Solar Analytics: Changing the World One Solar Panel at a Time (IOT2026)

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A Few of My Data Points

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2, 9, 4, 20

What I'll Enlighten You With

Solar 101

Building a Splunk add-on for REST API endpoints

Splunk metrics and event to metric conversions

Splunk IoT common information model (CIM)

Leverage Splunk Industrial Asset Intelligence (IAI)

Leverage the Splunk Essentials app for Industrial Control Systems (ICS)

Solar analytics solution

Solar 101

A beginner’s guide to some things photovoltaic (PV)

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Every hour the sun beams more energy onto Earth than it needs to satisfy global energy needs for an **entire year.**

National Geographic

Understanding Solar Energy Terms

A watt (W) is a unit of **power**, and power is the rate at which energy is produced or consumed.

A watt-hour (Wh) is a unit of **energy**, and it's a way to measure the amount of work performed or generated.

100W

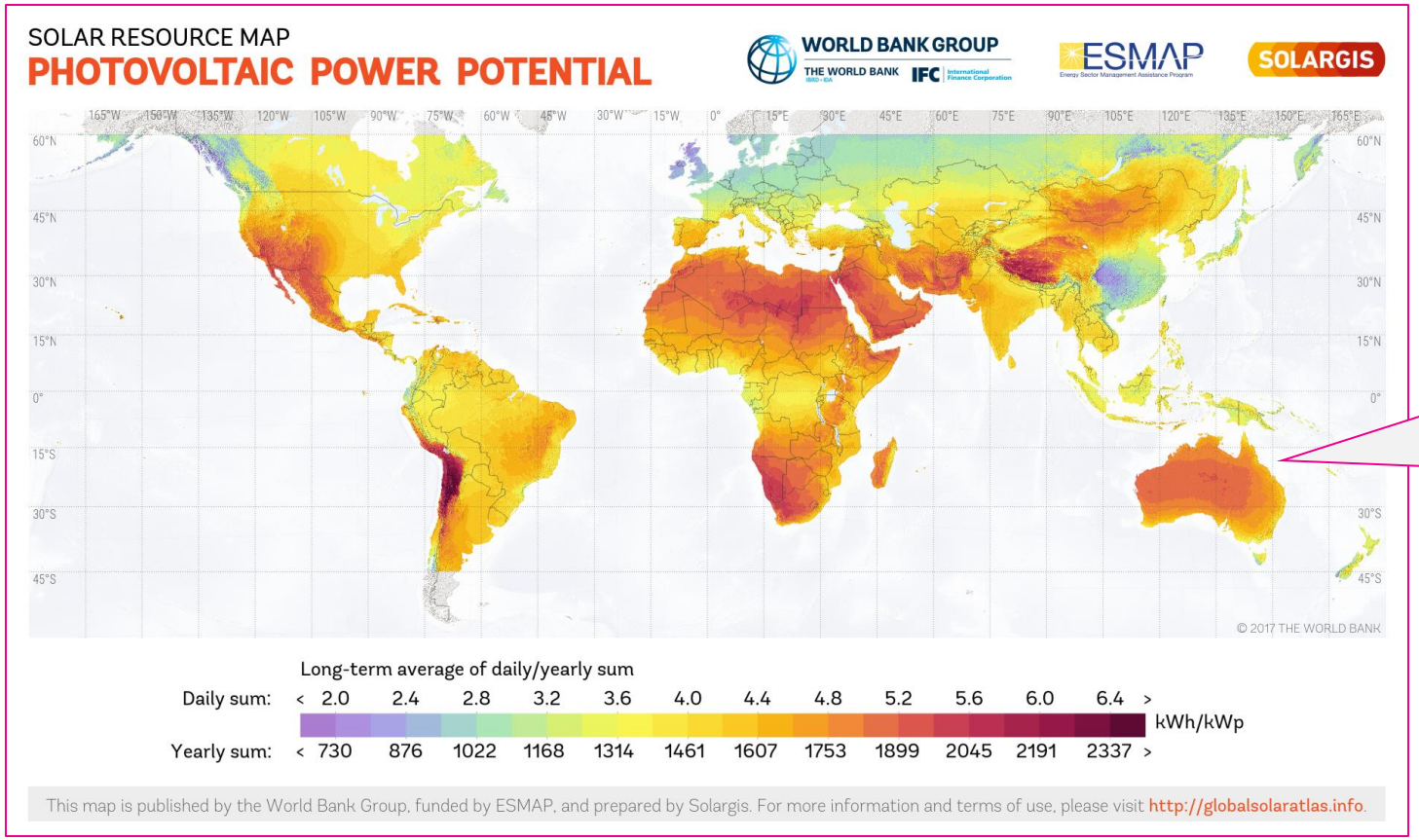
Power

24h

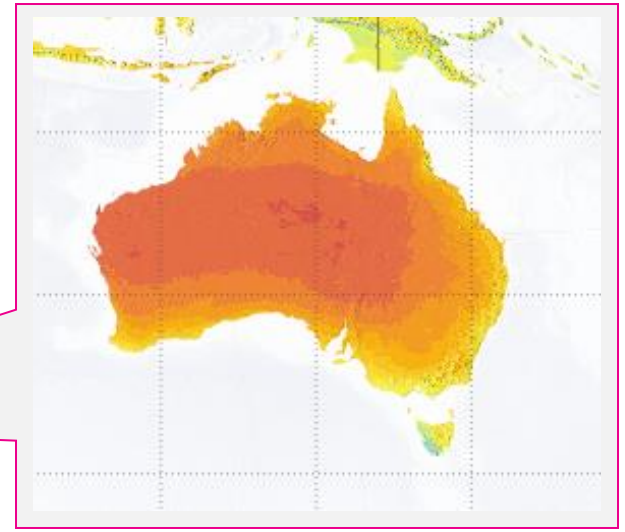
2400Wh

Energy

World Solar Energy Potential



Average home uses about **23 kWh** per day



About **4kWh** per day per square meter!

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Acting Locally: My Energy Solution

48 x LG Neon 2 Black (330W) solar panels
48 x Enphase microinverters (S270 + iQ7+)
2 x Tesla PowerWalls (gen2)

LG Solar

enphase ENERGY

POWERWALL
TESLA HOME BATTERY

End to End Photovoltaics

LG Solar

15,840W

DC Power

enphase ENERGY

12,800W

AC Power

900/1hr

CO²

67kg

POWERWALL

TESLA HOME BATTERY

27kWh

AC Energy

Energy Production

Up to 90kWh/day
1kWh/m2

Energy Storage

Getting Data In

Building A REST API Add-On

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Getting Data In

- Solar production per panel
- Metering (not used)

[e] enphase ENERGY

API Local API

API Cloud API

REST Poll

- Solar production
- Battery usage
- Grid usage
- Site (home) usage

TESLA

API Local API

API Cloud API

REST Poll

Tesla Energy Gateway API


```
{"site":{"last_communication_time":"2019-09-
09T02:32:17.791073608+10:00","instant_power":22,"instant_reactive_power":-1225,"instant_appa
nergy_imported":1020457,"instant_average_voltage":409.30092633660144,"instant_total_current"
"battery":{"last_communication_time":"2019-09-
09T02:32:17.790629134+10:00","instant_power":540,"instant_reactive_power":0,"instant_apparen
ergy_imported":4804700,"instant_average_voltage":235.55,"instant_total_current":-14.4,"i_a_c
{"last_communication_time":"2019-09-
09T02:32:17.790095791+10:00","instant_power":602.3566676679201,"instant_reactive_power":-715
nergy_exported":0,"energy_imported":15404576.745833335,"instant_average_voltage":409.3009263
urrent":0,"i_c_current":0,"timeout":1500000000},"solar":{"last_communication_time":"2019-09-
09T02:32:17.790095791+10:00","instant_power":49.82892608642578,"instant_reactive_power":488.
95012283325195,"energy_exported":17624819.074166667,"energy_imported":15.328333331909445,"in
current":0,"i_b_current":0,"i_c_current":0,"timeout":1500000000}}
```


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Splunk Add-On Builder

On Splunkbase (free)

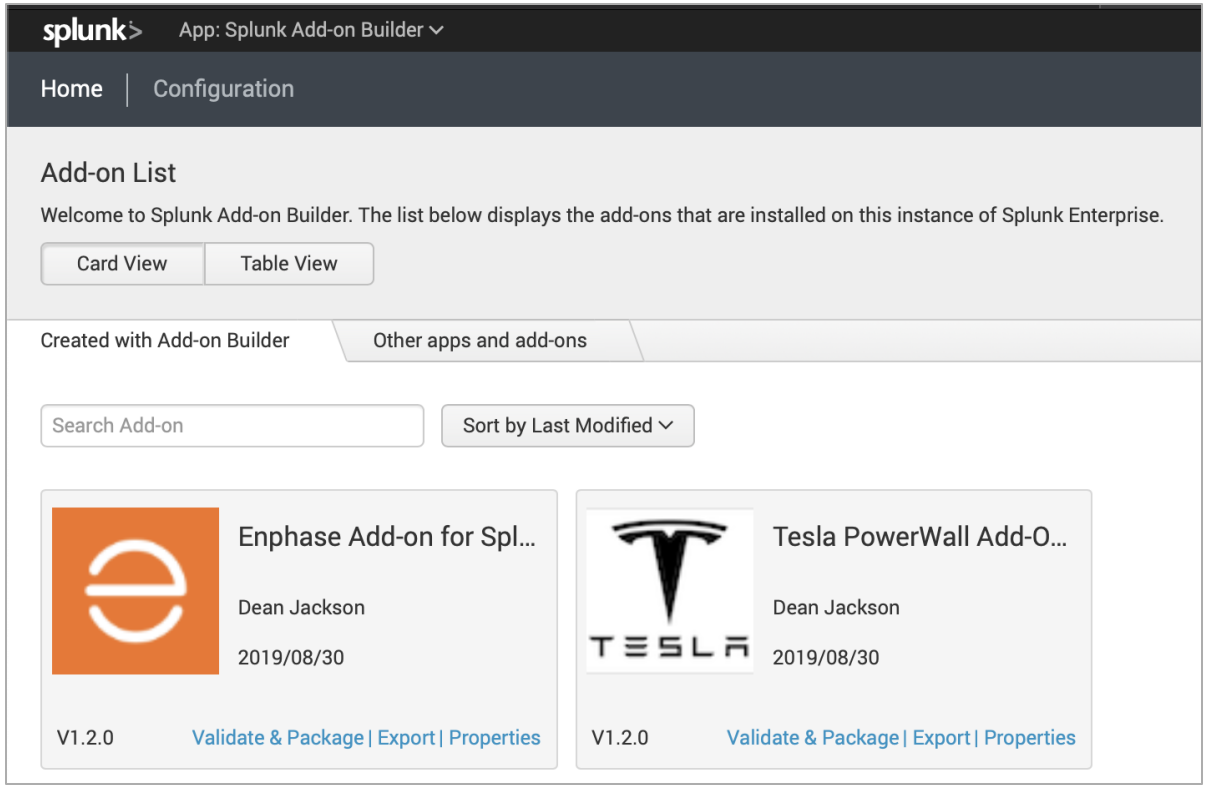
Guide you through all of the necessary steps of creating an add-on

Maintain CIM compliance

Maintain quality of add-ons

Validate and test the add-on

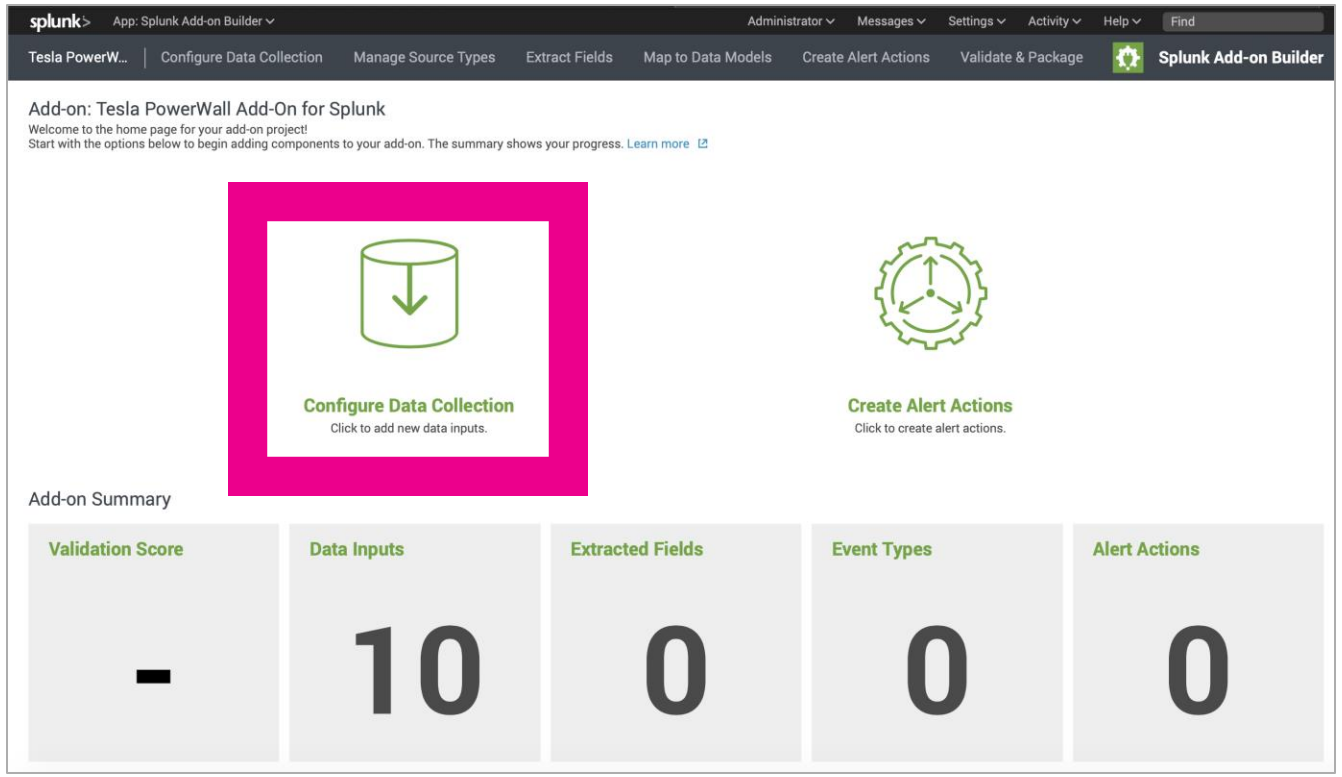
Also does alert actions!



Splunk Add-On Builder

Create new add-on

Configure data collection



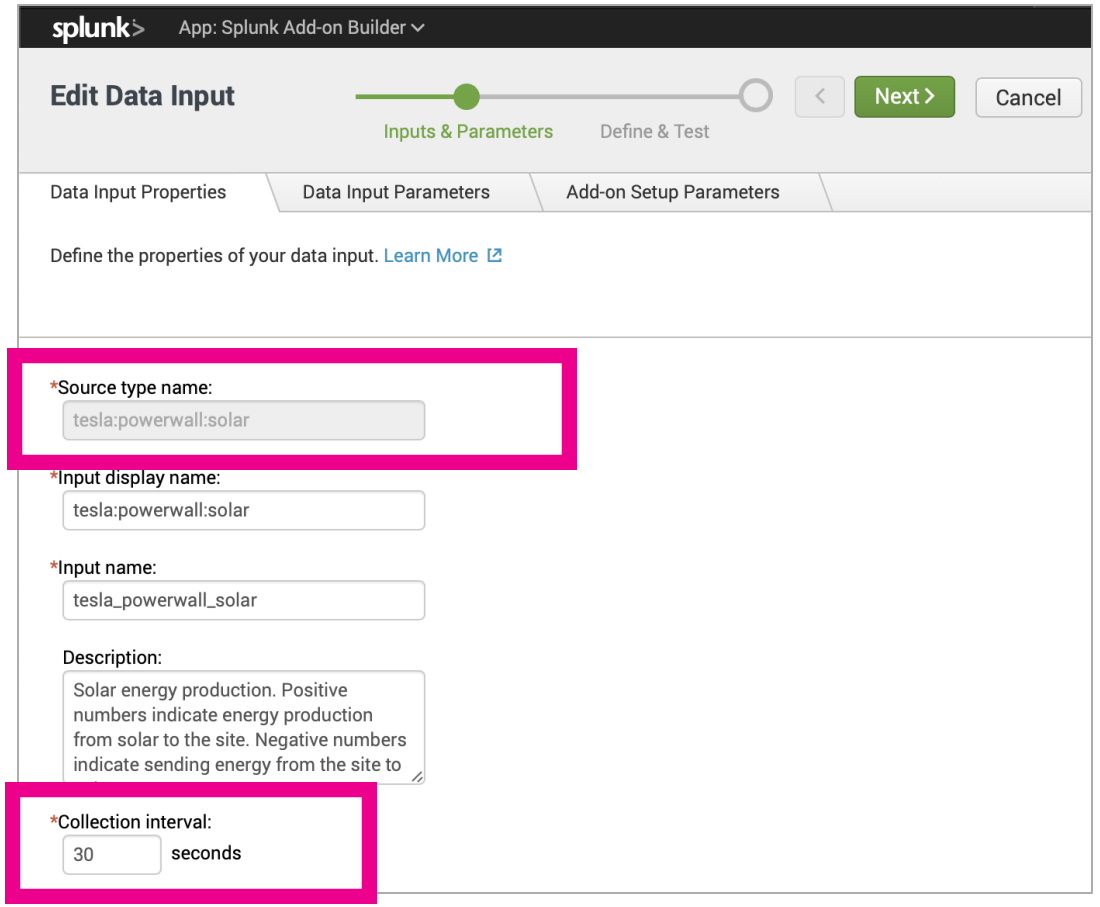
Splunk Add-On Builder

Specify sourcetype

Give it a description

Set a default interval for collection

Also supports basic auth if required



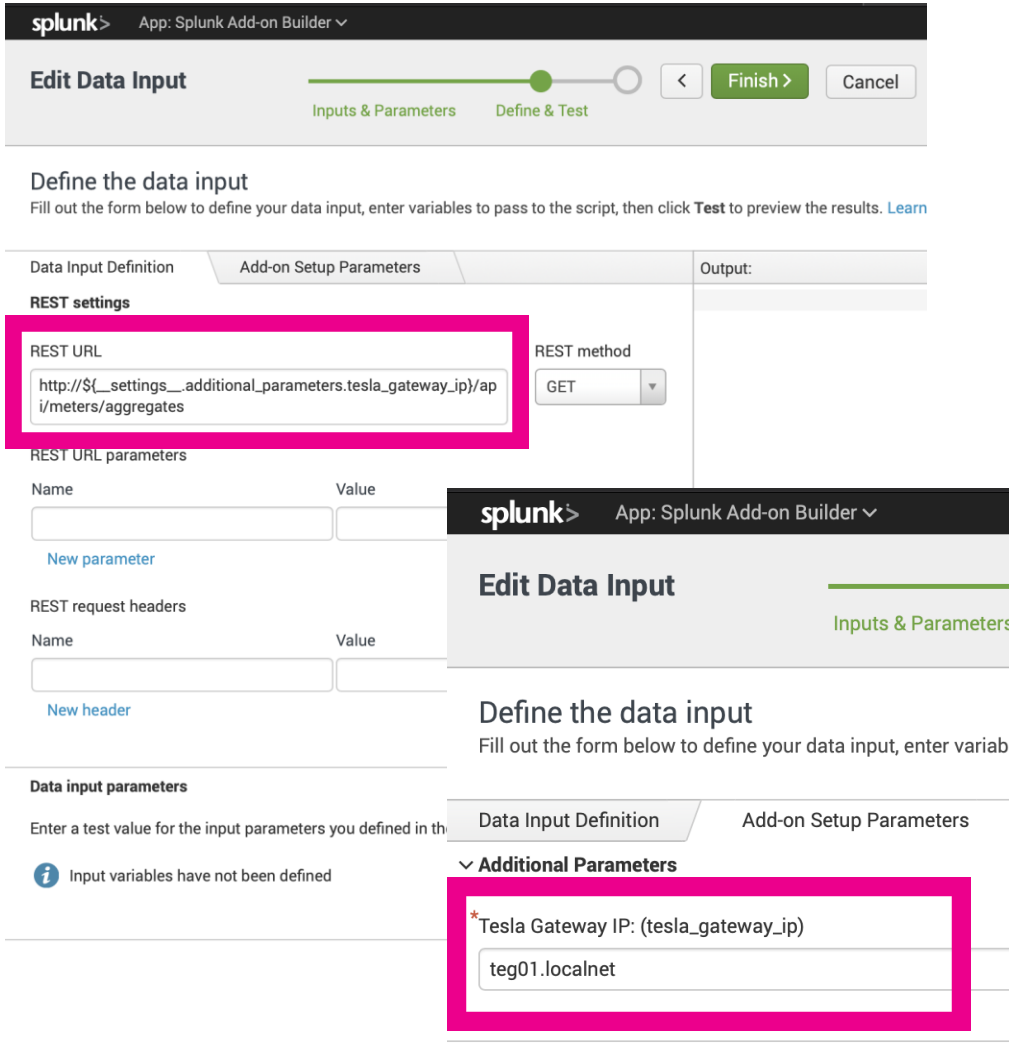
Splunk Add-On Builder

Specify REST URL

Can use variables, set in add-on setup parameters

Variable format is:
`${__settings__.additional_parameters.tesla_gateway_ip}`

Purpose is to setup once

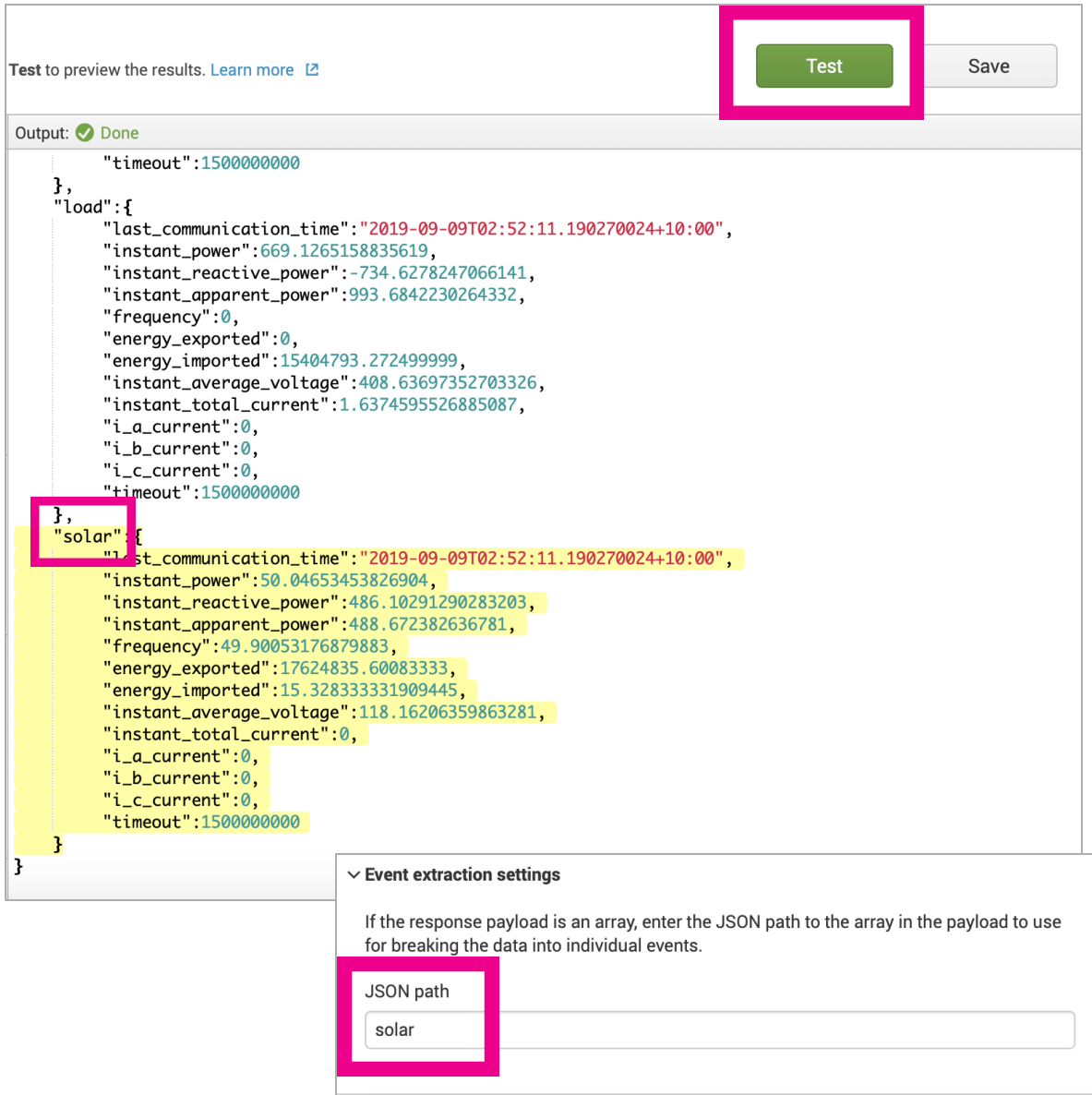


Splunk Add-On Builder

Click test

Notice there are JSON path extraction capabilities

Have a look at user guide on docs.splunk.com for details

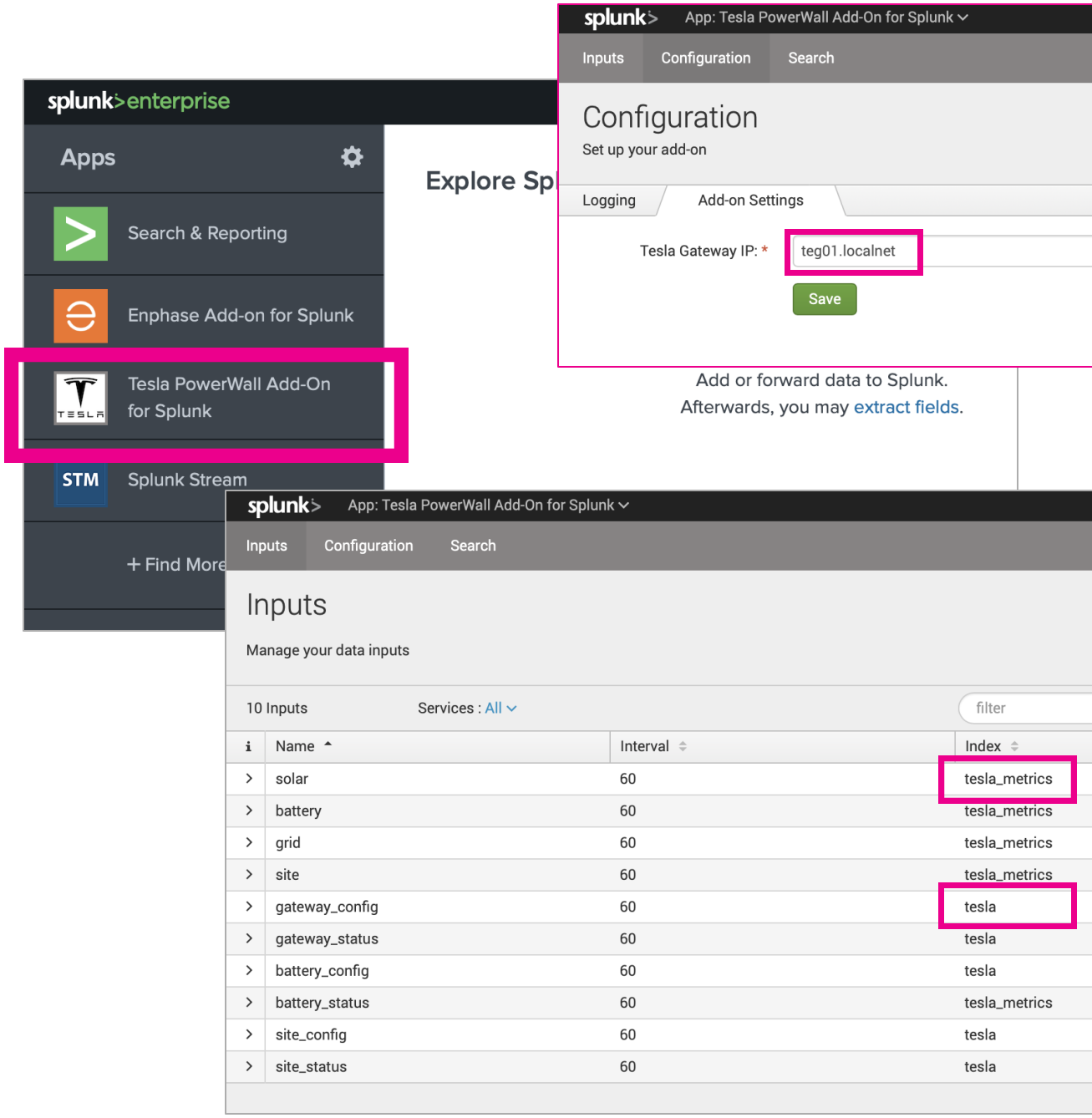


Deploy Add-on

Install on Splunk HF

Enter IP address of Tesla Energy Gateway

Set inputs indexes and intervals



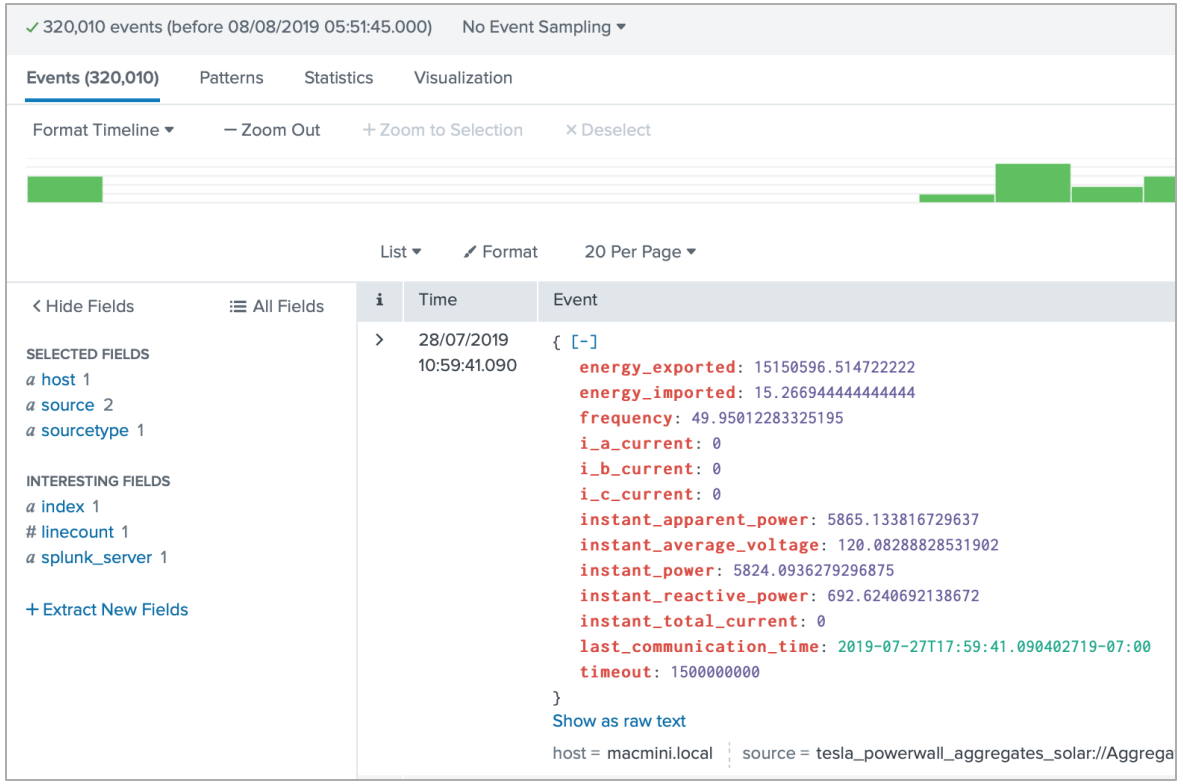
Data Ingested!

JSON format

Awesome data but these are all numeric values

And we don't need all these

Let's be efficient!!



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Metrics vs. Events

So many choices!

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Events vs. Metrics

An Event…

Single, multiline, different formats

Historically log data payload

Typically used for root cause and analysis

What we are used to in Splunk

Event

{ [-]
  energy_exported: 15150596.514722222
  energy_imported: 15.266944444444444
  frequency: 49.95012283325195
  i_a_current: 0
  i_b_current: 0
  i_c_current: 0
  instant_apparent_power: 5865.133816729637
  instant_average_voltage: 120.08288828531902
  instant_power: 5824.0936279296875
  instant_reactive_power: 692.6240692138672
  instant_total_current: 0
  last_communication_time: 2019-07-27T17:59:41
  timeout: 1500000000
}

Show as raw text

host = macmini.local | source = tesla_powerwa

Metrics vs. Events

A Metric…

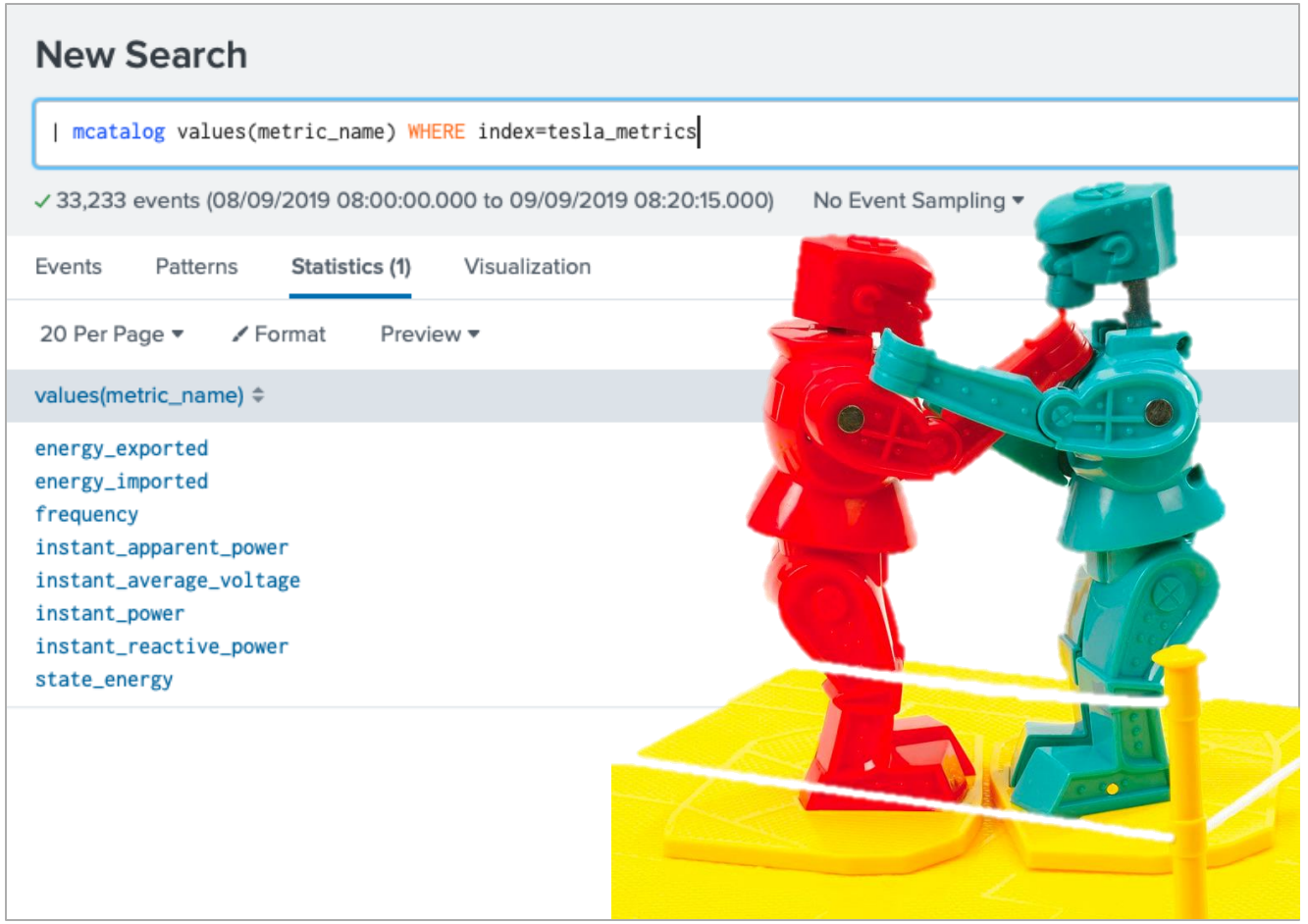
Contains:

- `Metric_name`
- `_time`
- `_value`
- `dimension`

Lightweight, numeric

SUPER FAST ☺

Used to support statistical analysis



Metrics Requirements

Supported Splunk 7.0+

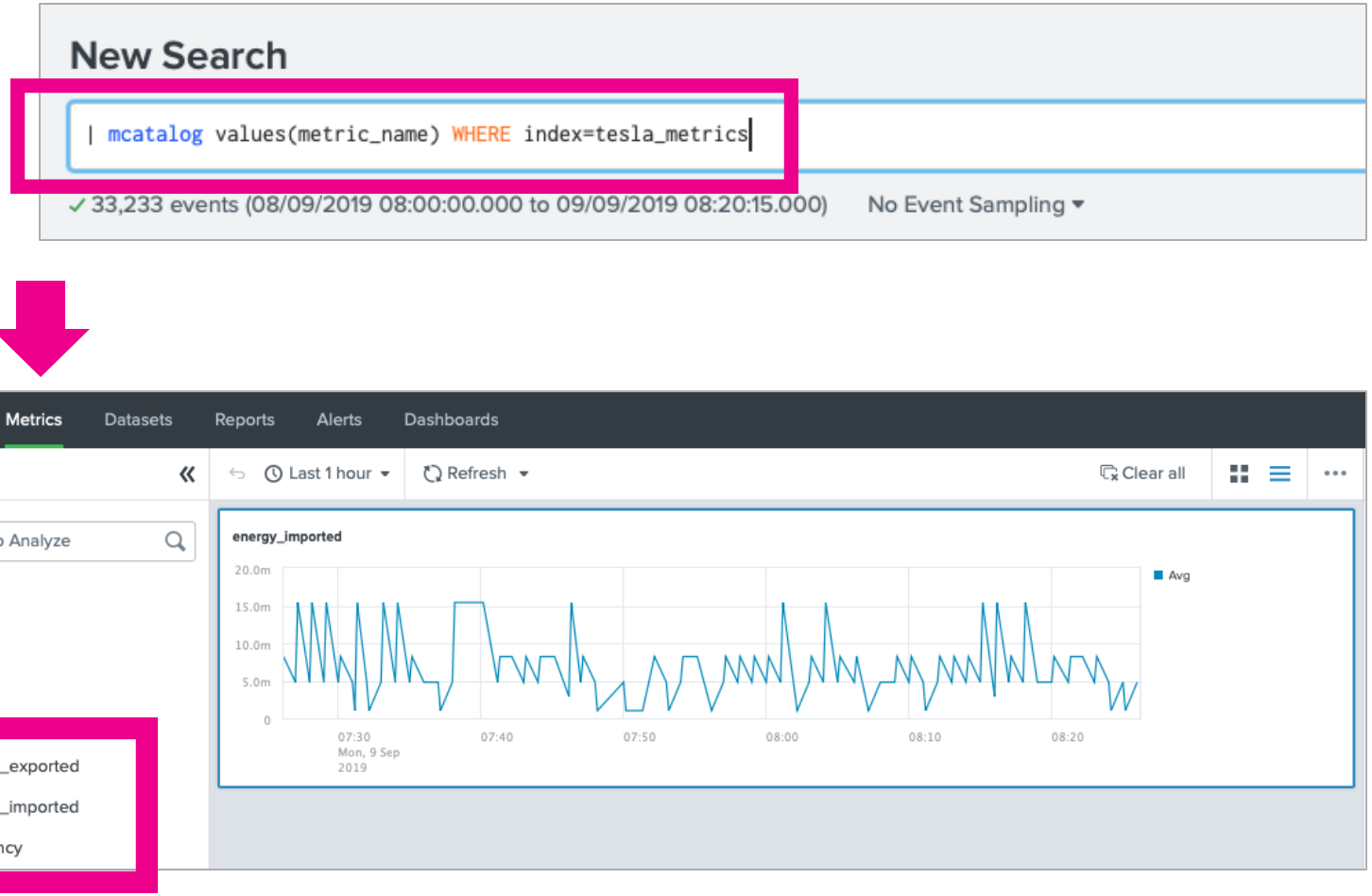
Require a metrics index

For ingest time log to metrics, require 7.2+

Forwarder version and type	Type of data	Indexer version required	Location of log-to-metrics configuration files
7.2+ Universal Forwarder	Structured	7.x	Universal Forwarder
Any Universal Forwarder version	Unstructured	7.2+	Indexer
7.2+ Heavy Forwarder	Structured	7.x	Heavy Forwarder
7.2+ Heavy Forwarder	Unstructured	7.x	Heavy Forwarder

Did You Know…

There's a **metric workspace** in Splunk, it was an app, now embedded in search and reporting as of 7.3



Did You Also Know…

Licensing was previously calculated at 150 bytes per metric

Licensing in 7.3+ is calculated based on ingestion and capped at 150 bytes

How data is metered

For **event data**, data volume is based on the amount of raw external data that the indexer ingests into its indexing pipeline, after any filtering. It is not based on the amount of compressed data that gets written to disk.

For **metrics data**, each metric event is metered by volume on a scale similar to the scale used for event data. However, this scale is capped at 150 bytes. Metric events with volumes over 150 bytes are metered as if they are only 150 bytes. Metrics data does not use a separate license. Rather, it draws from the same license quota as event data.

Summary indexing and metric rollup summaries do not count against your license. Internal indexes, such as `_internal` and `_introspection`, also do not count against your license.

https://docs.splunk.com/Documentation/Splunk/7.3.1/Admin/HowSplunklicensingworks

Event to Metric Conversion

Only need a few values

There are all numerical and will be used with stats (mstats)

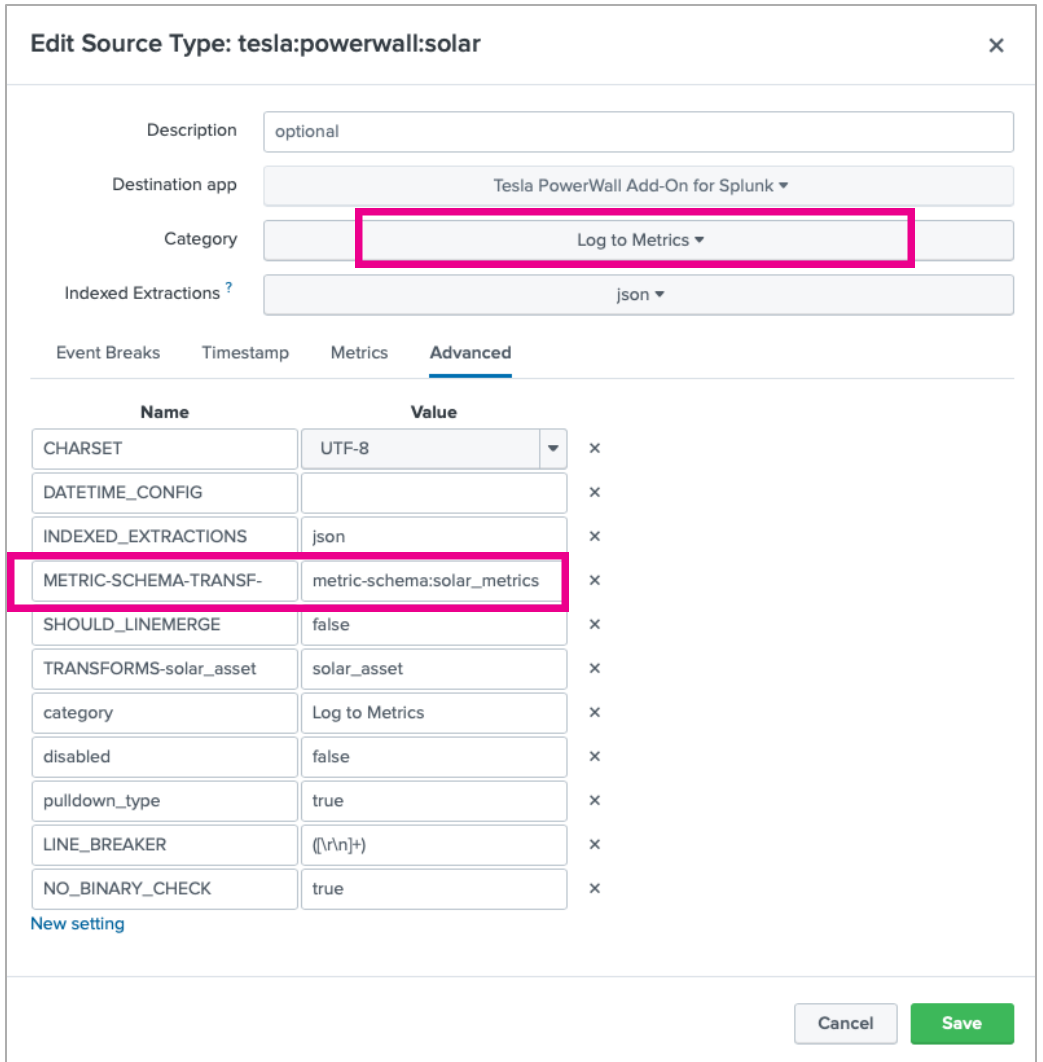
Done at Splunk forwarder (UF or HF)

Event

{ [-]
  energy_exported: 15150596.514722222
  energy_imported: 15.266944444444444
  frequency: 49.95012283325195
  i_a_current: 0
  i_b_current: 0
  i_c_current: 0
  instant_apparent_power: 5865.133816729637
  instant_average_voltage: 120.08288828531902
  instant_power: 5824.0936279296875
  instant_reactive_power: 692.6240692138672
  instant_total_current: 0
  last_communication_time: 2019-07-27T17:59:41.090402719-07:00
  timeout: 1500000000
}

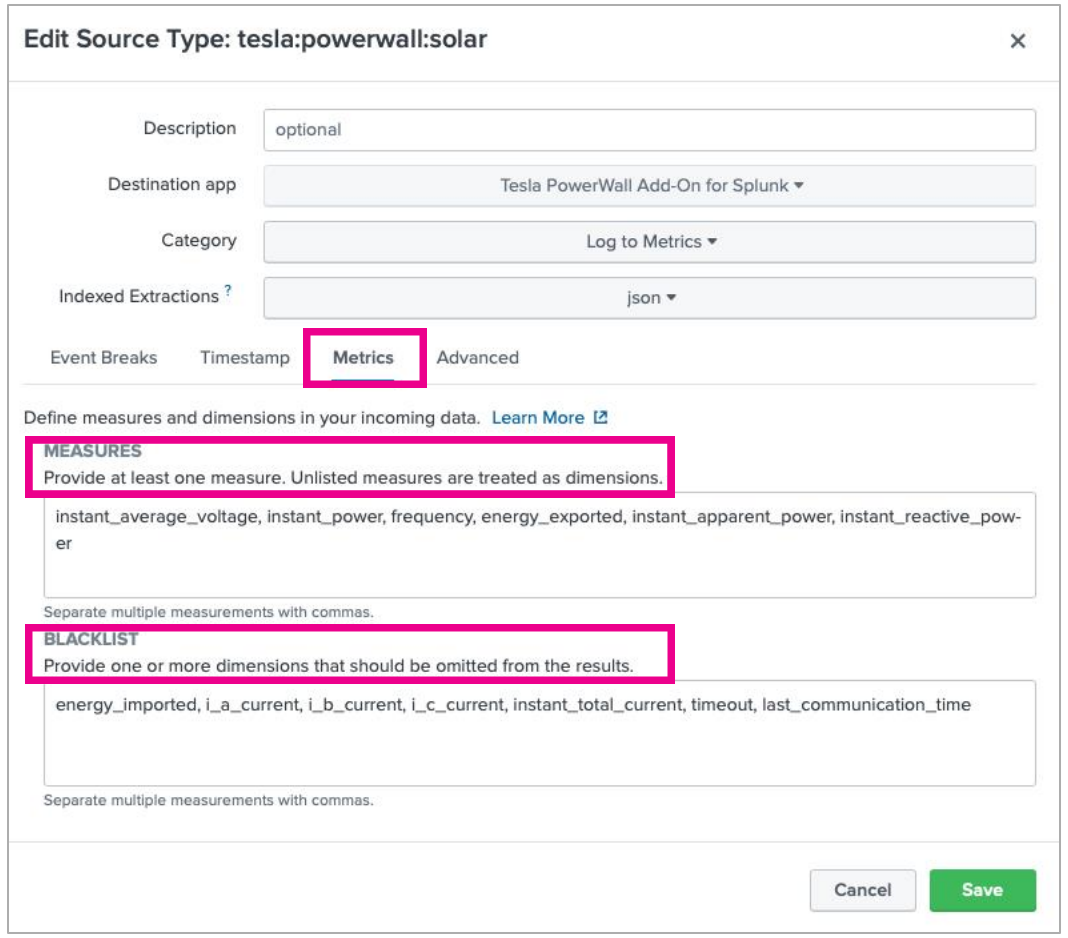
Show as raw text

Event to Metric Conversion: Splunk Web



Measures

Blacklist



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Event to Metric Conversion: Conf Files

Props.conf

```
[tesla:powerwall:solar]
SHOULD_LINEMERGE = 0
category = Energy
pulldown_type = 1
INDEXED_EXTRACTIONS = json
TRANSFORMS-solar_asset = solar_asset
METRIC-SCHEMA-TRANSFORMS = metric-schema:solar_metrics
```

Call transforms

Transforms.conf

```
[metric-schema:solar_metrics]

METRIC-SCHEMA-BLACKLIST-DIMS = energy_imported, i_a_current,
i_b_current, i_c_current, instant_total_current, timeout,
last_communication_time

METRIC-SCHEMA-MEASURES = instant_average_voltage, instant_power,
frequency, energy_exported, instant_apparent_power,
instant_reactive_power
```

Ignore

Metric Name(s)

Bonus!! – Adding Dimensions

Props.conf

```
[tesla:powerwall:solar]
SHOULD_LINEMERGE = 0
category = Energy
pulldown_type = 1
INDEXED_EXTRACTIONS = json
TRANSFORMS-solar_asset = solar_asset
METRIC-SCHEMA-TRANSFORMS = metric-schema:solar_metrics
```

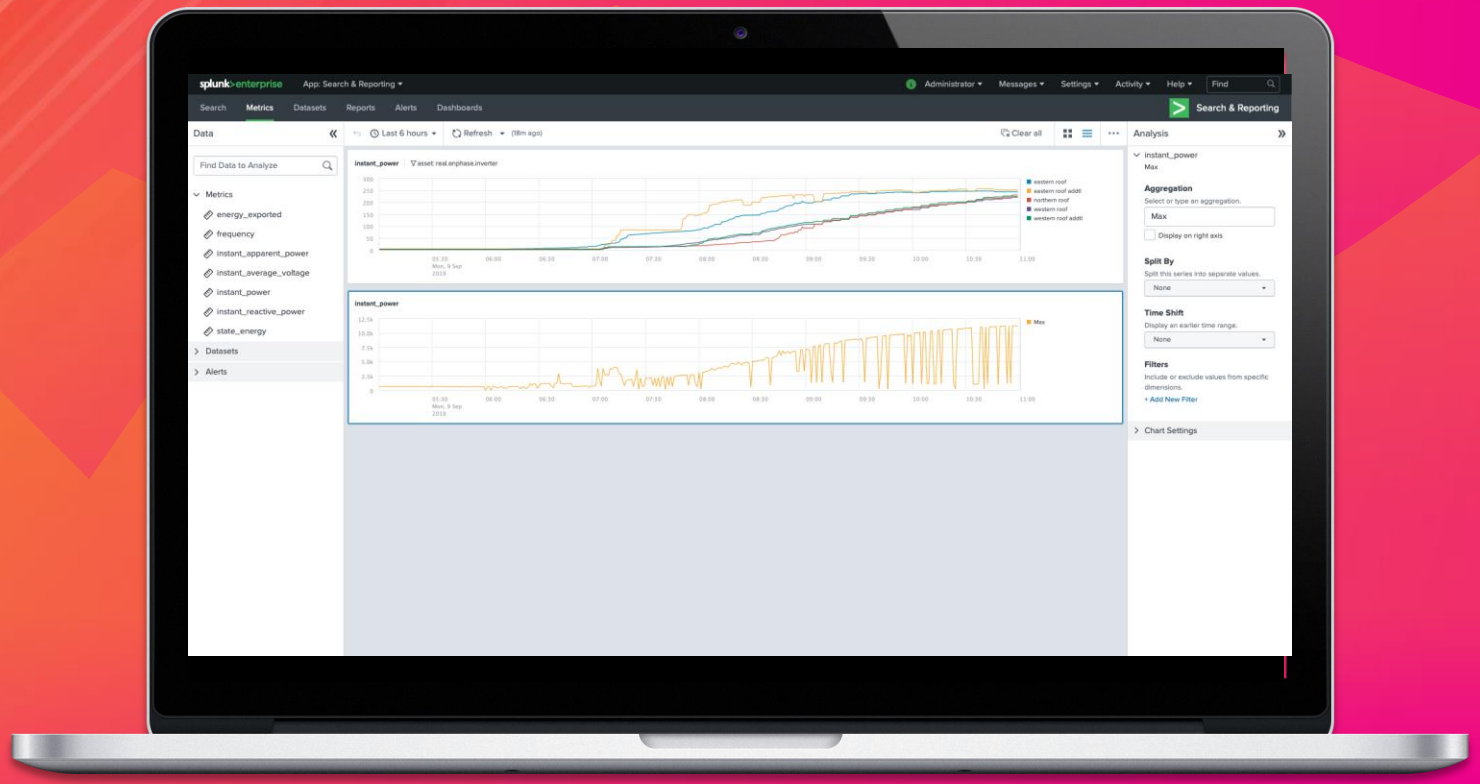
Call transforms

Transforms.conf

```
[solar_asset]
INGEST_EVAL = asset="powerwall.solar", category="solar",
location="real"
```

Dimensions

Demo:
How To Browse Metrics



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Splunk IAI

Monitor and investigate Metric Data

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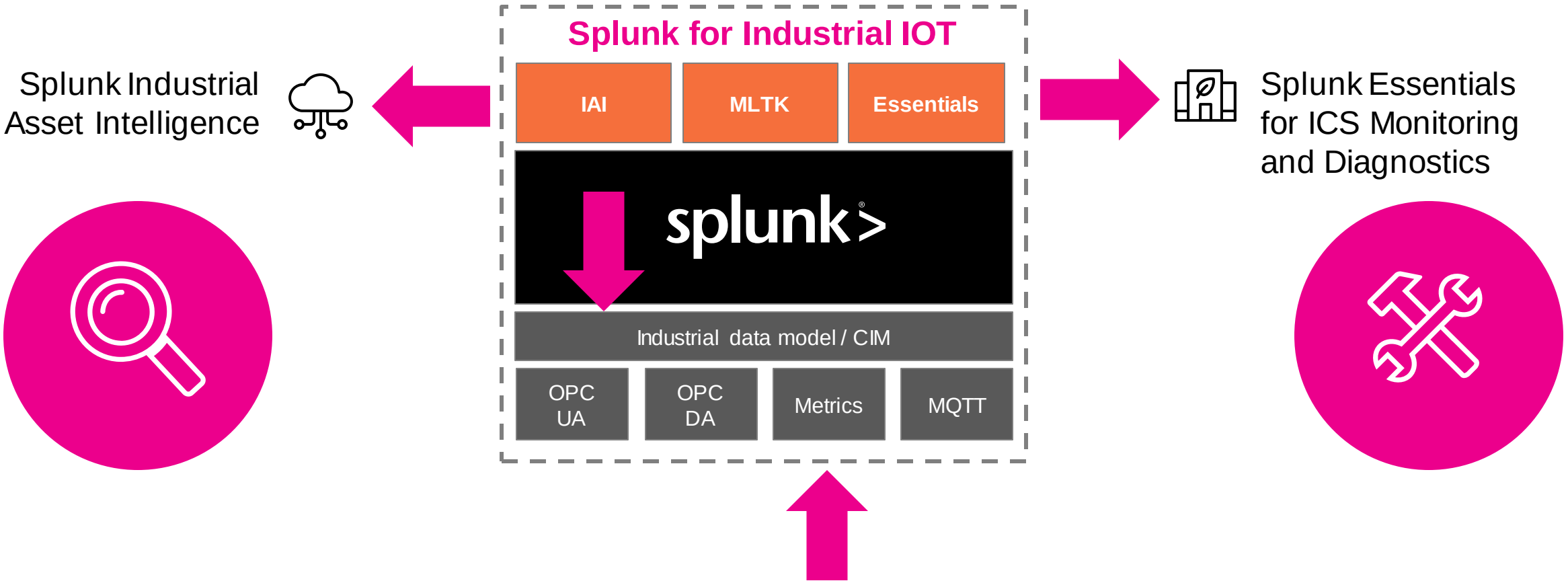
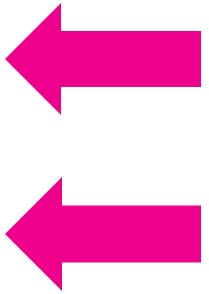
Using Splunk for Industrial IoT Suite



Splunk IoT Common Information Model

Field	Type	Required?	Description
_time	time	Required field for all metrics data.	The timestamp of the metric in UNIX time notation.
_value	string	Required field for all metrics data.	The numeric value of the metric. This field is a 64-bit floating point number, which supports precision between 15 and 17 decimal digits.
metric_name	string	Required field for all metrics data.	The name of the metric. In Splunk IAI, the metric_name must not contain dot notation.
asset	string	Required dimension field for IAI.	Represents the name of the asset, device, or sensor that is generating or monitoring the metric. To facilitate data association in Splunk IAI, you can use dot notation to describe the full path to the asset as defined by your asset hierarchy, but this is not required.
quality	string	Optional dimension field for IAI.	Quality associated with the generated metric.
metric_type	string	Optional dimension field for IAI.	Type of metric. Defaults to "gauge", the only supported type of metric.
status	string	Optional dimension field for IAI.	Captures the status of the asset when the metric was generated.
unit	string	Optional dimension field for IAI.	Unit of the metric.



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Energy Data in IAI

Asset Hierarchy

L0	L1
powerwall	grid
powerwall	site
powerwall	battery
powerwall	solar

POWERWALL
TESLA HOME BATTERY

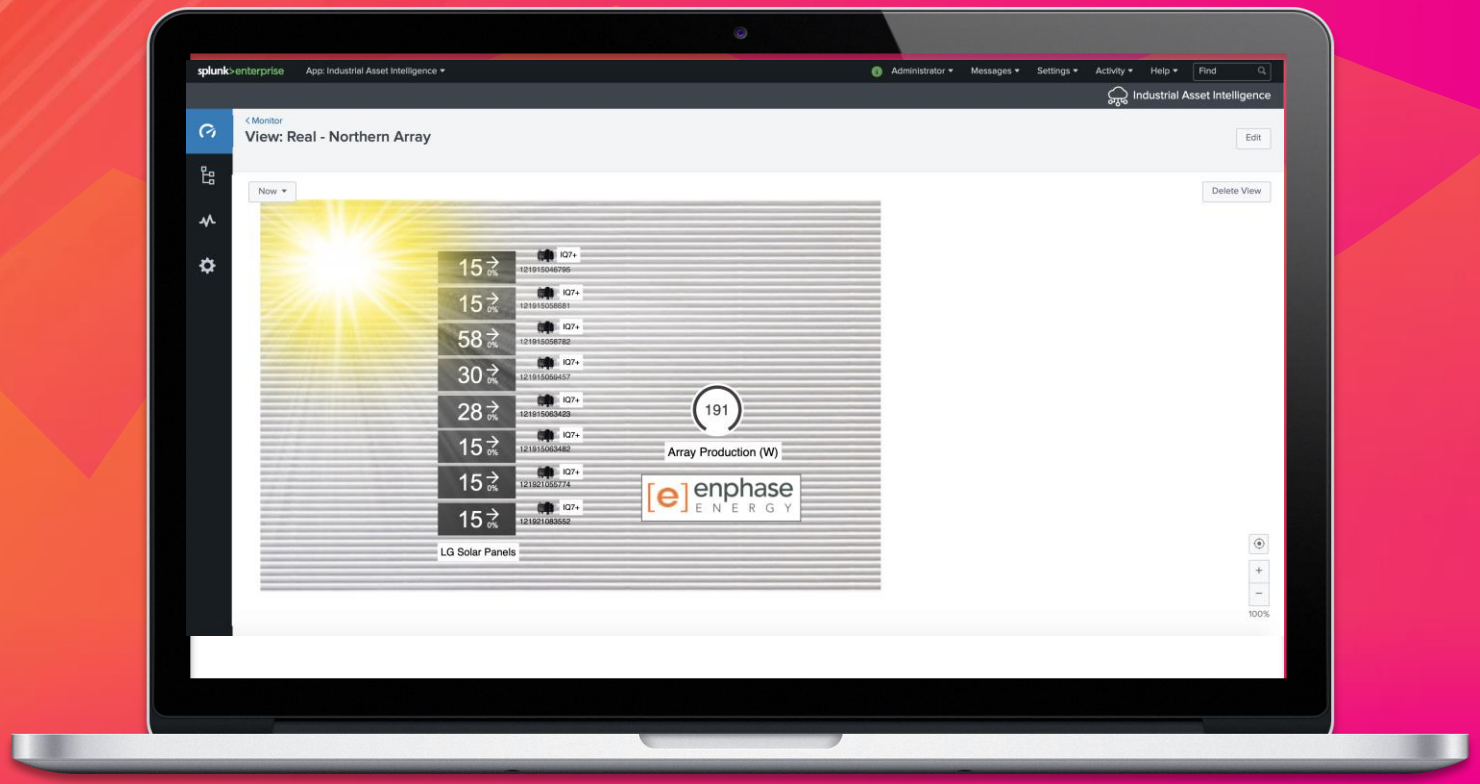
```
Metric_name: instant_power
Location: real
Asset: powerwall.solar
Category: solar (battery, grid, site)
```

L0	L1
enphase	inverter

[e] enphase ENERGY

```
Metric_name: instant_power
Location: real
Asset: enphase.inverter
Category: inverter
Serial: 121813038357
Solar_array: western roof
```

Demo:
Monitor and Alert with IAI



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Splunk ICS Essentials

Help with use cases

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Splunk Essentials For Industrial IoT

Splunk Essential for Predictive Maintenance

- Created for maintenance reliability leaders and engineers who are looking for ways to improve and optimize their current preventive maintenance program.

Splunk Essentials for ICS Security and Compliance

- Designed to help you gain a clearer understanding of the impact of security incidents on Industrial Control Systems.

Splunk Essentials for ICS Monitoring and Diagnostics

- Provides common use cases relevant to ICS environments to enhance or augment current vendor tools.

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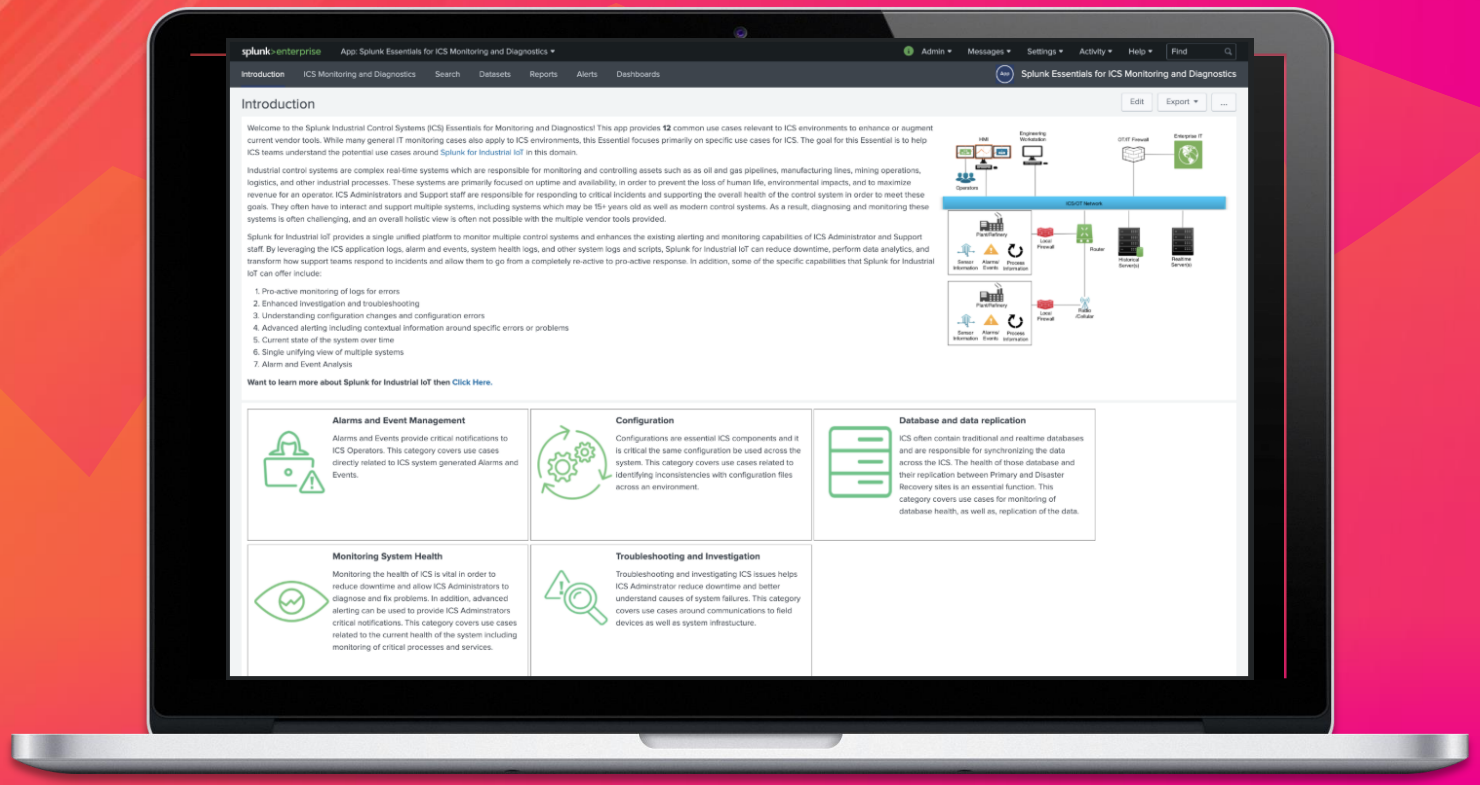
Demo:
Leveraging ICS Essentials



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Solar Analytics

It Will Never Be Finished ☺

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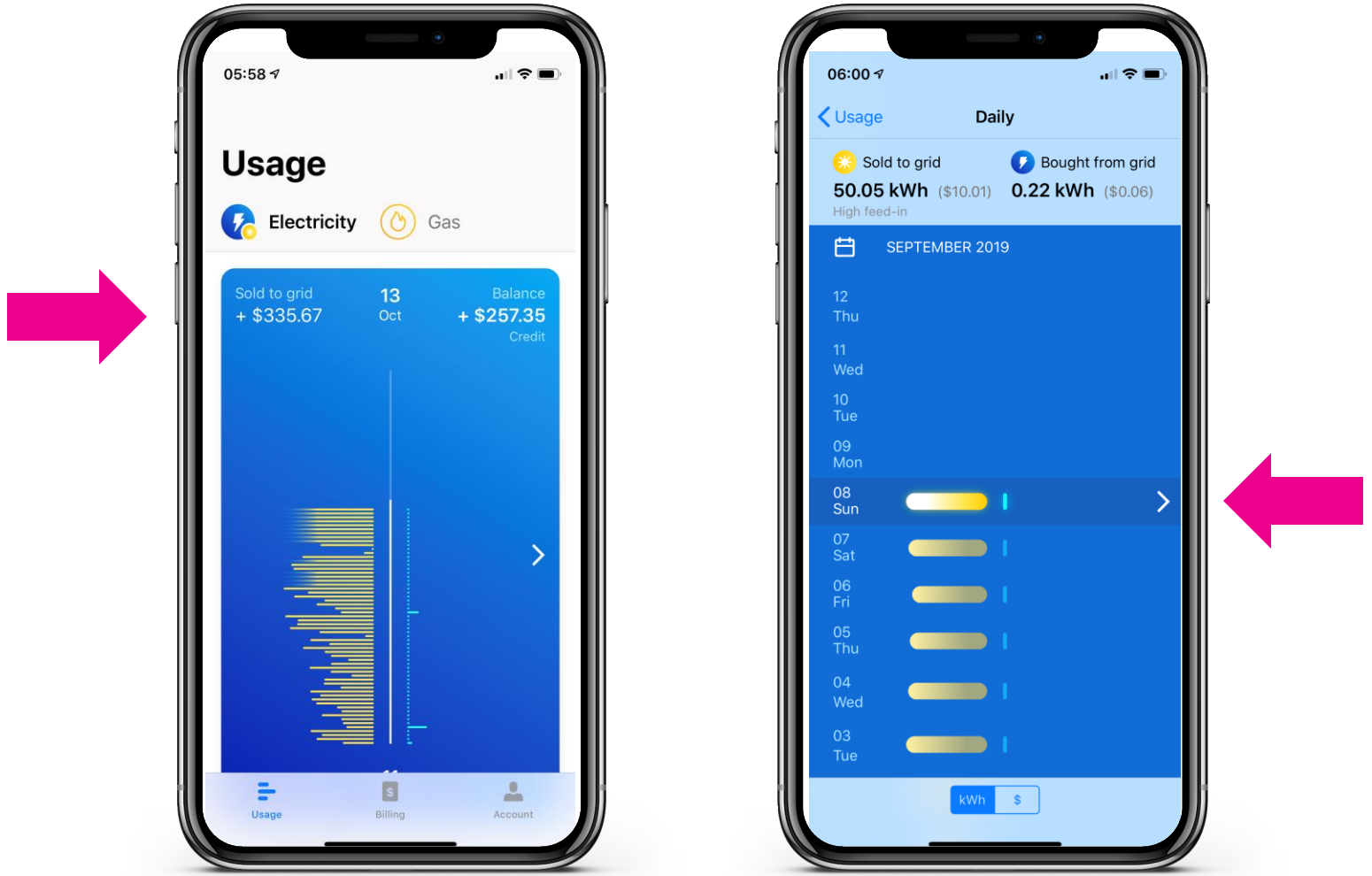
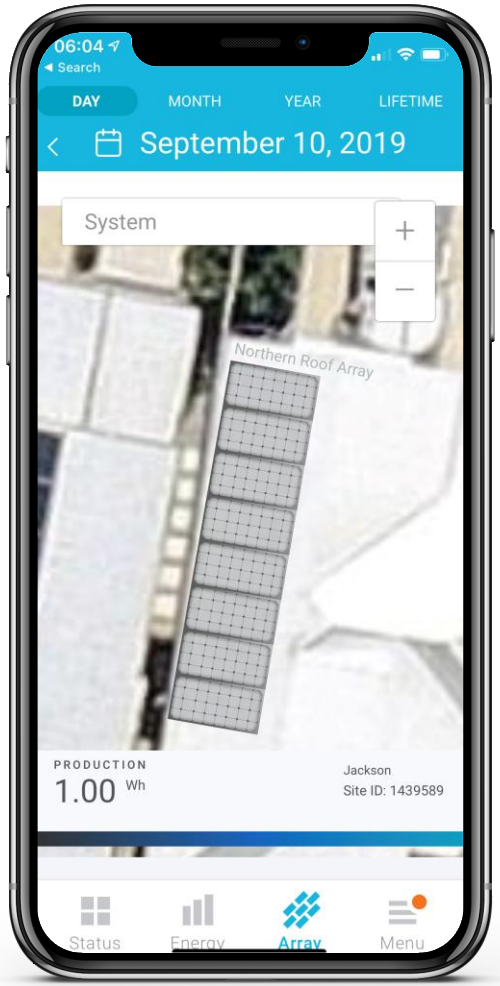
Calculating Costs, ROI, CO2



Viewing Data Across Many Platforms

POWERWALL
TESLA HOME BATTERY



[e] enphase ENERGY

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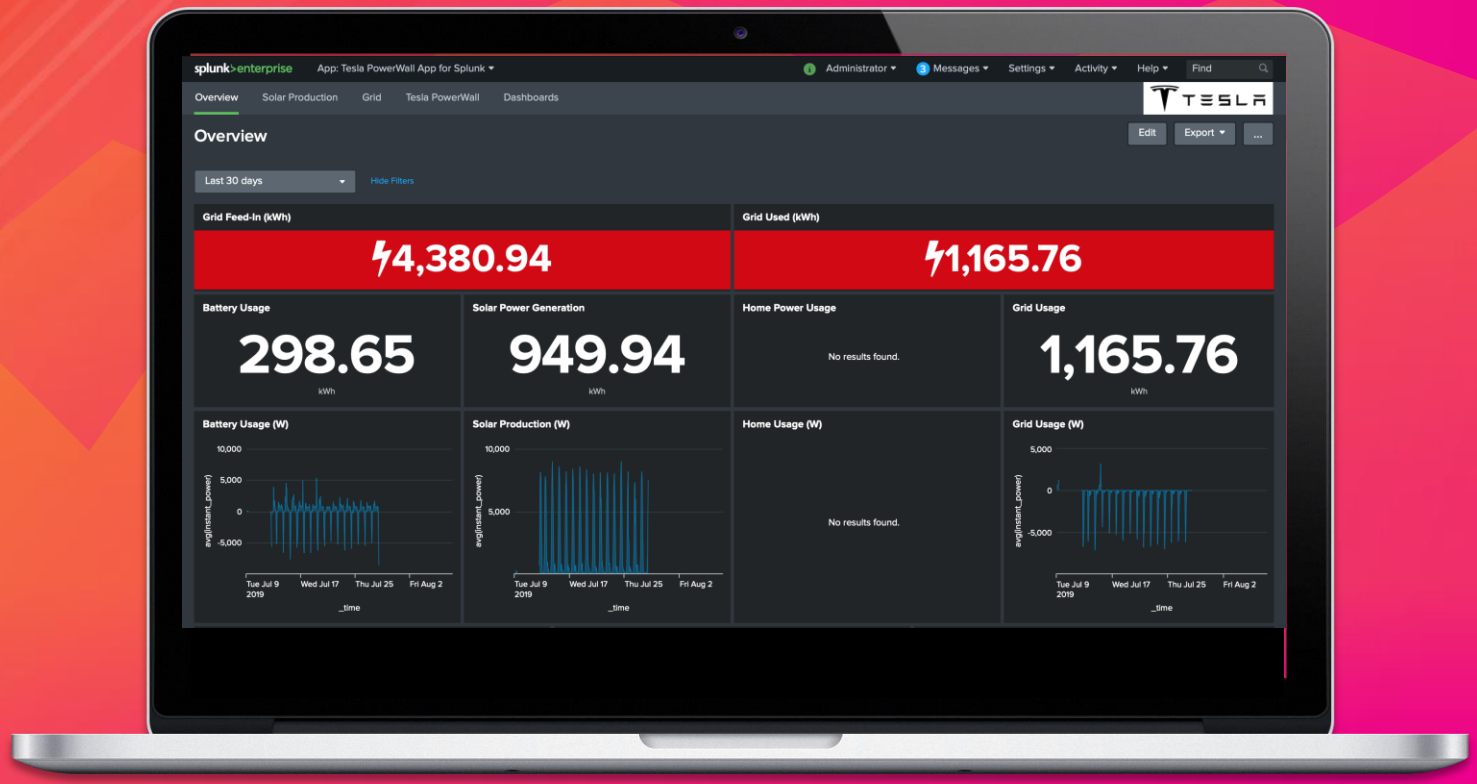
Demo:
Putting It All Together



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Were You Enlightened?

Easy to build REST API add-ons for Splunk with the add-on builder.

Metrics are easy to use and awesome!!

Bringing different industrial technology data into one place is really useful.

This can be done at scale with the Splunk IoT Suite.

Solar generation is cost effective and energy effective.

ROI for solar energy for your home is better than you think ☺

We shouldn't do everything in life on ROI – sometimes just do the right thing!

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splunk>

Thank You!

Go to the .conf19 mobile app to

RATE THIS SESSION