



Intelligent Efficiency Conference

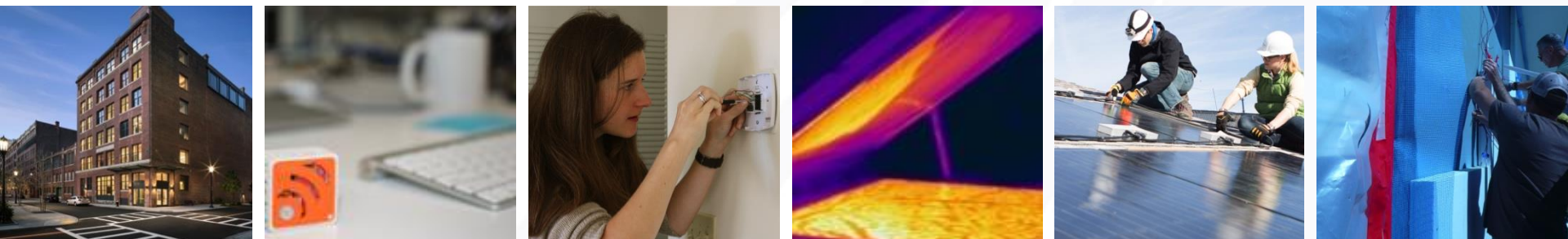
Track A: Integrating Distributed Resources

3A Integrating Nanogrids and Microgrids into the Modern Grid

**Kurt Roth, Fraunhofer Center for Sustainable
Energy Systems
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An Integrated SHINES System Enabling High Penetration Feeder-Level PV



Kurt Roth, Ph.D.

ACEEE Intelligent Energy Conference
December 6, 2016

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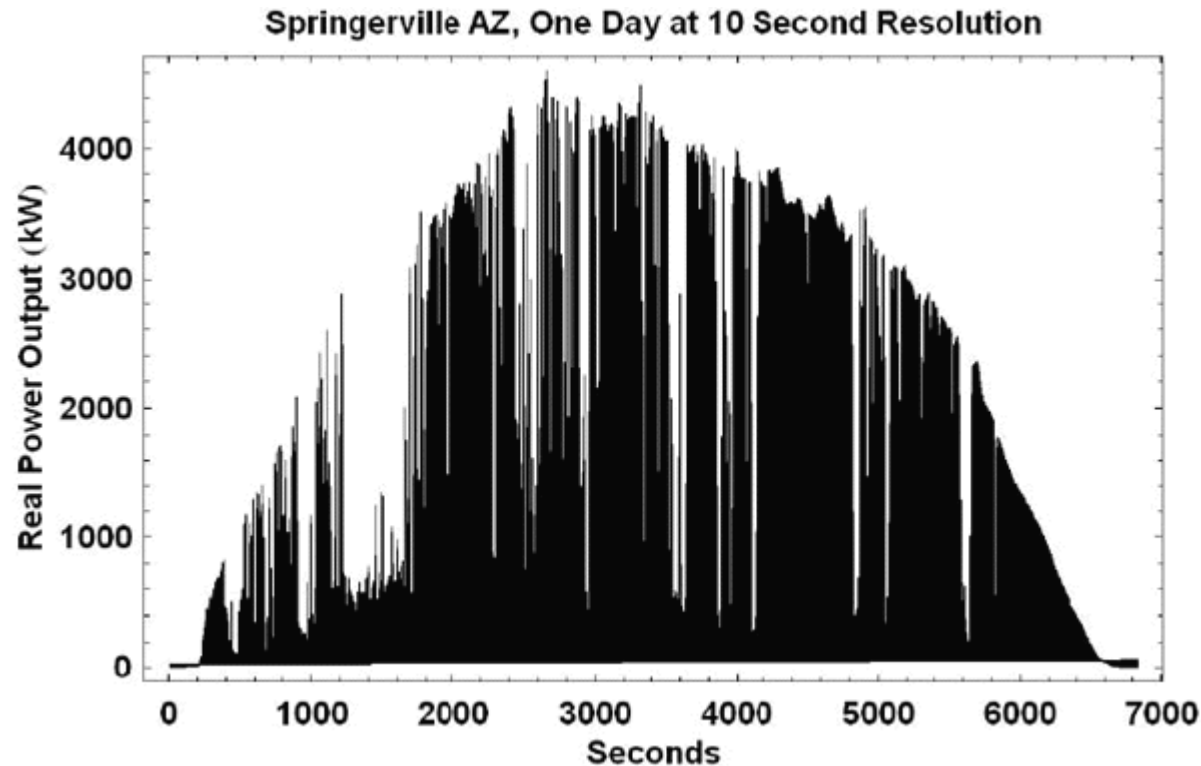
High Penetration PV is:

Rated PV Power = Peak Facility Loads



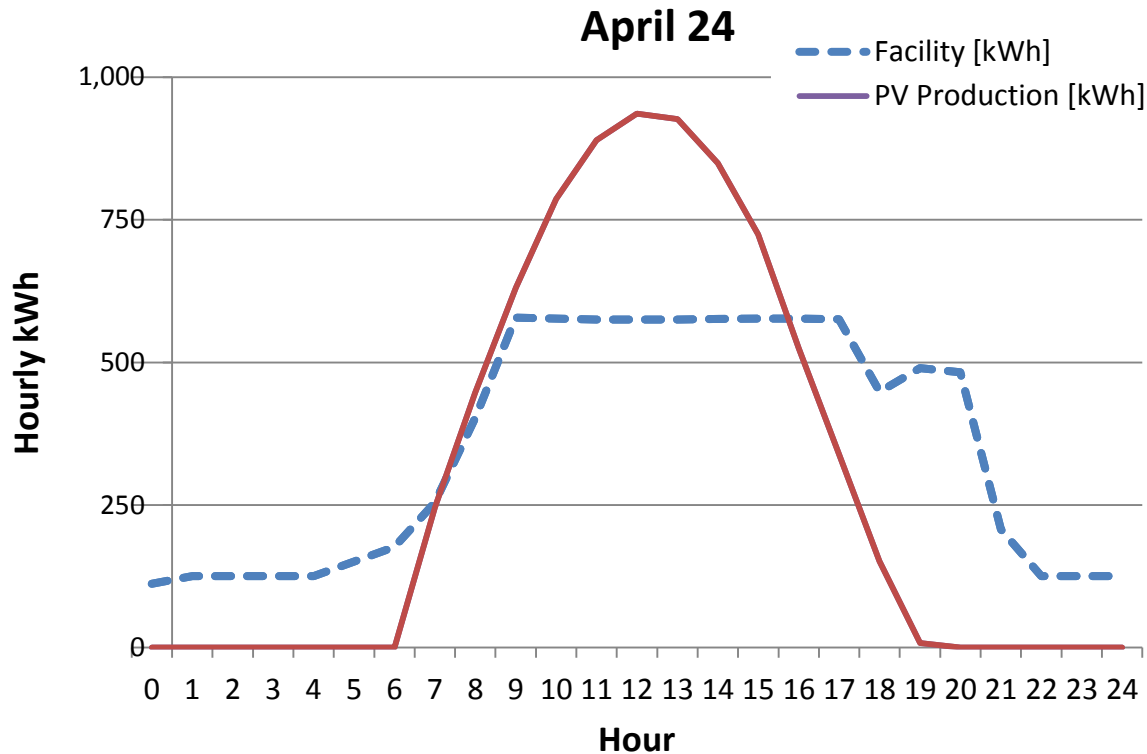
Challenge: PV Intermittency

Power ramps up to 50% of peak output in one minute



Source: Curtright and Apt (2008).

Challenge: Solar Surplus on Sunny Spring Days



- Worcester, MA climate
- “Typical” April 24th
- Big Box Retail (simulated)
- PV = 1,000 kW
- Building Peak = 1,000 kW
- $T_{\text{high}} = 73^{\circ}\text{F}$

The Solution: Storage + Integrated optimized system control



- 1MW of PV Solar
- **0.5/1.0MWh of storage**



- 1MW of **Managed Loads**

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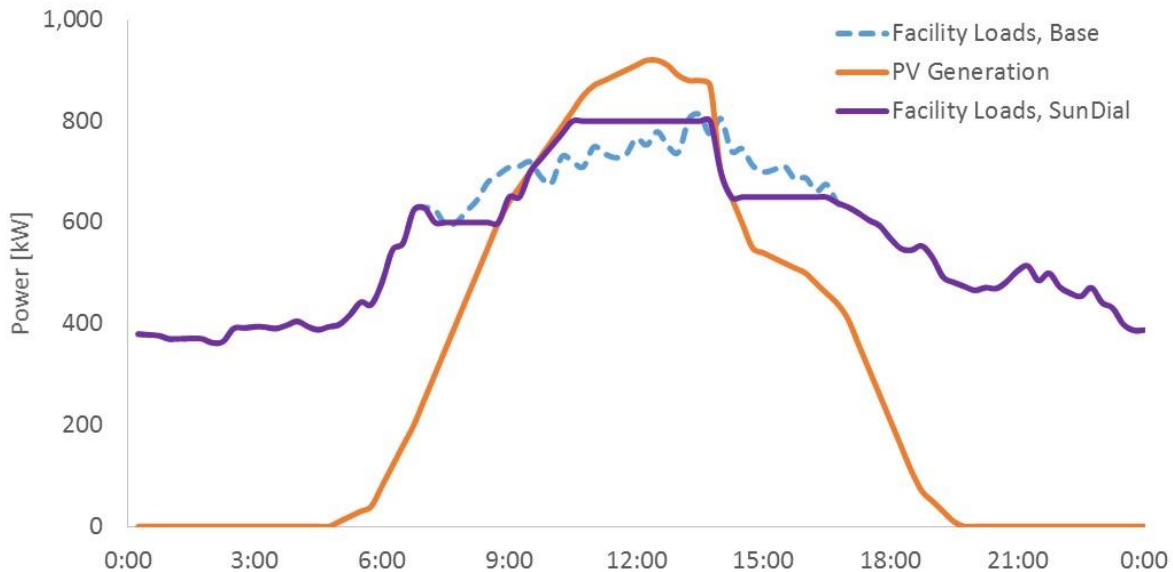
Sources: National Grid, Steward Health Care, Wikimedia Commons.



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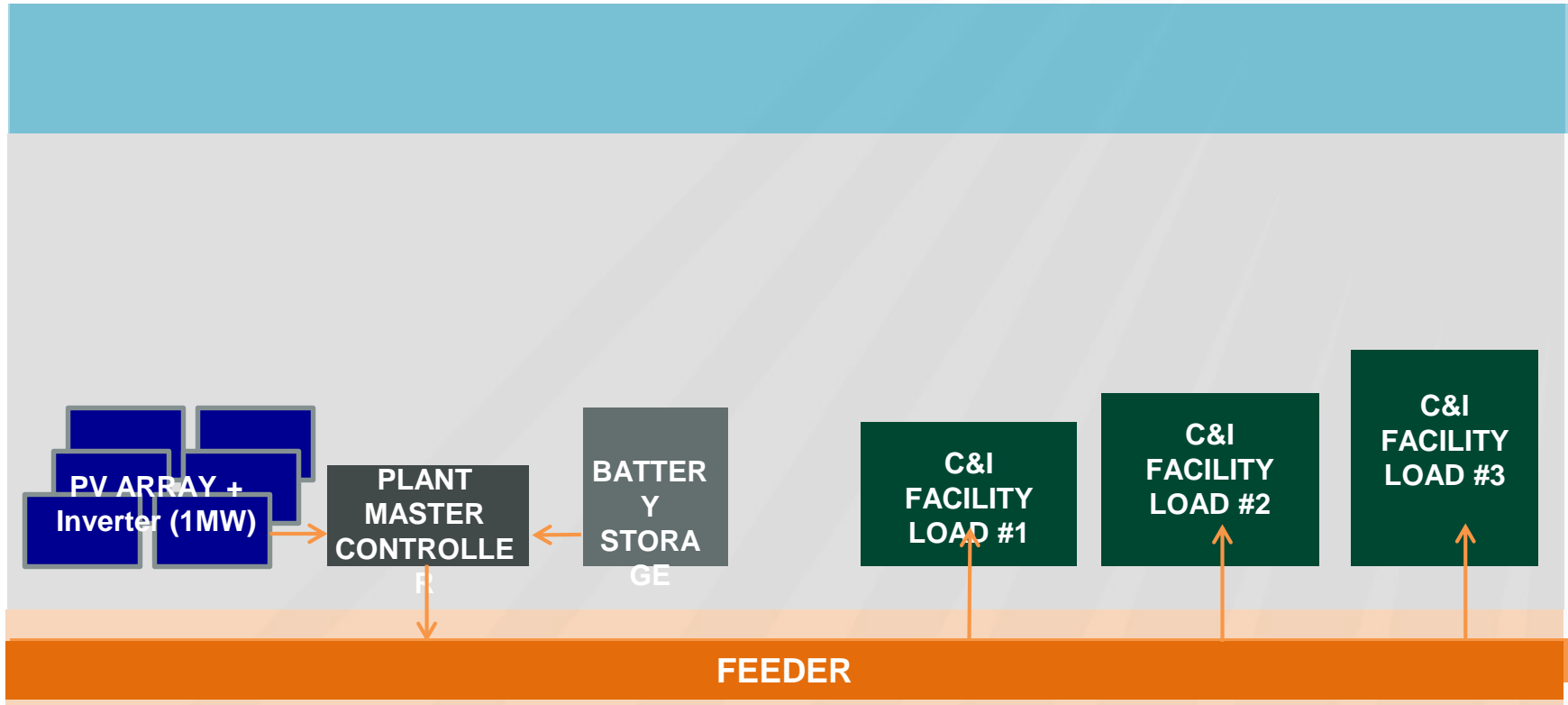


Solution: Mitigate Solar Surplus

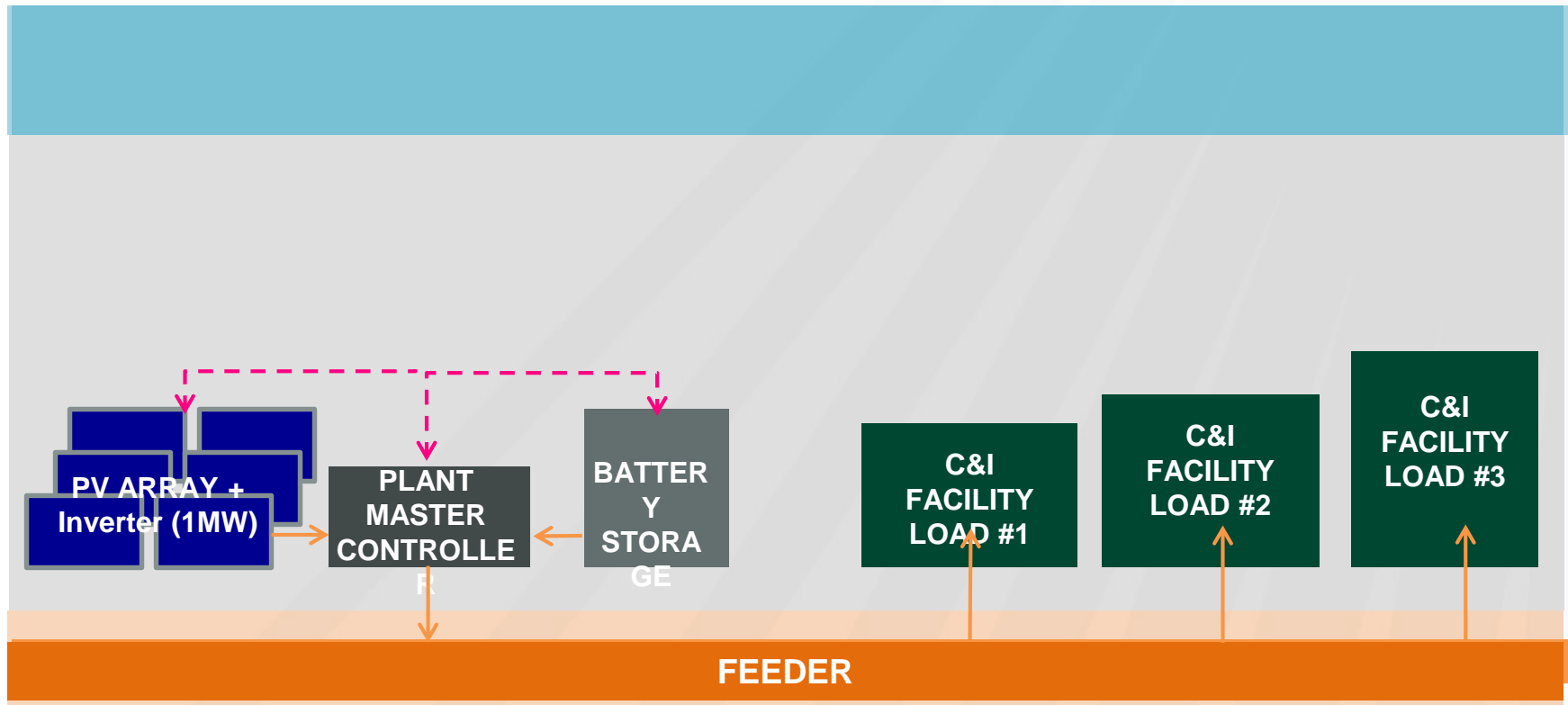


- Mix of C&I facilities
- PV = 1,000 kW
- Building Peak = 1,000 kW
- July 21, 2015

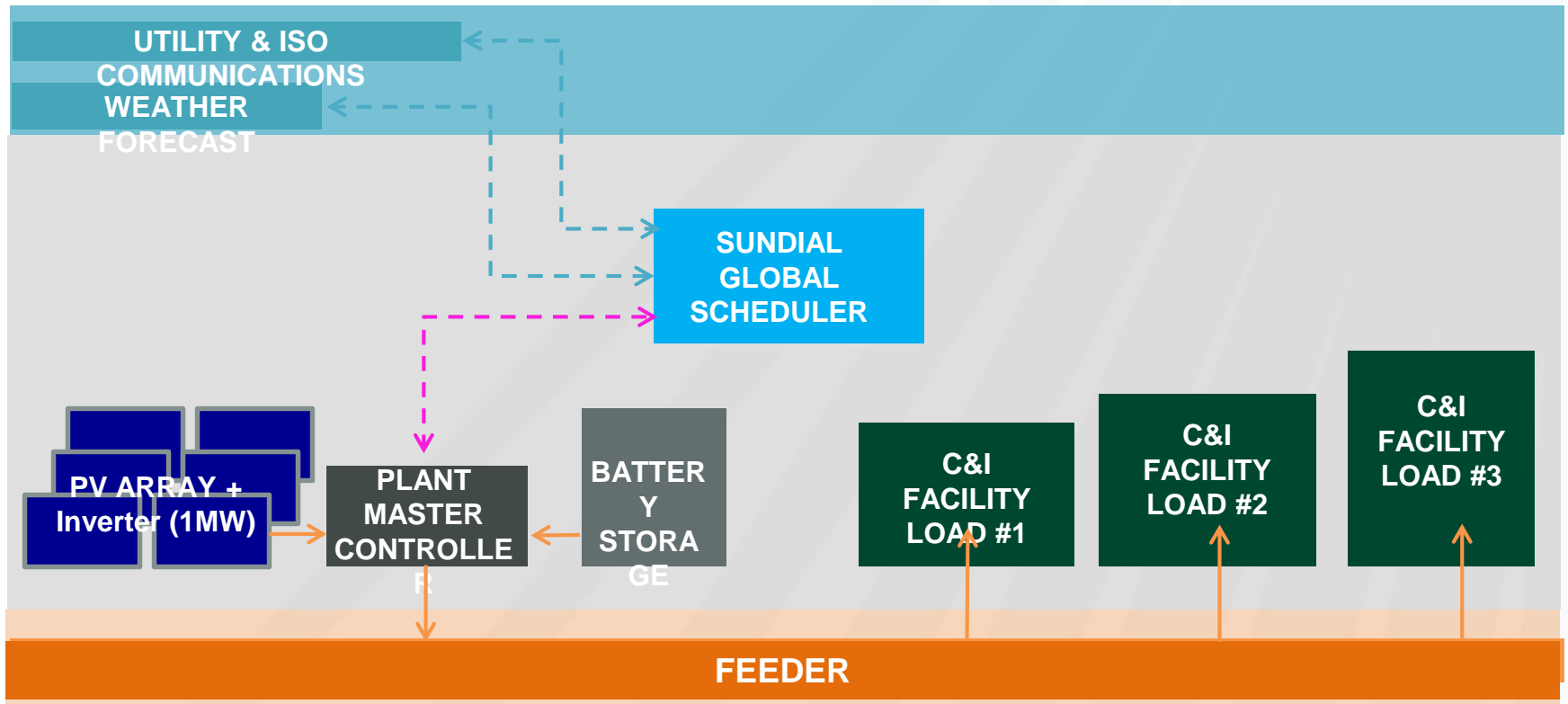
Architecture – Major Components



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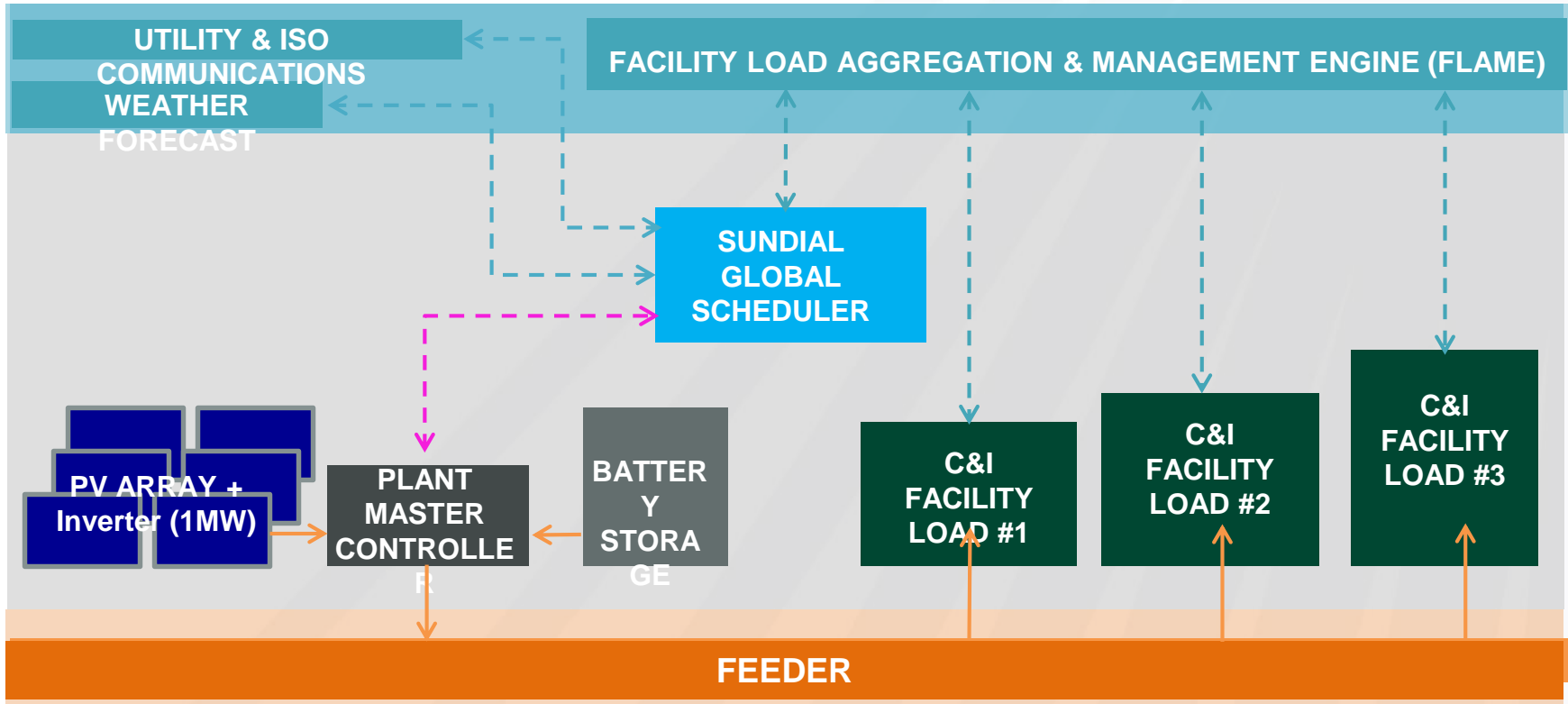
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Architecture – Major Components



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SunDial: A Vision for Integrating Hundreds of GW of Solar

SunDial Objectives

- Create extensible framework to readily integrate loads, storage, and PV
- Test and pilot business models and market mechanisms to enable high PV penetration

Market Transformation: *A transparent, low-friction market for storage / solar integration on the feeder level*

- Flexible with respect to markets: multiple use cases, vendors, and business models
 - Potential T&D deferral
 - Avoided system upgrades
 - Virtual Power Plant , etc.
- Flexible with respect to asset location, ownership, and type

Year-long Demonstration Project

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