

# OpenFIDO

LF Energy Proposal

5 October 2022

David P. Chassin, SLAC National Accelerator Laboratory, Menlo Park, California (USA)

Contact: [dchassin@slac.stanford.edu](mailto:dchassin@slac.stanford.edu) (1+650-926-5499)

## **Name**

The project name is "OpenFIDO" which stands for the "Open Framework for Integrated Data Operations".

## **Mission statement**

The mission of the OpenFIDO project is to enable and support the commercial use of DOE's GridLAB-D technology by utilities, researchers, and vendors of smart grid, renewable energy, and climate-change mitigation technology with special attention to electric energy delivery systems.

## **Project Description**

OpenFIDO provides a framework for interorganizational data interchange, data and model synthesis, and system performance analysis between different power systems tools such as CYME, GridLAB-D, OpenDSS, Opal-RT and RTDS software. OpenFIDO can be used to (1) collect data from a wide variety of open sources, private databases, and commercial product; (2) transfer model and telemetry data between various tools that are part of the suite of tools widely used by utilities, distributed energy resource (DER) engineers and regulators in California; and (3) provide the ability to create permanently available reproducible results.

OpenFIDO is designed for utility planners and grid researchers that need a tool and data integration framework to quickly move data from one application to another as part of their engineering, planning, and review activities. OpenFIDO also supports emerging user groups such as DER system integrators and aggregators that use multiple tools to analyze the grid impacts of DERs, as well as governments and agencies that use these models in both their oversight role and identifying opportunities for clean energy deployments.

In 2018 the California Energy Commission authorized \$6M of EPIC program funding for an open-source project at SLAC National Accelerator Laboratory to create a commercially viable tool that provides a data interchange, model synthesis, and analytics support framework which can provide access to open-source data and model exchange and analytics tools for power

systems researchers, utility planners, and regulators. OpenFIDO is used to apply system models, weather data, load and system telemetry data exchanged between various software products as part of the suite of tools widely used by utilities, distributed resource engineers and regulators in California. OpenFIDO is intended for utility planners and grid researchers that need a tool to quickly and consistently move data and models from one application to another and apply these to their engineering, planning, and review activities. OpenFIDO also supports emerging user groups such as distributed energy resource (DER) system integrators and aggregators that use multiple tools to manage the grid impacts of DERs, as well as governments and agencies that use these data and models in both their oversight role and identifying opportunities for new energy and climate policies.

The purpose of OpenFIDO is to reduce the time and effort involved in setting up models, assembling data, and running analysis of various scenarios in order to better plan and study distribution system investments, with particular emphasis on studies involving renewable energy resource integration and energy system decarbonization.

The specific objectives of OpenFIDO projects included the following:

- Identify data exchange and analysis requirements by working with California's Investor Owned Utilities (IOUs), Pacific Gas & Electric, San Diego Gas & Electric, and Southern California Edison, and tool vendors through understanding their planning processes;
- Develop and test a platform that can use data and models from IOUs and convert them to those used by emerging data-intensive analysis and agent-based simulation tools;
- Demonstrate data exchange and analysis in the primary use-cases identified by IOUs.

OpenFIDO implements a scalable data curation framework capable of (1) ingesting data from various sources, including cloud-hosted data systems, power system simulation tools, and web-based endpoints; (2) running data-intensive analysis and agent-based simulations; and (3) delivering data to external users through modern data-exchange infrastructure.

OpenFIDO builds upon several capabilities introduced in the DOE VADER system [1], a scalable data management platform. OpenFIDO has 3 core components that are oriented toward highly efficient, scalable, and customizable data processing: methods, pipelines, and workflows. Each component builds on the previous in a self-similar architecture that facilitates speed, diverse execution environments, and open-source distribution.

**Methods:** Methods are primitive data operations needed to perform basic data processing functions, such as obtaining data from remote sources, manipulating data, and delivering data to endpoints for access by other tools. Methods are generally distributed through open-source repositories, such as GitHub, but can also be distributed through private repositories.

**Pipelines:** Pipelines are simple data operations that require zero or more inputs, perform multiple data processing steps, and generate one or more outputs. Pipelines are always composed of zero or more methods that must be executed in series. Pipelines are generally

distributed through open-source repositories, such as GitHub. Pipelines can also be distributed through private repositories.

**Workflows:** Workflows are complex data operations that require zero or more inputs, perform multiple data processing steps, and generate one or more outputs. Workflows are always composed of two or more methods that can be executed in parallel. Workflows are generally distributed through open-source repositories, such as GitHub. Workflows can also be distributed through private repositories.

OpenFIDO was developed using the following approach:

1. Workshops and interview utility engineers and potential users to gather use-cases and data requirements. Two workshops were held and interviews conducted with IOU, municipal, and cooperative utilities, reliability organizations, government agency users, vendors and consultants as well as a select group of people who have served in technical advisory groups. The interviews provided insight into the data handling requirements among various tools used in the process of planning distribution systems.
2. Develop a platform to support planning process data exchange: The platform comprises the methods, processing pipelines, and analysis workflows described above. The platform also delivers the data handling tools and services to convert data to and from different power system tools used by the industry.
3. Gather sample datasets: Sample data and model files were collected from the industry to test and validate the framework.
4. Design and Develop data architecture for the data interchange platform: Presence Product Group designed the system architecture to meet the needs of users and developers.
5. Develop and test platform features using real-world use cases: The platform was tested and validated for four use-cases identified by the project team in collaboration with two other CEC-funded projects, HiPAS GridLAB-D and Hitachi GLOW:
  - a. Integration capacity analysis (ICA): utilities need to complete system-wide ICA to determine the maximum node-level hosting capacity for a circuit to remain within key power system criteria.
  - b. End-use electrification: utilities need to study the impact of increasing electrification of fossil end-use loads, specifically heating, cooling, cooking, hot water, clothes drying, and light vehicles.
  - c. Tariff design: utilities need to study the revenue impacts of emerging technologies and planning scenarios that include high penetration of DER and end-use electrification.
  - d. Resilience analysis: utilities need to study the resilience impacts of emerging technologies that support high penetration of DER and end-use electrification in

the presence of increasing climate change impacts on system operations and planning.

6. Organize technology workshops and plan the commercialization of OpenFIDO.

### **Is this a new project/working group/special interest group or an existing one?**

This is an existing project based on a project initiated by the US Department of Energy in 2016 called VADER and a later Technology Commercialization Fund proof-of-concept called LoadInsight. The current project, called OpenFIDO, is funded by the California Energy Commission in 2018 and ends in 2023.

### **Current lead(s)**

David P. Chassin, PhD, SLAC National Accelerator Laboratory operated by Stanford University ([dchassin@slac.stanford.edu](mailto:dchassin@slac.stanford.edu)).

### **Sponsoring organization(s), along with any other key contributing individuals and/or organizations**

Current sponsors: California Energy Commission.

Previous sponsors: US Department of Energy Office of Electricity and US Department of Energy Solar Energy Technology Office

Key organizations: Stanford University

Key contributors: David Chassin (SLAC), Mayank Malik (SLAC), and Duncan Ragsdale (SLAC)

### **Existing community infrastructure**

#### ***Github Repositories***

Primary GitHub repository: <https://www.openfido.org/> (aka github:openfido/openfido)

Supporting resource repositories: see <https://github.com/openfido> organization

#### ***Website and/or docs***

Main user documentation: <http://help.openfido.org/>

Main develop documentation: <https://github.com/openfido/openfido/wiki>

AWS S3/DNS/EC2 Infrastructure: \*.openfido.org

**Communication channels ( such as Mailing lists, Slack, IRC )**

**Slack:** None

**Email:** [support@openfido.org](mailto:support@openfido.org)

**Social Media Accounts**

**Twitter:** None

**Slack:** None

**Are there any specific infrastructure needs or requests outside of what is provided normally by LF Energy (please refer to the lifecycle for project benefits)? If so please detail them.**

None.

**Why would this be a good candidate for inclusion in LF Energy?**

OpenFIDO enables regulators, researchers, and other interested stakeholders to access and analyze electric grid data that has historically been inaccessible due to the use of proprietary software tools. The data exchange platform increases the transparency of the electric grid and empowers stakeholders to work with utilities and regulators to integrate DERs more quickly, reliably, and cost-effectively.

**How would this benefit from inclusion in LF Energy?**

OpenFIDO provides a framework with which all tools used in DER resource financing, planning, and permitting processes can interoperate. The capabilities of OpenFIDO will benefit greatly from the range of tools and services delivered by LF Energy to help utilities and other stakeholders access more reliably and efficiently exchange system model data with analysts, regulators, and vendors. The reduction in labor intensity and cost of staff training will improve utility staff productivity, help expedite utility resource integration reviews, and simplify utility regulator compliance activities. All these work reductions will ultimately result in savings to electricity ratepayers.

More specifically OpenFIDO would benefit from inclusion in LF Energy in a number of important ways, including (1) increasing its visibility worldwide, (2) stabilizing the funding needed to support it in the mid-term, (3) receiving technical and market guidance from a broader group of experts and potential stakeholders, and (4) identifying and collaborating with other LF Energy projects in a mutually beneficial manner.

**Provide a statement on alignment with the mission in the [LF Energy charter](#).**

OpenFIDO is a technical project related to the generation, transmission, distribution, and delivery of energy. The project requires funds for the technical resources that will ensure its open-source delivery model is sustainable in the mid-term while it transitions from the government agency research funding model it currently employs to the commercial funding model it requires in the long-term. As such, the OpenFIDO project team believes the project is aligned with the mission of the LF Energy Charter, because its purpose "is to raise, budget and spend funds in support of various open source and/or open standards projects relating to the generation, transmission, distribution and delivery of energy, including infrastructure and support initiatives related thereto".

**What specific need does this project/working group/special interest group address?**

OpenFIDO addresses the needs of key stakeholders such as power system researchers, planners, operators, policy-makers and regulators. Specifically, this software provides an open-source utility data integration platform capable of supporting integration of very large scale electric power system analysis tools that support a large fraction of so-called smart grid technology and distributed energy resources that key stakeholders cannot obtain and/or afford to license from existing software vendors.

**Describe how this project/working group/special interest group impacts the energy industry.**

OpenFIDO has focused on data and model integration for use-cases that are not supported well by the current community of electric utility software vendors. The earliest deployment focused on some key use-cases that will help increase the adoption rate among utilities that have hesitated to employ new smart grid technologies. These (1) include tariff design tools to evaluate the revenue impacts tariffs that consider the impact and variability of distributed energy resources; (2) electrification evaluation tools to evaluate the asset degradation impacts of decarbonizing the residential, commercial, and transportation sectors; (3) hosting capacity analysis tools to identify the distributed energy resource and end-use electrification carrying capacity of existing and planned distribution system infrastructure; and (4) resilience analysis to identify the impact of extreme weather events, wildfires, and flooding on existing and planned distribution system infrastructure.

**Describe how this project/working group/special interest group intersects with other LF Energy projects/working groups/special interest groups.**

OpenFIDO has been help integration tools to bring together diverse data and system models in power distribution analysis, with particular emphasis on data acquisition for machine-learning solutions and communication with behind-the-meter devices. Several of LF Energy projects are engaged the development and promulgation of such protocols.

## Who are the potential benefactors of this project/working group/special interest group?

Current OpenFIDO is designed to serve the following key stakeholders:

- Researchers: these stakeholders are among the first to take an interest in OpenFIDO and have continued to be among the leading users. These include national laboratory scientists and engineers performing research projects for government agencies, academic researchers conducting research on smart grid technology impacts, and utilities and vendors assessing the potential impact of these technologies on electric power system performance and economics.
- Utility Planners: utility planners have started using OpenFIDO for long term load forecasting, resilience analysis, and climate change impact studies.
- Utility Operators: utilities have been examining how OpenFIDO can support wildfire studies such as public safety power shutoffs (PSPS) optimization.
- Policy-makers: DOE has funded several large projects examining various policy/strategy reports such as conservation voltage reduction and distribution system operations with transactive energy.
- Regulators: The California Public Utility Commission has identified four key use-cases it would like to use OpenFIDO for, including tariff design, electrification impact studies, resilience analysis, and integration capacity analysis.

## What other organizations in the world should be interested in this project/working group/special interest group?

- Hitachi America Laboratories: the developer of GLOW, a simulation platform that uses HiPAS GridLAB-D as a core simulation engine, and OpenFIDO as a data and model integration platform.
- Southern California Edison: A principal user of HiPAS GridLAB-D and OpenFIDO.
- National Grid: A principal user of HiPAS GridLAB-D and OpenFIDO.

## Plan for growing in maturity if accepted within LF Energy

The OpenFIDO team would like to engage in road-mapping, case-studies, training video production, developer coaching and community building, increasing developer support capacity, other commercialization activities, and make the case for additional grant funding for special projects that support new and emerging use-cases for data and model integration.

## Questions for Technical Projects ONLY

- **Project license**

BSD-3

- **Is the project's code available now? If so provide a link to the code location.**

<https://github.com/openfido>

- **Does this project have ongoing public (or private) technical meetings?**

The Technical Advisory Committee meets publicly twice a year. The meetings are convened and materials curated by [Gridworks](#).

- **Do this project's community venues have a code of conduct? If so, what is it?**

Not explicitly as such. Currently contributions are restricted to individuals authorized by SLAC National Accelerator Laboratory, who are all bound by the Stanford University's code of conduct and the [DOE operating contract for SLAC](#). This may be changed when the funding is no longer managed by the laboratory under the DOE operating contract.

- **Describe the project's leadership team and decision-making process.**

The project is currently managed by David P. Chassin, manager of the Grid Integration Systems and Mobility (GISMo) group at SLAC National Accelerator Laboratory. Decisions about research, development, and deployment of OpenFIDO are made under a consensus process with the HiPAS GridLAB-D and OpenFIDO project teams at SLAC, the GLOW project team at Hitachi America Laboratory, and the CEC Advanced Grid Simulation Technical Advisory Committee.

- **Does this project have public governance (more than just one organization)?**

No.

- **Does this project have a development schedule and/or release schedule?**

Yes. The OpenFIDO schedule was developed in consultation with the HiPAS GridLAB-D and GLOW project teams, the Technical Advisory Committee, and approved by the California Energy Commission.

- **Does this project have dependencies on other open source projects? Which ones?**

Yes. A significant number of open-source python, javascript and C++ libraries are used to build OpenFIDO. These include the following at this time:

- Linux OS
- Docker
- Python 3.9 or better
- python-dotenv
- Pandas
- Numpy
- Matplotlib



- Sklearn
- Fuzzywuzzy
- Python-Levenshtein
- Scipy
- Networkx
- Flask
- Flask-cors
- Flask-sqlalchemy
- flask-migrate
- Requests
- HiPAS GridLAB-D
- Geopandas
- Shapely
- CensusData
- Geopy
- Pyodbc
- Psutil
- Psycopg2-binary
- Pytest
- Pytest-cov
- Pylint
- Pylint-flask-sqlalchemy
- Invoke
- Celery
- networkx
- Black
- flasgger
- Simplejson
- Marshmallow
- Marshmallow\_enum
- Boto3
- Requests
- Pyjwt
- Flanker
- Freezegun
- sendgrid
- @ant-design/icons
- @fast-csv/parse
- @testing-library/jest-dom
- @testing-library/react
- @testing-library/user-event
- antd
- axios
- axios-oauth-client

- axios-token-interceptor
- babel-core
- babel-eslint
- babel-plugin-import
- babel-plugin-named-asset-import
- babel-preset-react-app
- date-fns
- dotenv
- eslint-config-airbnb
- eslint-loader
- eslint-plugin-import
- eslint-plugin-jsx-a11y
- eslint-plugin-only-warn
- eslint-plugin-ramda
- eslint-plugin-react
- eslint-plugin-react-hooks
- express
- fast-csv
- gatsby-cli
- lodash
- mime
- moment
- moment-timezone
- normalize.css
- prop-types
- query-string
- react
- react-csv
- react-date-range
- react-dom
- react-multi-select-component
- react-redux
- react-router
- react-router-dom
- react-scripts
- react-select
- recharts
- redux
- redux-devtools-extension
- redux-localstorage-simple
- redux-logger
- redux-thunk
- sortedmap
- styled-components

- validator
  - **Describe the project's documentation.**

The user documentation is provided at <https://help.openfido.org/>. The developer documentation is available at <https://github.com/openfido/openfido/wiki>.
  - **Describe any trademarks associated with the project.**

No.
  - **Do you have a project roadmap? please attach [Are this project's roadmap and meeting minutes public posted?]**

No.
  - **Does this project have a legal entity and/or registered trademarks?**

No.
  - **Has this project been announced or promoted in any press?**

No.
  - **Does this project compete with other open source projects or commercial products?**

No. OpenFIDO has been promoted as complementary with existing software tools. Moreover, it is current US government policy is to not develop technologies that compete with commercial products.
-