

# Energy Systems Integration and the Global Power System Transformation (PST) Consortium

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Chair Research Agenda Group Global-PST

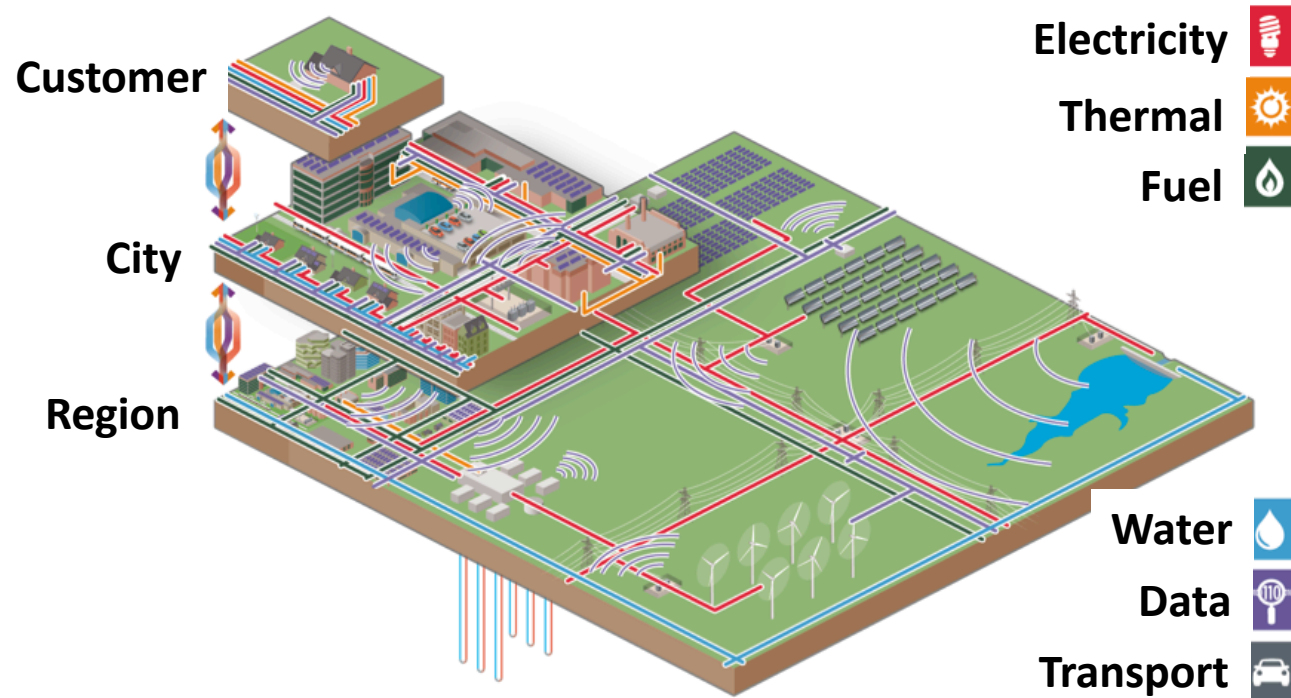
Professor of Electrical Engineering, UCD



# Outline

- Recent historical context
- Energy Systems Integration and the Energy Systems Integration Group (ESIG)
- Global Power System Transformation Consortium (G-PST)
- The Role of Digitalisation
- Conclusions

# Energy Systems Integration



**Energy system integration** is the process of coordinating the operation and planning of energy systems across multiple pathways and/or geographical scales to deliver reliable, cost-effective energy services with minimal impact on the environment.

# International Institute for Energy Systems Integration (iiESI.org)



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Think. Share. Evolve.

iiESI is an international community of researchers collaborating to address global energy challenges.



### iiESI Leadership

 [Mark O'Malley](#)  
iiESI Director  
(University College Dublin)

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 [Bryan Hannegan](#)  
iiESI Executive Director  
(National Renewable Energy Laboratory)



Solving complex global energy challenges requires changing the way we THINK about energy systems, providing opportunities to SHARE knowledge, and helping nations EVOLVE by informing the discussions that are guiding energy investments and policy decisions.



# EERA JP in ESI



## JOINT PROGRAMMES

### About JPs

How does a Joint Programme operate  
What is the outcome of a Joint Programme

Integrated Research Programmes  
Collaborating with industry  
International Cooperation  
National Alignment

### List of JPS

AMPEA  
Bioenergy  
Carbon Capture and Storage  
Concentrated Solar Power (CSP)  
Economic, environmental and social impacts (JP e3s)  
Energy Efficiency in Industrial Processes  
Energy Storage  
Energy Systems Integration  
Fuel Cells and Hydrogen  
Geothermal  
Nuclear Materials  
Ocean Energy  
Photovoltaic Solar Energy  
Shale Gas  
Smart Cities  
Smart Grids  
Wind Energy

You are here » EERA Joint Programmes (JPs)

## Energy Systems Integration

### The EERA Joint Programme in Energy Systems Integration

This Joint Programme in Energy Systems Integration seeks to bring together research strengths across Europe to optimize our energy system, in particular by benefiting from the synergies between heating, cooling, electricity, renewable energy and fuel pathways at all scales. The energy elements of the water and transport system are also included as is the enabling data and control network that enables the optimization.

The Joint Programme in Energy Systems Integration is designed to develop the technical and economic framework that government and industries will need to build the future efficient and sustainable European energy system. It is fully aligned with the recently published SET Plan Integrated Roadmap and potential impact include increased reliability and performance, minimisation of cost and environmental impacts and, in particular, increased penetration of renewable energy sources.

The Joint Programme is organised in 5 Sub-Programmes (SP) that target different aspects of Energy Systems Integration. Given the nature of Energy Systems Integration, the SPs are strongly interlinked.

SP1: Modelling, coordinated by Dr. Juha Kiviluoma, VTT (FI)

SP2: Forecasting, aggregation & control, coordinated by Prof. Henrik Madsen, DTU (DK)

SP3: Technology, coordinated by Prof. William D'haeseleer, KU Leuven (BE)

SP4: Consumer, coordinated by Mr. Didier Van den Abeele, CEA (FR)

SP5: Finance & regulation, coordinated by Dr.ir. Laurens J. De Vries, TU Delft (NL)

The Description of Work (DoW) for the Joint Programme in Energy Systems Integration is available [here](#).



News of this program



Useful documents



EERA intranet

### Coordinator

Prof. Mark O'Malley  
✉ e-mail



Claire Cullen  
✉ e-mail



### Contact at EERA

Maria Oksa  
✉ e-mail



# Energy Systems Integration Group

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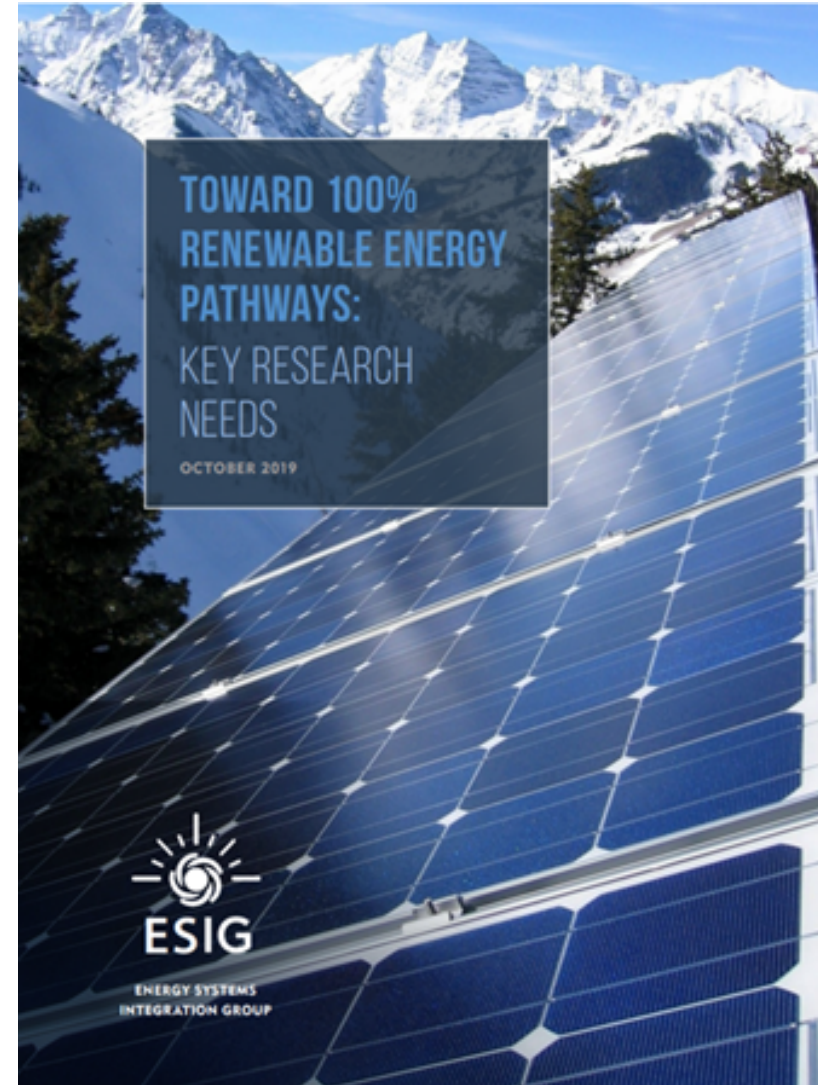
- Formed in 1989 as the Utility Wind Interest Group
- Became ESIG in 2018 with a merger with iiESI
- Non-profit educational association that provides workshops, resources and education
- Total system view of the energy systems we use today, focusing on the combined strength of electricity, heat and fuel systems
- Committed to industry collaboration, forward thinking and knowledge sharing
- Supports engineers, researchers, technologists, policymakers and the public with the transformation of energy systems in a way that is economic, reliable, sustainable, thoughtful and collaborative



[www.ESIG.energy](http://www.ESIG.energy)

# ESIG Towards 100 % Workshop

- Denver May 2019
- Limited to approximately 60 participants
- International effort
  - Asia – 2
  - Europe – 12
  - North America – 42
  - South America - 2
  - Australia 1
- Across all segments
  - Research and Academic – 29
  - Industry – 29
  - Government – 1



# Workshop Takeaways/Insights

- Discussions permeated by a sense of the **dimensionality and complexity** of the undertaking
- Challenges range from **engineering to economic to social sciences**
- Human behavior and societal acceptance present **major unknowns**
- They require a mix of **research, knowledge transfer and education**
- There is significant **uncertainty** about the technologies that will emerge as dominant
- Each electricity **system is different**, which will drive regional solutions as is the case today
- **Global coordination** of efforts in research, education, and implementation is desirable





# GLOBAL PST CONSORTIUM



# G-PST Launch BNEF Summit October 20<sup>th</sup> 2020



Embargoed until:

October 20, 2020 (8:00 a.m. London time)

## World's leading power system operators launch global consortium

*Global effort aimed at reaching 50% emission reductions over next 10 years*

**Oct. 20, 2020 (LONDON)** – Earlier today during the BloombergNEF Summit, Audrey Zibelman, CEO of the Australia Energy Market Operator (AEMO) announced the launch of the Global Power System Transformation Consortium (G-PST). Speaking during the *European Energy Infrastructure in Transition Session*, Zibelman highlighted the need for a major global collaborative effort in overcoming technical barriers related to the integration of clean energy into power systems at an unprecedented scope and scale.

“Countries around the world are looking to pursue a path to modern, low-emissions energy systems, but face significant challenges in acquiring and applying the technical knowledge needed to operate and plan rapidly transforming power systems,” said Zibelman. “This consortium will help meet this need by engaging key power system operators, applied research and educational institutions, governments, businesses, and stakeholders from developed and developing countries to accelerate clean energy transitions at the ambitious scope and scale that is required.”

The goal of the consortium is to dramatically accelerate the transition to low emission and low cost, secure, and reliable power systems, contributing to >50% emission reductions of all pollutants globally over the next 10 years by enabling the efficient integration of substantial clean energy investments into power systems.

CEOs of six of the world's leading system operators, Australia Energy Market Operator (AEMO), National Grid Electricity System Operator UK, California Independent System Operator (CAISO), Electric Reliability Council of Texas (ERCOT), Ireland's System Operator (EirGrid), and Denmark's System Operator (Energinet) are leading this consortium.

These founding system operators are partnering with more than 25 prominent system operators from Africa, Asia, Latin America, Eastern Europe, and other regions as well as renowned research and educational institutions from around the world to help guide the G-PST vision. The system operators from emerging and developing countries will engage in technical collaboration, peer learning, and workforce development to support the application of advanced engineering and operational solutions to meet their priorities.

“We're excited to join fellow system operators in leading the consortium's research agenda that is holistic and driven by making it all work together,” said Fintan Slye, Director, National Grid Electricity System Operator (ESO). “Through the consortium, we'll scale up global research collaboration on cutting-edge technical innovations in areas such as real-time intelligent control applications and state-of-the-art power electronics that will enhance the reliability and accelerate our transitions to best-in-class, low emission reliable power systems. These pioneering innovations will be shared rapidly with countries around the world.”

The core technical team for the consortium includes the Energy Systems Integration Group (ESIG), Imperial College London, Council of Scientific and Industrial Research (CSIR), Fraunhofer Cluster of Excellence for Integrated Energy Systems, National Renewable Energy Laboratory (NREL), Latin American Energy Organization (OLADE), Institute of Electrical and Electronics Engineers (IEEE), Electric Power Research Institute (EPRI), Commonwealth Scientific and Industrial Research Organization (CSIRO), the Danish Technical University (DTU), and ASEAN Center for Energy (ACE).

According to Professor Mark O'Malley, Chair of the ESIG Research and Education Working Group, the consortium will engage in activities across five key pillars – *System Operator Research & Peer Learning, System Operator Technical Support, Workforce Development, Standards & Testing and Open Data & Tools*.

“Our collaborative system operator research and peer learning pillar is unique in its holistic approach, global ambition and rapid application, and the work in the other four pillars will leverage the research outcomes, reinforce existing initiatives and drive the global coordination of our efforts toward achieving cost-efficient, clean, and reliable power systems,” said O'Malley.

“The coordinated effort and magnitude of this initiative is astounding,” said Pak Haryanto, Director, Regional Business of Java Madura and Bali, Perusahaan Listrik Negara (PLN). “To engage in such deep technical cooperation across the world's leading system operators along with structured peer learning to all corners of the globe will have an immeasurable impact on achieving the goal of cost-efficient, clean, and reliable power systems worldwide.”

Key sponsors and partners of the G-PST Consortium include Wellspring Climate Initiative, United States Agency for International Development (USAID), Children's Investment Fund Foundation (CIFF), BMWi (Federal Ministry for Economic Affairs, Germany) and Energy Innovation.

For additional information on the G-PST, please visit <https://globalpst.org/>.

###

[Download Fact Sheet](#)

[Download Expected G-PST Outcomes](#)

[Additional comments from CEOs of the Founding System Operators](#)

**Media:** for additional information, on the announcement and to set up interviews, please contact Ryan Willis, Marketing Director of ESIG – [info@esig.energy](mailto:info@esig.energy) / +1 (704) 473-0135 or Sadie Cox, Director of Interim Secretariat of G-PST Consortium – [Sadie.Cox@nrel.gov](mailto:Sadie.Cox@nrel.gov) / +1 (303) 704-1870

# Global Power System Transformation (G-PST) Consortium

## What?

A new **Consortium** focused on identifying **shared problems** and developing **innovative solutions** for **Power System Operators**

*Core Team*

## Who?

*Founding System Operators*



## Why?

The **engineering knowledge** required to support the **global energy transition** is not being created or transferred at sufficient **speed and scale**

*Example Developing Country System Operators*

*(Partnerships under development)*

## Why work with System Operators?

System Operators are responsible for implementing power system transformation

Policymakers and other stakeholders listen to System Operators, which can help raise confidence and ambition

System Operators must transform procedures and grids to integrate high levels of clean energy and can attract private investment

System Operators best learn from and become inspired by their peers, including those at the forefront of integrating RE

System Operators have an emerging role in cross-sector electrification and end-use efficiency efforts

# Global Power System Transformation Consortium will advance action in 5 key *pillars*

## 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 TA delivery efforts for Africa, Asia, and Latin America and the Caribbean



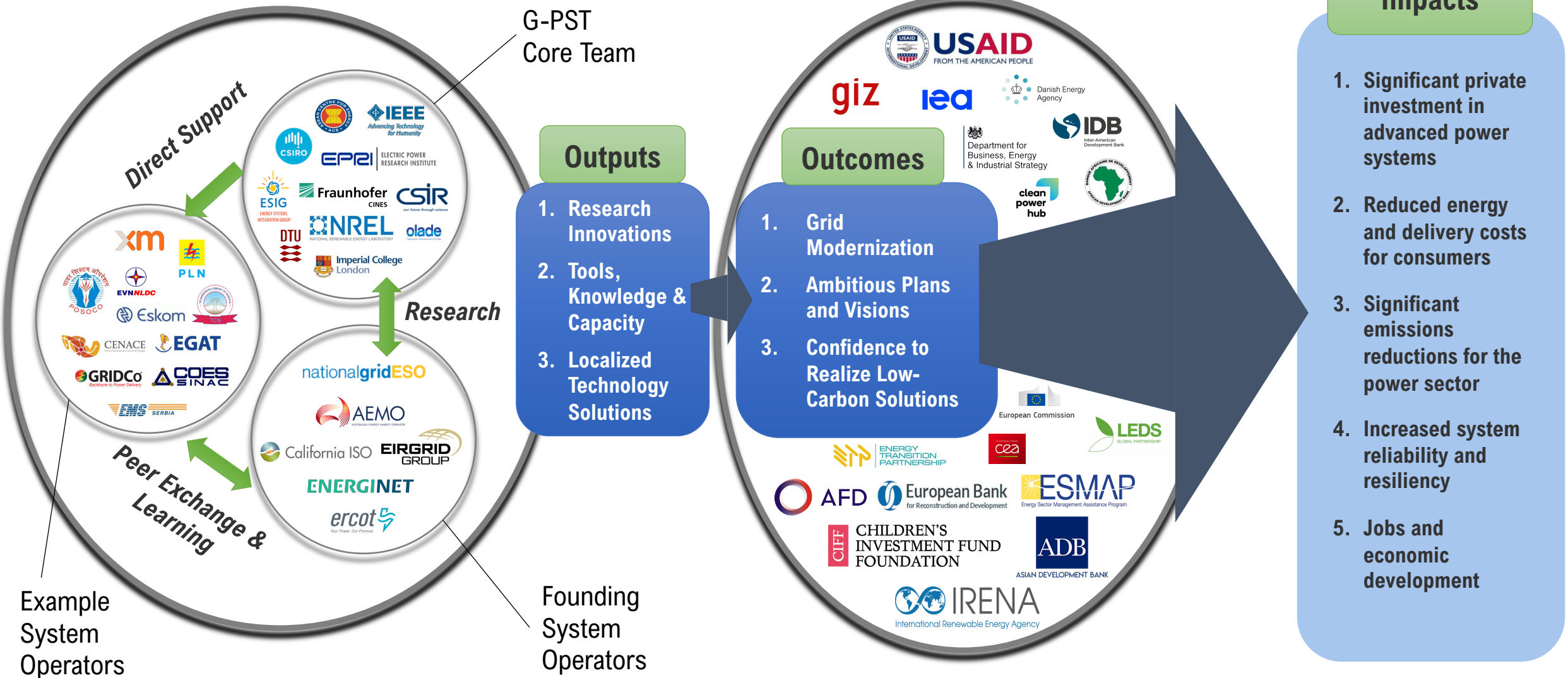
INTERIM SECRETARIAT – Work program coordination, partnerships and support, outreach, etc.



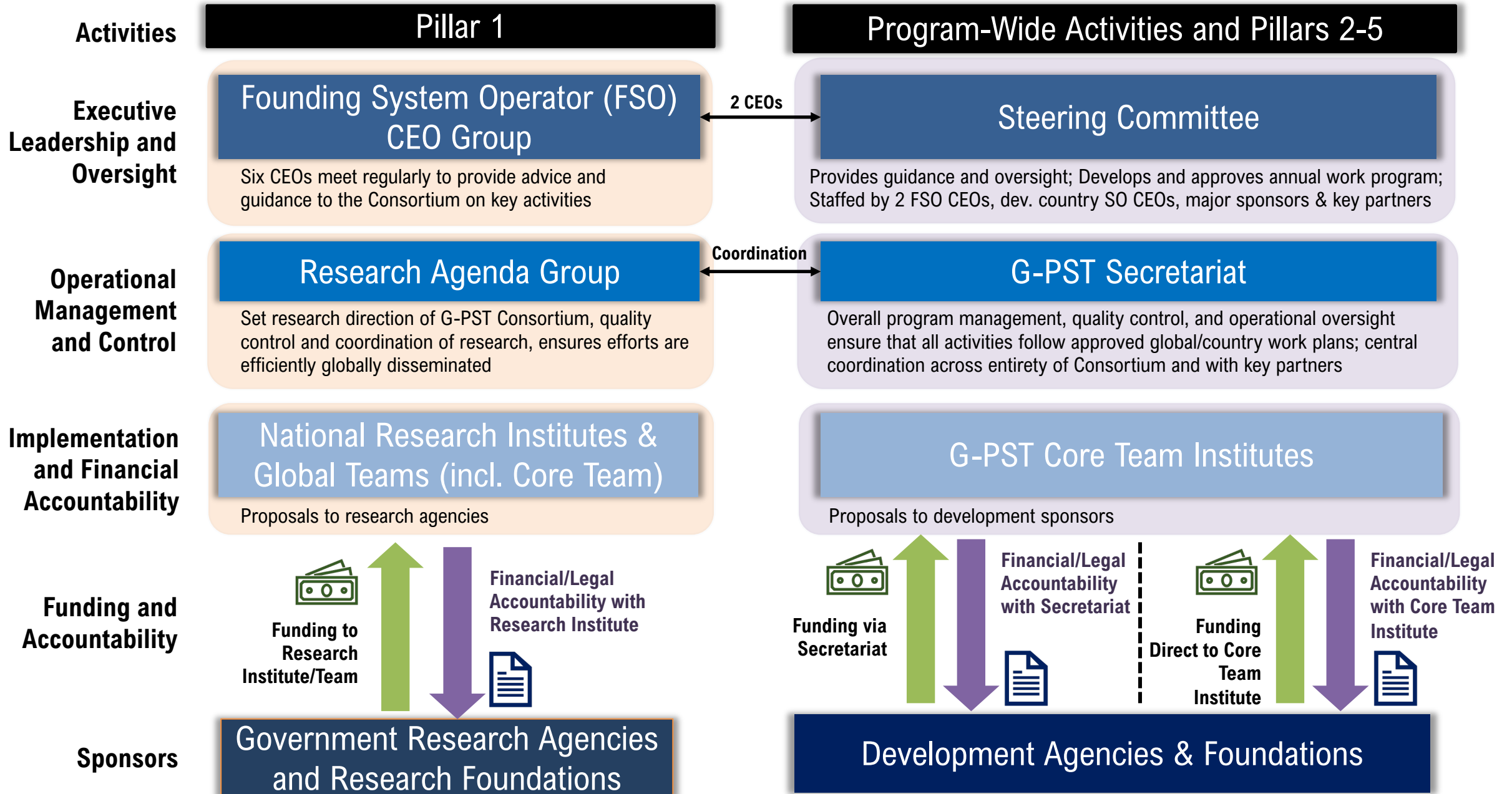
# Outputs, Outcomes and Impacts

## G-PST Consortium

## Ecosystem of Collaborators



# G-PST Consortium Governance & Funding Model







# Research Priorities from Research Agenda Group (RAG)

## Research Agenda Group

## Consensus Priority Research Program Areas

## Quick Wins

## Transformative Solutions

**6+ month consultation process** with leading System Operators and global Research Institutes

**A. Analytical Tools and Methods**  
➤ Generating new methods and insights into the reliable operation of future power systems

**B. Power Electronics Design**  
➤ Designing inverter capabilities for future power systems

**C. Control Room of the Future**  
➤ Enhancing real-time awareness and control over future power systems

**D. Planning for Reliability and Resilience**  
➤ Creating innovative and cost-effective investment approaches for reliable and resilient operation

All areas highly interrelated

*Effective Coordination to Achieve Holistic Solutions*

- Understand and apply known cutting edge solutions from System Operator peers
- Translate existing state-of-the-art research results into application
- Commence coordinated research piloting activities

**Breakthrough technologies**  
**Innovative engineering solutions**  
**Paradigm shifts**

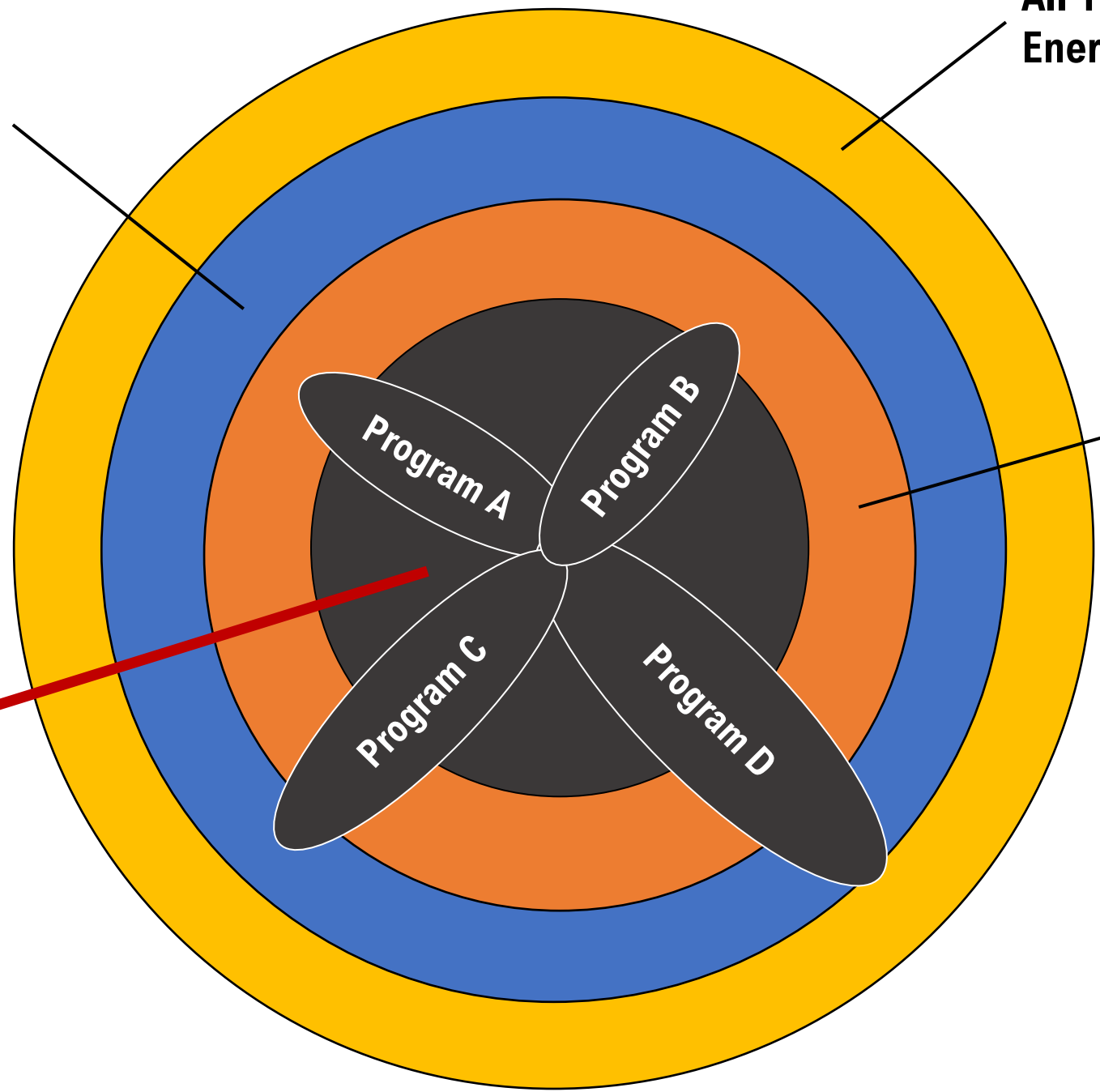


**All Things  
Energy & Power (ESI)**

**Adjacent Issues**  
(e.g., markets,  
distribution)

**FSO Research  
Landscape**  
(i.e. 61 questions)

**“In Focus”  
Issues**

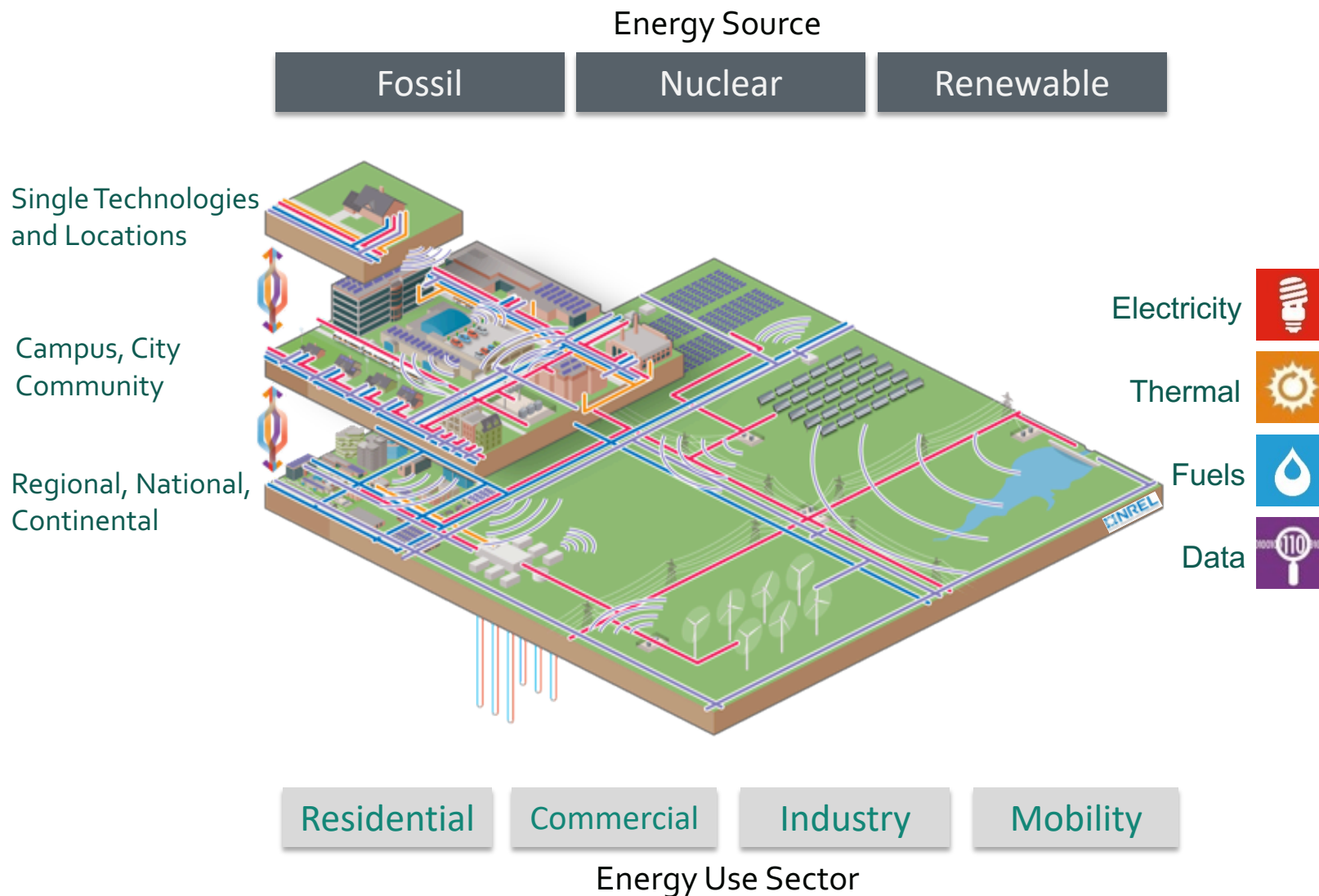


# My Observations on the Research Agenda

- Highly integrated and communications across the programs is critical
- Needs a global community that has critical mass to solve including vendors, OEMs etc.
- Driven mainly by IBR characteristics
- The Control Room is at the heart of the issues
- We have accomplished much – but there is more to be done and it is different
- What about digitilisation ?

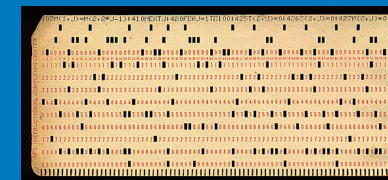


# Big picture: The integrated energy system



## Digitalization

- Everywhere
- Team Member
- Glue/Enabler



# Conclusions

- Electricity is at the centre of Energy Systems Integration
- System Operators are the Key Actors
- Global collaboration is required to get transition done quickly
- Digitalisation has an important role to play

**Let's get stuff done**