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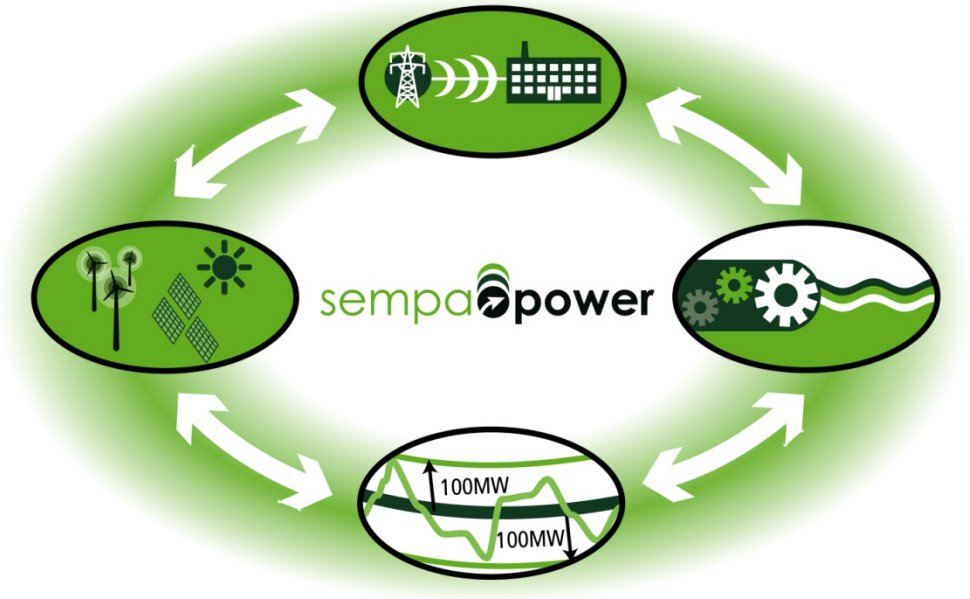
Regulation Services Network



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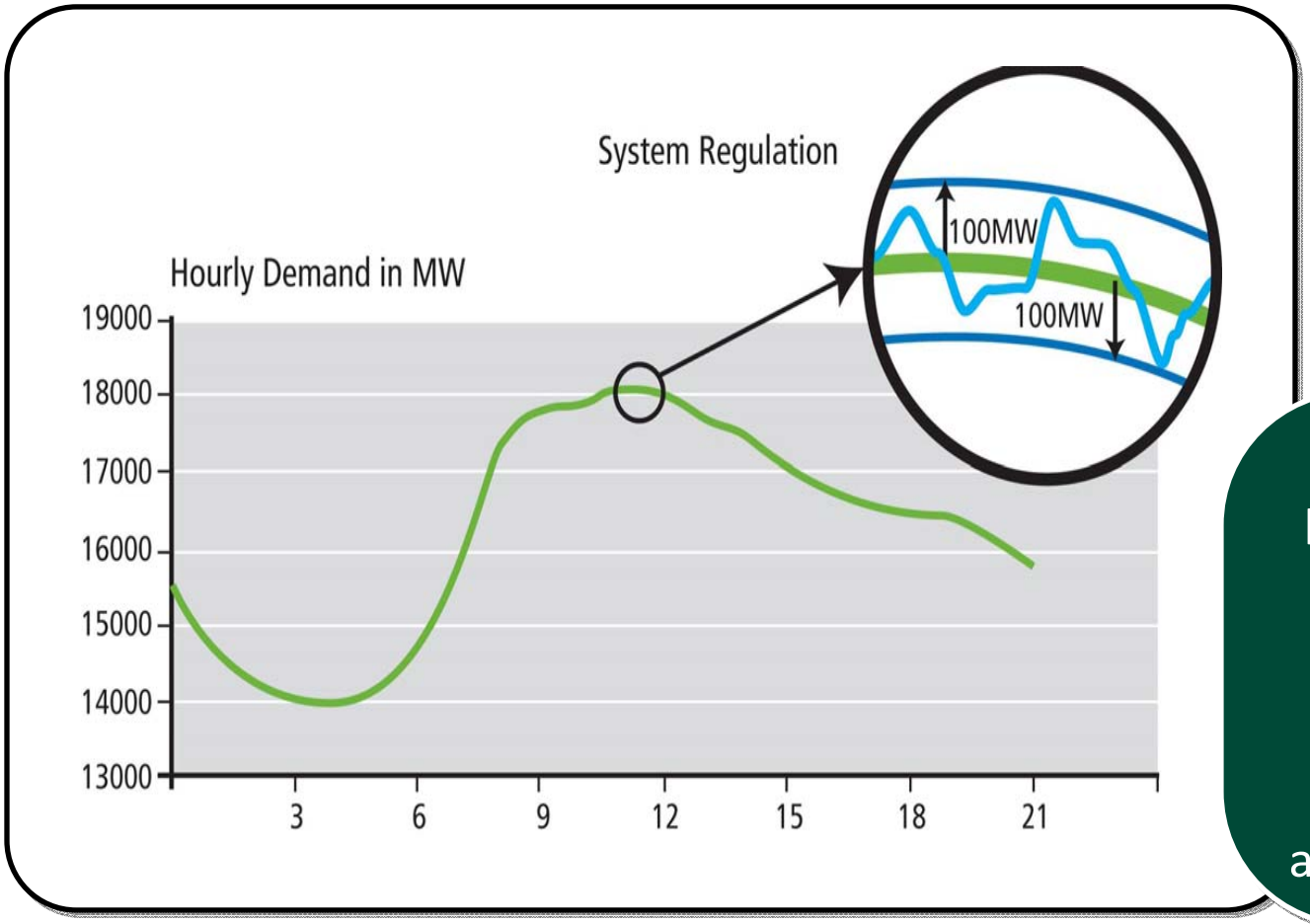
System Regulation



Second by second balancing of supply and load (system regulation), is currently accomplished by adjusting generation

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A Shift in Direction…

- Since Edison's time…
  - Load has been sporadic and largely uncontrolled
  - Generation has been stable, controllable and used to maintain the supply/demand balance
- Future – with Intermittent Wind and PV…
  - CAISO Maximum 3 Hr Ramp increases from 1,500 MW to over 6,000 MW with 33% RPS

Integration of Large Components of Renewable Energy will Require New Balancing Methods…

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Dedicated Generation for Regulation…

- System Regulation is a means of maintaining an ongoing balance between Supply and Demand… It is a "***Power*** Balancing System"
- Traditionally Generators have been used..
  - Power limits are relatively constrained…
  - Energy Limits are unconstrained…
  - Non Optimal use of Generation

The Use of Energy Storage Devices for Regulation brings Benefits and Challenges…

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Storage - Challenges & Benefits

- Limited Storage
- Fast Response Regulation
  - Less Regulation Capacity Needed…
- ACE Offset
  - Disproportionate Share of the Offset..

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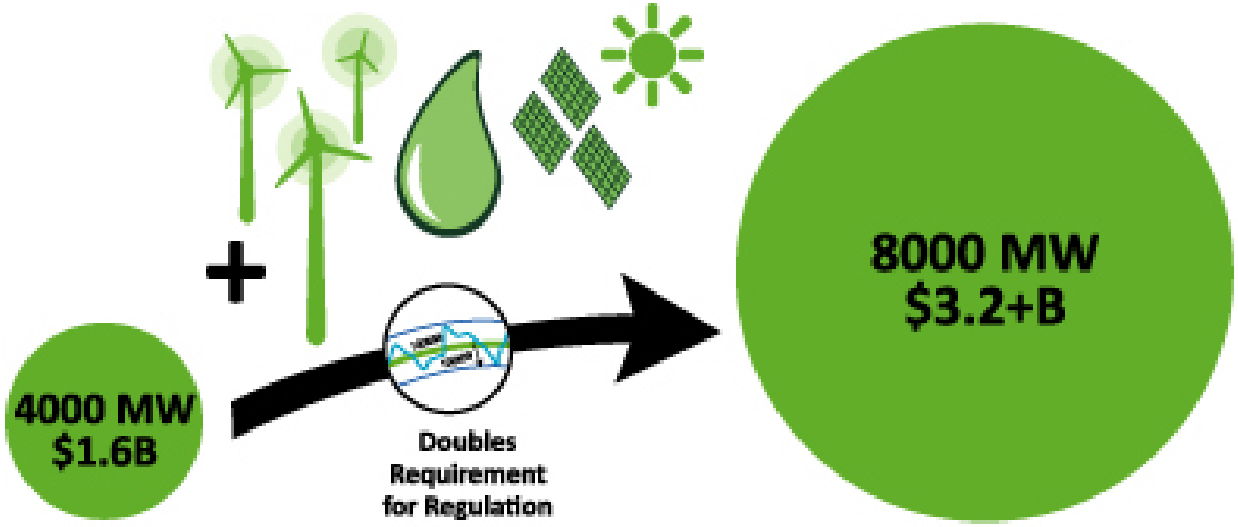
Growing Market Opportunity - Regulation



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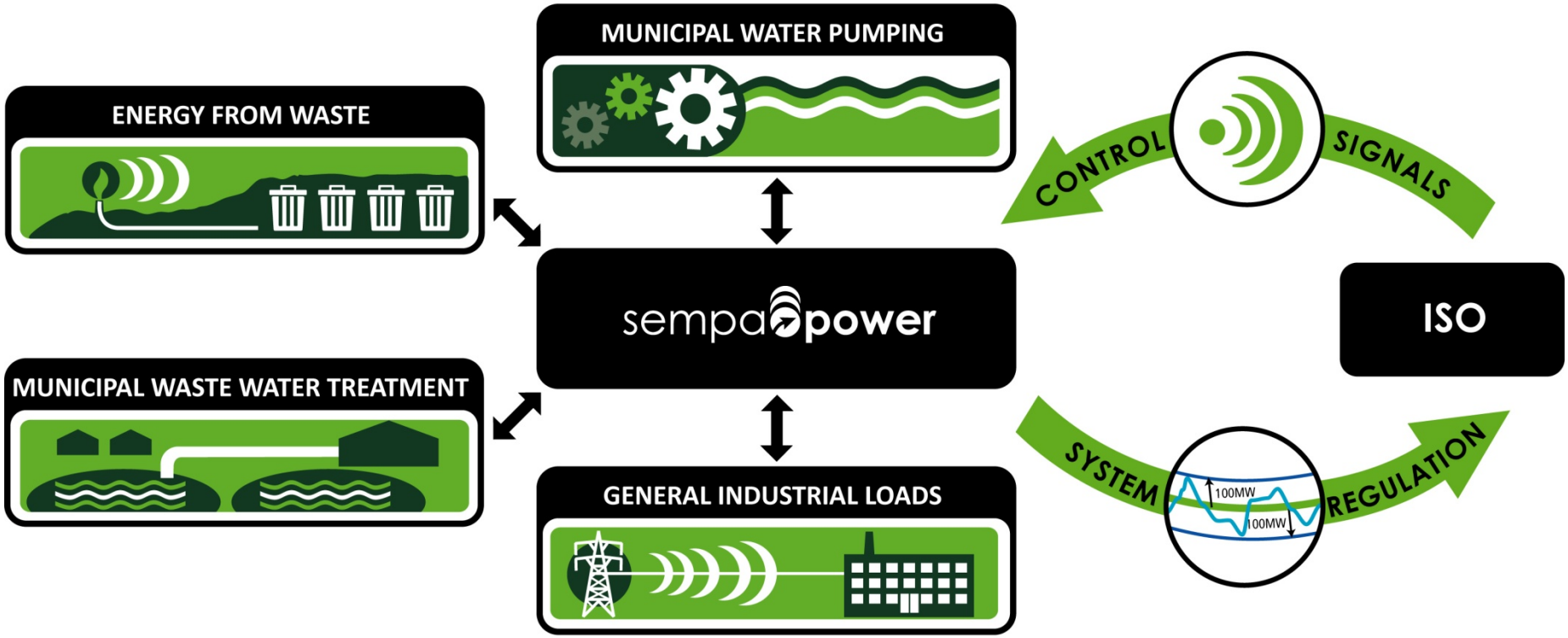
Sempa Regulation Services Network (RSN)



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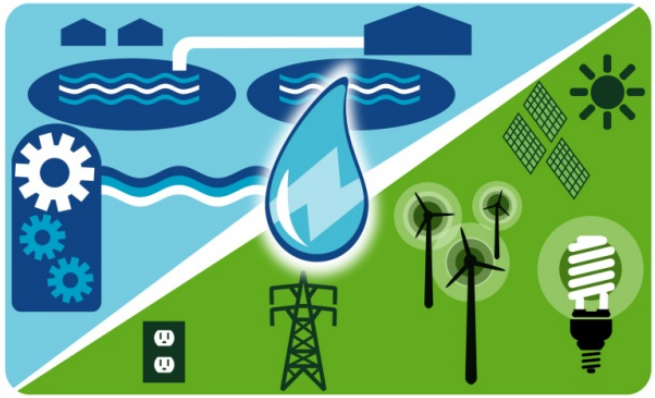
Water Energy Nexus - Smart Grid Pilot

Smart Grid to Smart Water – Uncovering Hidden Revenue in Municipal Water and Waste Water



- New Revenue stream from existing assets
- Maximize Revenue by leveraging current assets
- Demonstrate Leadership in Smart Grid Technology
- Sempa RSN provides the vehicle

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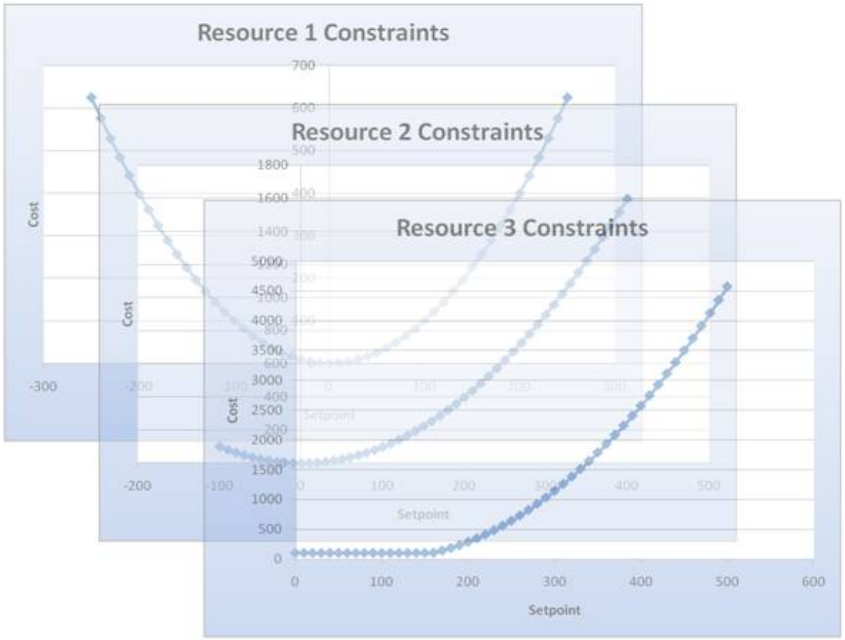
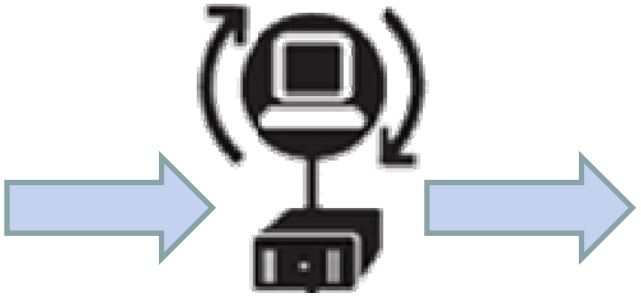
Resource Control and Optimization



Setpoints selected to achieve ISO target <u>within resource constraints</u>



Resource Ontology: State-dependent operating constraints for each resource

Resource Regulation Response Optimization Engine (R3OE)

Resource State feedback

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RSN Aeration Demonstration

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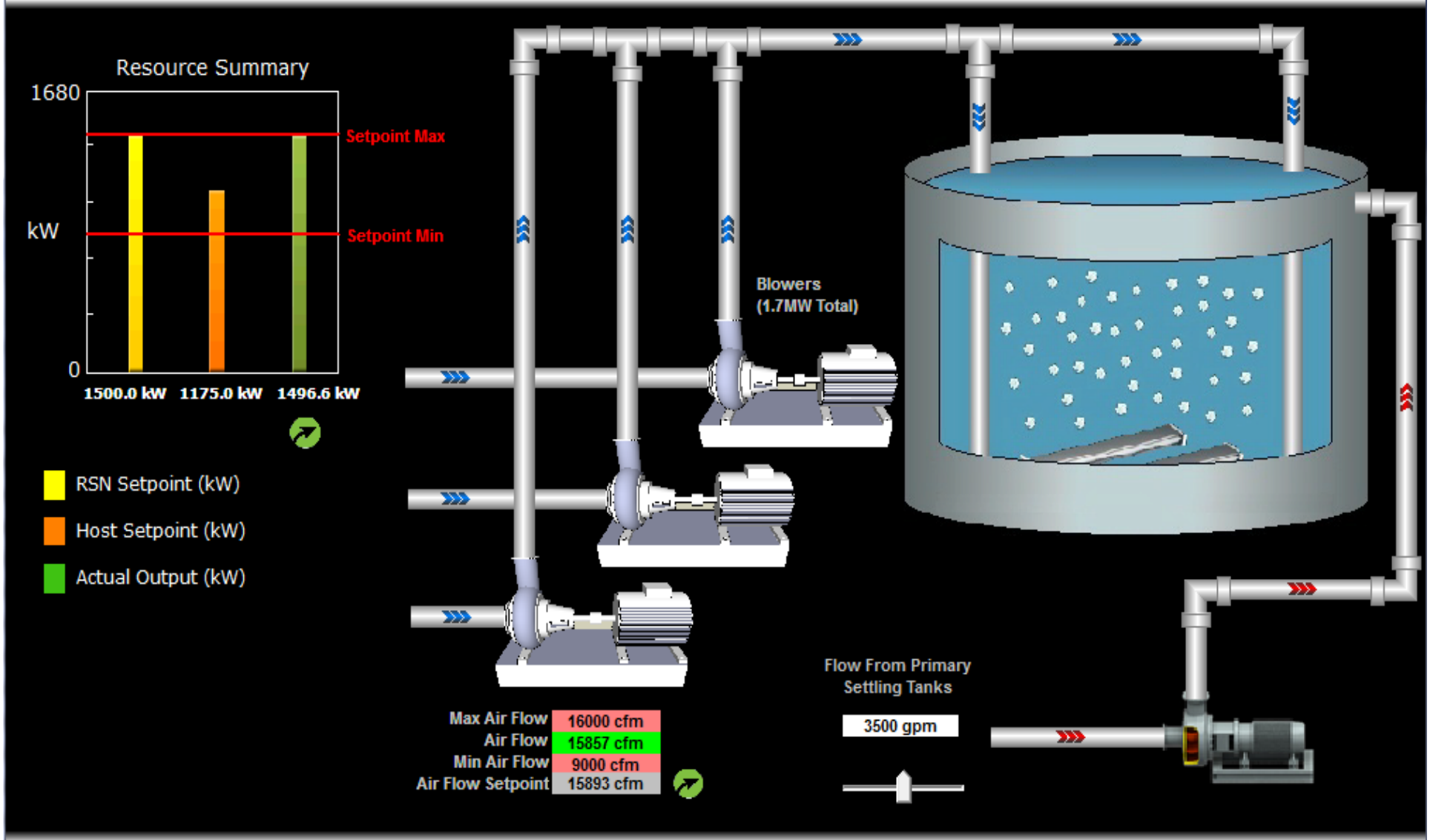

Legend:

Point is under RSN control

Point is under site control

Disable RSN

Demonstration Program Aeration

Instaneous Response Graph

Boiler Demo

Pump Demo

RSN Water Pump Demonstration

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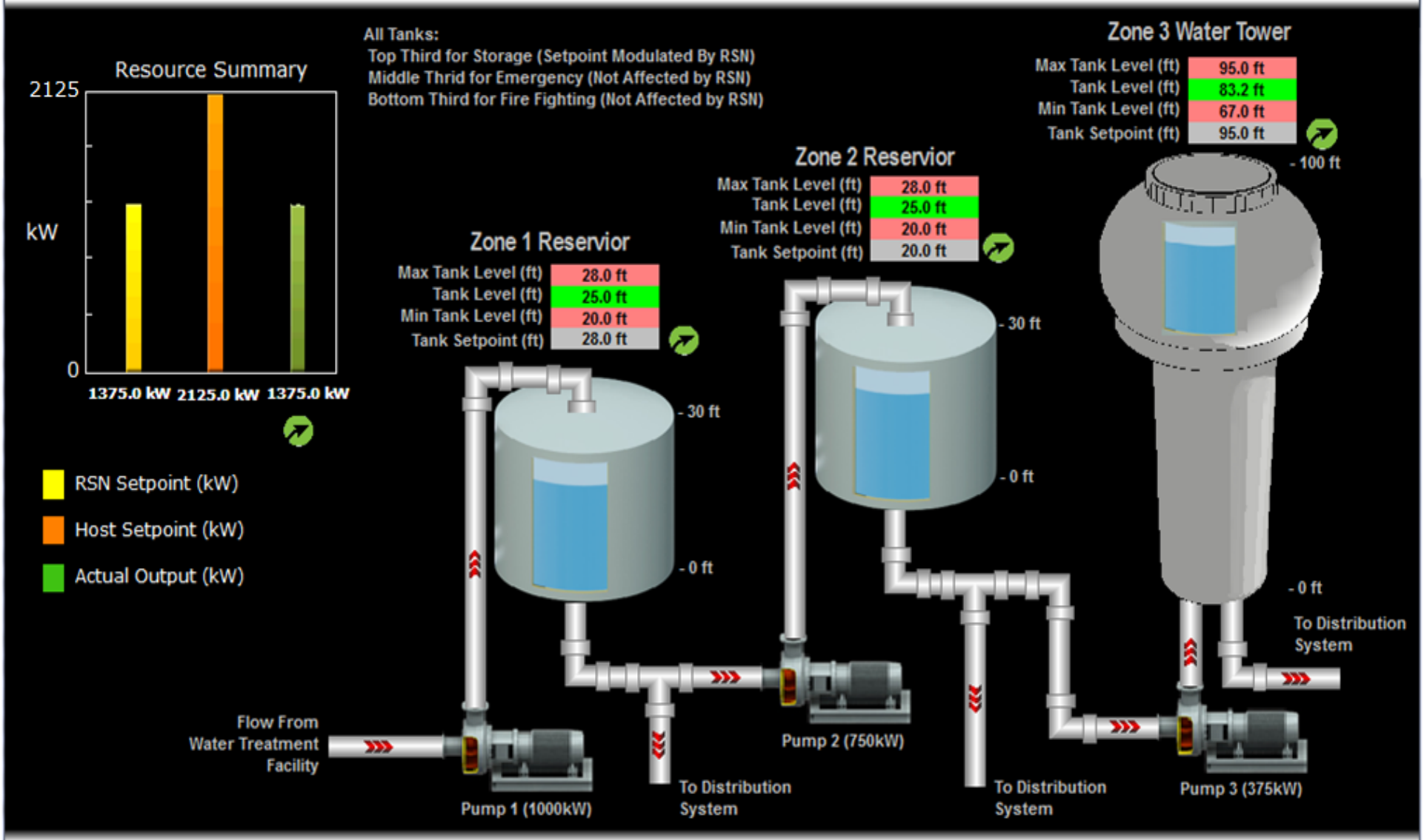

Legend:

Point is under RSN control

Point is under site control

Disable RSN

Pump 1 Status: Full Speed

Pump 2 Status: Off

Pump 3 Status: Full Speed

Instaneous Response Graph

Boiler Demo

Aeration Demo

RSN Water Pump Demonstration

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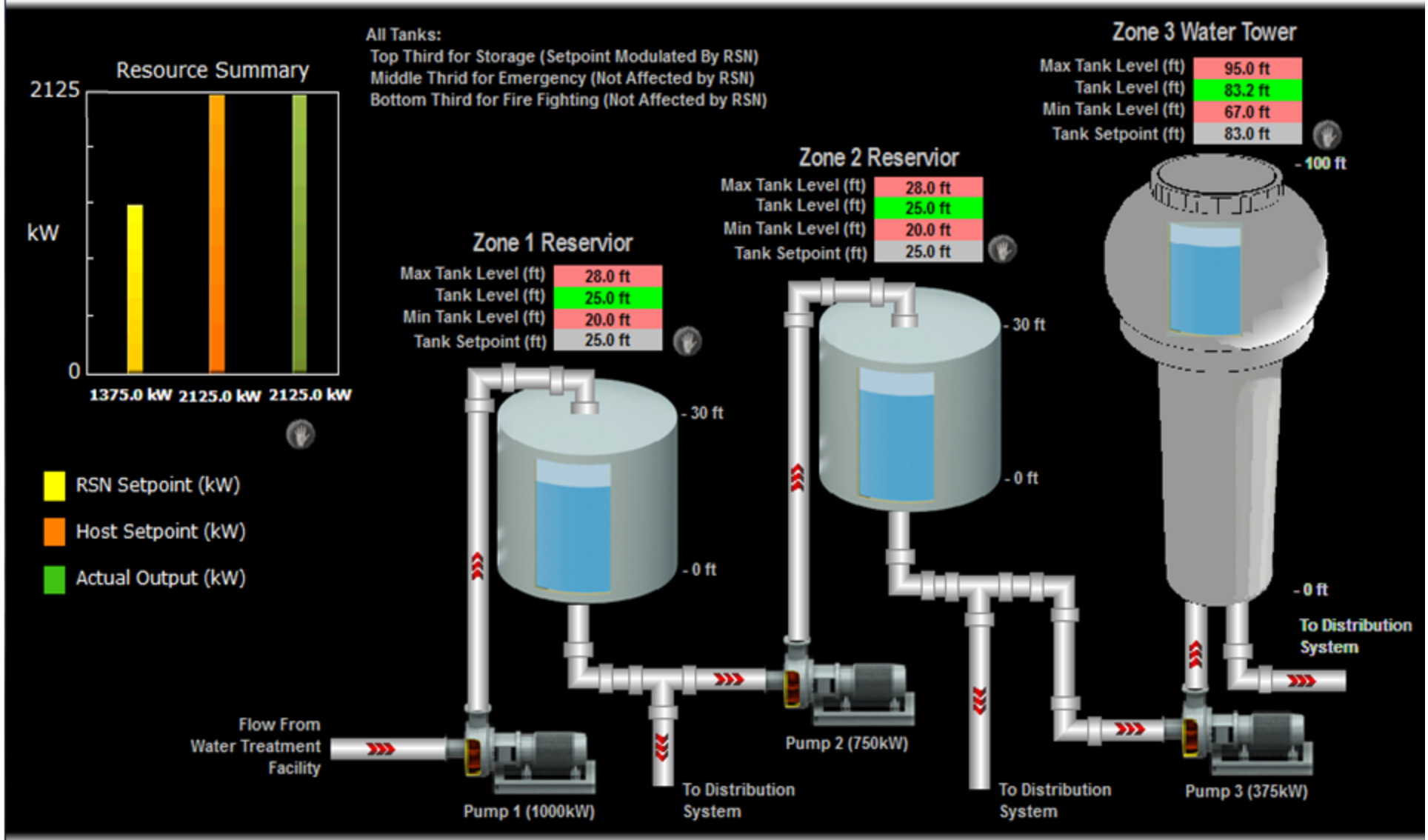


Legend:

Point is under RSN control

Point is under site control

Disable RSN

Pump 1 Status: Full Speed

Pump 2 Status: Full Speed

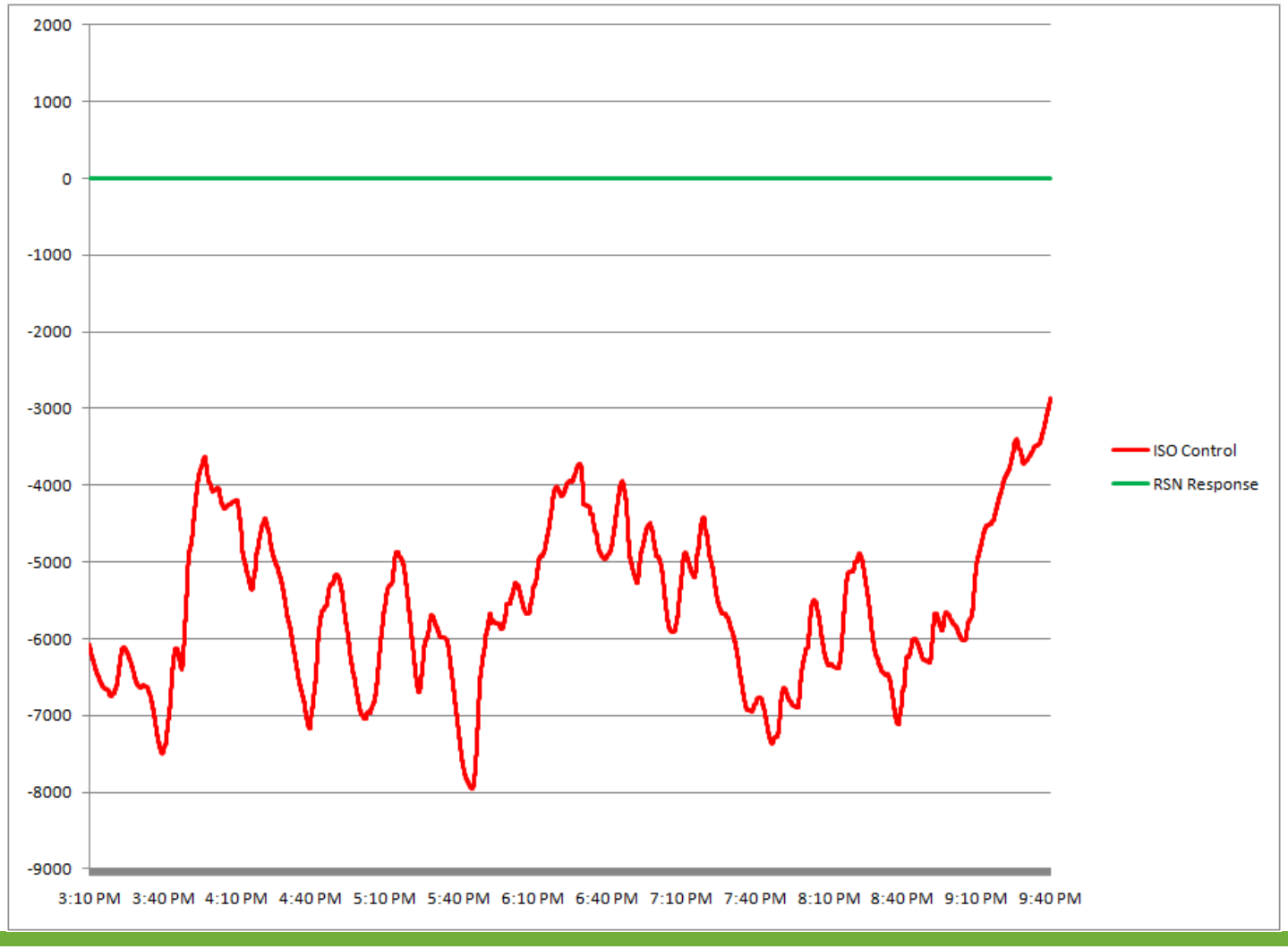
Pump 3 Status: Full Speed

Instaneous Response Graph

Boiler Demo

Aeration Demo

Regulation – ISO Signal



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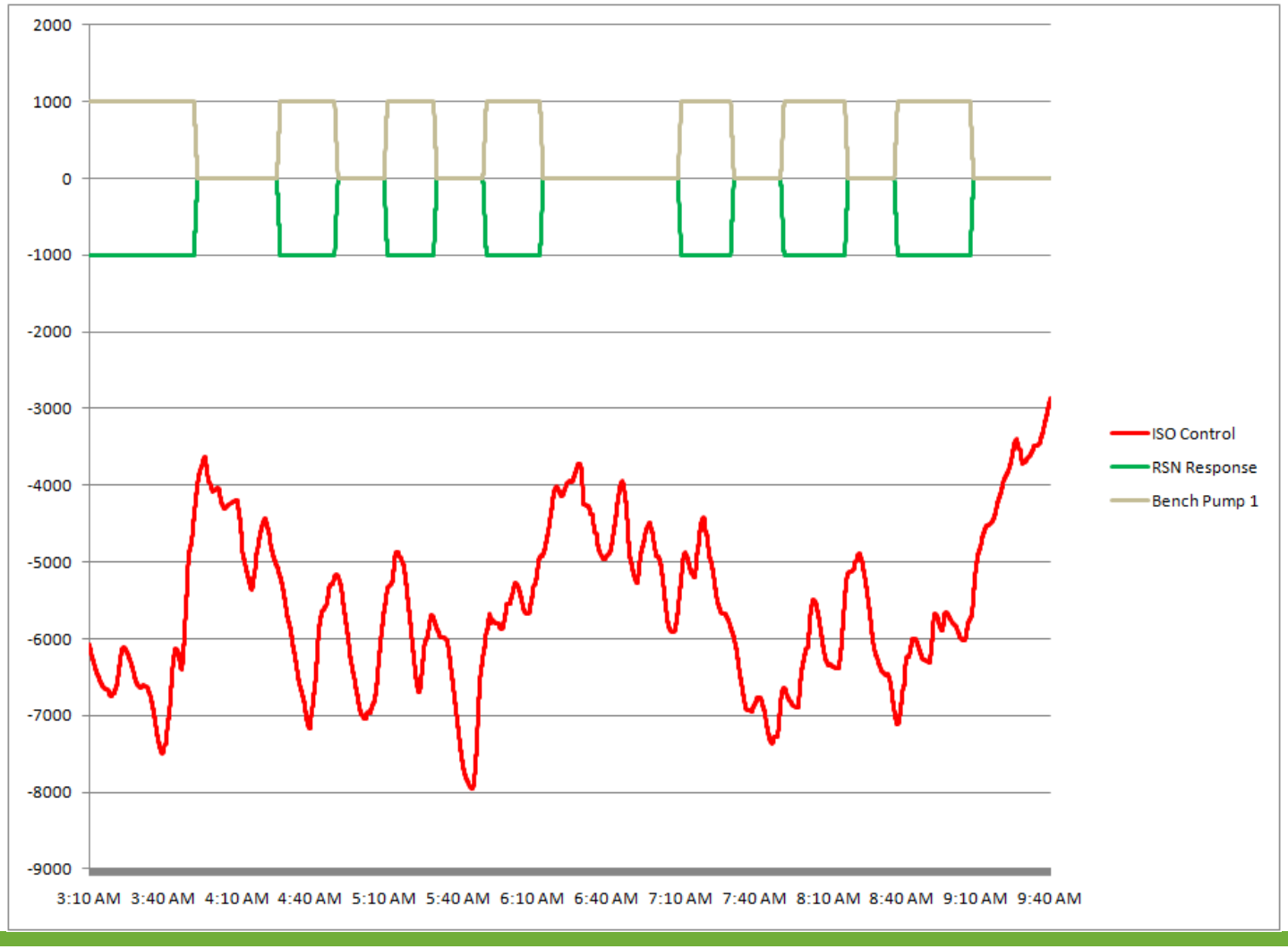
Regulation – Resource Response



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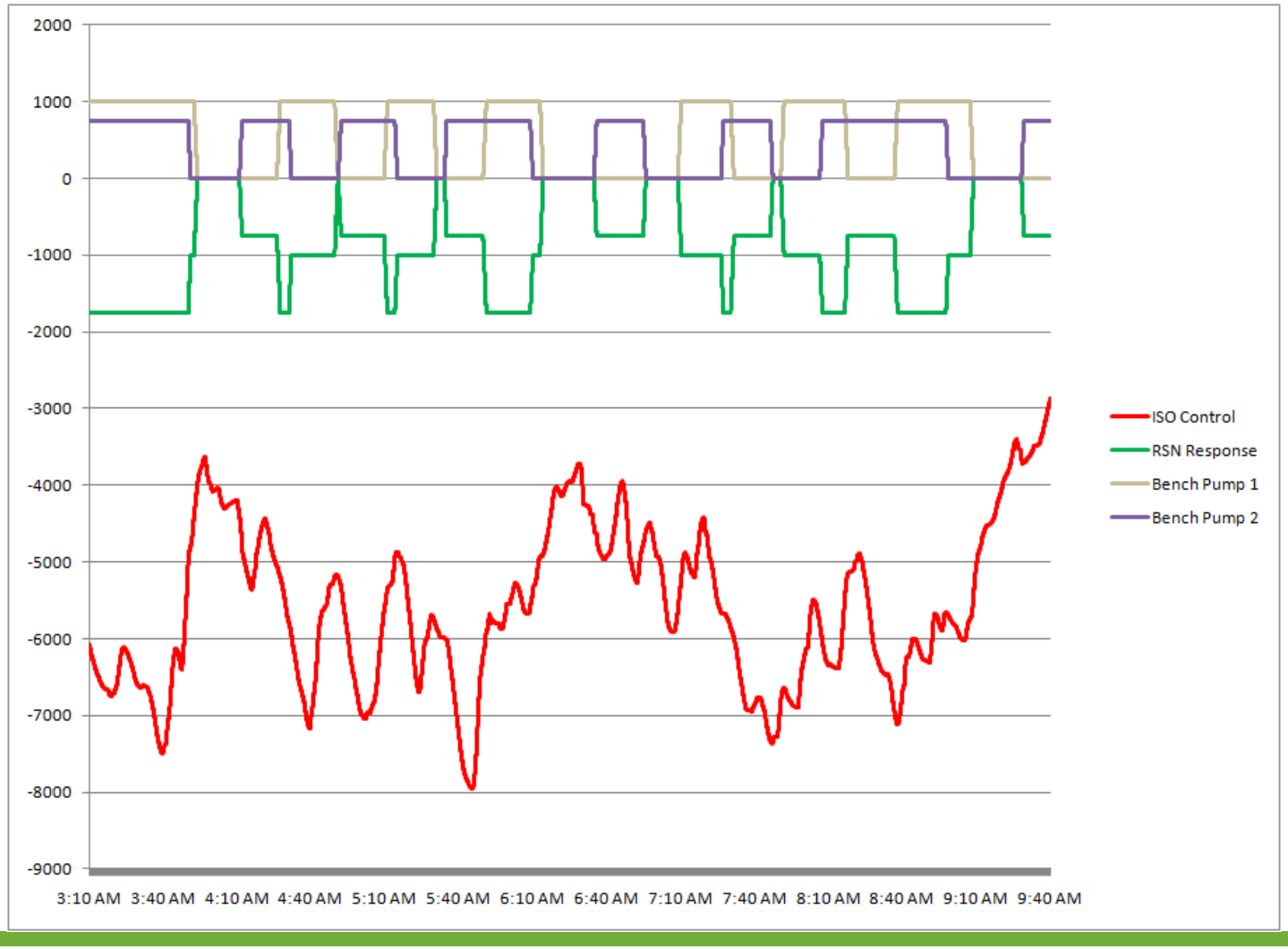
Regulation – Resource Response



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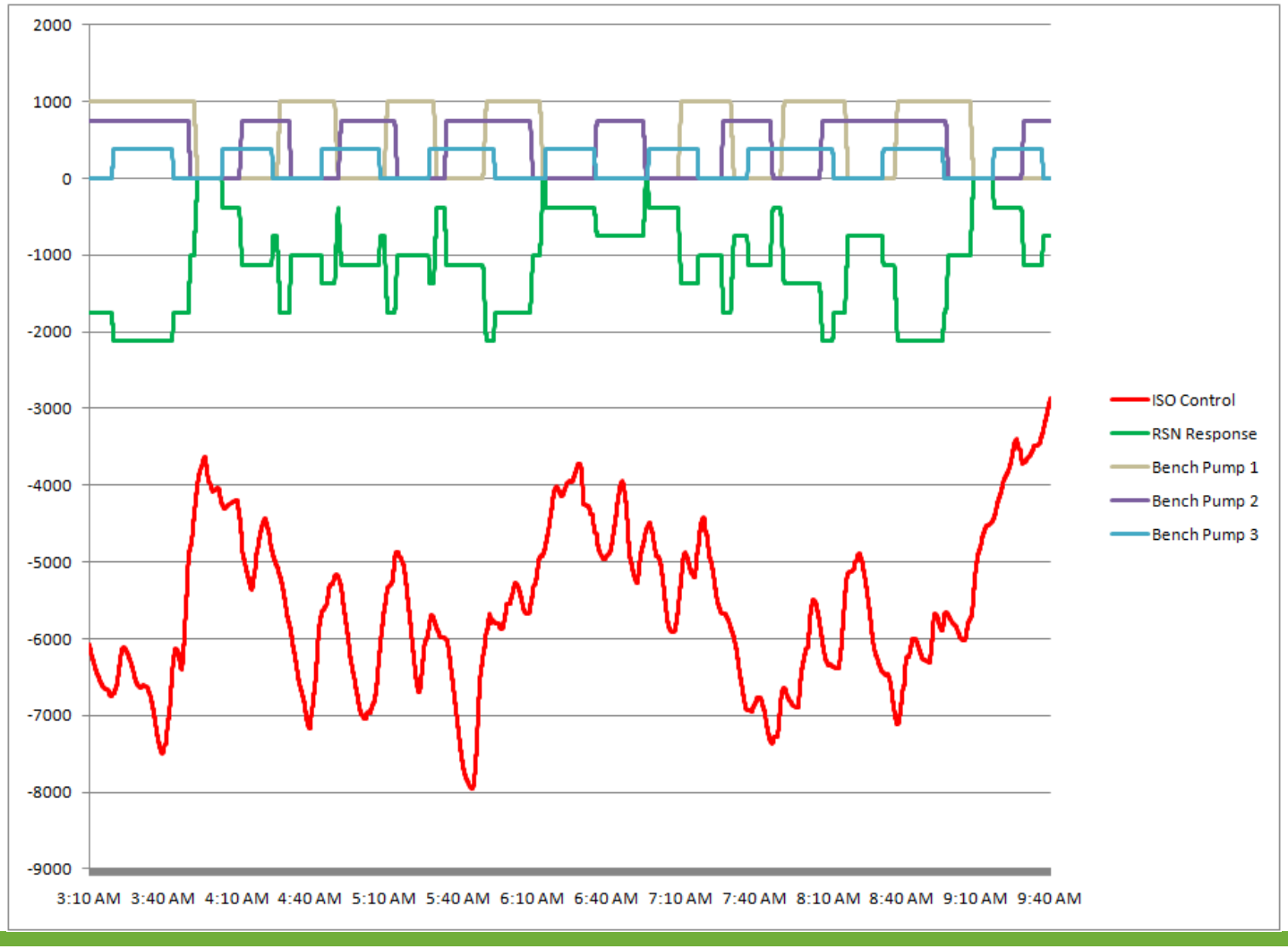
Regulation – Resource Response



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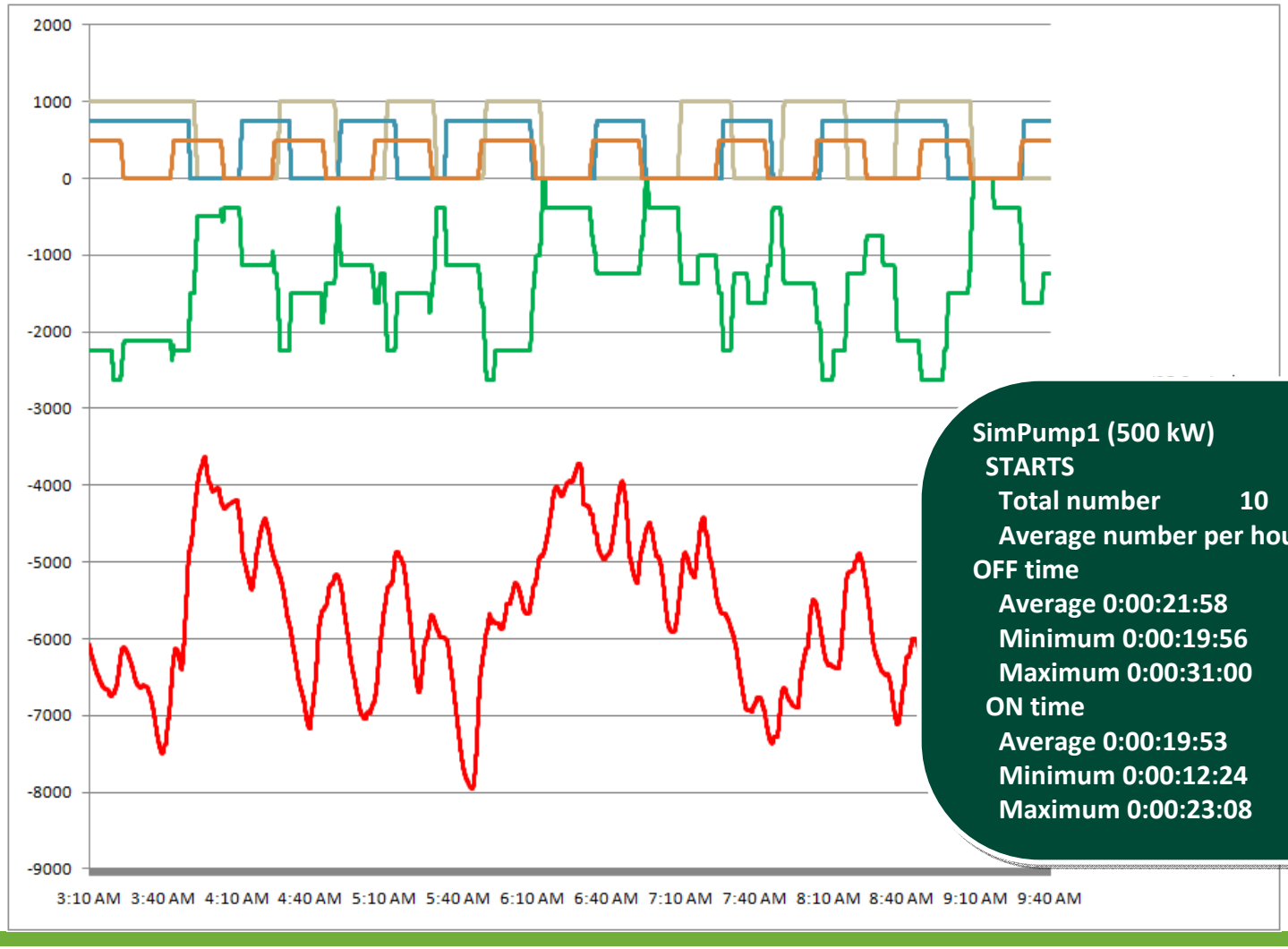
Regulation – Resource Response



SimPump1 (500 kW)
- **STARTS**
  - **Total number 10**
  - **Average number per hour 1.54**
- **OFF time**
  - **Average 0:00:21:58**
  - **Minimum 0:00:19:56**
  - **Maximum 0:00:31:00**
- **ON time**
  - **Average 0:00:19:53**
  - **Minimum 0:00:12:24**
  - **Maximum 0:00:23:08**

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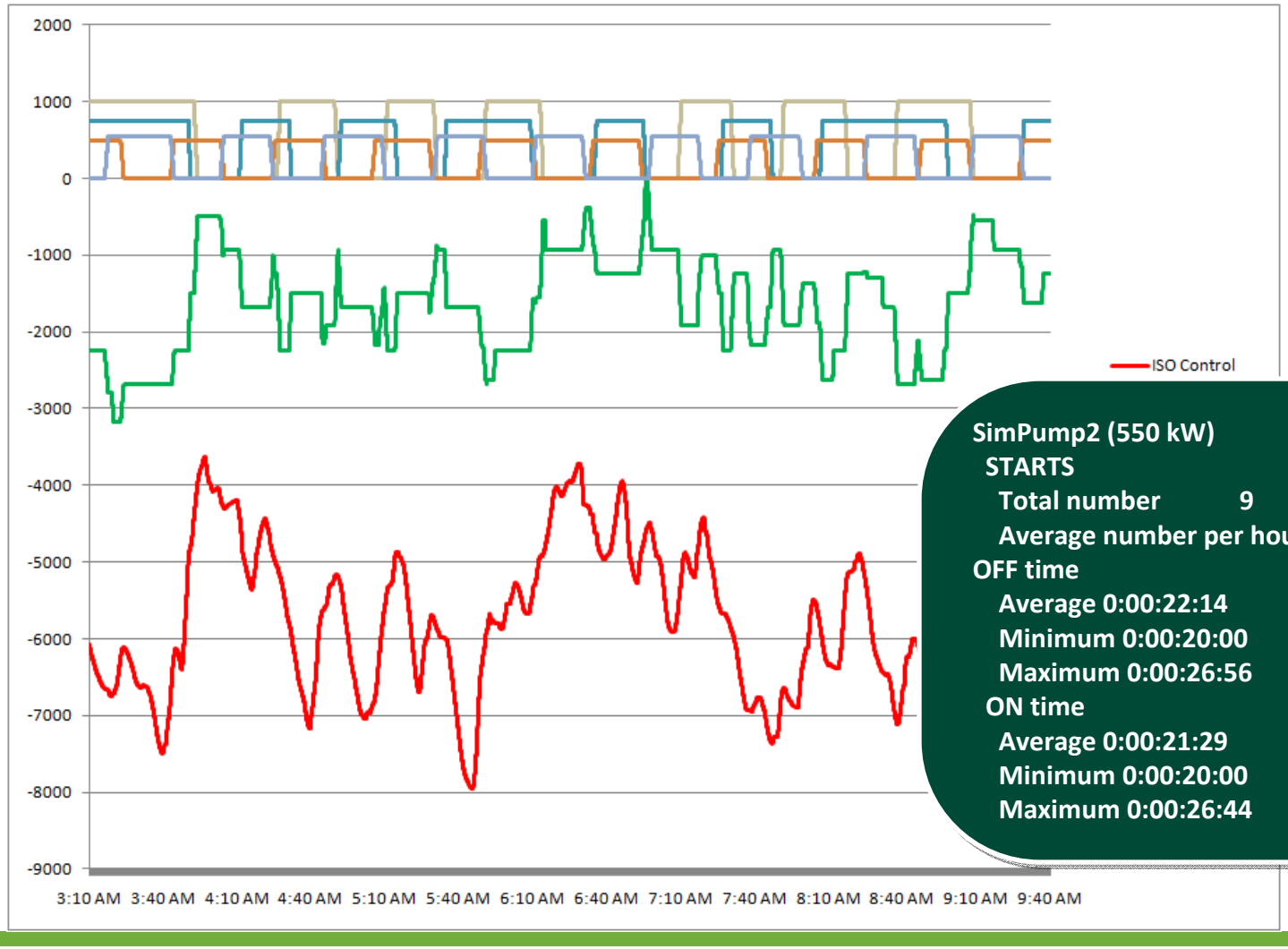
Regulation – Resource Response



SimPump2 (550 kW)

STARTS

- **Total number 9**
- **Average number per hour 1.38**

OFF time

- **Average 0:00:22:14**
- **Minimum 0:00:20:00**
- **Maximum 0:00:26:56**

ON time

- **Average 0:00:21:29**
- **Minimum 0:00:20:00**
- **Maximum 0:00:26:44**

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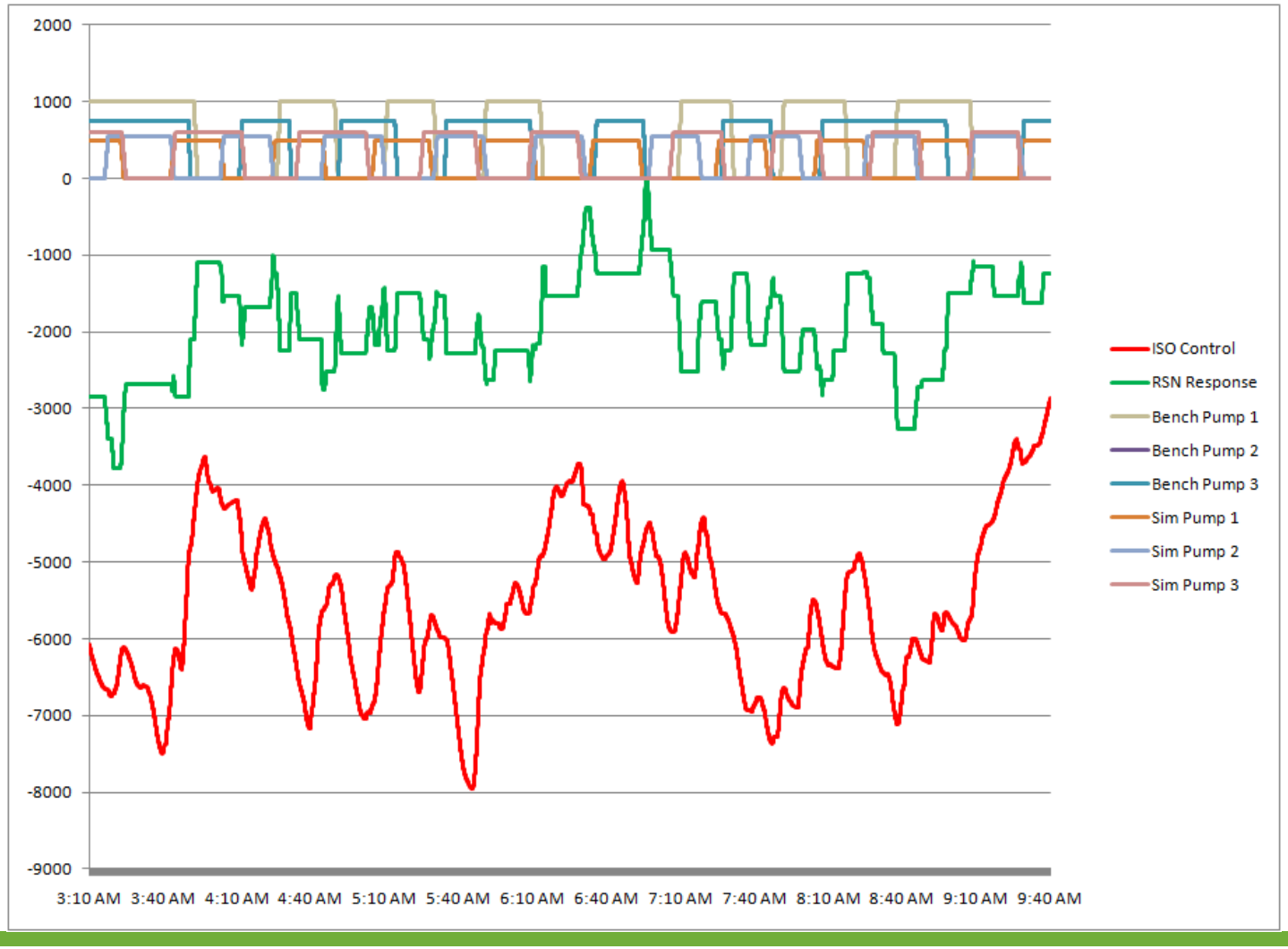
Regulation – Resource Response



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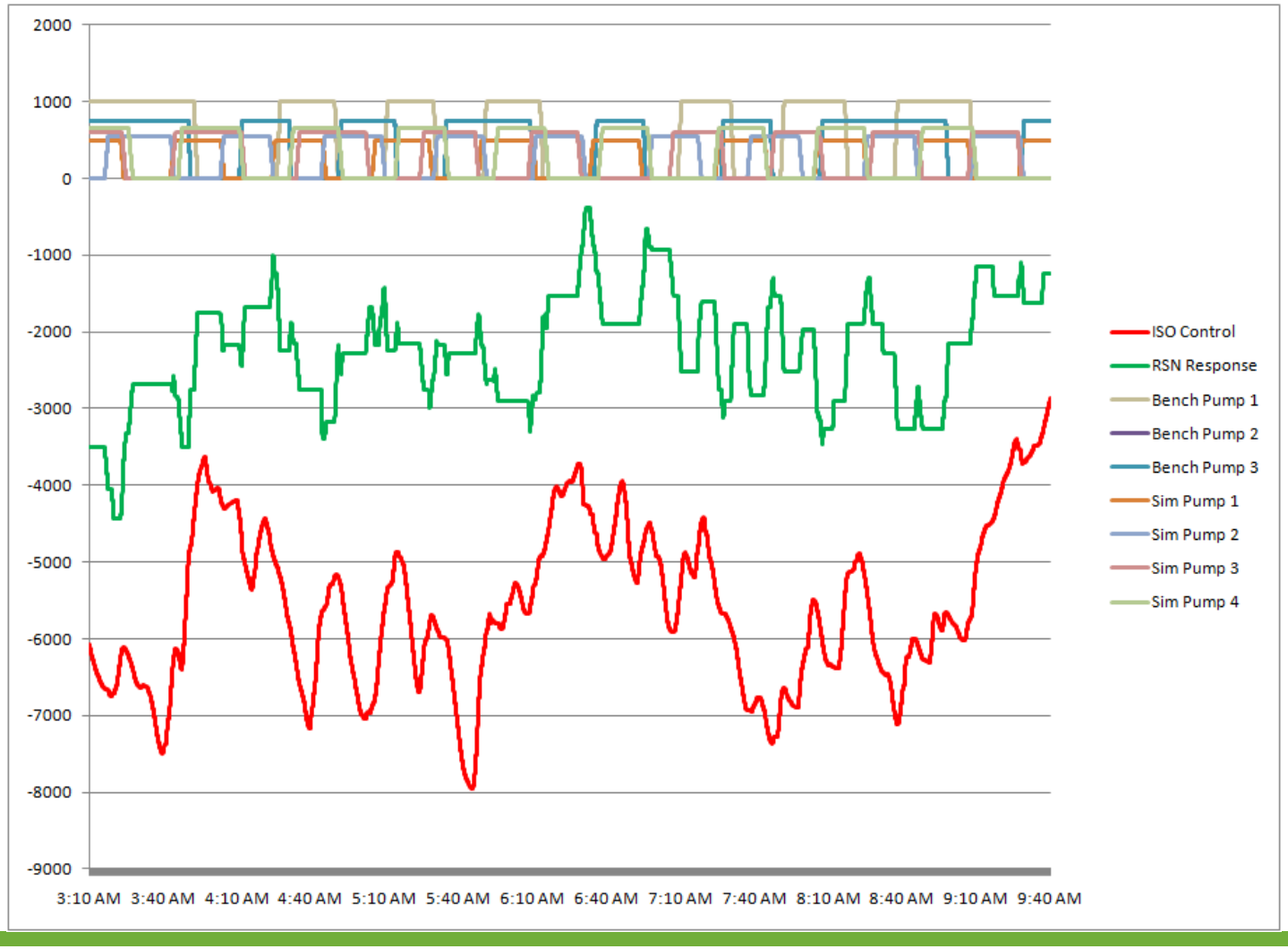
Regulation – Resource Response



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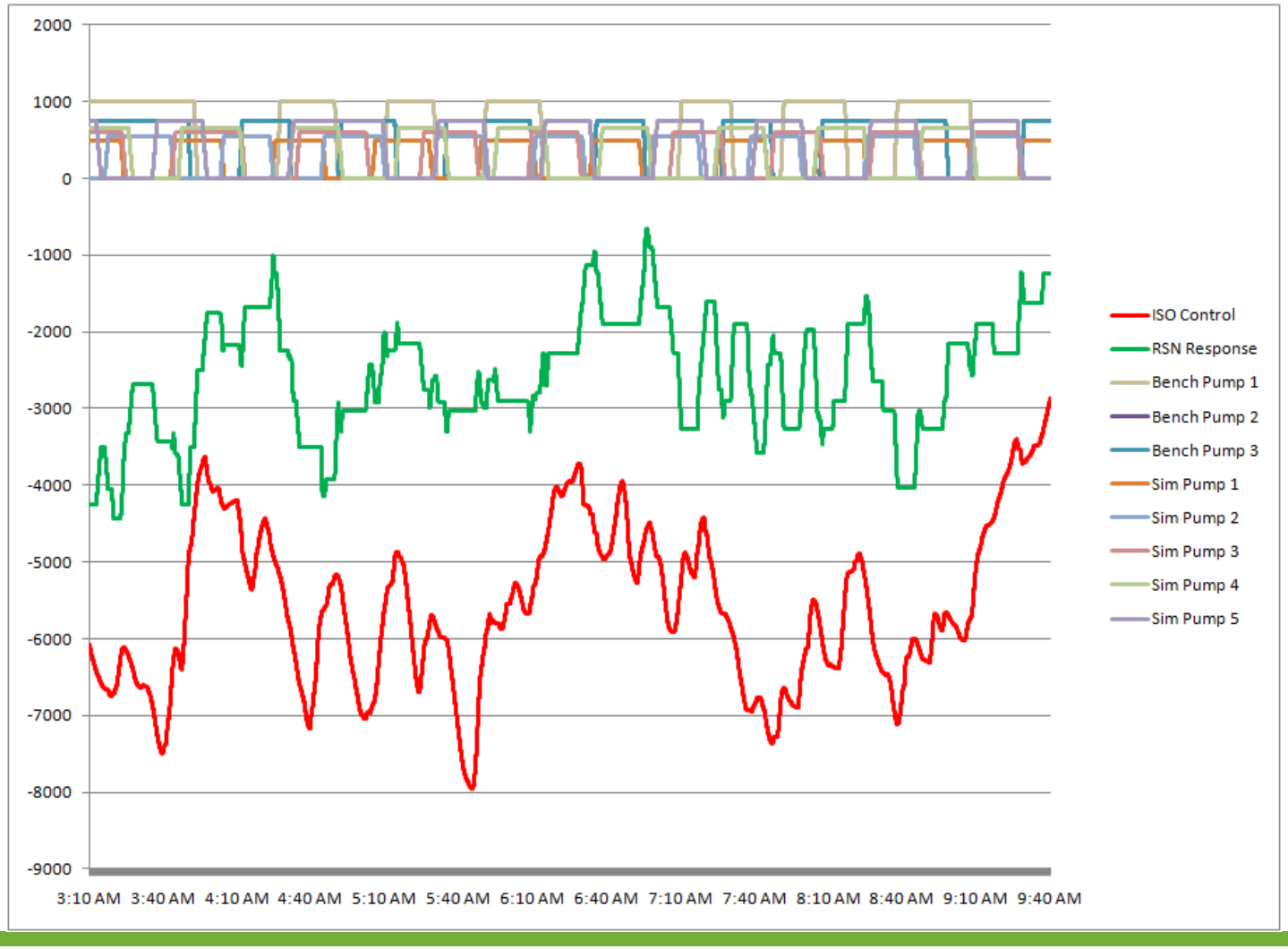
Regulation – Resource Response



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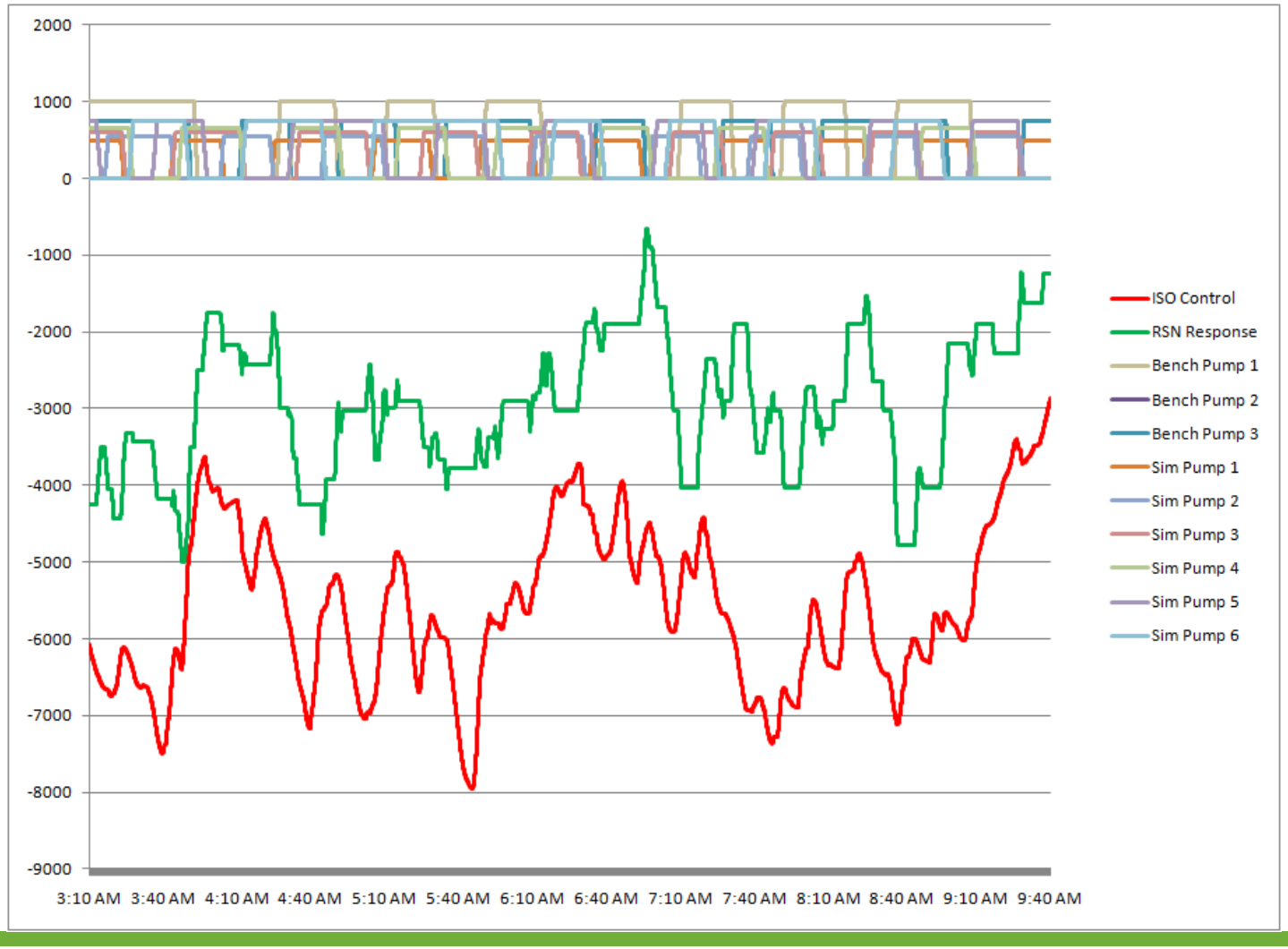
Regulation – Resource Response



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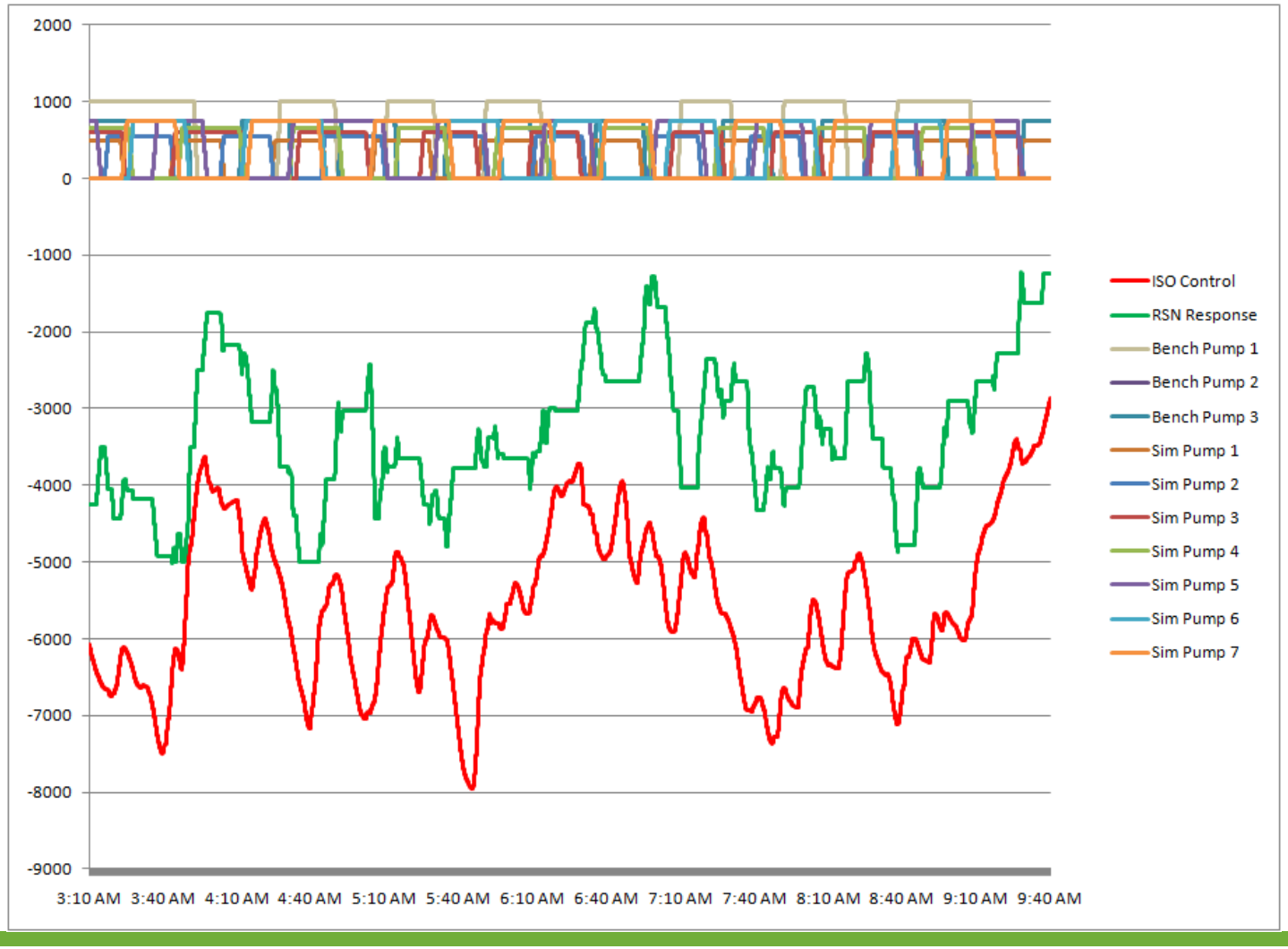
Regulation – Resource Response



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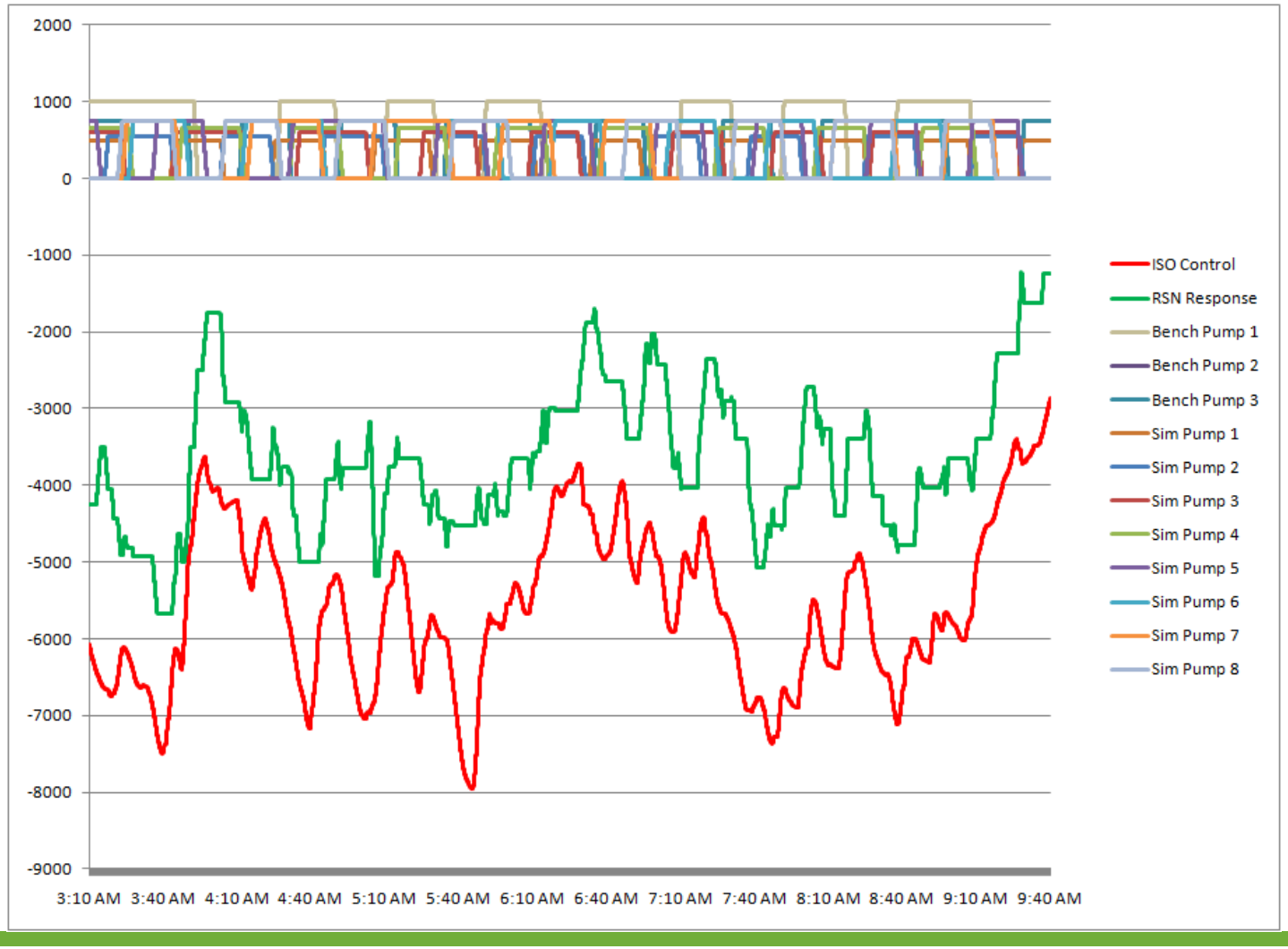
Regulation – Resource Response



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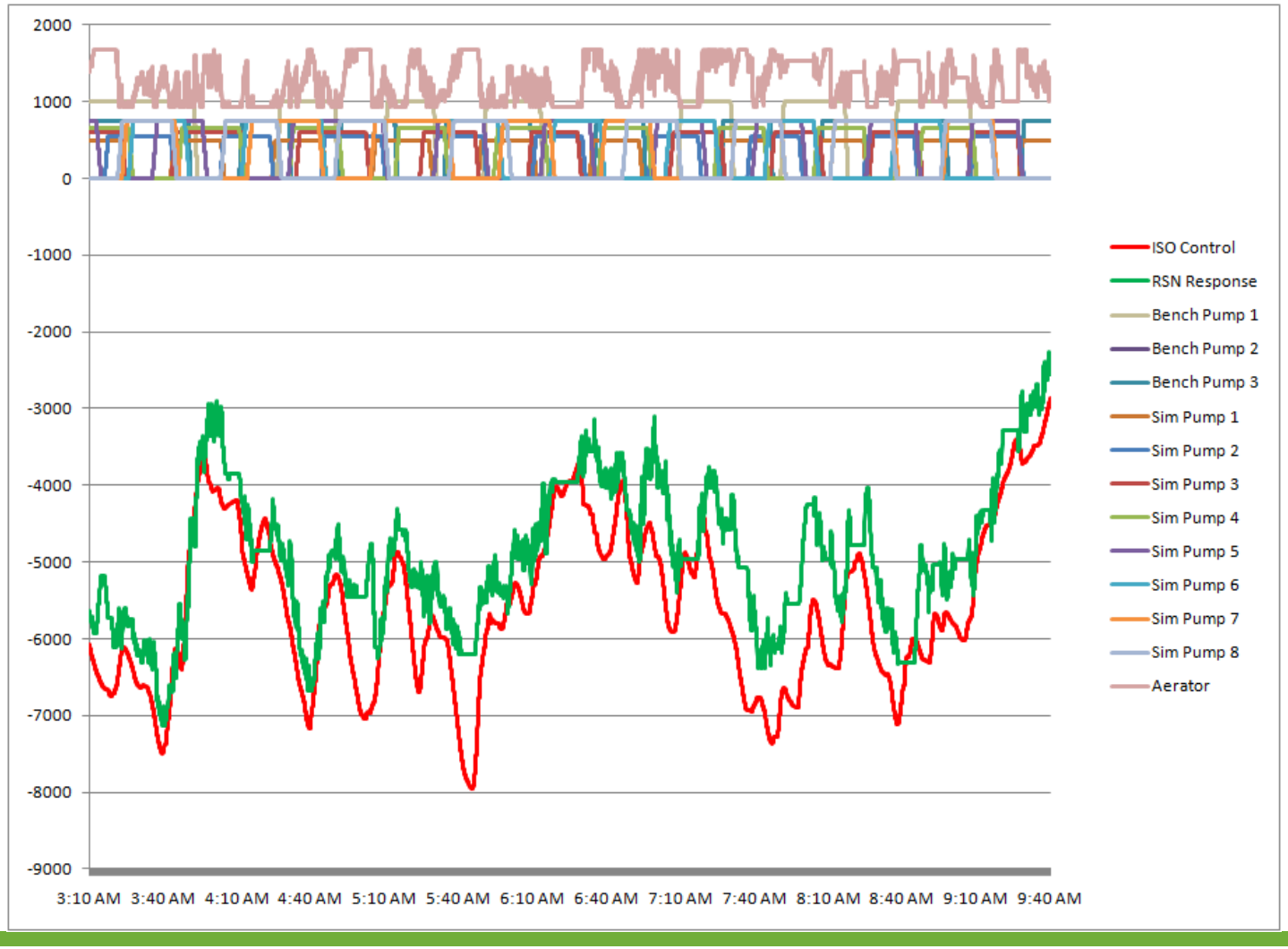

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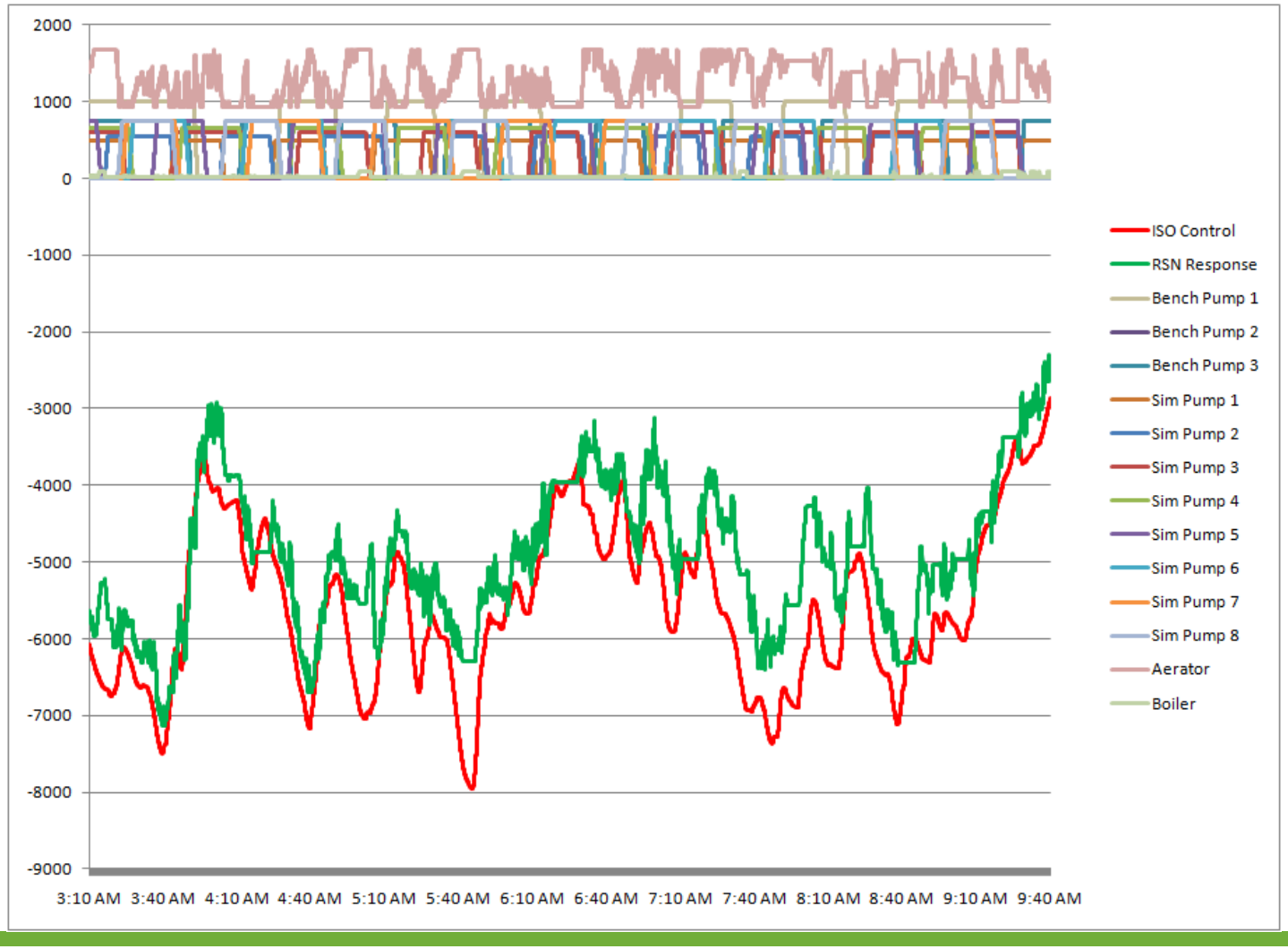
Regulation – Resource Response



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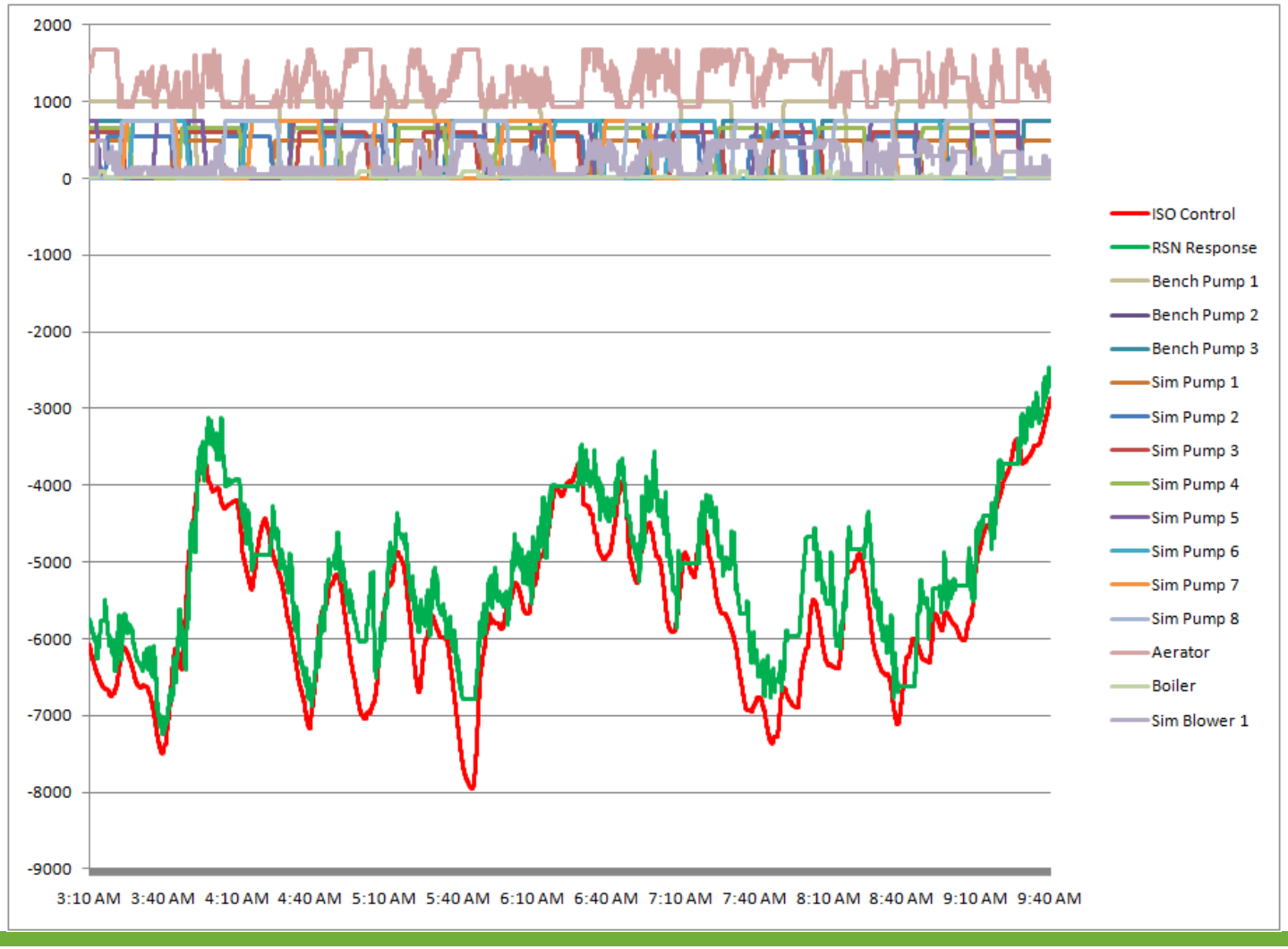
Regulation – Resource Response



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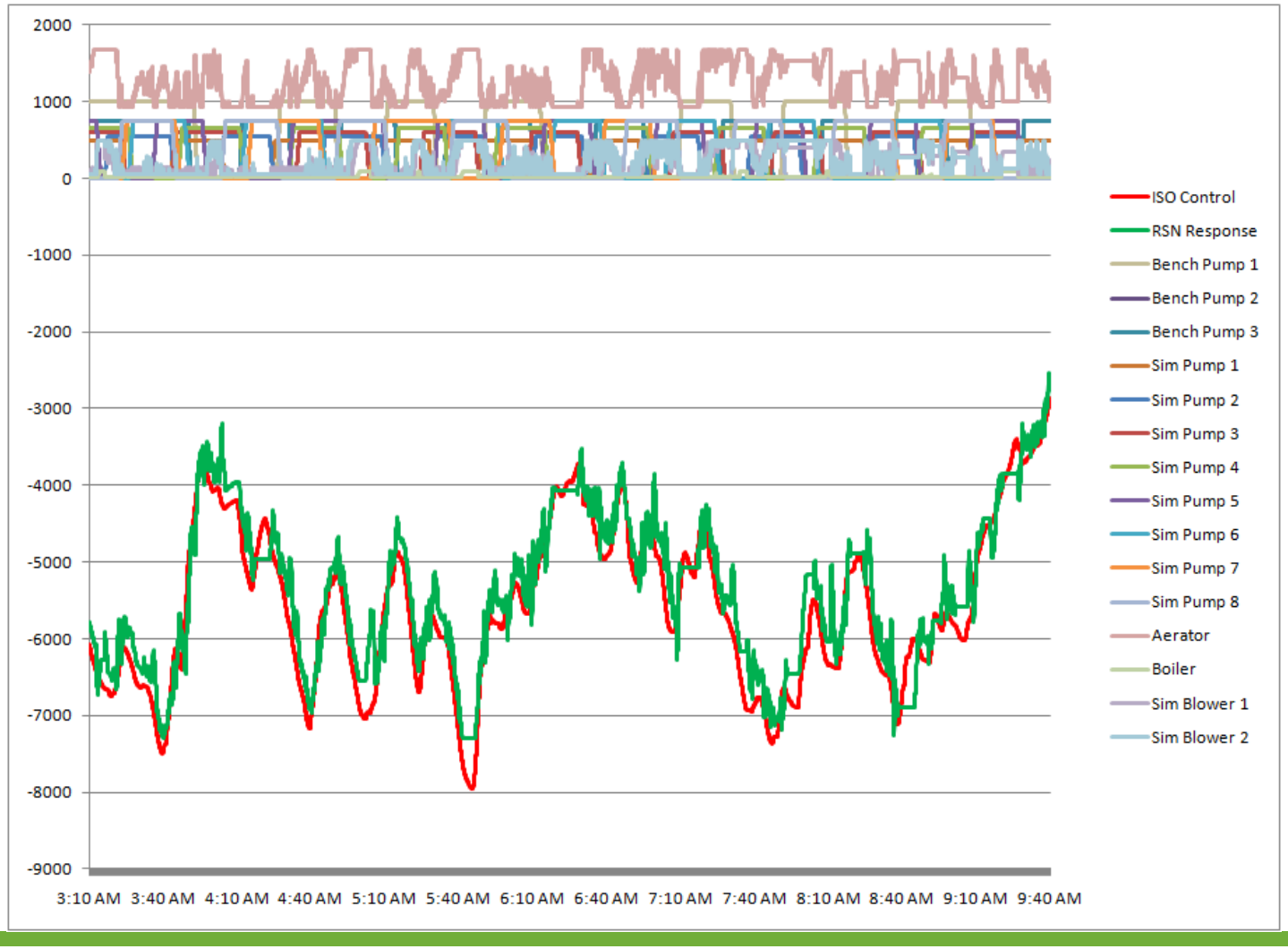
Regulation – Resource Response



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Regulation – Resource Response

The aggregate response of each resource in the network is compiled to form the regulation response

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Resource Operating Neutrality

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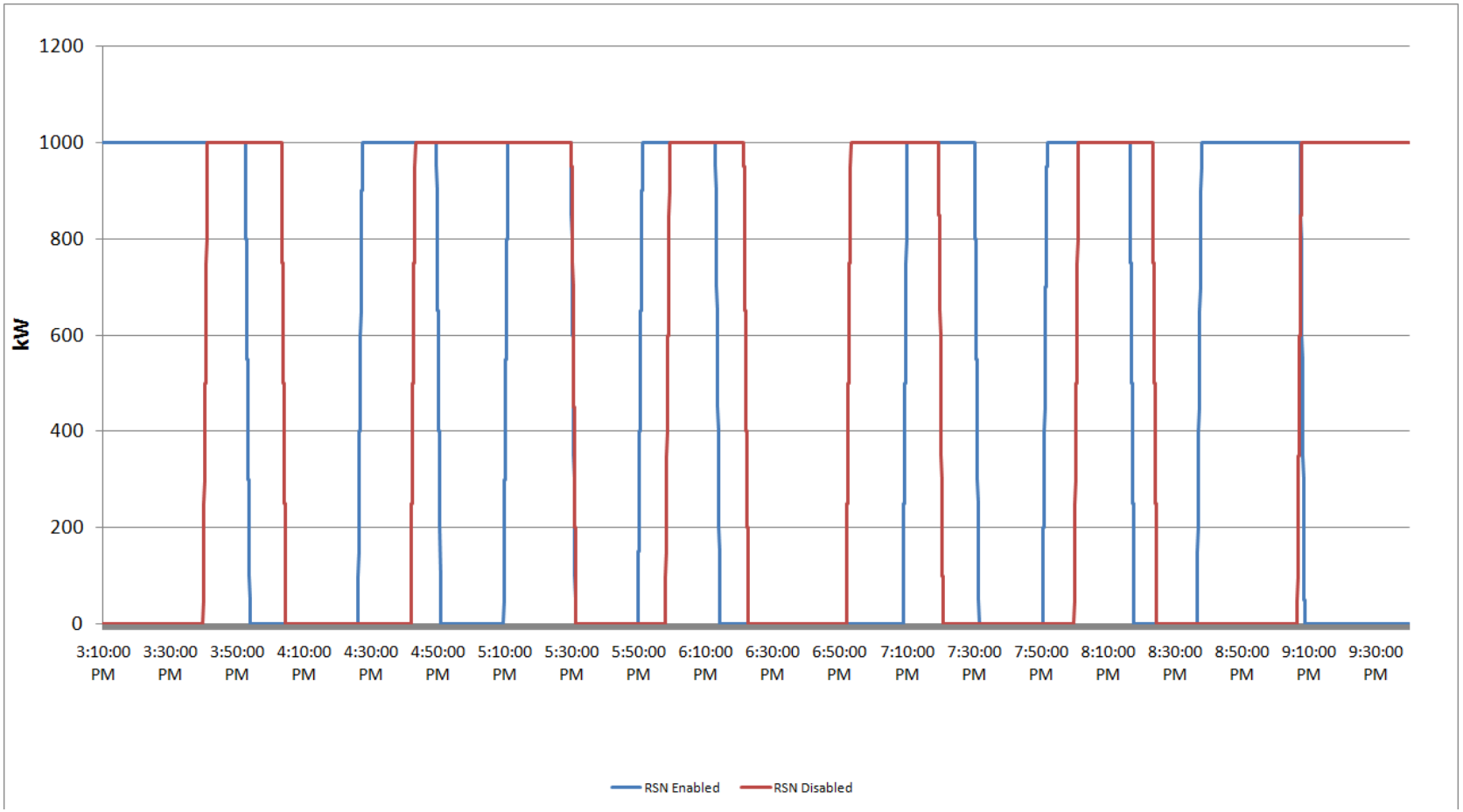
Resource Operating Neutrality



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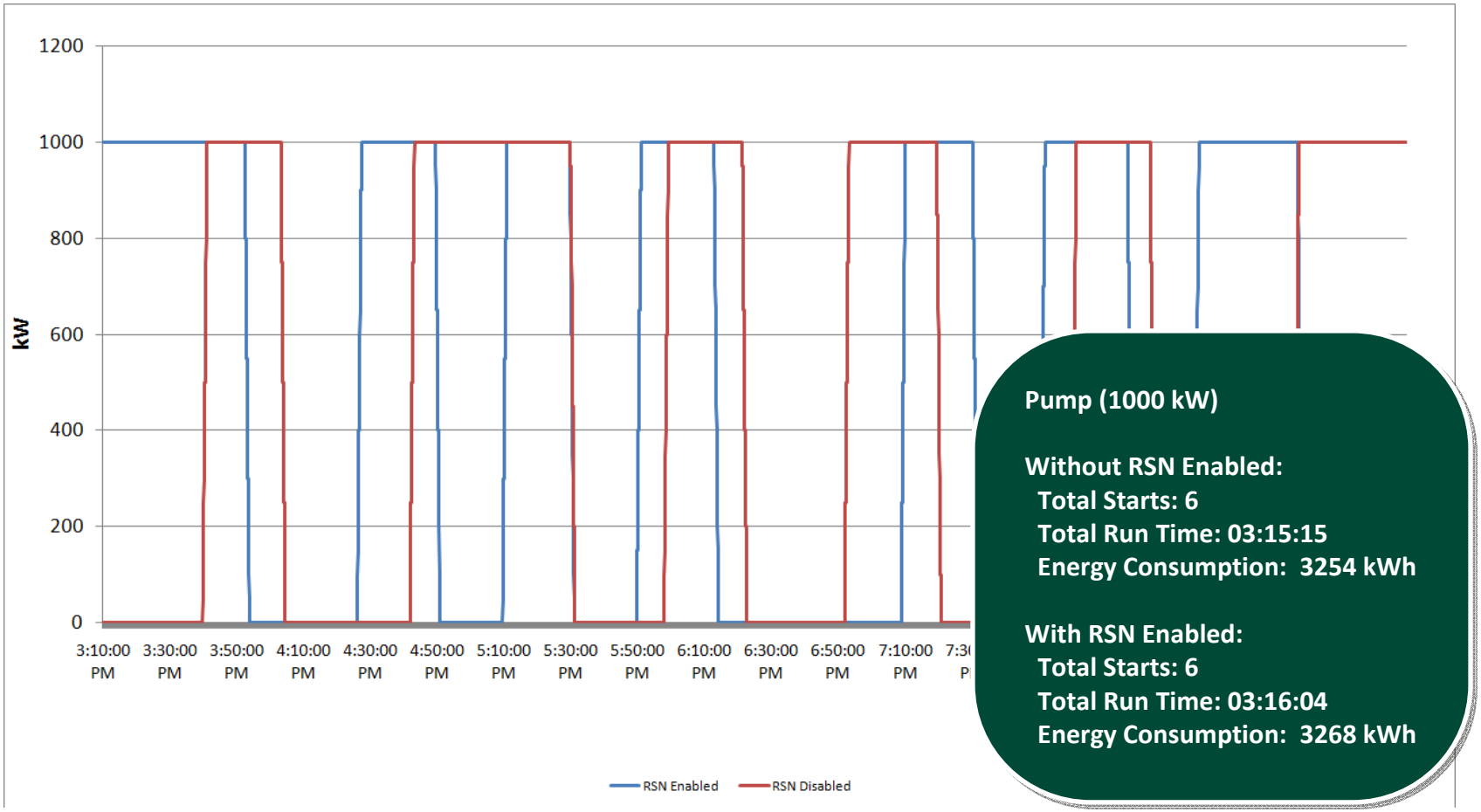
Resource Operating Neutrality



Pump (1000 kW)

Without RSN Enabled:
- **Total Starts: 6**
- **Total Run Time: 03:15:15**
- **Energy Consumption: 3254 kWh**

With RSN Enabled:
- **Total Starts: 6**
- **Total Run Time: 03:16:04**
- **Energy Consumption: 3268 kWh**

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RSN Advantages

- The RSN is NOT impacted by the ACE offset
- Storage Devices can be used effectively on the RSN…
- Vehicle Chargers and V2G applications for fleets can participate effectively in the RSN…
  - Can operate in an "Energy" Reg Down Mode – maintaining a high average charge – ready to use… capability. The RSN will use other Resources to balance the system, delivering Full Regulation to the ISO
  - Low utility impact just prior to being called for vehicle use

The RSN Network Approach Enables More Effective and Efficient Use of Generation and the RSN Resources

Other Applications for the RSN

- Spinning Reserve
- Demand Response
- Frequency Regulation
- Ramp
- Firming
- Etc…

Summary

The Utility Industry has grown with a Mission

"Power on Demand…"

- Generation has historically been stable… controllable, and has provided the balancing required… Loads were sporadic…
- Times are changing – Generation now has a sporadic component… and loads are being controlled
- The new technology being implemented by the Smart Grid may create opportunities for improved efficiency

Utilities have had good success controlling loads for Demand Response and for use in emergencies

Controlled Loads and Storage can be used to provide almost all Ancillary Services

Thank You

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