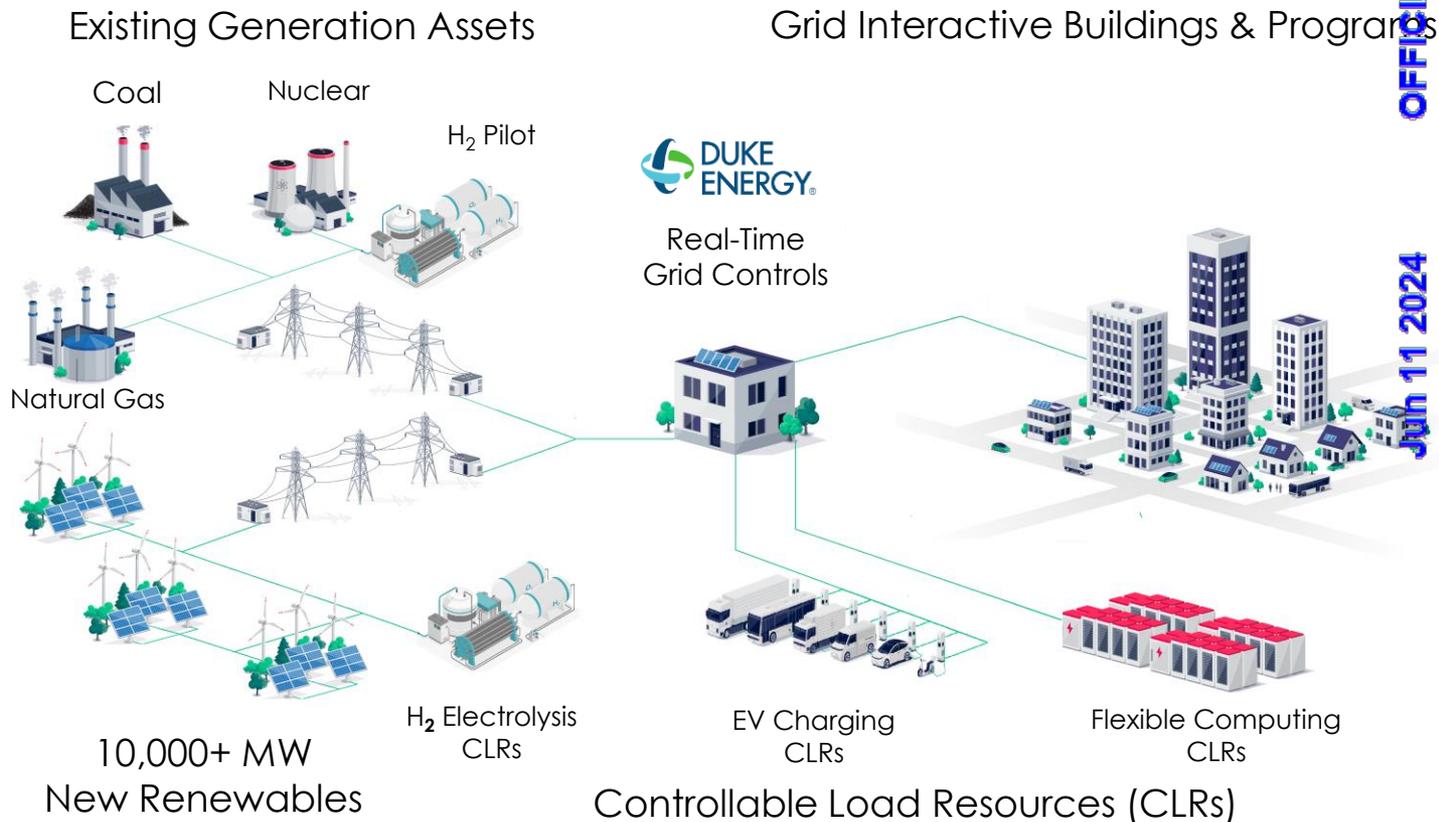# CLR Achievable Grid Services & Value Streams

Value Streams

- Real-Time Grid Control
- Renewables Integration
- Avoided Capacity
- Energy Orchestration
- Performance M&V

Existing Generation Assets

Coal

Nuclear

H_2 Pilot

Natural Gas

Grid Interactive Buildings & Programs

DUKE ENERGY

Real-Time Grid Controls

H_2 Electrolysis CLRs

EV Charging CLRs

Flexible Computing CLRs

10,000+ MW New Renewables

Controllable Load Resources (CLRs)

Controllable Load Resource (CLR) Overview

Duke Energy

Controllable Load Resources Grid Service Attributes

- Flexible & Bi-Directional

- Responsive (<10 seconds)

- Automatable (ADR)

- Reliable

- Modular

- Standardizable

Duke Emerging Technology Office (ETO)

Flexible Computing Load (ETO NC)

Installed & Operating

- 7 x Whatsminer M33S++ Servers
- ~48 kW Total / 90% Flexible Capacity
- 1,694 TH/s
  Cx & Testing (Oct '23)
- VPN Data Access (Nov '23)
- DCFC Control Integration (Complete)

North Carolina

Duke-Owned EV Chargers (DCFC NC)

Installed & Operating

- 16 x BTC POWER DC Fast Chargers
- Duke-Owned Asset
- Establish Real-Time Data Feed (Nov '23)
  - AMI Meter
  - DCFC Cabinet
  - On-Site Power Meter
  - Transformer / Substation Meter
- Benchmarking Grid Services (Nov '23)
- CLR Control Coordination (Complete)

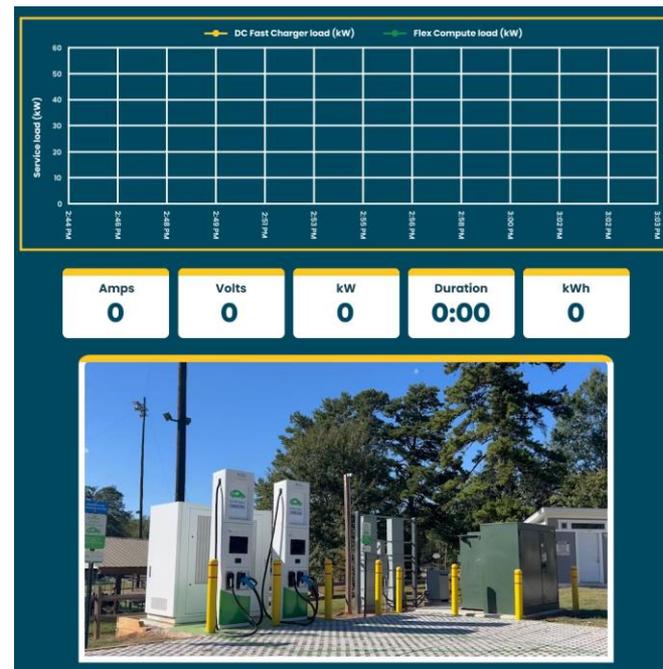# CLR Pilot Study – Phase I Dashboard

Duke Energy & NCREPS

CLR Grid Controls
Flex Compute & EV Chargers
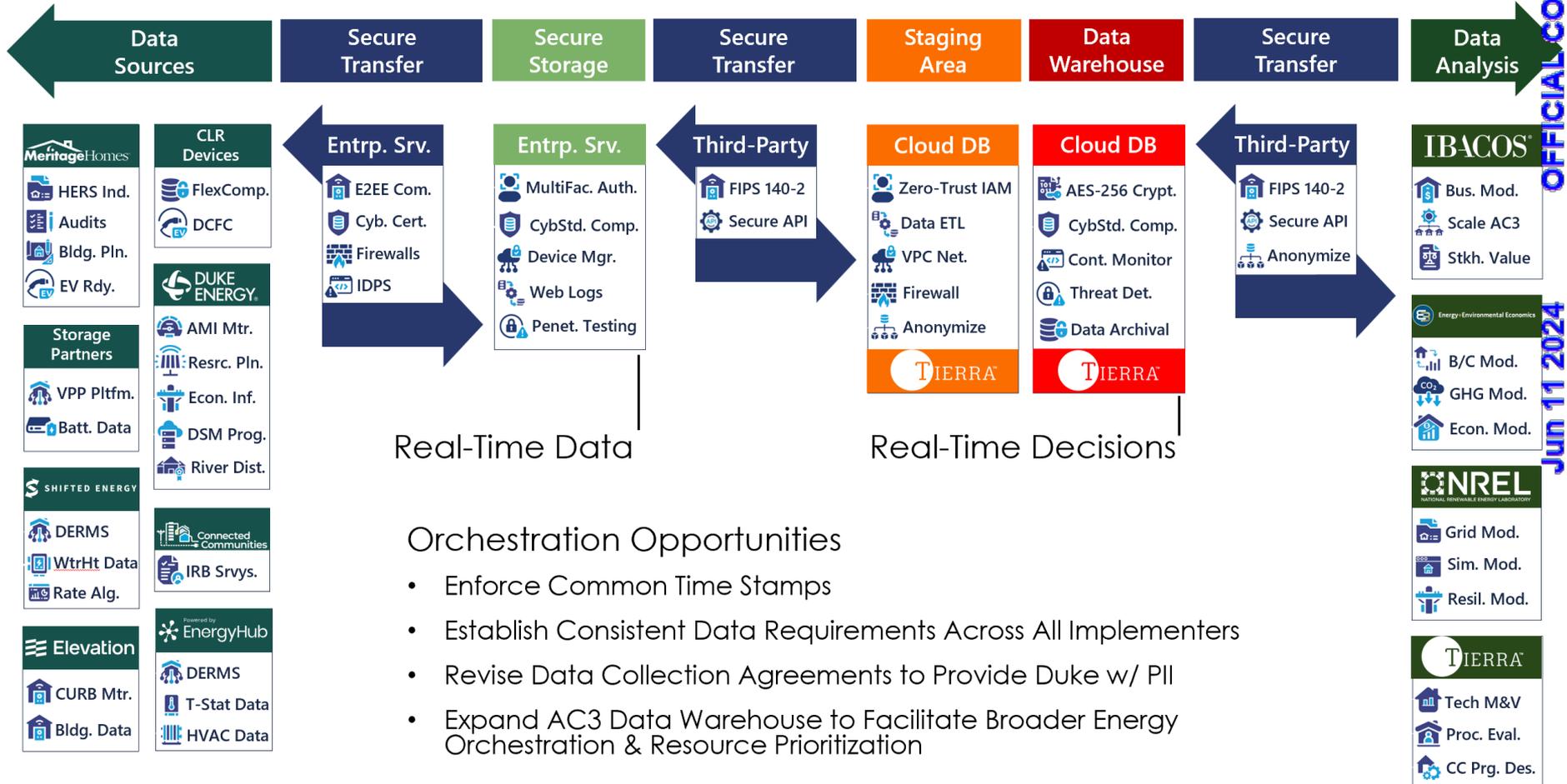
- Real-Time CLR Load-Fill Control (Dec '23)

- Energy Orchestration Coordination (Ongoing)

- Real-Time CLR Control Dashboard (Ongoing)

Energy Orchestration Secure Data Framework

Data Sources	Secure Transfer	Secure Storage	Secure Transfer	Staging Area	Data Warehouse	Secure Transfer	Data Analysis

Data Sources

MeritageHomes
- HERS Ind.
- Audits
- Bldg. Pln.
- EV Rdy.

CLR Devices
- FlexComp.
- DCFC

DUKE ENERGY
- AMI Mtr.
- Resrc. Pln.
- Econ. Inf.
- DSM Prog.
- River Dist.

Storage Partners
- VPP Pltfm.
- Batt. Data

SHIFTED ENERGY
- DERMS
- WtrHt Data
- Rate Alg.

Connected Communities
- IRB Srvys.

Elevation
- CURB Mtr.
- Bldg. Data

Powered by EnergyHub
- DERMS
- T-Stat Data
- HVAC Data

Secure Transfer

Entrp. Srv.
- E2EE Com.
- Cyb. Cert.
- Firewalls
- IDPS

Secure Storage

Entrp. Srv.
- MultiFac. Auth.
- CybStd. Comp.
- Device Mgr.
- Web Logs
- Penet. Testing

Secure Transfer

Third-Party
- FIPS 140-2
- Secure API

Staging Area

Cloud DB
- Zero-Trust IAM
- Data ETL
- VPC Net.
- Firewall
- Anonymize

TIERRA

Data Warehouse

Cloud DB
- AES-256 Crypt.
- CybStd. Comp.
- Cont. Monitor
- Threat Det.
- Data Archival

TIERRA

Secure Transfer

Third-Party
- FIPS 140-2
- Secure API
- Anonymize

Data Analysis

IBACOS
- Bus. Mod.
- Scale AC3
- Stkh. Value

Energy+Environmental Economics
- B/C Mod.
- GHG Mod.
- Econ. Mod.

NREL NATIONAL RENEWABLE ENERGY LABORATORY
- Grid Mod.
- Sim. Mod.
- Resil. Mod.

TIERRA
- Tech M&V
- Proc. Eval.
- CC Prg. Des.

Real-Time Data

Real-Time Decisions

Orchestration Opportunities

- Enforce Common Time Stamps
- Establish Consistent Data Requirements Across All Implementers
- Revise Data Collection Agreements to Provide Duke w/ PII
- Expand AC3 Data Warehouse to Facilitate Broader Energy Orchestration & Resource Prioritization

Current Control Strategies & Data Framework

Energy Control Center	Power Share	Power Manager	Rate Optimizer	Open Source
Control Standard	**Control Standard**	**Control Standard**	**Control Standard**	**Control Standard**
ECC Platform	Telephone Calls	MercuryDERMS	Grid Maestro	OpenADR
	Fax Messages			OCPP
	E-Mail Requests			

Control Attributes

- Unique and Device-Specific Controls

- Cross-Communication and Coordination Challenges

- One-Way Communication (Verification Challenges)

Current Control Strategies & Data Framework

Energy Control Center

DUKE ENERGY®
- Grid Controllers

Control Standard
- ECC Platform

Intermediary (Option)
- Emergency Switch

Controlled Devices
- Generation Assets
- Substations

Power Share

DUKE ENERGY®
- Program Staff

Control Standard
- Telephone Calls
- Fax Messages
- E-Mail Requests

Intermediary
- PowerShare Customers

Controlled Devices
- Steel Plant Loads
- Data Center Loads
- Process Loads

Power Manager

DUKE ENERGY®
- Program / Agg. Staff

Control Standard
- MercuryDERMS

Controlled Devices
- Thermostats

Rate Optimizer

DUKE ENERGY® DOE Pilot
- Optimization Algorithm

Control Standard
- Grid Maestro

Intermediary Device
- CTA-2045 Port

Controlled Devices
- Water Heater Controls

Open Source

DUKE ENERGY® ETO Pilot
- ETO Staff

Control Standard
- OpenADR
- OCPP

Intermediary Device
- CTA-2045 Port

Controlled Devices
- Res. Thermostats
- Res. Wtr.Htr. Controls
- EV Chargers

CLR & Energy Orchestration

Duke Energy

Standardized & Centralized Communication& Controls

- Common Time Stamps
- Updated Data Accessibility Requirements for Partners
- Cross-Device & Control Platform Compatibility
- Active Insights with Real-Time Performance Data (Coordination, Prioritzation, etc.)
- Integrated Performance / Control Dashboard

DUKE ENERGY® Central Control Platform

Energy Orchestration & CLR Pilot (Test Case)
Duke Program & Control Staff

Control & Communication Standard
OATI Central Platform

Intermediary (Option)
OEM Translator

Controlled Devices
- Flexible Computing
- Data Centers
- EV Chargers (DCFC)
- H² Electrolysis

ECC

Direct Outreach

Aggregators

Rate Optimizers

Open Source