Open Framework for Integrated Data Operations

OpenFIDO

Operated by Stanford University for the US Department of Energy under contract DE-AC02-76SF00515.

Meeting agenda

- Project description
- Goals and objectives
- Summary of major technical tasks
- Summary of results
- Conclusions and moving forward
- Q&A / Discussion

Project Description

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The Problem

- Need reliable and consistent data and model exchange
- Ingest from many sources
- Curation of heterogeneous data
- Run complex analyses on multiple tools
- Delivery of data with long-term availability

The Solution

- Identify exchange and analysis requirements for California IOUs
- Develop and test a platform to satisfy identified needs
- Demonstrate solution for primary use-cases identified
- Commercialize platform to enable large scale deployment

Goals and Objectives

Support major use-cases

- ICA
- End-use electrification
- Tariff design
- Resilience analysis

Other use-cases identified

- CYME to GLM conversion
- Forecasting (e.g., load weather)
- Data access (e.g., vegetation)

Validation

- Forecasting load at National Grid
- Resilience analysis at SCE
- Tariff and electrification tests

Pathways to commercialization

- Adoption by commercial entity

Summary of Major Technical Tasks

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Task 1 - Management

Task 2 - Requirements Analysis

Task 3 - Implementation

Task 4 - Testing and Validation

Task 5 - Finalize Production

Task 6 - Evaluation of Benefits

Task 7 - Technology Transfer

Summary of Major Technical Tasks

Task 1 - Management

- Subtask 1.1 - Products
- Subtask 1.2 - Kick-off Meeting
- Subtask 1.3 - CPR Meetings
- Subtask 1.4 - Final Meeting
- Subtask 1.5 - Progress Reports
- Subtask 1.6 - Final Report
- Subtask 1.7- Match Funds
- Subtask 1.8 - Permits
- Subtask 1.9 - Subcontracts
- Subtask 1.10 - TAC
- Subtask 1.11 - TAC Meetings

CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

FINAL PROJECT REPORT

Open Framework for Integrated Data Operations (OpenFIDO)

Agreement Number: EPC-17-047

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Month Year | CEC-500-XXXX-XXX

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Summary of Major Technical Tasks

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Task 2 - Requirements Analysis

Establish requirements needed for OpenFIDO extension to VADER and to assess those requirements for the data exchange implementation to VADER.

Deliverables

1. Data Exchange Requirements and Assessment Presentation
2. Data Exchange Implementation and Validation Plan
3. Data Exchange Implementation and Validation Presentation

Summary of Major Technical Tasks

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Task 3 - Implementation

Implement the data import and export codes in VADER software that meet the requirements established in Task 2.

Deliverables

1. Implementation Report - CPR Report 1

Summary of Major Technical Tasks

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Task 4 - Testing and Validation

Verify the VADER code functionality and validate the data exchange capabilities between VADER software and external tools.

Deliverables

1. Testing and Validation Presentation
2. Testing and Validation Report

Summary of Major Technical Tasks

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Task 5 - Finalize Production

Prepare and release the final OpenFIDO extensions of VADER software.

Deliverables

1. Developer and User Training Documentation
2. Final Product Release Report
3. Production Report (CPR Report #2)

Summary of Major Technical Tasks

Task 6 - Evaluation of Benefits

Report the benefits resulting from this project.

Deliverables

1. Kick-off Meeting Benefits Questionnaire
2. Final Meeting Benefits Questionnaire

Summary of Major Technical Tasks

Task 7 - Technology Transfer

Develop a plan to make the knowledge gained, experimental results and lessons learned available to the public and key decision-makers.

Deliverables

1. Initial Fact Sheet
2. Final Project Fact Sheet
3. Final Presentation Materials
4. Technology/Knowledge Transfer Plan
5. Technology/Knowledge Transfer Report

Summary of Results

Capabilities delivered in pipelines

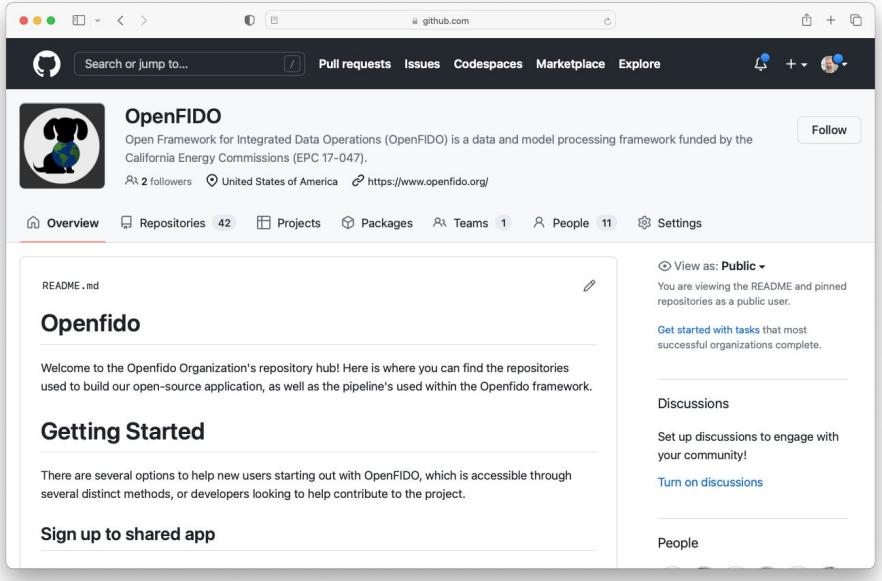
Data/Model Handling

1. Weather
2. Census
3. Address
4. CYME Converter

Analysis Tools

1. Hosting capacity analysis
2. Electrification impacts analysis
3. Resilience analysis
4. Tariff design analysis

Commercialization by LF Energy



https://source.openfido.org/

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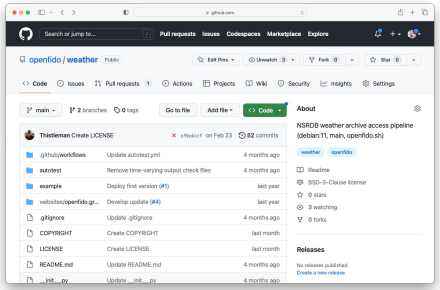

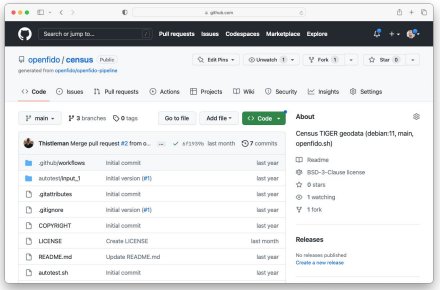

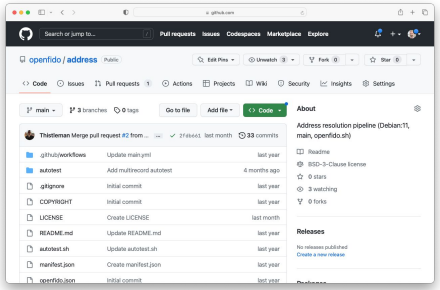

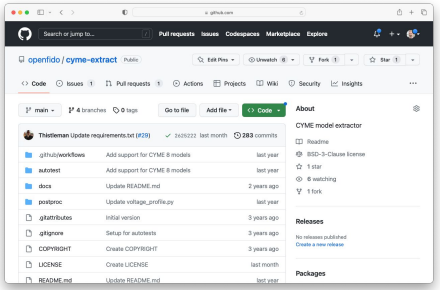

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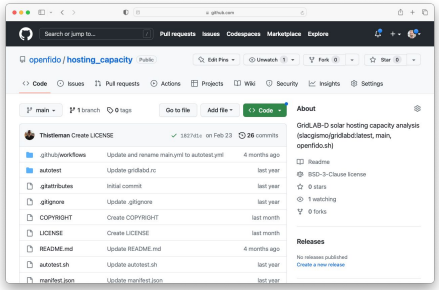

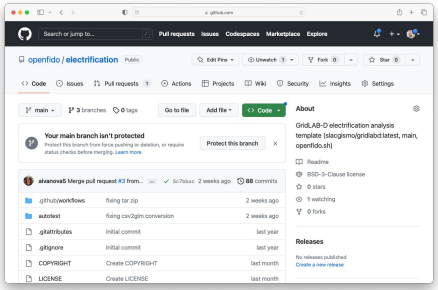

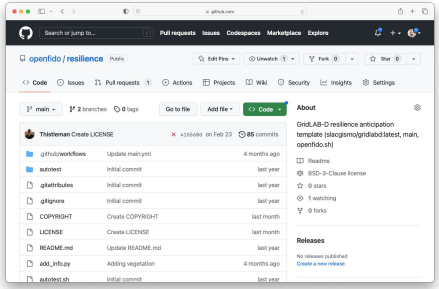

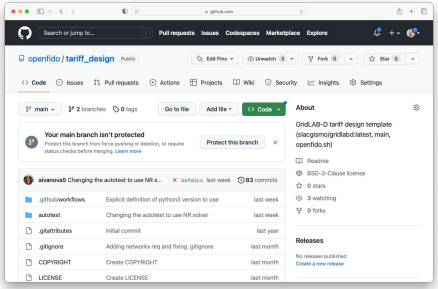

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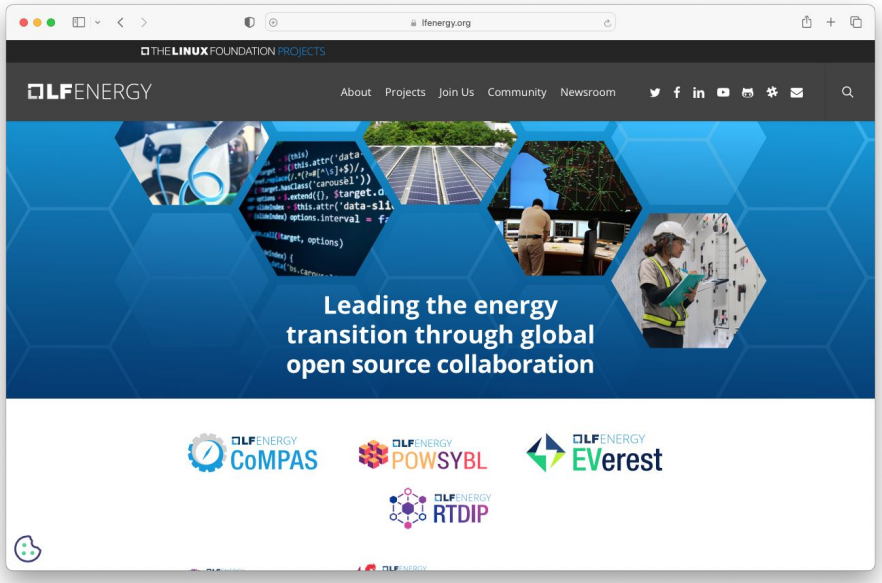


https://www.lfenergy.org/

Summary of Results

Activities

1. Operational support
2. Open issues/resolution
3. LF Energy commercialization

Online documentation

- http://help.openfido.org/
- https://auth.openfido.org/apidocs/
- https://api.openfido.org/apidocs/

Online tutorials

1. **Getting Started**
2. **Use Case Tutorial**
3. **New Developer Build**
4. **Loadshape Analysis**
5. **Loadshape Synthesis**
6. **Weather Forecast**
7. **Resilience**
8. **Electrification**
9. **Tariff Design**
10. **Cyme Converter**

Summary of Results

Online/cloud platform (AWS)

- Registered/invited users only
- https://app.openfido.org/

On-premise/private cloud platform

- Testing in progress at SCE

Local/private workstation platform

- Deployed via OpenFIDO CLI
- Available to general public
- **https://source.openfido.org/cli**

Use-case Pipelines

1. CYME model extractor
2. GridLAB-D (converters, geodata, tools)
3. Integration Capacity Analysis
4. Electrification
5. Tariff analysis
6. Resilience analysis (DOE/GMLC)
7. Wildfire analysis (DOE/CESER/DHS)
8. NERC load composition (DOE/OE)

Summary of Results

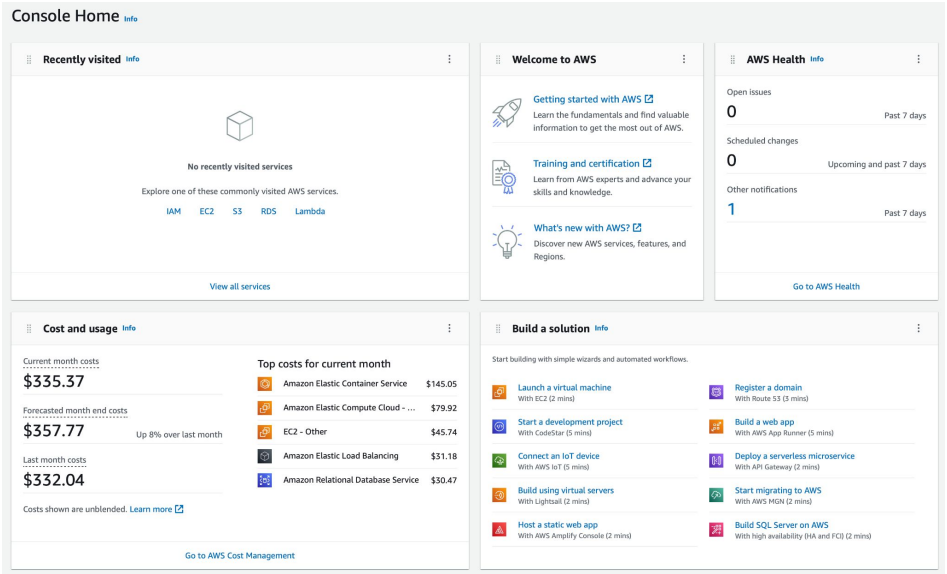
Two deployments on AWS

- Production (for users)

  app.openfido.org

- Staging (for developers)

  app-staging.openfido.org



Conclusions and Moving Forward

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Support for major use-cases

- ICA
- End-use electrification
- Tariff design
- Resilience analysis

Other use-cases supported

- CYME to GLM conversion
- Forecasting (weather, load)
- Data access (vegetation)

Validation completed

- Forecasting load at National Grid
- Resilience analysis at SCE
- Tariff and electrification

Pathway to commercialization

- Adopted by Linux Foundation

Conclusions and Future Work

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Identified issues

1. Pipeline start dialog

   Lacks clear guidance as to what data/files are required to successfully run pipeline

2. Visualization dialog

   Needs options to handle various forms CSV outputs (e.g., transpose)

3. Lack of clear diagnostic outputs

   Output messages do not provide guidance on how to fix the problem found

Resolution status

1. Form-based pipeline start dialog

   Pipelines can present input form that generates files needed to run

2. Upgraded visualization dialog

   Visualization dialog will support additional options and plot formats

3. Improved diagnostic output

   Pipelines use error message guidelines for troubleshooting

Conclusions and Future Work

Load decomposition

End-use loadshapes from SCADA and AMI data

Census data

Customer demographic, economic, and population data for load modeling

Advanced building loads

Satellite imagery to generate/link building load models to network

Grid resilience analysis

Standardize PSPS optimization method,

Support long term climate impacts analysis

Advanced workflows

Capability built-in but not publicly available needs to be connected to standard tools such as Apache BEAM

Shared data/model security

Security enhancements to share artifacts with state agencies and utility partners

Legacy data handling/aging

Access to long-term historical data repositories for weather, assets, usage, prices, etc.

Thank you!

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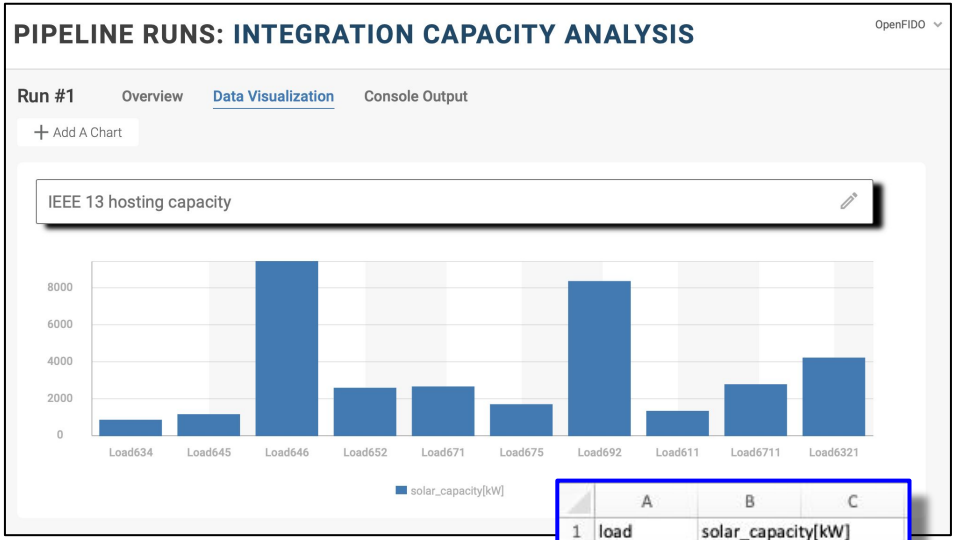
Questions and Discussion

Contact	David Chassin (dchassin@slac.stanford.edu)
Website	https://github.com/openfido
Online	https://app.openfido.org/

Results: Hosting Capacity

Finds maximum PV capacity

- ANSI voltage limits
- 3% voltage fluctuations
- Over-current limits
- Applies PV at all loads
- Runs time-series if enabled
- Includes weather, DR, etc.

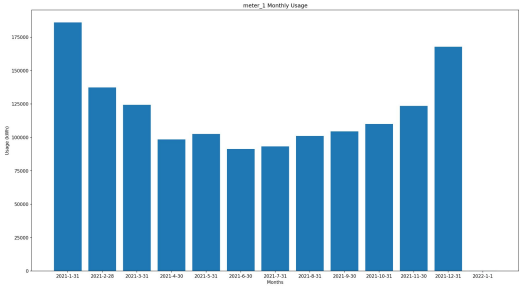


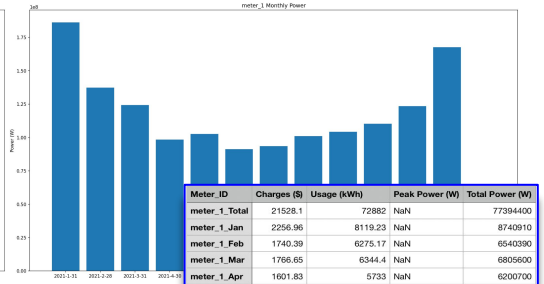
	A	B	C
1	load	solar_capacity[kW]	
2	Load634	840	
3	Load645	1140	
4	Load646	9420	
5	Load652	2570	
6	Load671	2640	
7	Load675	1680	
8	Load692	8340	
9	Load611	1320	
10	Load6711	2760	
11	Load6321	4200	

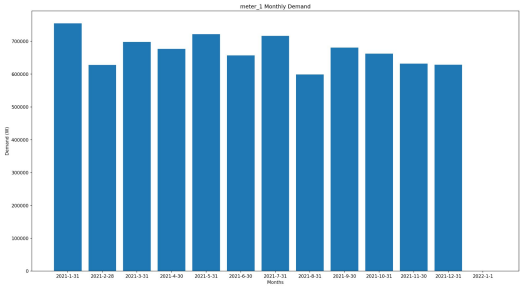
Results: Tariff Design

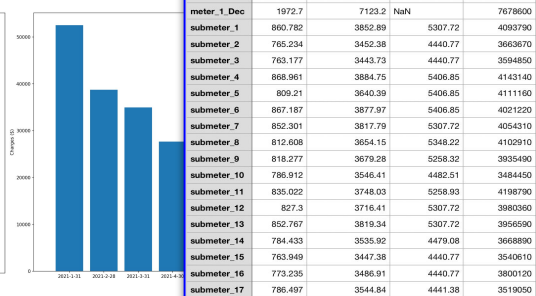
Monthly power, energy, and costs aggregated to feeder level.

- Data from OpenEI utility rate database (NREL)
- Uses `create_meters` tool to generate meters for models, as needed.
- Validated on IEEE-13 and DOE taxonomy feeders.
- 99% accuracy between manual calculation and template.







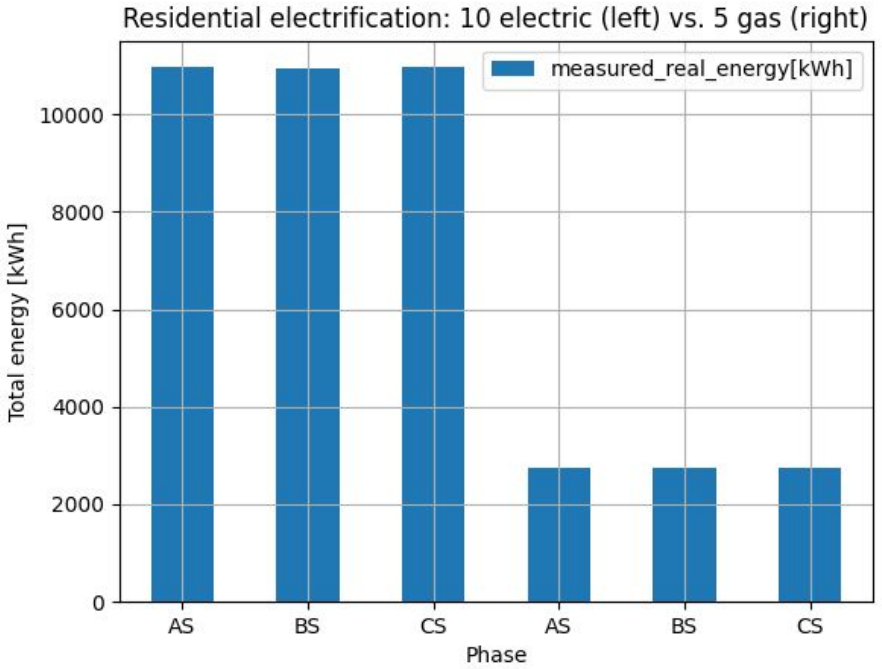


Meter_ID	Charges ($)	Usage (kWh)	Peak Power (W)	Total Power (W)
meter_1_Total	21528.1	72882	NaN	7739400
meter_1_Jan	2256.96	8119.23	NaN	8740910
meter_1_Feb	1740.39	6275.17	NaN	6540390
meter_1_Mar	1766.65	6344.4	NaN	6805600
meter_1_Apr	1601.83	5733	NaN	6200700
meter_1_May	1629.83	5825.3	NaN	5966800
meter_1_Jun	2007.44	6033.6	NaN	6347100
meter_1_Jul	1793.9	5358.7	NaN	5955800
meter_1_Aug	1918.8	5728.9	NaN	5852000
meter_1_Sep	1783	5336.4	NaN	5658200
meter_1_Oct	1542	5527.4	NaN	6036400
meter_1_Nov	1514.6	5476.7	NaN	5611900
meter_1_Dec	1972.7	7123.2	NaN	7678600
submeter_1	860.782	3852.89	5307.72	4093790
submeter_2	765.234	3452.38	4440.77	3663670
submeter_3	763.177	3443.73	4440.77	3594850
submeter_4	868.961	3884.75	5406.85	4143140
submeter_5	809.21	3640.39	5406.85	4111160
submeter_6	867.187	3877.97	5406.85	4021220
submeter_7	852.301	3817.79	5307.72	4054310
submeter_8	812.608	3654.15	5348.22	4102910
submeter_9	818.277	3679.28	5258.32	3935490
submeter_10	786.912	3546.41	4482.51	3484450
submeter_11	835.022	3748.03	5258.93	4198790
submeter_12	827.3	3716.41	5307.72	3980360
submeter_13	852.767	3819.34	5307.72	3956590
submeter_14	784.433	3535.92	4479.08	3668890
submeter_15	763.949	3447.38	4440.77	3540610
submeter_16	773.235	3486.91	4440.77	3800120
submeter_17	786.497	3544.84	4441.38	3519050
submeter_18	782.702	3528.53	4513.73	3654190
submeter_19	809.98	3643.29	5258.32	4118040
submeter_20	781.813	3524.21	4405.75	3727360

Results: Electrification

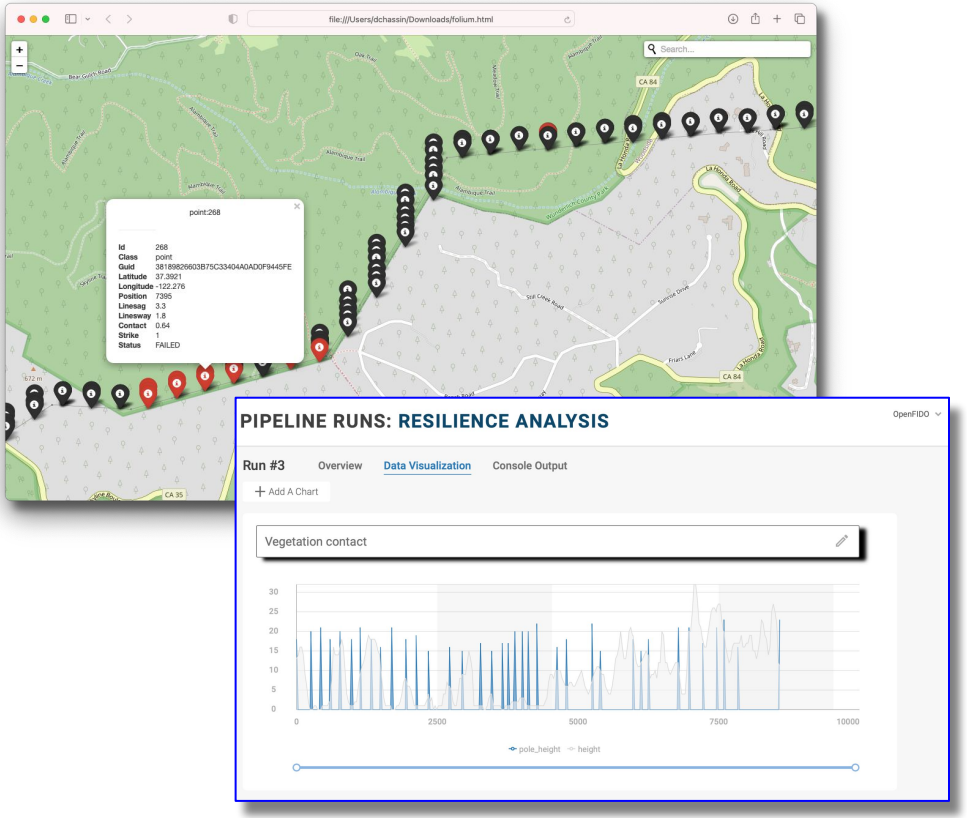
Determines the increased load at substation due to residential electrification

- Validated via manual calculations using component validation.
- Available for different climate regions
- Additional summer peaks are exposed due to availability of A/C under electrification



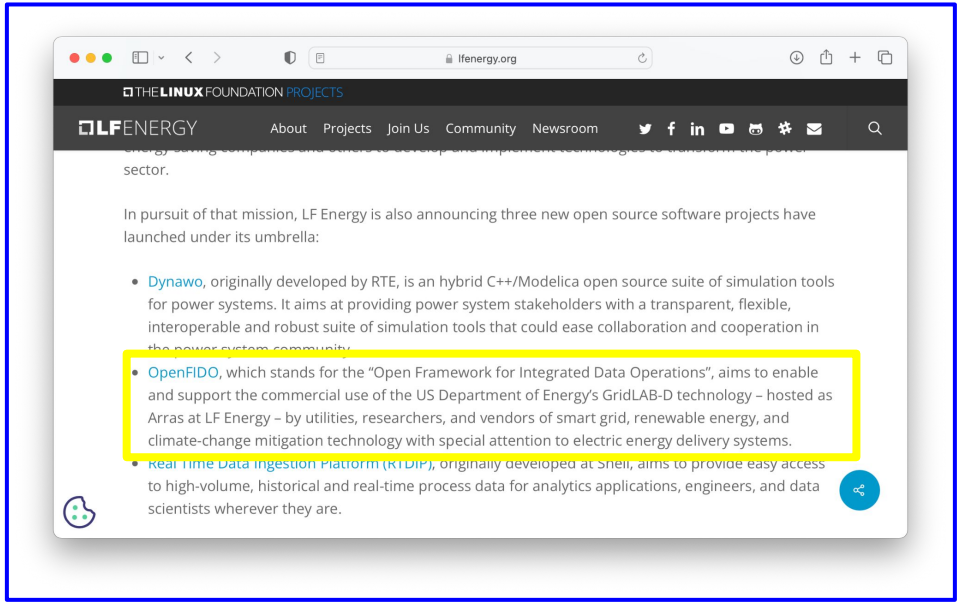
Results: Resilience

- Deployed at SCE
- Vegetation analytics tested using PG&E 230kV line
- Pole Analysis validated using manual calculations.
  - Automated skeleton grid formulation for bulk pole analysis
  - Integration with utility distribution grid available



Linux Foundation Energy Commercialization

- Adopted January 2023
- Open-source release
- Support for ongoing AWS operations
- Initial Technical Steering Committee meeting TBD
- TSC positions open to all interested parties



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