Smart Grid - Big Data visualized in GIS

Maximizing Data Value with GIS and CIM in a Smart Grid World

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DONG energy

Presenters from DONG Energy

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MSc in Economics & Business Administration,
Manager, Energy Management, DONG Energy

Since 1999 working with IT in DONG Energy. IT responsible for the projects ADMS, Wind Farm Management Data Platform, Power Hub (VPP), Bio Hub

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Ph.D. in GeoScience & Computing Science. Owner, Similix

Since 2011 Lead Architect, DONG Energy Smart Grid programme. 20 years of experience with IT and especially GIS, architecture and project management.

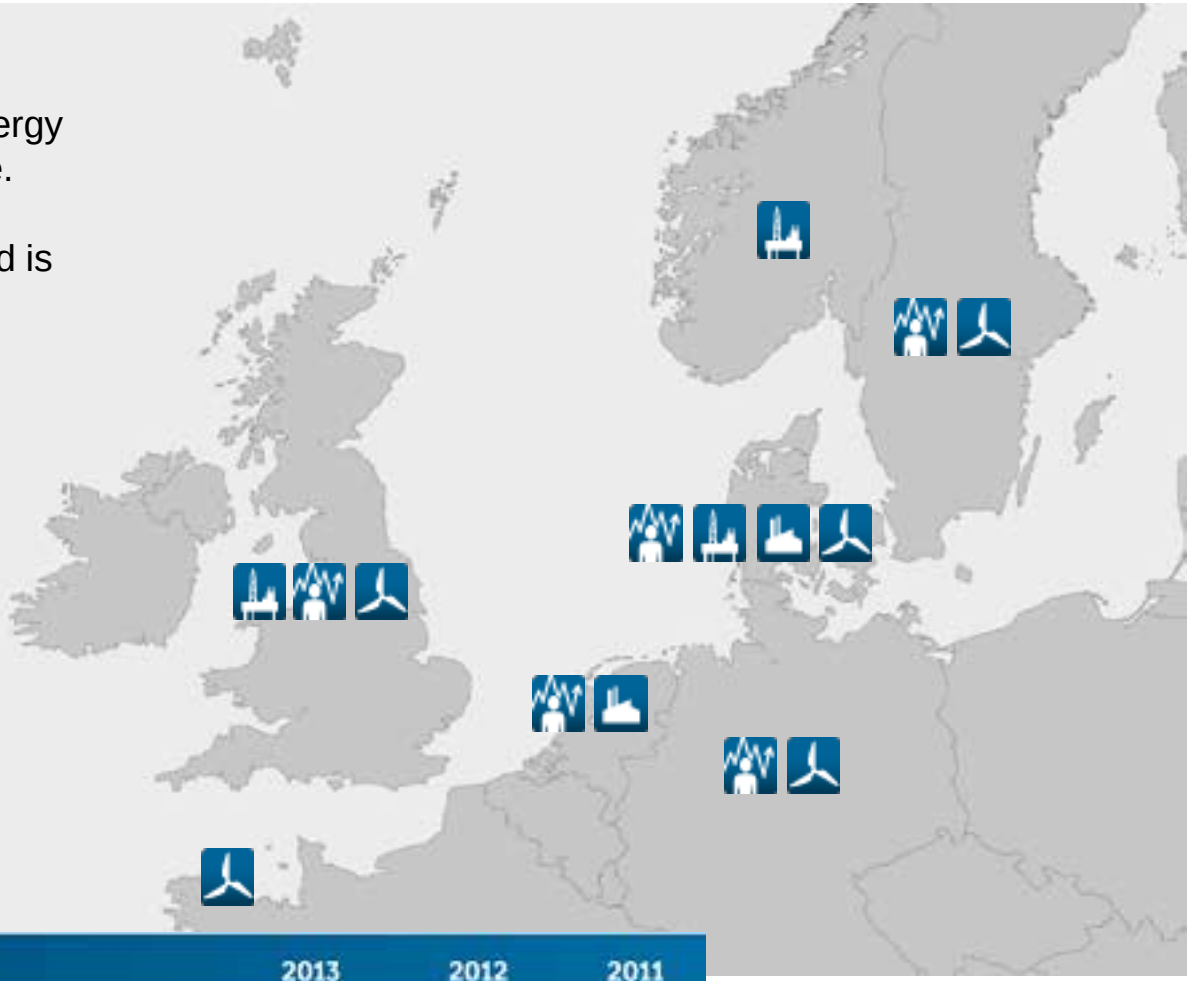
Gaurav Grigo, gaugr@dongenergy.dk
Masters in Geo-Informatics & Bachelors in Computer Applications.
Solution Architect (GIS-DMS), GIS & Custom Apps Dept., DONG Energy

Since 2012, as GIS Consultant & Solution Architect in DONG Energy, with 7.5+ years of experience in various IT-GIS based integration projects in Utilities domain.

DONG Energy is one of the leading energy groups in Northern Europe

Our business is based on procuring, producing, distributing and trading in energy and related products in Northern Europe.

DONG Energy has 6,500 employees and is headquartered in Denmark.



- **Exploration & Production**
- **Wind Power**
- **Thermal Power**
- **Customers & Markets**

PERFORMANCE HIGHLIGHTS			2013	2012	2011
Revenue	DKK million	▲	73,105	67,179	56,717

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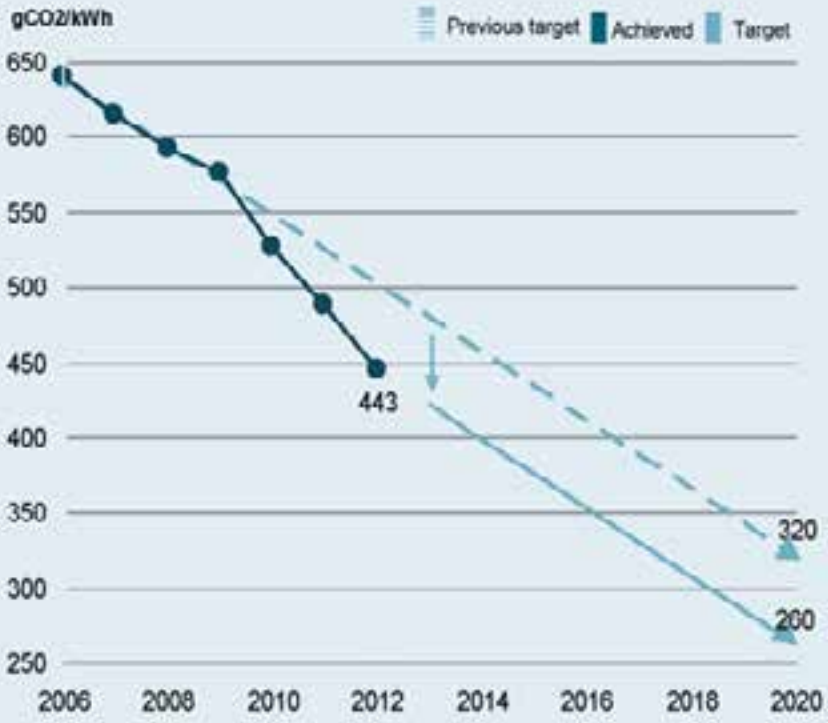
Energy transformation

Vision:
Leading the energy transformation

Mission:
Providing clean and reliable energy

Further reducing CO_2 emissions

Reinforcing the CO_2 reduction target for DONG Energy



2020 strategy

1. Sustain market leadership; quadruple capacity
2. Reinforce regional position; double production
3. Convert to biomass; provide flexibility
4. Develop energy solutions and intelligent grid
5. Simplify operating model

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Customers & Markets

Principal activity

§ Sales of electricity and gas in the wholesale and retail markets and optimisation and hedging of the Group's overall energy portfolio

Market position

§ Leading Danish electricity and gas distributor with market shares of 26% and 28% respectively
§ Active player in the wholesale energy market in North West Europe
§ Retail sales in Denmark, Sweden and the UK
§ Electricity and gas positions in Denmark, the UK, Germany and the Netherlands

Business drivers

§ Customer service
§ Changes in energy prices
§ Regulatory framework and distribution tariffs
§ Market liquidity
§ Renegotiation of long-term gas contracts
§ Cost efficiency

ROCE targets

§ 2013: 4.8%
§ 2016: >8%
§ 2020: >10%

Strategic targets for 2020

§ Quadrupling energy savings among Danish customers
§ Among the best in Europe in terms of handling energy exposures

CUSTOMERS & MARKETS

Revenue, DKK billion (%)[1,2]	**49.7**	(59%)
EBITDA, DKK billion (%)[1]	**2.3**	(16%)
Gross investments, DKK billion (%)[1]	**1.4**	(7%)
Employees, FTE (%)[1]	**1,639**	(25%)

1 The percentages indicate the proportion of the Group that each business unit represented in 2013.
2 Intragroup revenue means that the business units' combined revenue exceeds consolidated revenue.

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C&M: Efficient energy solutions; stable returns

Priorities

- Develop value adding energy solutions
- Invest in intelligent distribution
- Reinforce operational excellence
- Deliver high customer satisfaction

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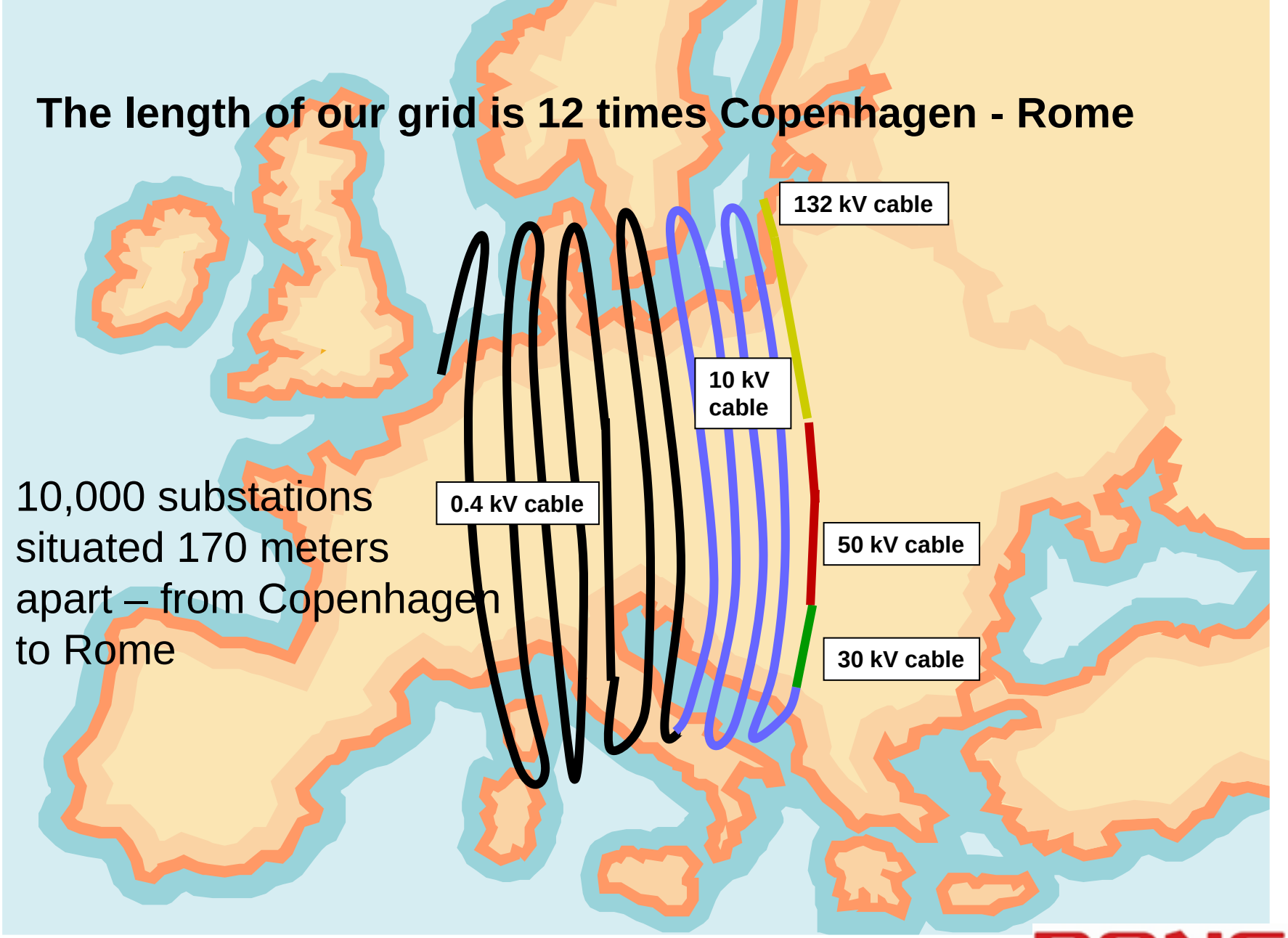
The length of our grid is 12 times Copenhagen - Rome



10,000 substations situated 170 meters apart – from Copenhagen to Rome

The length from Copenhagen to Rome is 1600 km in direct line

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Is your distribution grid a smart grid?

Increasing micro production?

Increasing demand for electricity?

Will you reach the limit of current grid capacity ?

Would you like to optimize your investment planning?

Would you like to improve SAIDI/SAIFI numbers?

The solution is Smart Grid

- Integrate IT/OT
- Bridge the silos of classic business and IT domains
- Heavily improve your data quality and governance
- Release the value of data throughout the energy value chain

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Bridging the silos: Marina San Bay, Singapore

Create business value by:

- creating the future business process based on company strategy

- creating the future architecture based on processes and branch standards (MS SERA 2.0)

- creating the domain model based on branch standards (CIM)

- focusing on data description, quality and ownership

- identifying standard systems, that naturally supports different parts of the process

- designing the missing applications and tools

- killing the standard system imperialism

- bridging the traditional silos IT/OT without compromising security

- gaining new insight by visualizing assets and sensor data analytics in GIS

- use the new insight to ask even better questions, demand further data analytics and improve business processes

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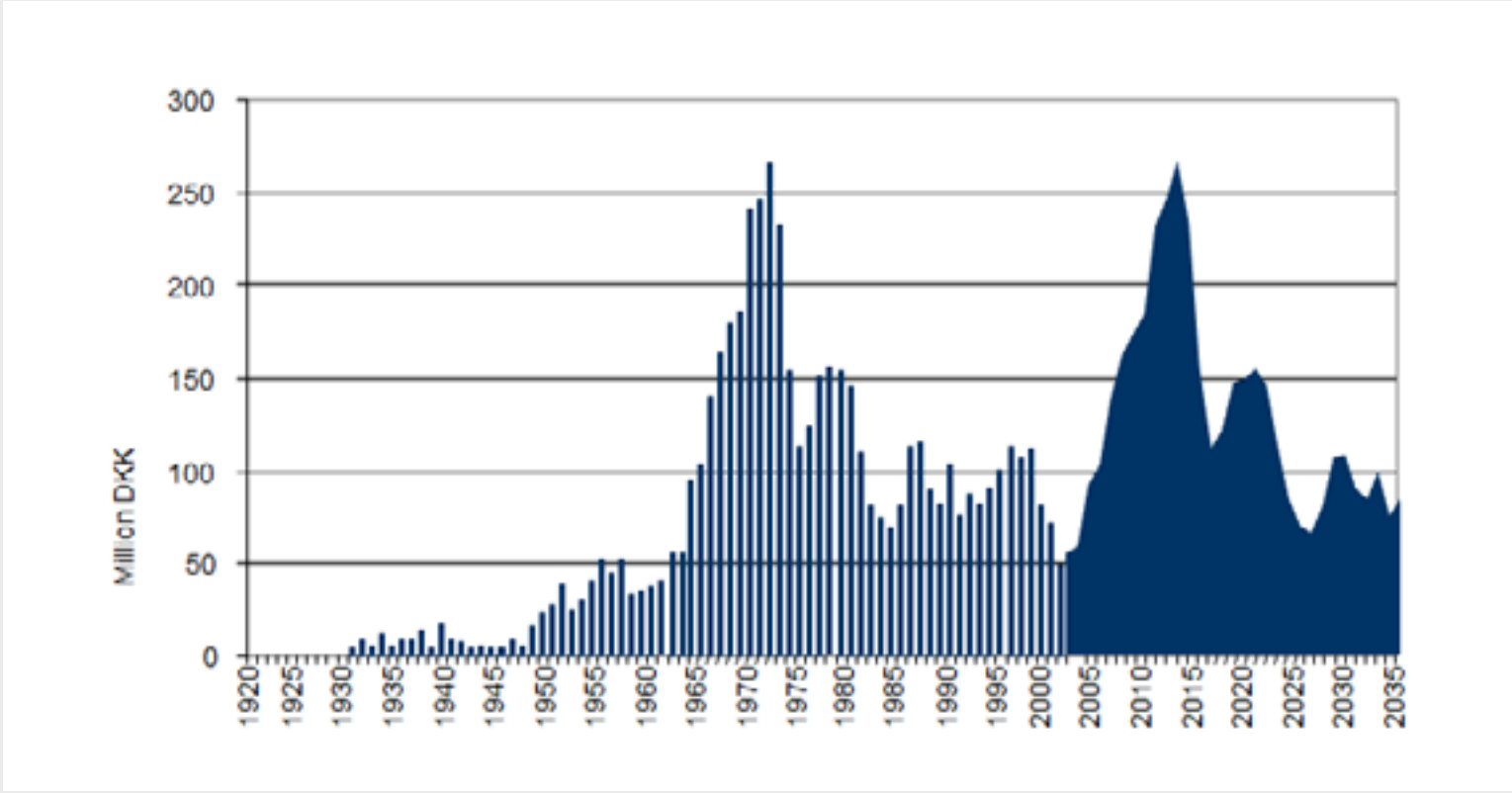
The Business Cases

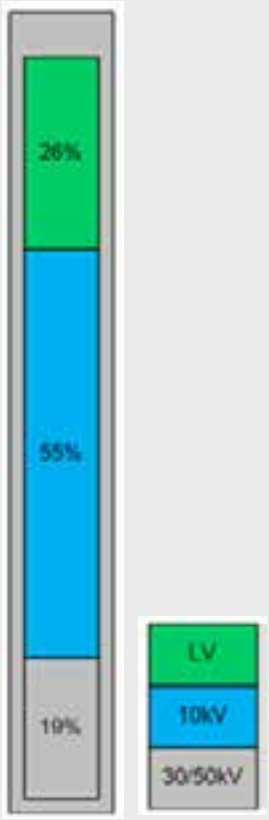
Historical and future asset investment profile

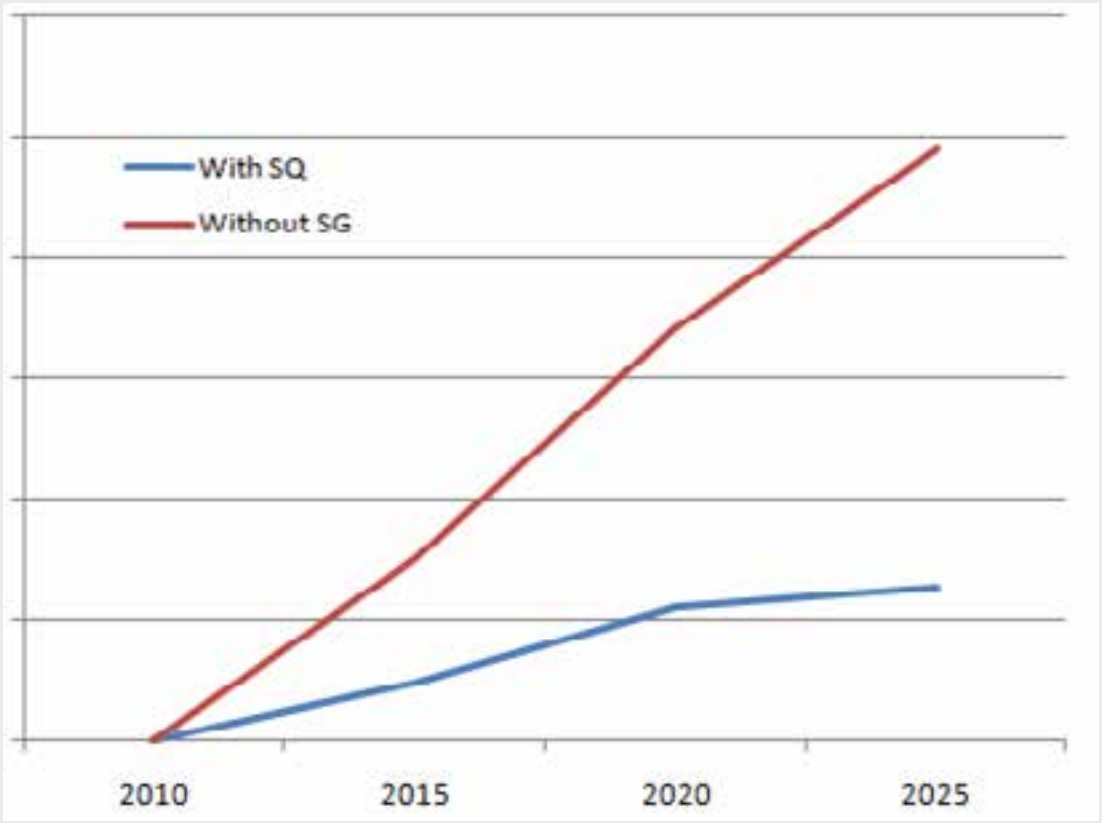
… if assets are replaced after 40 years



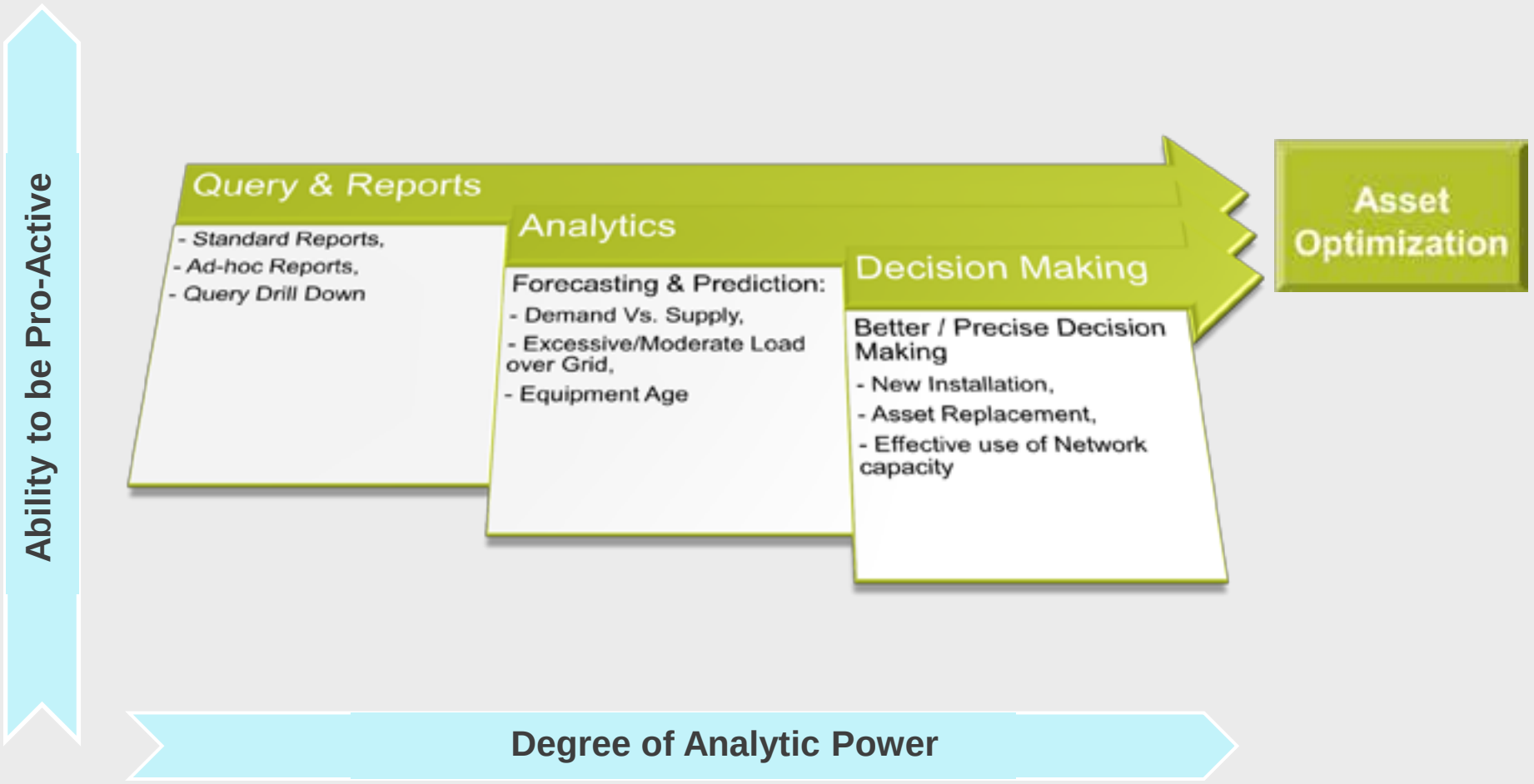
The Business Cases

Estimated need for grid investments – with and without Smart Grid
- and the reason to start with 10 kV





Towards Asset Optimization



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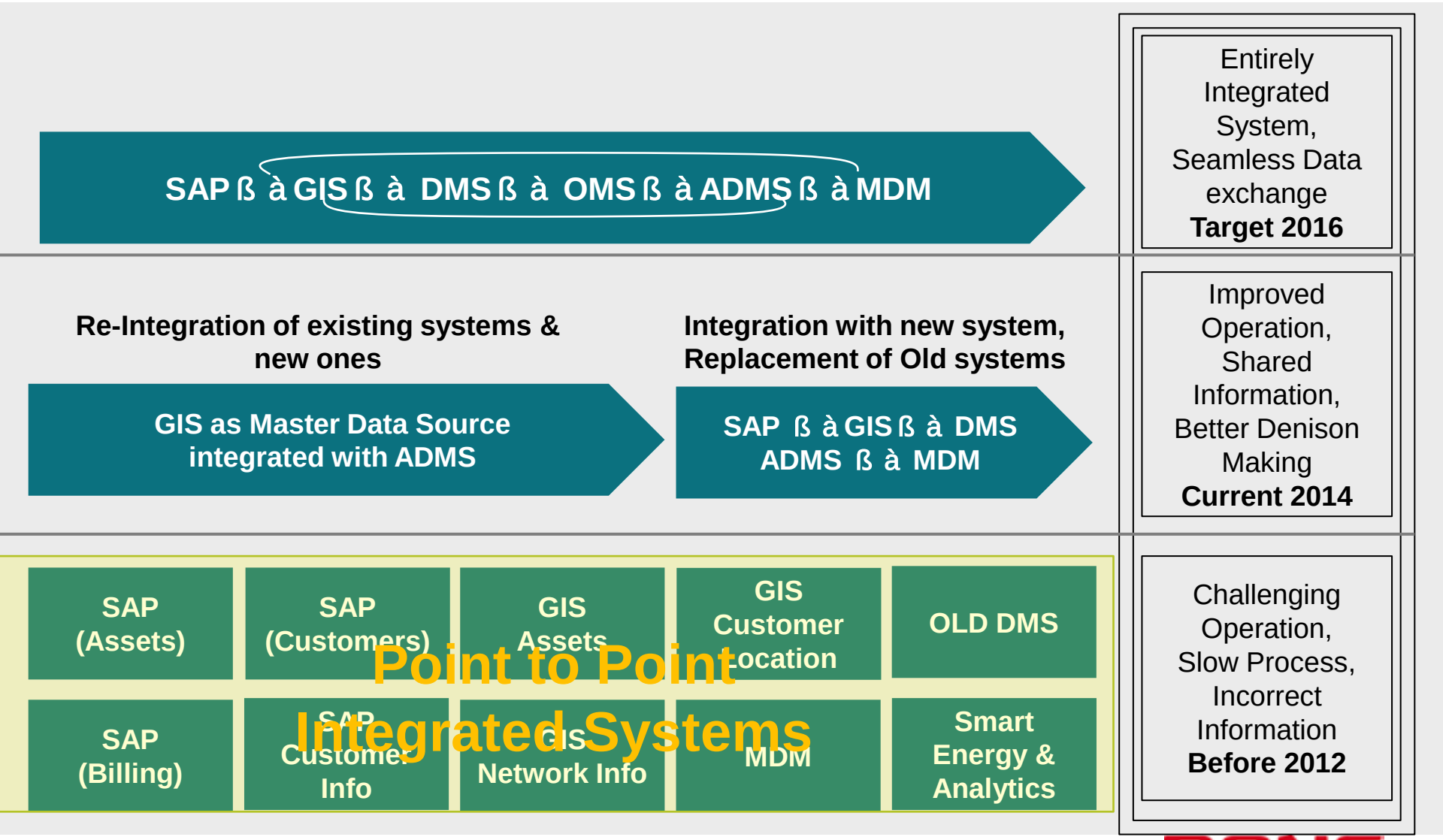
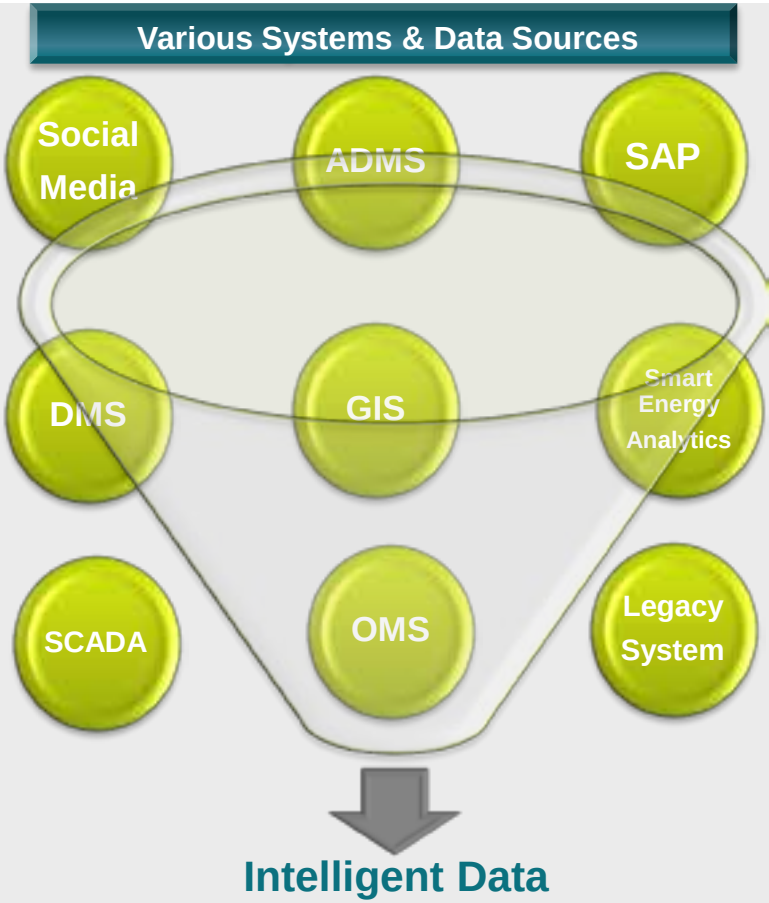
Vision/Roadmap Story



How Big Data at DONG Energy?

Volume	Velocity	Variety
• Tiered storage system • Relevant data collection • Eliminate data Redundancies • Continuous monitoring • Determine cold spots	• Operational Data stores • Caches • P2P Data Routing • Balance application data latency	• Data profiling • XML / CIM based format • Intelligent Middleware • Distributed query management • Metadata management • Advance indexing



Intelligent Data
Out Of Big Data Repository

Using Big Data Technologies for Analysing

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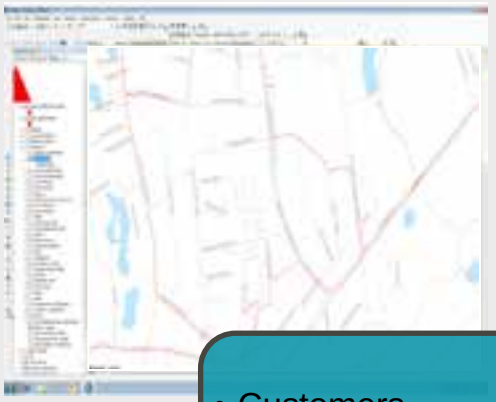
The role of GIS in Big Data – *everything* ***begins and end with GIS***



- Customers
- Asset master data
- Topology
- Normal Switching position

GIS, SAP

ADMS, OMS

- Current switching position
- Load flow
- Incidents
- Simulation

- Visualizing asset and sensor data
- Creating new knowledge
- Asking new questions

GIS

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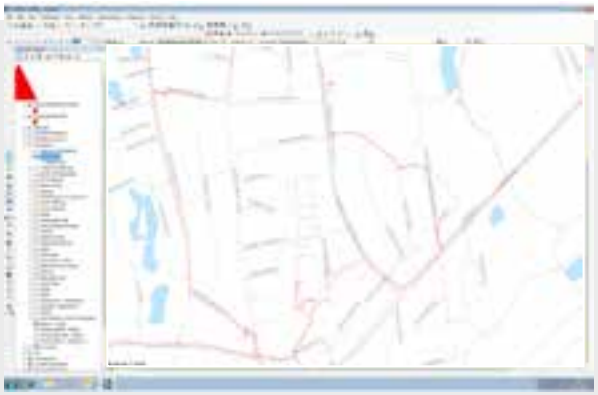
Case Study: C&M – Power Distribution



Esri ArcGIS

- Supports Design and Maintenance processes
- Leading system for the Static Network and owns the Normal Network State
- Visualization & Cartographic representation

Schneider ADMS

- Operational perspective
- Leading System for the Dynamic State of the Network and owns the Current Network State
- Fault & Alarm handling
- Study & Playback scenarios

DONG Energy/Schneider GridHub

- Risk, Contingency and Investment planning
- Time Series Analysis
- Snapshot of dynamic model
- 4 Billions Records added per year

Model-based Integration based on CIM IEC 61970 + 61968

ETL Engine record snapshots of the dynamic network state

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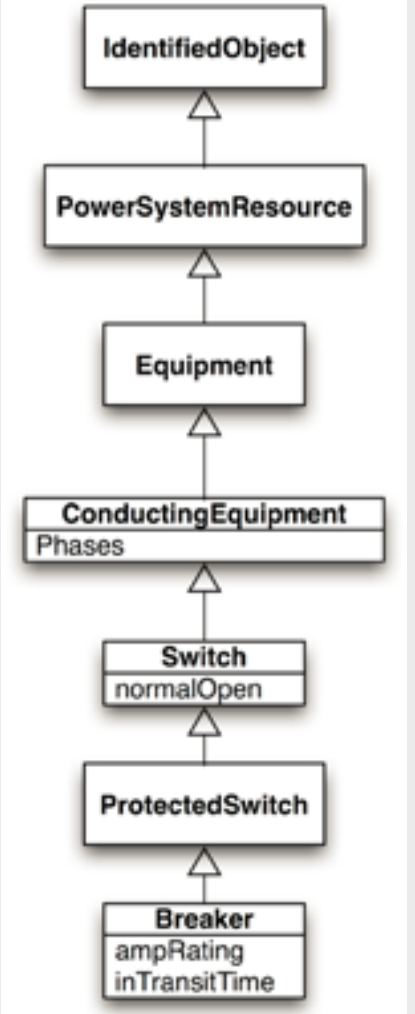
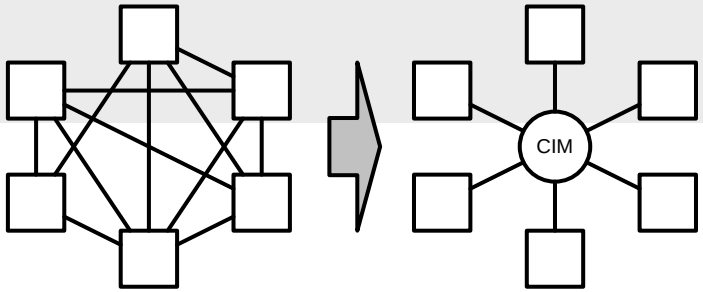
Common Information Model (CIM) – The most brief story

- CIM is a semantic model that describes the components and structure of electric power system
- It enables the exchange of information between applications
- It is specified in the IEC 61970 (Transmission) and 61968 (Distribution) standards. Using UML as the specification language
- Uses XML and RDF (Resource Description Framework) to encapsulate descriptions of e.g. electric networks
- CIM profiles are used to define a subset of the CIM-model relevant to specific usages of the standards
- Profiles can also be used to extend the CIM model to fit specific needs





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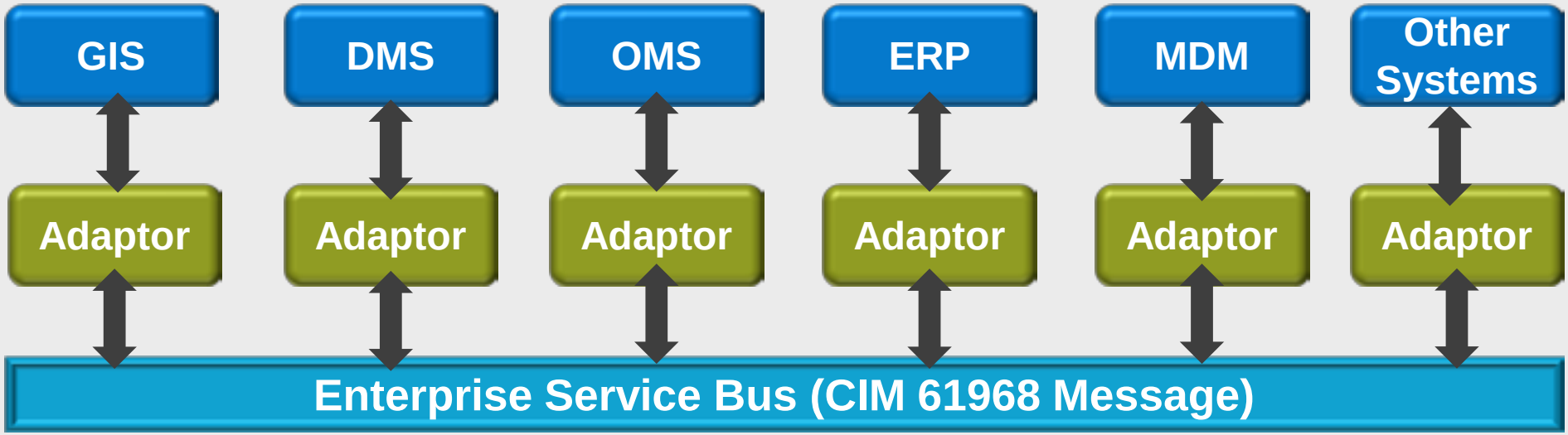
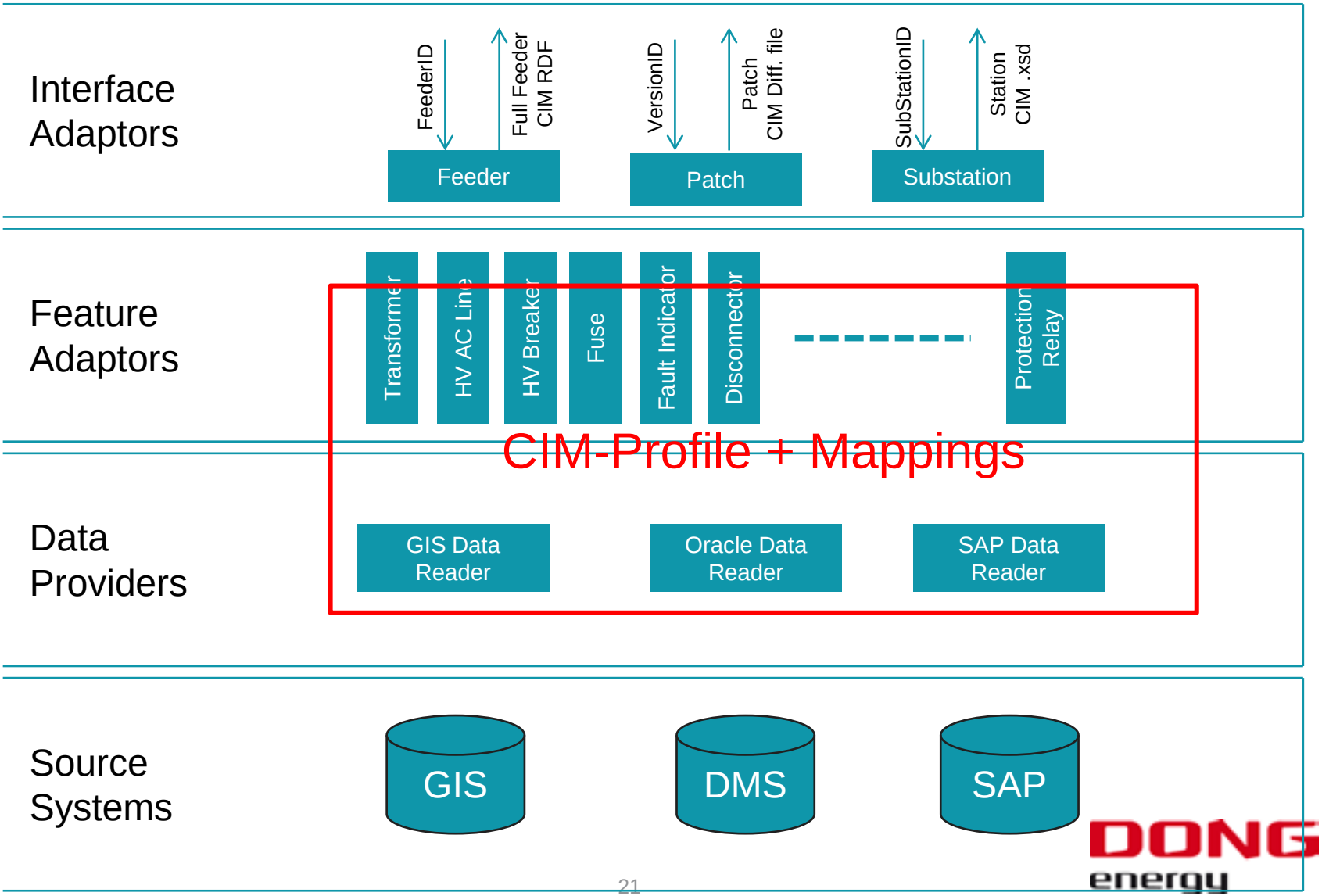
Overall Architectural Framework

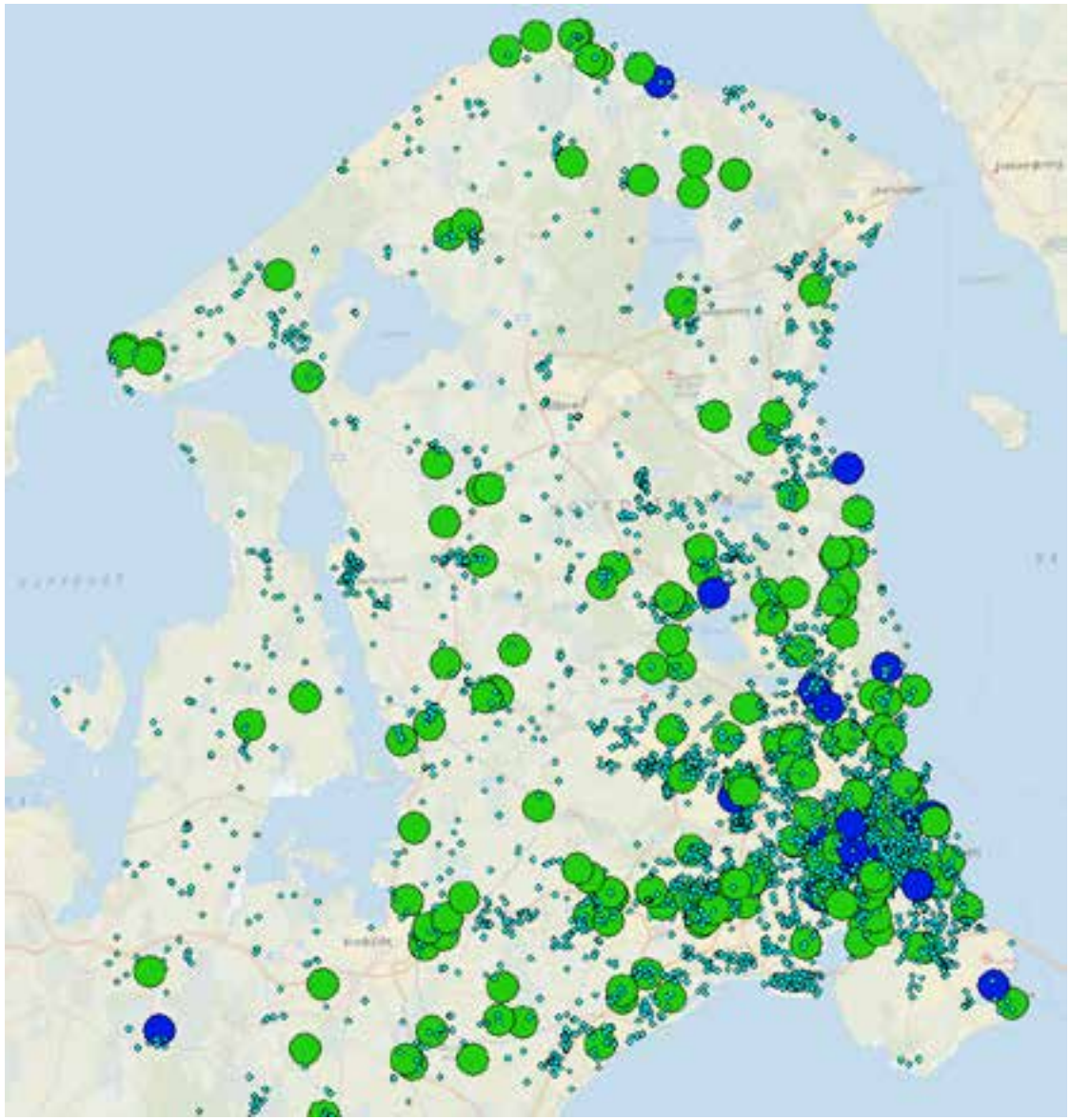
- CIM based Integration
- Challenges in defining Master & Slave systems



Retrieving Data from Source Systems

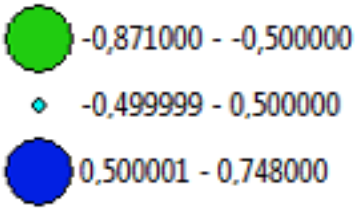


Case Study: Correlation Between Weather & Consumption For Large Consumers



Correlation inputs:
- Temperature data
- Consumption data

Symbology:
- Green: opposite correlation
- Blue: correct correlation



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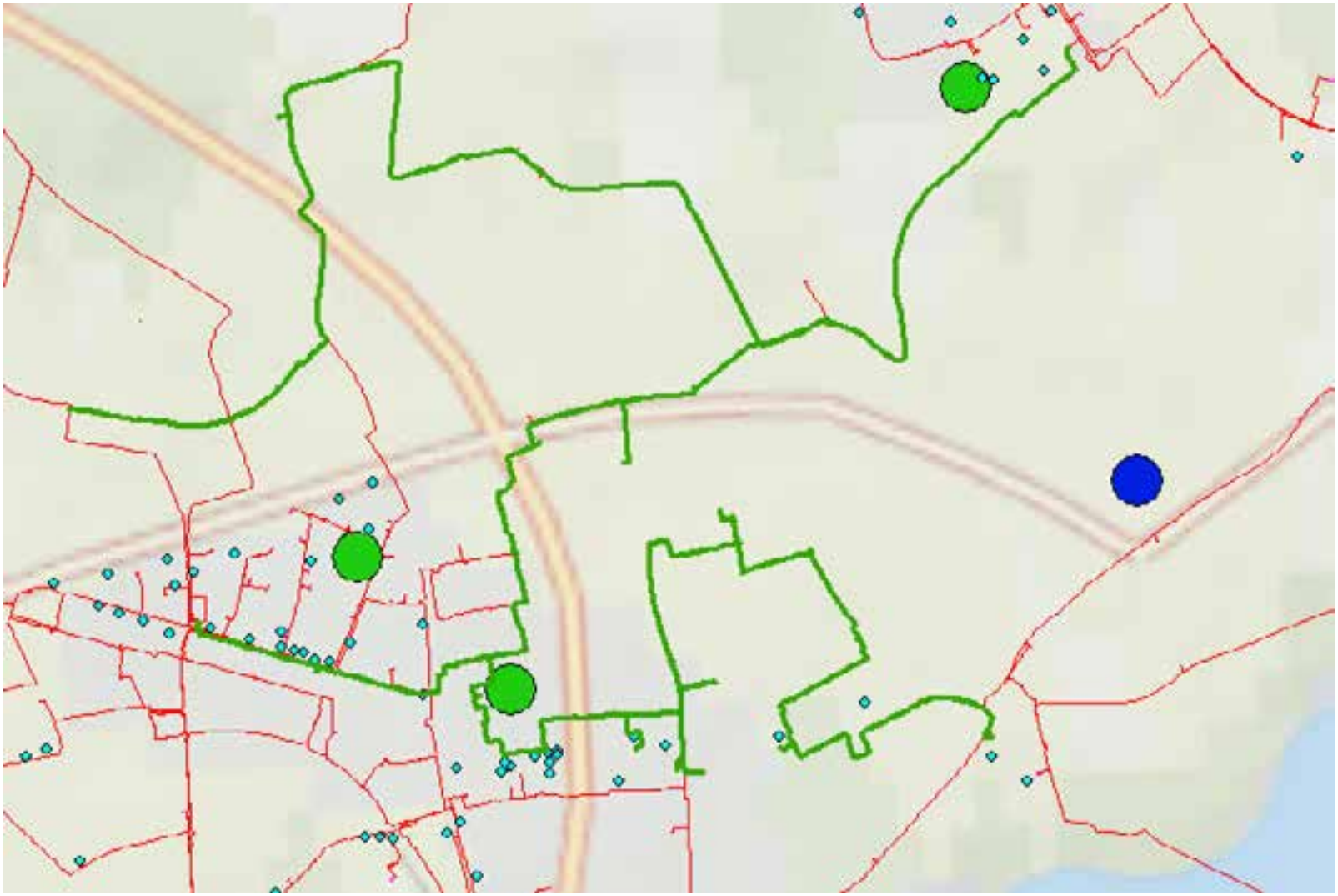
Case Study: Large Consumers Over 10Kv Feeder



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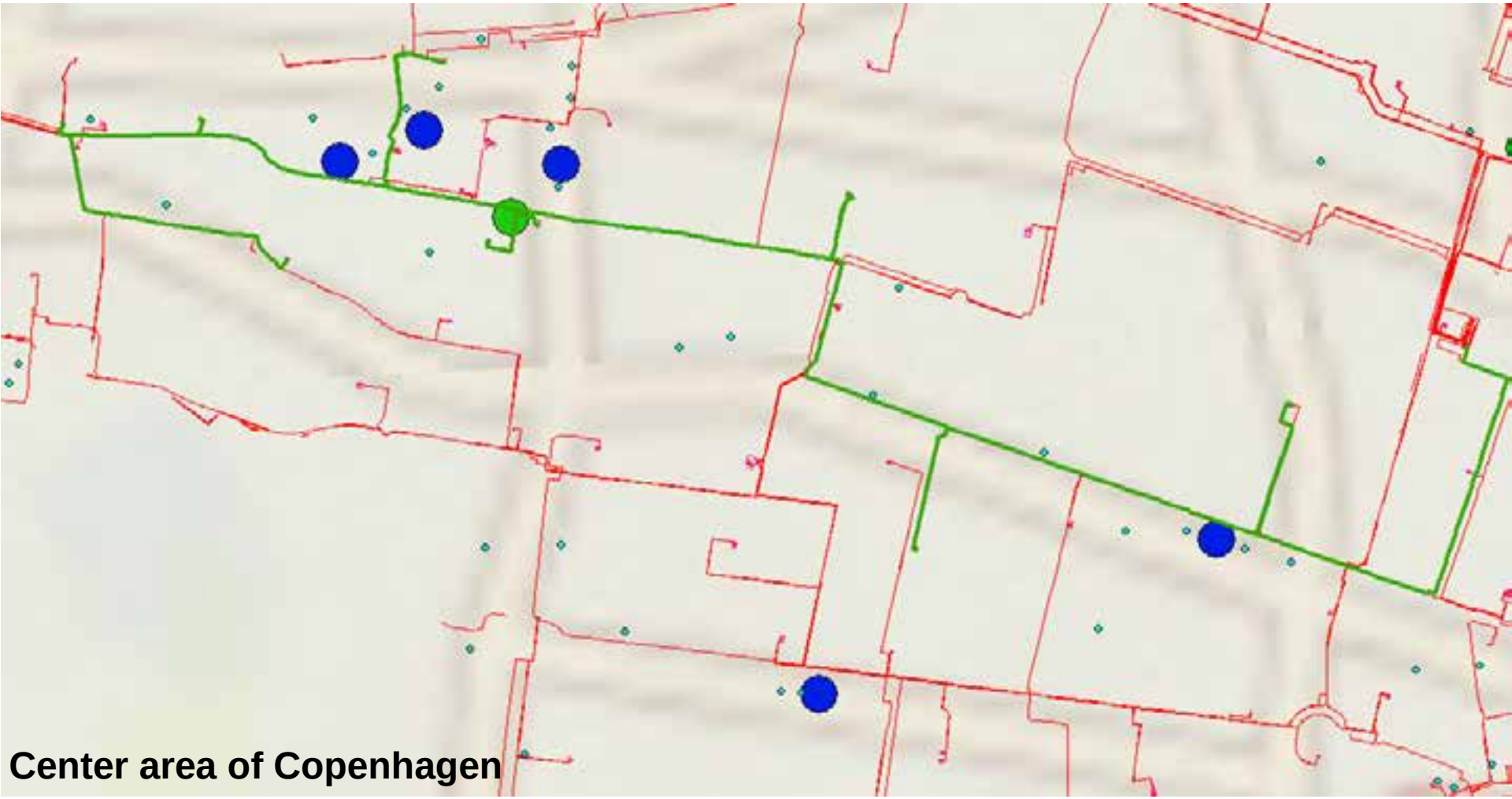
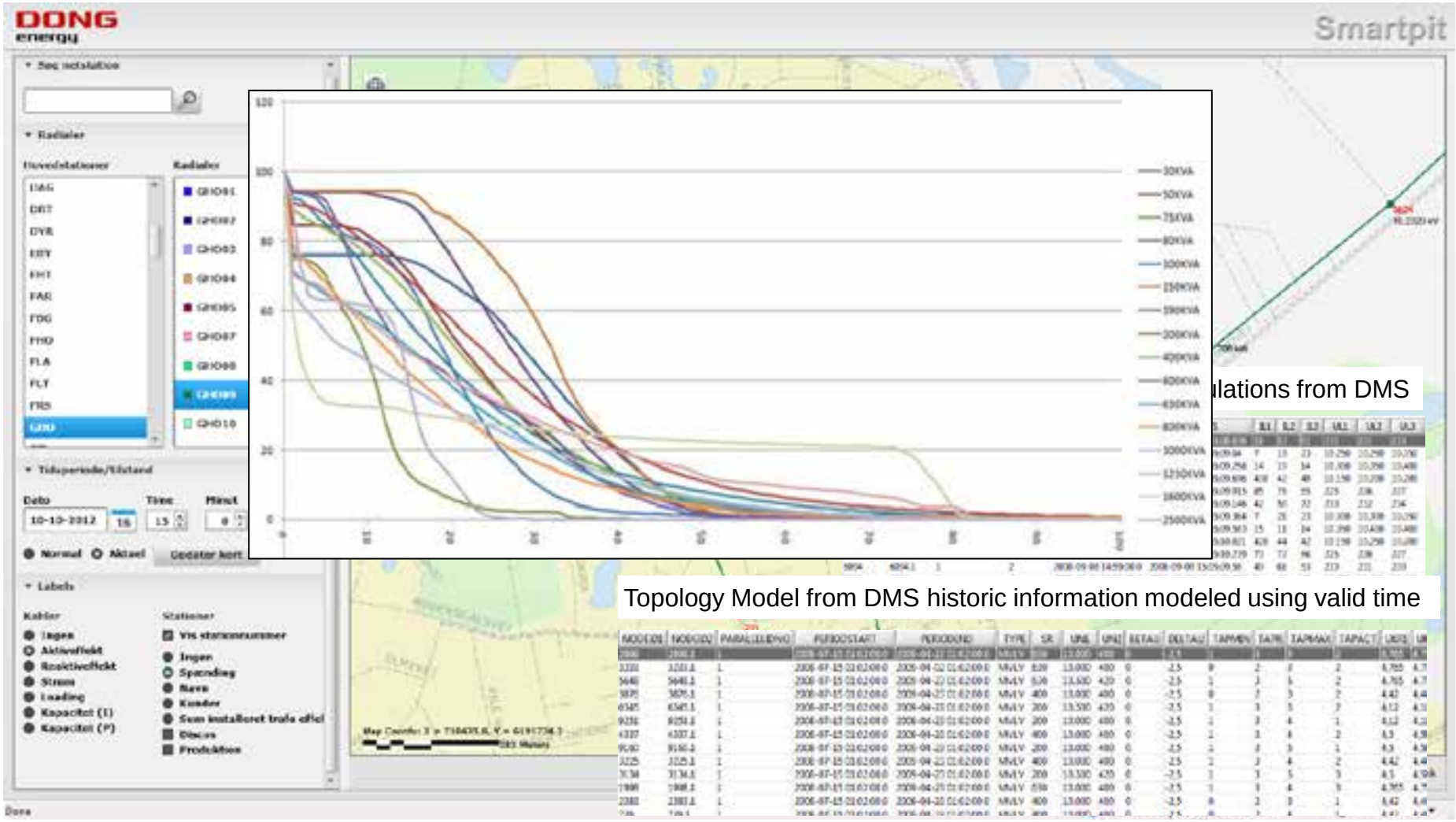


Center area of Copenhagen

Querying & Visualization of time series in GIS



Conclusion: The ability to be precise in data definitions on the lowest level is key to success in releasing the value of data in a smart grid world

- CIM is not only a neutral object model – it is also a virtual Master Data Management system – enabling GIS to hold the one and only truth on relevant master data across systems all the systems constituting a Smart Grid platform

- A virtual Master Data System forces us at one hand to be very precise in the definition of data and having a high quality in maintenance of the data

- At the other hand it enables us to be very agile in our response to real world changes

- If you succeed, you will have a Smart Grid application, that is actually consisting of several applications underneath

- If you succeed, you will spend a lot of hours on mapping and washing data, but you will gain new insight into the Grid enabling to take operation, maintenance and planning to a much higher level – and this is a great business case

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