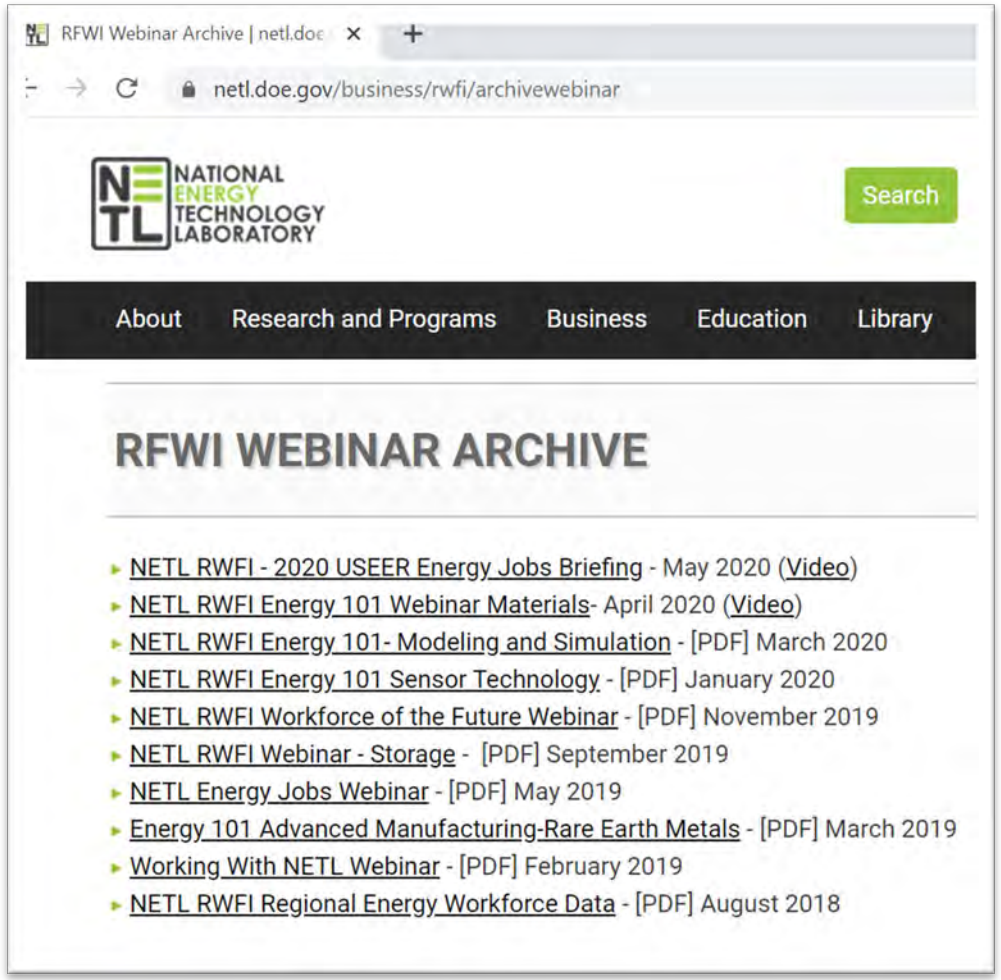
Welcome to the Webinar! NETL RWFI Energy 101- BlockChain



Energy 101 Webinars

The NETL RWFI Energy 101 Series provides a basic primer on the research and development conducted at NETL. Researchers at the Lab present information on their work in an easy-to-follow and thus easy-to-communicate fashion. Discussion topics include the potential economic and workforce development opportunities that successful research into these topics and their related challenges.

Please Keep Yourself on Mute for the Duration of Webinar

Q&A using chat function at end of presentations

A YouTube page for recordings and Webinar Archive is at the RWFI webpage

NETL RWFI Energy 101- Blockchain

In this month's Energy 101, we will learn about how NETL is using blockchain technology to secure the U.S. energy sector through an effort called Blockchain for Optimized Security and Energy Management (BLOSEM). BLOSEM is a multi-lab collaboration, established to develop energy-sector guidance, standardized metrics, and testing environments for technology maturation of novel blockchain-based concepts for device security, secure communications, and grid resilience. This project is seeking to build out a testing infrastructure to evaluate blockchain-based concepts that may be useful for industry as a resource for evaluating and testing use cases.

Agenda

1. The Regional Workforce Initiative- Anthony Armaly, Federal Coordinator NETL RWFI
2. Blockchain R&D for Improved Cybersecurity – Sydni Credle, NETL Technology Manager
3. Workforce and Economic Development Q&A

NETL Regional Workforce Initiative (NETL RWFI)

NETL Regional Workforce Initiative

A Consistent, Collaborative, Coordinating, and Communitive Placed Based Engagement Platform

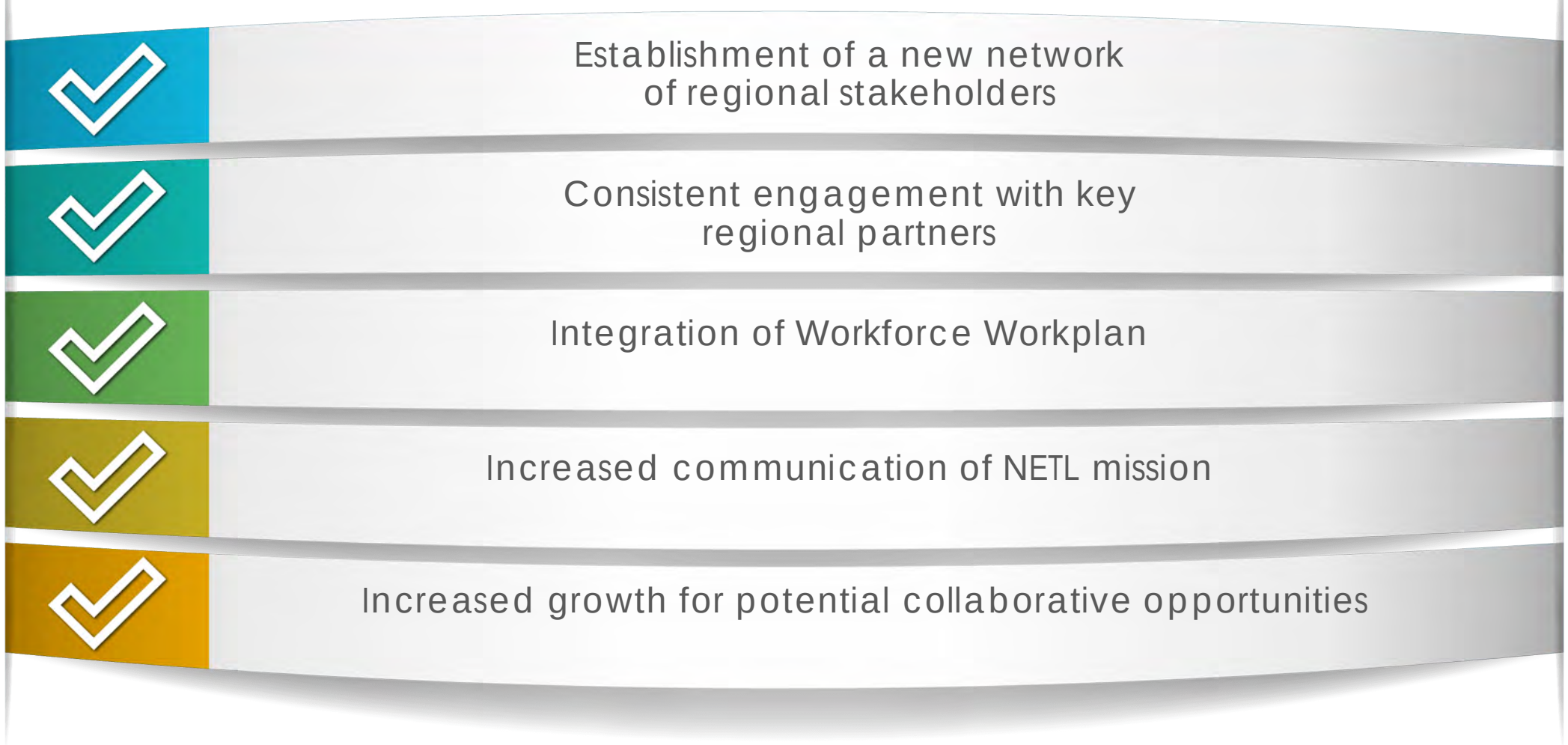
Key Metrics to Date

800+	400+	1200+	290+
individual stakeholders	institutions and organizations represented	registrants to the NETL RWFI Webinar Series	subscribed to the NETL RWFI e-Note Monthly Newsletter

- NETL RWFI is a platform for engagement and collaboration with key workforce, economic development and education stakeholders who are critical for the deployment of U.S. DOE and NETL Energy and Advanced Manufacturing technological research.
- RWFI aligns with the Administration's efforts to connect R&D investment to economic growth, job growth, and development of a skilled technical workforce
- Has catalyzed over 1M in follow on funding and workforce, education and economic development activities

Collaboration with stakeholders and partners around workforce readiness and economic opportunities
Coordinating across energy and manufacturing economic development education and workforce development initiatives
Communicating activities, research, and funding opportunities to stakeholders

Key Outcomes to Date



Advanced Welding Workforce Initiative

Background

Create a pipeline of qualified workers who can apply the latest high-temperature materials, manufacturing processes and service/repair techniques

Support manufacturing for careers in the energy, automotive, aerospace, aviation and petrochemical industries;

Enroll displaced workers, new entrants to the workforce, incumbent workers and individuals recovering from substance abuse disorders

Advanced Welding Workforce Initiative

Updates

1M to 5 projects in OH, AL, WV, KY, PA

Supporting 332 Students & 94 workers retrained or upskilled

Equipment being bought, being students enrolled and faculty being hired.

Calhoun CC in Decatur, Il – more women enrolled than in the past 4 years combined, program meeting immediate employers needs

RCBI, Huntington, WV- 2 new cohorts of student beginning training, 20 students preregistered, more women ever enrolled

Universally and here too, there continues to be challenges for CC's to maintain enrollment to levels pre pandemic

Funding Announcements

Strengthening Community Colleges (SCC2) Training Grants

Department of Labor, Deadline, June 2, 2022

The purpose of this program is to address two inter-related needs: 1) to increase the capacity and responsiveness of community colleges to address identified equity gaps, and 2) to meet the skill development needs of employers in in-demand industries and career pathways, as well as the skill development needs of underserved and underrepresented workers.

Industry-University Cooperative Research Centers (IUCRC) Program

National Science Foundation, Deadline, June 8, 2022

The IUCRC program catalyzes breakthrough pre-competitive research by enabling close and sustained engagement between industry innovators, world-class academic teams, and government agencies. IUCRCs help industry partners and government agencies connect directly and efficiently with university researchers to achieve three primary objectives: 1) conduct high-impact research to meet shared and critical industrial needs in companies of all sizes; 2) enhance U.S. global leadership in driving innovative technology development; and 3) identify, mentor, and develop a diverse, highly skilled science and engineering workforce.

Just released funding opportunity

U.S. Department of Labor Announces $34.2M in Funding Available for Workforce Development in Delta and Appalachian Regions

Workforce Opportunity for Rural Communities Initiative invests in projects providing career training and support services for quality jobs in high-demand careers.

In partnership with the U.S. Department of Labor (DOL) and the Appalachian Regional Commission, Delta Regional Authority (DRA) today announced the availability of $34.2 million in a fourth round of funding through the Workforce Opportunity for Rural Communities (WORC) Initiative. The funding opportunity seeks to invest in projects providing career and support services to people in the Delta and Appalachian regions so they may secure quality jobs in stable, high-demand occupations.

Contact Information

For More Information, Contact Anthony Armaly

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Blockchain for Optimized Security and Energy Management (BLOSEM)

Sydni Credle, PhD, P.E.

Regional Workforce Initiative (RWFI)
"Energy 101" Webinar Series | April 28, 2022

BLOSEM
BLOCKCHAIN FOR OPTIMIZED SECURITY & ENERGY MANAGEMENT

Acknowledgments

This project was developed based upon co-funding from the U.S. Department of Energy's (DOE) Office of Fossil Energy and Carbon Management, the Office of Electricity, and the Office of Nuclear Energy as a part of the Grid Modernization Initiative (GMI).

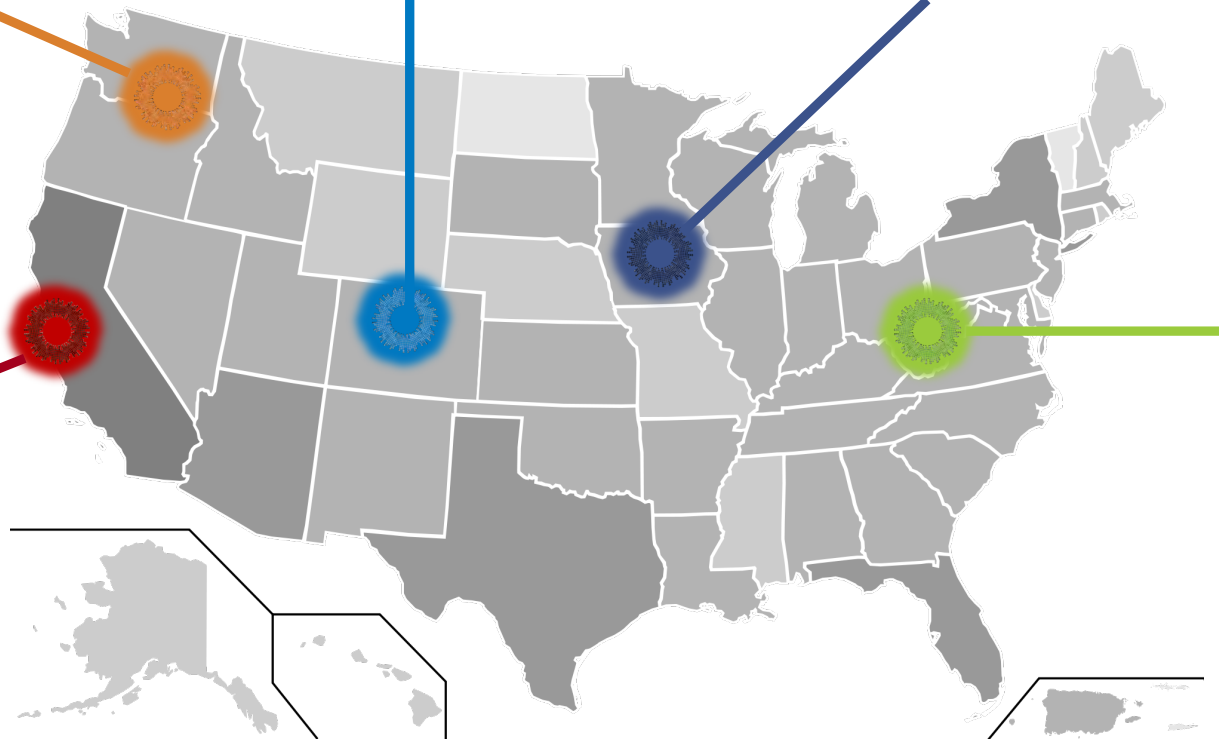
BLOSEM Team

NATIONAL ENERGY TECHNOLOGY LABORATORY

Pacific Northwest NATIONAL LABORATORY

NREL Transforming ENERGY

THE Ames Laboratory



SLAC

NATIONAL ENERGY TECHNOLOGY LABORATORY

*Lead Laboratory

Industry Advisory Group

NATIONAL ENERGY TECHNOLOGY LABORATORY

EPRI UTILITY BLOCKCHAIN INDUSTRY GROUP (UBIG)

IBM BLOCKCHAIN

UNITED STATES MILITARY ACADEMY WEST POINT

Carnegie Mellon University

HITACHI

NEVERMORE SECURITY

DERP TECH Distributed Electric Renewable Power

IEEE BLOCKCHAIN™

RIMATION Custom Solutions Engineering

Energy Web Foundation

SOUTHERN CALIFORNIA EDISON®

NIST National Institute of Standards and Technology

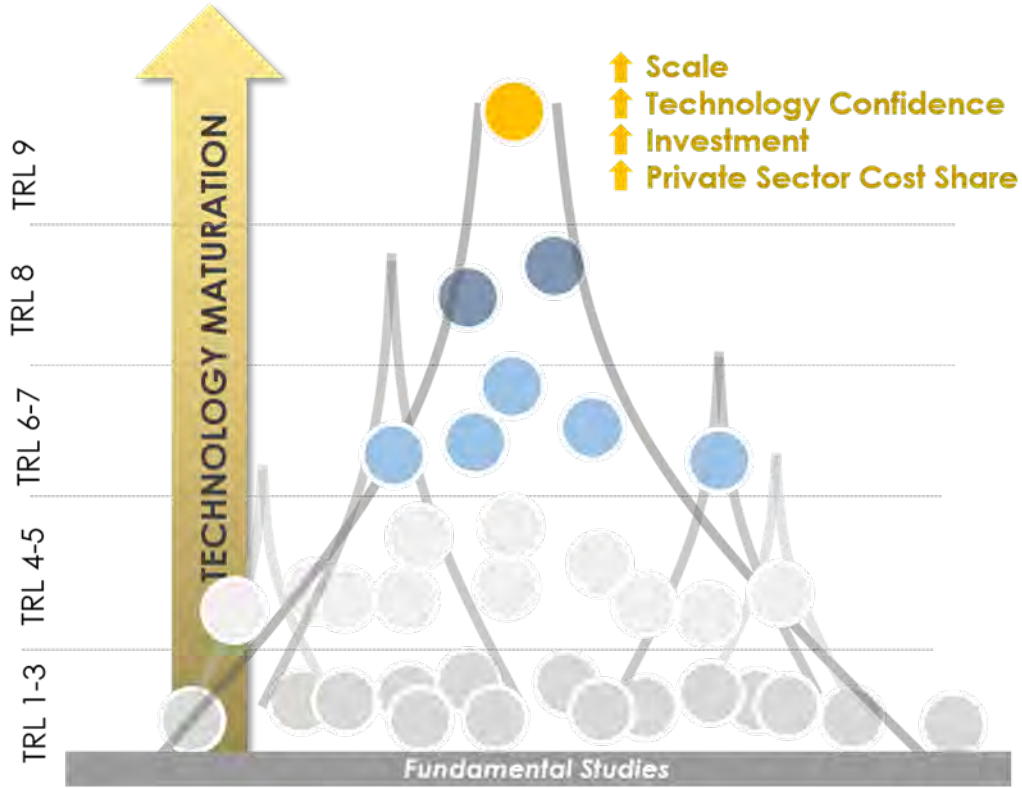
Project Overview

Blockchain technology may be leveraged for *securing operations at grid scale.*

- Features: Immutability, Transparency, Consensus, Finality
- Adds encryption of communications (in transit) and on the ledger (at rest)

Increases *trust* and *integrity of shared operations* in a competitive / collaborative community

- Resiliency to active attacks, removes single point of failure
- Detection of Tampering
- Complete and auditable history of transactions
- Trust in authenticity of source and integrity of data on public internet networks
- Transparent contract logic, agreed to by participants
- Some technologies allow private ledgers and private sharing



Source: NETL

Blockchain for Optimized Security and Energy Management (BLOSEM)

- Create a **multi-lab, unified testing platform (BLOSEM UTP)** that has interoperability to support a wide variety of blockchains. This testing environment will be representative of the modern grid of the future by encompassing generation, transmission, distribution, and end user (edge) for the electric grid.
- **Identify and implement specific use cases** that leverage inherent features of blockchain & ledger-based technologies to prevent, detect, and mitigate cyber-attacks.
- **Accelerate the pipeline of validated cyber-physical security concepts** from laboratory to utility sector, de-risking through standardized metrics and testing.

GMLC BLOSEM Project Approach

Unified Testing Platform (UTP)

- Enable the ability to rapidly connect blockchain solutions with grid emulation environments (HIL & Co-Simulations)
- Emphasize modularity, interoperability, and reusability to more rapidly connect and evaluate diverse blockchain solutions
- Develop core functionality in a use case agnostic manner, easily extendible to new grid emulation system configurations

Use Case 1: Supply Chain Security, Life Cycle Monitoring, and Real-Time Auditing

Focused on facilitating:

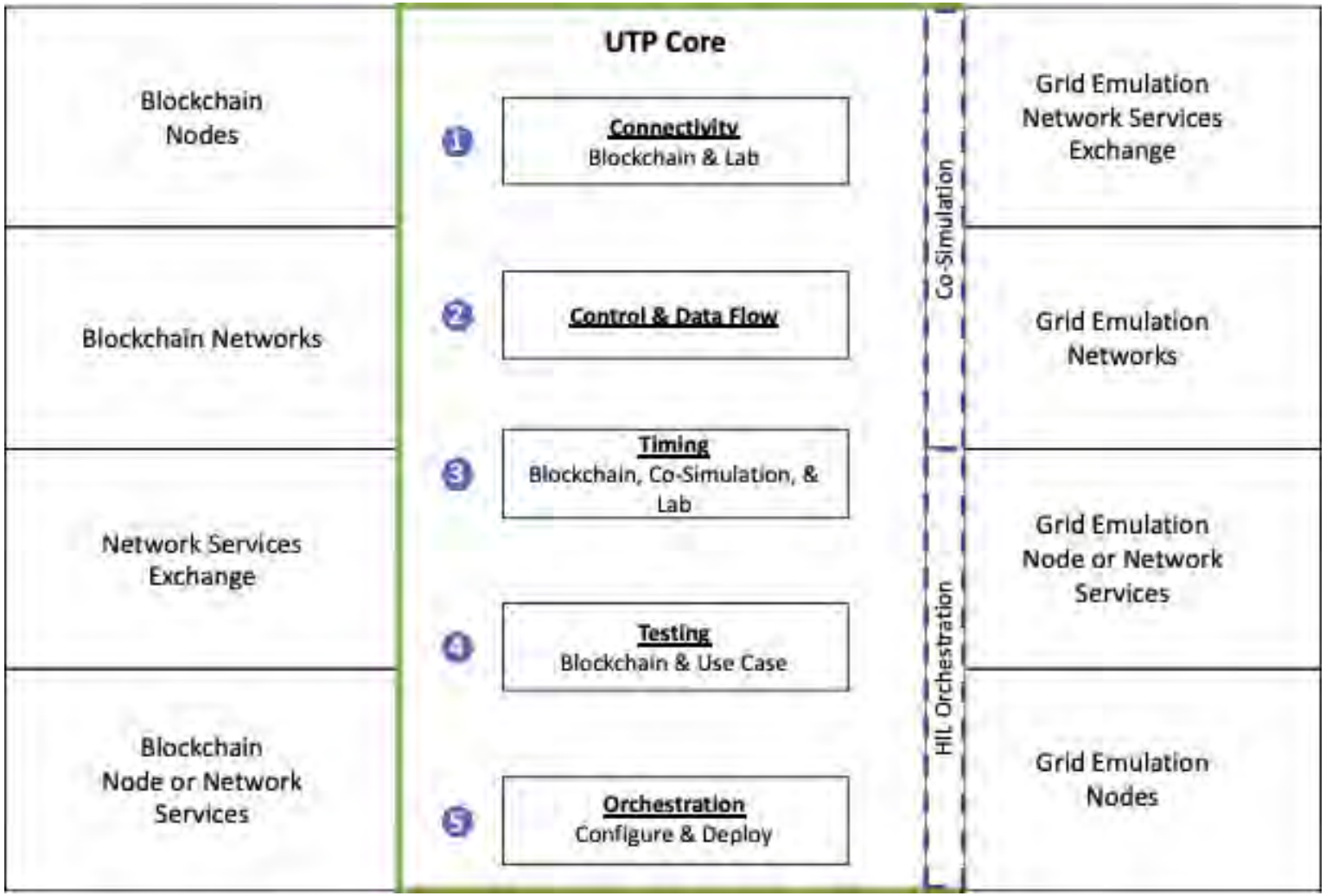
- Asset Lifecycle Management (software and hardware)
  - Auditing and tracking (ordered asset vs receipt)
  - Vulnerability Management
  - Patch and Configuration Management
  - Maintenance and Operations Monitoring
- Cyber Incident Response
- Risk Assessment — operations and remediation

Use Case 2: DER Coordination and Control: Supporting Secure Wholesale Market Participation and Information Exchange with Generation

Architecture supporting DER aggregator participation:

- Demonstrating BLOSEM UTP components
- Facilitating distributed communications architecture across disparate DER owners and energy entities
- Establishing trust anchors with integrity and confidentiality through blockchain
- Initiating flexible access controls and addressing grid constraints
- Addressing tier-bypassing (FERC Order 2222)

For more information: https://netl.doe.gov/BLOSEM


Blockchain Nodes
Blockchain Networks
Network Services Exchange
Blockchain Node or Network Services
UTP Core
1
Connectivity
Blockchain & Lab
2
Control & Data Flow
3
Timing
Blockchain, Co-Simulation, & Lab
4
Testing
Blockchain & Use Case
5
Orchestration
Configure & Deploy
Co-Simulation
HIL Orchestration
Grid Emulation Network Services Exchange
Grid Emulation Networks
Grid Emulation Node or Network Services
Grid Emulation Nodes

USE CASE: DER Coordination & Control

FERC Order No. 2222[1]

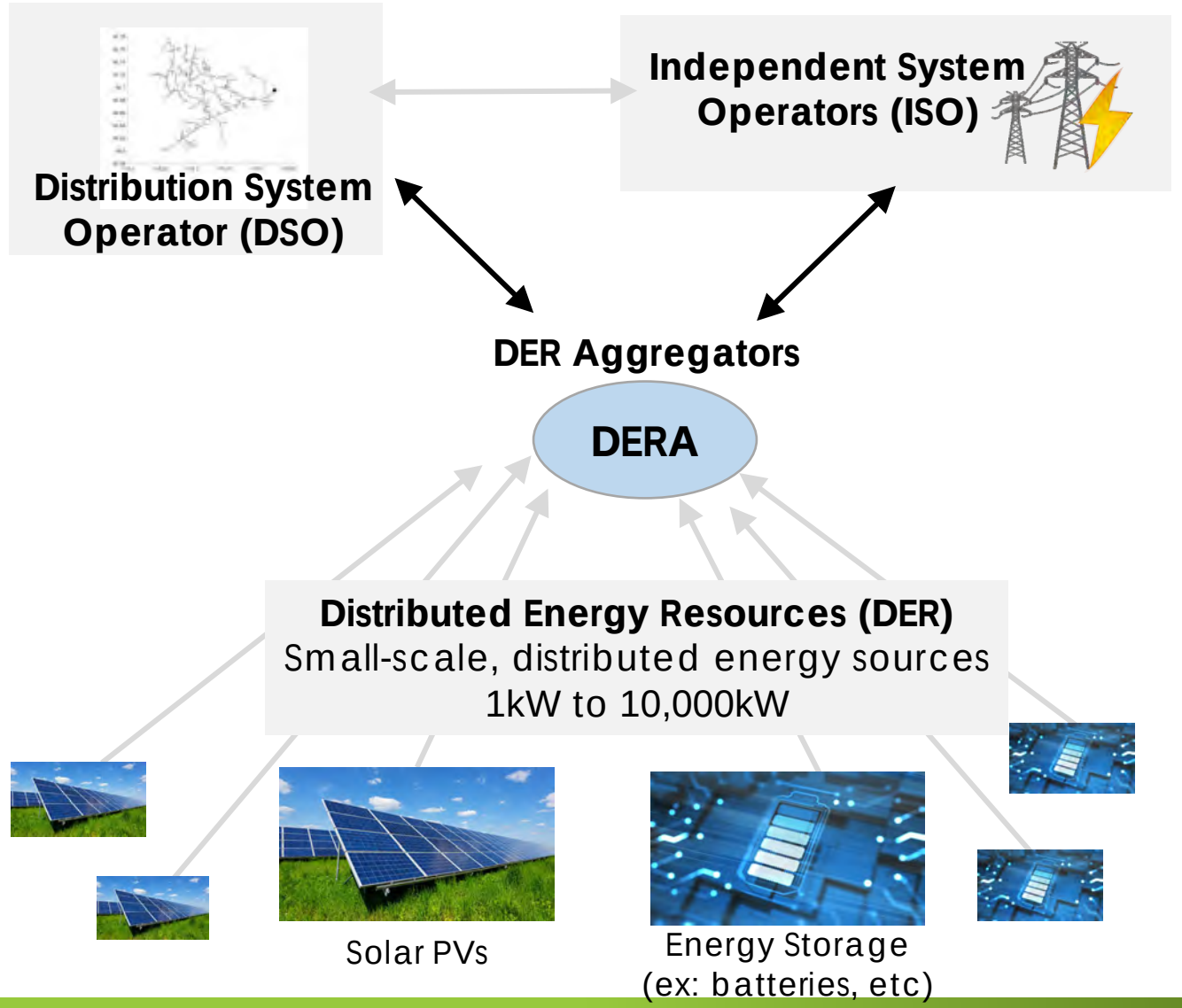
FERC Order No. 2222[1] allows DER to aggregate their electric power so that they can participate in wholesale markets

Challenges:

- Establishment of trust between multiple parties
- Controlled access for system actors (DER, DERA, DSO, etc)
- Scalability of the coordination and control platform

Benefits of Blockchain:

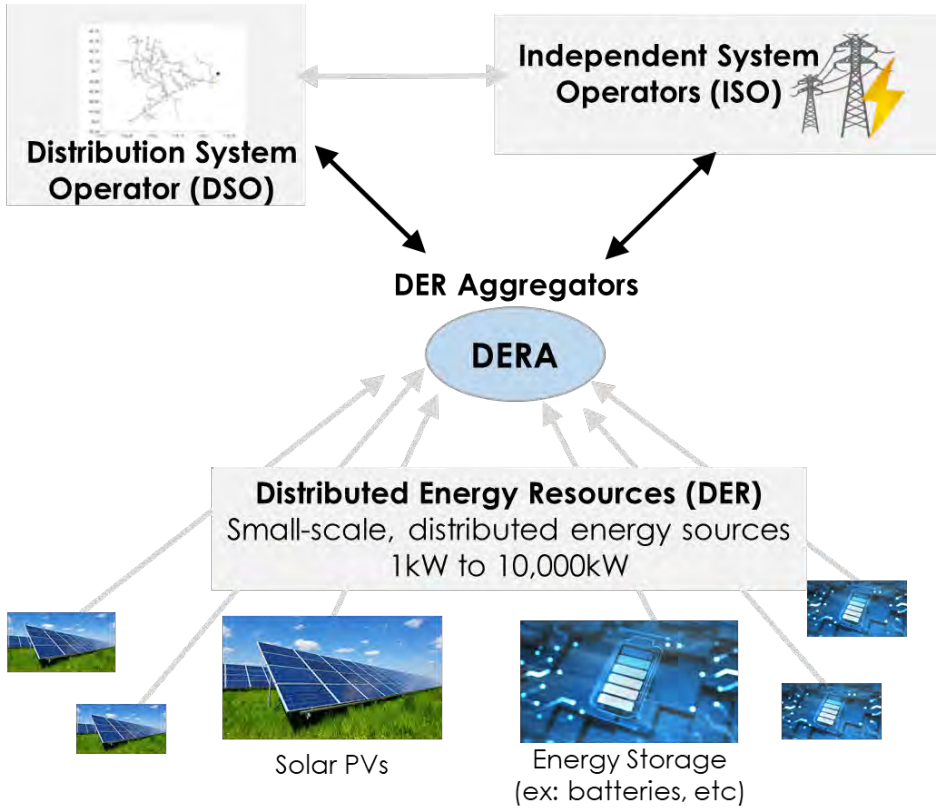
- Flexible access controls and addressing grid constraints
- Address tier-bypassing (prevent double counting; distribution factor)
- Mediation through smart contracts



[1] FERC Order No. 2222 Fact Sheet: https://ferc.gov/media/ferc-order-no-2222-fact-sheet

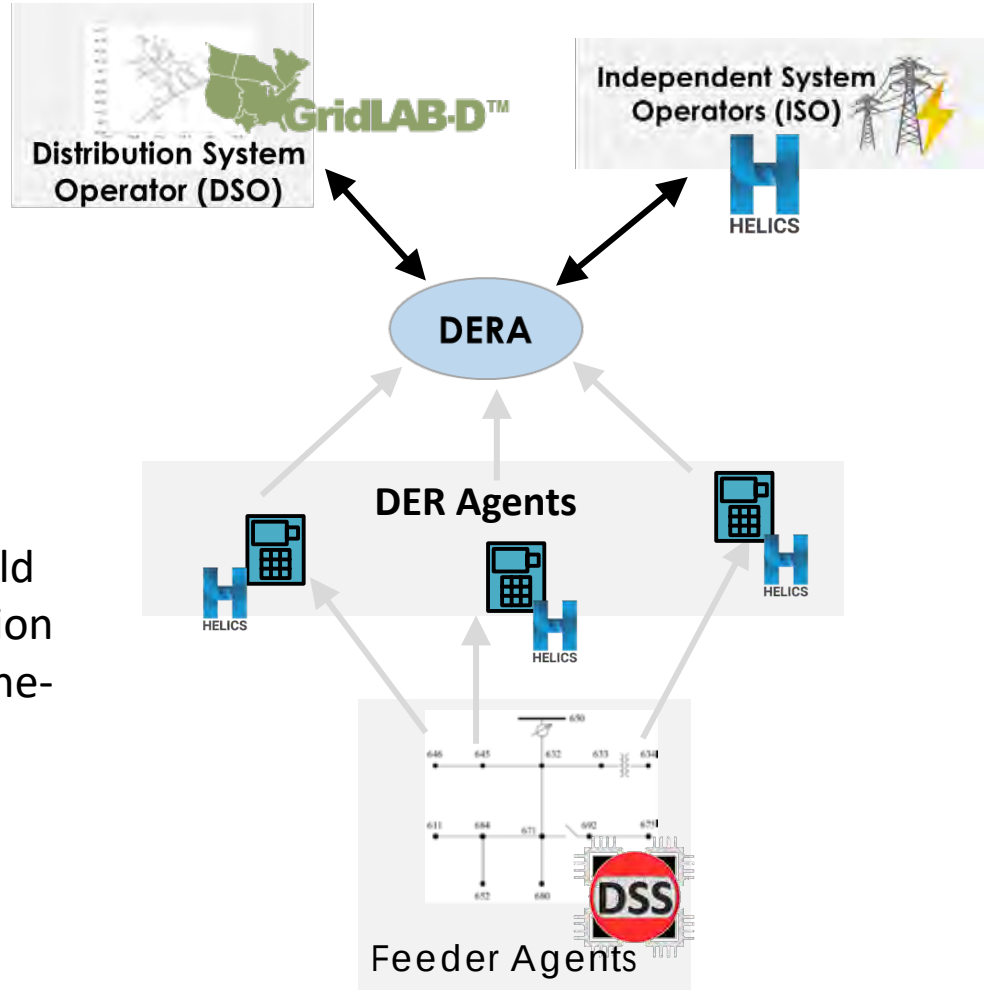
[2] Johnson G., D.J. Sebastian Cardenas, S. Balamurugan, M. Mukherjee, T. Markel, M. Blonsky, and B.E. Johnson. 2022. "A Unified Testing Platform to mature Blockchain applications for Grid Emulation environments." 2022 IEEE PES Transactive Energy Systems Conference (TESC), 2022, pp. 1-5

USE CASE: DER Coordination & Control



Represent the real-world system using co-simulation tools and hardware-in-the-loop resources

Grid Emulation



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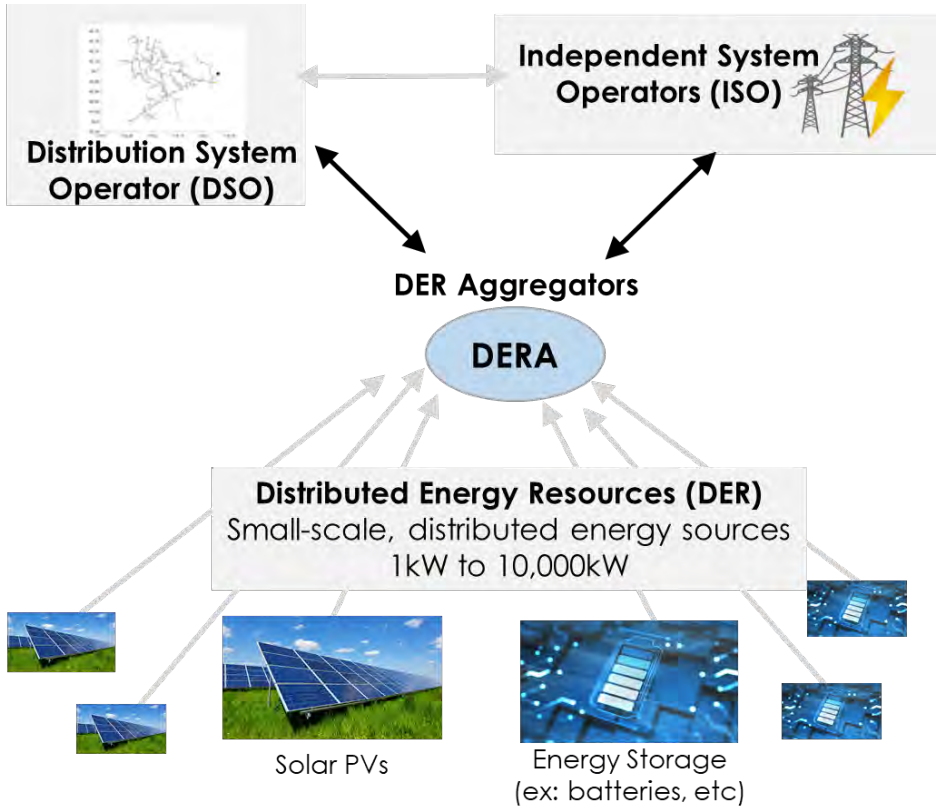
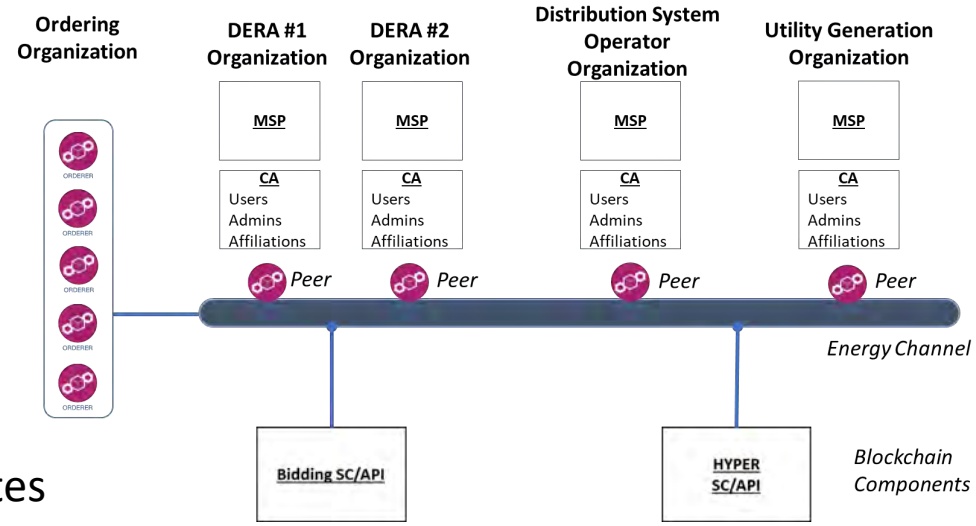


Blockchain Architecture

Create a blockchain architecture that facilitates multi-organizational DER network



HYPERLEDGER

Current implementation with Hyperledger Fabric

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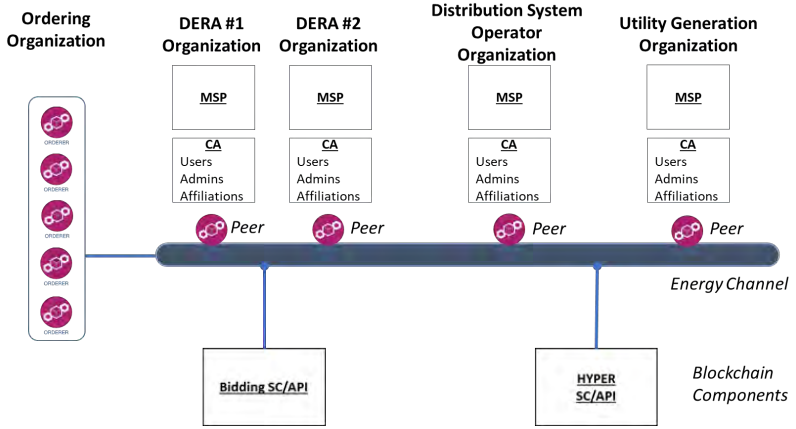
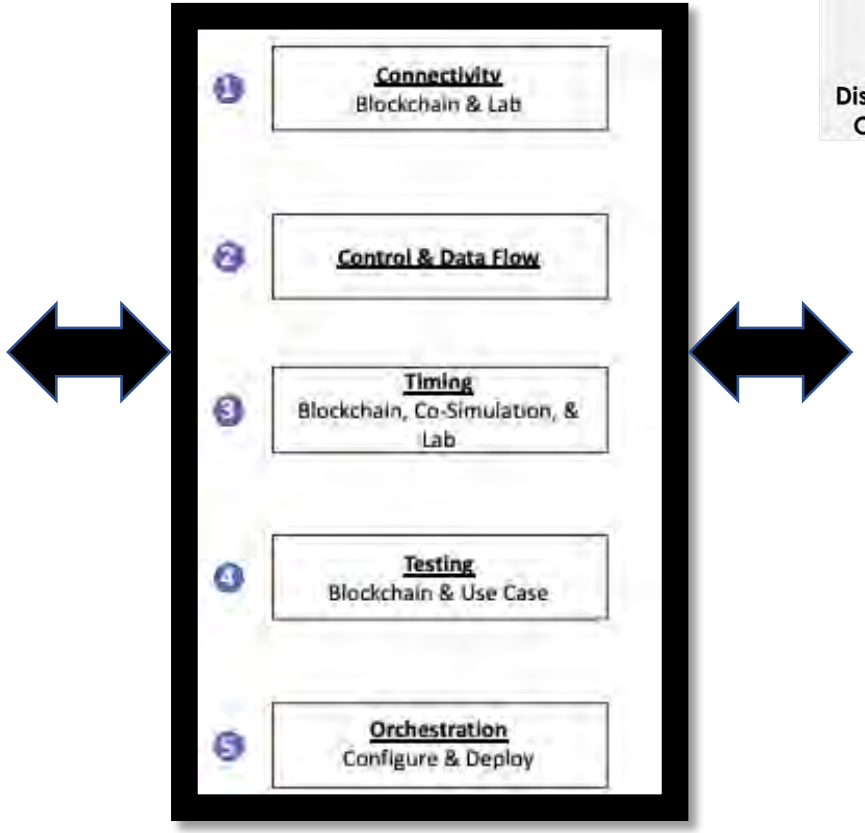
USE CASE: DER Coordination & Control

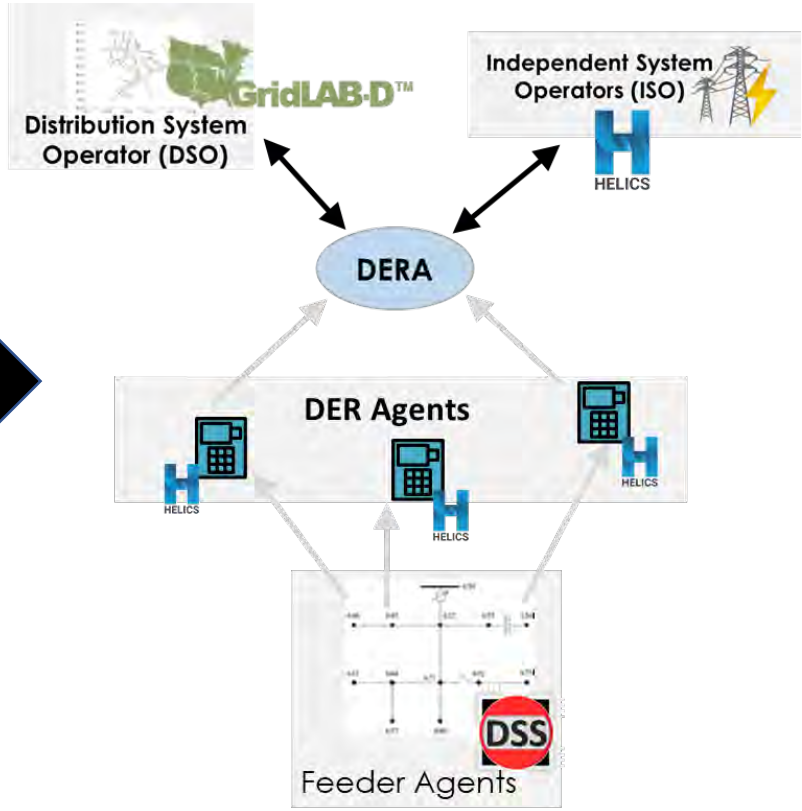
Blockchain Architecture



UTP Core



Grid Emulation



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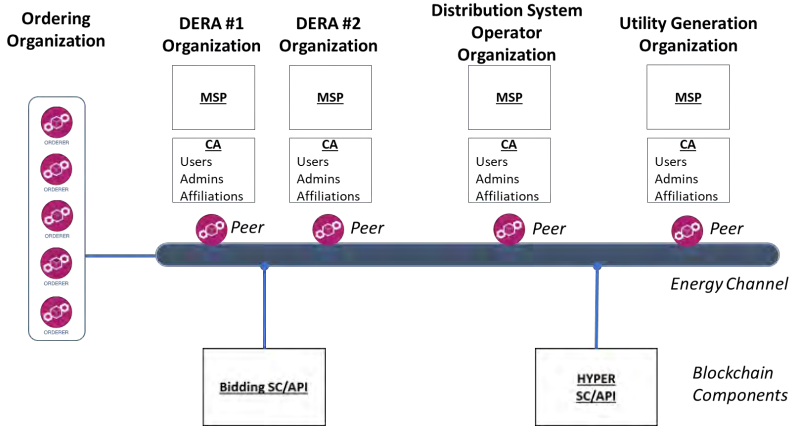
USE CASE: DER Coordination & Control

Blockchain Architecture



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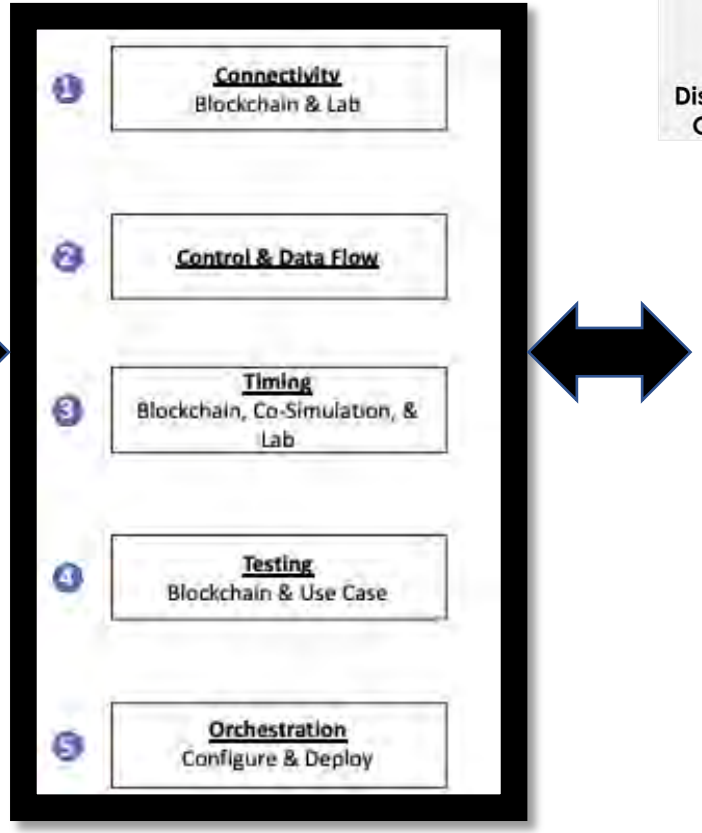
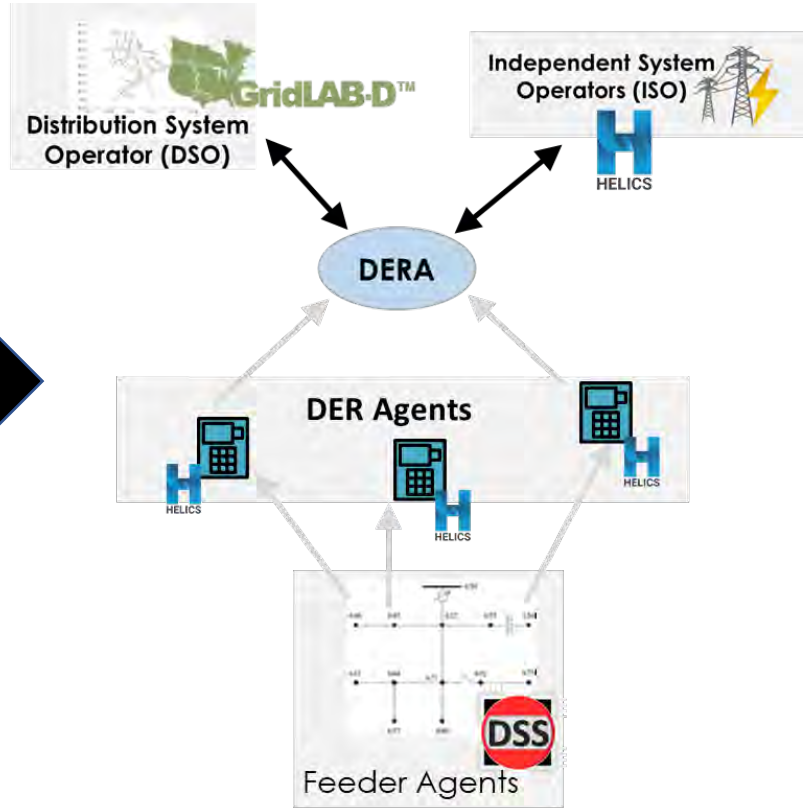


Grid Emulation



Ready to conduct holistic testing to evaluate blockchain AND use case scenario performance!

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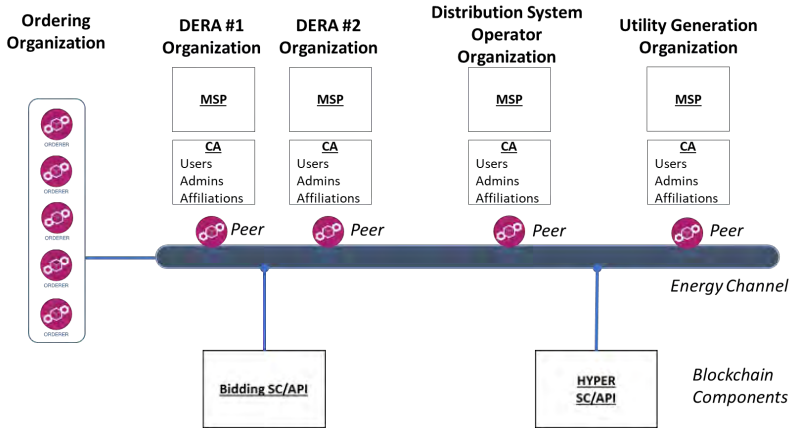

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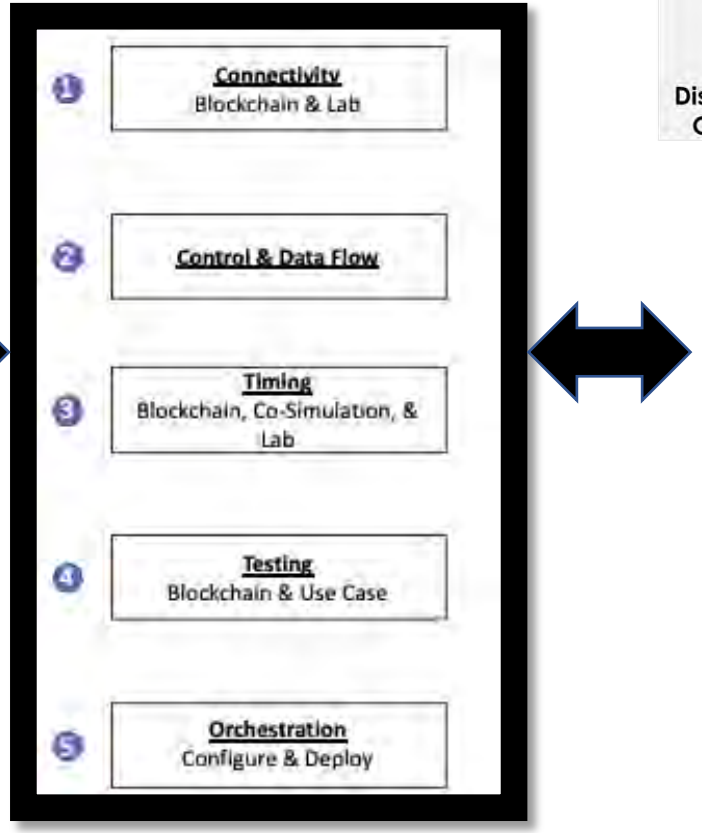

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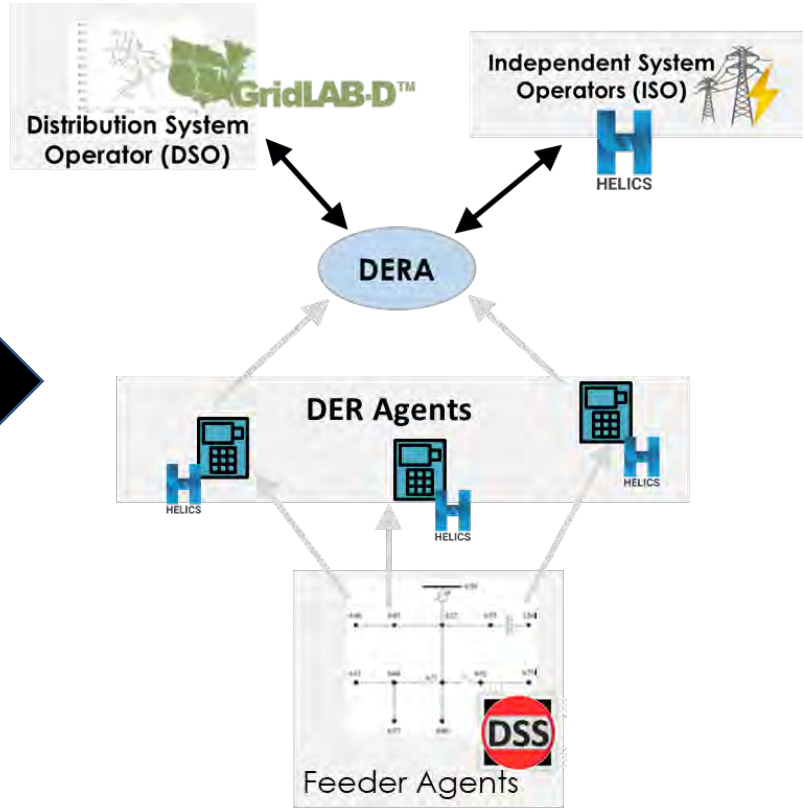
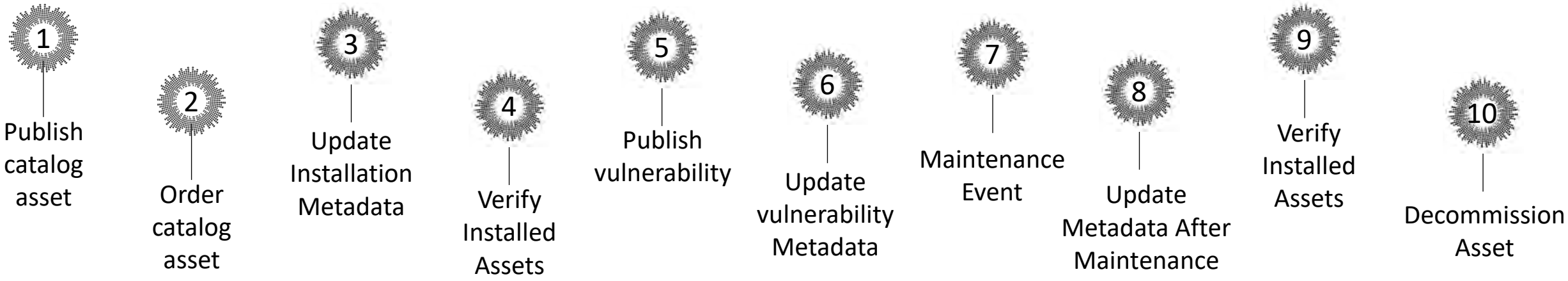


USE CASE: Supply Chain

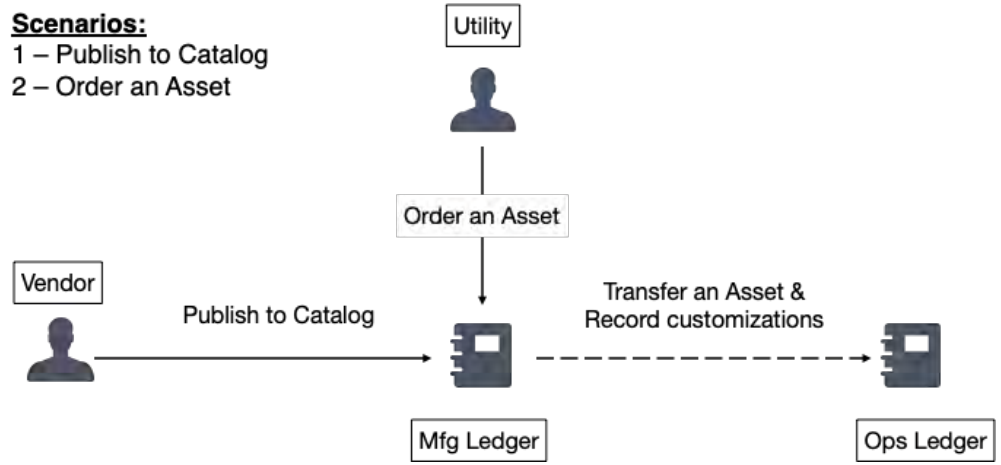
Improve the lifecycle tracking process for specific grid assets



USE CASE: Supply Chain

Improve the lifecycle tracking process for specific grid assets

1. Publish catalog asset
2. Order catalog asset
3. Update Installation Metadata
4. Verify Installed Assets
5. Publish vulnerability
6. Update vulnerability Metadata
7. Maintenance Event
8. Update Metadata After Maintenance
9. Verify Installed Assets
10. Decommission Asset



Workflow for Publishing and Ordering an Asset

USE CASE: Supply Chain

Improve the lifecycle tracking process for specific grid assets

1. Publish catalog asset
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5. Publish vulnerability
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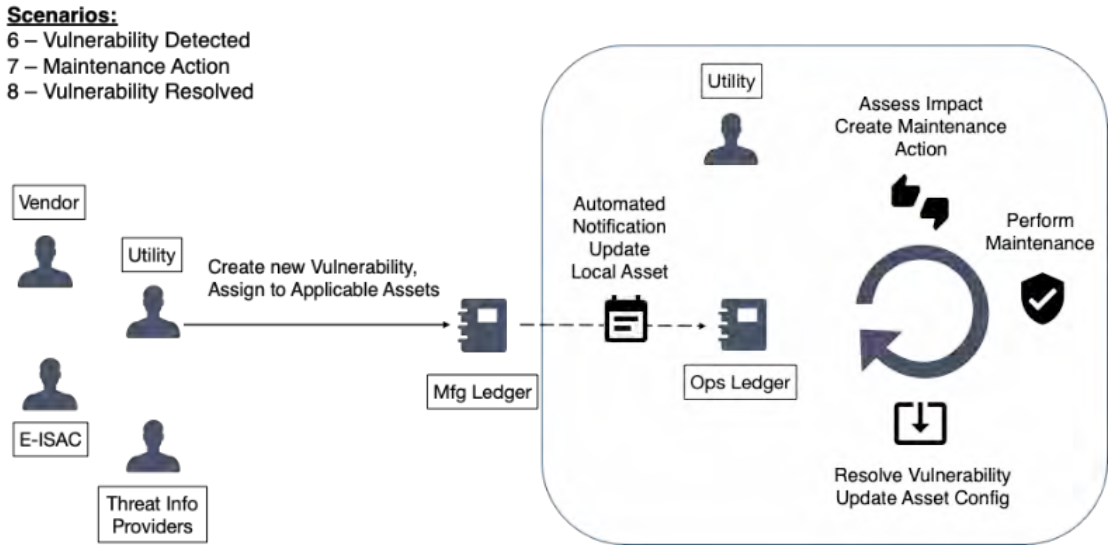

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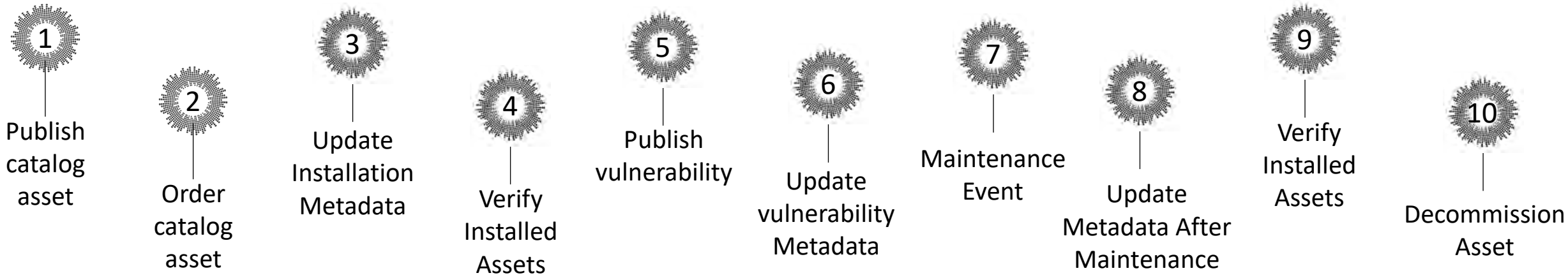
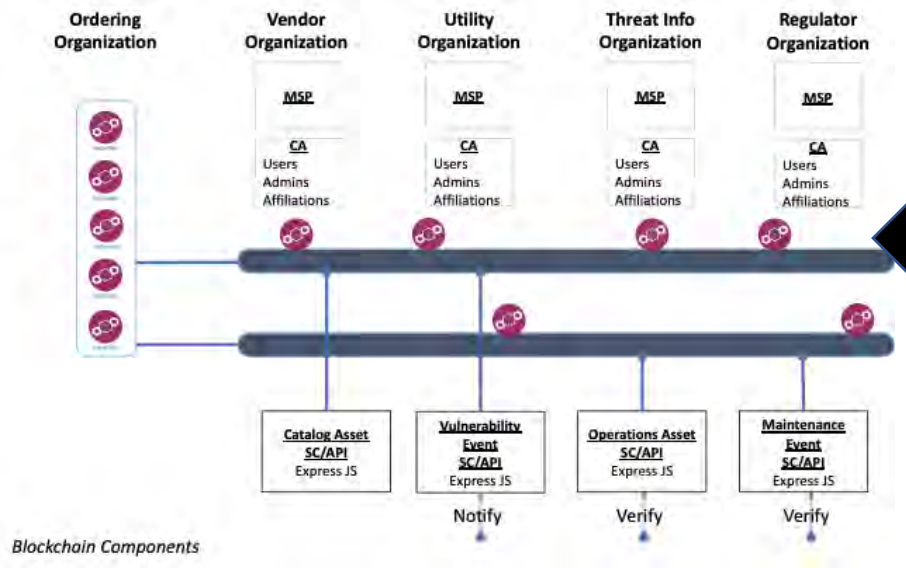


Use Case Research Goals:

- Is the asset (device or software) that **shipped the same asset that was received**?
- Is the asset deployed in operations the same asset that **was originally installed**?
- What is the **risk introduced and the urgency of remediation** when a **vulnerability** has been discovered or a cyber incident has occurred?
  - Can this traceability and risk assessment be *applied to hardware and software sub-components*?
- What vulnerability and cyber incident information is required to be **shared broadly across organizations**, and what must be kept to sharing within sub-groups of the network stakeholders?

USE CASE: Supply Chain

Blockchain Architecture



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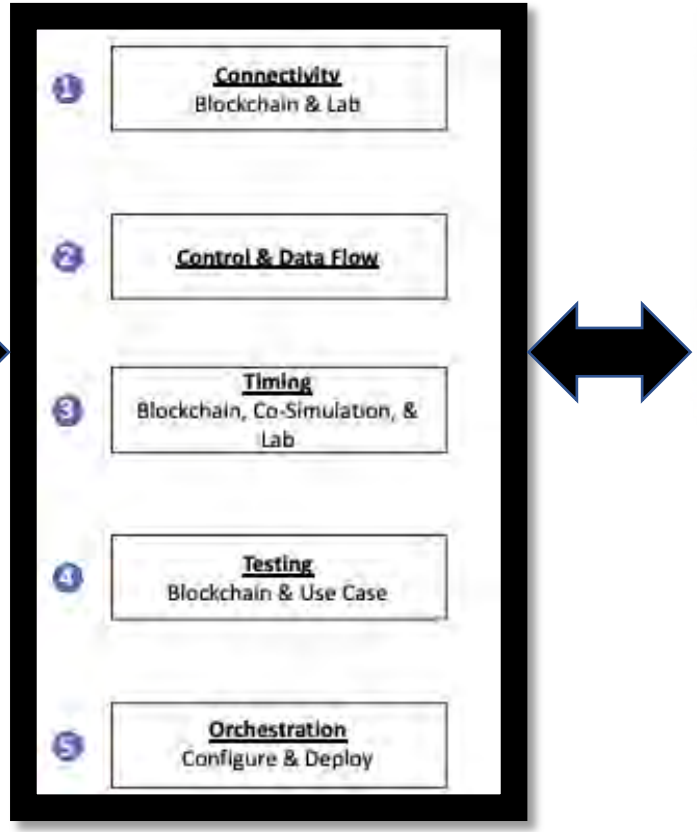
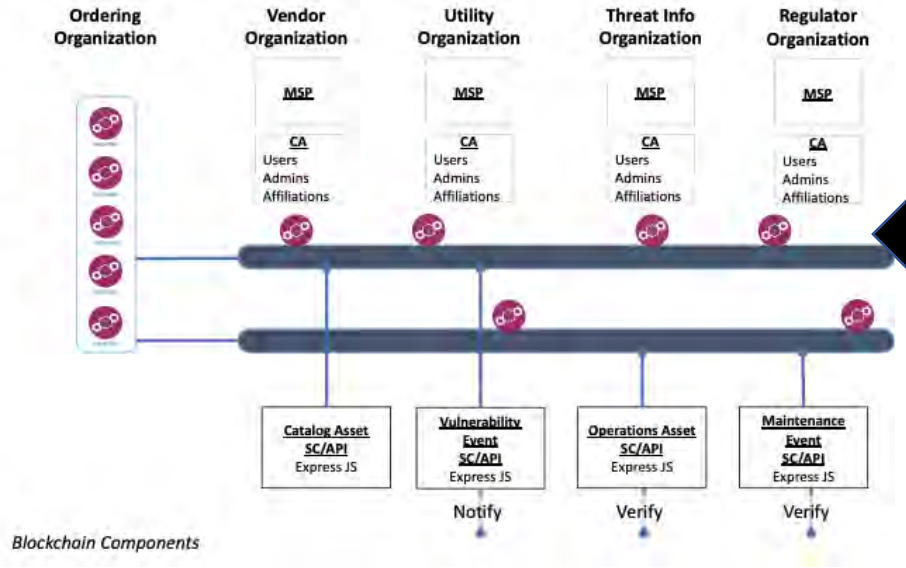


Grid Emulation

Software Applications – Executables and dependencies installed in operations
Embedded Systems – Electrical, mechanical, and embedded software sub-components
Hardware Only Sensors – Supplementing with compute to participate

USE CASE: Supply Chain

Blockchain Architecture



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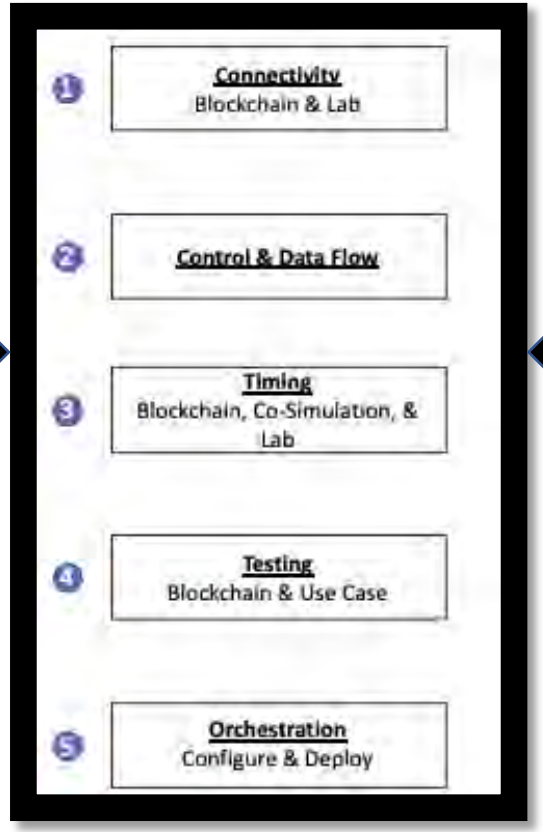


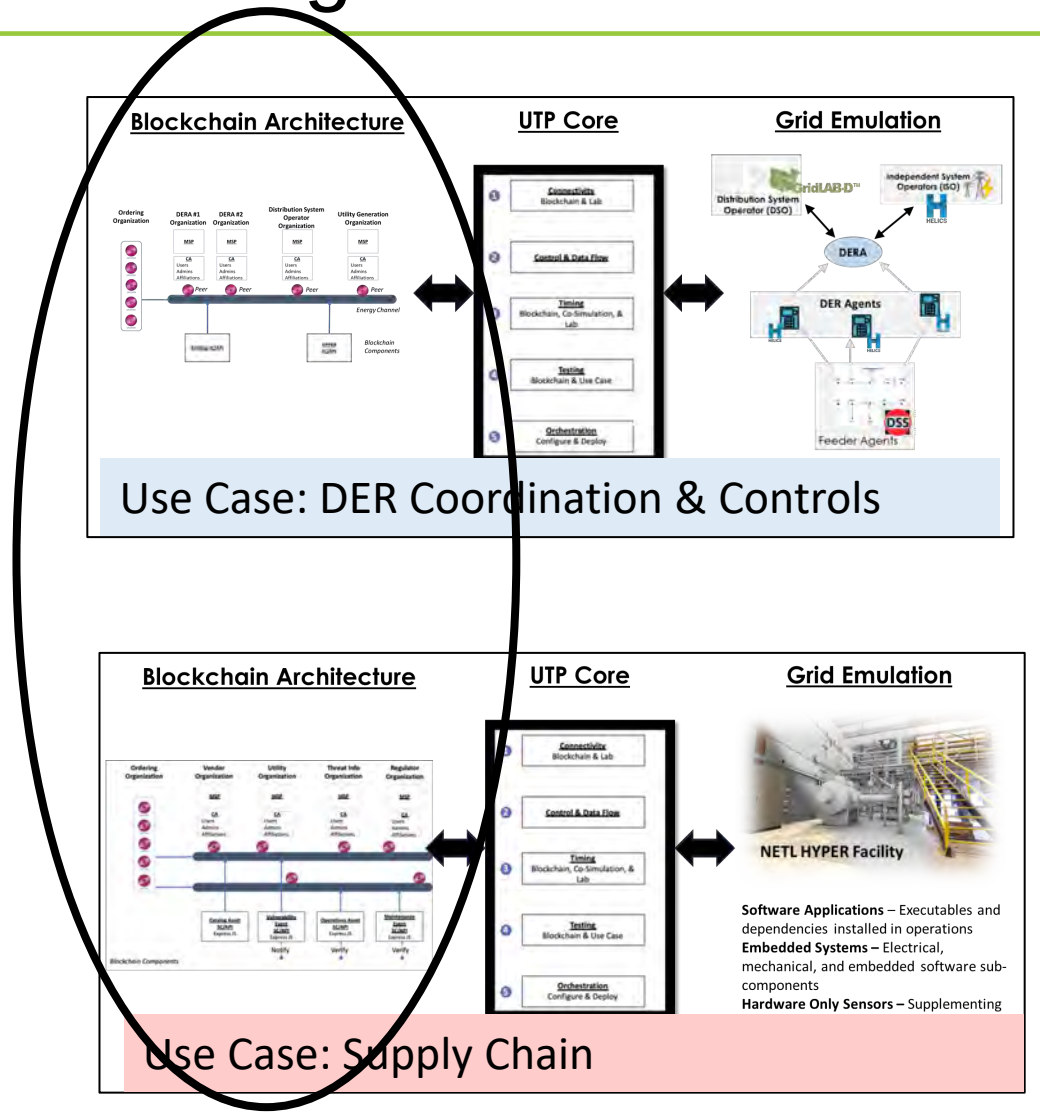
Grid Emulation

Software Applications – Executables and dependencies installed in operations
Embedded Systems – Electrical, mechanical, and embedded software sub-components
Hardware Only Sensors – Supplementing with compute to participate

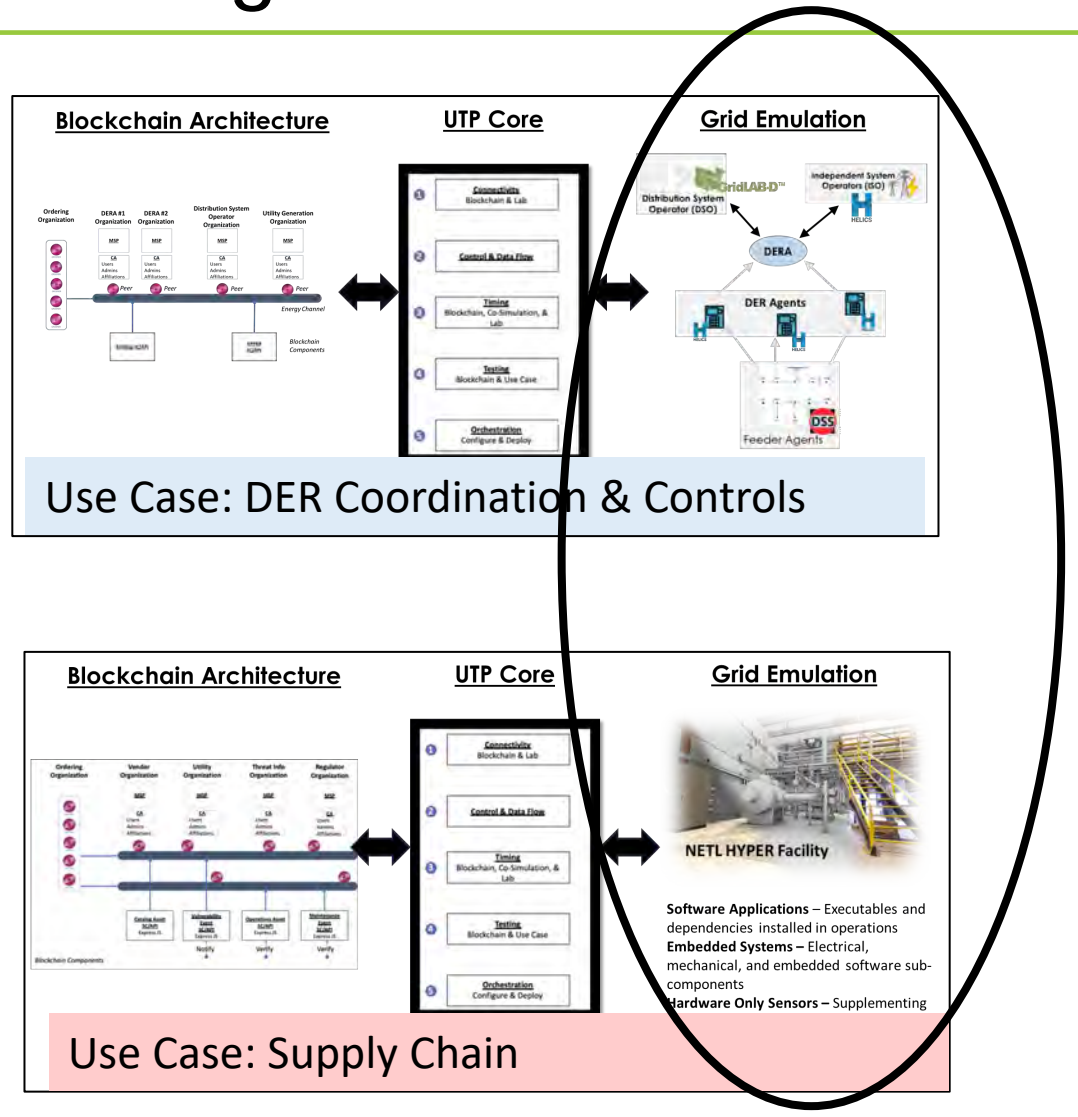
Ready to conduct holistic testing to evaluate blockchain AND use case scenario performance!

BLOSEM Unified Testing Platform

- Enables **design of Blockchain architectures** decoupled from UTP and Grid Emulation tools
- Ability to **interface with additional Blockchain environments** in the future (e.g. – Hashgraph, Energy Web, Ethereum, etc)

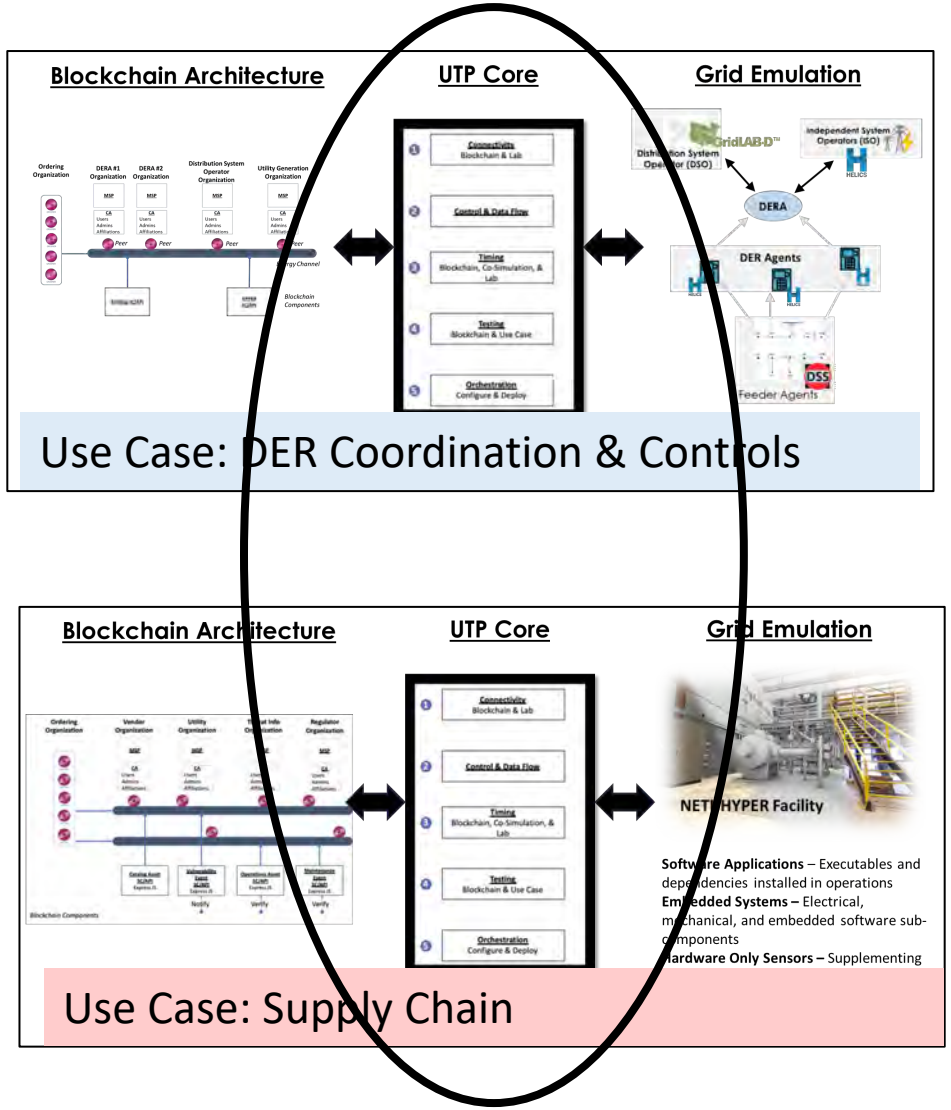


BLOSEM Unified Testing Platform



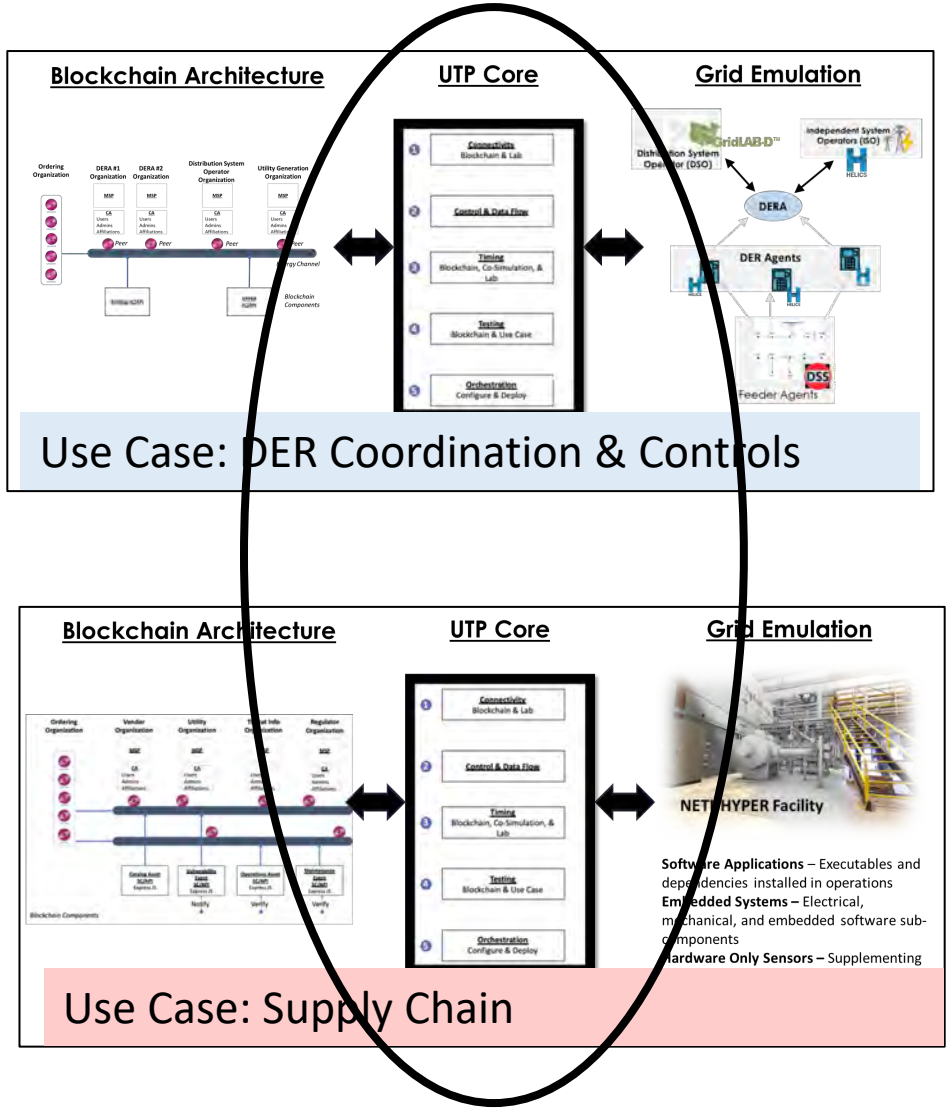
- Enables design of **Grid Emulation tools** and their communication interfaces with UTP
- **Reduces design effort** for reconfiguring grid tools for new grid scenarios

BLOSEM Unified Testing Platform



- Enables **decoupling of grid emulators and blockchain** components
  - Splits communication into data and control planes
  - Simplifies message passing across diverse systems
- Ability to **deploy automated tests**
- **Automated metric collection**

BLOSEM Unified Testing Platform



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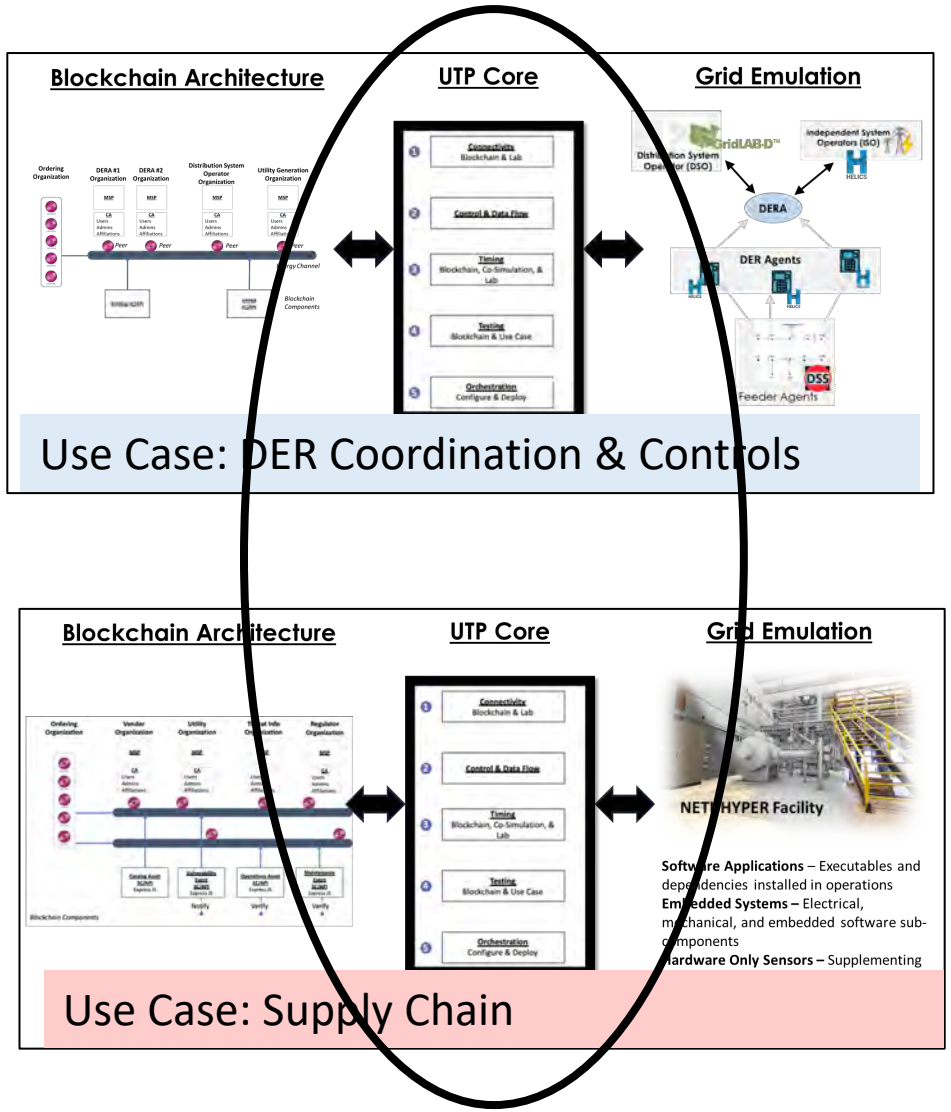
- **Automated metric collection**

BLOSEM Unified Testing Platform



Next Steps

- Final end-to-end testing for both use cases with full integration of target resources
- Finalize analytic dashboards (Splunk)
- Additional outreach to amplify project results
- Explore follow-on R&D:
  - Continue to expand library of grid emulation capabilities by leveraging additional DOE NL resources
  - Collaborations with industry/academia/etc to conduct additional use case demonstrations
    - Supply chain for tracking of raw materials
    - Controls of hybrid, integrated systems
    - Energy consumption performance analysis

BLOSEM Unified Testing Platform

- BLOSEM UTP is a **first-of-a-kind testing platform** that enables systematic performance evaluation of blockchain-based concepts for grid applications
- **Interoperable and reconfigurable** to demonstrate a wide variety of use cases as well as blockchain environments
- Testing and demonstration **reduces risk** for blockchain technologies and **accelerates pipeline of viable concepts** that may be transferred to industry
- UTP leverages DOE resources across the NL network and **will continue to grow in capability** in the future

Thank You!

For more information: https://netl.doe.gov/BLOSEM

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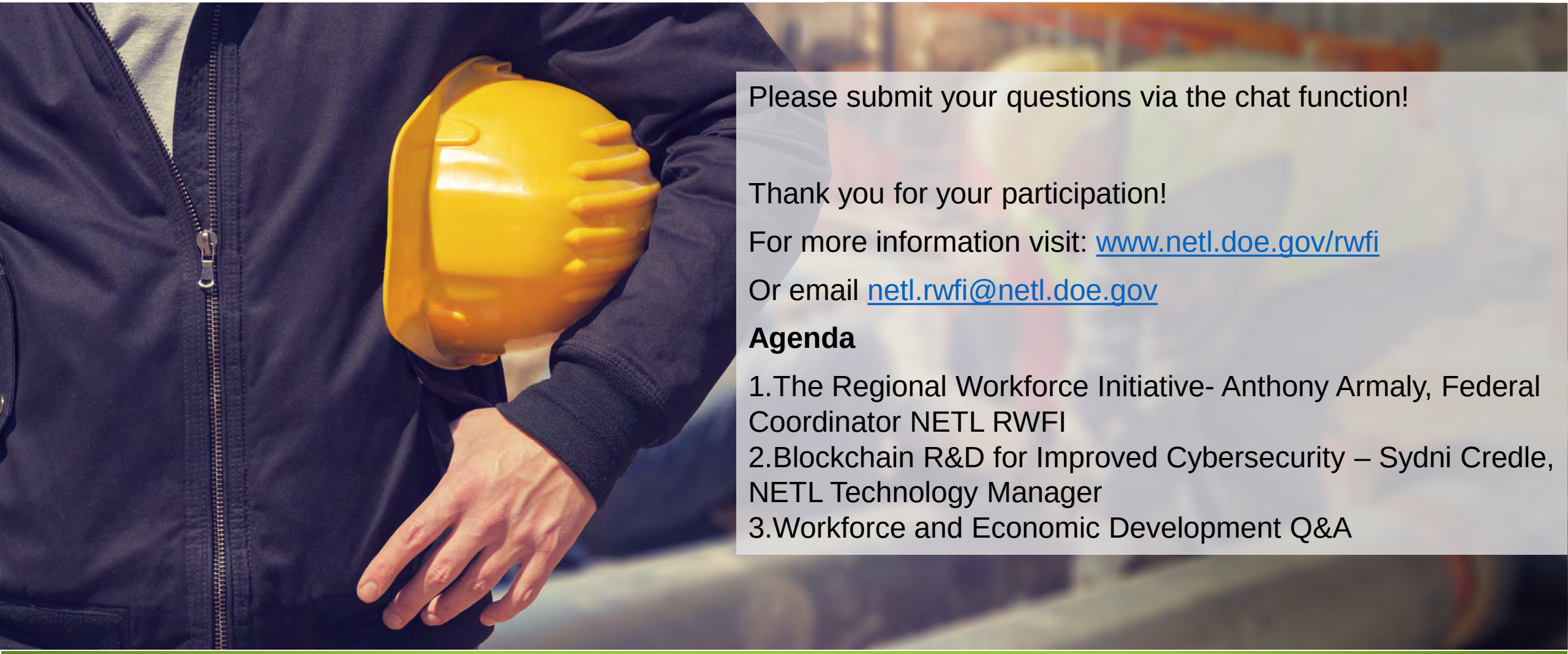
NETL RWFI Energy 101- Blockchain



Please submit your questions via the chat function!

Thank you for your participation!

For more information visit: www.netl.doe.gov/rwfi

Or email netl.rwfi@netl.doe.gov

Agenda

1. The Regional Workforce Initiative- Anthony Armaly, Federal Coordinator NETL RWFI
2. Blockchain R&D for Improved Cybersecurity – Sydni Credle, NETL Technology Manager
3. Workforce and Economic Development Q&A