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# GridLAB-D Open Workspace (GLOW)
# TAC - Project Update

04.27.22, 10AM-12:30 PM

Yanzhu Ye
Panitarn (Joseph) Chongfuangprinya
Bo Yang

R&D, Energy Solutions Lab, Hitachi America, Ltd. Santa Clara, CA, USA

# GLOW Overview


GridLAB-D Open Workspace (GLOW) is a project to deliver a web-based graphical user interface for GridLAB-D. The open-source user interface aims to augment GridLAB-D in a more intuitive, user friendly manner, contributing to wider use of the simulation technology.

Hitachi aims to achieve the intuitiveness of the tool by employing human-centered design approach. The process includes defining requirements for the interface through researching the potential users and designing the interfaces according to the discovered requirements.

# Agenda

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- Project Plan Overview
- Beta Test Latest Updates
- Future Work & Public Release Plan – GLOW V1.0
- Available Use Cases
- Commercialization Plan

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# Project Plan Overview

# CEC Distribution Resource Modeling Program

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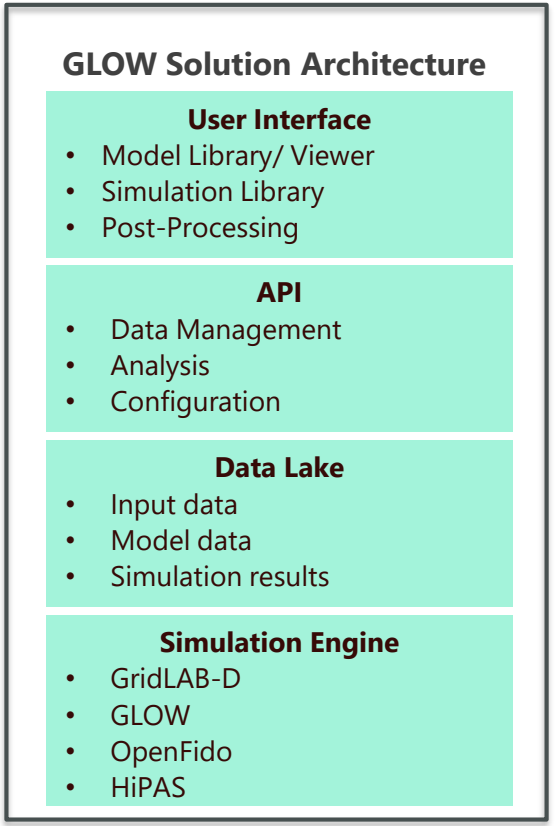
To deliver a set of open-source tools around distribution resource modeling and planning

- **GridLAB-D Open-source Workspace (GLOW)**
  - EPC 17-043 2018-2023
  - General user interface for simulation use cases
    - i.e., Power Flow, ICA
  - **GLOW is primary focus of this presentation**
- High-Performance Agent-based Simulation (**HiPAS)**
  - EPC 17-046 2018-2023
  - High-performance simulation in GridLAB-D
- Open Framework for Integrated Data Operations (**OpenFIDO)**
  - EPC 17-047 2018-2022
  - Data conversion from other tools, e.g. CYME



# GLOW Project Plan - Overview

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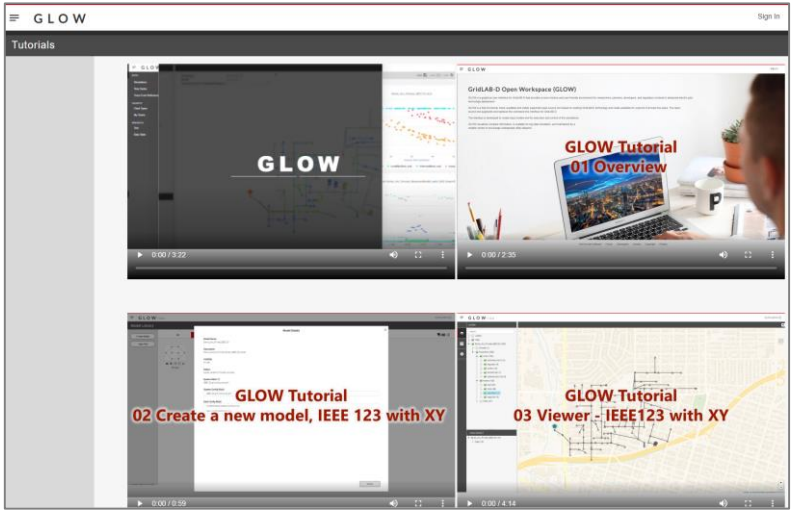
## Task 4.2: Beta Test – fix bugs and provide support

*September 2021 – September 2022*

- ☑ Beta test plan
- ☑ GLOW Beta version release
- ☑ Manual
- ☑ Tutorial videos
- ☑ Test files
- ☑ Monthly update
- ☑ Technical support
- ☑ Fix bugs and develop enhancements
- ❑ GLOW Version 1.0 release plan
- ❑ GLOW Production Test Document
- ❑ New Use Cases Using GLOW Document




## Task 5.1 : GLOW 1.0 Release

*Oct 2022, prepare and release GLOW 1.0 to user community*

- ❑ GLOW Version 1.0 release document

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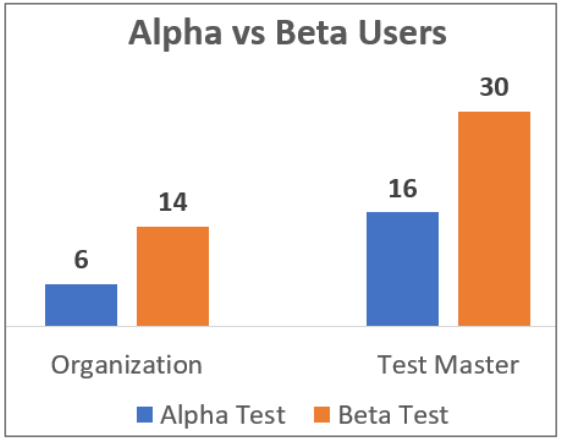
# GLOW Beta Test – Latest Updates

# Beta Test Update

- Environment
  - AWS: A staging environment, similar to production environment.
  - https://glow.hero-energy.com/
- Purpose
  - Unknown bugs and operational challenges
  - Functionality, usability, availability
  - Necessary additional features
  - Scalability and robustness
- Latest Status
  - 5 monthly updates
    - 11/01/21, 12/01/21, 02/01/22, 03/01/22, 04/01/22
  - 30 test masters from 14 organizations
    - (Alpha Test = 16 test masters from 6 org.)
  - USA, UK, Brazil, Singapore
  - 108 login records

# Beta Test Master Feedbacks

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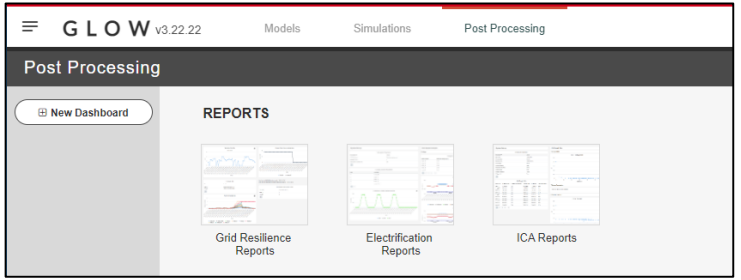
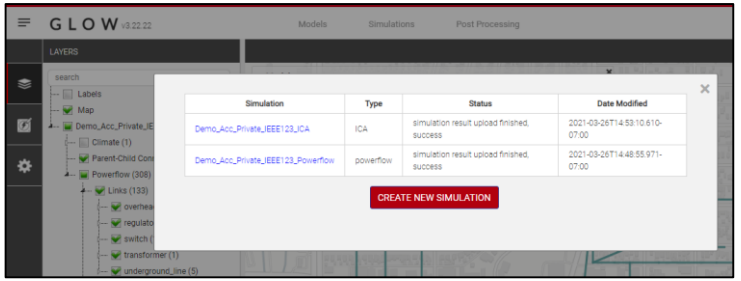
- **Implemented**
  - Additional use case (e.g., grid resilience and electrification)
  - Separate private/public folder in post-processing
  - Post-processing – save to the back-end instead of individual browser
  - User limit (e.g. number of model, parallel simulation)
  - Top bar navigation links to Models/Simulations/Post Processing
  - Create a new simulation directly from Model Viewer
  - In Post-Processing, a user can sort simulation by name or timestamp
  - Model editor, dropdown boxes for configuration parameters
  - Viewer – Editor, Split Link option
  - Default color palette




- **Feedbacks with Work in Progress**
  - Default dashboard for power flow simulation in Post-Processing
  - Automatic update within Model Viewer
  - Automatic validation within Model Viewer

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# Future Work
# &
# Production Release Plan – GLOW V1.0

# Future Works

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- Continue - Beta Test
  - Open to technical society – universities, utilities and research entities
  - Free individual user account, personal evaluation only
  - No sensitive data
  - Fix bugs
- Summarize Alpha and Beta test
- Optimize computational performance and performance test
  - Parallel computing for ICA use case
  - Parallel computing for multiple user
- DistribuTech 2022, Dallas, TX
- Prepare for Production Release (End of Sep 2022)

# Marketing Brochure

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## GLOW

**"A Cloud-based Distribution Modeling and Planning Platform**

GLOW can help **accelerate DERs interconnection** and carbon neutral grid planning

The **energy industry** is facing rapid **digitalization** and the rise of self-generating communities are disrupting the grid.

**Hitachi America R&D Energy Solution Lab** focuses on solving these challenges through **GridLAB-D Open workspace**, i.e. GLOW.

### Benefits

- Enable a broader set of stakeholders to access and use power systems analysis tools
- Improves transparency, availability and liability of advanced grid modeling tools
- Reduce training costs
- Increases productivity

**GLOW is a graphical user interface for GridLAB-D.**

**GLOW** is developed to bridge the industry gap and enables **intuitive resource planning**, which significantly lower the barriers for utility engineers to **analyze** the grid to **accommodate**, **manage**, and **mitigate** the impacts of **DERs** to provide reliable electric service.

- Open-source distribution modeling and planning platform empowered by the industry leading power flow solver, GridLAB-D
- Visualize complex information, support flexible data loading architecture, and provide scalability for big data simulation
- Provides a wide range of capabilities that support the policy, planning, and operation needs of the electric power industry
- Assess impacts to reliability, power quality, and market economics resulting from ders and controllable loads on distribution networks and substations
- Transparent, flexible, and future-proof
- Facilitate data analysis and result realization with integrated post-processing tool
- The open architecture design of glow makes it easy to drive ai based analytical functions interweaving with model-based simulations
- Support deployment on both workstation and cloud computing

### Use Cases

- Hosting capacity analysis
- Electrification evaluation for building and EV loads
- Grid resilience assessment
- Tariff analysis

GLOW is under development by Energy Solution Lab of Hitachi America R&D, with support from SLAC National Accelerator Laboratory, Pacific Northwest National Laboratory, National Grid, Gridworks, and over 30 technical advisors.
The effort is funded by California Energy Commission EPIC program.

HP: https://www.hitachi.us/rd/solutions/energy.html
2535 Augustine Dr, 3rd Floor,
Santa Clara, CA 95054
Phone: +1-669-261-9318
Email: bo.yang@hal.hitachi.com

# Production Release - GLOW V1.0

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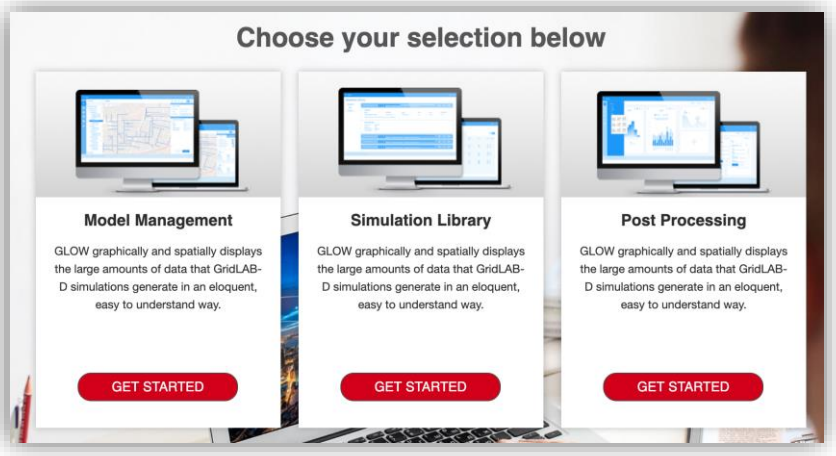
## GLOW Production Release (end of Sep, 2022)




**Objectives**

- Release GLOW 1.0 to public
- Provide support

**Features**

- Model Library
  - Create and validate a feeder model
    - From scratch
    - With default equipment library
    - From GLM and other files
  - View and modify a feeder model
  - Visualize result of simulation (power flow and ICA)
  - Create a simulation directly from Viewer
- Simulation Library
  - Power flow simulation, ICA simulation, Grid Resilience, Electrification
- Post-Processing
  - Visualize result of simulation
- News/Resources
  - Manual, Tutorial Videos

# Production Release Plan

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- Open registration to public
  - Alpha Test = TAC
  - Beta Test = TAC + technical society (researcher, national lab)
  - Production release = public
- 2 Methods
  - https://glow.hero-energy.com/
    - Same as Alpha and Beta test
    - Need approval from us, usually less than 2-3 days.
  - Download a package from a repository
    - May not be available from the beginning
    - BSD license

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# Available Use Cases

# Use Case: Integration Capacity Analysis - Overview

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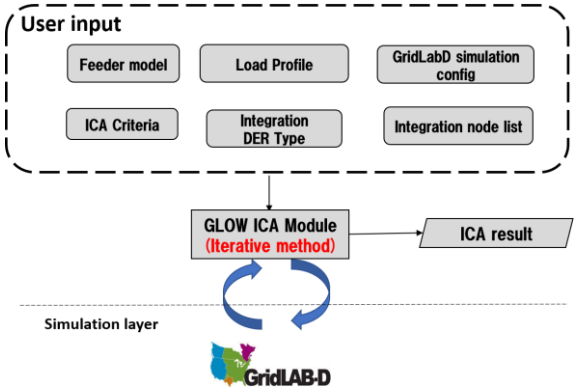
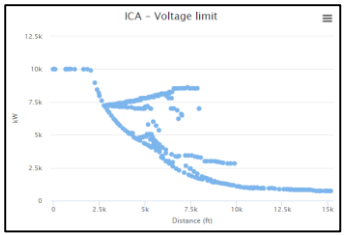
- **Objective**: Identify the maximum DER size that can be integrated onto distribution system down to the line section or node level considering a variety of system operation limits, e.g. voltage limit, thermal limit, etc.
- **Methodology**:
  - *Follow CPUC DRP guidance*
  - Iterative simulation with GLOW enhancement
- **Data Input**:
  - Distribution network feeder model (.GLM model)
  - ICA analysis settings
    - Integration DER type, system integration node list, ICA criteria, integration capacity limit, etc.
- **Analysis Output**
  - Integration capacity analysis report (template-based)
  - Customized dashboard plotting
  - Graphical visualization over distribution map



# Summary & Updates– ICA

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- **Summary:**
  - ✓ GLOW Analytical workflow for integration capacity analysis
    - Meets CPUC DRP guidance.
    - Multi-thread processing for efficiency improvement
    - Flexible ICA reporting format
  - ✓ Benchmarking with industry tools
    - ICA results from GLOW ICA and CYMDIST are well aligned for IEEE 123 testing feeder.

- **Updates**
  - ✓ Performance testing using utility feeders of different sizes
  - ✓ Further computational efficiency improvement
  - ✓ Graphical visualization over distribution map in GLOW/Viewer

- **Status:**
  - ✓ currently deployed/validated

Table. Methodology matrix

| | GLOW ICA | CPUC DRP requirement |
|---|---|---|
| Iterative approach | √ | √ |
| Three-phase node | √ | √ |
| Load-type ICA | √ | √ |
| Generation-type ICA | √ | √ |
| Thermal criteria | √ | √ |
| Voltage variation criteria | √ | √ |
| Voltage steady-state criteria | √ | √ |
| Accessible ICA results | √ | √ |

# Performance testing with utility feeders

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- Computation performance testing
  - IEEE 123 + 5 utility feeders with different system size
  - System-wide ICA calculation (*all three-phase nodes*)
  - Computational environment:  4 vCPUs, 16GB memory
  - Maximum integration capacity: 10,000 kW
  - ICA resolution: 50KW
  - ICA criteria: *SSV*(steady state voltage) limit: 95%-105%

**Summary:**

- The ICA run-time is impacted by
  - no. of ICA nodes being studied,
  - feeder system size,
  - maximum integration capacity, ICA resolution, etc.
- Further improvement can be done through parallel computation.

Table. ICA computation time (SSV) for different feeders

| Feeder name | No of nodes | No of link | Nominal Voltage (V) | ICA run-time (second) | No of ICA node (3-phase only) | ICA run-time (second) | No of ICA node (1,2,3-phase) |
|---|---|---|---|---|---|---|---|
| **IEEE123** | 134 | 130 | 2041 | 1.7 | 70 | 2.6 | 130 |
| **Feeder #1** | 1547 | 303 | 4200 | 19 | 142 | 109 | 1435 |
| **Feeder #2** | 990 | 921 | 4800 | 41 | 330 | 105 | 807 |
| **Feeder #3** | 1364 | 408 | 4200 | 23 | 179 | 98.8 | 1236 |
| **Feeder #4** | 1670 | 1323 | 4800 | 81 | 371 | 271 | 1344 |
| **Feeder #5** | 2455 | 1797 | 13200 | 97 | 381 | 544 | 2012 |

# Use Case – Electrification Analysis - Overview

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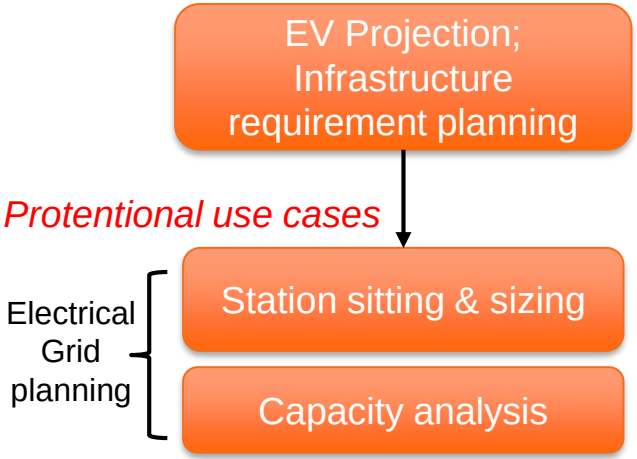
- **Objective**: To study the impact of EV charging station integration on distribution networks under different scenarios.
- **Methodology**
  - GridLAB-D time-series power flow simulation
  - EV charging load profiling
  - EV placement modelling
  - Grid impact assessment
    ✓ *system voltage, system component thermal loading, system peak demand, system losses, etc.*
- **Data Input**
  - Distribution network feeder model
  - System loading characteristics
  - EV placement settings: EV charging station number, deployment type
  - EV charging load profiles
- **Analysis output**
  - Grid impact analysis report (template-based)



# Summary & Updates– Electrification Analysis

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- **Summary:**
  - ✓ GLOW Analytical workflow for Electrification Analysis

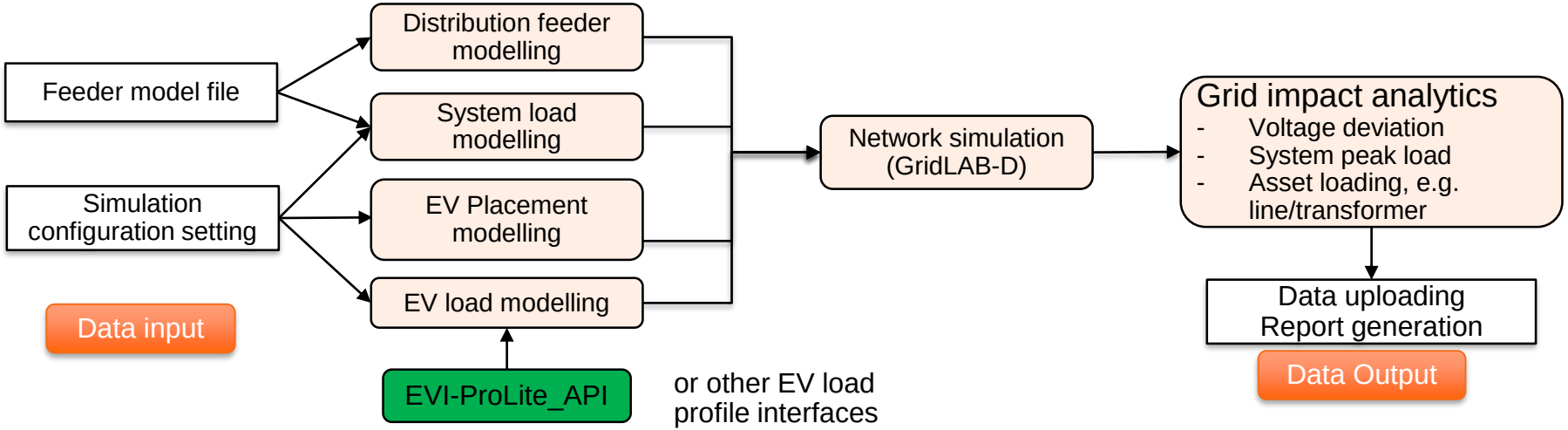
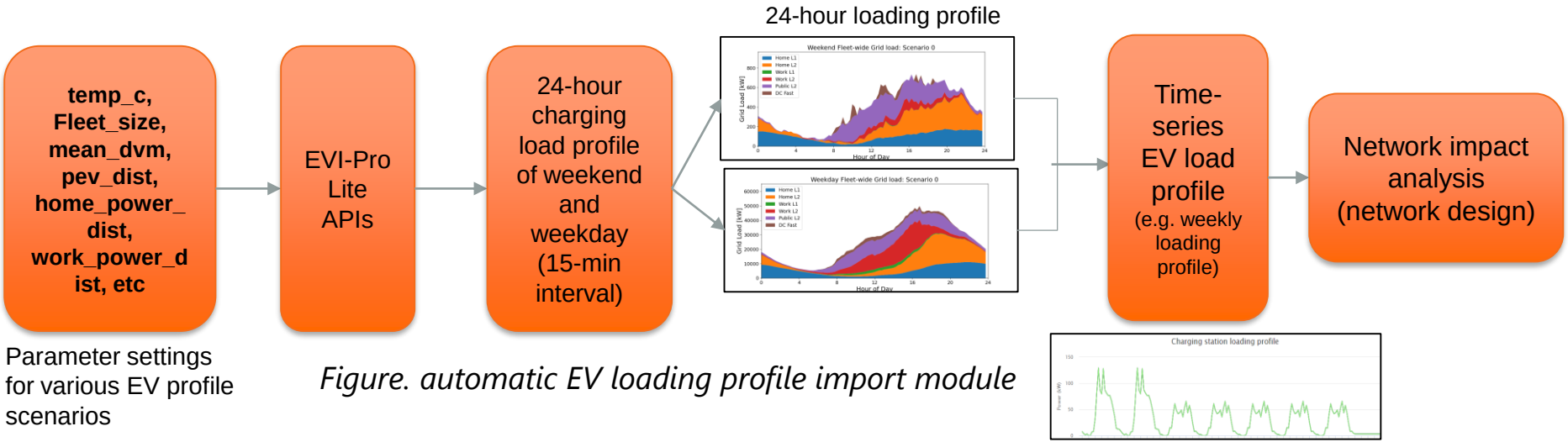



Fig. GLOW data/control flow for GLOW electrification use case

- **Updates**
  - ✓ Performance testing on utility feeders
  - ✓ *New EV loading profile import module using EVI-Pro-Lite APIs*
- **Status:**
  - ✓ currently deployed/under active testing

EVIProLite_API

EVI-Pro Lite is a simplified version of the Electric Vehicle Infrastructure Projection Tool (EVI-Pro), which has been developed through a collaboration between NREL and CEC.
*EVI-Pro Lite API*: query of synthetic charging load profiles (weekends and weekdays) for a variety of customizable scenarios




Parameter settings for various EV profile scenarios

*Figure. automatic EV loading profile import module*

❖ https://afdc.energy.gov/evi-pro-lite/load-profile/assumptions

# Summary & Updates– Grid Resilience

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- **Summary:**
  - ✓ Analytical framework for grid resilience assessment (grid anticipation)
    - ✓ Support HiPAS GridLAB-D analytical pole/line vulnerability model
    - ✓ Perform grid and asset vulnerability assessment under extreme weather conditions (through time-series simulation)
    - ✓ Grid resilience metric analysis
    - ✓ User-friendly graphical simulation set-up wizard + automatic report generation (template)
- **Updates**
  - ✓ Support latest updated powerflow module within **HiPAS GridLAB-D**
    - ✓ Pole object
    - ✓ Pole configuration
    - ✓ Pole mount
- **Status:**
  - ✓ Currently deployed/under active testing

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# Consortium for post project support

# Post project collaborations

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DER modeling efforts won't stop after the project

- Continuous support for what we have developed
  - GLOW 1.0 production release
  - Bugs and issues
  - Minor changes

Beneficial to keep the momentum and further advance the frontier

- New features/use cases development
- Additional modeling capabilities
- As a service to those needed

# DER modeling consortium – preliminary thoughts

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Provide a group/entity that is lead by and serves the users of GLOW, HiPAS GridLAB-D, and OpenFIDO.

Proposed range of services

- Training and Education
- Technical Support
- Software Maintenance and Operations
- Research and Development

# Consortium Benefits

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**Training and Education** - Deliver training videos, continuing education course, and university/college courseware to ensure sufficient workforce for utilities, regulators, vendors, and researchers.

**Technical Support** - Provide highly qualified technical support resources.

**Software Maintenance and Operations** - Maintain the open-source operational infrastructure needed to use the tools

**Research and Development** - Provide advanced technical services for new use-cases, data sets, and tools needed by utilities, regulators, and vendors.

# Consortium Operation model – Software as a service

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## GLOW/HiPAS/OpenFido as a service

- Hosted on the cloud
- Use it as you wish – save infrastructure and license investment
- Integration with 3rd party tools through APIs

## Consortium to keep it up

- Available when you need it
- Cloud computing at ease
- Flexible cost structure
- Dedicated support

# Consortium Operation Model – Special projects

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New feature or use case development

- At your request
- Prioritized per your needs
- Feasibility study and value proposition for new initiatives

A customized program for repeatable and scalable use

- Pilot implementation with solid product quality
- Shared cloud platform with reduced development cost

# Thank You


- California Energy Commission
- California Public Utility Commission
- South California Edison
- Pacific Gas & Electric
- Sunrun
- Kevala Analytics
- SLAC
- Gridworks


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