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GridLAB-D Open Workspace (GLOW) Technical Advice and Discussion

04.06.23, 12:45 PM-1:15 PM

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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
- Alpha and Beta Test
- GLOW Version 1.0 Release
- Other Activities
- Parallel Computing Test
- Summary
- Discussion / Questions

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Project Plan

CEC Distribution Resource Modeling Program

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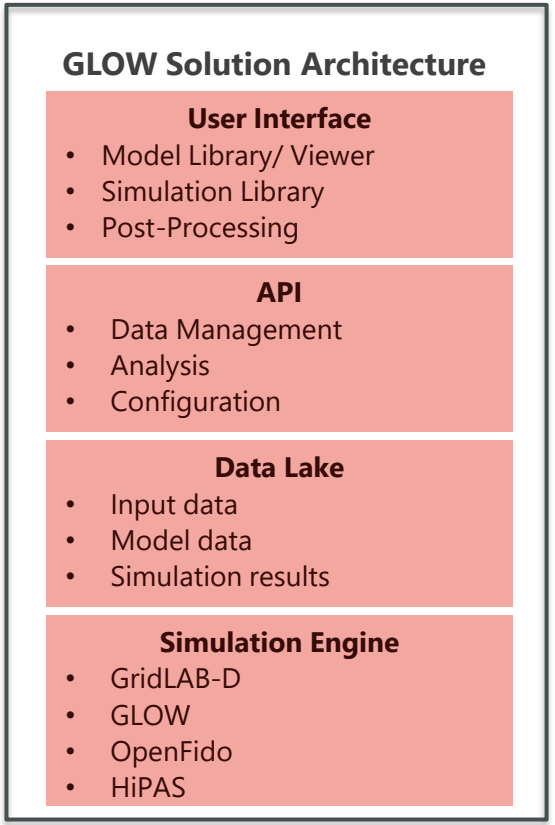
To deliver a set of open-source tools around distribution resource modeling and planning

- **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 2: User Requirements / Specification

January 2019 - March 2019

- ☑ Interviews with TAC members
- ☑ Ethnographic analysis
- ☑ GLOW ideation and architecture

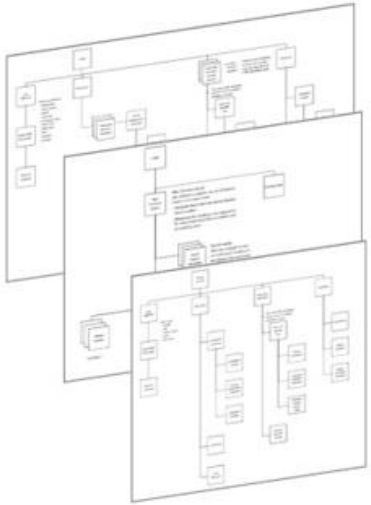
Task 3 : Implementation

April 2019 – September 2020

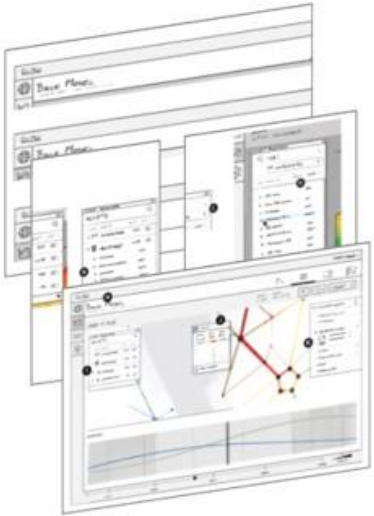
- ☑ GLOW architecture design
- ☑ UI blueprint design
- ☑ UI prototype implementation
- ☑ Backend implementation
- ☑ GridLAB-D integration and validation
- ☑ Production candidate one release (Alpha Version)

Workshops

Task Flows



Sketches



Requirements

GLOW Project Plan – Overview

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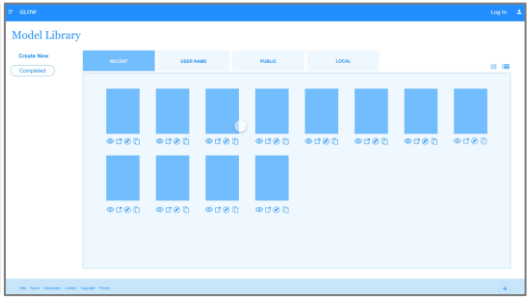
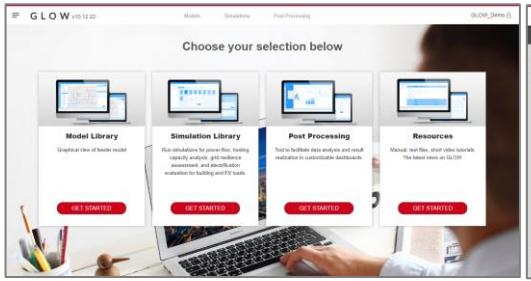
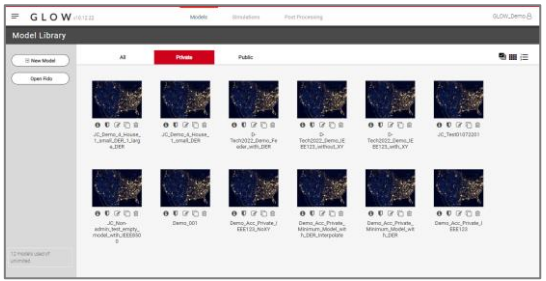
Task 4: Quality Test (Alpha & Beta Test)

September 2020 – August 2022

- ☑ Alpha & Beta test plan
- ☑ Monthly meeting and update
- ☑ Quick guide document
- ☑ Additional use cases
- ☑ GLOW Beta version release
- ☑ Manual
- ☑ Tutorial videos
- ☑ Test files
- ☑ Technical support
- ☑ Fix bugs and develop enhancements







Task 5: GLOW 1.0 Release

Release GLOW 1.0 to user community

- ☑ GLOW V1.0 (Cloud)
- ☑ GLOW V1.0 (Download) release
- ☑ GLOW release document
- ❑ Software Maintenance

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GLOW Alpha and Beta Test

Alpha and Beta Test Summary

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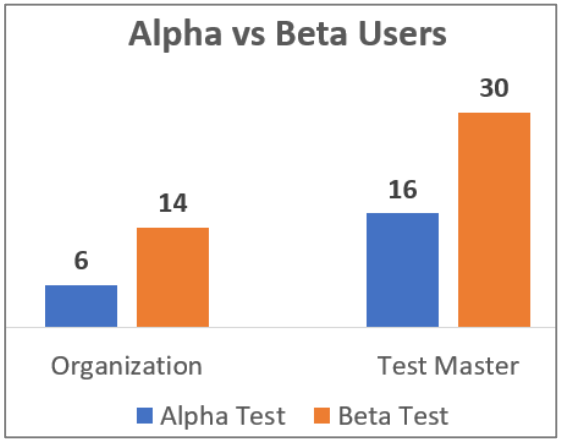
- Environment
  - AWS: A staging environment, similar to production environment.
  - https://glow.hero-energy.com/
- Purpose
  - Unknown bugs and operational challenges
  - Functionality, usability, availability
  - Necessary additional features
  - Scalability and robustness
- Test Masters
  - 30 test masters from 14 external organizations
  - USA, UK, Brazil, Singapore



From Alpha to Beta to V 1.0

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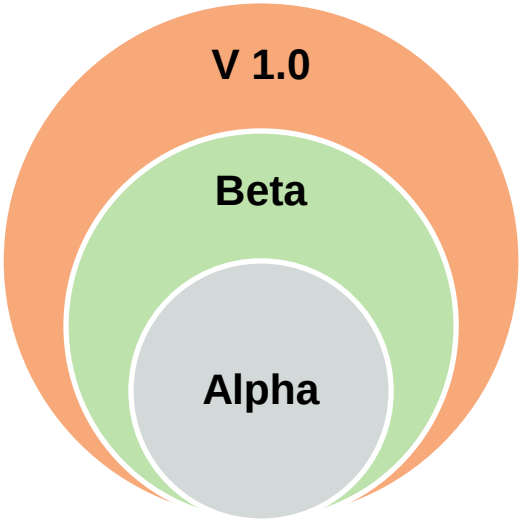
Alpha
- **40 %** of overall requirements
- Implemented based on priority
- Only core functions
- Minimal viable features
  - Load GridLAB-D dataset for power flow simulation
  - Graphic view of models
  - Post-processing – only snapshot

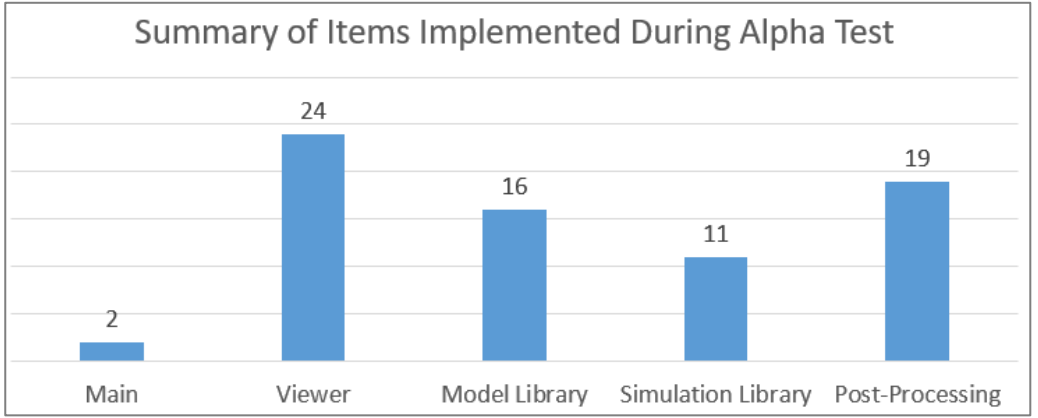


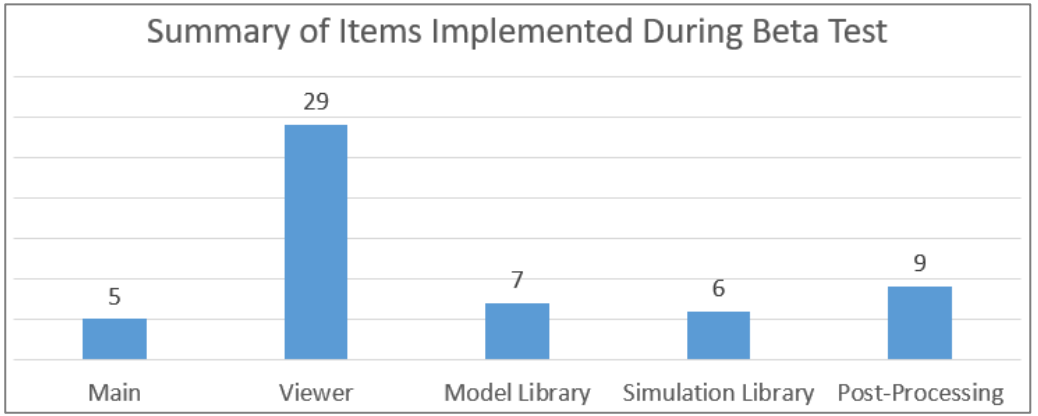
Beta
- **80 %** of overall requirements
- Add features / fix bugs based on feedback
  - Create a model from scratch in GLOW
  - Preloaded data (equipment library from IEEE 8500 model)
  - Display only required parameters as default
  - Clarification message for model validation error
  - Post-processing – time-series chart

V 1.0
- **100%** of overall requirements
- Add features / fix bugs based on feedback
  - Additional use case (e.g., 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
  - 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

Implemented Features

- Based on feedbacks from Test Masters
- Alpha Test
  - September 2020 – August 2021
  - 10 monthly updates for Alpha Test
  - 72 items
- Beta Test
  - September 2021 – August 2022
  - 8 monthly updates for Beta Test
  - 52 items





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GLOW Version 1.0

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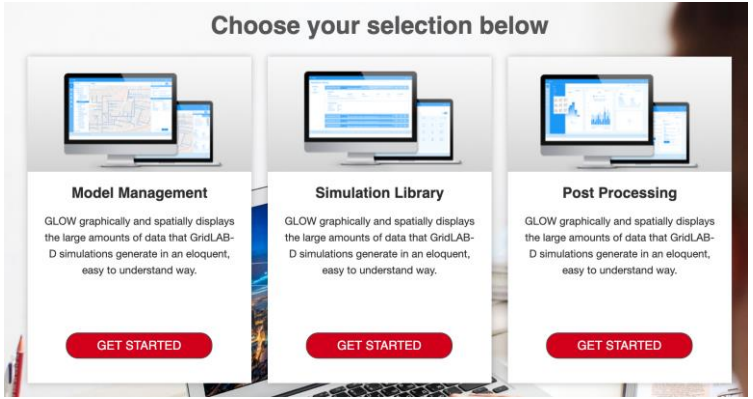
GLOW Production Release

Objectives

- Release GLOW 1.0 to the 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 / Use Cases
  - Power flow simulation, ICA simulation, Electrification
- Post-Processing
  - Visualize result of simulation
- News/Resources
  - Manual, Tutorial Videos



Production Release

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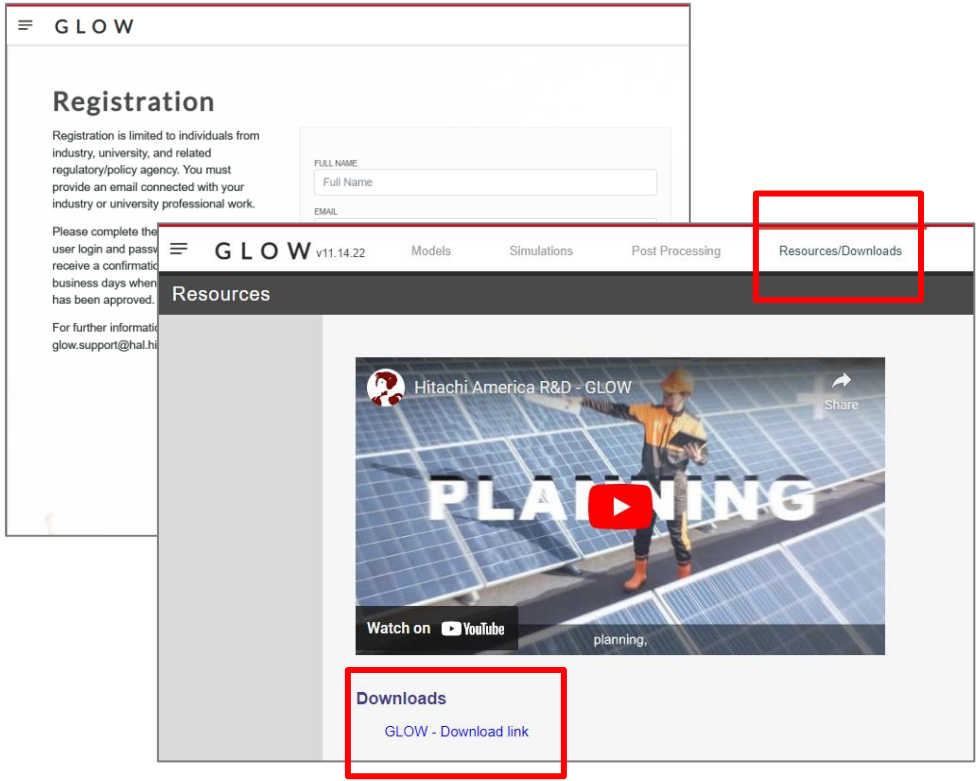
- **GLOW Website**
  - **https://glow.hero-energy.com/**
- Open registration to public
- GLOW is available in 2 versions:
  - GLOW as a service on the cloud
    - Released 10/2023
  - Download Version
    - Released 03/2023
- A user can register through GLOW website to access both versions of GLOW.



- Note – GLOW is using HiPAS GridLAB-D 4.3.1-220805 as a simulation engine.

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Other Activities

Recent Knowledge Transfer Activities

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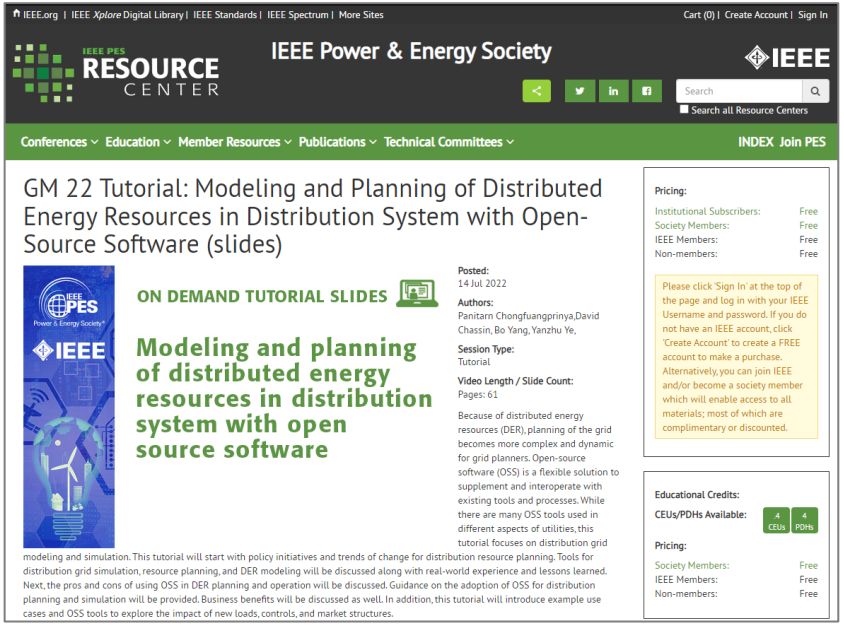
1. Title: “Hitachi America R&D – GLOW”
   - Marketing Video on YouTube - 07/2021
   - https://www.youtube.com/watch?v=ep70nKCPct4&ab_channel=HitachiGlobalResearch
2. Title: “Modeling and Planning of Distributed Energy Resources in Distribution System with Open-Source Software”
   - IEEE General Meeting Tutorial 2022
   - Panitarn Chongfuangprinya, David Chassin, Bo Yang, Yanzhu Ye
   - https://resourcecenter.ieee-pes.org/education/tutorials/PES_ED_TUT_GM22_0717_DERDS_SLD.html
3. Title: GLOW “A Cloud-based Distribution Modeling and Planning Platform”
   - Marketing Brochure – (e.g., for DistribuTech 2022, Dallas, TX)
   - https://glow.hero-energy.com/
4. Series of 10 GLOW Tutorial Videos
   - https://glow.hero-energy.com/



DistribuTech 2022, Dallas, TX

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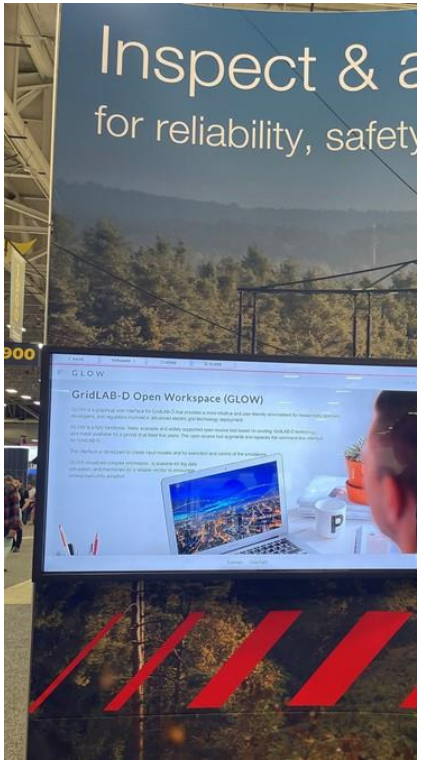

Marketing Brochure

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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.

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Commercialization discussions

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- Leverage Hitachi's customer relations for more GLOW pilot, e.g., National Grid, SCE
- Internal effort evaluating integration of GLOW with our Grid Edge solutions
- Promote GLOW (open source) through research partners
    - PSERC universities
    - Apply GLOW in several DOE proposals (FOA 2565-Energyshed)

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Parallel Computing Test

National Grid Use Case Project

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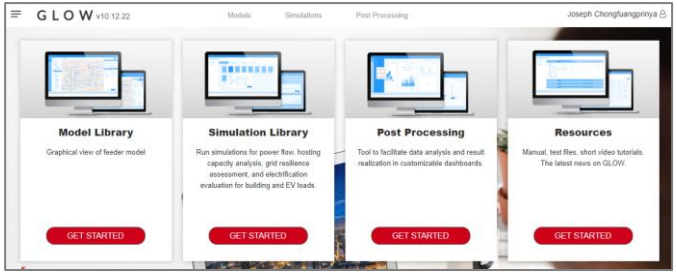
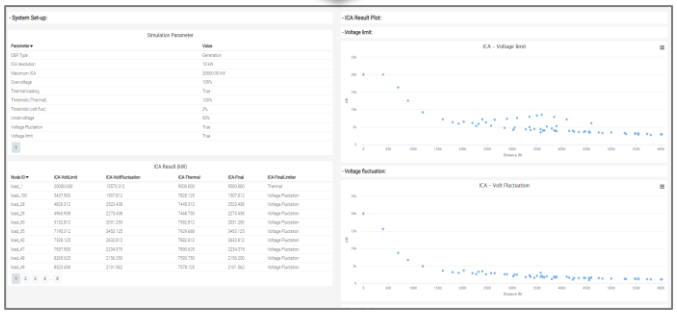
- Collaboration with SLAC Team
- Benefit to GLOW development
  - To validate GLOW with actual data
  - To make an enhancement to GLOW
  - To test parallel computing
- Long-term load forecast for the NY region (15 Years)
  - Over 1,000 feeders
  - Hourly power flow simulation for 1 year
  - Less than 4 hours to run with parallel computing
- Recommendations of GLOW enhancement
  1. Long term load forecast module
  2. Standardize the process
  3. Automatic data and model update (e.g., API)
  4. Viewer page for model debugging
  5. Parallel computing



5th Module: Long-Term Load Forecasting

Example page for result validation



Parallel Computing

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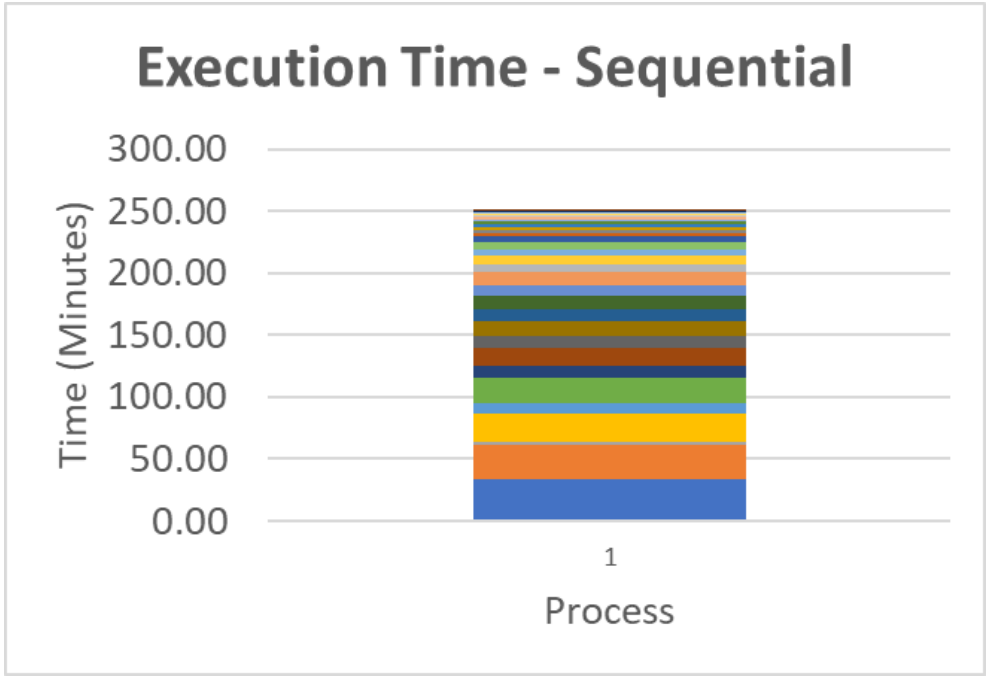
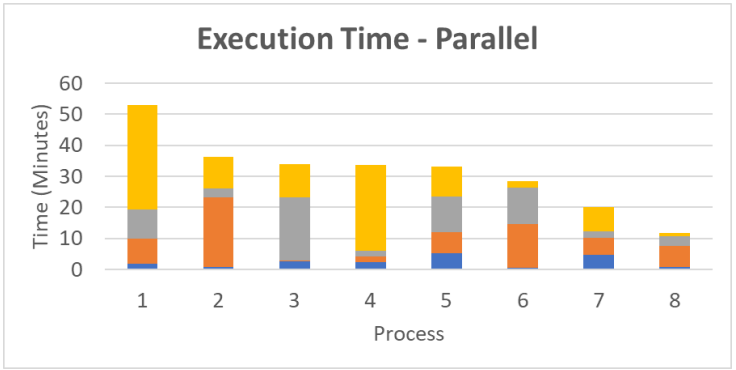
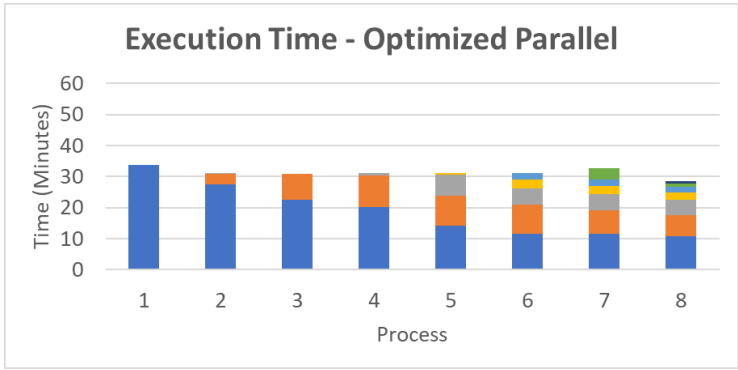
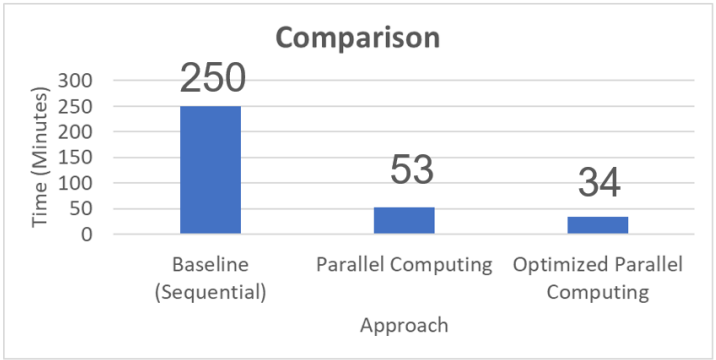
- 8760-hour power flow
  - 32 utility feeders
  - Maximum 34 minutes
  - Minimum 15 seconds
  - Total 250 minutes



Parallel Computing







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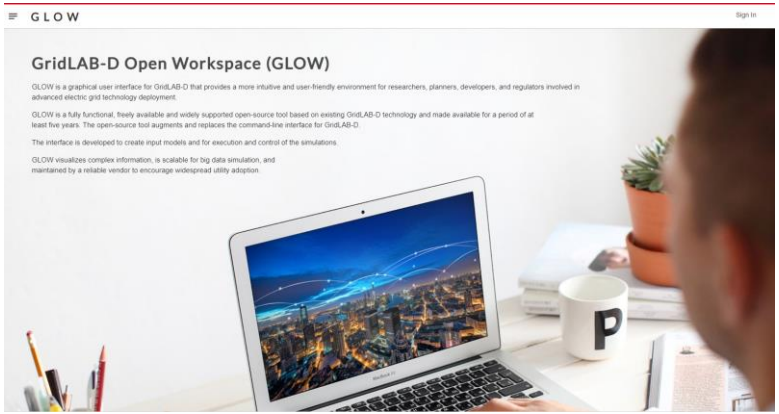
Summary

Summary

- GLOW V1.0
  - A distribution planning and modelling platform
  - Designed for distribution resources planning
  - Web-based GUI for GridLAB-D
  - Open-source
  - Support deployment on workstation/cloud
  - Use Cases
    - Power flow simulation, ICA simulation, Electrification
  - **https://glow.hero-energy.com/**
- Activities related to knowledge transfer
  - Tutorial
  - Marketing
- Benefit
  - Attract more user community
  - Facilitate the adoption of DER integration
  - Facilitate decision-making process



Discussion / Questions

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- What future applications do you anticipate long term?
- What new capabilities do you wish to see?
  - Additional need/features for utilities ?
  - High performance parallel simulation ?
  - Use cases ?
  - Priority?
- What benefits were made possible by this project?
- What is necessary to realize those benefits?
- Recommendation?

Thank You

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