Exelon Utilities Data Analytics Journey
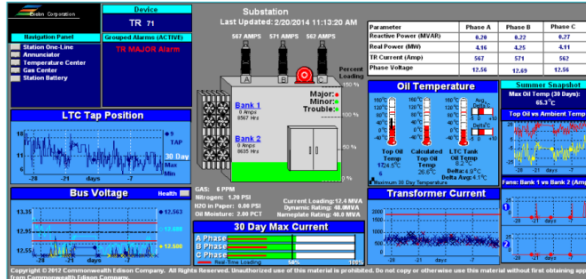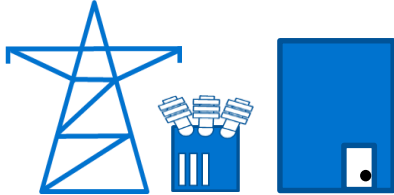
Presented by **Dean M Hengst**

PI System uses with-in Exelon Utilities
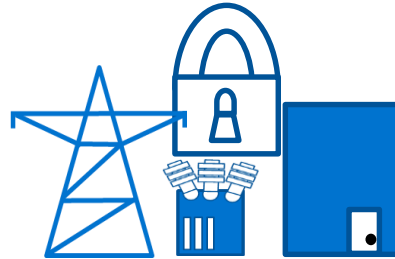
Intelligent Substation	Substation Security	Historical Playback / Capacity Planning
ComEd as implemented many microprocessor relay's into their substations to gather better engineering data that will allow for more proactive monitoring and analytics.	PECO and ComEd as implemented a program to understand when personnel enter into substations via door sensors. This data allows for proactive monitoring and understanding of authorized and unauthorized access into substations.	Across the Exelon Utilities the PI System is used to aid in Capacity Planning and the Historical Playback of storm data. These functions are critical to a utility from the sizing of their system to sizing of their electrical network.

Background - Business Intelligence Data Analytics

Exelon Utilities is embarking upon a multi-year Business Intelligence Data Analytics (BIDA) program. This program is inclusive of all Exelon Utilities and data "domains" identified to be in scope. Our business leadership for each domain ensures that we are pursuing use cases to derive the most business value.

High Level BIDA Domains

The Exelon Utilities Information Technology BIDA team in an effort to support the overall BIDA program and the first project domain (Smart Energy Services) developed a reference architecture of capabilities to be used as a template for future solutions and best practices. The goals of our technology strategy are:

- To pursue a technology vendor and hosting approach to deliver the foundational Data Analytics Platform (DAP) that will be leveraged by the overall Business Intelligence Data Analytics program

- To select a technology vendor that provides a robust and flexible hosting solution for the Data Analytics Platform, and also offers diverse software solutions to address data ingestion, data integration and comprehensive reporting, visualization and data discovery tools.

Overview of Exelon Business Intelligence Data Analytics Program

Exelon BIDA addresses 60 opportunities to leverage analytics, clustered into 5 functional domains. The underlying Data Analytics Platform exchanges data with multiple sources and will provide flexibility for future users and vendors.

Customer | Grid (T&D) | Business Support

| Smart Energy Services | Customer Experience | AMI | Grid (T&D) | Business Support |

Data Analytics Platform

Grid Domains
30 use cases across:
- Reliability & Operations
- Workforce
- System Planning & Asset Management
- Distributed Energy Resources (DER)
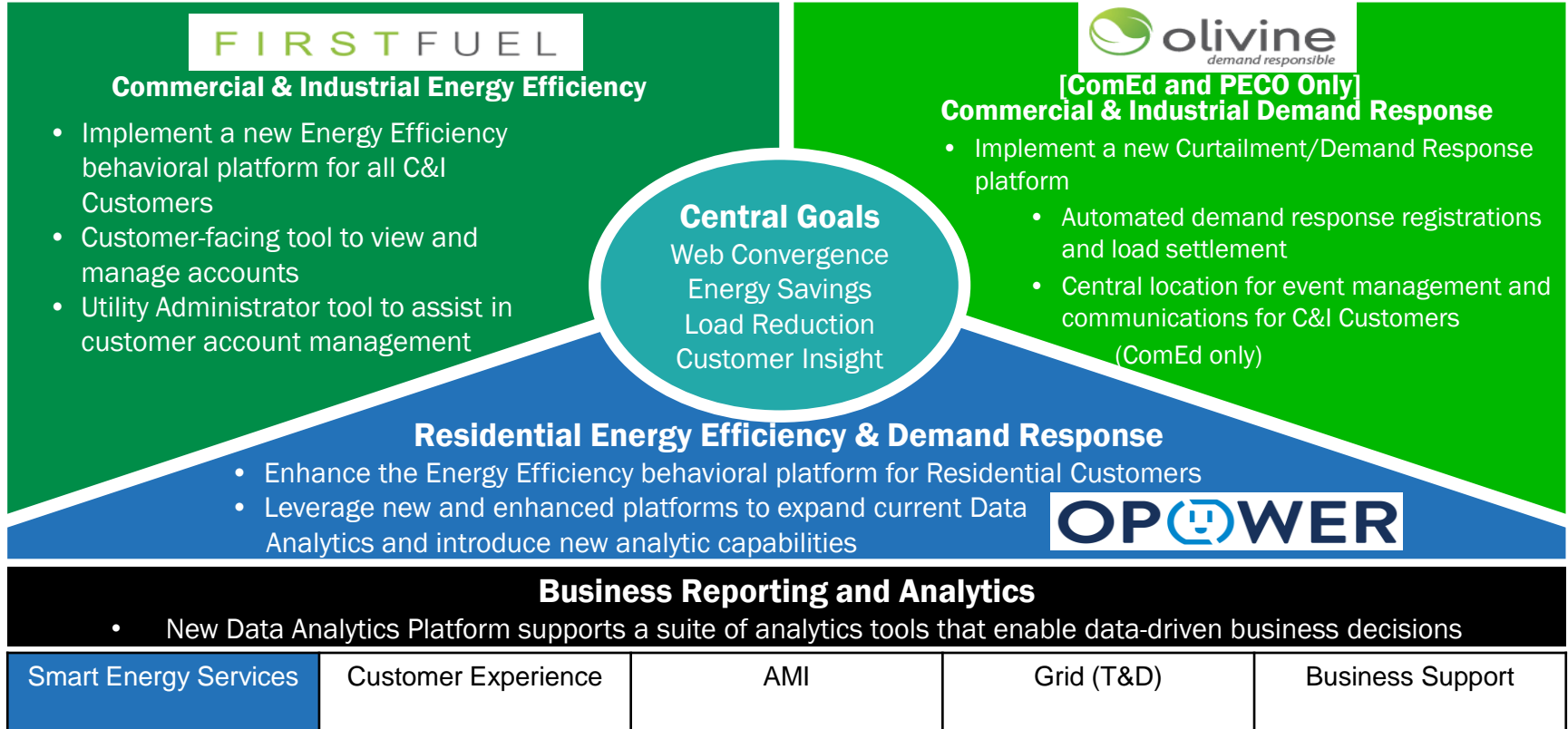
Customer Domains
18 use cases to benefit:
- Customer Satisfaction
- Energy Efficiency
- Demand-Side Management
- Cost-to-Serve, Calls per Customer

Business Support
Opportunities include:
- Crew Prep & Routing
- Credit & Collections
- Inventory Management
- +more

First Implementation – Smart Energy Services

FIRSTFUEL

Commercial & Industrial Energy Efficiency

- Implement a new Energy Efficiency behavioral platform for all C&I Customers
- Customer-facing tool to view and manage accounts
- Utility Administrator tool to assist in customer account management

olivine
demand responsible

[ComEd and PECO Only]
Commercial & Industrial Demand Response

- Implement a new Curtailment/Demand Response platform
  - Automated demand response registrations and load settlement
  - Central location for event management and communications for C&I Customers (ComEd only)

Central Goals
Web Convergence
Energy Savings
Load Reduction
Customer Insight

Residential Energy Efficiency & Demand Response

- Enhance the Energy Efficiency behavioral platform for Residential Customers
- Leverage new and enhanced platforms to expand current Data Analytics and introduce new analytic capabilities

OPOWER

Business Reporting and Analytics

- New Data Analytics Platform supports a suite of analytics tools that enable data-driven business decisions

Smart Energy Services	Customer Experience	AMI	Grid (T&D)	Business Support

Smart Energy Services "By the Numbers"

6,200 Terabytes
Available Capacity in Data Analytics Platform All Tiers (DAP)

72 Peak IT Project Team Resources

7,650 Data Attributes from 28 Production Source Systems

7 Vendor Delivery Partners

13 Distinct Steps in Data Modeling, Mapping and Ingestion Process to Populate the DAP

1,600 Business Rules to be analyzed and/or developed in IT data integrations
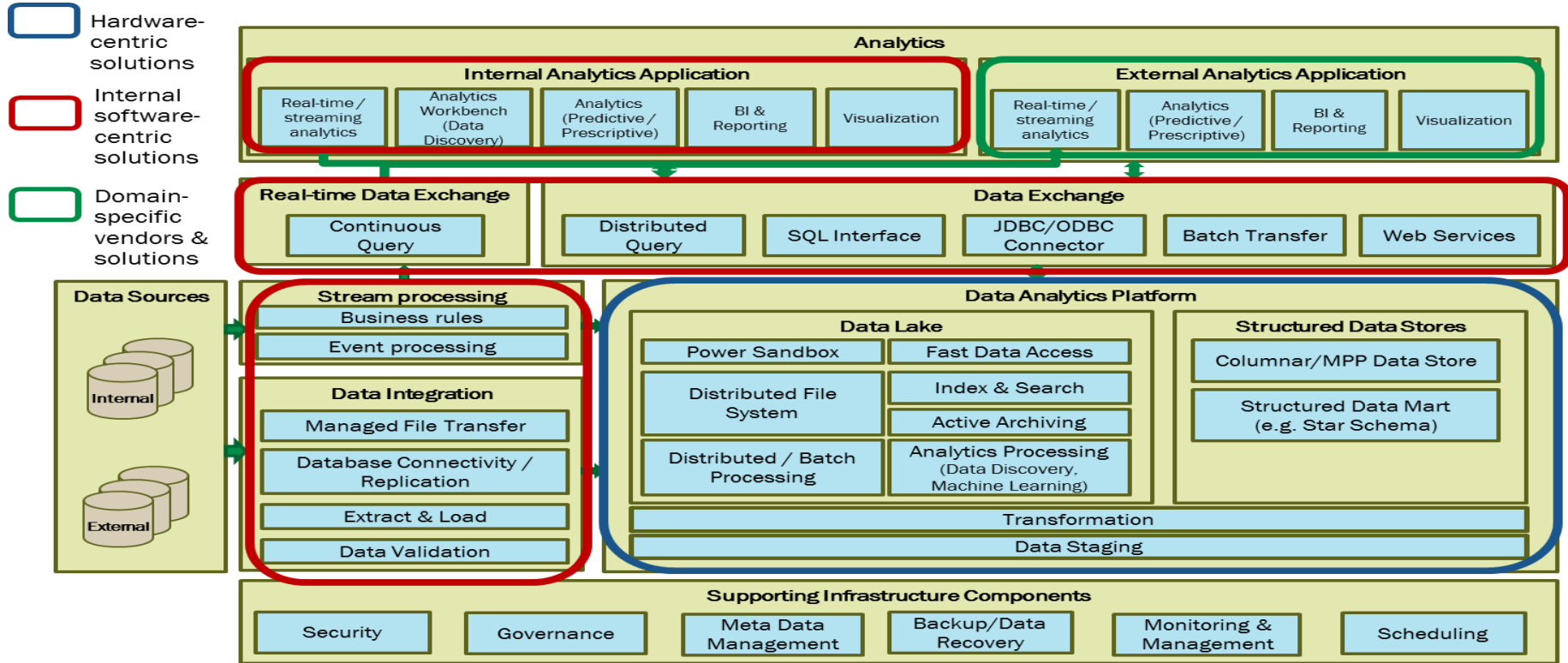
New Technologies including Hadoop, Scoop, Impala, OBIEE, Spark, Hive, Big Data SQL, Scala, Oracle R, Big Data Appliances, Oracle Data Integrator and Oracle Fusion Middleware **12**

Exelon Utilities BIDA Reference Architecture

The reference architecture is comprised of both hardware and software solutions (referred to as the Data Analytics Platform) to enable the business requirements of current and future domains.

Hardware-centric solutions

Internal software-centric solutions

Domain-specific vendors & solutions

Analytics

Internal Analytics Application

| Real-time / streaming analytics | Analytics Workbench (Data Discovery) | Analytics (Predictive / Prescriptive) | BI & Reporting | Visualization |

External Analytics Application

| Real-time / streaming analytics | Analytics (Predictive / Prescriptive) | BI & Reporting | Visualization |

Real-time Data Exchange

Continuous Query

Data Exchange

| Distributed Query | SQL Interface | JDBC/ODBC Connector | Batch Transfer | Web Services |

Data Sources

Internal

External

Stream processing

Business rules

Event processing

Data Integration

Managed File Transfer

Database Connectivity / Replication

Extract & Load

Data Validation

Data Analytics Platform

Data Lake

Power Sandbox	Fast Data Access
Distributed File System	Index & Search
	Active Archiving
Distributed / Batch Processing	Analytics Processing (Data Discovery, Machine Learning)

Structured Data Stores

Columnar/MPP Data Store

Structured Data Mart (e.g. Star Schema)

Transformation

Data Staging

Supporting Infrastructure Components

| Security | Governance | Meta Data Management | Backup/Data Recovery | Monitoring & Management | Scheduling |

Key Benefits of Exelon Utilities Reference Architecture

1. Data Integration Layer
2. Data Analytics Platform
3. Data Exchange Layer
4. Internal Reporting & Analytics
5. External Vendor Analytics Applications

- Enables internal analytics and reporting by Exelon data scientists and provides data exchange for vendor analytics for all operating companies.

- In addition to analytics and reporting, a common internal BIDA architecture enables a standardized integration layer for internal and external data exchanges, applications and external vendor

- De-couples external vendor and internal data and analytics solutions, allowing for flexibility in modifying, adding or changing vendor analytics partners.

- Our BIDA Architecture Roadmap will consolidate data warehouse silos embedded in the individual utilities by delivering a common data repository (i.e. data lake) which is not in scope for external analytics vendors.

- Vendor-provided solutions for external analytics are mostly domain-centric while the internal BIDA architecture will enable cross-domain/cross operating company analysis.

- Data Lake design is extensible allowing for future data stores and use cases not currently identified in the 5 target domains in scope for BIDA.
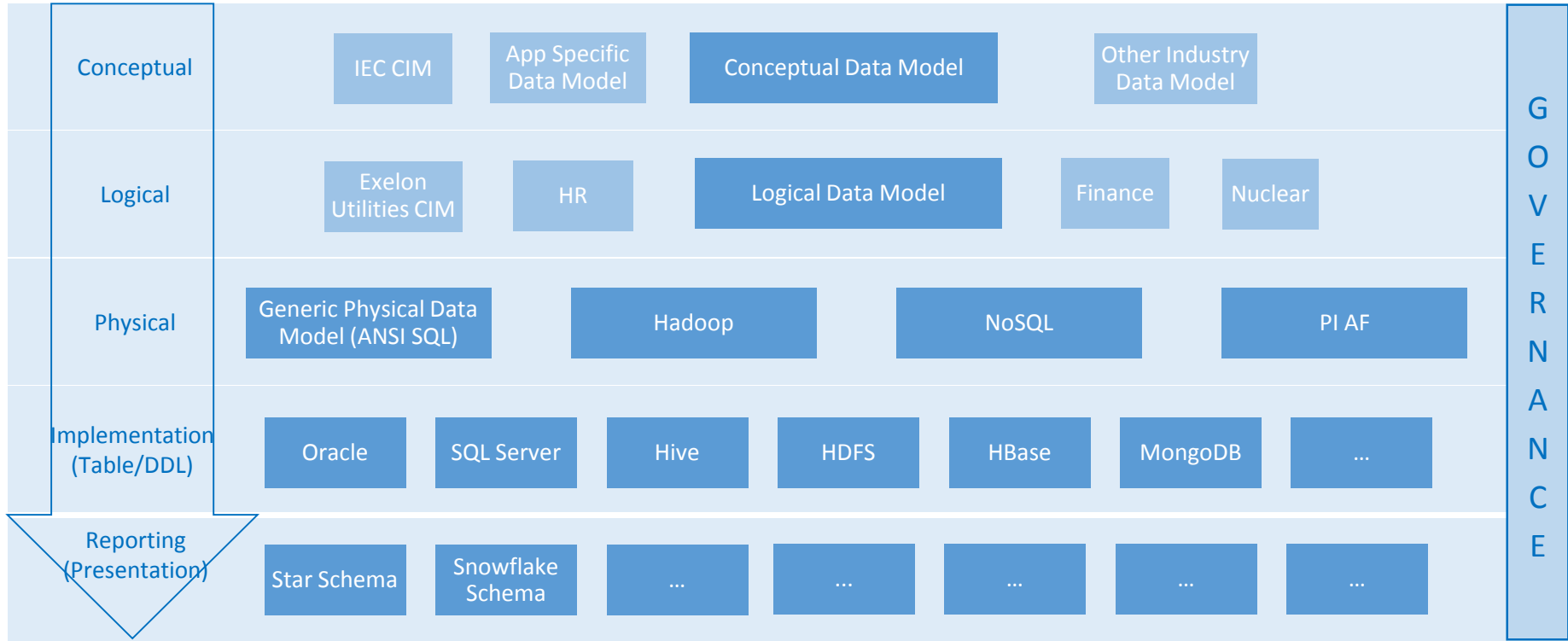
PI Server™ Role in the BIDA Landscape

The PI Server™ data that is necessary only for specific use cases will be extracted and placed into the Data Analytics Platform. There may be a need to create a time series instance as a part of the DAP to store the use case specific data.
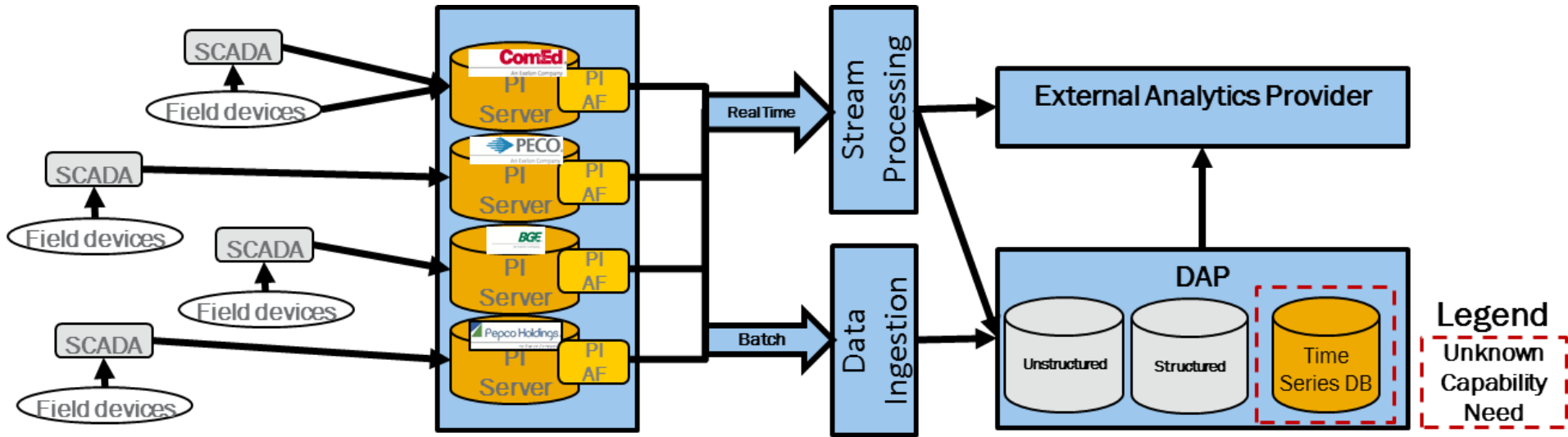
BIDA Data Model Reference Diagram

Governance is key to enforcing Data Model Integrity throughout the data model design stack layers

Layer						
Conceptual	IEC CIM	App Specific Data Model	Conceptual Data Model		Other Industry Data Model	
Logical	Exelon Utilities CIM	HR	Logical Data Model		Finance	Nuclear
Physical	Generic Physical Data Model (ANSI SQL)	Hadoop		NoSQL	PI AF	
Implementation (Table/DDL)	Oracle	SQL Server	Hive	HDFS	HBase	MongoDB ...
Reporting (Presentation)	Star Schema	Snowflake Schema	...	...	...	... ...

GOVERNANCE

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

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