

A photograph of an offshore wind farm with several wind turbines in the ocean under a clear sky.

CAPABILITIES FOR ENERGY TRANSITION

**USING IOT AND DIGITAL TWIN
AT SCALE**

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CHALLENGE ME..... NOT TO COMPLETE 100+ SLIDES



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CONCLUSION

BUSINESS DONE DIFFERENTLY





AGENDA

- 1** Market trends →

- 2** Challenges →

- 3** How to respond with IoT →

- 4** Curtailment →

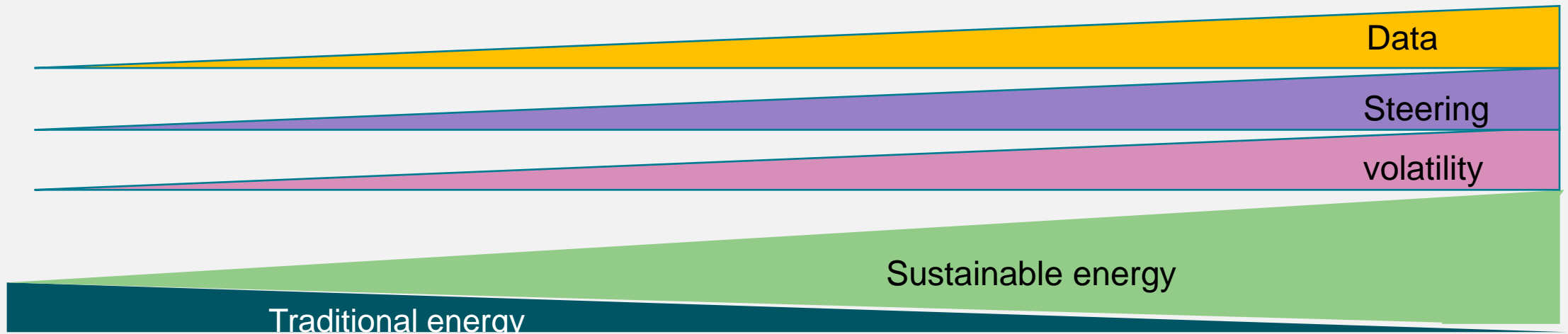
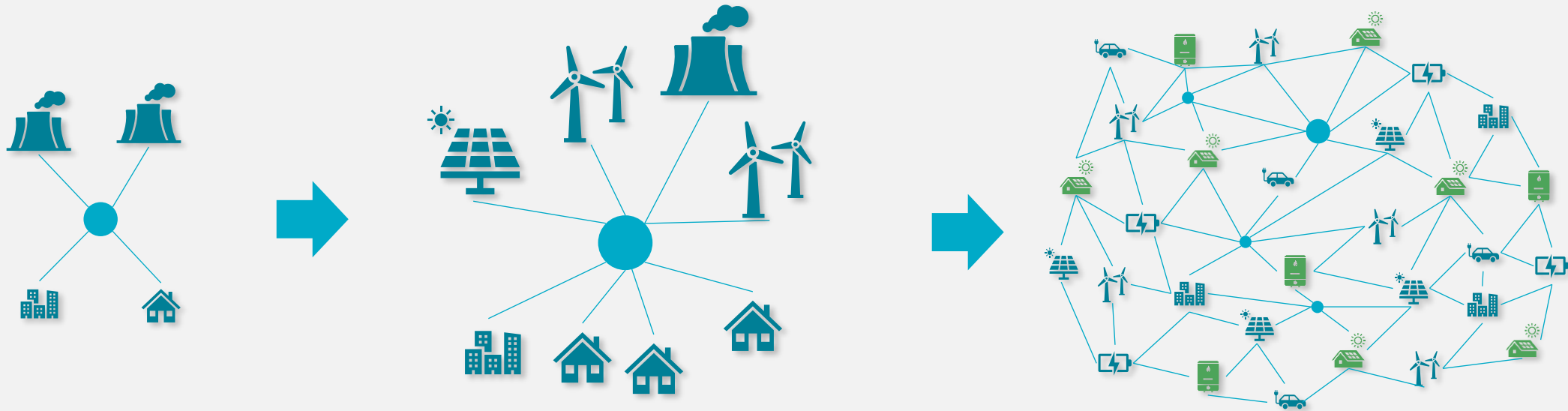
- 5** Virtual PowerPlant →

- 6** Digital Twin →

- 7** Tips and Questions from me →

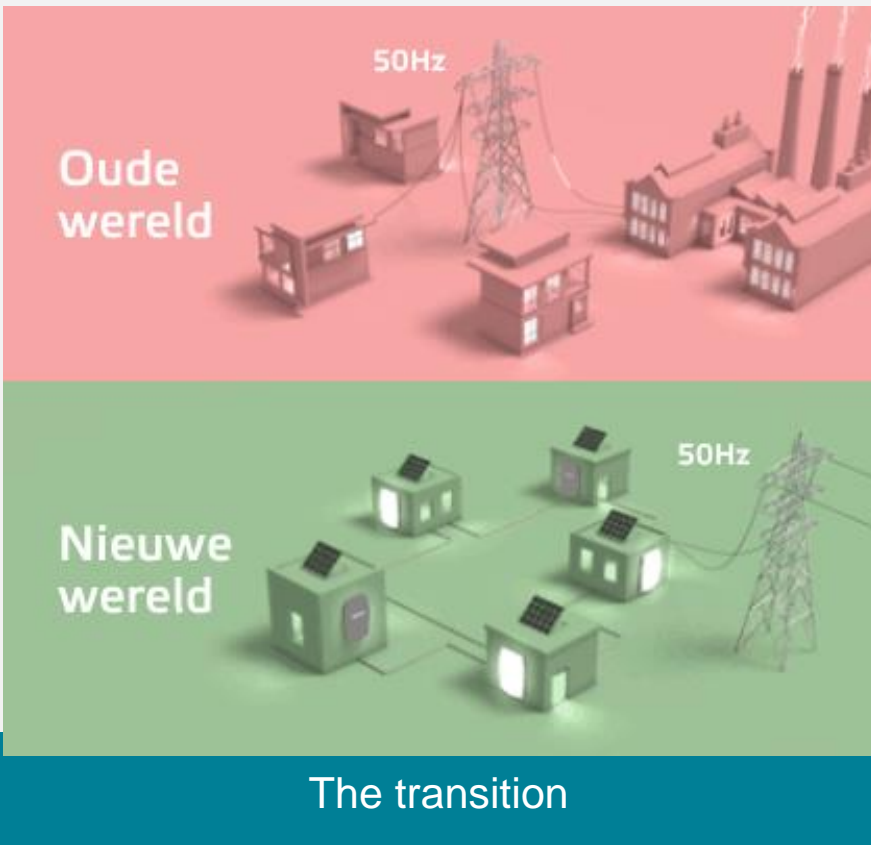
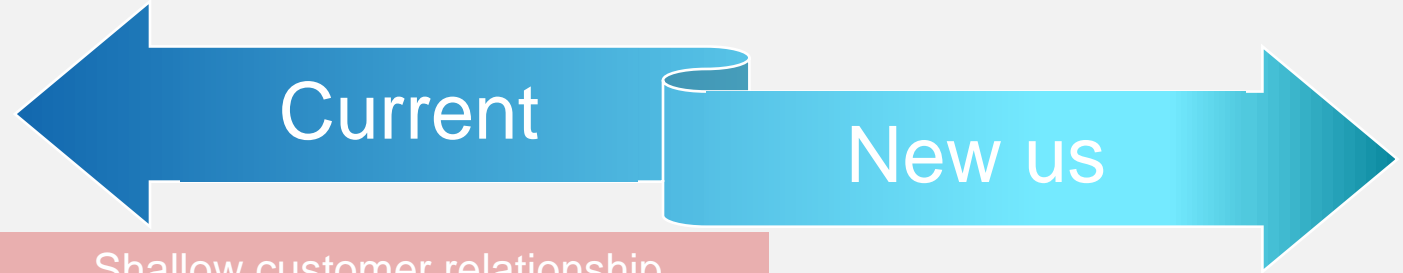
- 8** Discussions →

HIGHER DEMAND FOR ENERGY MANAGEMENT AT SCALE



THE ENERGY SYSTEM DEVELOPS IN SUCH A WAY THAT MARKETS, CUSTOMER RELATIONSHIPS AND BUSINESS PROCESSES WILL CHANGE.

• **The future envisioned**



Shallow customer relationship	Customer is part of the system
Low interest product (price)	Services and journeys that help adaptation
Volume driven wholesalemekets	Flexibility, P2P, Multi markets, P2X, congestion
A few big assets	Decentralised generation, Swarms, Virtualisation



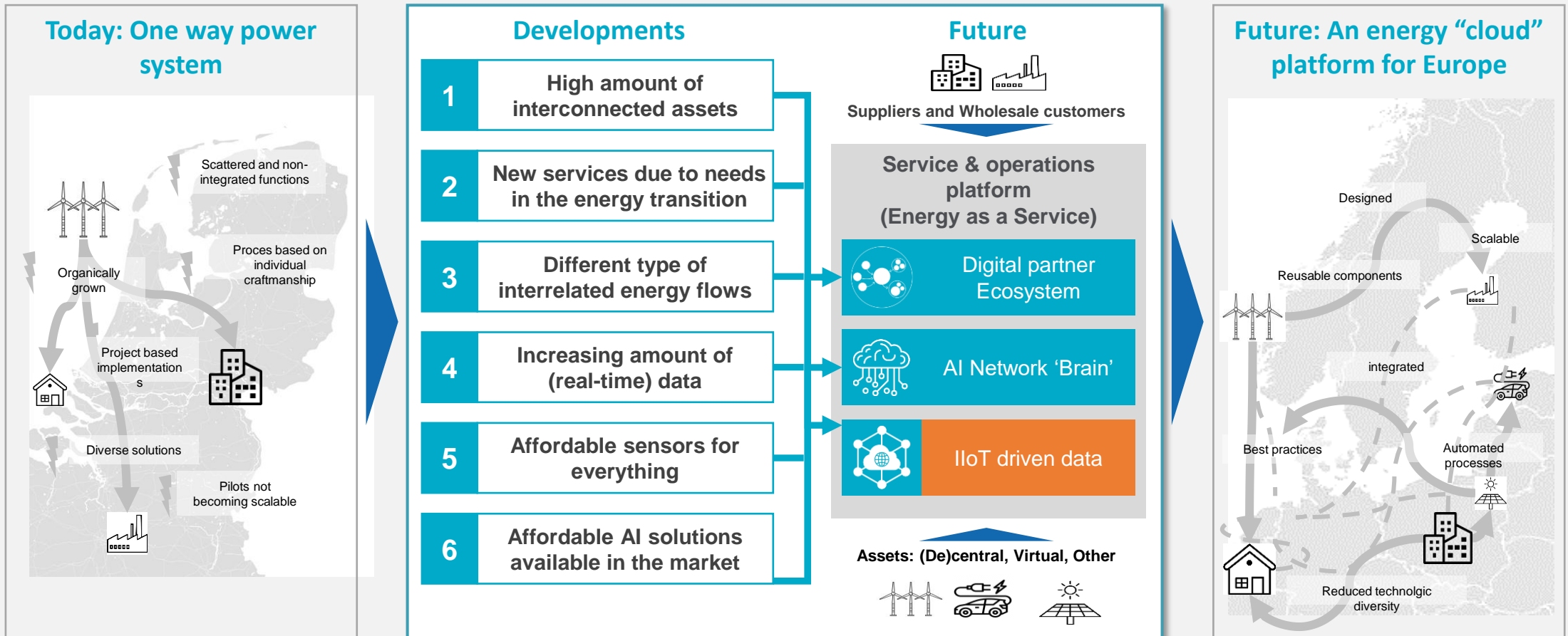
BHAG:

Big Hairy Audacious Goal

THE DAWN OF THE ENERGY “CLOUD” PLATFORM FOR EUROPE

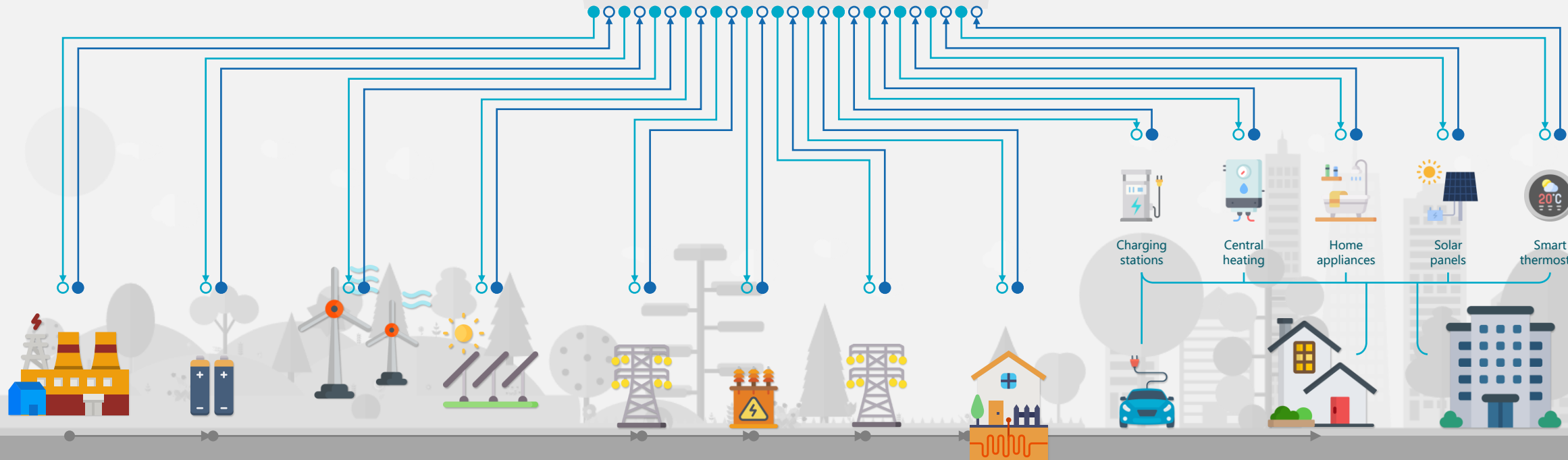


Develop cross energy solutions and optimization; Build an efficient integrated platform; Create new business models based on emerging market roles ; Reduce asset lifecycle costs by Realizing a transition to data-driven asset management (digital asset twin)





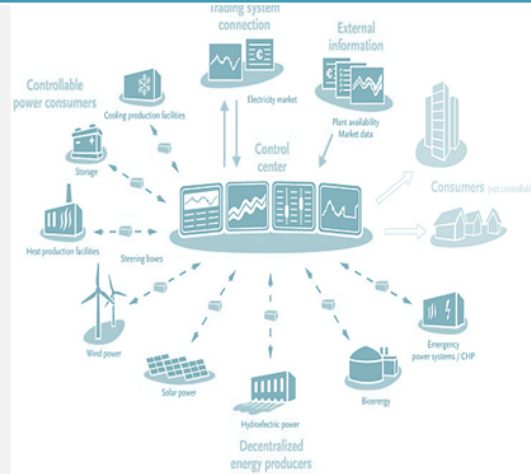
Virtual Power Plant



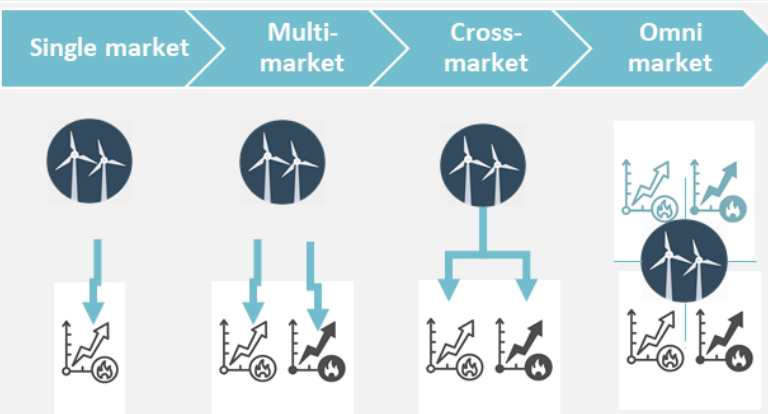
KEY CHALLENGES

- 1. Scalability: Millions
- 2. Heterogeneity
- 3. Growing with Business use cases
- 4. Affordability, Edge and connectivity

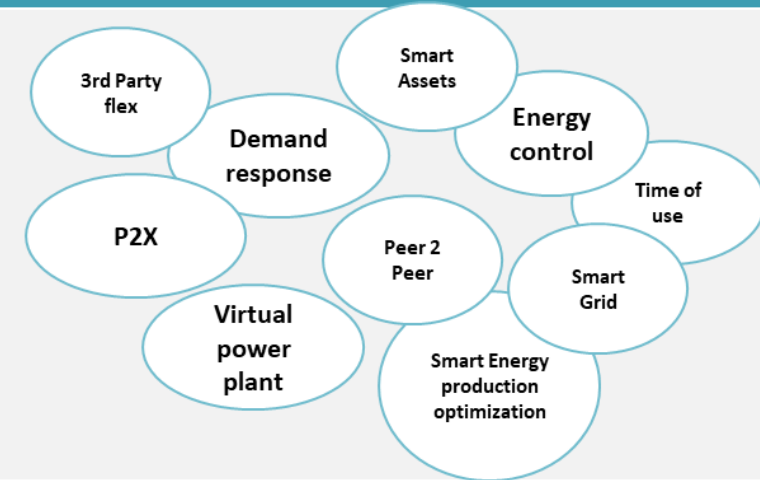
1. From few large assets to a wide and diverse portfolio of assets



2. From a multi/Cross market to a cross or omni market approach

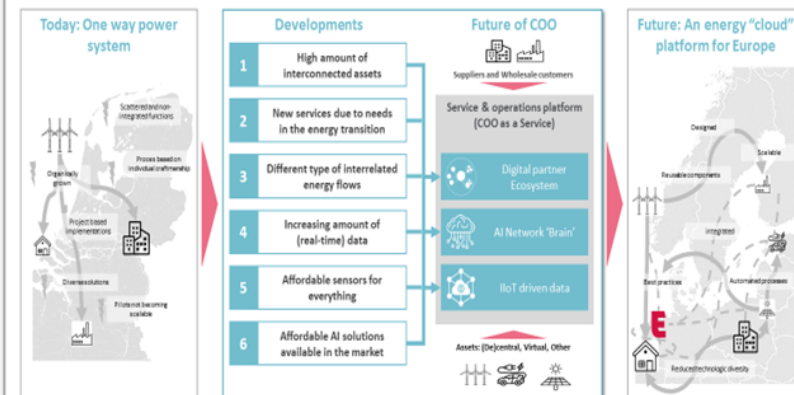


3. Towards a portfolio of smart features for collaboration with wholesale customers

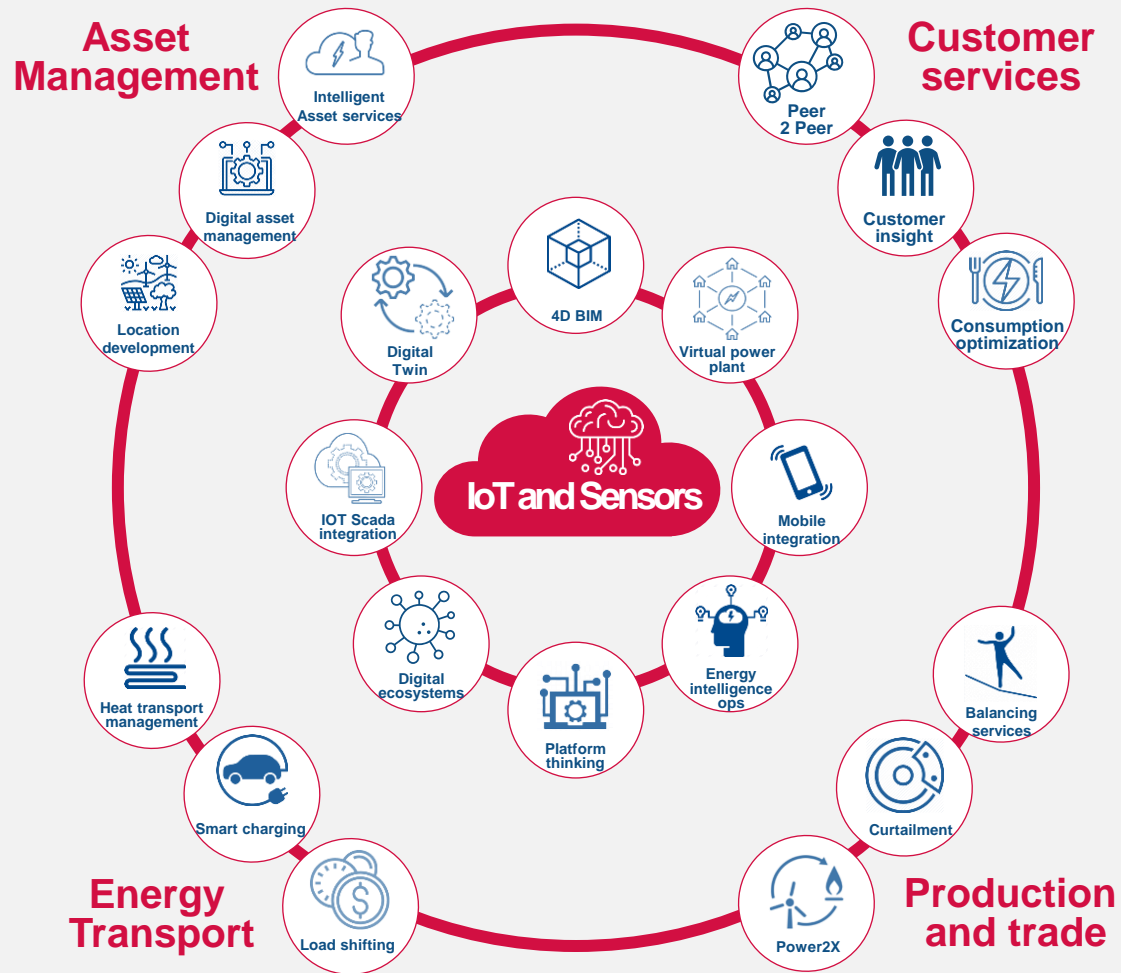


4. From craftsmanship to digital intelligence

The audacious goal

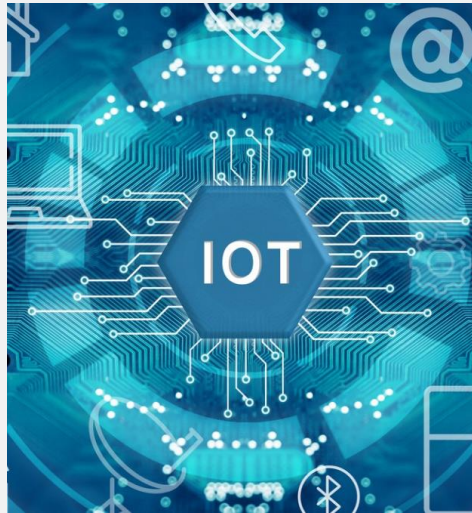


HOW TO SELL THIS ?



THE SAME DATA IS THE FOUNDATION FOR USE CASES IN MULTIPLE DOMAINS

WHAT DO WE NEED TO BUILD THIS



**IoT data
Integration**



Digital Twin



**Energy
Management
(AI/ML)**



**Asset Operations
and maintenance**

(a lot of) computer power and (very) fast connectivity

(a lot of) data storage

CONNECTIVITY VIA EDGE DEVICE

Small edge

- Large numbers
- Simple install
- Some latency
- Mbus, ModBus, OPC, > MQTT via LTE-M (options to expand to e.g. PLC)
- For end meters, sub stations, domestic and small businesses.

Big Edge

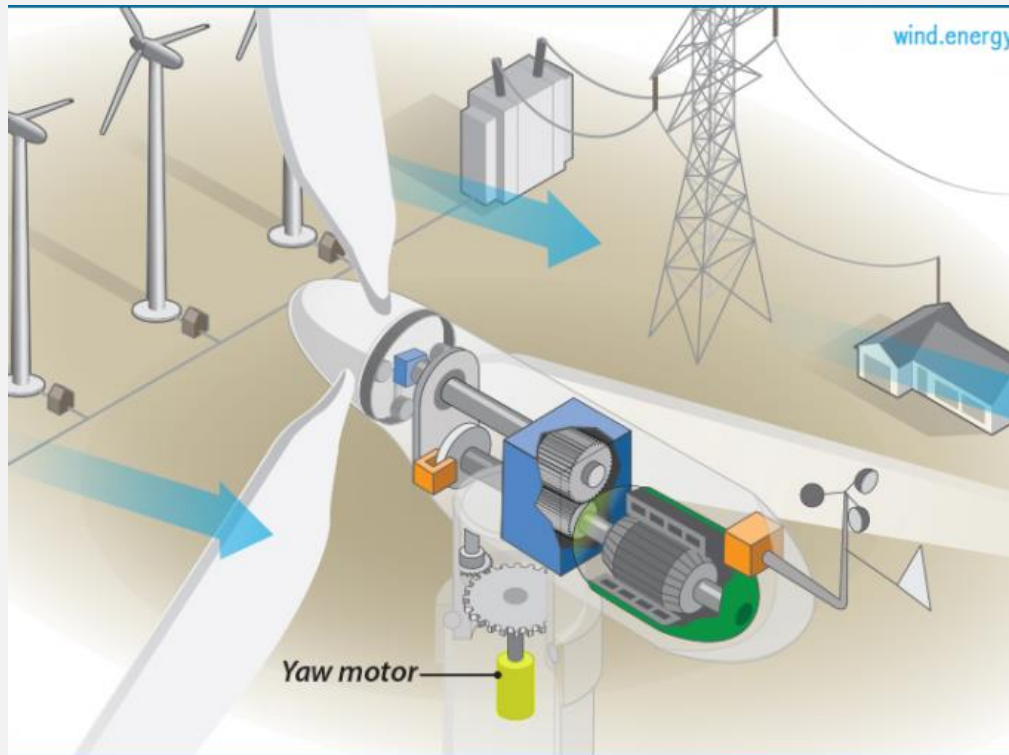
- Lower numbers
- Robust, reliable, some more time to install
- Low latency
- OPC, PLC, SCADA > MQTT via LTE-M / 4G and cable
- Runs applications.
- Large plants, solar / wind farm



HOW DOES A WIND TURBINE WORK / CURTAILMENT

Wind turbines can only regulate down (other assets can regulate up, e.g. gas turbine)

Main turbine component



Pitch system

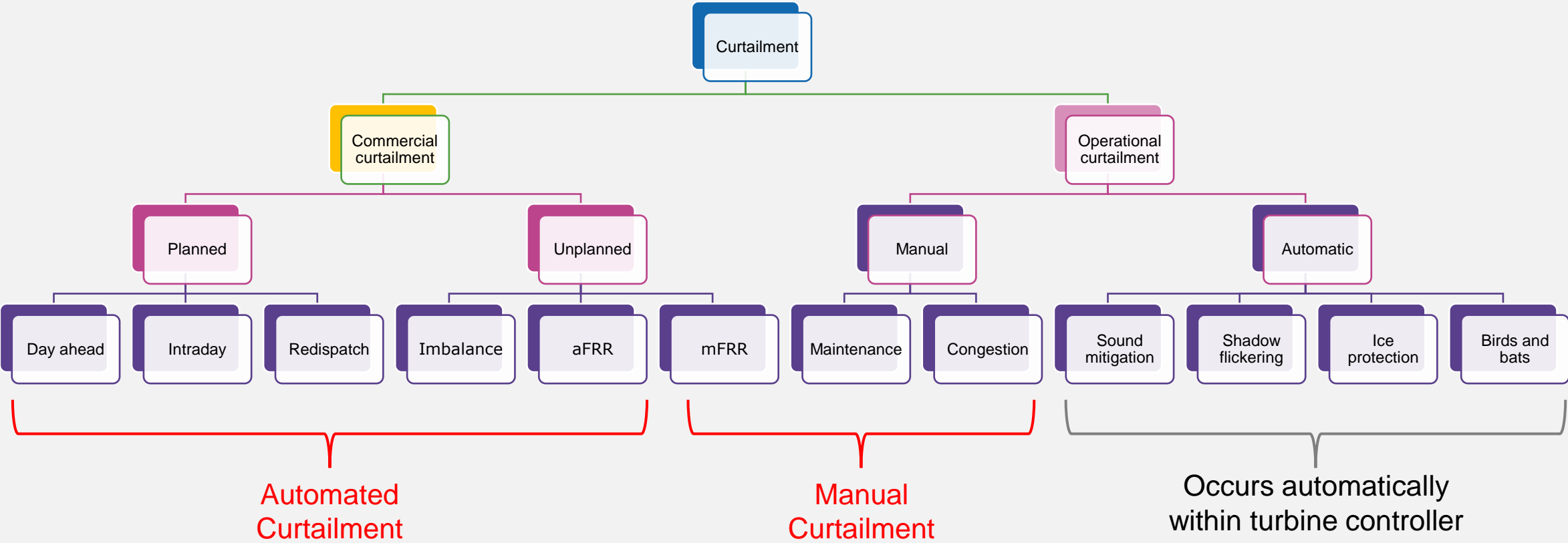


Blade profile



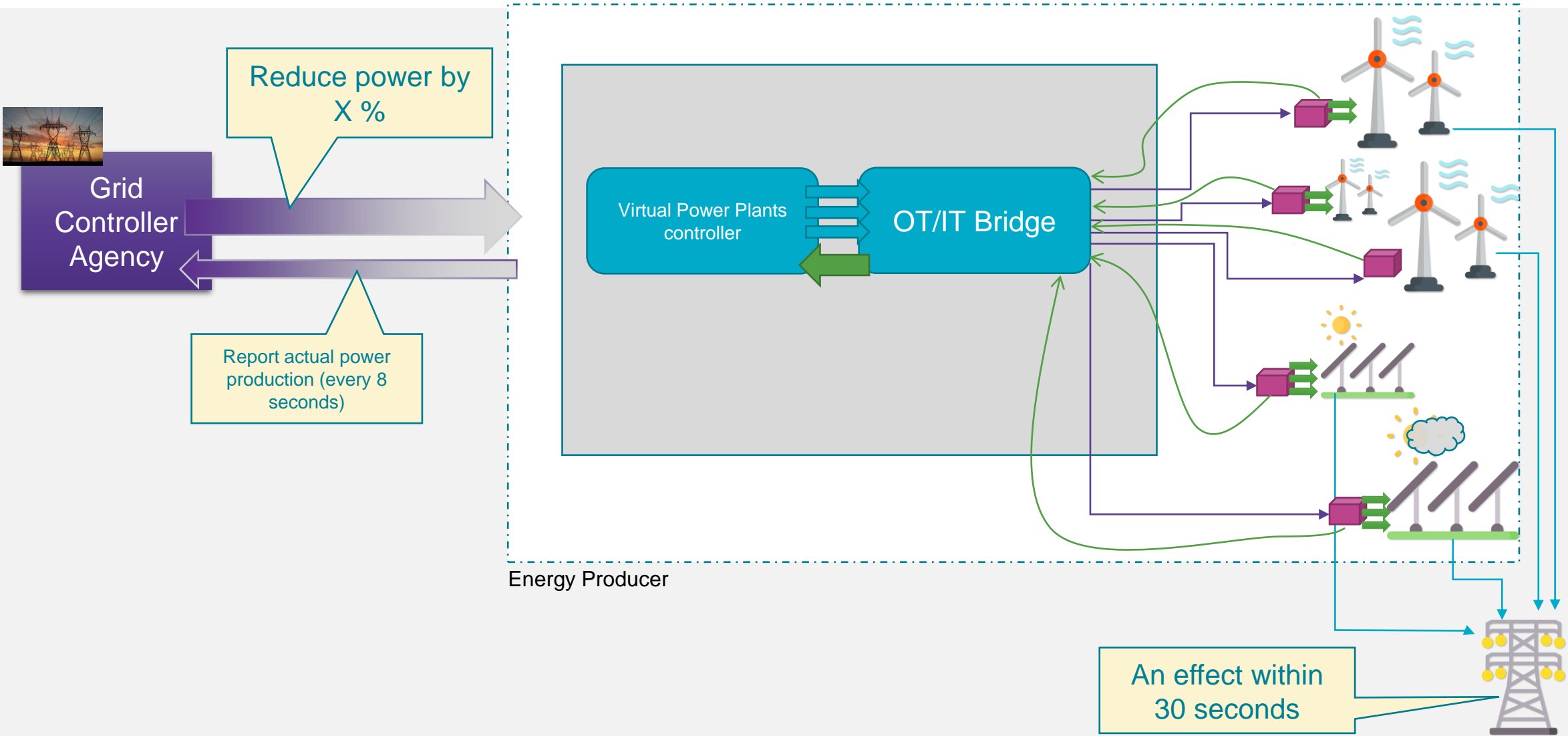
COMMERCIAL AND OPERATIONAL CURTAILMENT

CHALLENGE IS THE VAST NUMBER OF MANAGEABLE ENERGY SOURCES

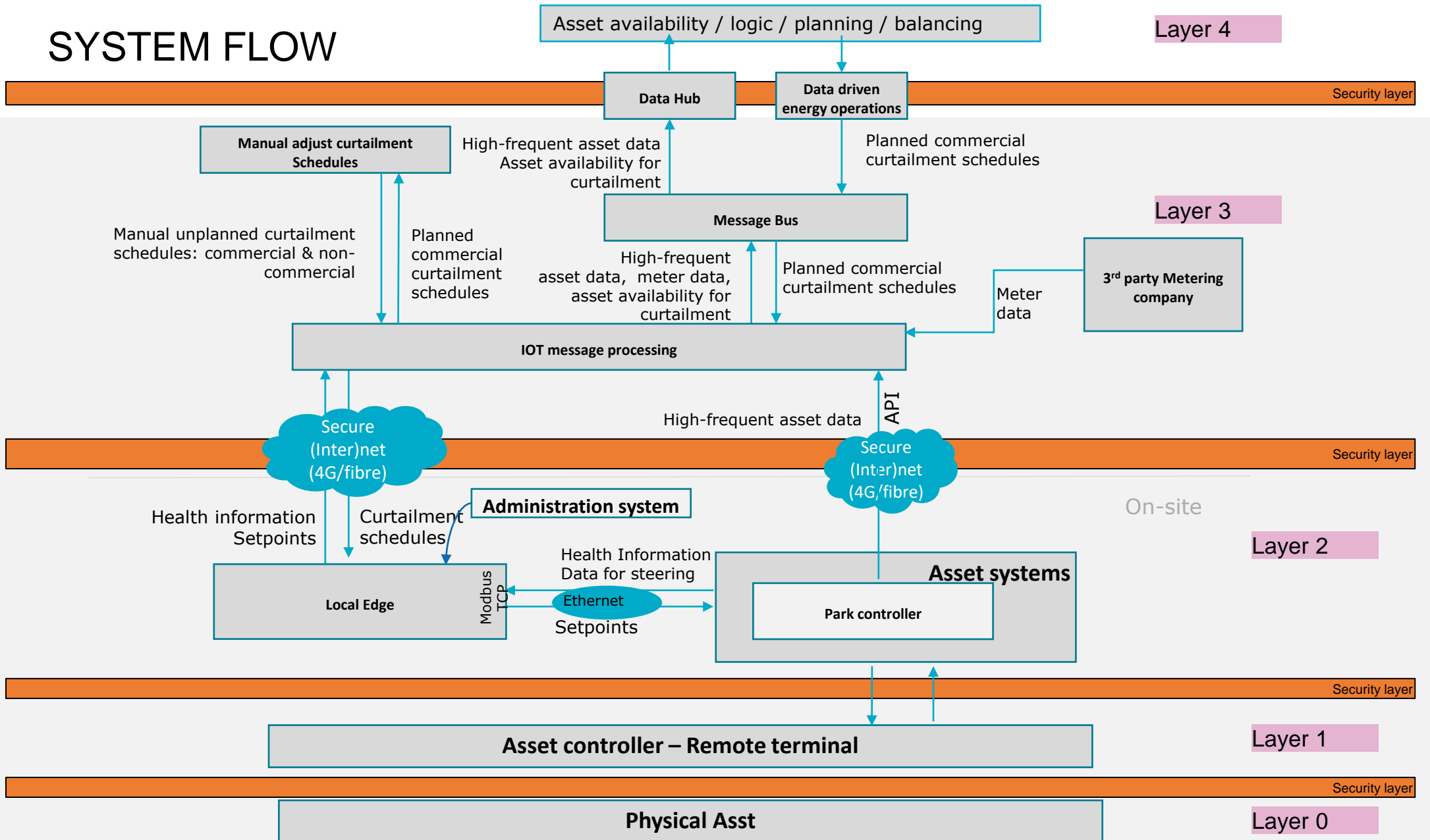


FRR = Frequency Restoration Reserve for balance and congestion management

REAL TIME MEASURING OF *CURRENT* PRODUCTION IS CRUCIAL: CLOUDS ON THE HORIZON



SYSTEM FLOW



WHAT WE HAVE TO DEAL WITH

Current Challenges

- Different Scada/PLC systems
- Increased demand for asset intelligence
- Increased complexity of software
- Increased number of updates of software
- Growing number of connected assets
- Lower latency
- Higher data sampling frequency
- More threats to critical infrastructure
- Availability of skilled (local) workers
- Availability of skilled (software) engineers



Current solutions

- Rationalize Scada / PLC systems
- Place intelligence in cloud
- Split primary operations OT and optimization
- Automated and tested updates / roll out
- Automate asset self registration
- Reliable fast connectivity (5G?)
- Store data in buckets within the system
- Design with highest security level
- Make OPS simple and automate
- Maximize reuse and standard components

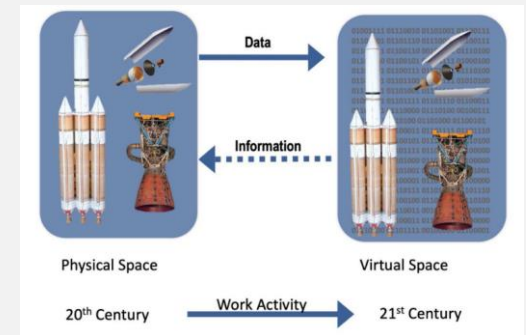
DIGITAL TWIN (WHAT IS IT?)

A digital twin is a virtual representation of real-world entities and processes, synchronized at a specified frequency and fidelity.

- Digital twin systems transform business by accelerating holistic understanding, optimal decision-making, and effective action.
- Digital twins use real-time and historical data to represent the past and present and simulate predicted futures.
- Digital twins are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems.

It is a methodology, a business process that connects something physical to the digital realm within an organization, enabling a new level of insight and decision-making

Source: Digital Twin Consortium



Digital Twin

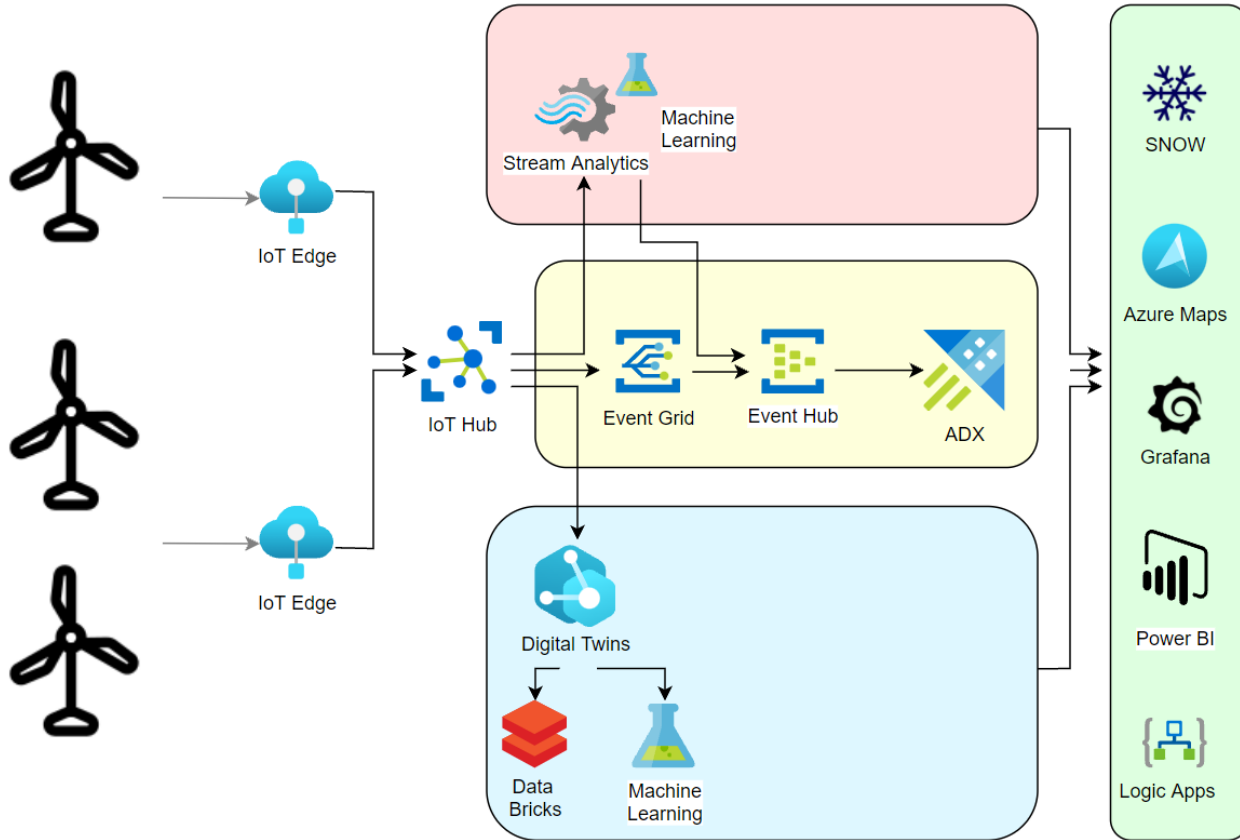
1. Use digital models
2. Used for improving products and processes
3. Real-time data
4. Two-way flow of information: actions based on collected data
5. Large scale "reality" models



Simulation

1. Use digital models
2. Used for improving products and processes
3. (Typically) uses generated data
4. Insights, no actuators
5. Typically, one or few processes/data flows

HOW WE USE DIGITAL TWIN IN A COMPLEX NETWORK

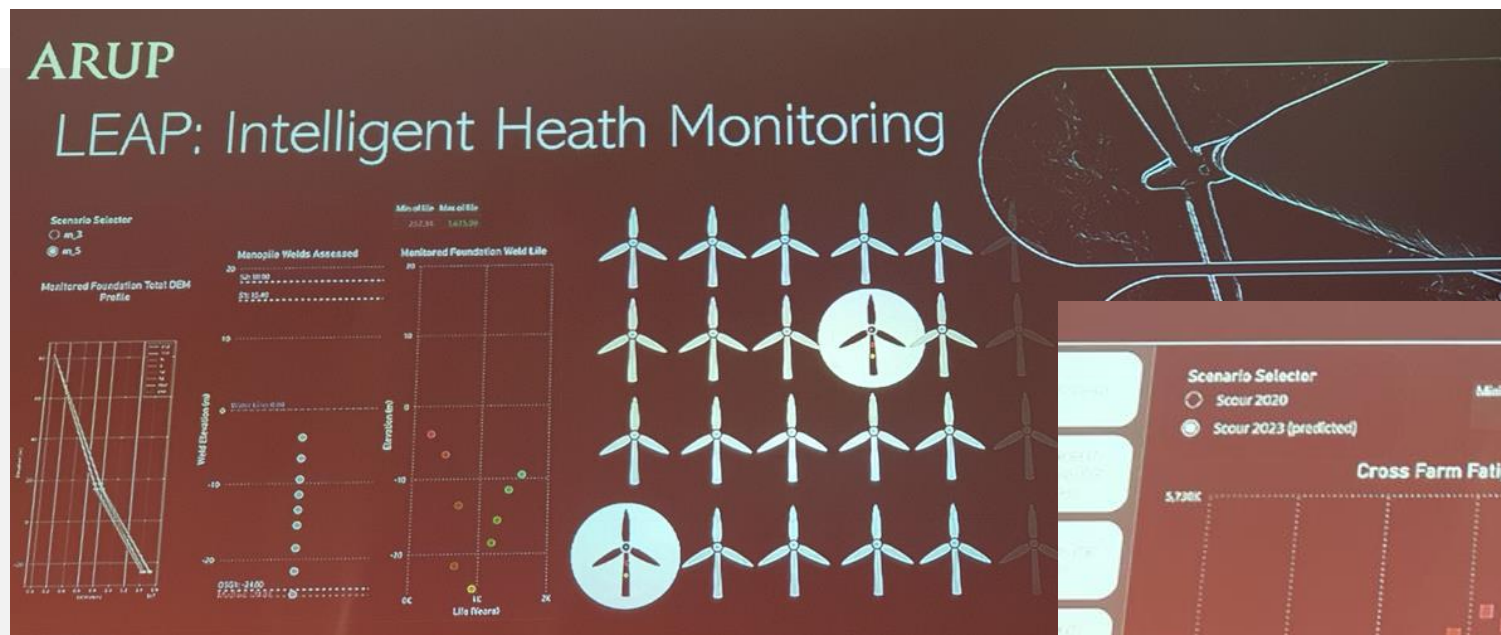


Hot path:
 - events
 - peaks/lows

Warm path:
 - Errors
 - Values
 - Levels

• Cold path:
 - Trends
 - Patterns
 - Virtual sensors

DIGITAL TWIN IMPLEMENTATION...



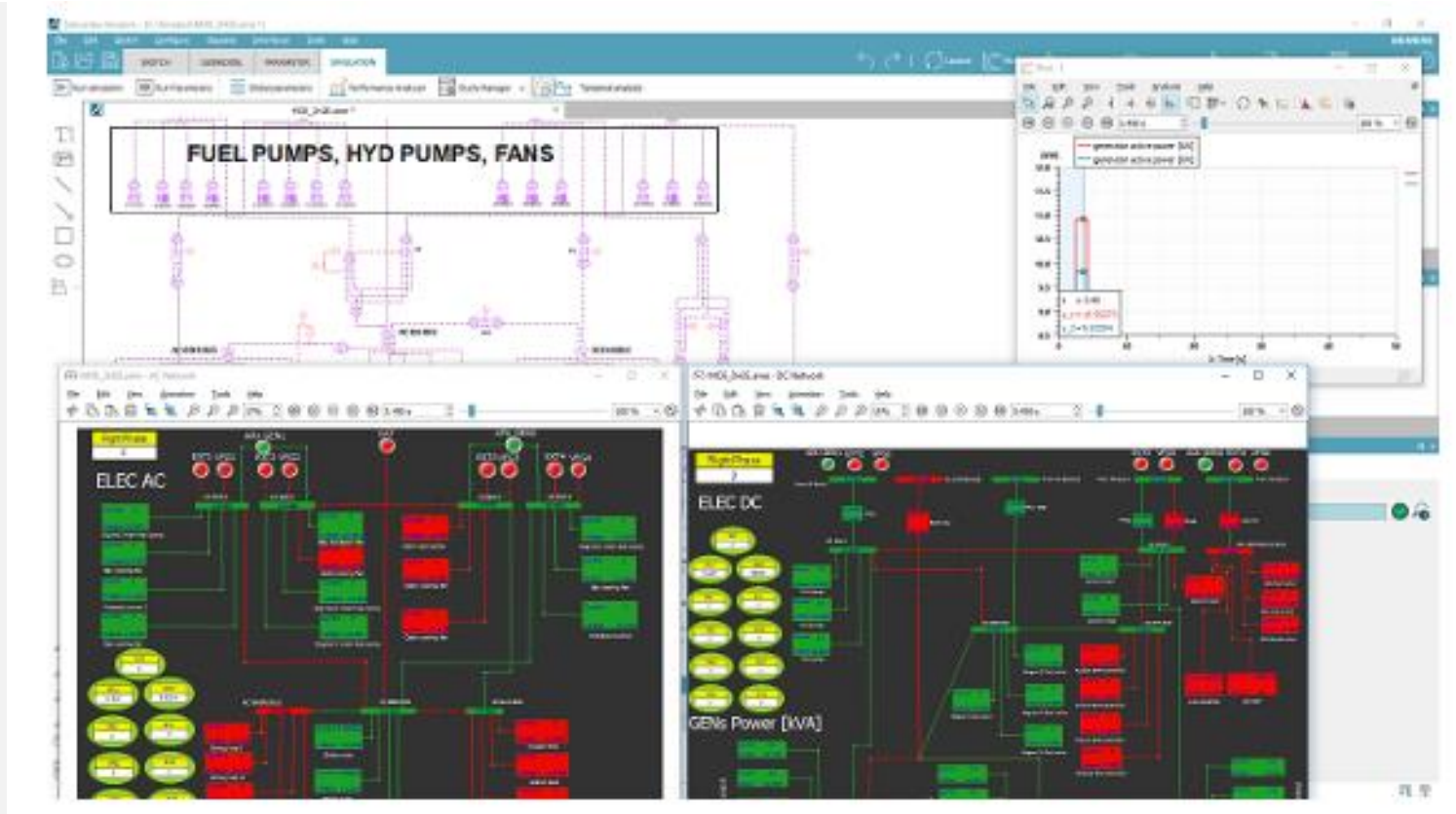
Source: London Array

...JUST DATA VISUALIZATION...



Source: Cityzenith

...OR A SYSTEM SIMULATION



Source: Siemens

The European Energy cloud

Next step / Asset API (standardization required) for digital twin

Make all assets interchangeable between departments, plants, companies and countries facilitating self building digital twin models

- Administrative API (who am I)
- Information model semantics API (what can I do)
- Data exchange API (my state)
- Publish / Subscribe bus API (listen to me)
- Actuator API (operate me)
- Disconnected operations and replicate API
- Discovery API (find me with governance)

This can be a research topic.



EUROPEAN DATA SPACE INITIATIVE



- Driven by stakeholders
- Rich pool of data of varying degree of openness
- Sectoral data governance (contracts, licenses, access rights, usage rights)
- Technical tools for data pooling and sharing

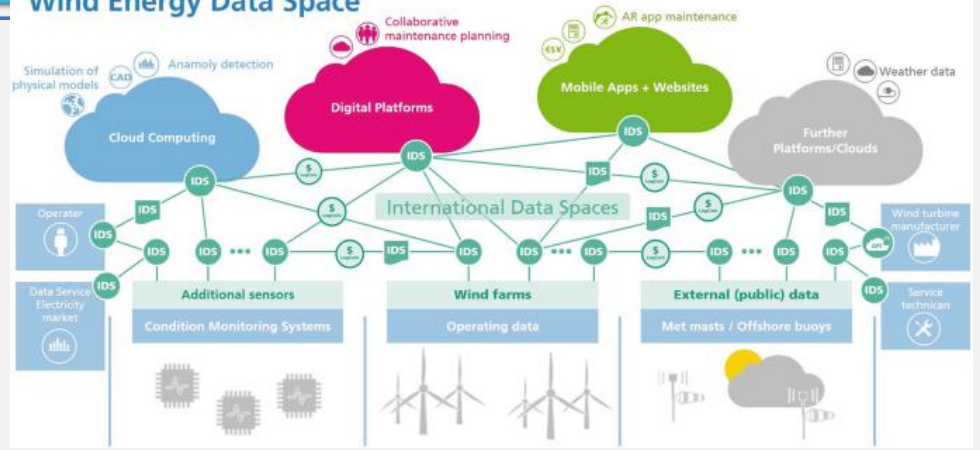
Personal data spaces

High Value Datasets from public sector

Technical infrastructure for data spaces



Wind Energy Data Space



Source : <https://digital-strategy.ec.europa.eu/en/policies/strategy-data>



**PRACTICAL
EXAMPLES**

STORE SURPLUS ENERGY IN ELECTRICAL BOILERS



Surplus of sustainable energy



Remotely activate a pool of 10k + electrical boilers

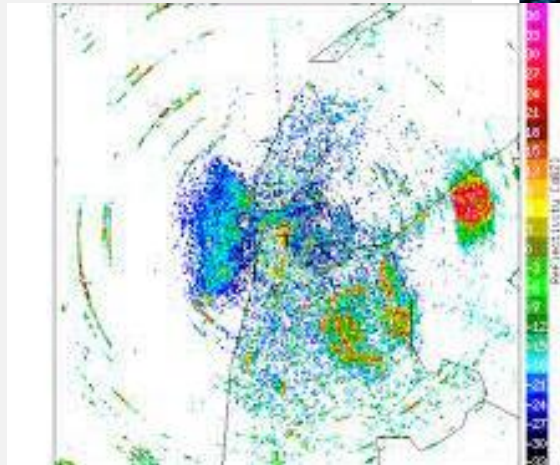
BIRTAILMENT

turbines are threat to endangered Scots birds of prey

Martin Williams

3 January 2023 · 4-min read

In this article:



Bird radar



On/off wind turbine (offshore)

MY CHALLENGES

= YOUR CHALLENGES



KNOWLEDGE

- Academic models for energy management
- International collaboration
- Academic theory on digital twin models
- IoT / Energy data standards
- European data initiative

RESEARCH - INTERN

- Internship software / IoT / energy industry
- Research in large scale iot models for energy
- Validation Control Room of the future
- Public – private – Academic collaboration
- Validate academic models in practice

Contact me or Arsenio.Zaandam@amis.nl>



DISCUSSION

> next slide for invitation 😊

EVENT: Retrospect IoT Solutions World Congress 2023 in Nieuwegein

On Tuesday 7 March we will be organizing the review of the IOT Solutions World Congress 2023 at our office in Nieuwegein. AMIS, a regular visitor to this conference, brings a summary of the most important developments and innovations to the Netherlands in a free information session of 3 hours.

Register now for this unique opportunity to stay informed about the latest trends and developments in the world of IoT.

January 18, 2023 | Event | By: AMIS | Conclusion **Part**   

March 7, 17:00h-21:00



You Can't Improve What you Don't Measure