OpenFIDO
(EPC-17-047)

Orientation and Education

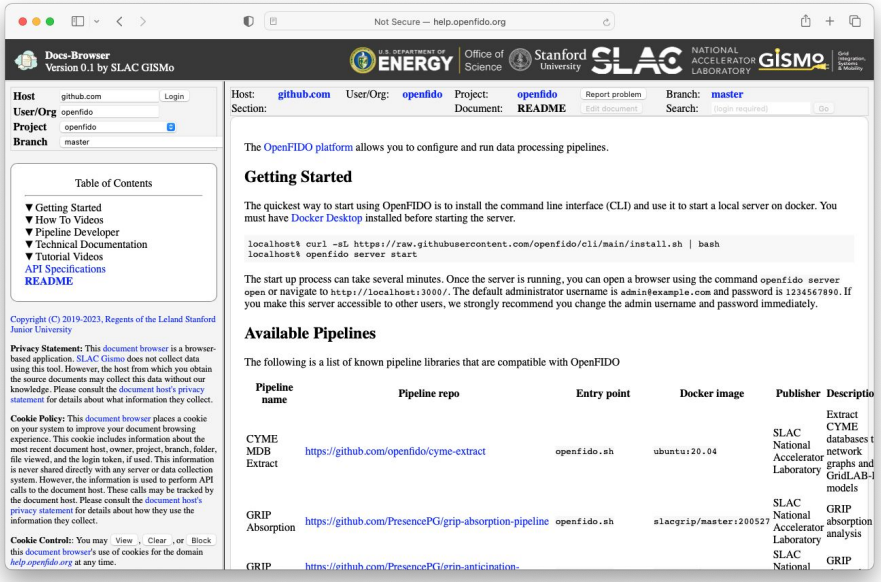
6 April 2023

U.S. DEPARTMENT OF ENERGY | Stanford University

SLAC NATIONAL ACCELERATOR LABORATORY

Workshop Agenda

1. Product Overview
2. Download and installation (video)
3. Loadshape analysis (video)
4. Resilience (video)
5. Electrification (video)
6. Poll questions



https://help.openfido.org/

Product Overview

Capabilities delivered in pipelines

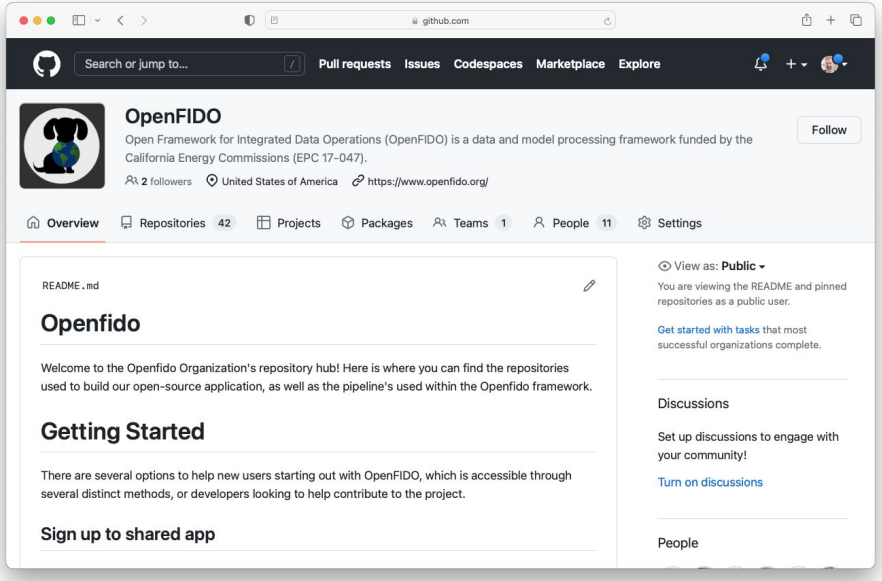
Data/Model Handling

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



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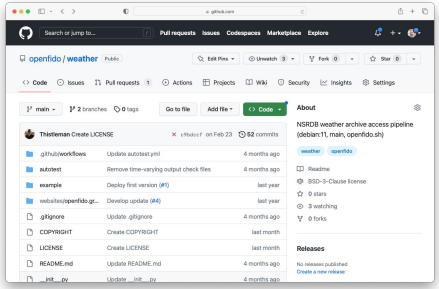

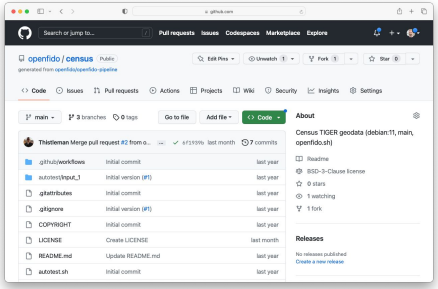

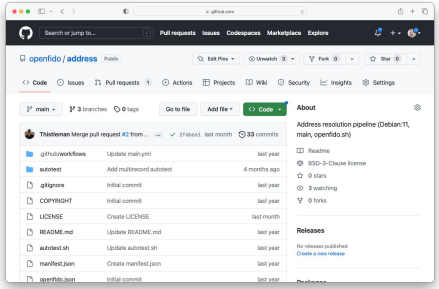

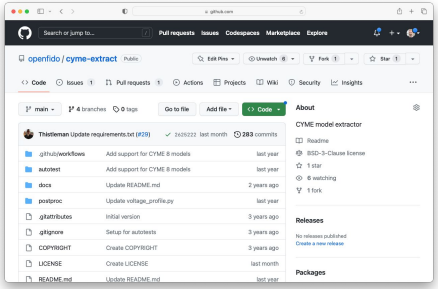

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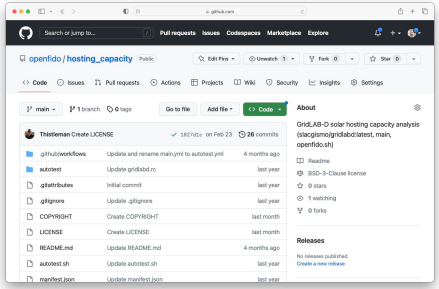

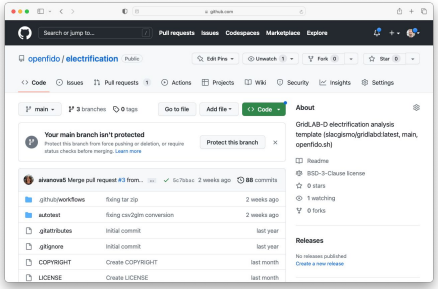

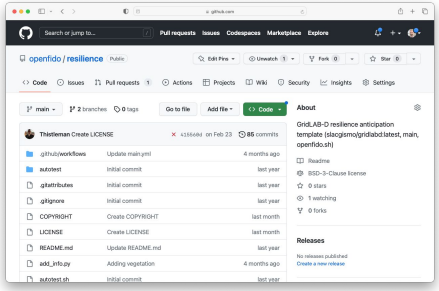

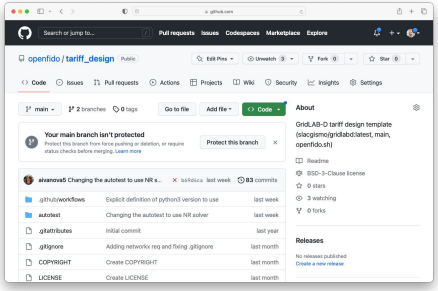

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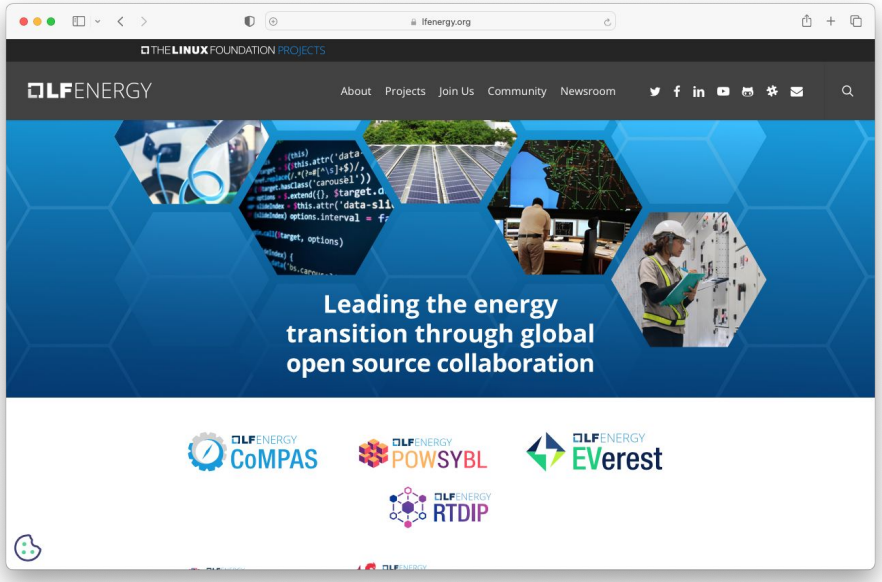

https://www.lfenergy.org/

Download and installation

SLAC

Two quick-start methods

1. Download and start server

```
curl -sL install.openfido.org/install.sh | bash

openfido server start

openfido server open
```

2. Hosted app on Amazon AWS

   https://app.openfido.org/

   Note: you need to request an account

Watch the full video on YouTube:

https://youtu.be/WLyl6nimr40

Loadshape analysis

Analyse load data

- Uses AMI data
- Identify load shapes
- k-means clustering
- Generated GLM models
- Includes visualization

https://youtu.be/Js9gPTFuL1s

Resilience

Extreme weather scenarios

High wind (pole stress)

- Data from SpidaCalc
- Physics-based pole model
- Micro-weather data (local to pole)

Multiple failure modes

- Base/cable stay moment
- Line stress included
- Includes pole tilt angle/direction

Wildfire (line contact with vegetation)

- California Forest Observatory (CEC-funded)
- Includes line sag and sway, with elevation at 10m

https://youtu.be/RkDNJtiKYug

Electrification

Compare gas-fueled to electrified homes

Inputs

- Local weather conditions
- Home thermal integrity
- HVAC controls
- Appliance types (gas vs. electric)
- Number/fraction of electric homes

Outputs

- Time-series or instantaneous
- Power and energy at substation
- Side-by-side results by phase
- Option to output current/voltage

https://youtu.be/F2ZhiQlRkrA

OpenFIDO

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Technical Advice and Discussion

6 April 2023

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Project status overview

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

Operational status

SLAC

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**

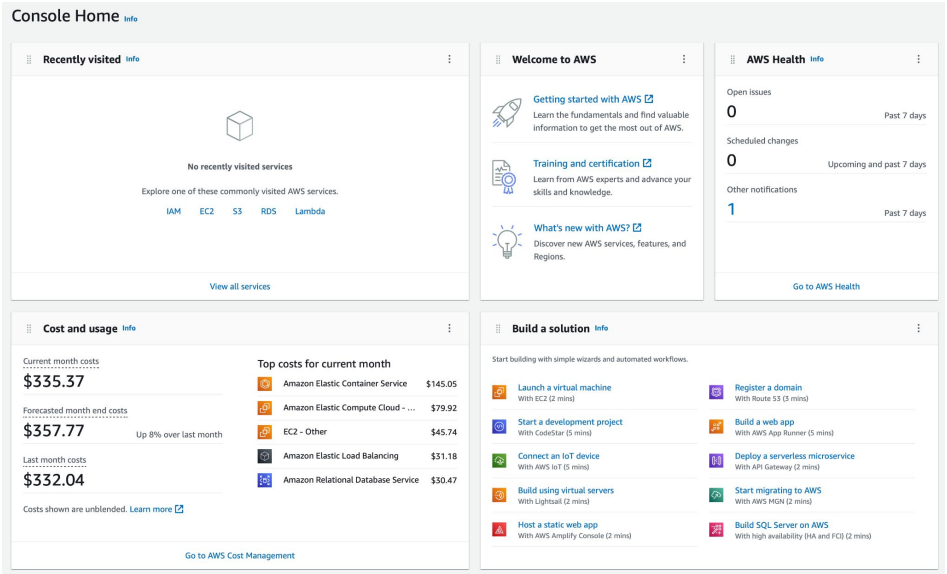
Use-case Pipelines

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)

Cloud Deployment

Two deployments on AWS

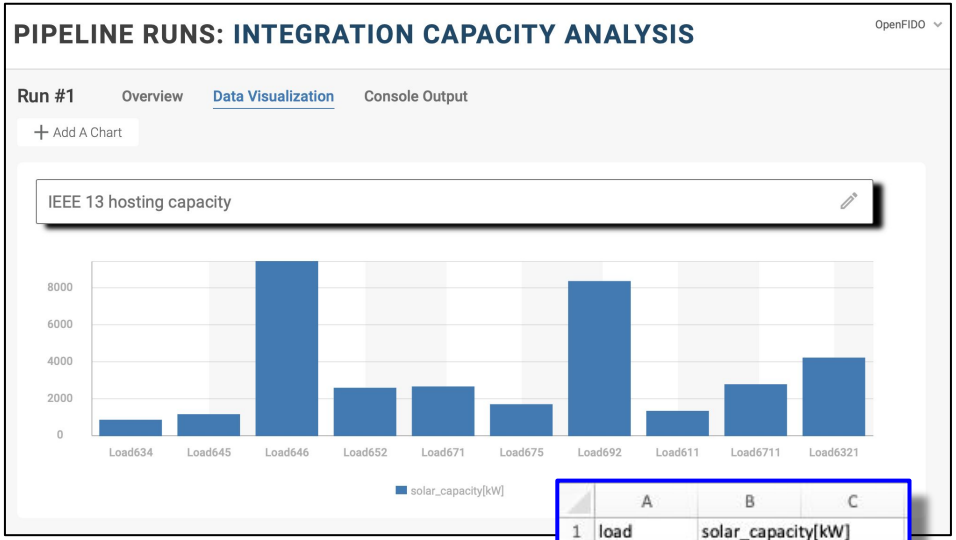
- Production (for users)
  app.openfido.org
- Staging (for developers)
  app-staging.openfido.org



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.

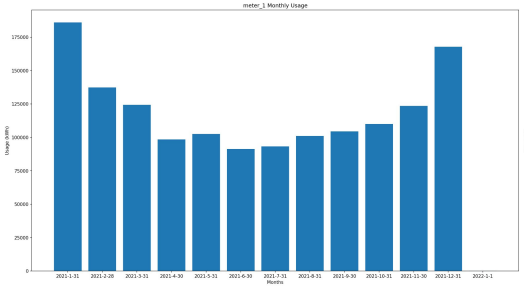


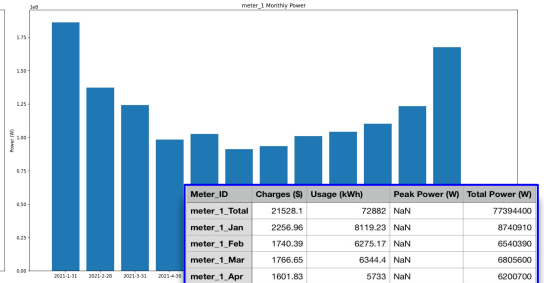
	A	B	C
1	load	solar_capacity[kW]	
2	Load634	840	
3	Load645	1140	
4	Load646	9420	
5	Load652	2570	
6	Load671	2640	
7	Load675	1680	
8	Load692	8340	
9	Load611	1320	
10	Load6711	2760	
11	Load6321	4200	

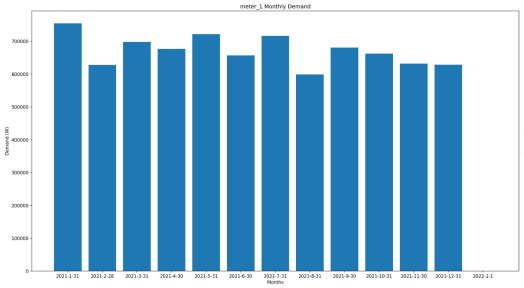
Results: Tariff Design

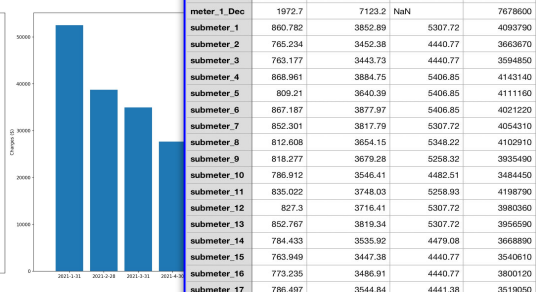
Monthly power, energy, and costs aggregated to feeder level.

- 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.







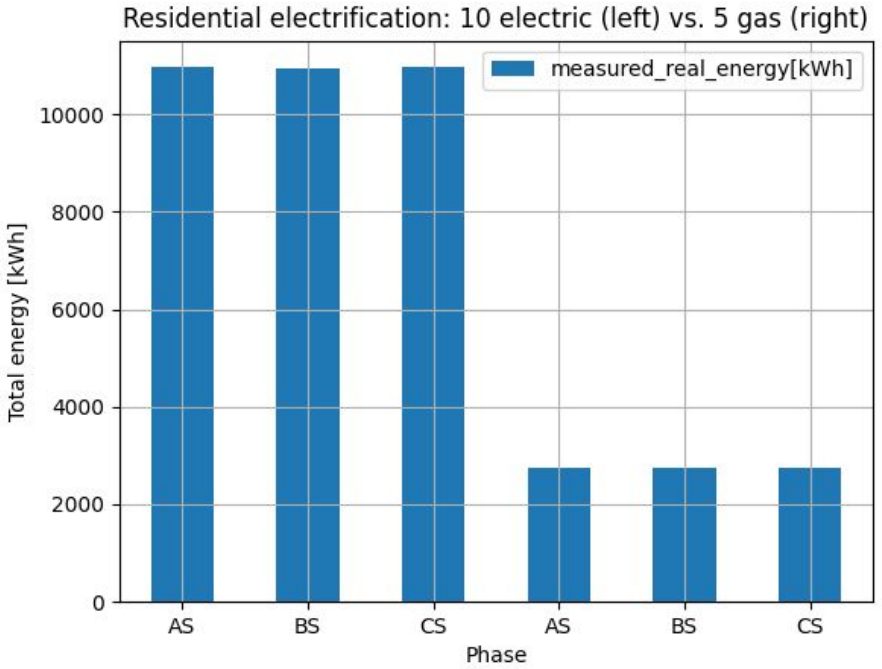


Meter_ID	Charges ($)	Usage (kWh)	Peak Power (W)	Total Power (W)
meter_1_Total	21528.1	72882	NaN	7739400
meter_1_Jan	2256.96	8119.23	NaN	8740910
meter_1_Feb	1740.39	6275.17	NaN	6540390
meter_1_Mar	1766.65	6344.4	NaN	6805600
meter_1_Apr	1601.83	5733	NaN	6200700
meter_1_May	1629.83	5825.3	NaN	5966800
meter_1_Jun	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

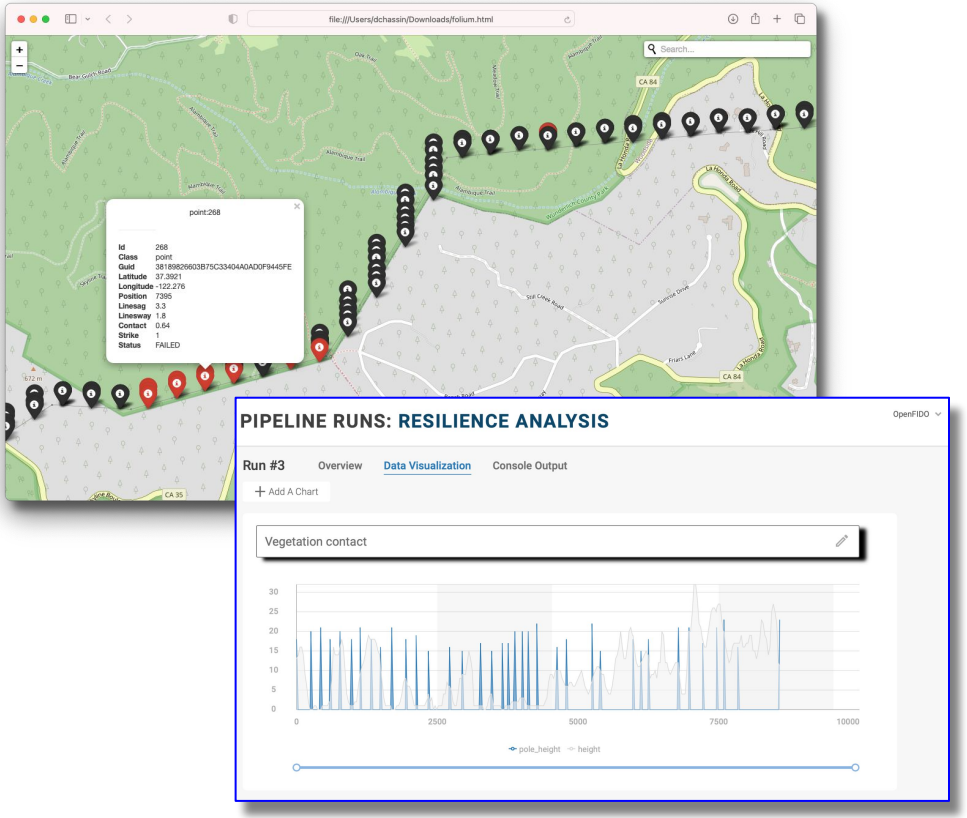
Determines the increased load at substation due to residential electrification

- 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



Open issues and resolution status

SLAC

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

👷: updates pending

🚧: not available to users at this time

Recommendations for further 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**

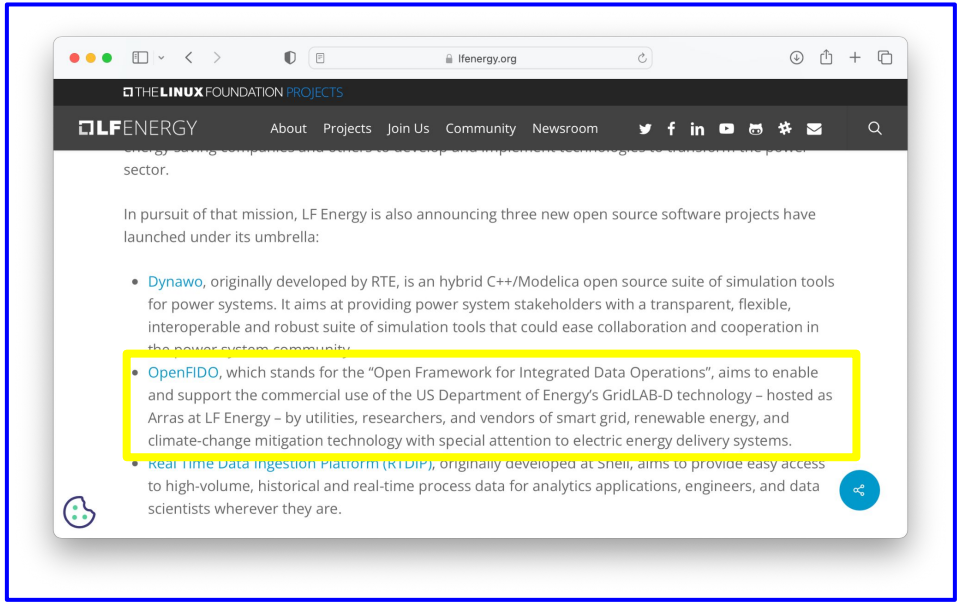
  Capability built-in but not publicly available needs to be connected to standard tools such as Apache BEAM
- **Shared data/model security**

  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.

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



https://www.lfenergy.org/

Questions

SLAC

1. How are you using OpenFIDO now or in the near term?
2. What future applications do you anticipate long term?
3. What new capabilities do you wish to see?
4. What benefits were made possible by this project?
5. What is necessary to realize those benefits?

Thank you to our TAC members!

Adam Shumavon
Allen Le
Amrit Rajagopal
Anastasia Osling
Andy Bilich
Andy Eiden
Andy Schwartz
Anthony James
Aram Shumavon
Audrey Lee
Balaji Doraibabu
Berk Serbetcioglu
Bill Peter
Bo Chen
Brian McCollough
Chris Irwin
Davianna Olert
David Pinney
Dina Mackin
Eric Lightner
Fernando Pena
Frances Bell
Frank Gonzales
Frank Tuffner
Gerhard Walker
James Wolf
Jameson Thornton
Jamie Fine
Jamie Patterson
Jason Fuller
Jennifer Lee
Jim Baak
Jim Parks
John Mead
Jose Aliaga Caro
Jose Lopez
JP Dolphin
Justin Regnier
Kristen Brown
Laura Fedoruk
Liuxi Zhang
Manal Yamout
Marc Monbouquette
Masahiro Asano
Matthew Kedis
Merrian Borgeson
Niloy Patari
Ning Lu
Obadiah Bartholomy
Pedram Jahangiri
Rachel Huang
Raul Perez-Guerrero
Riam Chantree
Richard Bravo
Roger Dugan
Roger Salas
Sandori Horigachi
Shinnosuke Kameyama
Simon Baker
Supriya Premkumar
Takanovi Tamozava
Ted Ko
Tim Heidel
Tom Bialek
Tom McDermott
Tom Russell
Yanzhu Ye
Yuki Nomoto

Thank you

Contact: dchassin@slac.stanford.edu

OpenFIDO source available online at http://www.openfido.org/

Documentation available online at http://help.openfido.org/