

## Thank you for your interest in this slide deck from the Renewable Dispatch – In the Cloud

This slide deck was part of an “In the Cloud” webinar, one in a planned series, sponsored and produced by BetterGrids.org. Its objective is to expose and foster outcomes from ARPA-E funded research for Secure Grid Data Exchange—In the Cloud.

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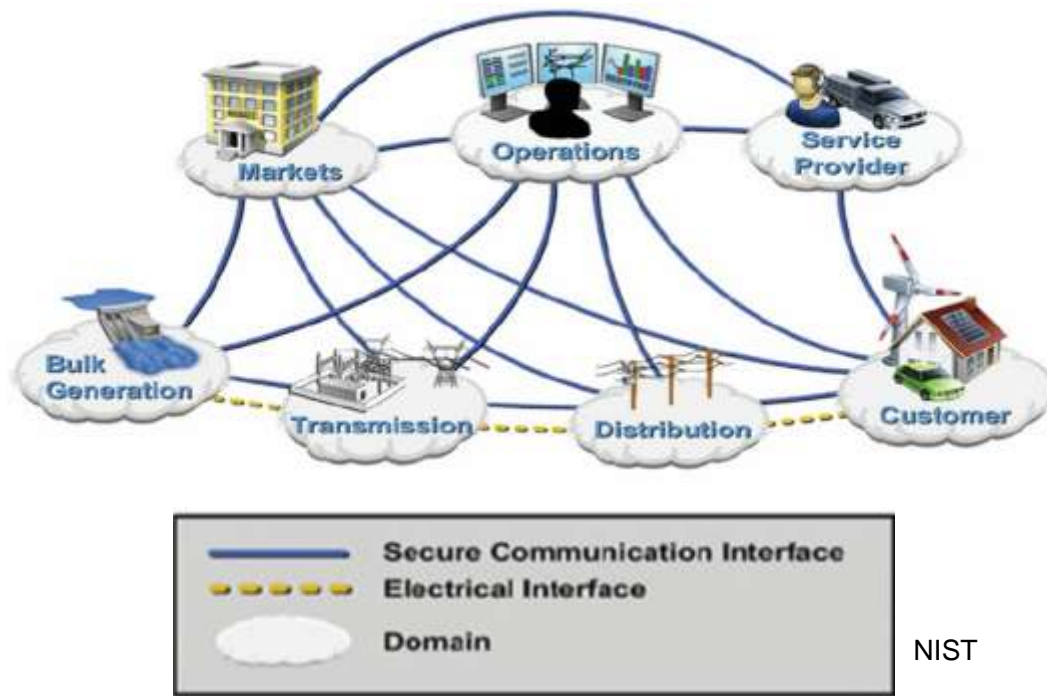
# Building a Cloud-based Solution for Renewable Dispatch

Travis Rouillard

CTO, GridBright  
Moderator

# Utility Grid Data Integration

- Grid Data is regularly shared among entities in the electricity value chain using established business protocols and computer systems
- Major exchange hubs are ISOs & Reliability Coordinators
- But value chains are being disrupted and inverted
- New communications and computing operations are distributed on the cloud



NIST

# Secure Grid Data Exchange (SGDX) Project

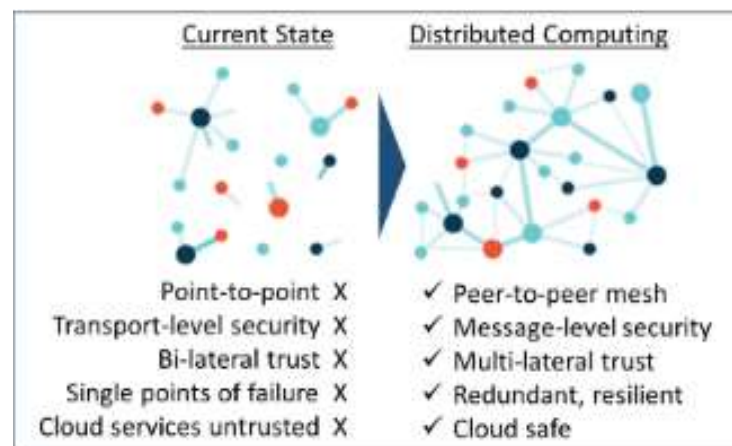
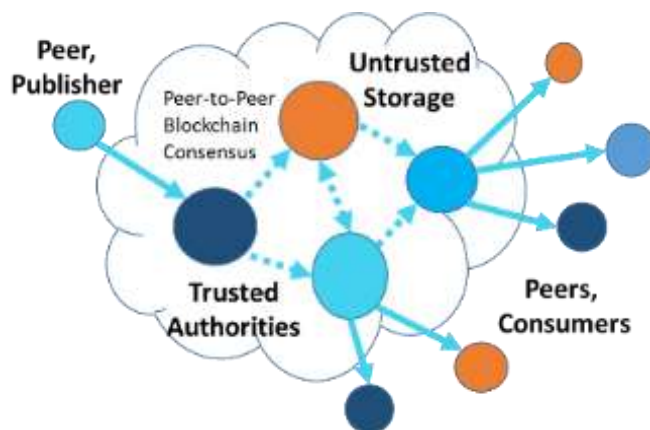
A DOE ARPA-E  
Open Project

Start date  
February 14, 2019

Term  
3 Years

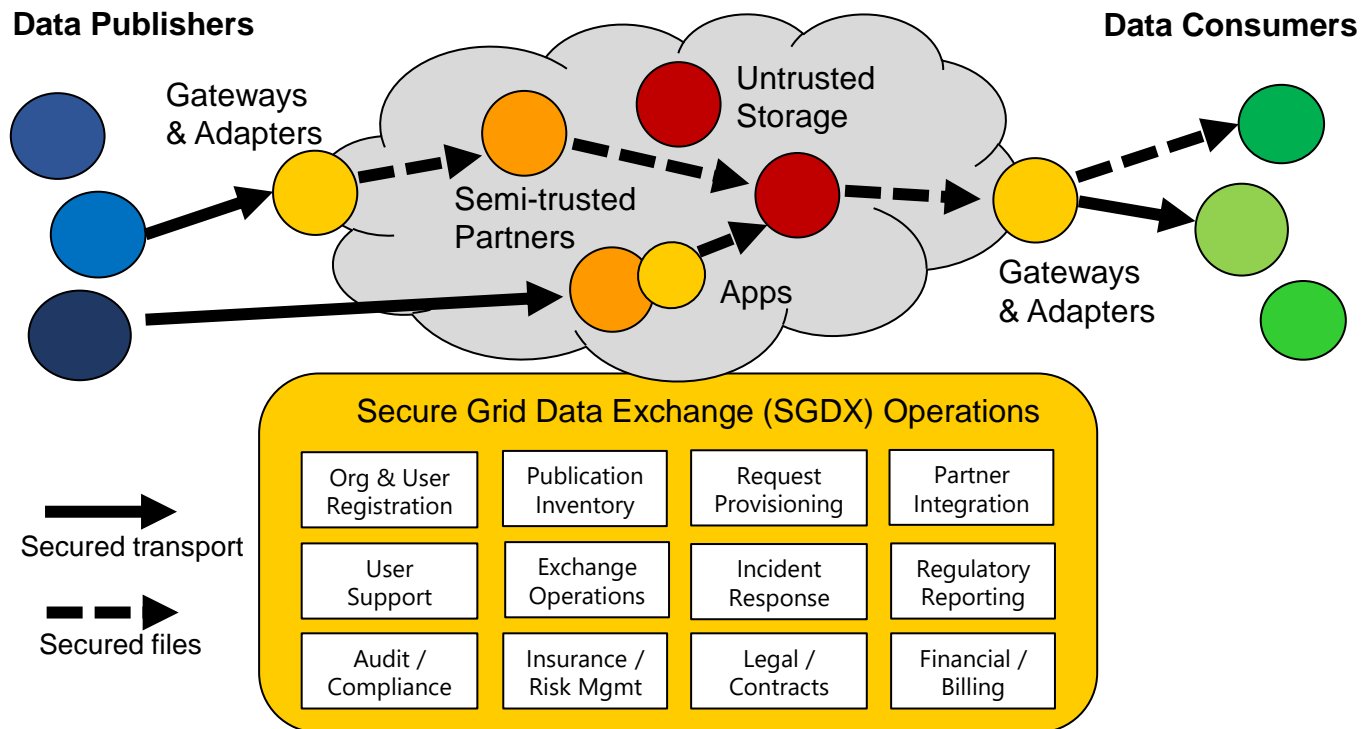
Budget  
\$2.5M Federal

10% Cost Share



*Develop a simple secure solution for sharing of grid data.*

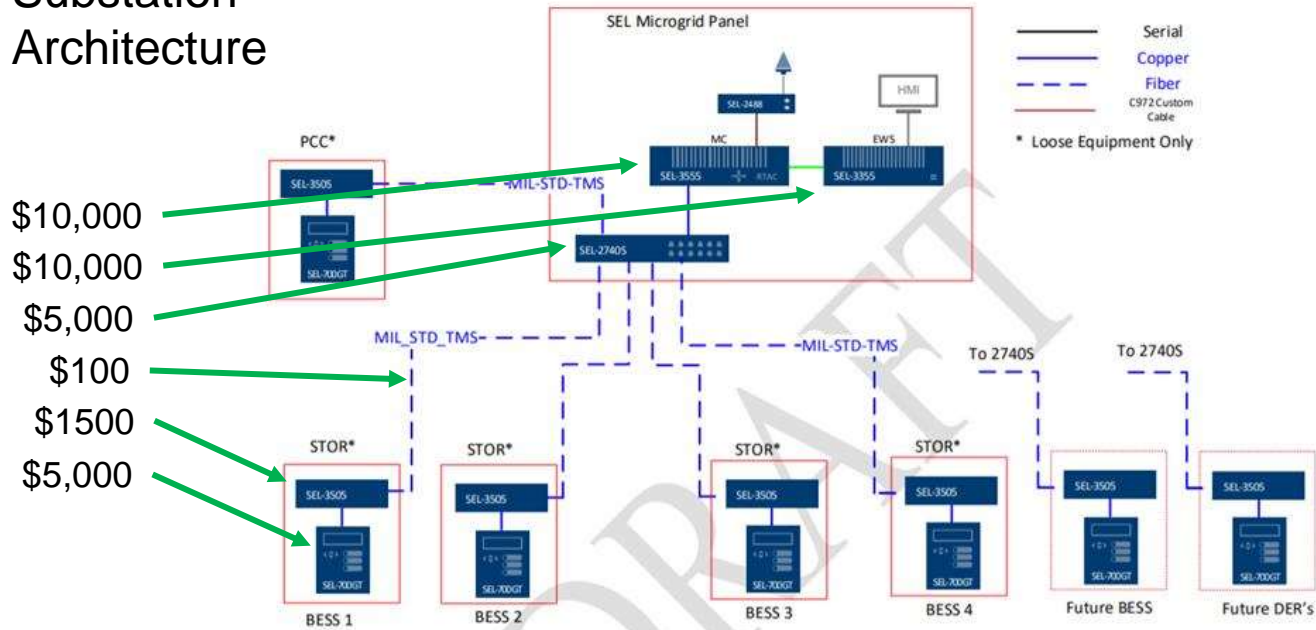
# SGDX Business Vision



# Current State – Expensive OT Comms

## Example Utility Substation Architecture

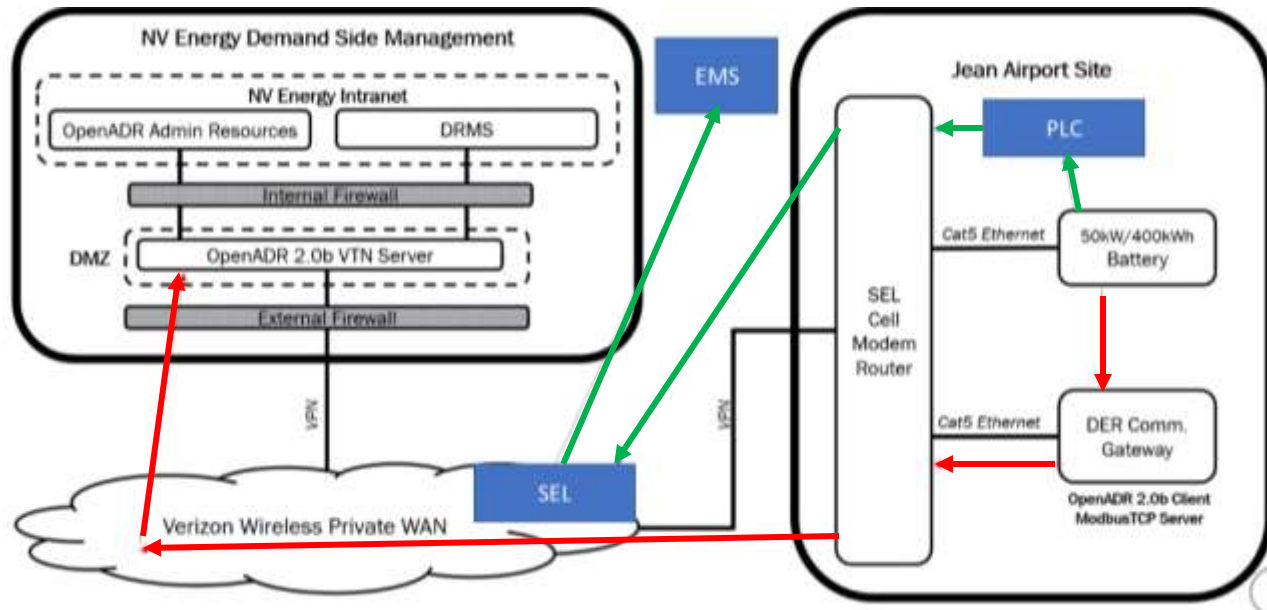
OK for substations and transmission level resources, but not for scaling to smaller renewables or DERs



# Current State – Redundant IT/OT Comms

## Example Utility Battery Architecture

Two separate data paths (and gateways) used for **EMS monitoring & control** and **DRMS monitoring & control**



# 100x Cost Difference between OT and IoT

~\$1500

Traditional OT  
Gateway  
Substation or Field  
(DNP3, ModBus,  
BacNet)



~\$150

Modern IT Gateway  
Field, Industrial, or  
Commercial  
(OpenADR, SEP 2.0)



~\$15

IoT Gateway  
Commercial or  
Residential  
(REST, MQTT)



Comms through public IoT clouds (eg AWS) ~\$1/device-year!



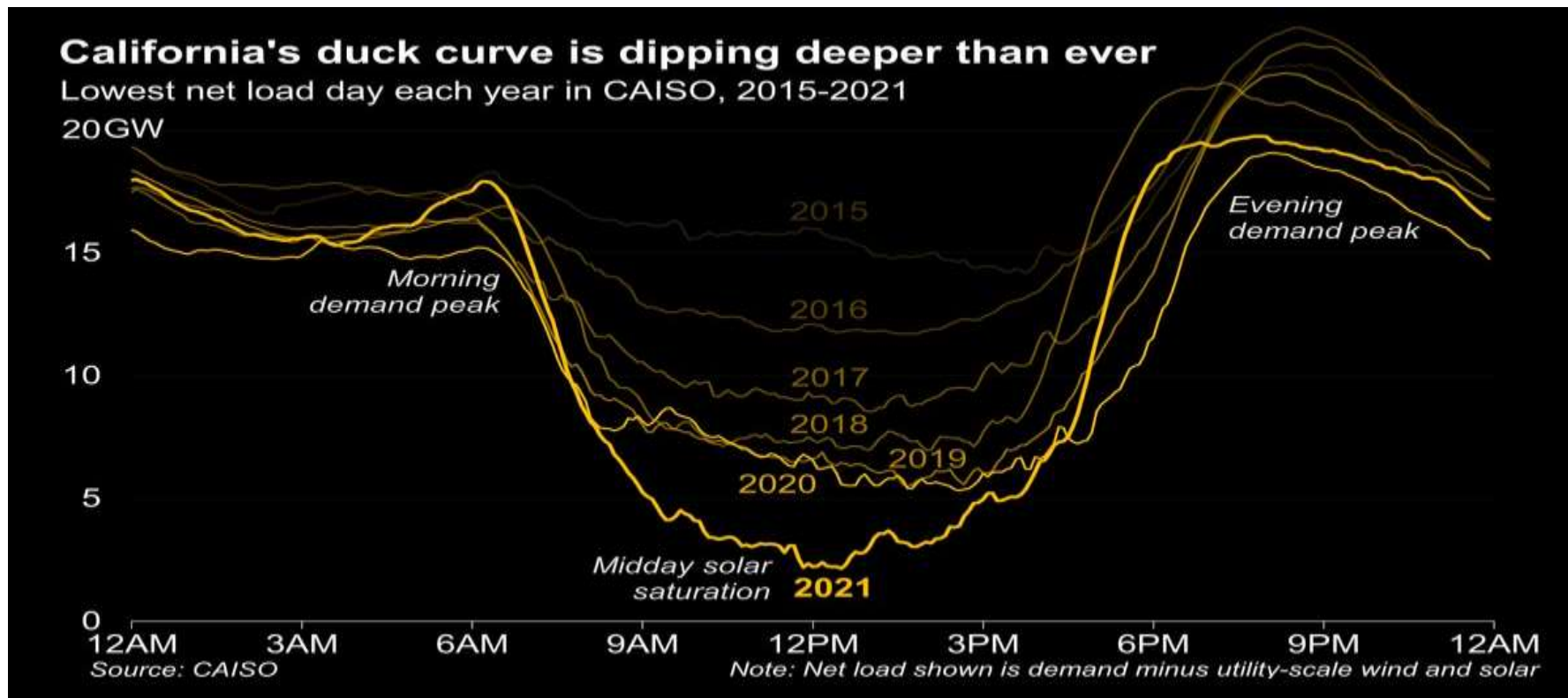
# SCADA-IoT Convergence

MQTT protocol increasingly supported in modern SCADA software and industrial process control devices

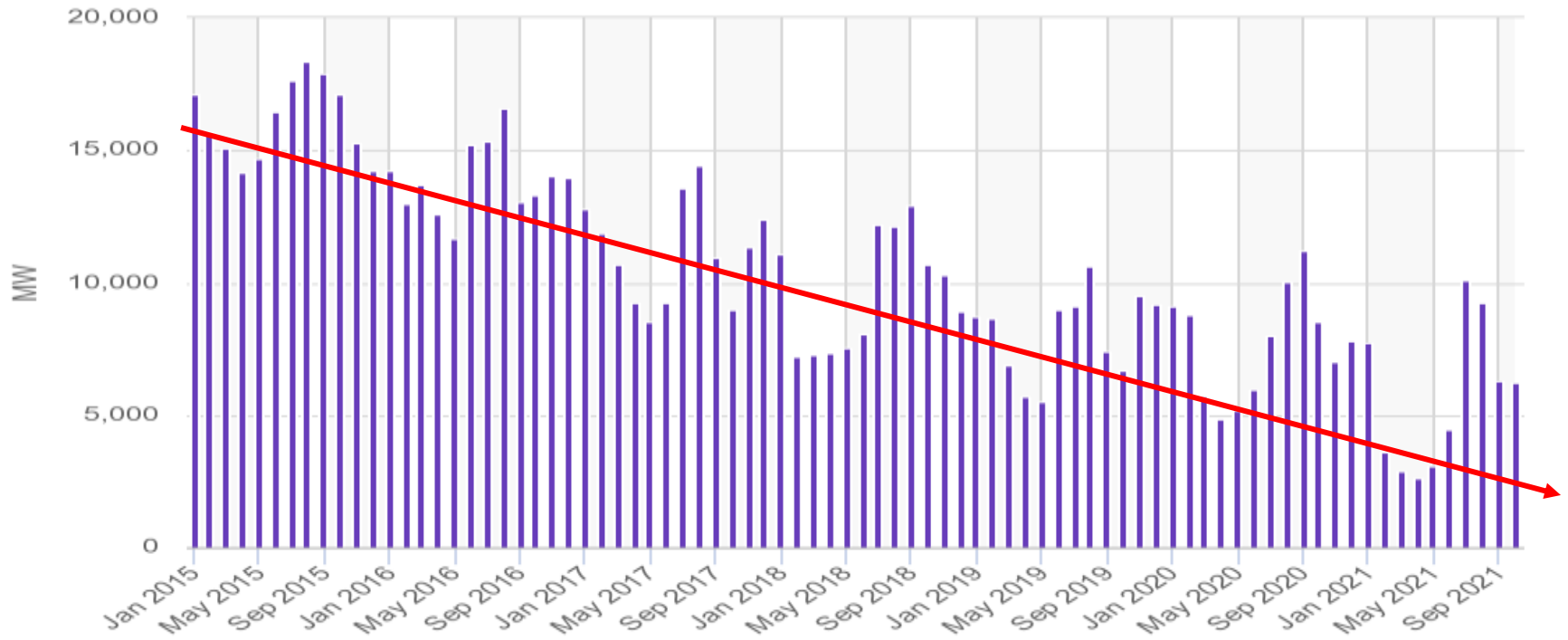
The collage consists of several screenshots:

- MQTT Client Driver (AWSIoT,TestAWSIoT) Properties:** Shows configuration for a MQTT Client ID (VTScaDa[7AA163118FA...]), Sparkplug B SCADA Host ID (VTS-CADA[8163a17a-e0bf-438b-b101-d4cd9fb4388]), Keep Alive (120), and Protocol (JSON).
- TCP/IP Port (AWSIoT) Properties:** Shows Name/Address (its-iot.us-west-2.amazonaws.com) and TCP/IP Port Number (8883).
- TCP/IP Port (AWSIoT) Properties (TLS):** Shows TLS settings with 'Enable TLS' and 'Enable mutual authentication' checked. A table of certificates is visible, with 'AWS IoT Certificate' highlighted.
- Device List Table:** A table with columns: Name, Description, Equipment Type, and Protocol. It lists devices like AWSIoT1, AWSIoT2, AWSFlag1, and AWSFlag2 with their respective equipment types (Analog/Digital In) and protocols (gb-mqtt/spgb/scada/gen1/flag).
- Wind Stream PROPERTIES LLC SCADA Interface:** Shows real-time data for 'Link 1' (17.84) and 'Link 2' (60.83) and a map of the facility.

# Business Context: CAISO 'Duck Curve'



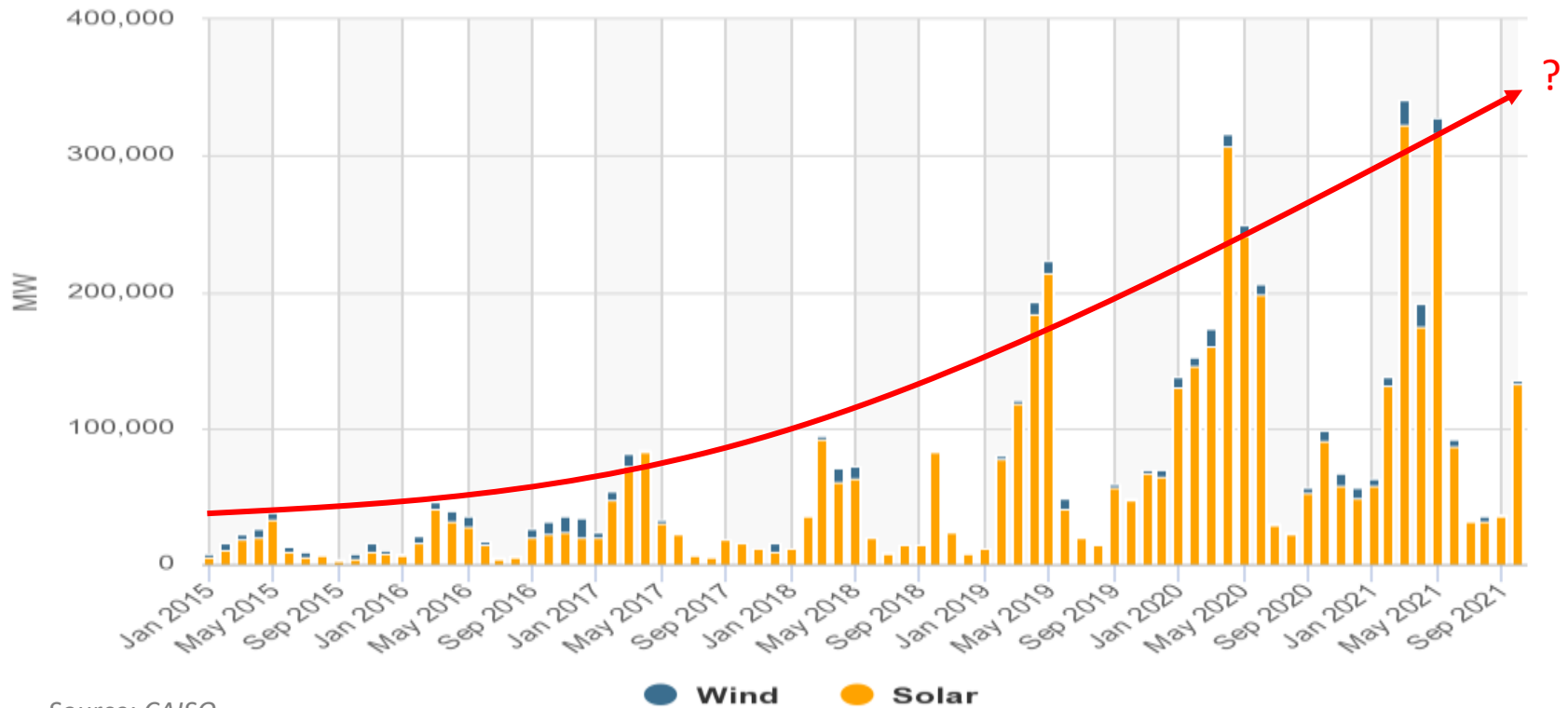
# CAISO Net Load Decreasing Trend



Source: CAISO



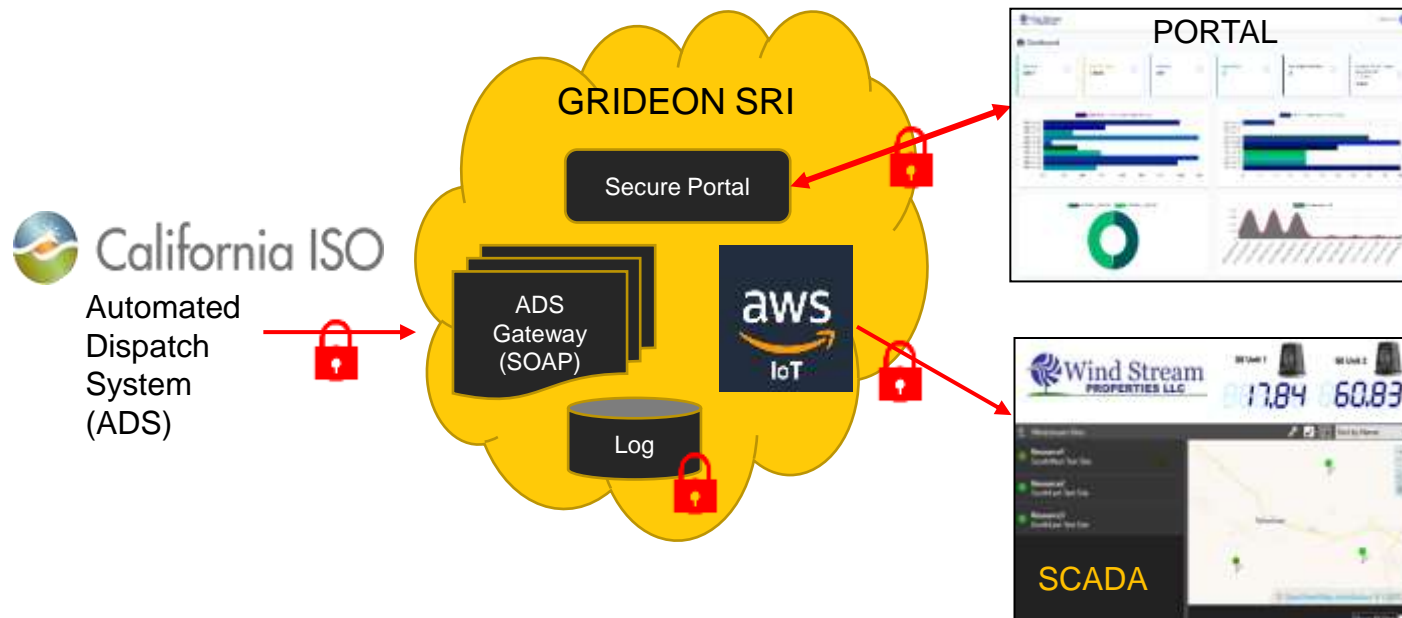
# CAISO Renewable Curtailments Trend



Source: CAISO

# Secure Resource Integration (SRI)

- Wind Stream interested in a secure solution for integrating their 5 Tehachapi wind farms with CAISO's ADS to receive automated curtailment instructions.
- Leverage cloud-based 'server-less' technology and IoT communications.



# Cloud Functionality

Grideon SRI converts a complex HTTP-SOAP/XML dispatch instruction message from CAISO ADS into a simple flat MQTT/JSON message that can be easily converted by a recipient into a SCADA setpoint and status.

## CAISO SOAP/XML Instruction (example)

```
<SOAP-ENV:Envelope xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header/>
  <SOAP-ENV:Body>
    <v8:getDispatchBatchesSinceUIDResponse
xmlns:v8="http://ads.caiso.com/api/webservices/dispatch/v8">
      <result><![CDATA[<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<APIDispatchResponse xmlns="http://ads.caiso.com">
  <dispatchBatchList>
    <DispatchBatch batchUID="DISP-58EDF60-7821-4038-8F21-AC18002CA84C">
      <marketID>120051409</marketID>
      <batchStatus>3</batchStatus>
      <batchReceived>2020-05-14T14:56:31Z</batchReceived>
      <batchSent>2020-05-14T14:56:31Z</batchSent>
      <batchExpires>2020-05-14T15:44:45Z</batchExpires>
      <batchType>1</batchType>
      <startTime>2020-05-14T16:00:00Z</startTime>
      <dispatchMode>0</dispatchMode>
      <bindingFlag>Y</bindingFlag>
      <revisionNo>803</revisionNo>
    </DispatchBatch>
  </dispatchBatchList>
</APIDispatchResponse>
    </v8:getDispatchBatchesSinceUIDResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```



## MQTT/JSON Setpoint (example)

```
{ "instructionUID": "DISP-2BC6A9F0-D131-4039-
  "resourceId": "NZWIND_6_WDSTR4",
  "startTime": "2021-07-27T17:57:30Z",
  "dot": "24.0",
  "followDotFlag": "Y" }
```



'resourceId' = generating unit  
'startTime' = target time interval  
'dot' = dispatch operating target  
'followDotFlag' = Yes/No

# Client-Side Integration

Client (eg SCADA) uses any standard-compliant MQTT software library (in any language) to subscribe to a resource specific 'topic' (managed by AWS) –

```
caiso/windstream/# (wildcard)
caiso/windstream/json/resource_id_name
caiso/windstream/json/NZWIND_6_WDSTR4
```

Every ~5 minutes the client receives a heartbeat and/or simple dispatch instruction from CAISO converted into JSON format –

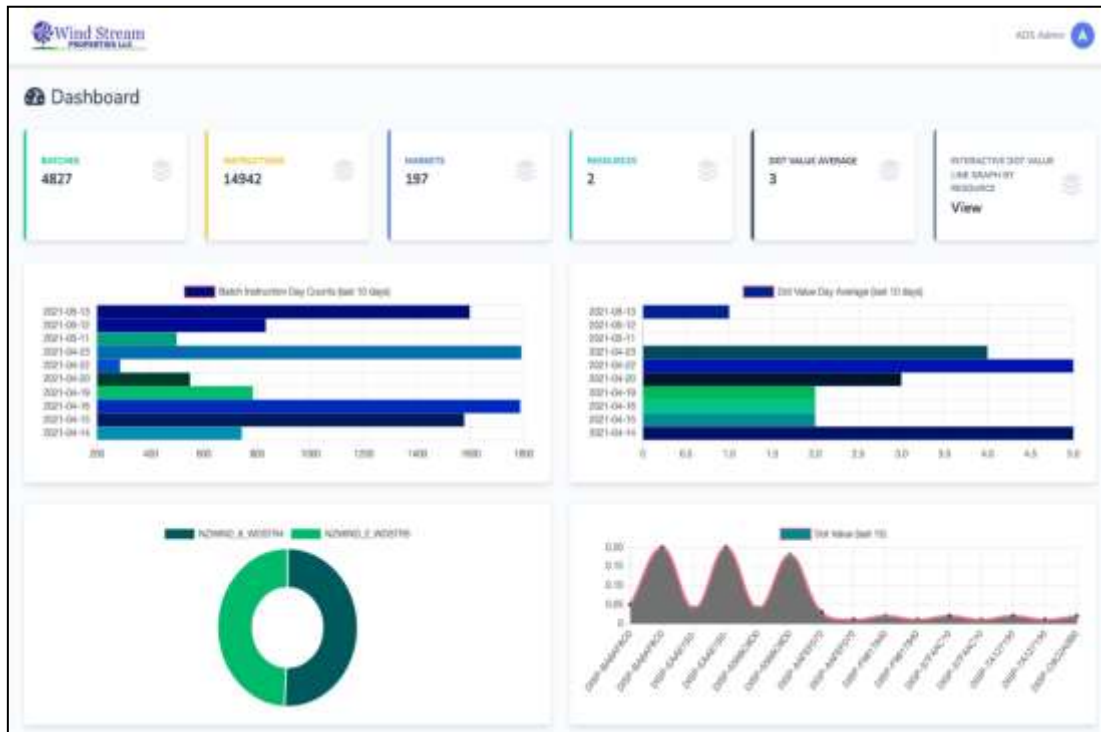
```
{"instructionUID":"DISP-2BC6A9F0-D131-4039-8131-AC194215082D-I2044",
  "resourceId":"NZWIND_6_WDSTR4",
  "startTime":"2021-07-27T17:57:30Z",
  "dot":"24.0",
  "followDotFlag":"Y"}
```

The entire logon and communication chain is secured with SSL certificates.



# Portal Functionality

## Overall Monitoring Dashboard



## Communications Error Log

Log ID	Created At	Log Service	Log Type	Log Message
1010	2021-08-08 20:30:01	https://dotvalue.map.cdn.com:447/ADS/APP/WebServices/v8	error	Response is NOT a valid XML (Document/Structured)
1009	2021-08-08 20:30:01	https://dotvalue.map.cdn.com:447/ADS/APP/WebServices/v8	error	Response is NOT a valid XML (Document/Structured)
1008	2021-08-08 20:29:01	https://dotvalue.map.cdn.com:447/ADS/APP/WebServices/v8	error	Response is NOT a valid XML (Document/Structured)
1007	2021-08-08 20:30:01	https://dotvalue.map.cdn.com:447/ADS/APP/WebServices/v8	error	Response is NOT a valid XML (Document/Structured)

## Alert Notifications to Users

ID	Created At	Service	Type	Message
11	2021-04-02 19:08:49	a3bdk57jpsam-ats-1ot-west-2.amazonaws.com	error	[5] Transferring data over socket failed: Sending data over the socket failed. Has it been closed?
12	2021-04-02 19:08:49	a3bdk57jpsam-ats-1ot-west-2.amazonaws.com	error	[5] Transferring data over socket failed: Sending data over the socket failed. Has it been closed?
13	2021-04-02 19:08:51	a3bdk57jpsam-ats-1ot-west-2.amazonaws.com	error	[5] Transferring data over socket failed: Sending data over the socket failed. Has it been closed?

# Portal Functionality

## Search Dispatch History

**Search Batches**

Batch Search Fields:

- Batch UID:
- Batch Instruction UID:
- Market ID:
- Batch Status:
- Batch Type:
- Resource ID:
- Received Date:
- Sent Date:
- Expires Date:

Results: 100 | 100 Rows | Batch Date |

**Batch Search Results** |

Show 100 2 entries | Search:

Batch Start	Batch UID	Market ID	Batch Status	Batch Type	Batch Received	Created At
2021-05-13 20:00:00	DISP-97800F40-964F-4039-FFCB-AC15E26CC4D	121061313	3	3	2021-05-13 19:30:26	2021-05-13 19:35:02
2021-05-13 13:45:00	DISP-04C9C480-964D-4039-FFCB-AC15E26CC4D	121091313	3	3	2021-05-13 19:17:49	2021-05-13 19:20:03

## Review Batch Instruction Details

**Batch Details**

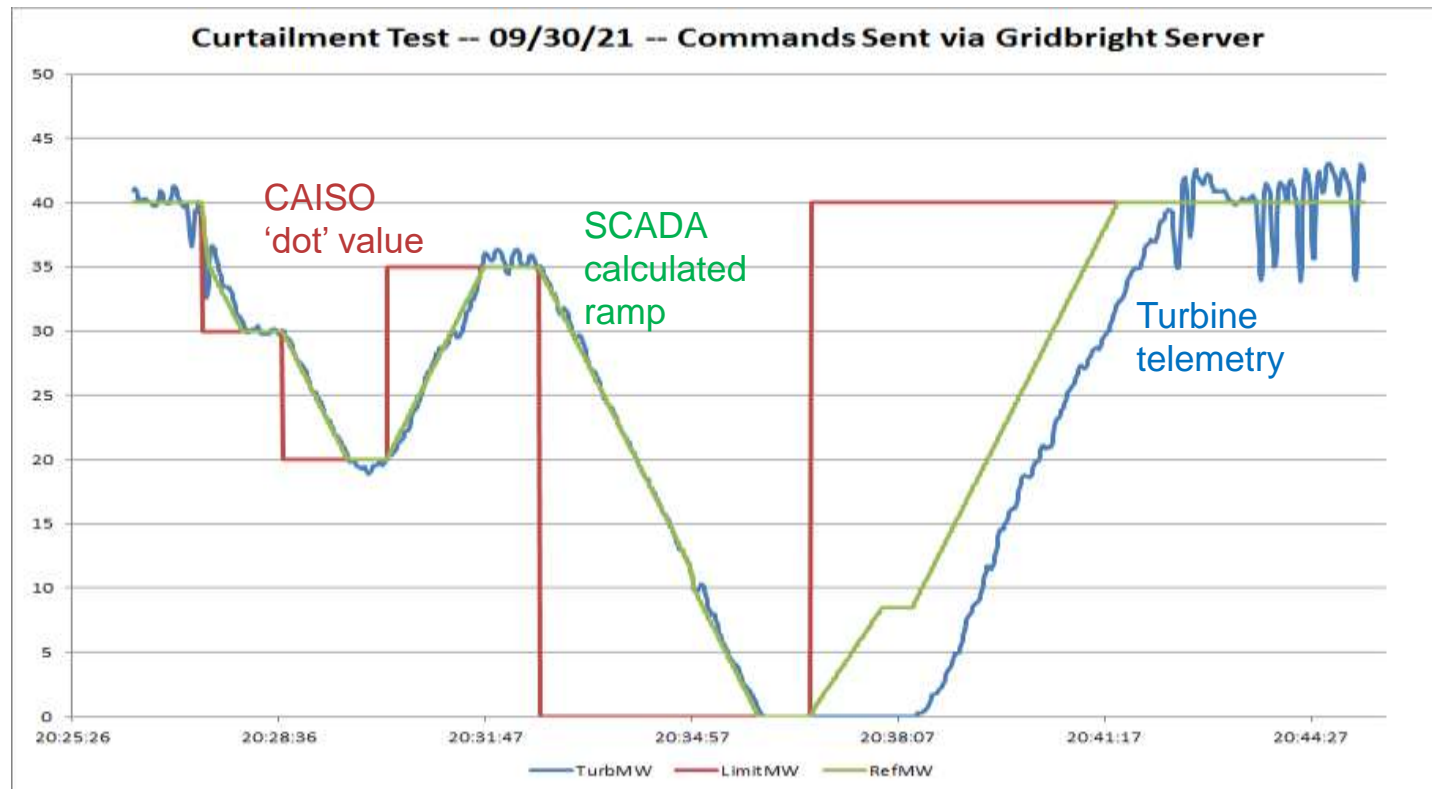
Batch Details | DISP-BABA7BC0-964F-4039-FFCB-AC15E26CC4D

- Batch UID: DISP-BABA7BC0-964F-4039-FFCB-AC15E26CC4D
- Market ID: 121061313
- Batch Status: Closed (3)
- Batch Type: 5 minute dispatchable (0)
- Dispatch Mode: 0
- Batch Received: 2021-05-13 19:31:34
- Batch Expires: 2021-05-13 19:31:34
- Batch Start Time: 2021-05-13 19:35:00
- Created At: 2021-05-13 19:35:02
- Updated At: 2021-05-13 19:35:02

**Batch Instruction - JSON Details**

- Batch Instruction | DISP-BABA7BC0-964F-4039-FFCB-AC15E26CC4D-96
- dst: 0.05
- srcFlag: 0
- srcOrder: 0.04
- minFlag: 0
- batchUID: DISP-BABA7BC0-964F-4039-FFCB-AC15E26CC4D
- bidDelay: 2
- hourlyFlow: 0.0
- acceptDet: 0.05
- startTime: 2021-05-13T19:37:30Z
- resourceId: R2WIND\_2\_WDSTRS
- statusCode: 0
- instructionUID: DISP-BABA7BC0-964F-4039-FFCB-AC15E26CC4D-960
- baseSchedule: 0.0
- passedKicker: RTE0
- revisionNumber: 0
- instructionType: 0

# 16 Turbine Curtailment Simulation





# Future Communications and Dispatch

Wind Stream's background and vision

Albert Davies

January 11, 2022

[www.windstreamproperties.com](http://www.windstreamproperties.com)

# Wind Stream Background



- Founded in 1981 by Zond Systems, Inc. including partners Al Davies and Bob Gates
- First commercial wind energy facility in Southern California Edison territory, about 900 acres
- One of large many developments by Zond, which became the largest wind energy developer in its day
- Zond started manufacturing in the 1990s, placing prototype turbines on Wind Stream
- Zond acquired by Enron in 1997

# Wind Stream Background



- Wind Stream re-acquired the development after Enron bankruptcy from GE, NextEra, Terra-Gen, and AES.
- Through Terra-Gen installed GE 1.7 MW and 2.85 MW turbines in 2014
- Wind Stream continues to operate about 30 MW of legacy turbines, ranging in size from 65 kW to 1.5 MW, about 250 turbines total

# Vision for future



- Current technology for communication and dispatch relies on varying user systems
- Motivation for information depends on contract terms and pricing methodology. This ranges from a) fixed price, all-in power sales agreement to b) real time price, separate transactions for Renewable Energy Credits, Resource Adequacy, and federal wind energy Production Tax Credits
- Shift to cloud based system can increase security, standardize interface, and reduce cost when fully implemented



# ZGlobal Inc.

## Cloud-Based Data Access

## Scheduling Coordinator Perspective



# Consolidated Data Sources

1. CAISO data
  - a. CMRI – Customer Market Results Interface
  - b. MRI-S – Market Results Interface Settlements (meter data)
  - c. ADS – Automated Dispatch System
2. Plant Information System (PI)
  - i. Near Real-Time Plant Data

# Aggregated Facilities (DER)

1. Multiple Facilities Aggregated to Allow CAISO Interface
  - a. Difference between utility scale and customer scale
  - b. Utility scale solution is cost prohibitive for customer scale
  - c. Functional application – interface with physical meters vs virtual meters



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# Renewable Dispatch - In the Cloud

Peter Klauer  
Senior Advisor Smart Grid Technology

1/11/22

## California ISO

Within its balancing authority area, the California ISO:

- Maintains reliability on the grid
- Manages the flow of energy
- Oversees the transmission planning process
- Operates the wholesale electric market

For much of the western U.S., the ISO:

- Operates the Western Energy Imbalance Market (EIM)
- Serves as Reliability Coordinator (RC West)



# Secure Resource Integration

## California ISO Perspective

- Federal regulatory efforts are opening wholesale markets to DER under FERC Order 2222
- California is on the leading edge of DER proliferation
- Advanced hybrid resource configurations
- The need for secure, cost efficient information exchange solutions to support dynamic and complex use cases is increasing
- The California ISO supports solutions such as SGDX which can enable secure, reliable, and cost effective grid resource integration at both distribution and transmission levels

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Please jump on and ask any follow up questions we may not have gotten to during our webinar. We'd love to engage in some discussion after the webinar.

See you at the BetterGrids Forum!

We also hope to see you at our next webinar!



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