



An Introduction to the Global Power System Transformation Consortium

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nationalgridESO

NREL
Transforming ENERGY

IEEE
Advancing Technology
for Humanity

VTT

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

Imperial College
London

DTU

ercot

California ISO

CSIR
Touching lives through Innovation

ENERGINET

ASIAN CENTRE FOR ENERGY
ACE

ESIG
ENERGY SYSTEMS
INTEGRATION GROUP

CSIRO

EirGrid
GROUP

Fraunhofer
CINES

olade
Organización Latinoamericana de Energía

GLOBAL PST CONSORTIUM



What is G-PST?
Why is it necessary?

System Operators are Critical to Enabling the Transformation of the Electricity Sector



System
Operators

- Balance electricity supply and demand
- Integrate new technologies and resources (e.g. renewables)
- Develop forecasts and plans for the evolution of electricity grid
- Establish market rules and grid codes
- Manage and evolve electricity markets for least-cost operations
- Ensure safety and reliability of the electric grid

5

More data-intensive, more digital

Rapidly expanding data flows
and data needs for decision
making and planning



Data

4

More interconnected

Country and regional grids
are expanding



Regional grids

3

More dynamic

Bidirectional flow
and more varied,
distributed
resources causes
more complex grid
networks

Transmission
and Distribution
Grid

2

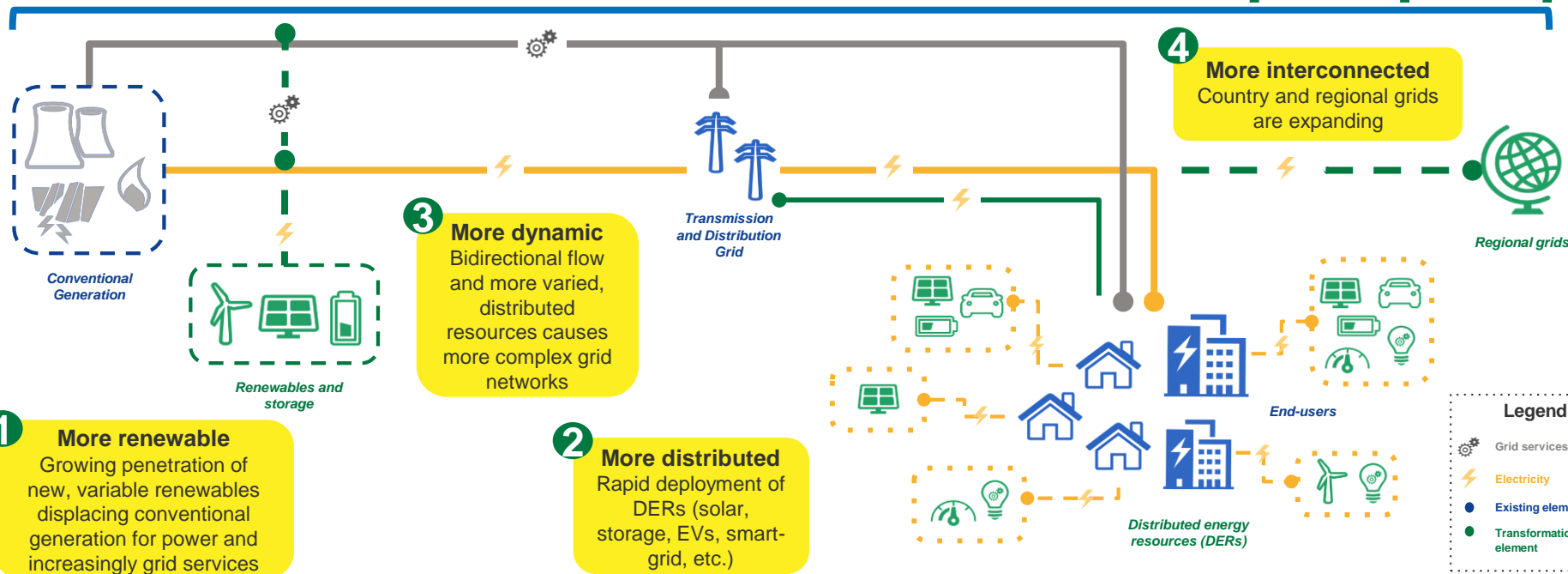
More distributed

Rapid deployment of
DERs (solar,
storage, EVs, smart-
grid, etc.)

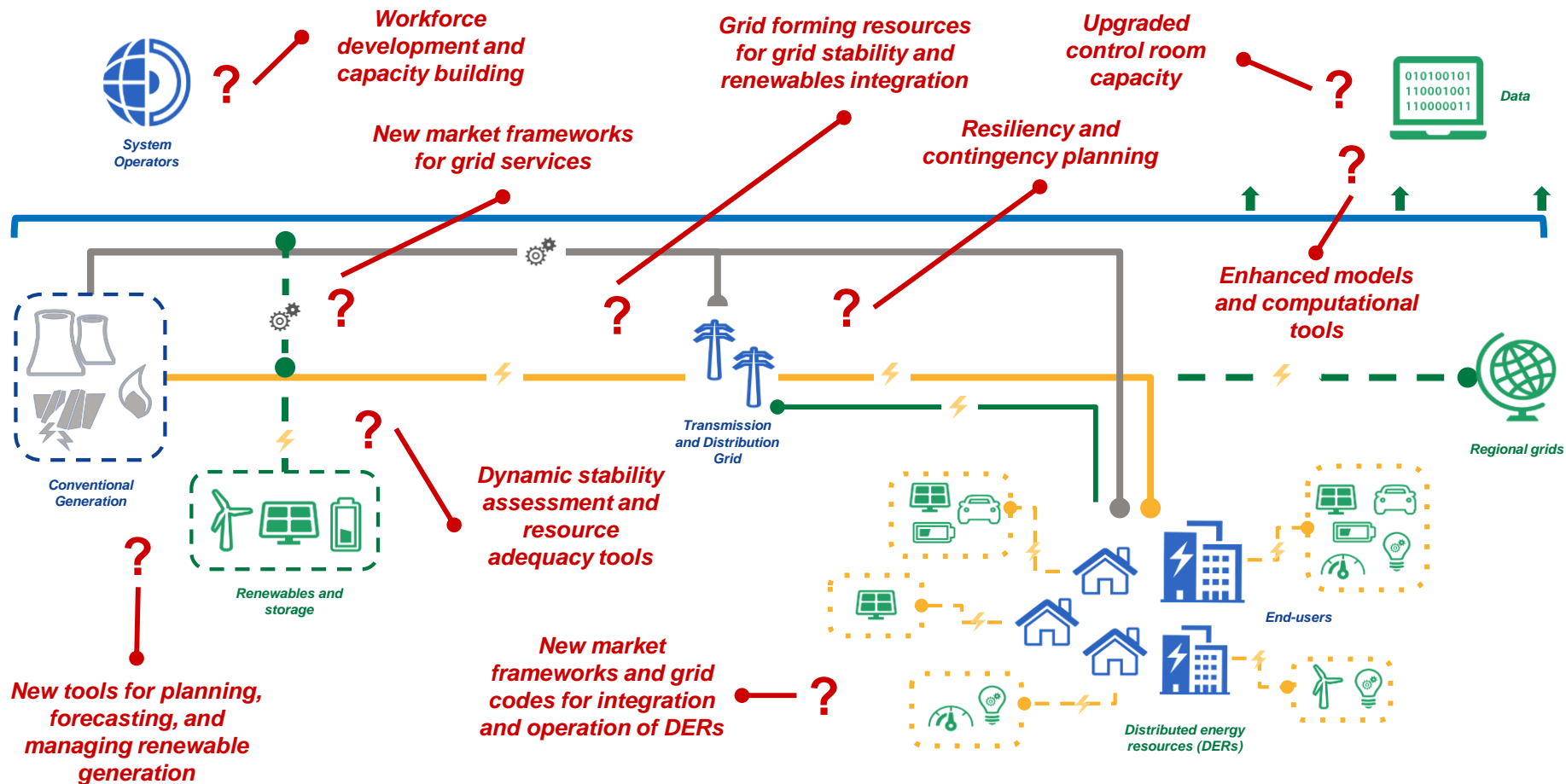
1

More renewable

Growing penetration of
new, variable renewables
displacing conventional
generation for power and
increasingly grid services

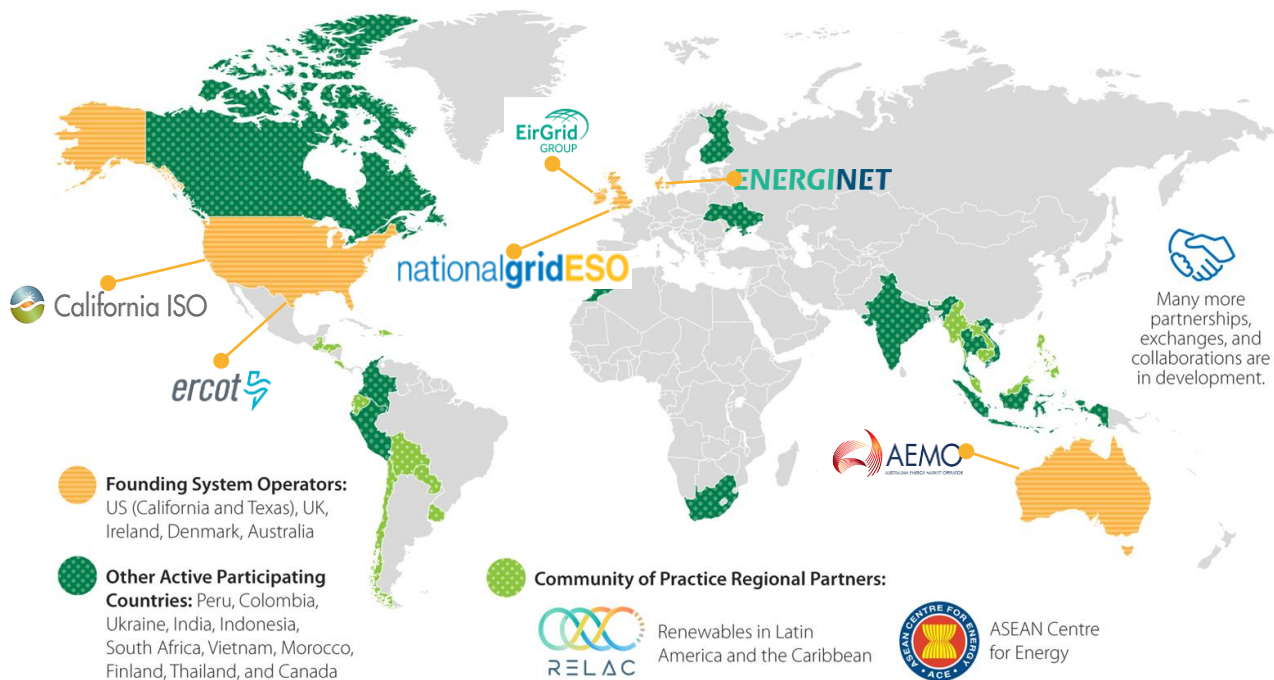


What do Systems Operators Need to Enable the Clean Energy Transition?



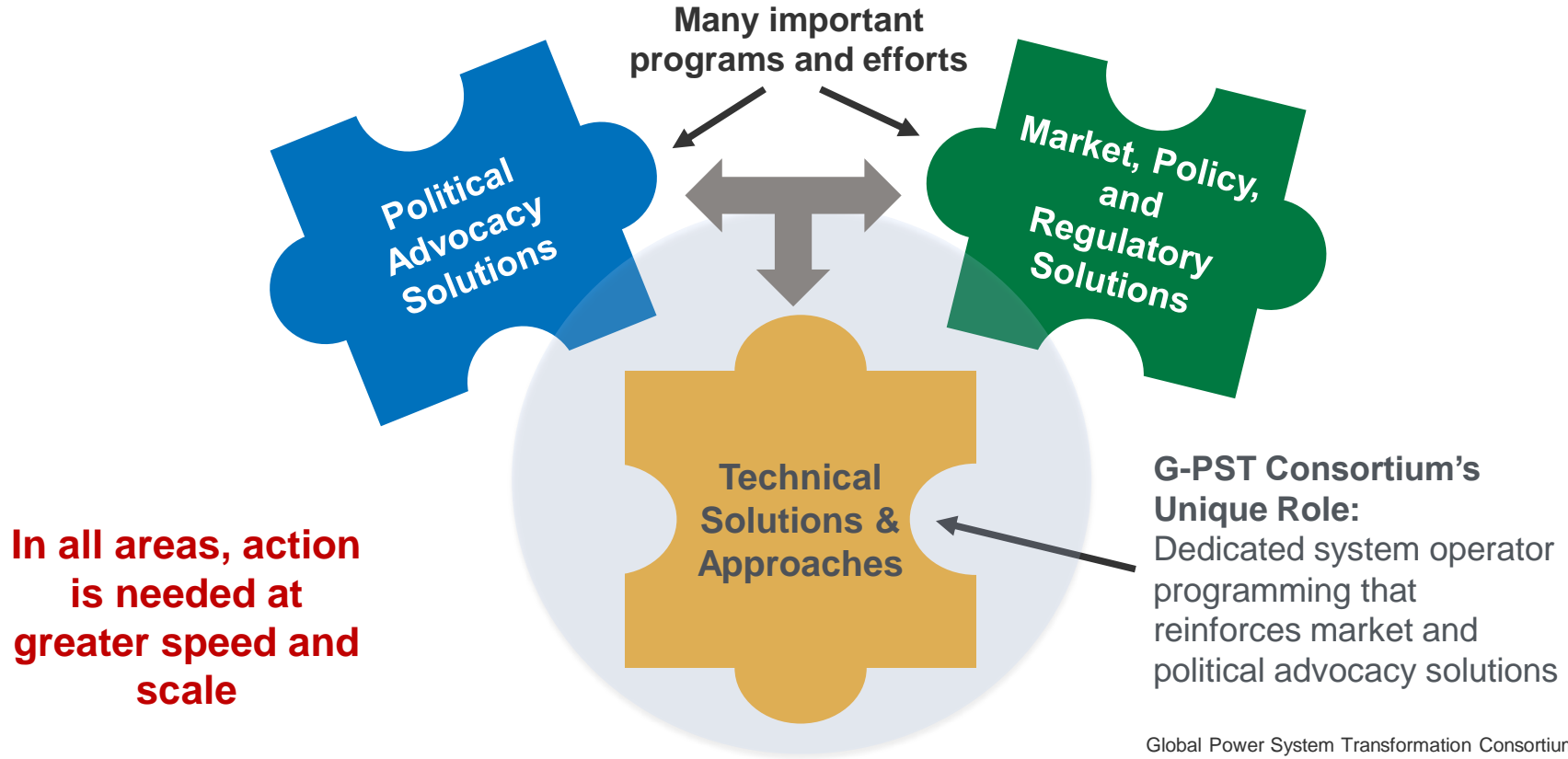
G-PST Global Collaboration with System Operators

The Global Power Systems Transformation Consortium (G-PST) leverages a significant network of technical expertise and partners to support and scale tailored research, learning, and collaboration in partnership with systems operators around the world

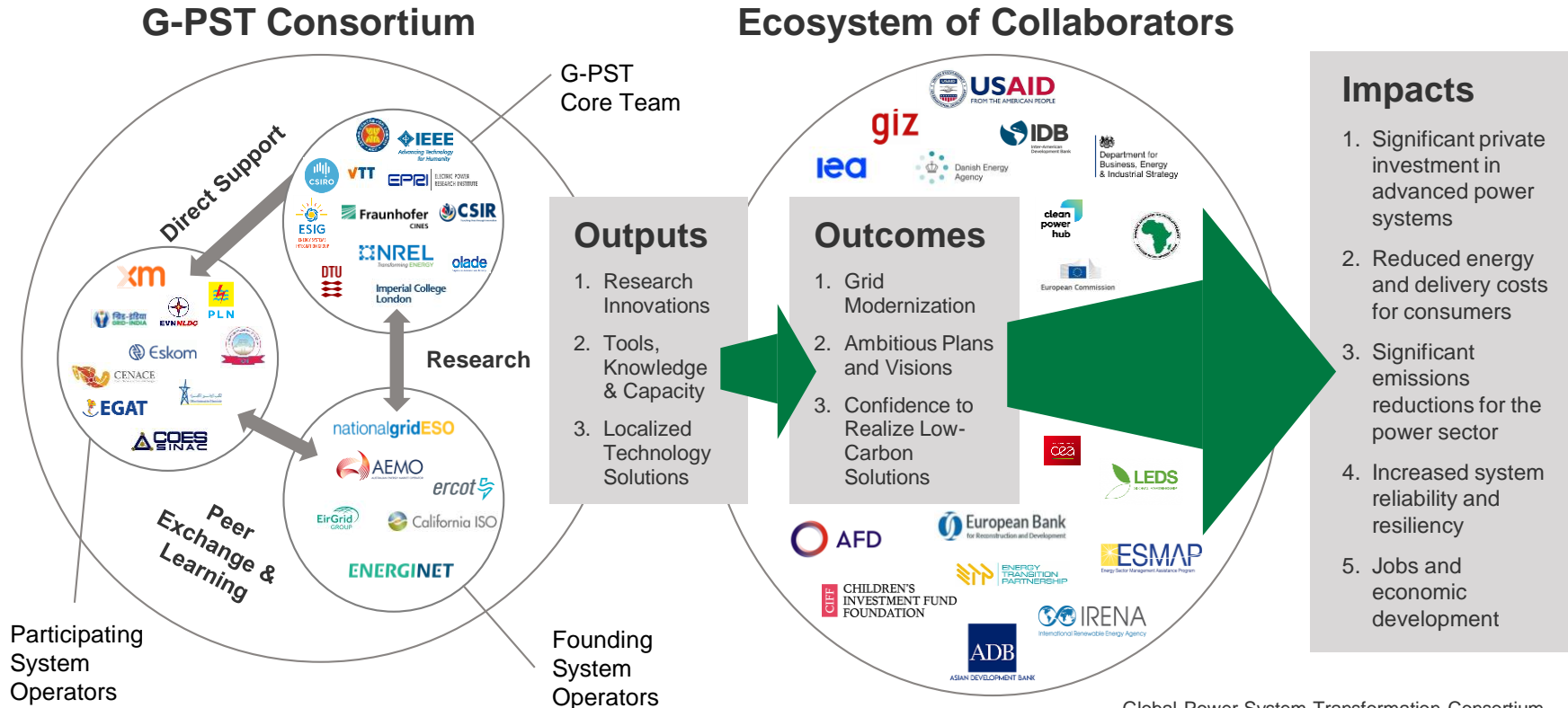


<https://globalpst.org/>

Broader Ecosystem of Theory of Change



Theory of Change for the G-PST Consortium



Advancing Action in Five Key Areas

1. System Operator Research & Peer Learning



Perform cutting edge applied research to create novel system operator solutions and globally disseminate and infuse new insights through peer learning

2. System Operator Technical Assistance



Provide implementation support to scale established best practice engineering and operational solutions

3. Foundational Workforce Development



Build the inclusive and diverse workforce of tomorrow through enhanced university curriculum and technical upskilling for utility and system operator staff

4. Localized Technology Adoption Support



Adapt modern power system technologies to individual country contexts through testing programs and standards development activities

5. Open Data and Tools



Support rigorous planning, operational analysis and enhanced real-time system monitoring through open data and tools

CORE TEAM – All Core Team members contribute to all activity pillars



REGIONAL LEADS – Coordinate regional peer learning networks and country-level technical assistance delivery efforts for Africa, Asia, and Latin America and the Caribbean



INTERIM SECRETARIAT – Work program coordination, partnerships and support, outreach, etc.



Global Power System Transformation Consortium

2021-2022 Accomplishments Highlights

- Global [Research Agenda](#) and [Teaching Agenda](#) in execution
- Ten technology collaborations among FSOs for operational changes, model demos
- Grid-forming technology council launched; Big three electrical equipment suppliers now members (Hitachi Energy, Siemens Energy and GE). First draft of phased GFM testing program prepared. Collaboration underway with ENTSO-E
- Oscillation source detection tool deployed in India's Southern Load Despatch Centre; inertia monitoring toolkit implementation underway with South Africa's ESKOM and Vietnam's NLDC; control room modernization [roadmap](#) published with Peru's COES
- Internships at NREL, EPRI; PLN (Indonesia) and CAISO (California) fellowships
- Launch of five free course modules; accessed by more than 300 users
- Power system standards implementation pilots in Panama and India
- Open-source [tools portal](#); benchmarking activities, 148 people from 111 organizations

**Scan the QR to learn more
about G-PST's impact so far.**



How is G-PST different?



Advances technical solutions; not focused on decarbonization



Solutions platform for low-carbon development across sectors; policymaker focus



US Government led; ministry partners; works across all economic sectors



Independent experts group focused on energy technology solutions



Government leaders; policy; across all energy sectors



R&D initiative; government, industry, academia; across all energy sectors



Collaborative focused on integrated energy systems; research & dissemination

G-PST: Only organization built and focused on the needs of advanced system operators to operate reliable, very high IBR systems in the near future, and meeting the energy transition needs of *all* system operators through technical assistance, workforce development, and implementation of tools and standards

Priority Program Areas



System needs and services

New frameworks for assessing system needs and services to balance and maintain reliability and stability of the grid



Stability assessment

New tools, computational efficiency and advanced control room technologies for stability assessments



Grid forming resources

Demonstration, verification, and development of scalable requirements and standards to align manufacturers and systems operators on GFM resources for system services



Resource adequacy

New methodologies, metrics, and criteria for resource adequacy assessment and integrated resource planning



Control room of the future

Advanced control room operational capabilities including probabilistic and risk-based methods, & advanced forecasting, automation, situational awareness, and decision support tools



Distributed energy resources

DER architecture, operation, and impact tools and approaches to support optimal deployment and utilization of DERs on the grid

G-PST Implementation Councils

- Purpose: to coordinate across system operators, industry, and research institutions to advance progress in 6 technical focus areas

Grid Forming Controls Implementation Council

Goal Enablers

GFM Technology Demonstrations
GFM Codification & Standards
GFM Modeling & Planning
GFM Adoption & Deployment at scale



Delivery of Results

- 5 GFM demonstration projects
- Research and codification/ standardization of GFM requirements
- Experience with GFM equipment models
- Dissemination of GFM project experience, modeling and recommendations globally
- Support GFM Teaching Agenda

Next planned Implementation Council: Control Room of the Future



How is G-PST supporting decarbonization progress in power systems around the world?

Types of Support to System Operators



Grid Integration Solutions

- Roadmaps for control center modernization
- Management and real-time monitoring of power system inertia



Workforce Development

- Partnership with local universities and training institutes
- Specialized continuing education for system operators



Localized Technology Adoption

- Establish or upgrade power electronics testing capabilities
- Expert input on national equipment performance standards



Open Tools and Data

- Open tools to support planning and operation of high RE grids
- Datasets necessary for advanced analysis

Learn more at: <https://bit.ly/work-with-gpst>

Modes of Support to Country System Operators



Peer learning with other system operators



Direct technical assistance and training



G-PST fellowship program



Embedded expert assistance



Learning on research innovations



Conduct joint applied research

Key Accomplishments

25 system operator partners in 20 countries

15+ peer exchange technical trainings and discussions

2 control room upgrade plans developed

1 control room tool deployed

4 staff fellowships

45+ system operator & research institution staff
contribute to peer learning

Control Room Upgrades

- G-PST experts from NREL, EPRI, ERCOT, and CAISO provide recommendations for developing a new Control Center for the Java-Bali and Sulawesi grids for **Indonesia's PLN**.
- **Peru's COES** teamed up with experts from NREL and EPRI to develop and publish a roadmap in English and Spanish for updating its control room.
- Lessons learned from these activities and groundbreaking research from founding system operators on advanced **control room design** shared publicly:
 - Control Center of the Future Road Map for Peru's System Operator
 - Designing a Future-Oriented Control Center System for Successful Energy Transition
 - Industry and Researcher Perspectives on Control Center Upgrade Procurement
 - Designing Control Rooms to Support High Penetrations of Variable Renewable Energy
 - Use of AI and Big Data in the Control Room
 - Organizational Structure of the Control Center of the Future
 - G-PST Vision for the Control Room of the Future (May 2023)



Open Tools

- NREL and EPRI are partnering with **Vietnam's NLDC** and **South Africa's Eskom** to develop an open-source tool for system inertia monitoring.
- G-PST experts worked with engineers at **India's Grid-India** to deploy open-source tools to detect sources of network oscillations.
- Publicly available resources on Open Tools and Data provide a scalable solutions to meet emerging needs:
 - Building an Open-Source Strategy at Power Grid Operators
 - Open-Source Power Systems Analysis Packages: Workflow and Benchmarking on Common Load Flow Problem
 - Inverter-Based Resource (IBR) Research Team Stability Tools Inventory: Status and Needs
 - Open-Source Tools for System Operators – Focus on Power Flow Tools



Peer Learning on Priority Topics

- **Indonesia's PLN** system operator staff have participating in 10 knowledge sharing sessions with G-PST's Founding System Operators and technical institutions on priority topics including SCADA/EMS architecture, grid codes, and control room procurement.
- Founding System Operators and G-PST experts are responding to requests from **Colombia's XM** and **Vietnam's NLDC** for peer learning on technical topics of most interest including distributed PV, system flexibility, resiliency metrics, and reactive power and voltage optimization
- NREL, MISO, and POSOCO supported a webinar on cyber security related challenges for electric utilities for **Indian state load despatch centres**.

Webinar
POWER SYSTEM SHARING SERIES #3

THE GRID CODE ADAPTATION TOWARD VRE INTEGRATION

Wednesday, June 9th 2021

OPENING REMARKS
WILUYO KUSDHARTO
Director of PLN

HOST
E. HARYADI
Chief of PLN Center of Excellence

SPEAKERS:

- LUIS ROICO
IEEE Madrid Spain
- ROLAND BRÜNDINGER
AET Vienna Austria
- MARK MCCANNAGHAN
E.P.R.I. Dublin Ireland
- OSPREY NEMEN
General Manager of PLN UPT-6

MODERATOR & MC:

- AHMAD MURIDANI
Moderator
- AJENKA ALFONSO
Master of Ceremony

Logos: EUMN, UNIK INDONESIA, PLN, GLOBAL PST, EPR, IEEE, AET, PLN

Hashtag: #PowerBeyondGenerations

Website: www.gpsr.co.id

Technical Exchange Study Tours

- Engineers from **Colombia's Compañía de Expertos en Mercados (XM)**, **Vietnam's NLDC**, and **Ukraine's Ukrenergo** performed a technical exchange to work together in person with each other and other experts from around the globe.
- They visited **NREL** and attended the **Energy Systems Integration Group (ESIG)** Spring 2023 Technical Workshop to present about the technical challenges they are overcoming on their power systems, at a special session focused on G-PST.
- These visits provide an opportunity for technical exchange among the G-PST network and enable other G-PST core team members to learn more deeply about the advances taking place in Colombia, Vietnam and Ukraine.



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