HiPAS GridLAB-D
Technology Transfer Report

Technology Transfer Goals

The primary technology transfer objective of the HiPAS GridLAB-D project is to transform the DOE GridLAB-D software product into an open-source version that is more widely accessible to industry and academic users.

The collaborations with the GLOW and OpenFIDO projects have enabled two important channels to market through an open-source platform for modeling and simulation and an open-source platform for data management. In the former case, GLOW is supported and distributed by Hitachi America, and part of the HERO suite of energy system engineering products. In the latter case, OpenFIDO is made available to the same user community at no charge.

Technology Transfer Approach

By 2050, rapid innovations will transform how we create, distribute, and use energy. Software-centered energy infrastructure is the principal fulcrum for decarbonization. To achieve the vision of 100% clean energy for all, the SLAC team has focused on open-source software as the mechanism for maximizing the impact of the software tools developed for energy industry. Open source software leads the way by helping the energy industry transition from centralized fossil-fuel generation to renewable and distributed energy resources. This transition is the most significant reimagining of power systems in over 140 years. Approximately, 75% of our planetary carbon emissions can be mitigated through the electrification of buildings and transportation. By adopting an open source strategy that maximizes composability, agility, and robustness, our software tools can stay ahead of the innovation in the electric energy sector.

Open

When new technology is first introduced to an ecosystem, custom, proprietary solutions generally satisfy urgent short-term needs and minimum cost. Non-standard, opaque sorts of solutions can jump start evolution. However, as industries mature their digital solution, proprietary technologies perpetuate vendor lock-in, one-off solutions, and ultimately slow scaling and market transformation. Open source solutions and dissemination promote interoperability between solutions, whether they are developed in-house or delivered by vendors, so that utilities and researchers are able to leverage best of breed options in the ecosystem.

Open-source investments provide a core set of capabilities built and supported by all the stakeholders. Over time, this investment's value increases, and unlimited surpasses the narrow outcomes typically available within the silos of narrow institutional, national, state, and corporate boundaries. The shared technology investments in software like HiPAS GridLAB-D provide significant acceleration and act as a multiplier for investments that directly impact California's energy infrastructure transition goals.

Composable

The focus on open-source digital solutions for decarbonizing electric power systems is driving important changes for electrification, mobility, and power grids. Ensuring economic prosperity while addressing climate change mitigation requires that we enable reliable, secure, and resilient distribution hardware, data, and software solutions. Future grids will be built on platforms that consist in large part of basic hardware, virtual machines, and containers, managed by cloud orchestration systems dispatching them using software-defined network (SDN) controllers that enable high-speed, high-availability, and high-efficiency data processing.

These solutions resemble those that exist in telecommunications, but managing the flow of electricity presents unique challenges that are largely not yet solved by the existing software. In the coming years, we anticipate the need to build and compose solutions from open-source blocks that have been tried and proven in other domains. This open and flexible approach to building solutions will guarantee that the difficult work of gathering the necessary stakeholders working together under challenging time and technical pressures is given the maximum opportunity to succeed with the minimum risk of uncertainty from the software development side.

Agile

Software-defined solutions to energy infrastructure enable utilities to take a more agile approach to planning and operations. This contrasts with the traditional proprietary solutions, which require utilities to bring significant resources to updates, upgrades, and refits of critical infrastructure. This enables system and network operators to learn fast and learn often when bringing new software functions and services to market. The transition away from greenhouse-gas intensive energy resources that is necessary for decarbonization only works if we can also make the system more responsive, less expensive, and more secure. These are also essential features and benefits of open-source solutions.

By providing development operations (DevOps), continuous integration and continuous deployment (CI/CD) tools, this transition is facilitated and can become the backbone of how utilities operate in the 21st Century. With training communities and resources, utilities and researchers can come up to speed and stay up to date with the best-in-class solution available at the time. Open source communities provide sister projects, training resources, "to-do" groups, and leadership webinars to help open-source tool users make the most of what the open-source community has to offer.

Robust

The functional view of power systems must account for the more network centric nature of robustness, i.e., self-healing, scalable, dynamic, redundant, upgradeable and secure microservices mass-customized to a wide diversity of energy consumers and producers. This calls for a move away from the traditional, old-school, monolithic, and closed software solutions to a more iterative, flexible, and open approach that leverages cloud-based solutions, promotes flexible just-in-time scaling based on consumer demand, and exploits commercial off-the-shelf (COTS) open-source-ready hardware from reliable and secure supply chains. This alone will drive down costs while expanding the system capacity to meet the anticipated factor of 2 to 3 expansion anticipated over the next 20 years.

The open-source community approach aligns technical activities to ensure that all the elements of the ecosystem meet the highest standards for safety and security, while providing the maximum speed and flexibility, and minimizing the effort and risk for the engineers, technicians, and workers who manage and maintain power systems.

Technology Transfer Results

HiPAS GridLAB-D has been adopted as a project supported by the Linux Foundation Energy (LFE), an open source foundation focused on the power systems sector, hosted within The Linux Foundation. LFE provides a neutral, collaborative community to build the shared digital investments that will transform the world's relationship to energy.

LFE brings together stakeholders to solve the complex, interconnected problems associated with the decarbonization of energy by using resilient, secure and flexible open source software. The digitalization of power systems enables the abstraction of the world's largest machine into composable software defined infrastructure. Digitalization also means that operators can "network electrons" by orchestrating the metadata about an electron in ways never before possible. Digitalization facilitates a radically energy-efficient future. When every electron counts, renewable and distributed energy provides humanity with the tools to address climate change by decarbonizing the grid, powering the transition to e-mobility, and supporting the urbanization of world populations.

LFE leverages transparent, open source development best practices, along with existing and emerging standards, to efficiently scale, modernize and digitally transform the power systems sector. By providing frameworks and reference architectures, LF Energy minimizes toil and alleviates pain points such as cybersecurity, interoperability, control, automation, virtualization, flexibility, and the digital orchestration and balancing of supply and demand.

Market Assessment

TODO: add Tremonti market assessment

Technology Transfer Issues

TODO: add Tremonti market considerations