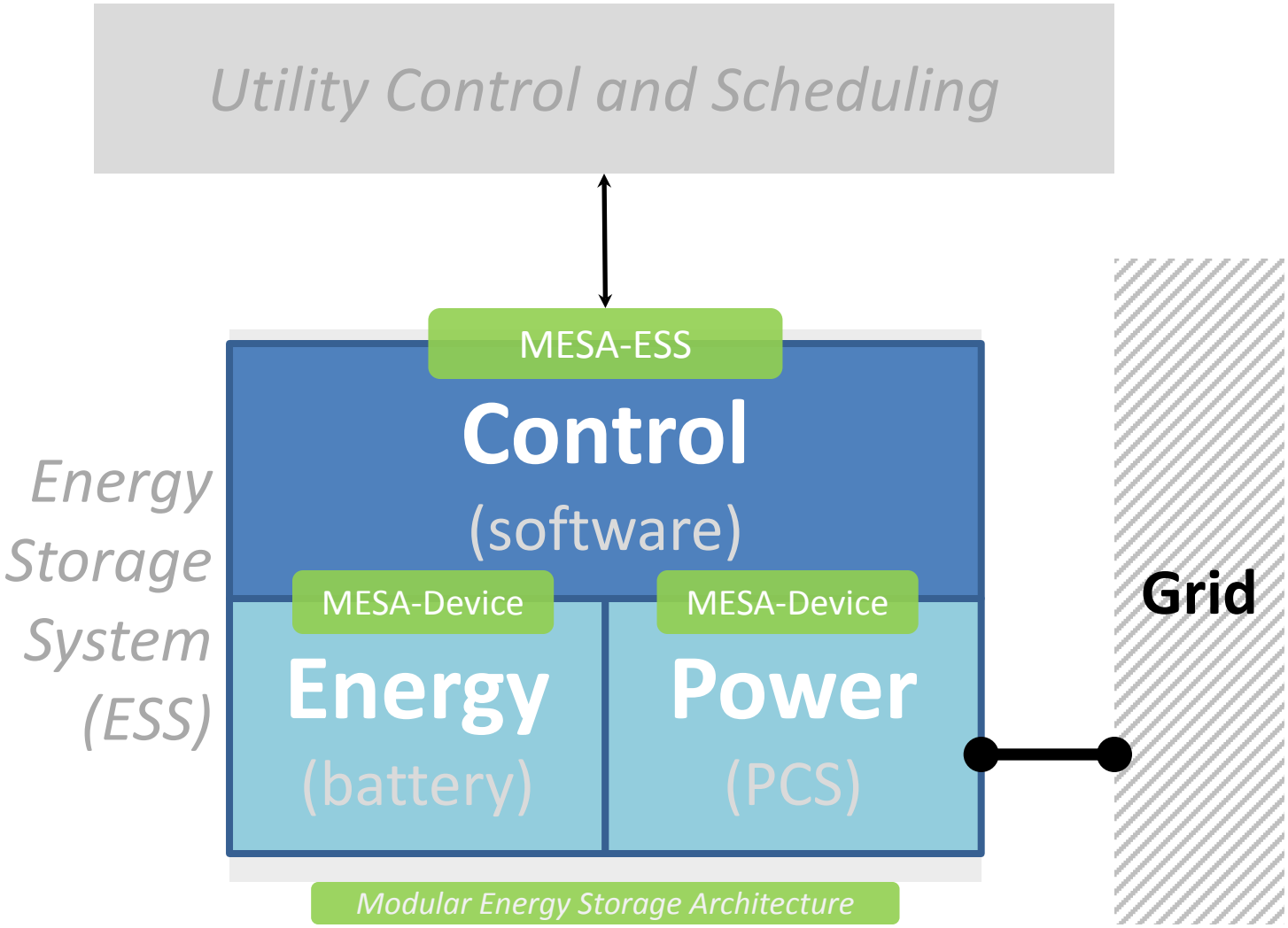
Source: California Independent System Operator

Grid Parity



Source: Intergovernmental Panel on Climate Change; Navigant

ESS Building Blocks



1Energy Projects

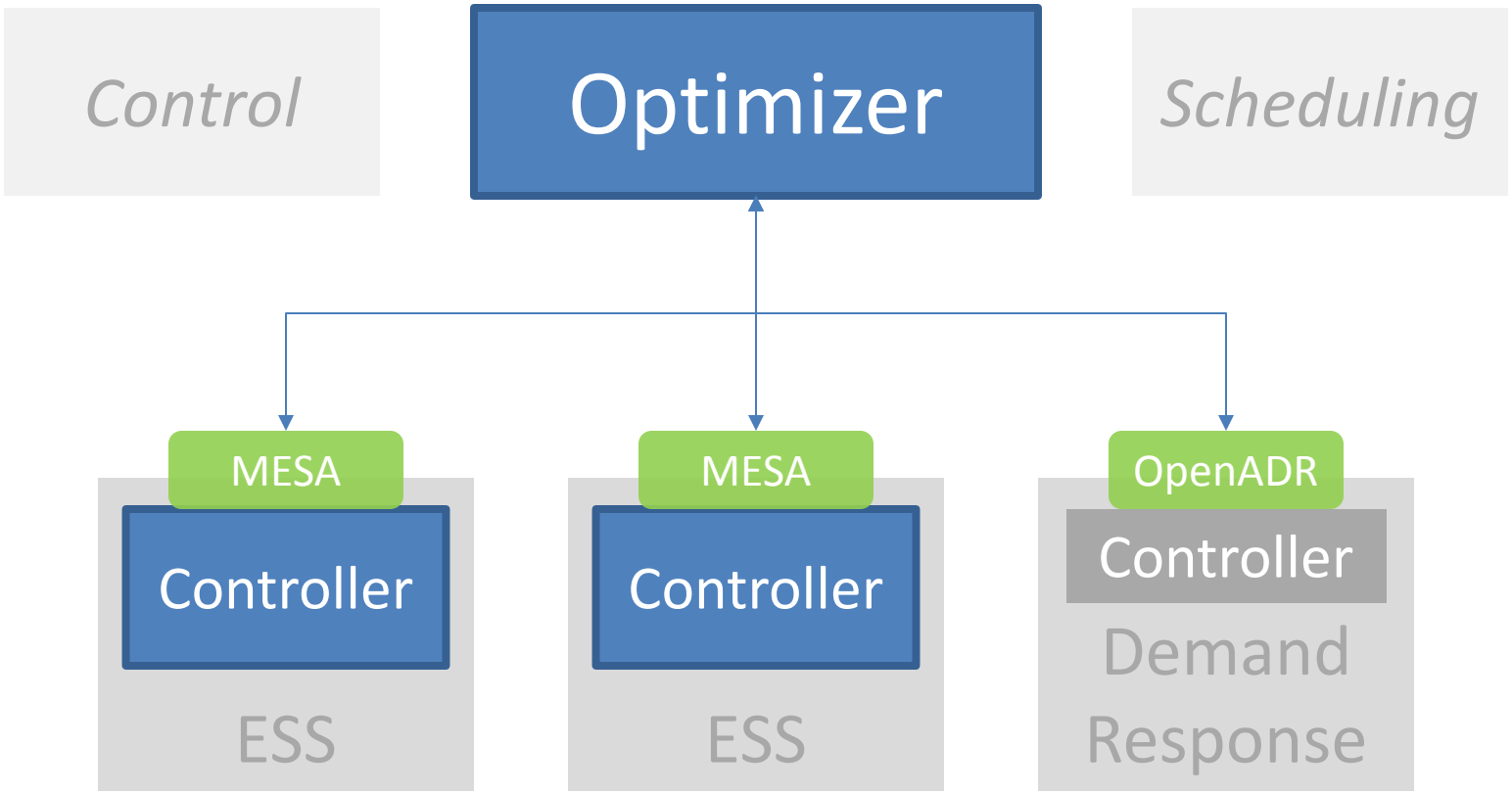
Project	Utility	Power	Energy	Purpose
MESA-1a	Snohomish PUD	1 MW	0.5 MWh Li-ion	Multiple use cases
MESA-1b	Snohomish PUD	1 MW	0.5 MWh Li-ion	Battery-agnostic
Rankin	Duke Energy	1.25 MW	0.3 MWh NaNiCl	PV-storage algorithms
Cochrane	AES (Chile)	20 MW	5 MWh Li-ion	Spinning reserves
MESA-2	Snohomish PUD	2 MW	7 MWh VRFB	Wind firm | Fleet mgmt
PSE 1	Puget Sound Energy	0.5 MW	1 MWh	Upgrade deferral
PSE 2	Puget Sound Energy	2 MW	4.4 MWh	Outage mitigation
[More]	Wa, Ca, Tx, …	…	…	…
		27+ MW	**18+ MWh**	
DR-1	Snohomish PUD	~0.5 MW	Demand response	Proof of concept

- Wide range of **power**, **energy**, **battery types**, **use cases**
- Designed and built to common **MESA standards**

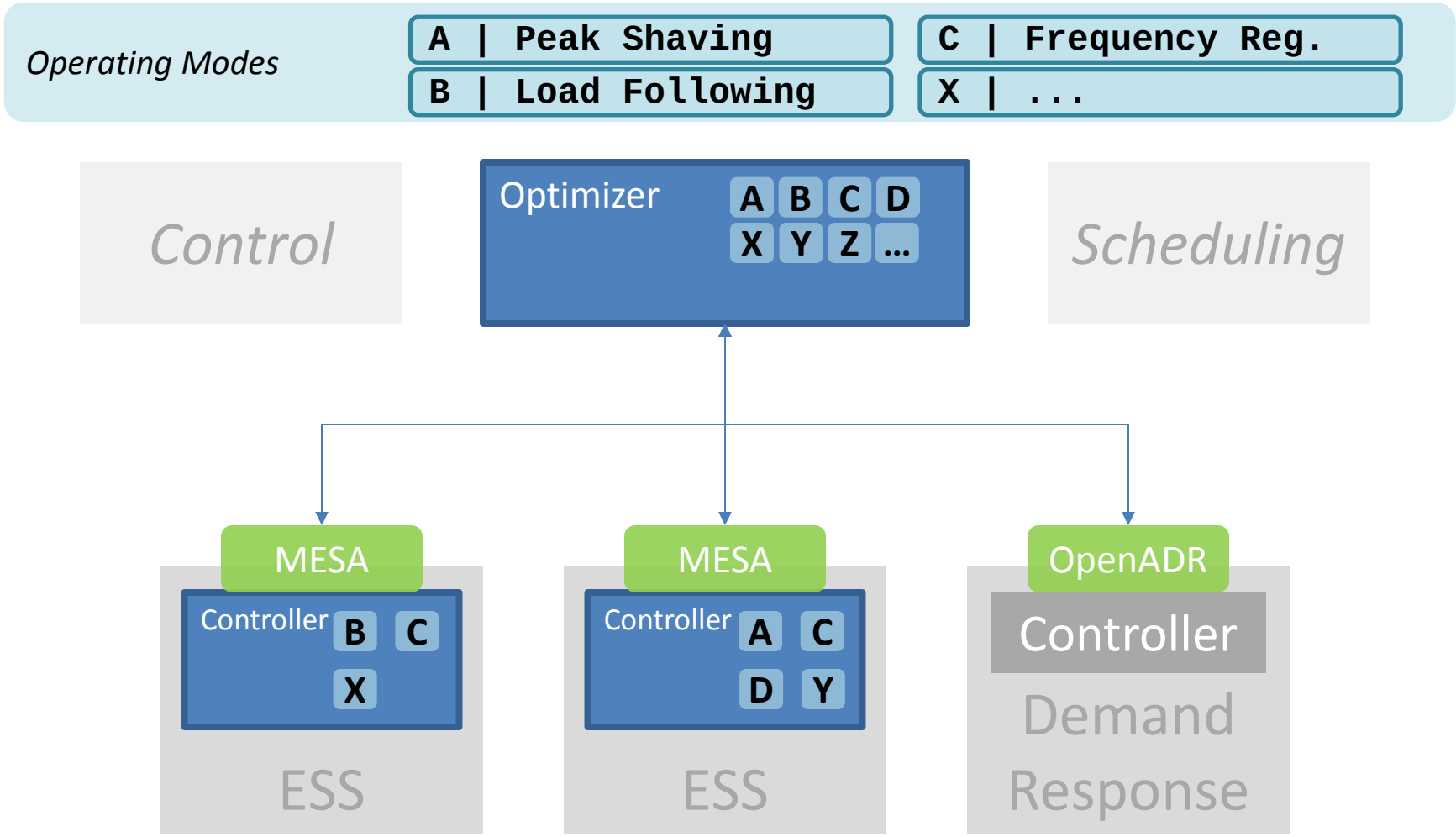
MESA

- Designed for utility needs
- Standardizes ESS design and engineering
- Enables innovation
- Open to all
- Market traction
- http://mesastandards.org/

Architecture



Applications



Application Example

- Duke Energy Rankin ESS (Charlotte, NC)
- PCS: 1.25 MVA S&C Electric
- Battery: 282 kWh FIAMM Na-Ni-Cl
- PV smoothing algorithms

Rankin Energy Storage System

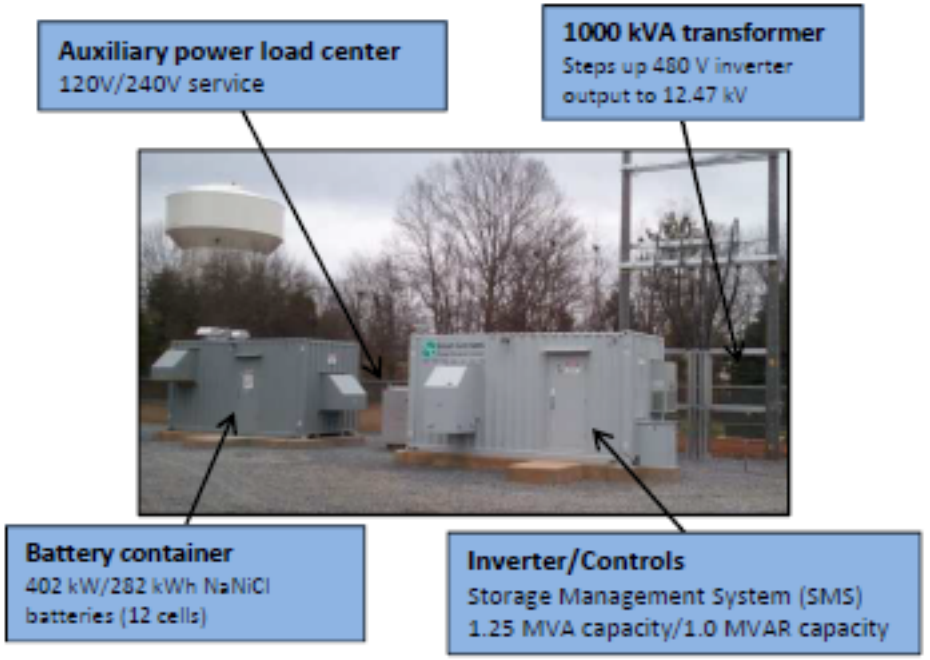
Rankin Ave. Retail Substation, Mount Holly, NC

Major system components:

- 402 kW / 282 kWh system capacity
- FIAMM sodium nickel chloride battery
  - 12 Zebra bus batteries connected in parallel
- 1.25 MVA S&C Electric Company Inverter (SMS)

Interconnection:

- Located on a 12.47 kV distribution circuit
- Interconnected immediately outside of the substation
- Circuit contains a 1.2 MW solar facility ~3 miles away



System attributes

- Installed Dec 2011, in service Mar 2012

- Remotely operable
- ZEBRA bus batteries by FIAMM for stationary application development
- Contains fiber connection to substation relaying; no connection to the solar facility on the circuit

Applications being tested

1 – centralized solar-induced power swing mitigation

a) senses substation real power loading and uses battery to "smooth" rapid ramp rates caused by cloud-induced solar intermittency

b) no direct connection to the solar – designed to smooth power swings from multiple dispersed solar sites on a circuit

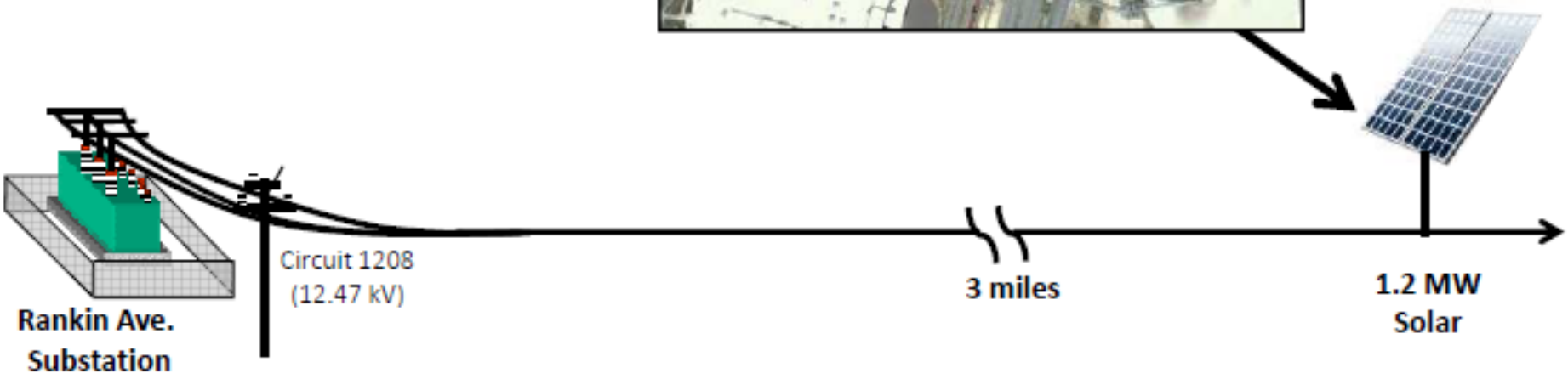
2 – active VAR/power factor management

3 – combined watt/VAR voltage control

a) compensation for rapid solar-induced voltage changes

National Gypsum PV solar facility

- 1.2 MW solar PV
- Mounted on the roof of manufacturing facility in Mount Holly, NC
- Located ~3 miles from the substation on a 12.47kV distribution circuit



Solar output intermittency caused by cloud cover