ET Summit 2024

Presented by

The Rise of Flexible Heat Pump Technology

Field Testing and Demonstration of Demand Flexibility of Variable Capacity Heat Pump in a Commercial Building Application

Smart City Santiago Building

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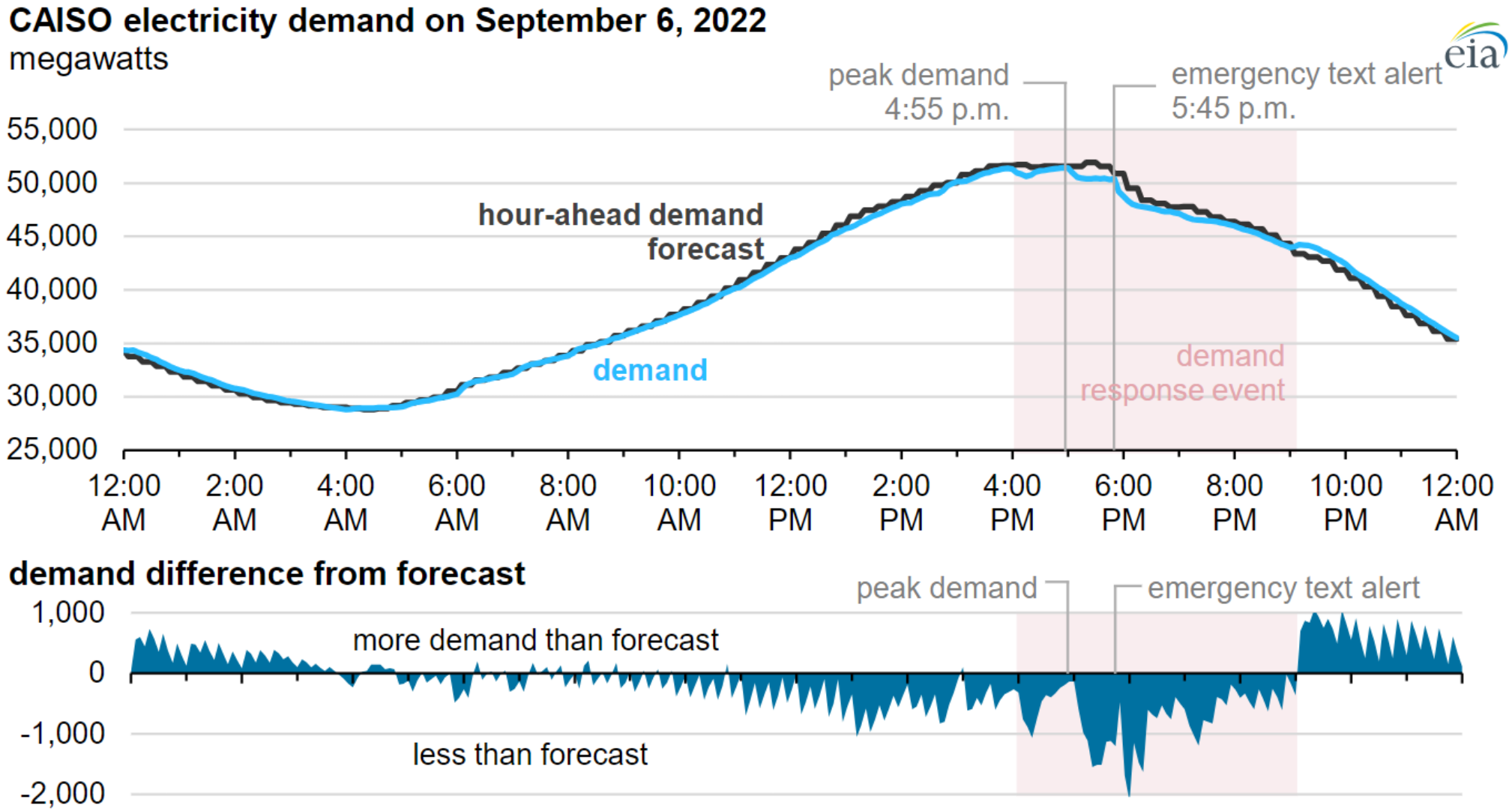
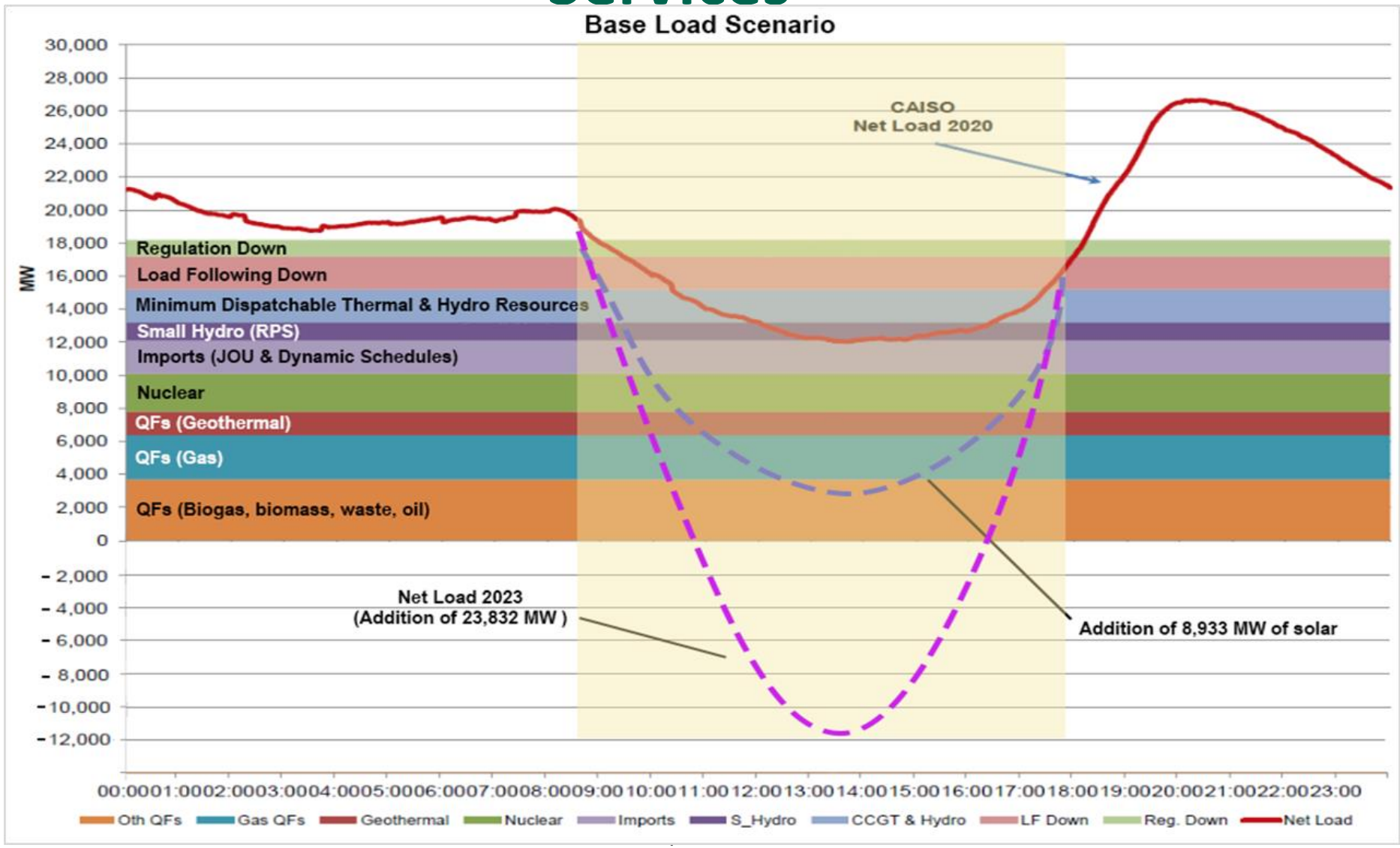
EPRI

A Demand Response Event in California



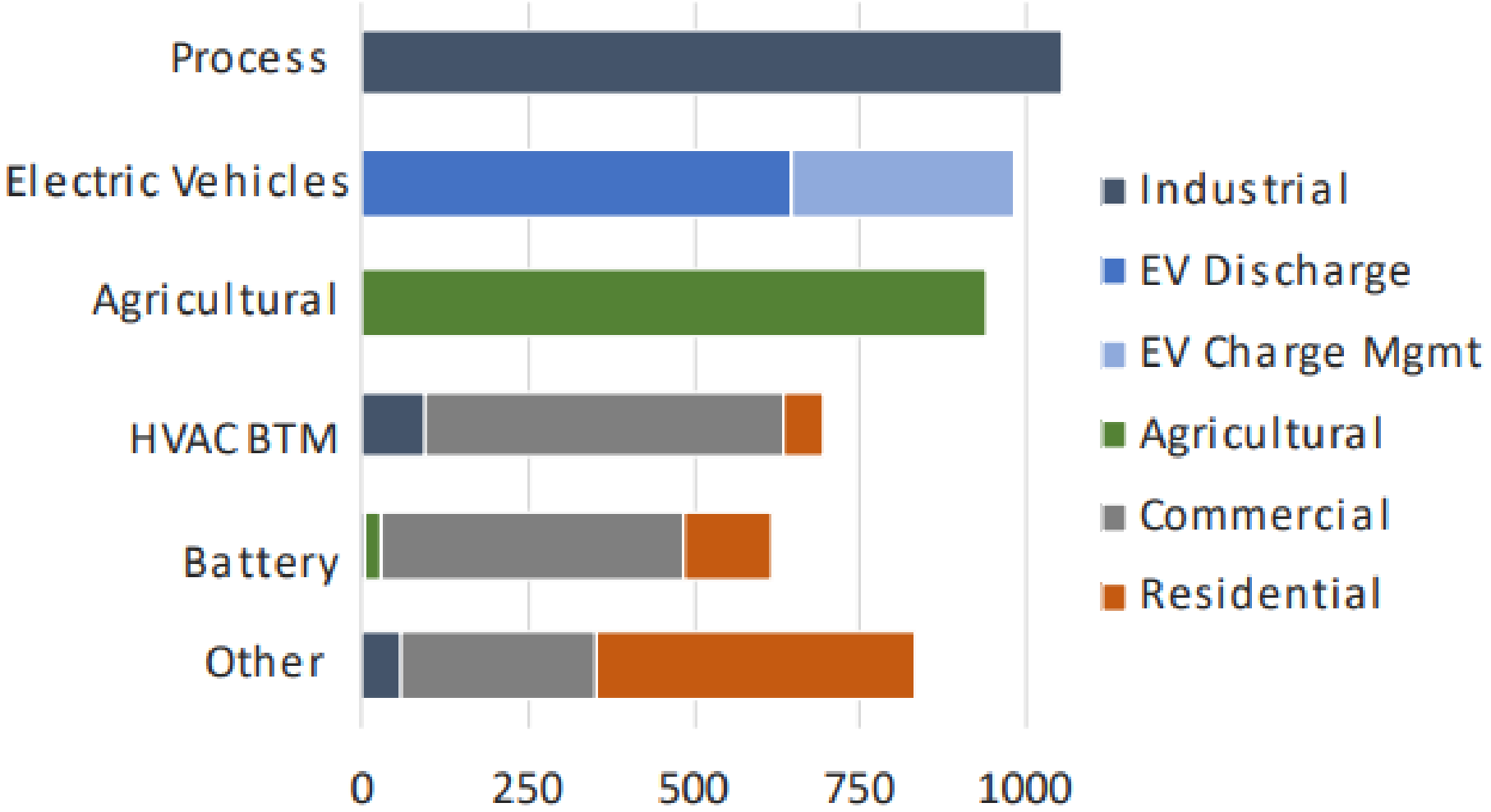
Demand Response – Addressing the Need for Ramping Services



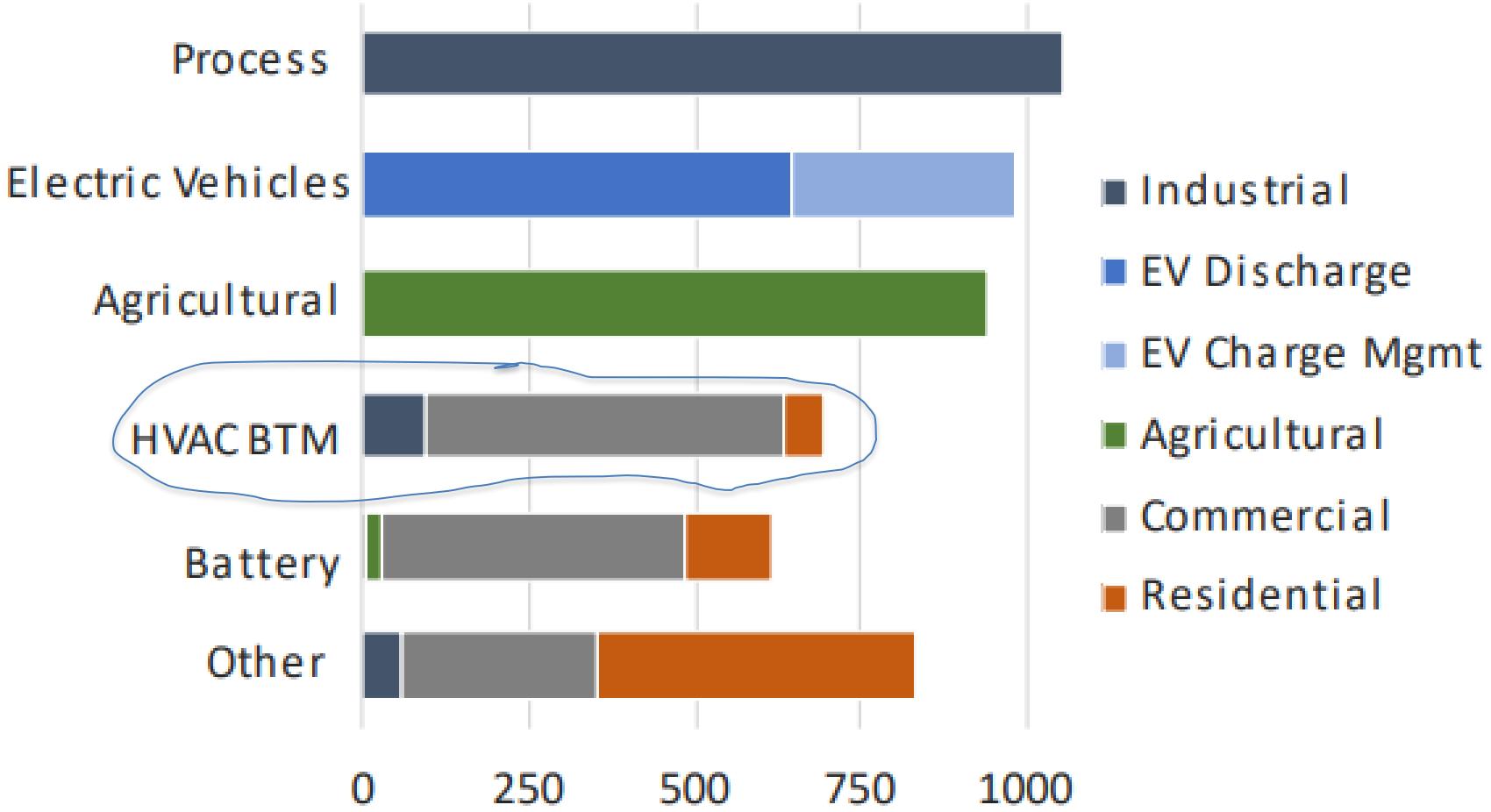
Proposed California Load Shift Goals by 2030

Category	Intervention	2022 Estimate	2030 Goal
Load-Modifying (LM)	TOU Rates	620–1,000 MW	3,000 MW
	Dynamic Pricing	30 MW	
	LM Programs	7 MW	
Resource Planning and Procurement	Economic Supply-side DR	670–825 MW	4,000 MW
	Reliability Supply-Side DR	740 MW	
	POU DR Programs (Non-ISO)	210 MW	
Incremental and Emergency (I&E)	I&E Programs	800 MW	
	Emergency Back-Up Generators*	375 MW*	
Total (nearest 100)		**3,100–3,600 MW**	**7,000 MW**

Load Flexibility Potential by End Use and Sector



Commercial HVAC Plays an Important Role

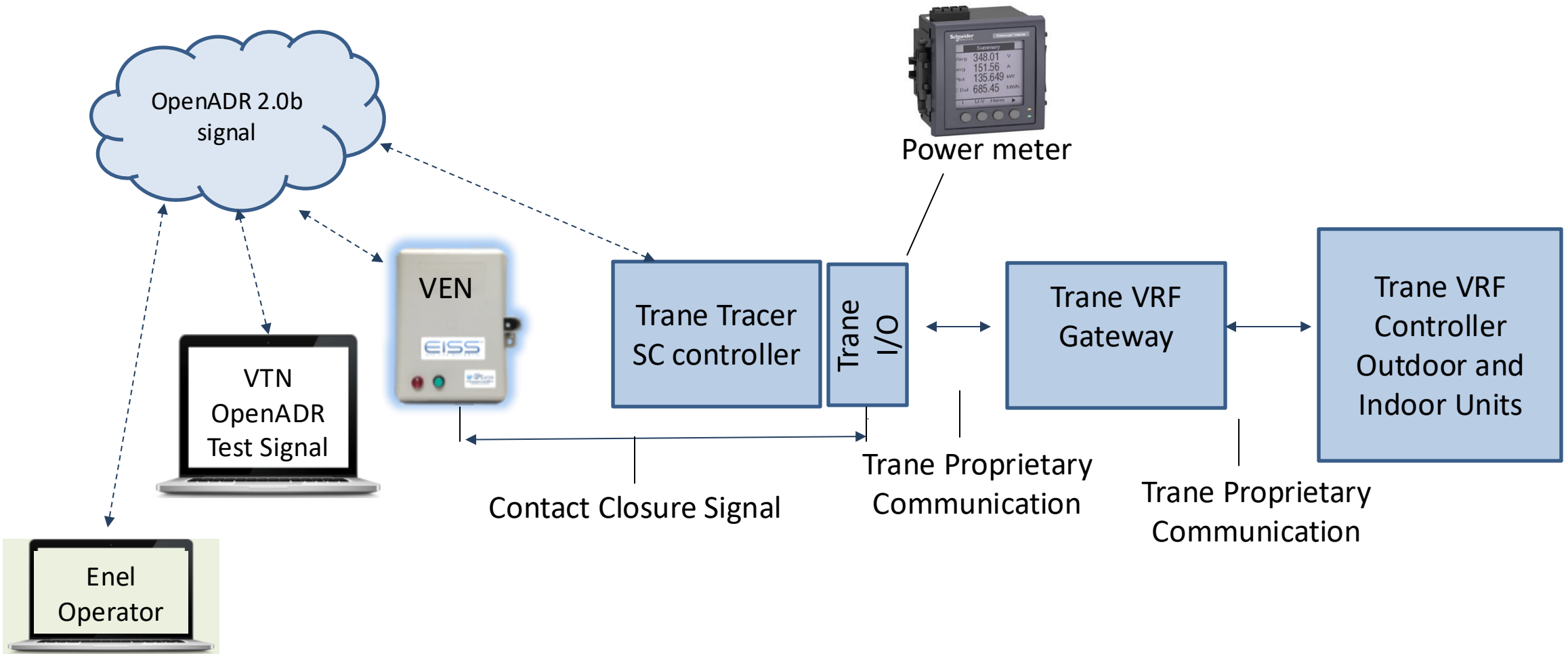


AutoDR testing/demonstration for HVAC system at Smart City Santiago

Demonstrate AutoDR functionality for reducing HVAC system demand at Smart City, Santiago, Chile

- Set up an AutoDR VEN at site to receive and acknowledge AutoDR signal
- Set up communications between VEN and HVAC system controls
- Set up HVAC system to respond to AutoDR signal
- Set up monitoring system to record HVAC system power demand, and indoors and outdoor temperatures
- Set up VTN and to send AutoDR signal to VEN
- Conduct AutoDR tests
- Present results
- Show Enel team how to conduct tests and review data

AutoDR Signal Communications to TRANE VRF



Operator, EISS Box (VEN) and Trane SC Controller Communications

EISS Box (VEN)

Tracer SC

Power meter

Outdoor units

VRF system Controller

Indoor units

Indoor units

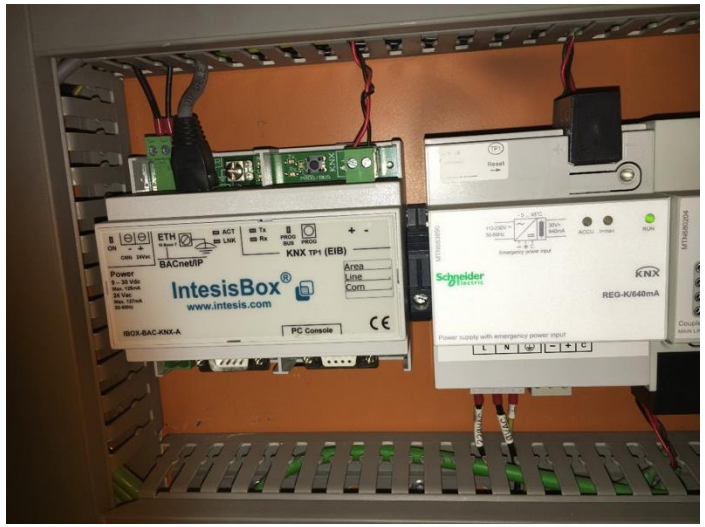
Enel Operator

Cloud

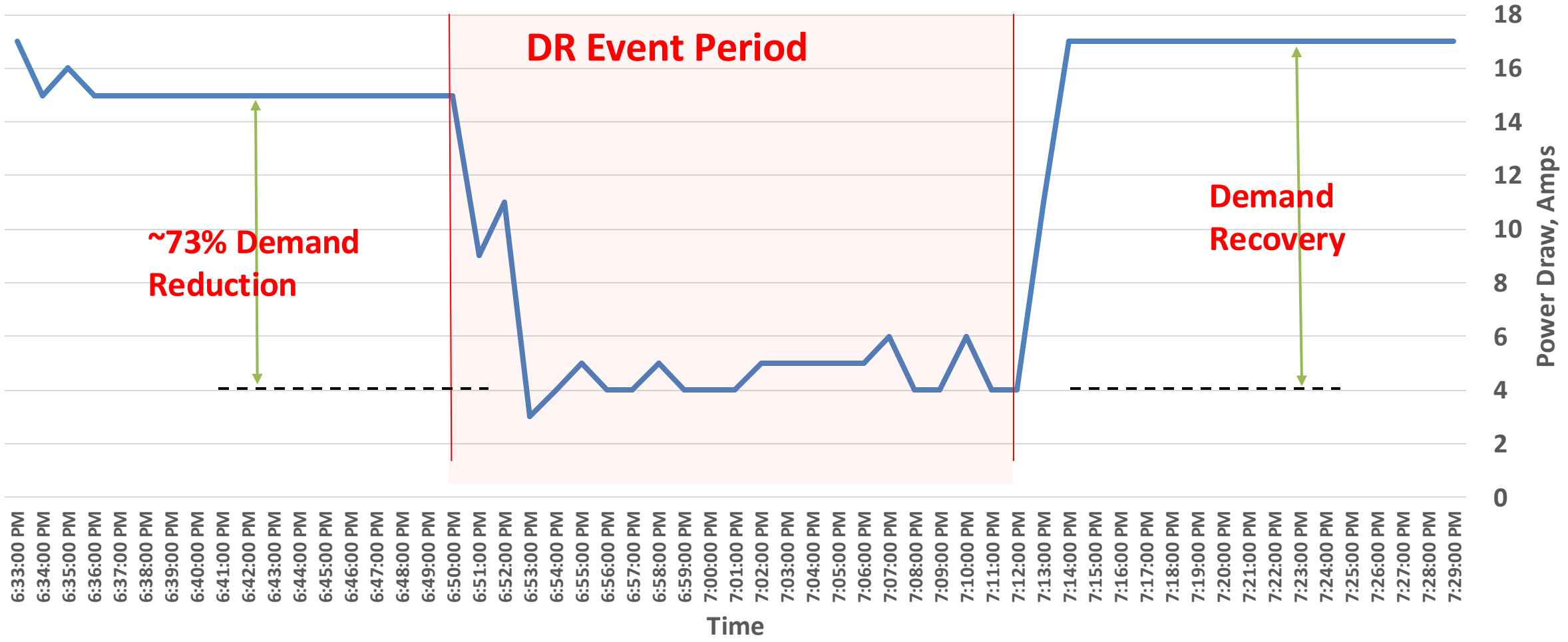
HVAC System Demand Response Sequence of Operation

HVAC System Demand Reduction Strategies

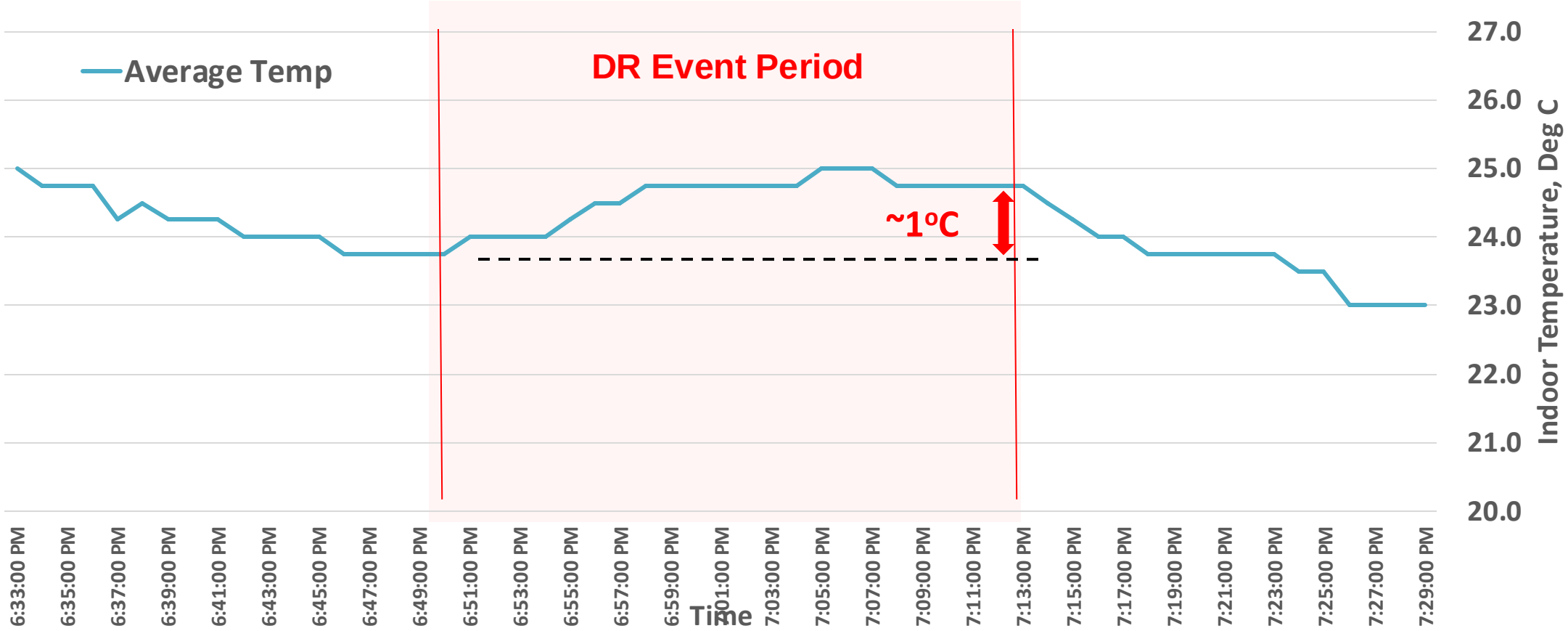
1. Thermostat Reset: Change indoor unit temperature set point
   a. Increase in summer (~2 C)
   b. Reduce in winter (~2 C)
2. Turn compressors off



Strategy #1: Thermostat Reset
HVAC Power Demand



Strategy #1: Thermostat Reset
Average Indoor Temp

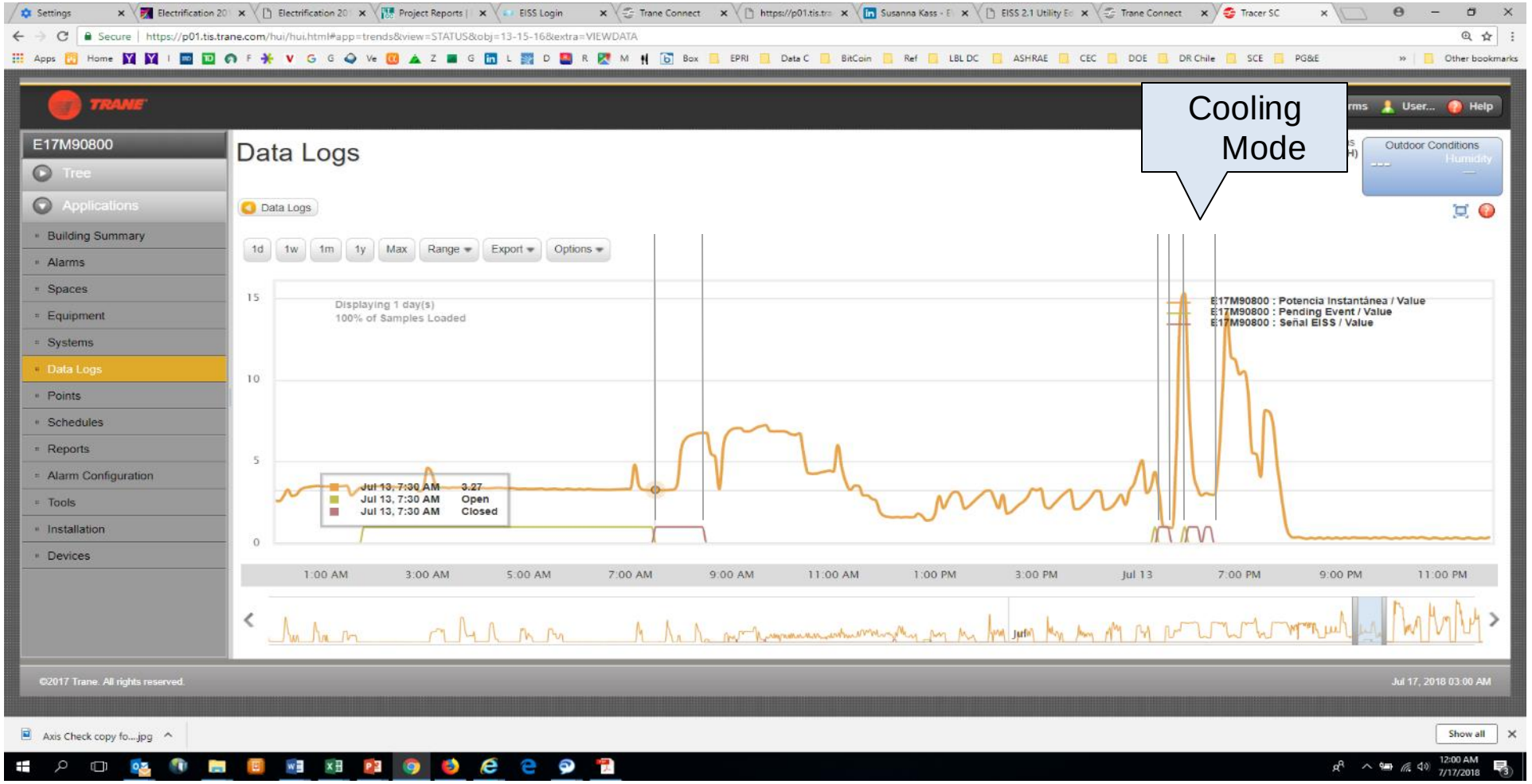


DR Test in Cooling Mode

Strategy 2: Compressor Turn Off - Load Profile

- Cooling mode
- Compressor Turned off from 5:30 to 6:30 PM

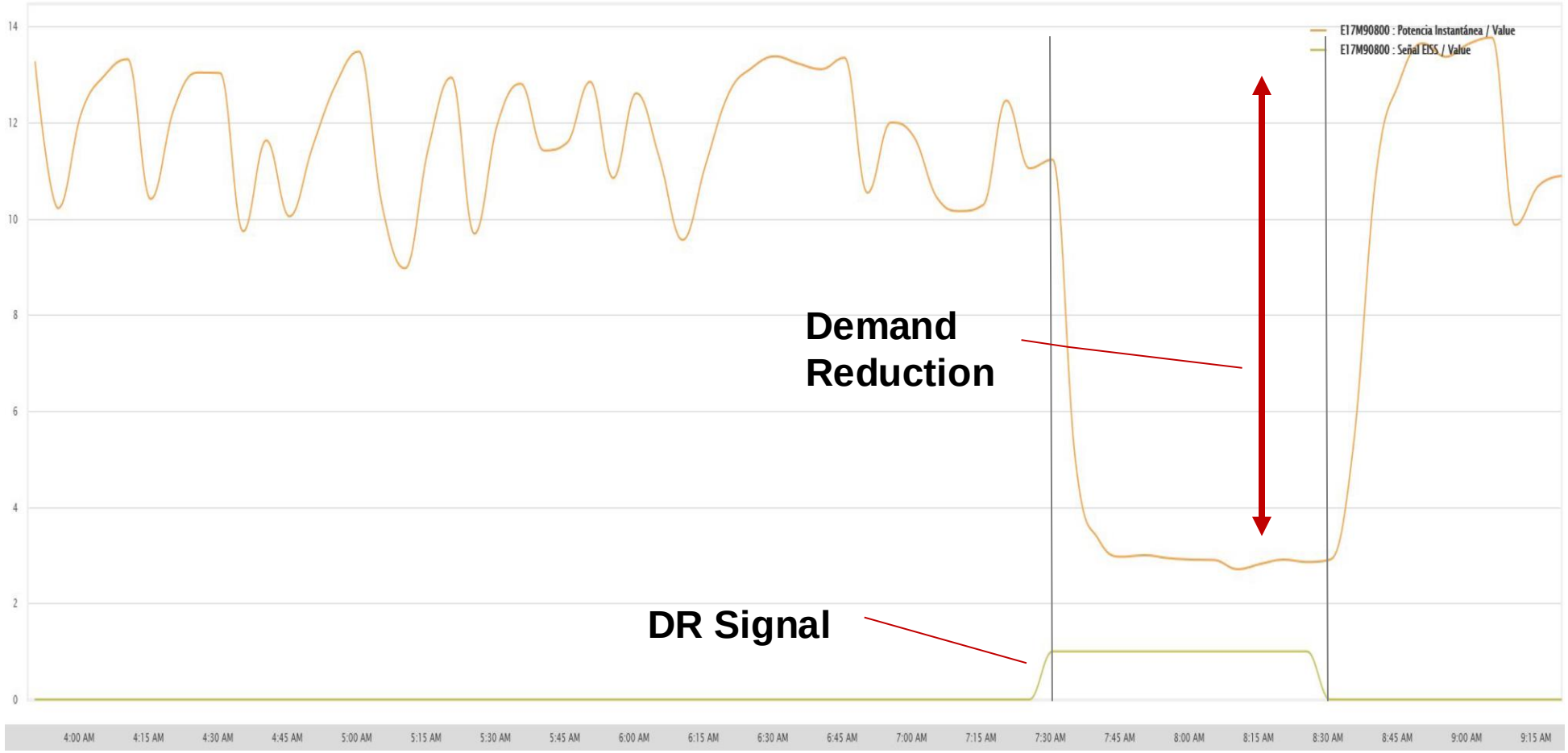
Demand Reduced from ~10 kW to ~3 kW.



DR Test in Heating Mode Mode
Strategy 2: Compressor turn off – Load Profile

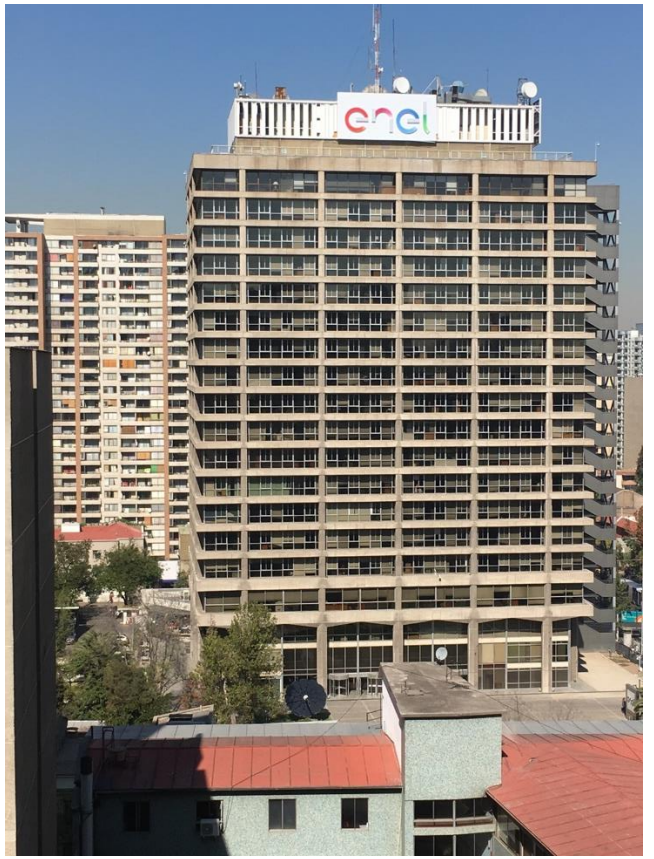
- Heating mode
- Compressor turned off 7:30 to 8:30 AM

Demand reduced from ~11 kW to ~3 kW



Results of AutoDR Demonstration

- AutoDR successfully demonstrated from end-to-end
  - From scheduling AutoDR event to reviewing monitored data
  - Two Strategies demonstrated
    1. Temperature Reset
    2. Compressor turn off
- DR Tests Status
  - Several DR tests conducted by EPRI and Enel teams
  - Strategies used: Both compressor reset and turn off
- Next Steps – Enel to conduct tests in their own building



Summary

- Large Opportunity for DR in Commercial Buildings
- Smart Heat Pumps Offer Opportunity for DR and Demand Flexibility
- Several Challenges in Connecting and Communicating Grid Signals to Heat Pumps
- Recommendation: Grid Connectivity Portion Should be Native to the Heat Pump

This Project was Funded by Enel

In Memory of my dear friend Mukesh Khattar

Thank You!

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