Session 8b: Contextualizing a Smart Grid in Cape Town

Speaker:

Rebecca Cameron

Energy Directorate

The City of Cape Town

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Overview of City Electricity Operations

- 37 points of delivery from the national grid
- 44 switching stations and 76 main substations service the City's supply area
- 3 existing dispatchable plants:
  - 180MW Hydro Pumped Storage Scheme
  - 2 x 40 MW Open Cycle Gas Turbines
- New: Utility-scale Solar Plant – 7MW
- 2 x network control centres
- Over 600 000 Customers (Large Power Users make up 65% of demand)
- +/- 1800 MW Maximum Demand
- As of June 2023, there were over 3500 grid-tied residential systems commissioned and 568 grid-tied commercial and industrial systems commissioned. – equalling a total grid-tied capacity of 109 MVA.

IPP_FAQs.pdf (capetown.gov.za)

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Overview of the Energy Strategy

VISION

Energy security for a prosperous Cape Town. Together, we can build a resilient energy system where all residents and businesses have access to reliable, affordable, and carbon neutral energy.

PRINCIPLES

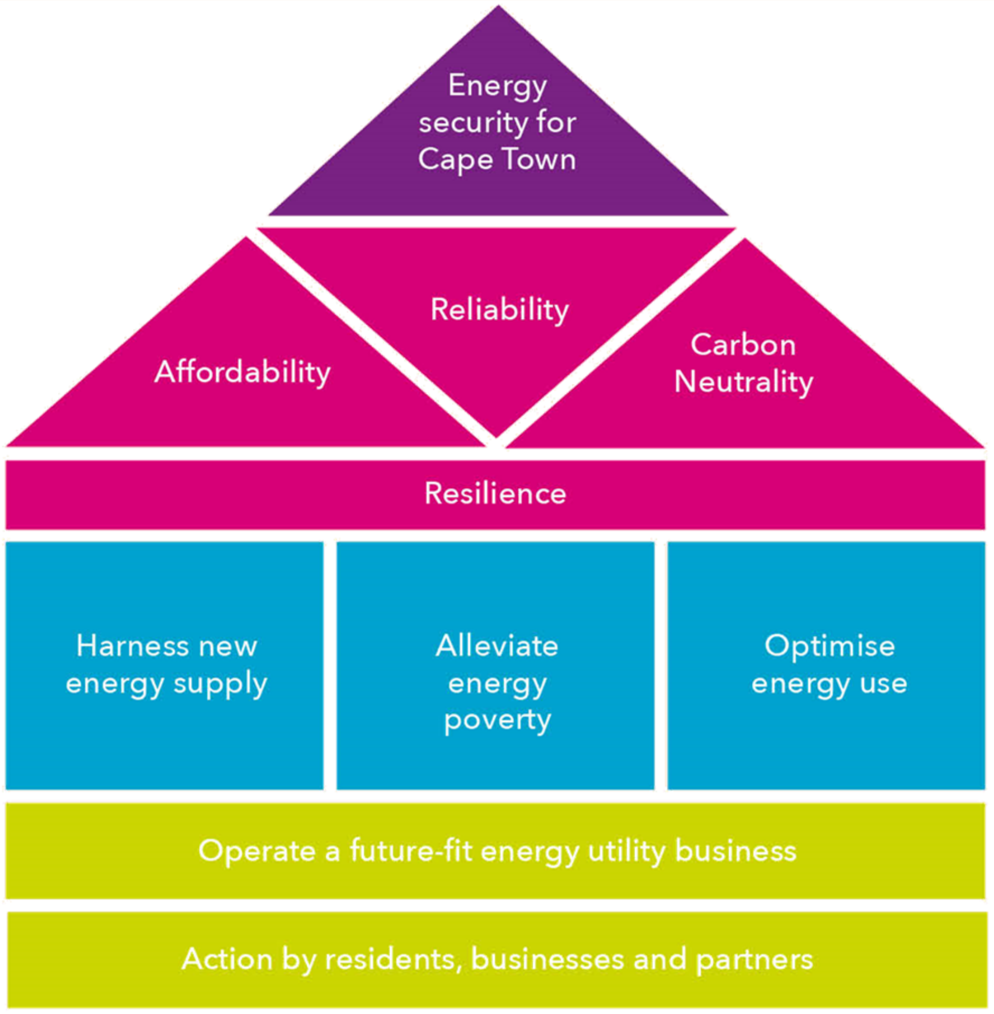
Reliability: Energy is available when it is needed
Affordability: Ability to pay without compromising other needs
Carbon neutrality: limiting greenhouse gas emissions
Resilience: The capability to adapt to change and disruption

COMMITMENTS

The City's commitments to deliver, enable and partner with stakeholders to build a resilient energy system to support social and economic development

ENABLERS

The ability to succeed in these commitments will depend on the actions by many people and corresponding changes made in how the energy utility operates.



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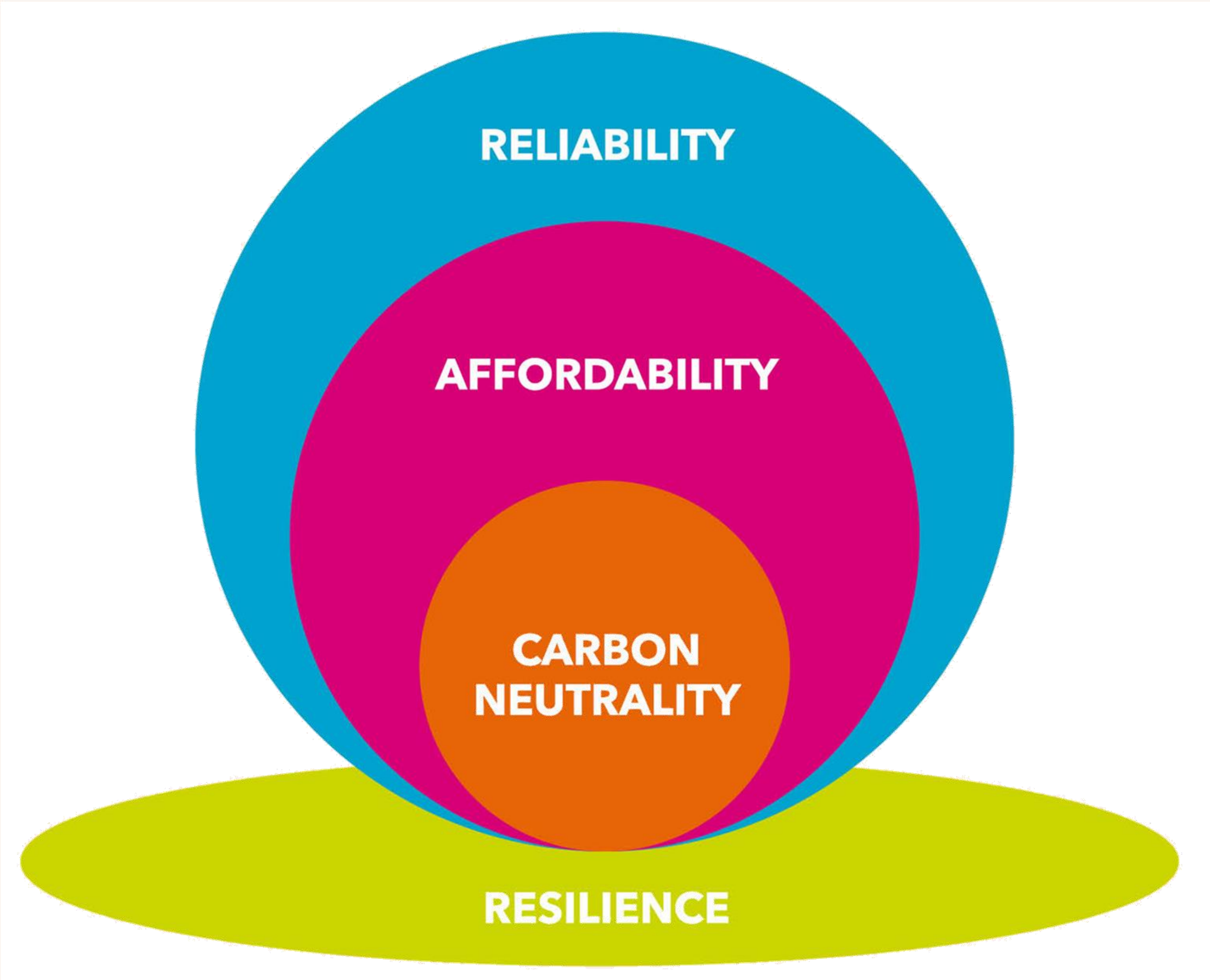
Energy Strategy Prioritisation Framework



Energy Strategy Prioritisation Framework

SHORT TERM (BY 2026): INCREASE CAPABILITIES TO MITIGATE UP TO FOUR STAGES OF LOAD-SHEDDING

Due to the current severity and frequency of load shedding and the devastating impact this is having on the economy, it is necessary to prioritise interventions and investments that will directly contribute to stabilising electricity supply in the short term.

MEDIUM TERM (BY 2031): REFORMS IMPLEMENTED TO MAINTAIN A MODERNISED AND FINANCIALLY SUSTAINABLE ELECTRICITY UTILITY

In the medium term, a modernised and financially resilient electricity utility is critical to ensure the long term financial sustainability of core utility services, such as network service provision and the continued provision of the energy social package to economically vulnerable households.

LONG TERM (BY 2050): TRANSFORMING THE ENERGY SYSTEM TO BE CARBON NEUTRAL

In line with global, national, and local climate commitments for carbon neutrality by 2050, it is critical that the carbon intensity of the energy system is reduced, as a major contributor to greenhouse gas production. This not only speaks to the sources of energy used, but also ensuring that the systems and value chains are in place to support a carbon neutral energy system.

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Enabler A: Operate a Future-fit Energy Utility Business

Goal: A municipal electricity utility with enhanced asset management of energy infrastructure that adapts its business model and systems to provide financially sustainable energy services in an increasingly competitive and distributed energy system.

Programme	**City Role**	**Status**
Institutional and Workforce Reform	Deliver	New (in planning)
Tariff and Financial Reform	Deliver	New (in planning)
Infrastructure and Technology Reform	Deliver	Expansion of existing programme
City-level Energy Planning	Deliver	Expansion of existing programme

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Enabler A - Prioritised Actions Over the Next 5 Years

- Institutional Redesign: **Restructure the electricity utility** to meet the demands of a changing energy market, to enhance cost-effectiveness and reduce risk exposure.
- **Redesign electricity tariffs** and assess the viability of a range of **tariff restructuring scenarios**
- Address the **technical constraints applying to time-of-use tariffs** due to capabilities of the current metering fleet, exploring smart residential metering options
- Explore opportunities for **new energy-related revenue streams**
- Invest in **software and systems for enhanced network control** and **operations** to effect better **load management** and maintain **network stability.**

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THE WORLD BANK IBRD • IDA

ESMAP Energy Sector Management Assistance Program

APUA ASEA

ISGF India Smart Grid Forum

Smart Grid Landscape and Roadmap for the City of Cape Town

Speaker:

Gehard Brown

Energy Directorate

The City of Cape Town

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Why do we need a Smart Grid Landscape and Roadmap?

- Smart Grid is a massive, complex, integrated system of interdependent systems that changes over time (often faster than the grid itself).
- Smart grid systems are resource intensive to implement, operate and maintain.
- Questions:
  - What does our current Smart Grid landscape look like?
  - Where should we focus your network modernisation initiatives as a municipal power utility?
  - How will we manage integration between different Smart Grid application systems over time?
  - How do we make decisions on smart grid budgets and projects to implement?
  - How do we maintain our Smart Grid systems and data?

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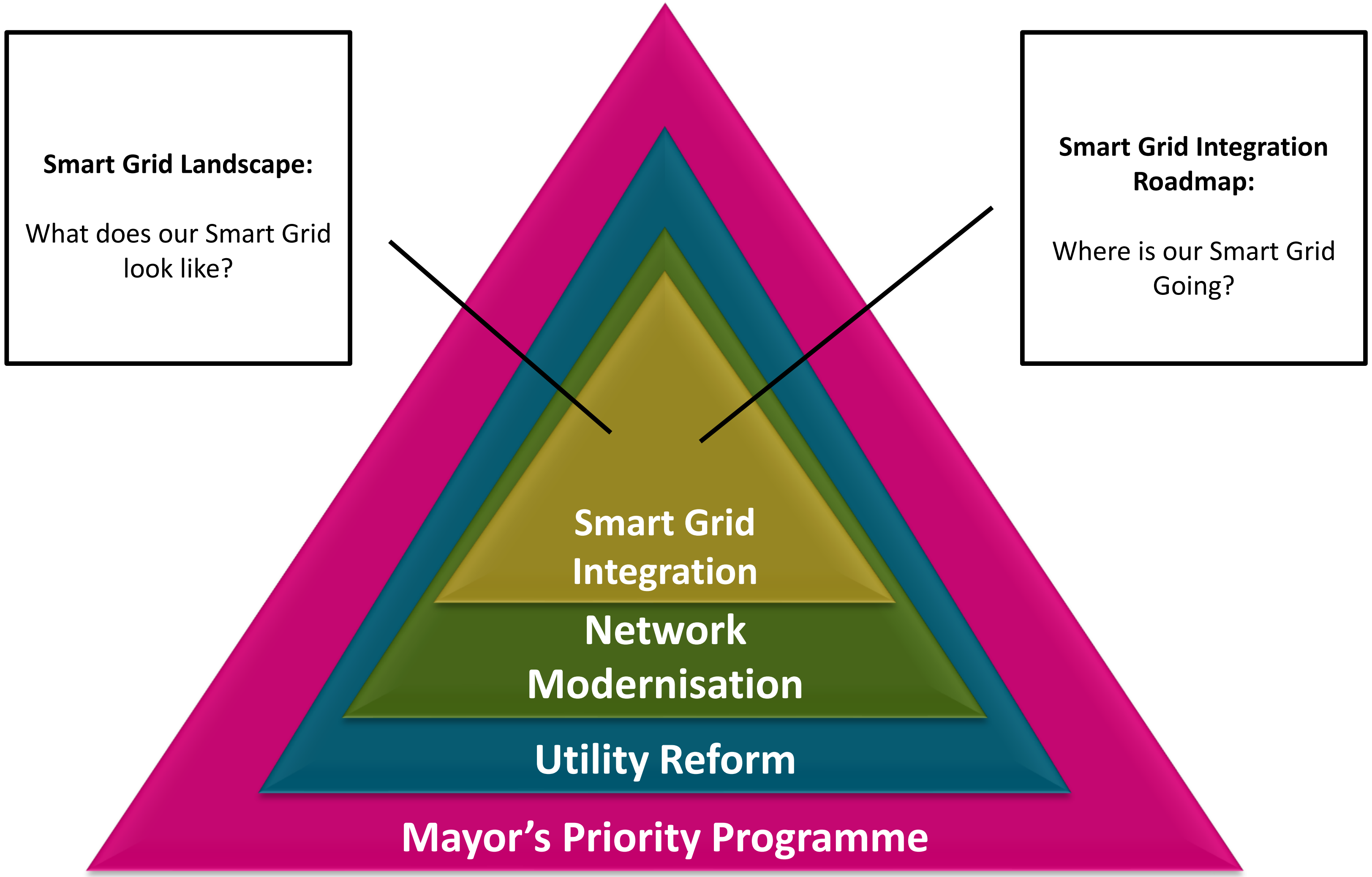
Smart Grid Integration in CCT



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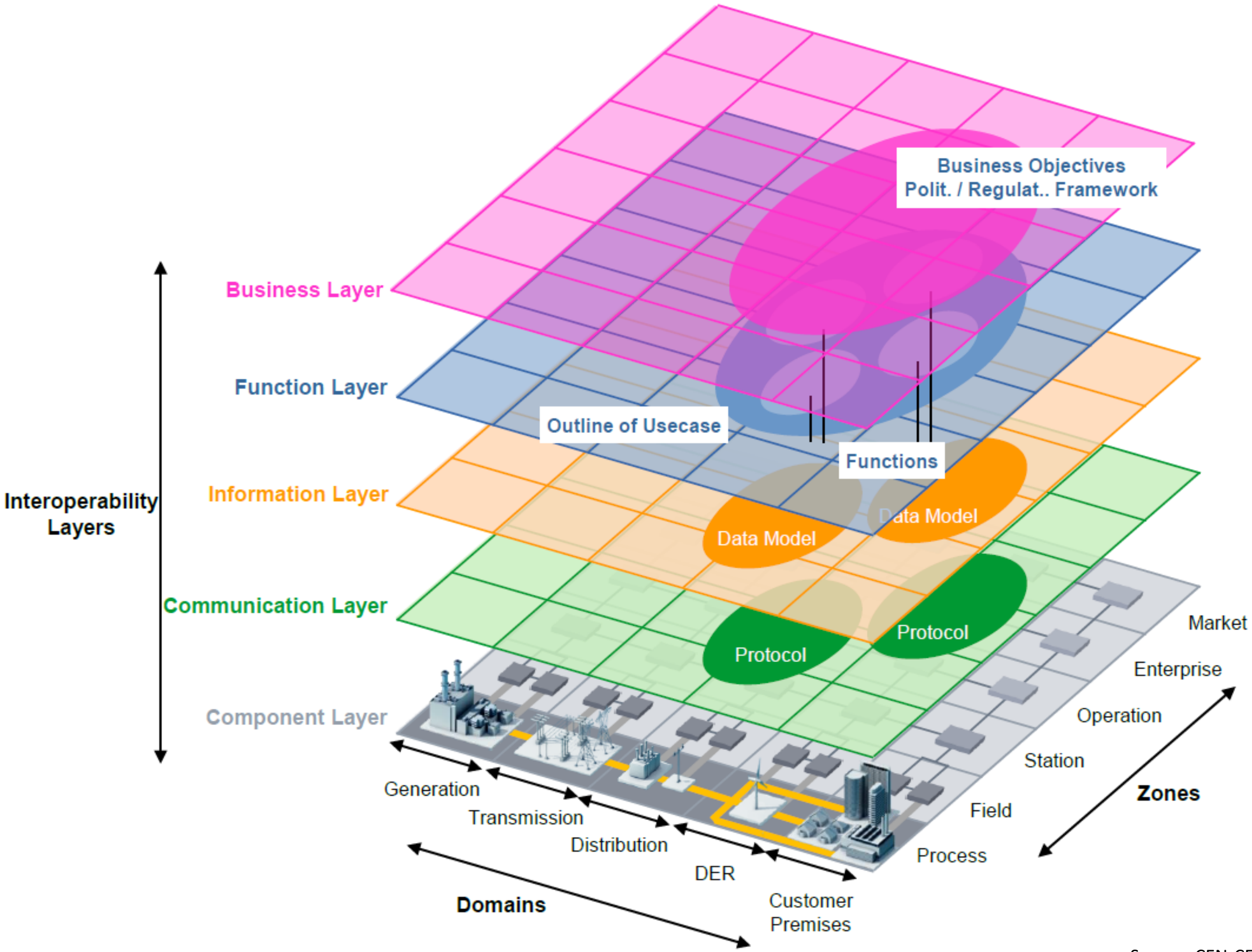
Following Best Practice: Smart Grid Architecture Model



Source: CEN-CENELEC-ETSI Smart Grid Coordination Group

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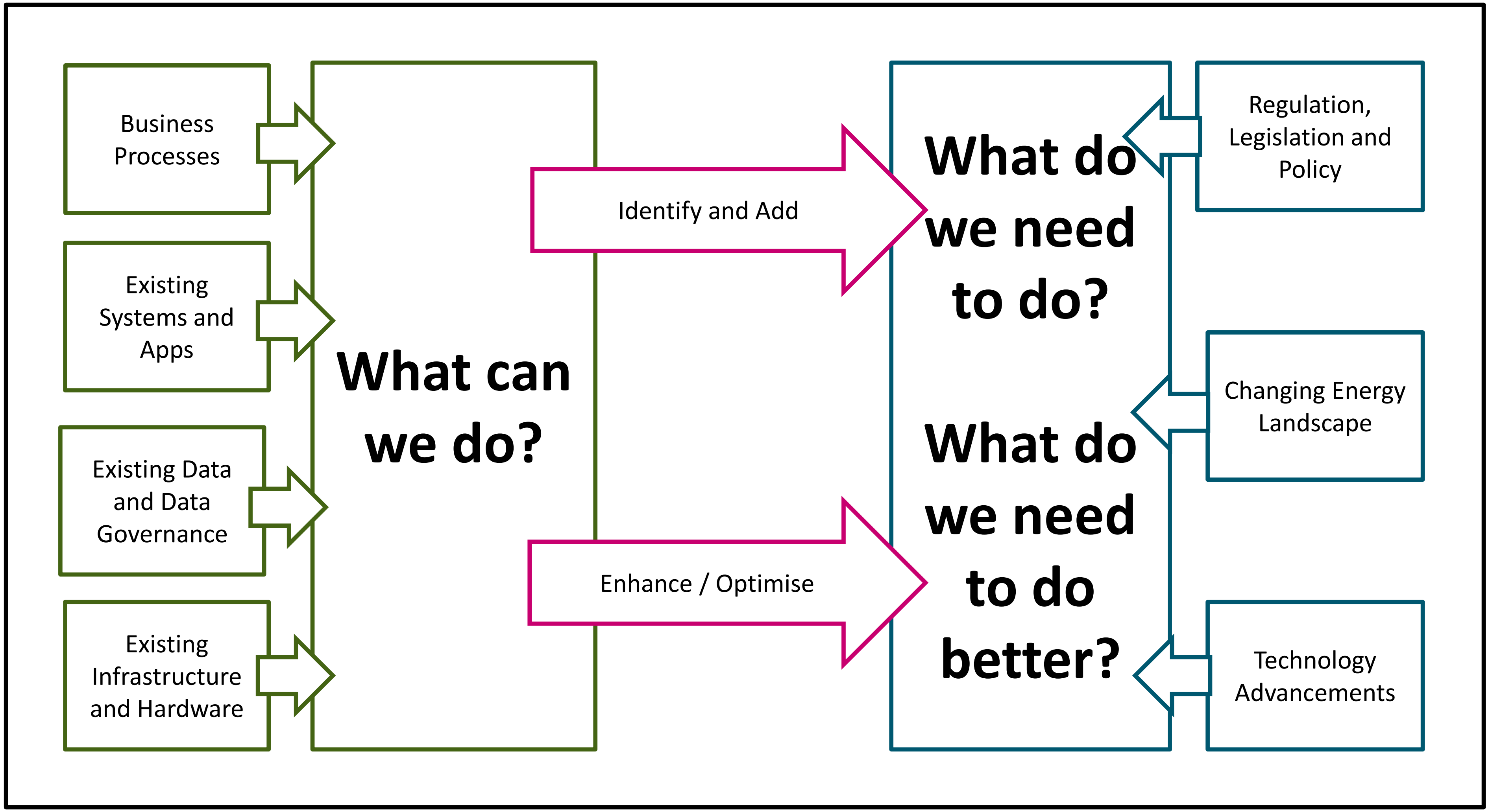
Framework for a Smart Grid Landscape and Roadmap



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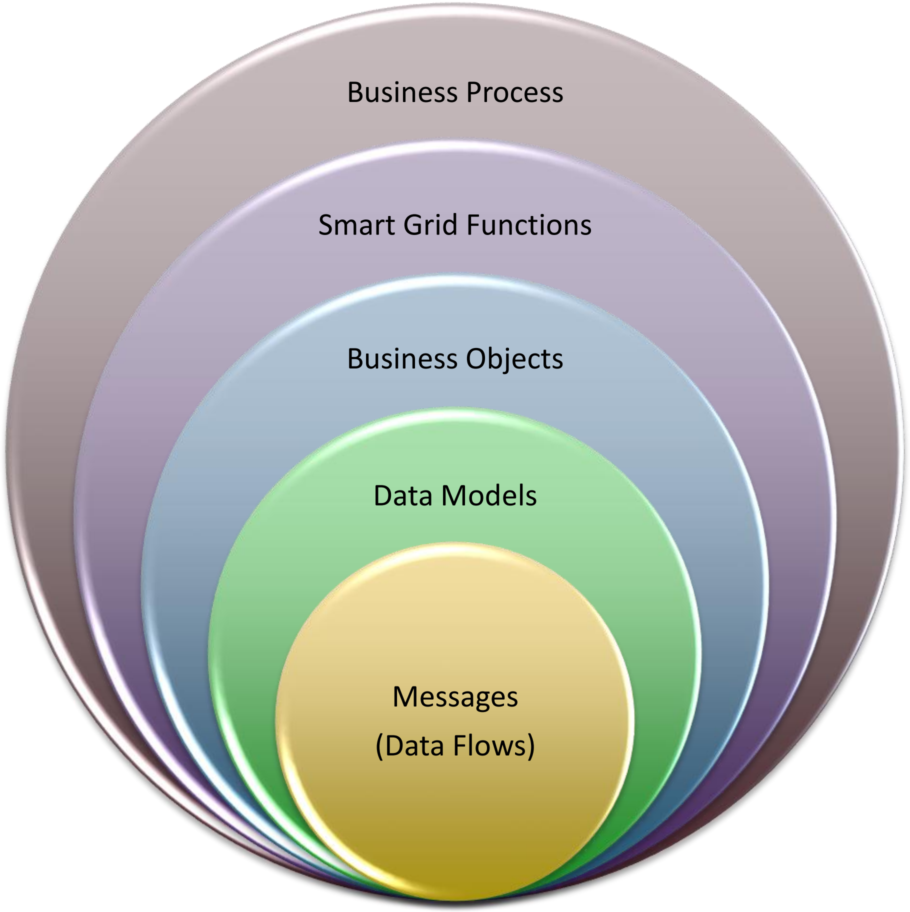
Inputs to a Smart Grid Roadmap:

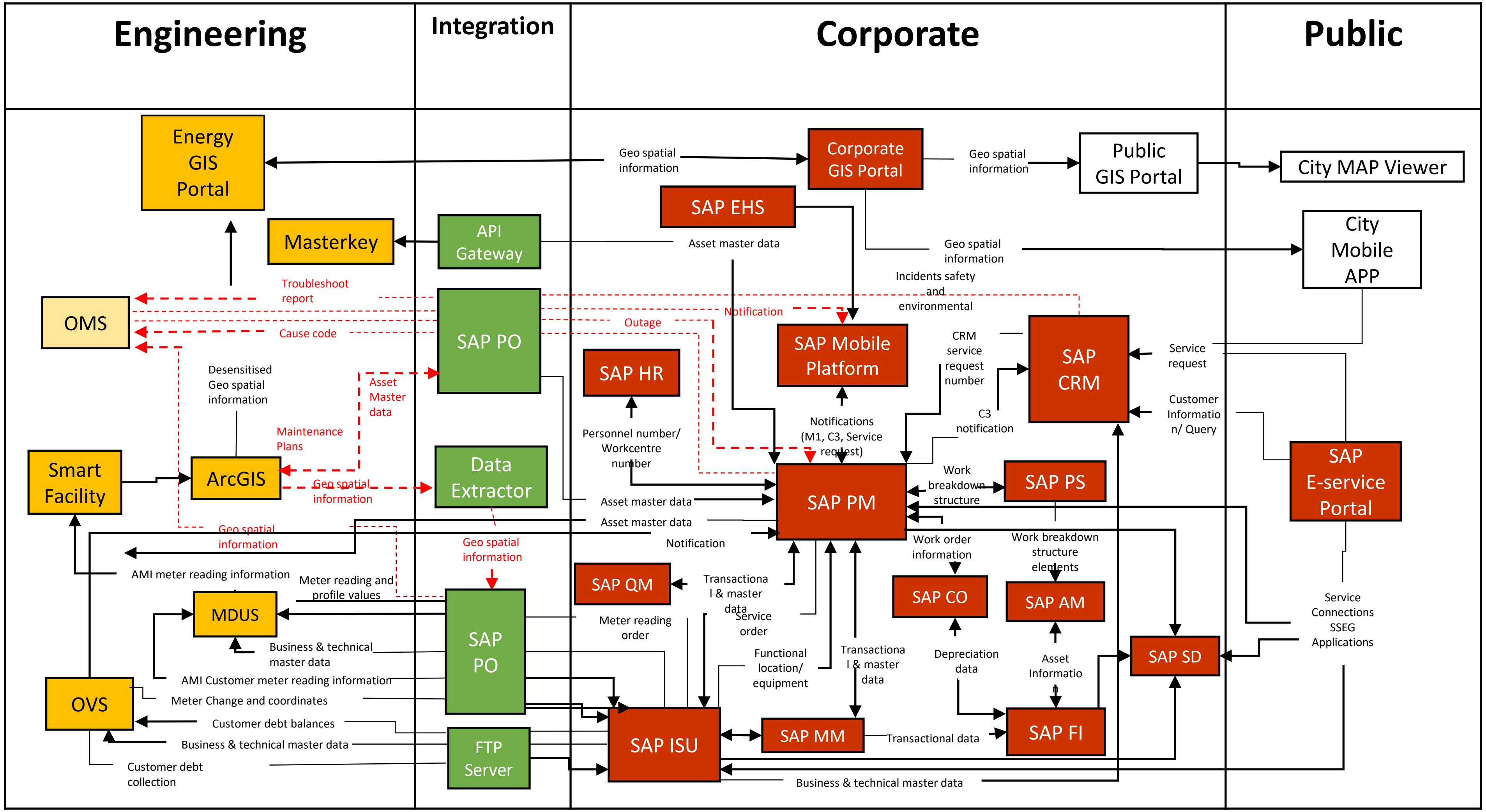
- Smart grid vision and objectives.
- Business Processes.
- Functions and use cases.
- Smart grid application systems landscape.
- Data Designs (CIM).
- System integration infrastructure.
- Communication policy / strategy.
- Cyber security policy / strategy.
- Communication network models.
- Grid models.
- Project plans.
- Maintenance strategies.



Step 1: Establish Current Applications Landscape

- Smart Grid progress in the City of Cape Town:
  - AMI: Meter Management and Meter Data Management System supporting smart meters rolled out to commercial and residential customers.
  - Grid Model: As-build designs and drawings in GIS.
  - Enterprise Asset Management: Digitised maintenance and inspection platform using mobile devices.
  - Distribution Management: SCADA, Energy- and Generation Management System (Up to Medium Voltage Level).
  - Outage management: OMS project in pilot phase.
  - Smart Facility: Facility management and carbon footprint reporting at various City facilities.
  - Integration: Direct integration between systems.

Step 1: Establish Current Applications Landscape



Step 2: Mission and Vision

- Power Grid that continually evolves over time and utilises modern, industry proven smart gird technologies to support the City's power utility objectives according to industry best practice.

- Smart grid that supports:
  - Quality electricity supply (NRS 047)
  - Quality service (NRS 048)
  - Sufficient public lighting
  - Access to electricity
  - Financial sustainability
  - Health and Safety
  - ***Environmental Sustainability (Incl. Renewable Energy)***
  - ***Grid Participation***

Clean
Accessible
Reliable
Equitable
Safe

"The South African grid should be advanced not by gathering a collection of interesting technologies and calling it modern or smart or intelligent but by first defining a vision and then constructing a grid that serves a defined purpose"

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Step 3: Map Out Functions and Focus Areas

- City of Cape Town’s current core smart grid focus areas:

Enterprise Resource Management (ERP)

- Asset Decision Support (ADS)
- Work Dispatching (WD)
- Observation Data Management (ODM)
- Customer Installation Management (CIM)
- Asset Record Management (ARM)
- Work Scheduling (WS)
- End Device Configuration (EDO)
- Customer Account Management (ACT)
- Catalogue Management (CM)
- Work Recording (WR)
- End Device Data Acquisition (EDA)
- Trouble Call Management (TCM)
- Asset Management Planning (AMP)
- Work Execution (WE)
- Financial Management (FM)
- Human Resource Management (HR)

Utility Model (GIS)

- Energy Connection Management (ECM)
- Asset Decision Support (ADS)
- Environment Information Management (EIM)
- Model Part Management (MPM)
- Catalogue Management (CM)
- Land Property Management (LPM)
- Network Case Management (NCM)
- Geospatial Data Management (GDM)
- Data Design Management
- Drawings

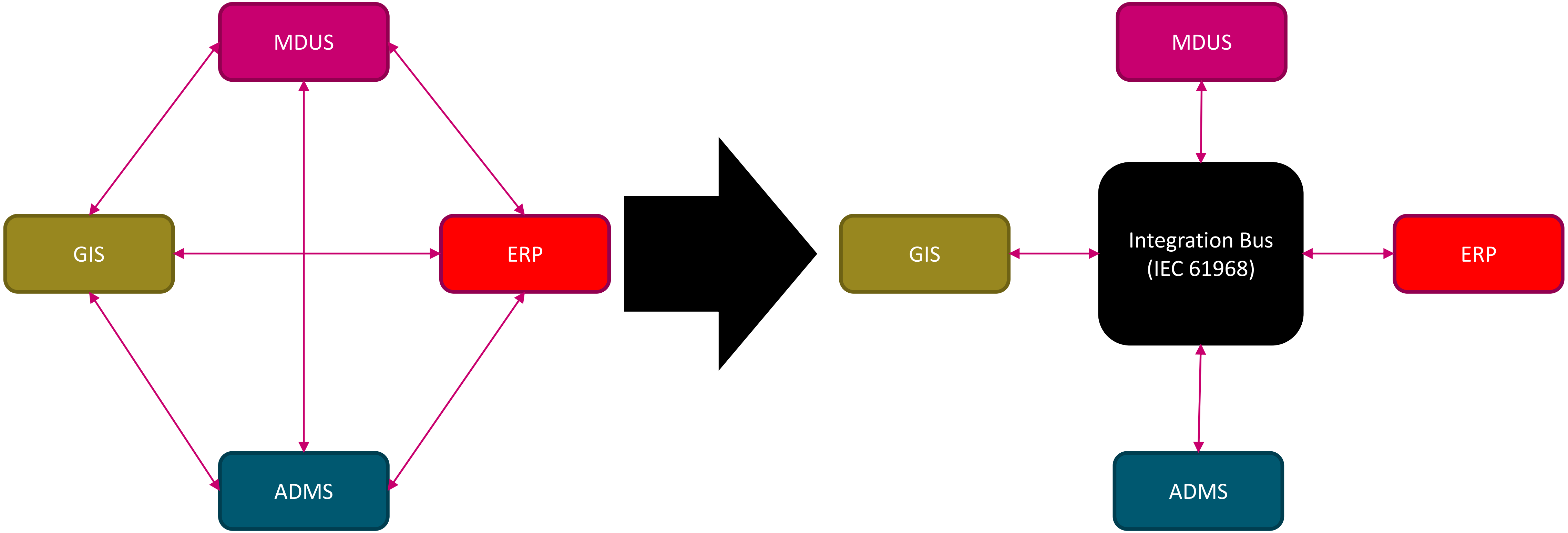
Network Management (ADMS / SCADA)

- Real-time Operation (RTO)
- Fault Identification (FI)
- End Device Data Acquisition (EDA)
- Committed Operation Planning (OP)
- Restoration Operation Planning (ROP)
- Observation Data Management (ODM)
- Post Event Analysis (PEA)
- Energy Forecasting (EF)
- Switch Action Scheduling (SAS)

Revenue Management (Metering and Vending)

- Observation Data Management (ODM)
- Market Trading (MT)
- Market Settlement Verification (MSV)
- End Device Configuration (EDO)
- Market Scheduling (MS)
- Dispute Resolution (DR)
- End Device Data Acquisition (EDA)
- Party Management (PM)
- End Device Control (EDC)

Step 4: Plan for Integration



- Transition from direct (API) integration to Integration Bus
- Consider procurement of IEC 61968 compliant integration bus

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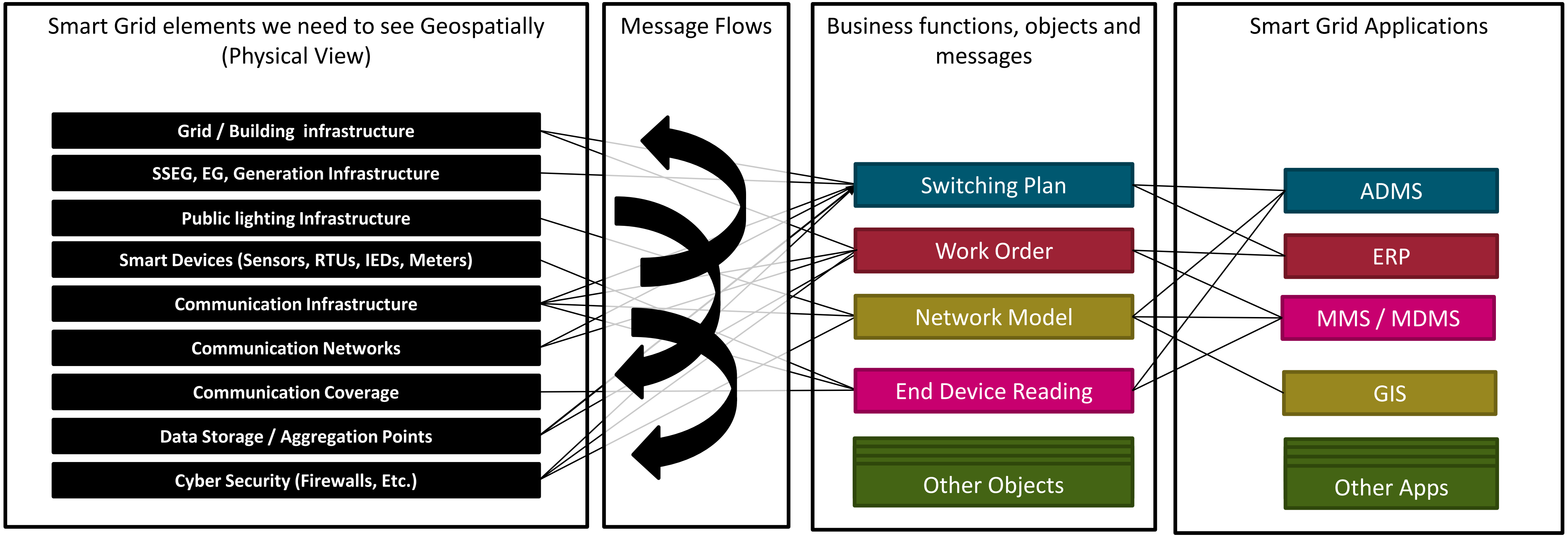
Step 4: Plan for Integration



- Develop integration and data flow maps.
- GIS systems for mapping to infrastructure.

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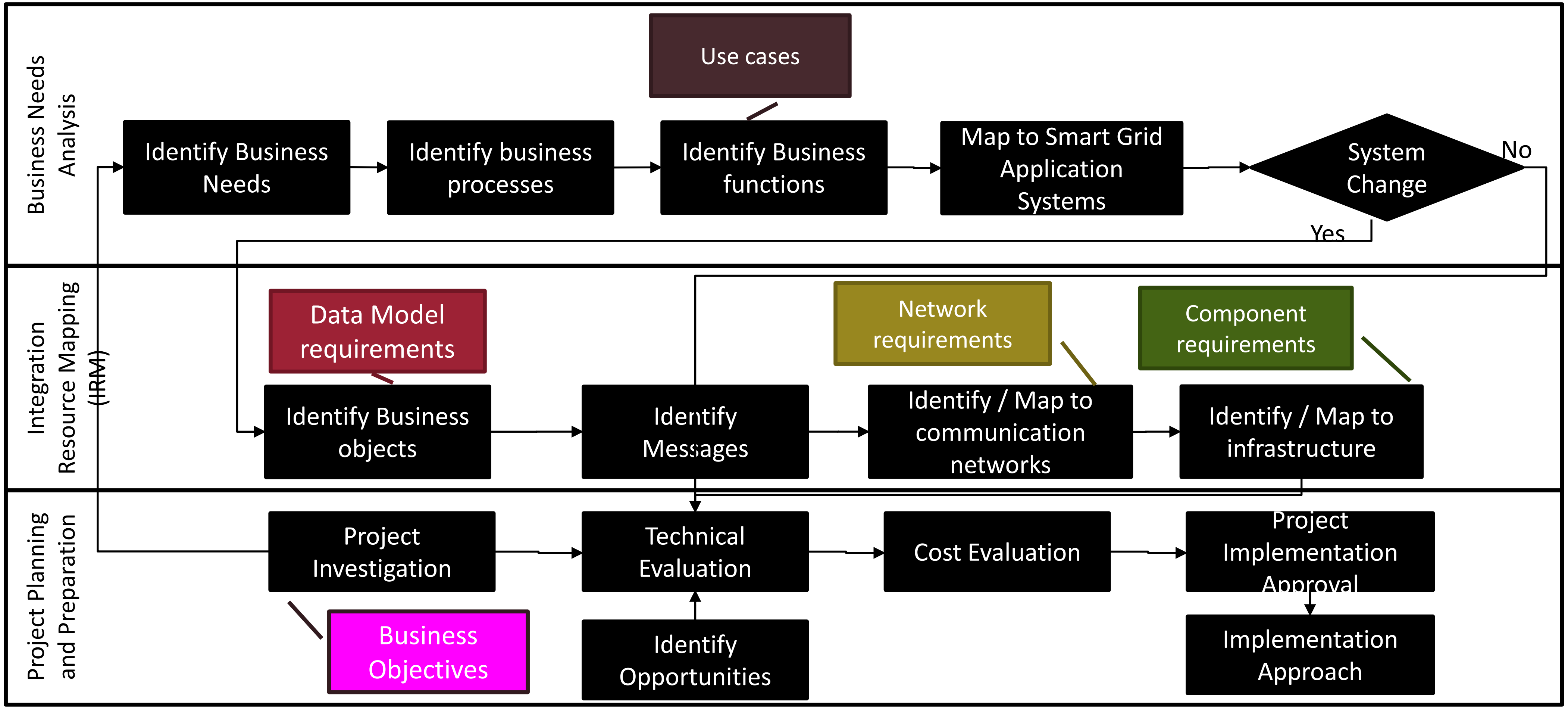
Step 5: Selecting Smart Grid Projects

- Process for selecting smart grid projects and initiatives



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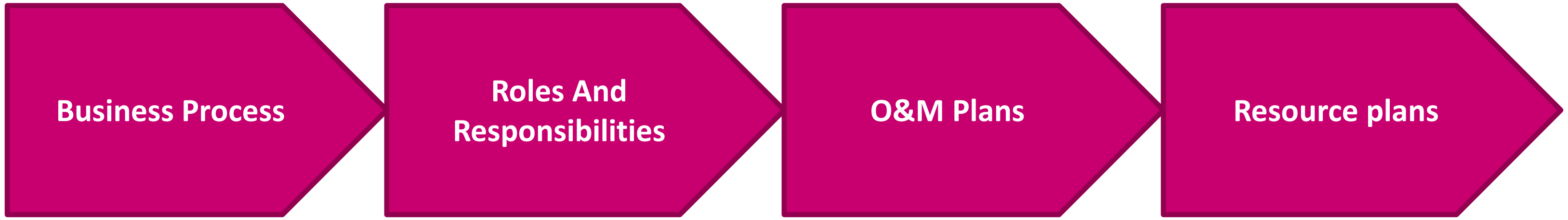
Step 6: Maintenance and Operating Strategy

- Smart Grid becomes a "second power grid" that also needs to be operated and maintained - <u>focus on data quality</u>.
- Develop business processes for system maintenance and operation.
- Assign Roles aligned to strategies:
  - Data and Asset Owners (Accountable)
  - Data Custodians and System Developers (Responsible for systems and data structures).
  - Data Stewards and System maintainers(Responsible for data quality and maintaining system functionality).
  - Data Users and system operators (Responsible for responsible data and system use).
- Define data competencies and link to job descriptions.
- Develop operating and maintenance plans based on processes and roles
- Develop resource management plans.



Key Points for Success:

- Business objectives need to drive technology selection (not the other way around).
- Business processes and functions are key – you need to know what you do and how you do it before you can do it smarter.
- Build on your strengths – It's better to improve the systems you already have than to buy new ones (more interfaces).
- Priorities change quickly, systems adapt slowly (and expensively).
- Utilities need to invest in IT and data skills and expertise. The need will grow as grid becomes smarter and more complex.
- Data quality will have a major impact on Smart Grid success. Rules and controls need to be in place before applications are implemented.

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Thank You

Making progress possible. Together.

Appendix Slides

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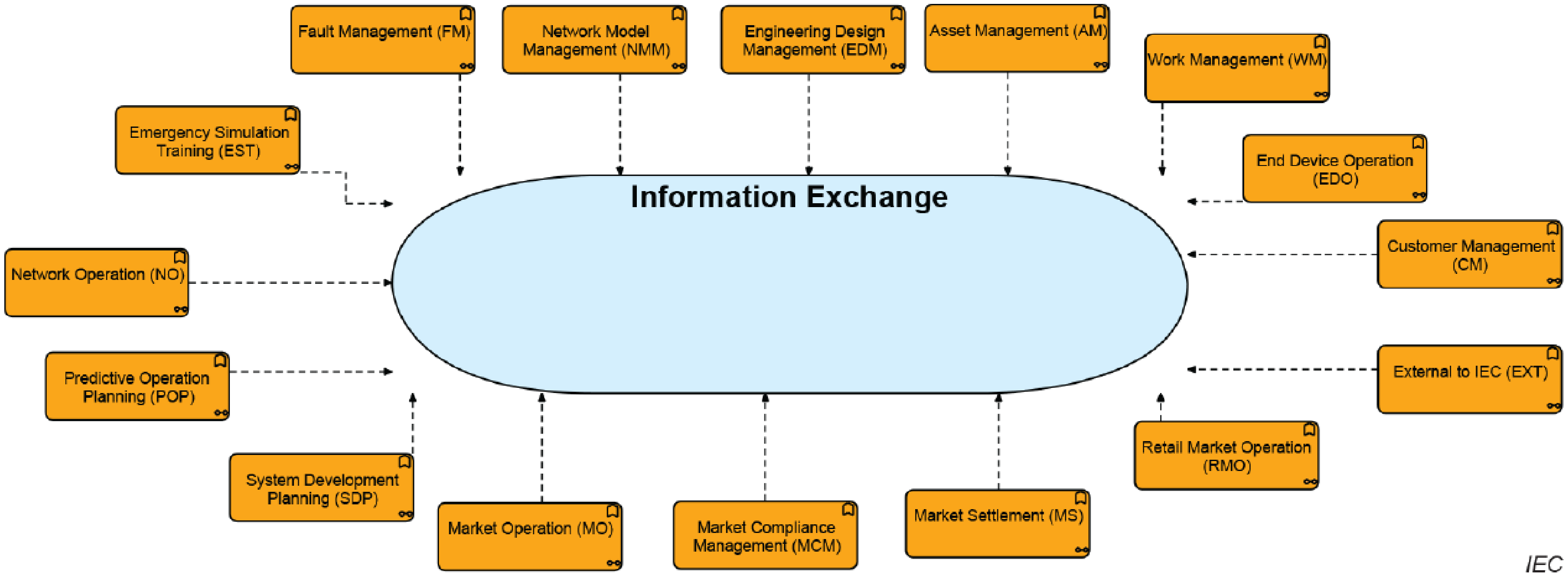
Best Practice: Information Exchange Standards

Title
IEC 61968:2020- Application integration at electric utilities - System interfaces for distribution management
IEC 61970:2023 - Energy management system application program interface (EMS-API)
IEC 61850:2023 - Communication networks and systems for power utility automation
IEC 62325:2018 - Framework for energy market communications
IEC 62351:2023 - Power systems management and associated information exchange - Data and communications security
IEC 62746:2018 - Systems interface between customer energy management system and the power management system
IEC 60870:1989 - Telecontrol equipment and systems



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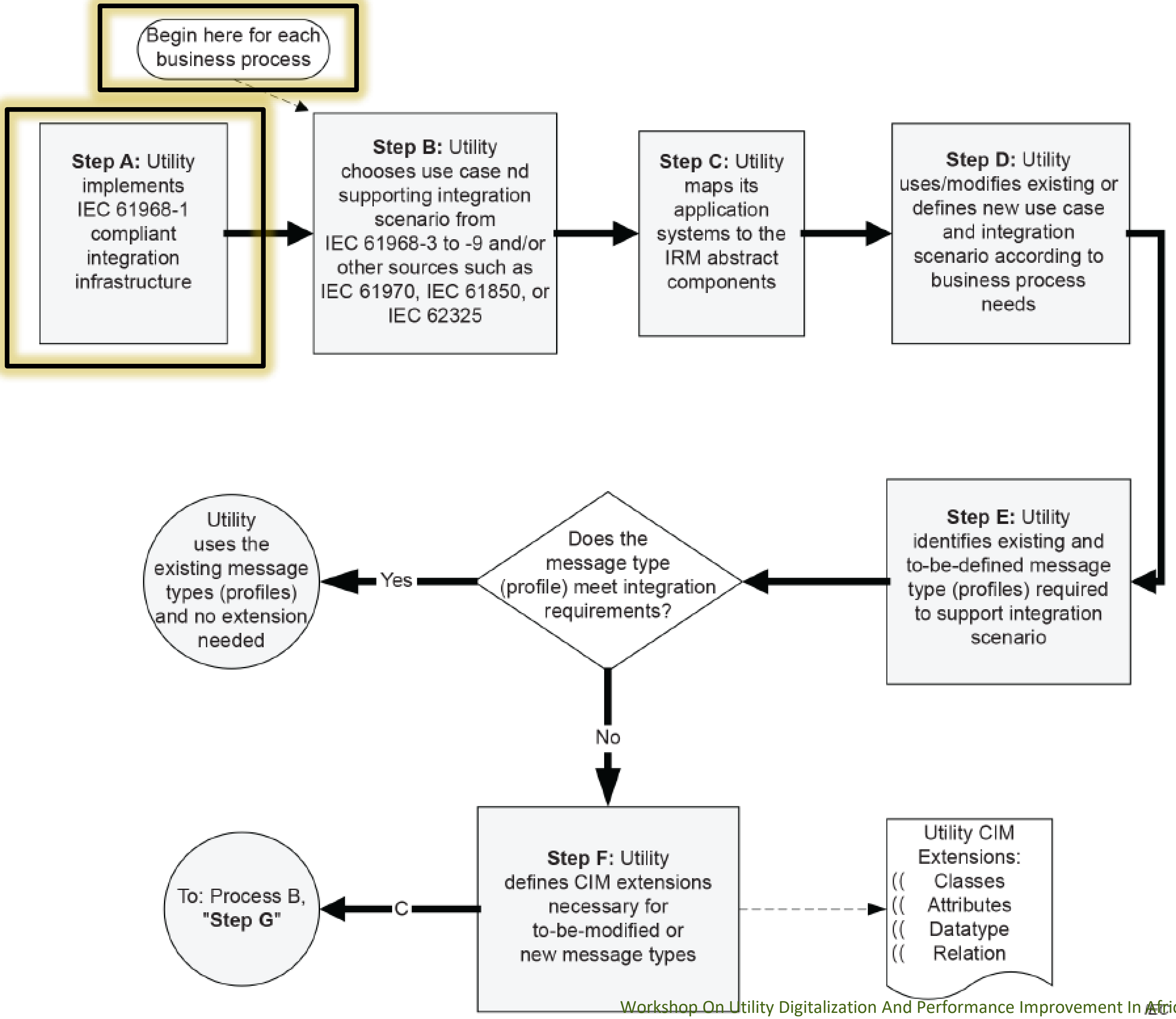
Following Best Practice: Application of IEC 61968 by utilities



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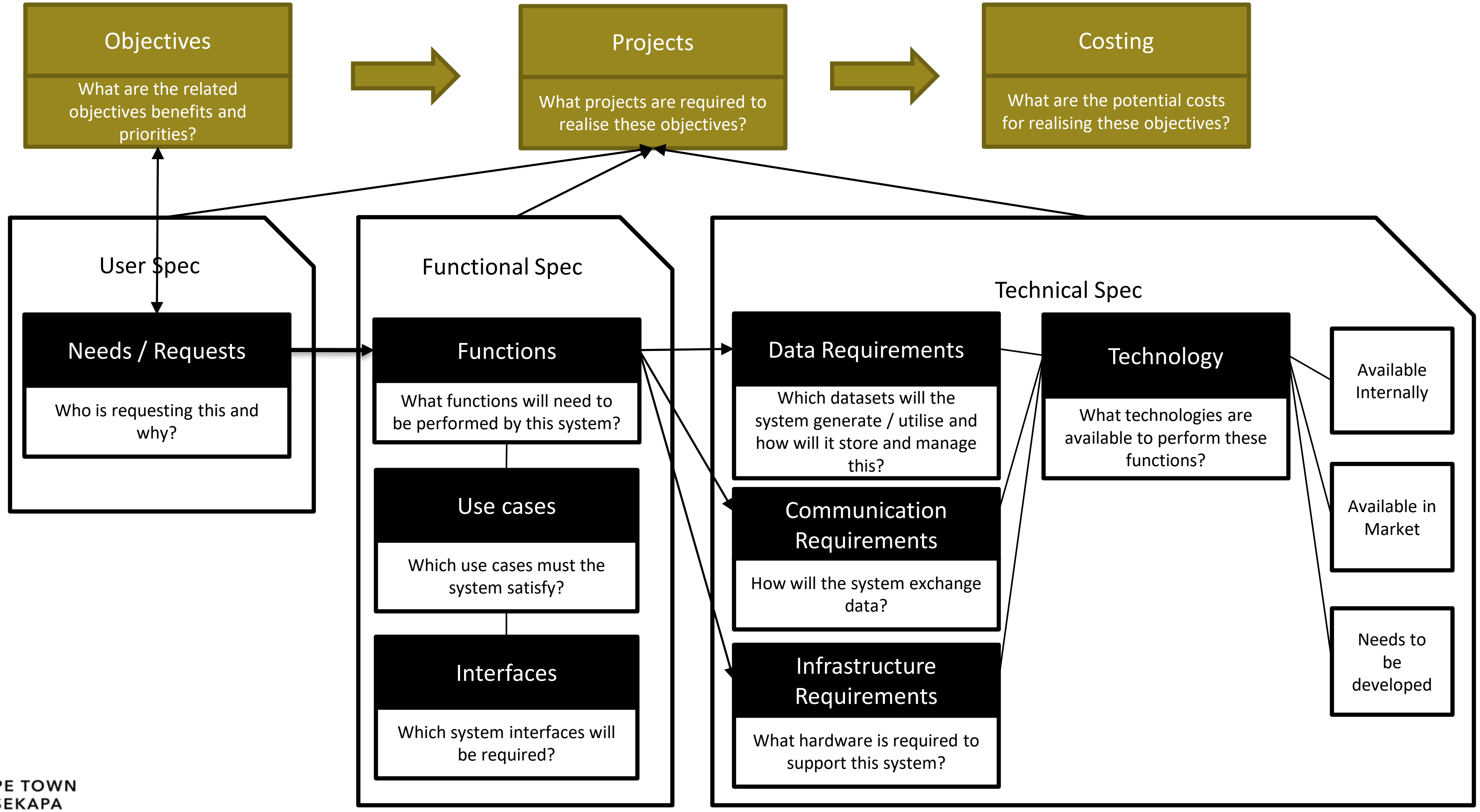
Step 5: Selecting Smart Grid Projects



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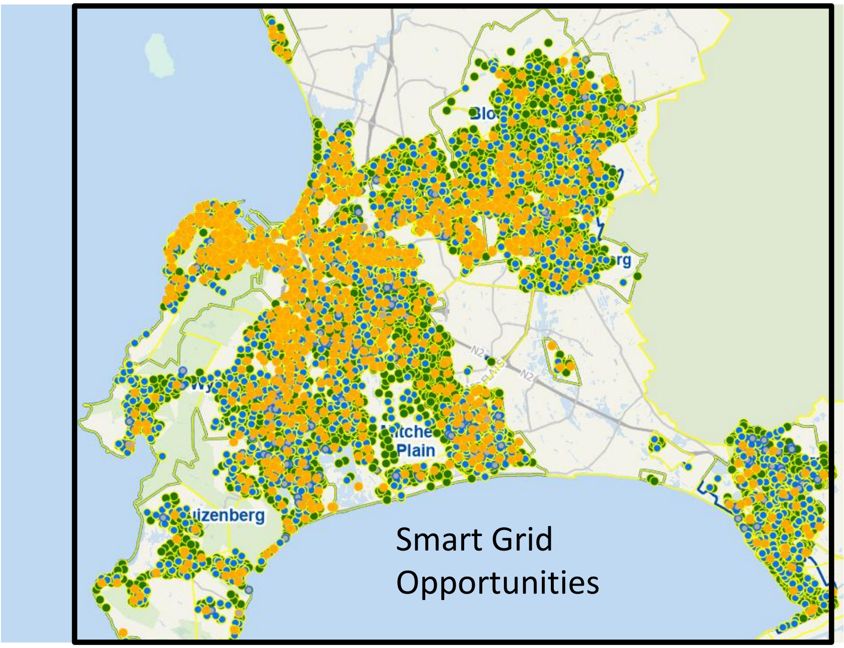
Implementation Approach

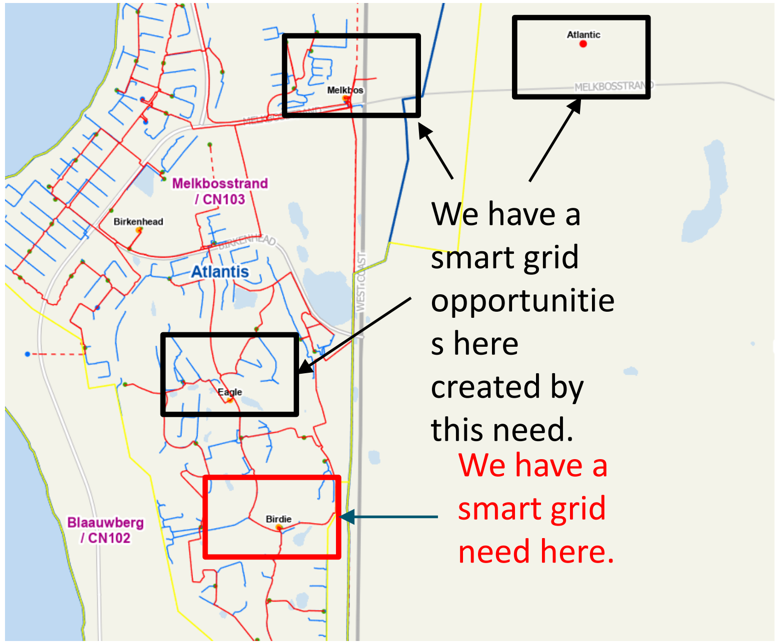
Roll-out



- Standardisation
- Optimisation
- Economies of scale

- High cost
- Long term implementation
- Tie-in

Upgrade (Case-by-case)



- Lower cost (per project)
- Quick wins

- Tech variance
- Integration
- Obsolescence

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