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QuESt 2.0 – Open-source Python Platform for Energy Storage Analytics: Major Updates.

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2023 DOE Energy Storage Peer Review

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Content

2023 DOE Energy Storage Peer Review

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Project Objective

- *Objective:* develop QuESt as a platform that can provide access points to multiple independent applications, a workspace for integrating multiple apps into a work process, and data analytics tool for the characterization and visualization of large datasets.

- *Methodology:*
  - standardized the data and program structure of individual applications to simplify the apps' installation, operation, and maintenance,
  - developed plug-ins to seamlessly integrate of applications within a work process,
  - created an application called QuESt-GPT utilizing Large Language Modeling (LLM) to characterize and visualize large datasets.

QuESt – Background

2017

2017
START THE DEVELOPMENT OF QUEST

2018-2019

2018
RELEASE QUEST 1.0 WITH VALUATION TOOL FOR ESTIMATING REVENUE OF ENERGY STORAGE IN ELECTRICITY MARKETS

2019
RELEASE QUEST 1.1, 1.2 WITH BEHIND-THE-METER (BTM) TOOL FOR VALUATING COST SAVING BY BTM ENERGY STORAGE FOR UTILITY CUSTOMERS

2020-2021

2020
- START THE DEVELOPMENT OF ENERGY STORAGE TECHNOLOGY SELECTION TOOL
- COLLABORATE WITH QUANTA TECHNOLOGY TO DEVELOP INTEGRATED RESOURCE PLANNING TOOL

2021
START THE DEVELOPMENT OF ENERGY EQUITY AND PERFORMANCE TOOLS

2022-2023

2022
- RELEASE QUEST 1.6 WITH ENERGY STORAGE TECHNOLOGY SELECTION AND PERFORMANCE TOOLS
- RELEASE QUEST 1.8 WITH ENERGY EQUITY AND MICROGRID
- REDESIGN QUEST LIBRARY AND QUEST DESKTOP APPLICATION.

2023
QUEST 2.0 PLATFORM: QUEST APP HUBS, QUEST WORKSPACE, QUEST GPT .

Current Plan

Develop QuESt platform and expand energy storage analytic capabilities

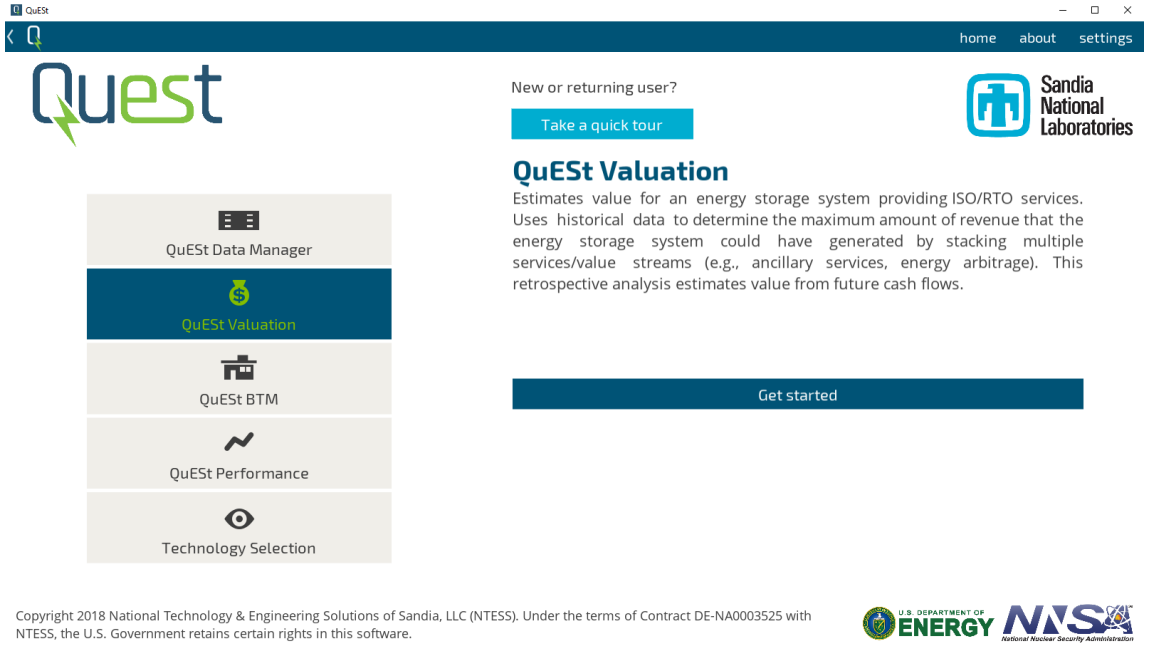
5-year Goal

Make QuESt platform as the one-stop shop for all Sandia's and OE's energy storage analytic capabilities

QuESt – Version 1.6

QuESt 1.6:

- **QuESt Data Manager** – Manages acquisition of data.
- **QuESt Valuation** – Estimate potential revenue generated by energy storage systems providing ancillary services in the electricity markets of ISOs/RTOs.
- **QuESt BTM** – Estimate the cost savings for time-of-use/net energy metering customers using behind-the-meter energy storage systems.
- **QuESt Technology Selection** – Support storage technology selection given applications and other requirements
- **QuESt Performance** – Evaluate energy storage system performance in different climates



- Version 1.6 available on GitHub
  - https://github.com/sandialabs/snl-quest

QuESt – Main Challenges

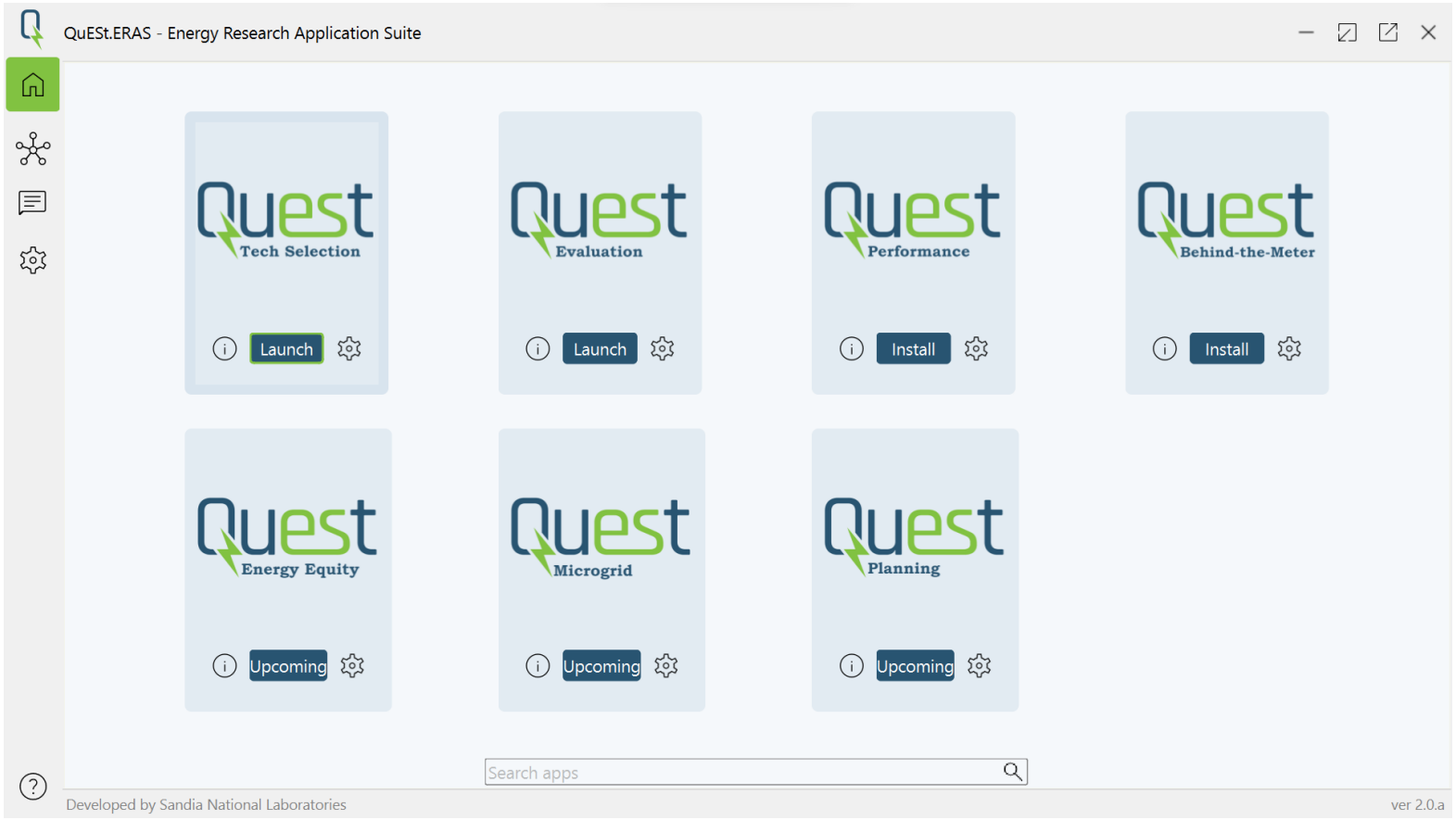
For users:

- Unable to install (50%):
  - Many dependencies: kivy, pyomo, solvers, ...
  - Users might only one application but have to install all.
- Program crashes due to unknown errors (45%):
  - APIs are not stable
  - Adding applications causes version control issues of libraries.
- Other issues (5%):
  - Unable to adjust window size.
  - Unable to generate reports

For developers:

- Difficult and time consuming to develop a new app:
  - Data, utilities, GUIs are well glued in one package
    - developers must understand the code very well to integrate a new element.
    - developers cannot work in parallel.
- GUI development is the bottle neck

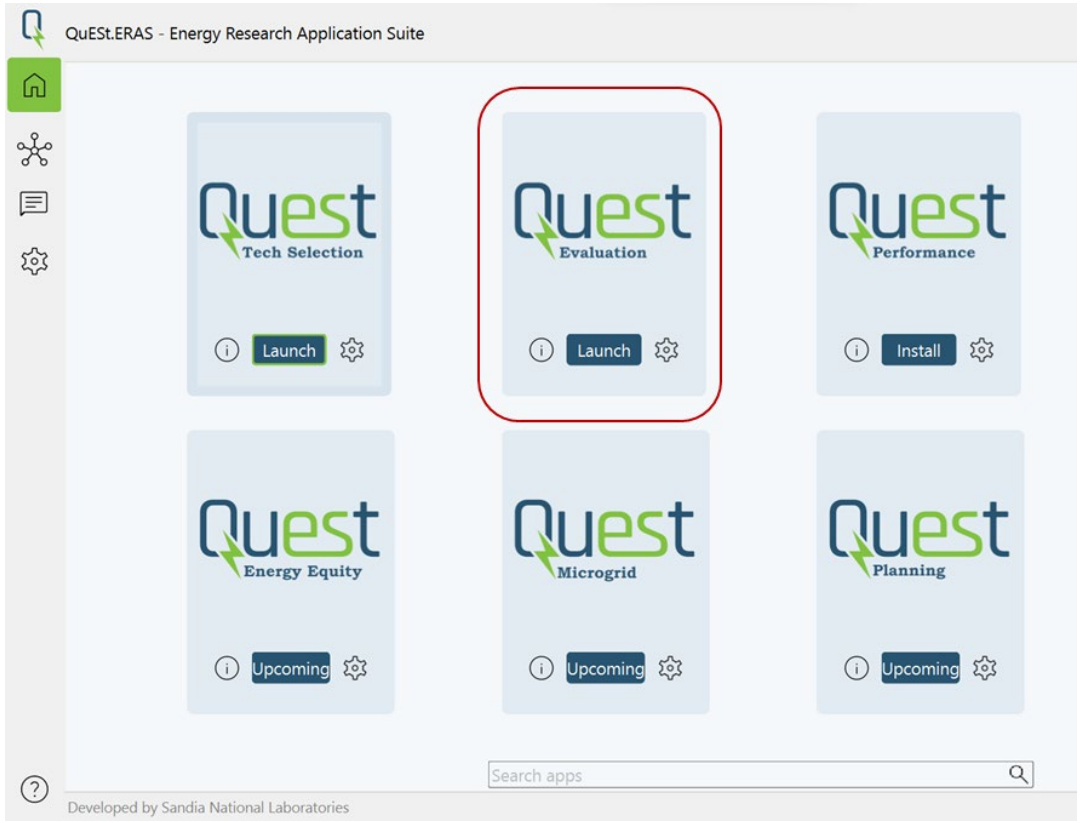
QuESt 2.0 – Major Updates

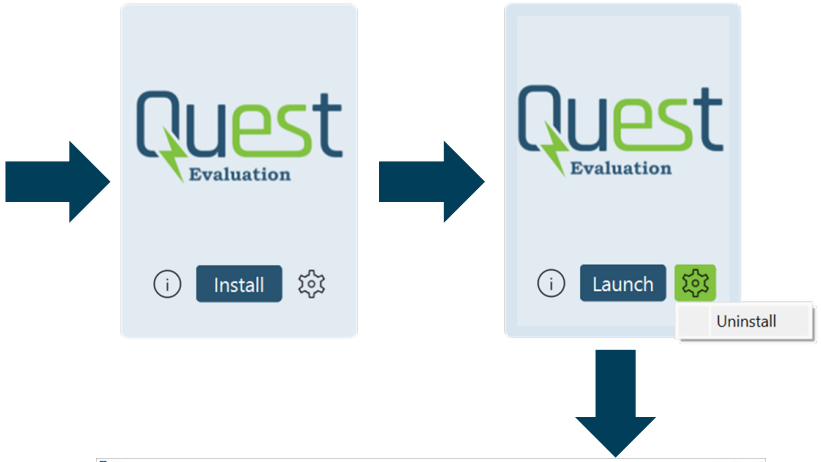


- QuESt 2.0 includes 3 main components:
  - QuESt App Hub works like an apps store that provides access points to multiple apps.
  - QuESt Workspace provides an environment for integrating multiple apps into a work process
  - QuESt GPT is a data analytic tool for the characterization and visualization of large datasets using LLM.

In Version 2.0, QuESt has been transformed from a software to a software platform.

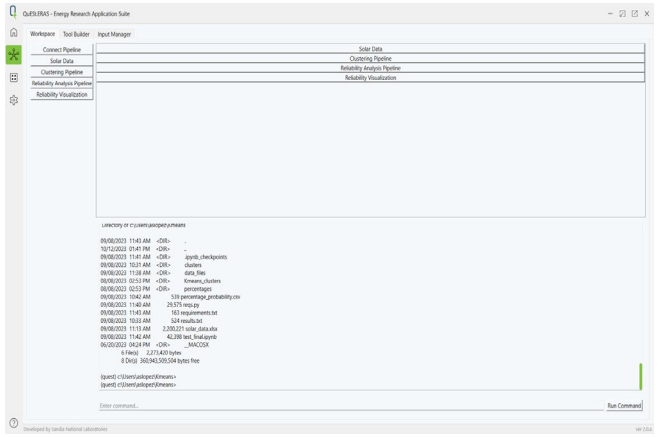
QuESt App Hub





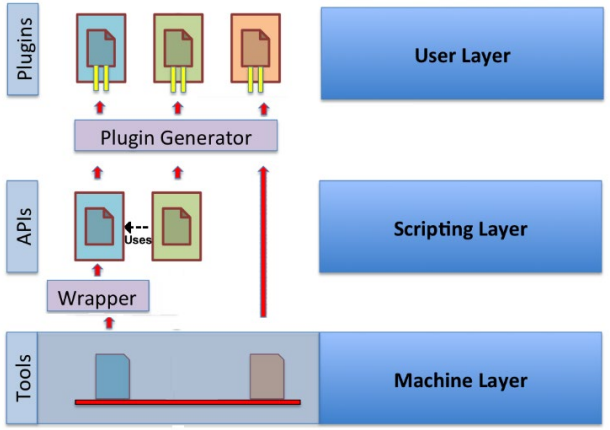
- Main features:
  - Users can find and install applications that suite their needs.
  - Installation initiates the creation of an isolated environment.
  - Each application runs in an isolated environment
  - Multiple applications can be installed and run simultaneously.

QuESt Workspace



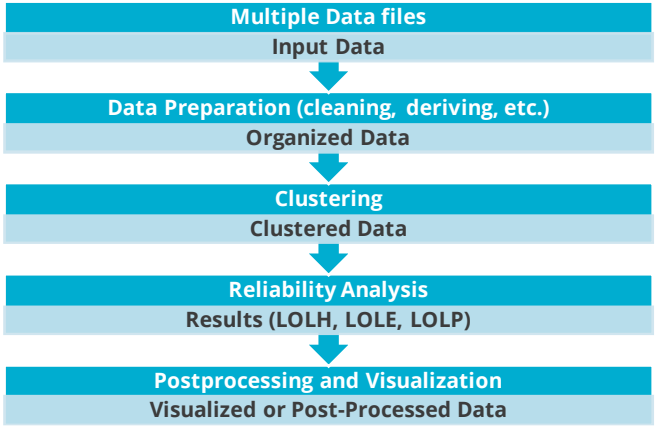
Workspace Overview

Workspace is where users can create work processes that integrate multiple apps by assembling pipelines using plugin extensions (Apps).



Conceptual Design of PluMA

Python, Perl and R plugins interface to the scripted layer of PluMA. Compiled plugins in C++ or CUDA to the computational (machine) layer.



Pipeline Example

Each stage in PluMA gets executed sequentially, with the output of a specific stage serving as input to a later stage of the pipeline.

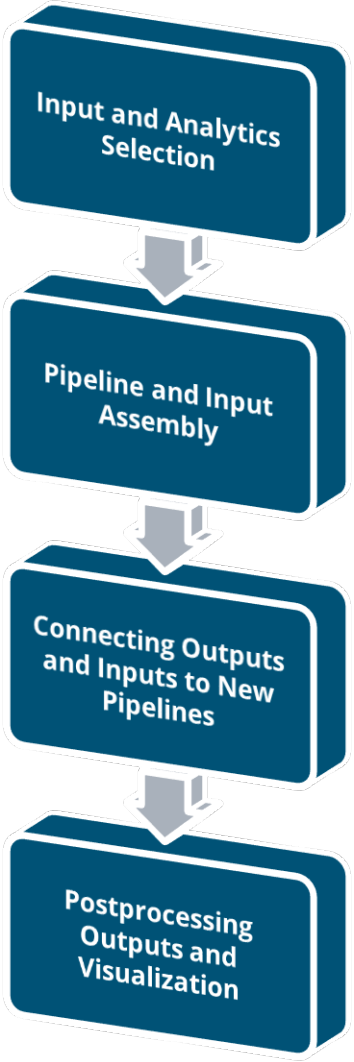
QuESt Workspace – Workflow

1
Selection

The Workspace's selection process allow users to choose the most suitable inputs and tools for their data analytics requirements.

3
Connections

The Workspace allows users to feed the outputs of smaller pipelines into new pipelines or tools transforming extensive pipeline strings into an easy-to-follow sequential workflow.



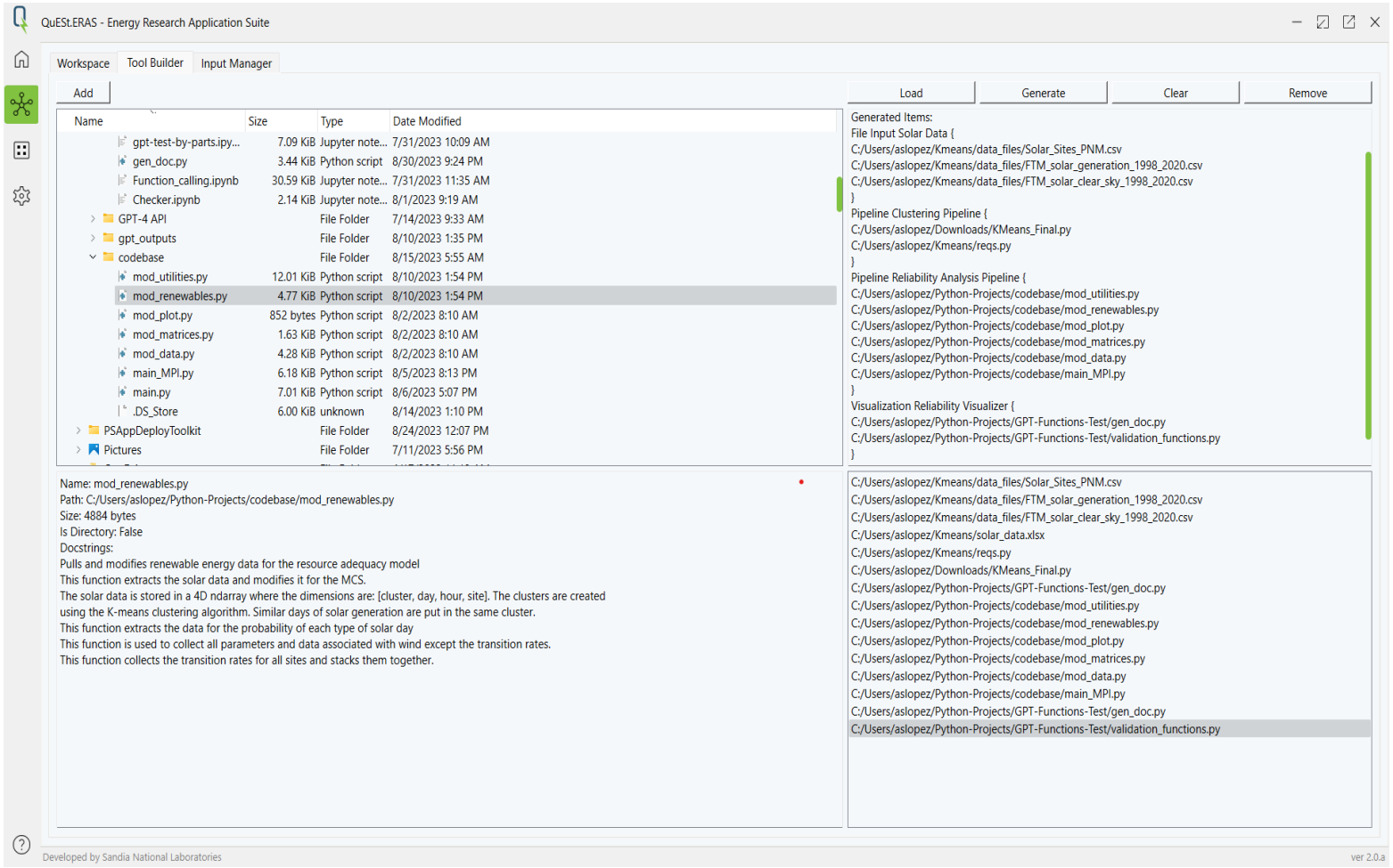
2
Assembly

The assembly process of the Workspace enhances data usability and the efficiency of analytics tools

4
Postprocessing

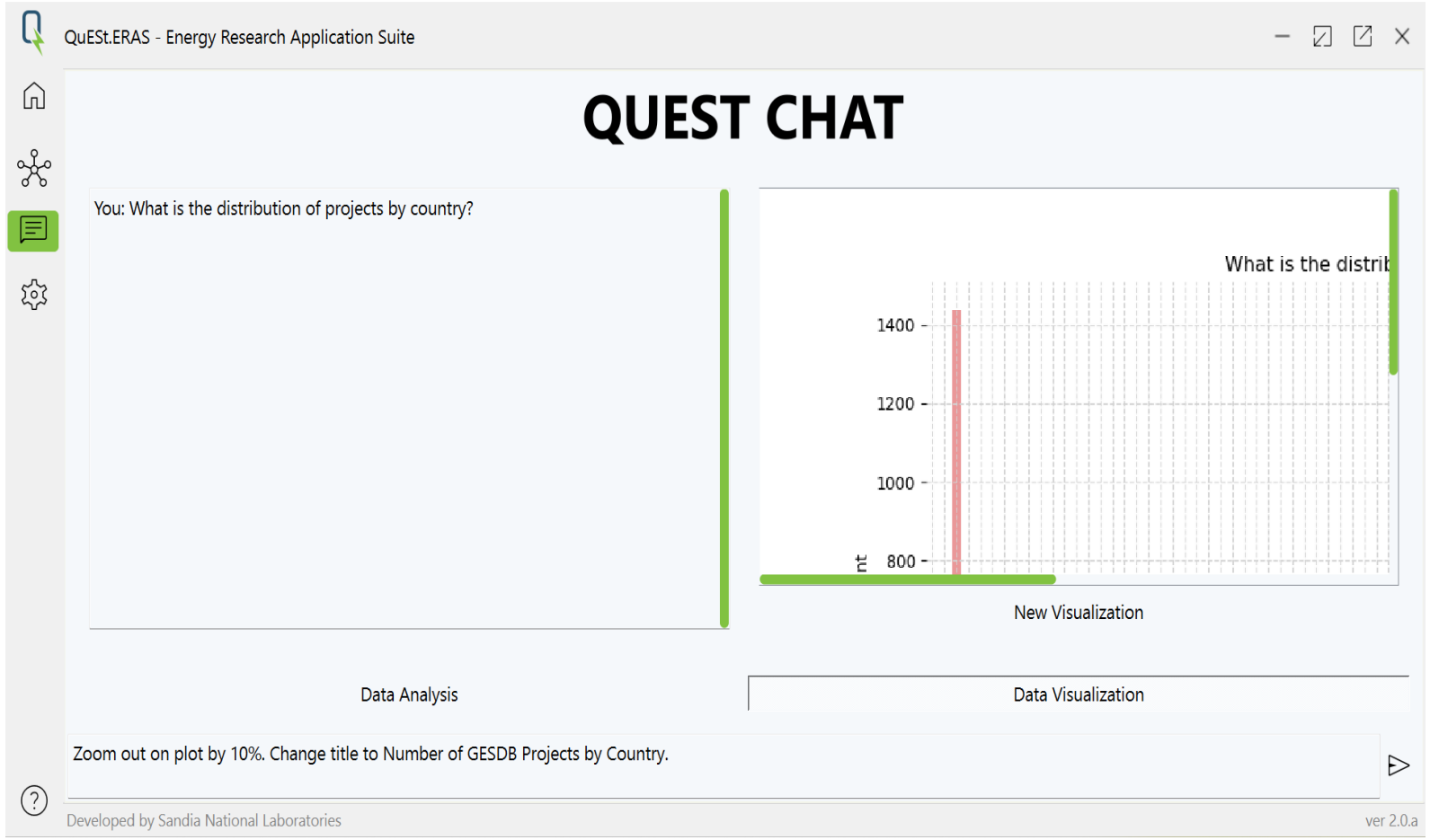
Beyond the interconnection of inputs, outputs, and pipelines, the system also allows for post-processing of data, preparing it for either visualization or subsequent utilization.

QuESt Workspace – Tool Builder



- The Tool Builder serves as the hub for both selection and assembly processes.
- Through the file explorer, users can select files, tools, and programs for use.
- These selected files or programs can then be loaded into pipeline tools, which are displayed in the workspace toolbar.
- In the details section of the Tool Builder, users can view the inputs and features of the selected programs.

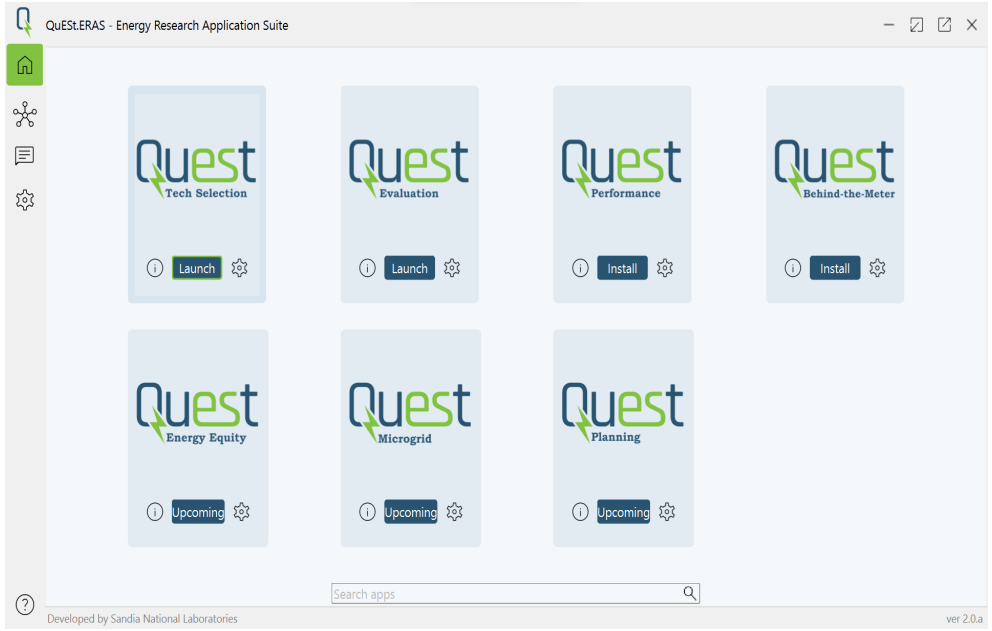
QuESt GPT



- QuEStGPT allows users to select the dataset they want and ask questions about the data.
- QuESt GPT utilizes OpenAI's core engines to characterize users' data.
- QuEStGPT knows the data only by column names and some example data points, so make sure to refer to data by its proper name.

QuESt – Future Work

- Release QuESt 2.0 on github by the end of 2023.
- Collect users' feedback and improve platform functionalities:
  - Workspace: automate plugin creation and add drag drop tool.
  - GPT: improve GUI and data visualization.
- Expand QuESt capabilities: increase the number of apps
  - QuESt Microgrid 2.0
  - QuESt Equity
  - QuESt Planning
  - QuESt Reliability



QuESt platform – the store front for all Sandia's energy storage analytic capabilities

Acknowledgements

QuESt Team

Platform Developers

Yung-Jai Pomeroy, Andres Lopez, Jeb Brysacz

Tool Developers

Atri Bera, Cody Newlun, Walker Olis, David Rosewater, Ujjwol Tamrakar, Will Vining, John Eddy

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