Making the Smart Grid Real

ZIV TWIN GRID

a real-time automation platform

What drives energy automation?

- **Increasing electricity demand**, exceeding rate of **costly grid reinforcement** capabilities
- Integration of **renewables** to reach **net zero goals**, causing loss of synchronous generation and network instability
- Manage **whole system operation**
- Grid meshing to improve **reliability**
- Provide **energy and flexibility trading** market operation

+ electrification
+ renewables
+ Net Zero

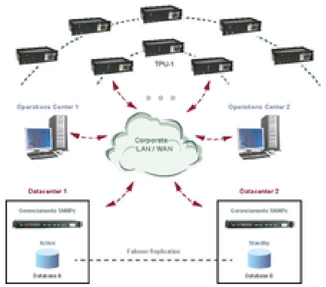
ZIV designs and manufactures Cutting-edge
Smartgrid Solutions for HV, MV & LV grid automation

P&C IEDs + Systems

Primary Substations
S. Substations and
MV Switchgears

Communications

HV Telecom
Networking & Sensors



RTUs

HV & MV RTUS
LV Supervision
Systems

Metering & EV Chargers

Standard based +
interoperable
equipment

Systems & Services

Systems Integration,
Engineering Services,
SW, Training

ZIV TWIN GRID

can help saving time, money and energy by providing the means to monitor the grid and use **real time flow information** to automate your network.

System Arquitecture

Real time Analysis Engine

Use cases

It is an Energy automation platform that offers advanced Power Management Software (PMS) functionality and **extends the lifespan of the existing SCADA infrastructure** while providing enhanced capabilities.

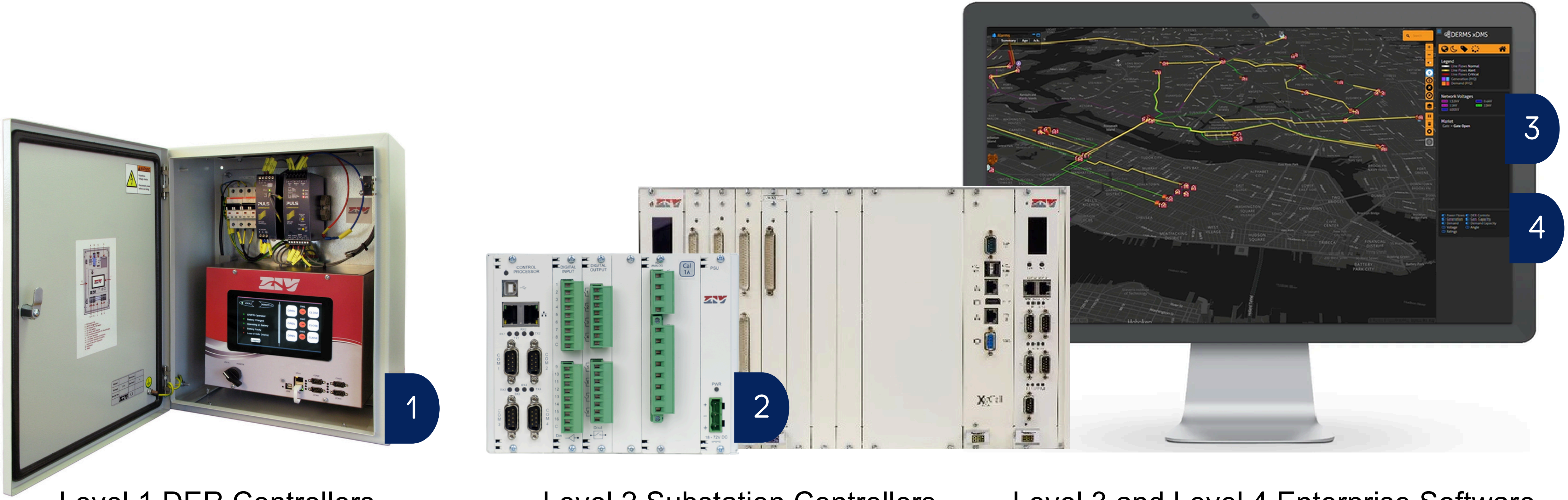
Applications

- Optimize the operation of the HV/MV & LV networks
- Automate the management of DERs such as generation and demand
- Protect the networks using constraint management
- Provide Forecasting/Prediction services
- Enable micro-grid/Islanding automation
- Integrate Energy Markets
- Aggregate Services
- LV automation to mitigate the impact of EV + heatpumps + ...

System Architecture

ZIV HW, SW, modules + engineering services for Levels 1,2,3 & 4

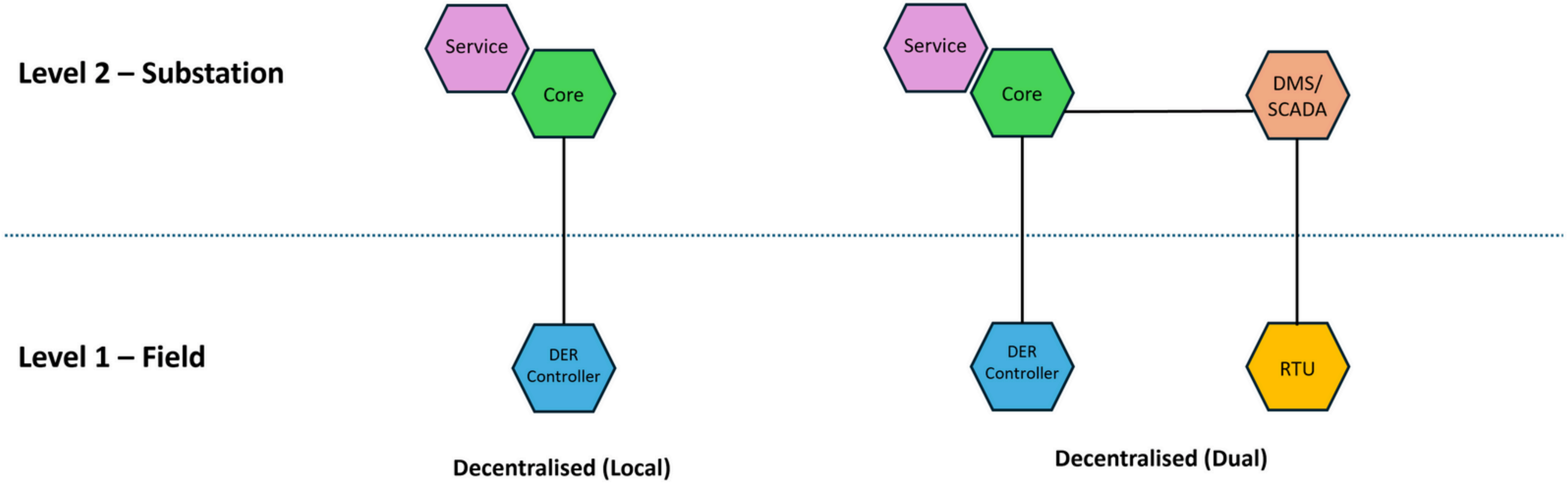
It is a full solution platform offering robust field hardware, substation and enterprise level software and complete design and integration services. It covers:



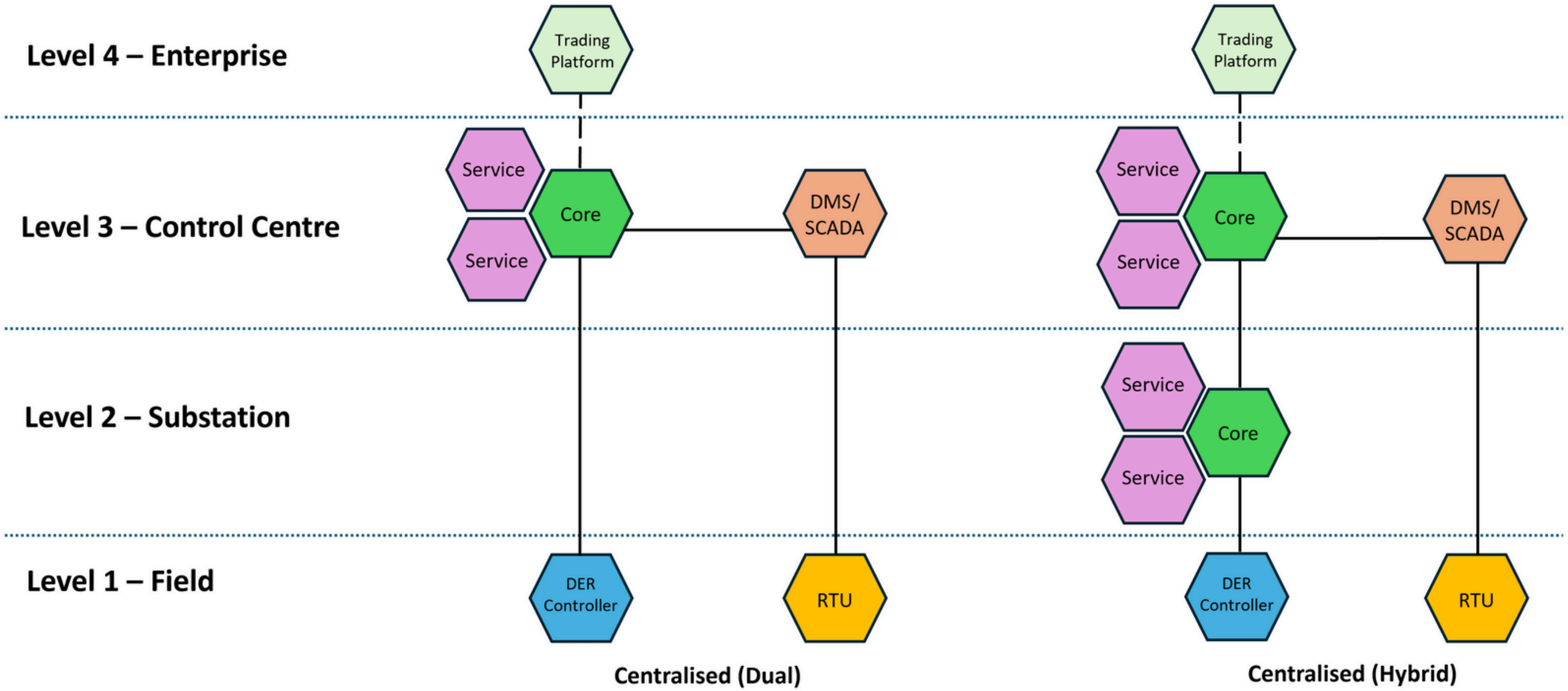
- Level 1 DER Controllers.
- Level 2 Substation Controllers.
- Level 3 and Level 4 Enterprise Software.

#Scalable #Hybrid

A **DECENTRALISED architecture** is useful for small projects
where the automation platform is deployed ***at the level 2*** substation controller.



A **CENTRALISED architecture** can handle l**arge quantities of data** and **multiple complex applications**.
It is deployed centrally at the ***level 3*** data centre in server-based hardware, and optionally at level 2.



Real Time Analysis
NOVA Engine

What is a microservice?

A microservice is a software term to define an architectural style where a product is a **collection of services that are independently deployable** and loosely coupled, enabling the delivery of large complex projects rapidly and reliably.

Each microservice has its own engine.

Any module running on a project is an individual service that has its own engine, where development and deployment is carried out independently to not interfere with any other applications.

It **continuously analyses the current network state and alternative N-1 states,** evaluating thermal and voltage ratings, network transients and fault levels to determine the optimal network operation.

The engine offers **complete visibility of the network**, so the automation control can manage the whole network effectively without any blind spots. This ties automation to the engine, from small constrain management to large enterprise systems.

This approach allows the ZIV Twin Grid to **scale efficiently and adapt quickly to changing requirements**. Each module can be updated or modified without affecting the entire system, ensuring seamless operation and enhancing the overall performance and resilience of the project. By embracing the microservices architecture, ZIV Twin Grid can stay agile, innovative, and responsive in the ever-evolving landscape of software development.

Adds ON

Realtime Loadflow Analysis

The Load Flow Component of the Nova Engine performs a set of calculations using a model of the power system network and power flow data both obtained from the ANM FEP. The network model and the power flow data may represent historical, forecast, simulated or real-time data depending on how the Nova Engine is being used.

Fault Level Analysis / Transient Analysis

Real time calculation of system fault levels allows the management of circuit breaker operations. Integration with available DERs enables a system where DERs can be tripped, and breakers can be managed in order to reduce excessively high or low fault levels if required.

Rating Analysis and Contingency Analysis

In order to ensure that the system is capable of delivery of the required services at all times this module uses contingency analysis to establish that the power flows and voltages remain within acceptable limits under defined abnormal or N-1 running arrangements

Thermal and Voltage Violation Detection

The Violation Checking and Generator Curtailment module involves running the power flow analysis and identifying all the thermal and voltage constraints in the network. Several settings are available to allow users to define the thermal and voltage limits for components on an individual and system wide basis..

USE CASES

VPP Ireland

Small rural distribution network with a high degree of DER penetration. IRELAND

PowerPotential - Energy Market UK

Large distribution network. The system includes an interactive energy market where flexibility services (Active Power and Reactive Power) can be procured as part of an energy market for balancing services.

First Realtime Loadflow in UK.
Largest ANM System in Europe

Mongolia - Transmission ANM

This project demonstrates a single application system providing thermal and voltage constraint management over a wide geographic area.

Model based L2 ANM, UK

L2 ANM system that manages all constraints, Seasonal Ratings, Shared Ratings and Reverse Power Flow. The system dynamically adapts to actual network topology and in response to thermal constraints setpoints are issued to DERs based on Merit Stack.

5

New connections, UK

The ANM system provides utility with the ability to actively manage new generation connections to ensure the network will continue to operate within its operational limit.

6

Four generation sites management from a substation. UK

This Generation Management System is implemented at a GSP Substation and was required to manage thermal constraints on cables and transformers, voltage constraints and export constraints. The system managed 4 generation sites

7

Hybrid arquitecture, Isles case

This is a thermal constraint management system that is deployed as a hybrid architecture. The Level 2 controller is deployed on the island and is connected to the centralised system on the mainland.

ZIV TWIN GRID
Shetland – Thermal Constraint Management USE CASE

Customer: **SSEN** (Scottish and Southern Electricity Networks)

ZIV TWIN GRID platform plays a vital role in the Shetland Islands, where over **100 islands** rely on local power generation.

Fast of connection of new power plants to the grid

Savings in grid reinforcement

Avoid revenue lost annually on account of improper monitoring and control of load flow

- Generators - 64
- Busbars - 149
- Circuits - 141
- Circuit Breakers - 129
- Transformers - 29

ZIV TWIN GRID
Mongolia DERM - United Green USE CASE

Customer:

Executed in collaboration with UB Grid Consultancy Ltd and Monhorus LLC, showcases the **effectiveness of smart grid techniques in the challenging context of Mongolia's harsh climate.**

- Solar Power Plant Capacity: 30MW
- Energy Production: 57,000MWh
- Households Served: 27,000
- Carbon Reduction: 45,000t annually

Making the Smart Grid Real

FAQS

What is the difference between ZIV Twin Grid and SCADA?

ZIV Twin Grid is an automation platform. It is software that lays on top of the existing SCADA monitoring and control infrastructure. The Twin Grid system takes real time readings of SCADA signals and combines it with a model of the power system network.

Calculations can then be performed on the full system model to identify constraints, and setpoints are sent to the assets in real time to increase or reduce generation to resolve those constraints.

The ability to combine real time data with a physical system model is the principal enabling technology which facilitates a wide range of services such as ANM, aggregation, predicted or future asset analysis and scheduling, and energy market based services.

What are the differences between L1, L2, L3 and L4?

These levels correspond to the SGAM (Smart Grid Architecture Model) zones that represent hierarchical levels of power system management.

- Level 1 corresponds to the field level, where a L1 Controller (provided by ZIV) is situated at the intake substation for a DER (wind farm or solar plant) that interfaces between the ANM system and the DER, for example by sending calculated setpoints from the ANM to the DER.

- Level 2 is the substation level, where a L2 controller is located in a primary substation and communicates with the L1 controller. In small scale systems, this can correspond to a decentralised ANM system that automates a smaller part of the network, but it is limited to load flow calculation and simple constraint management. In larger systems, the L2 controller receives all information from the substation and communicates with the L3.

- Level 3 is the operations level, where the software cluster is deployed at the control/data centre. All medium to large projects require a L3, which has the capabilities to run a complete list of applications.

- Level 4 is the enterprise level. This is where the energy trading platform sits in, allowing DER owners to place bids and system operators to buy energy and flexibility.

What are the main differences between decentralised and centralised systems? What advantages do each one of them have?

In a decentralised system, applications run on the hardware located in the level 2 architecture, such as an RTU at a substation. Decentralised systems are useful for small projects running simple ANM and constraint management.

A centralised system is deployed at a level 3 data centre in server-based hardware, where multiple schemes can be managed centrally. These systems are able to handle larger quantities of data and can include any application, especially useful if complex user interfaces are required.

What is a microservice?

A microservice is a software term to define an architectural style where a product is a collection of services that are independently deployable and loosely coupled, enabling the delivery of large complex projects rapidly and reliably.

For ZIV Twin Grid, this means that any module running on a project is an individual service that has its own engine, where development and deployment is carried out independently to not interfere with any other applications.

This approach allows the ZIV Twin Grid to scale efficiently and adapt quickly to changing requirements. Each module can be updated or modified without affecting the entire system, ensuring seamless operation and enhancing the overall performance and resilience of the project. By embracing the microservices architecture, ZIV Twin Grid can stay agile, innovative, and responsive in the ever-evolving landscape of software development.

What impact do heat pumps and LV loads have on LV ANM?

In a low voltage ANM system, these small-scale assets can be monitored for various reasons such as increasing or reducing their demand to resolve constraints in their local networks or be scheduled to recharge when energy cost is at its lowest price. Smart metering is usually required to integrate these assets to a market system, typically done by an aggregator due to the large number of services.

What are aggregate services?

TAggregators are independent intermediaries that coordinate and aggregate generation and demand responses from local consumers and enable their participation in energy markets. Our platform provides services to allow communication between the individual asset owners, the aggregators, and the energy market operators (although this feature is currently under development).

Where is the network model obtained from? How do we ensure that the data is mapped correctly?

For simple ANM schemes (Class 1 and Class 2 systems) there is no need for a detailed network model. A simple topological diagram is sufficient to create the network model. Large systems (Class 3, Class 4, and other complex services) do require a more accurate and representative power system model.

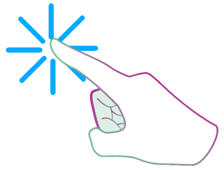
Typically, the client’s planning team provide these network models in PSSE, DigSilent, or another format. They are then converted into the appropriate format for the ZIV database, and the SCADA signals are mapped onto this model. Data quality checks are performed to ensure that the built model accurately represents the client’s network.

Next step

Let`s spend 10 min together to identify your key issues and the best demo

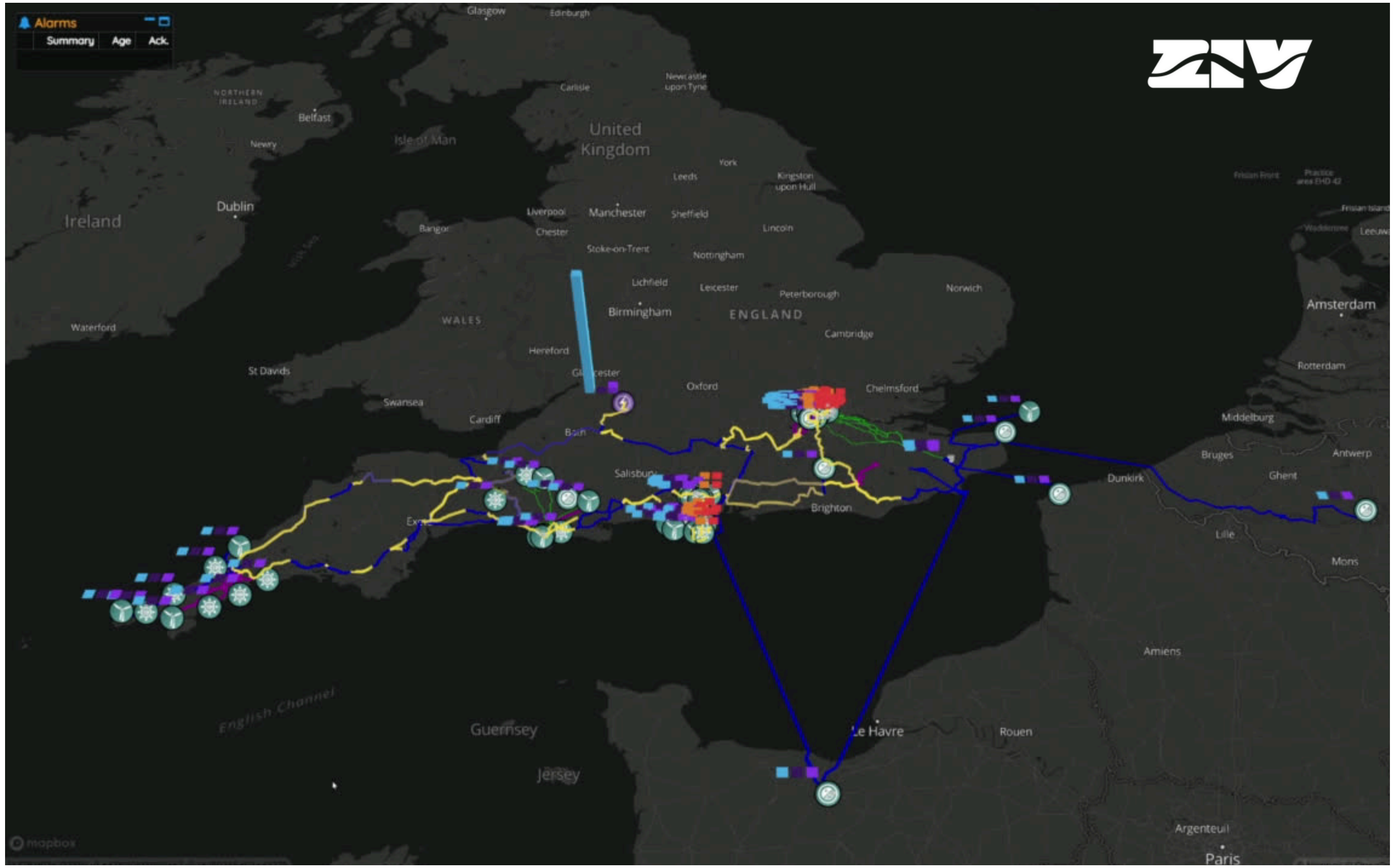
- A. WHOLE SYSTEM
- B. RURAL GSP
- C. LV AUTOMATION
- D. TRADE

E. ...



Identify your Issues → Request a specific DEMO → SAND BOX

ZIV TWIN GRID
Whole System approach demo



- Overview of scalable and modular architecture, all the way from transmission ANM to LV ANM
- Multiple application modules run in parallel in different network areas
- Overview of real time analysis engine with load flow fundamentals

ZIV TWIN GRID
Rural GSP application demo

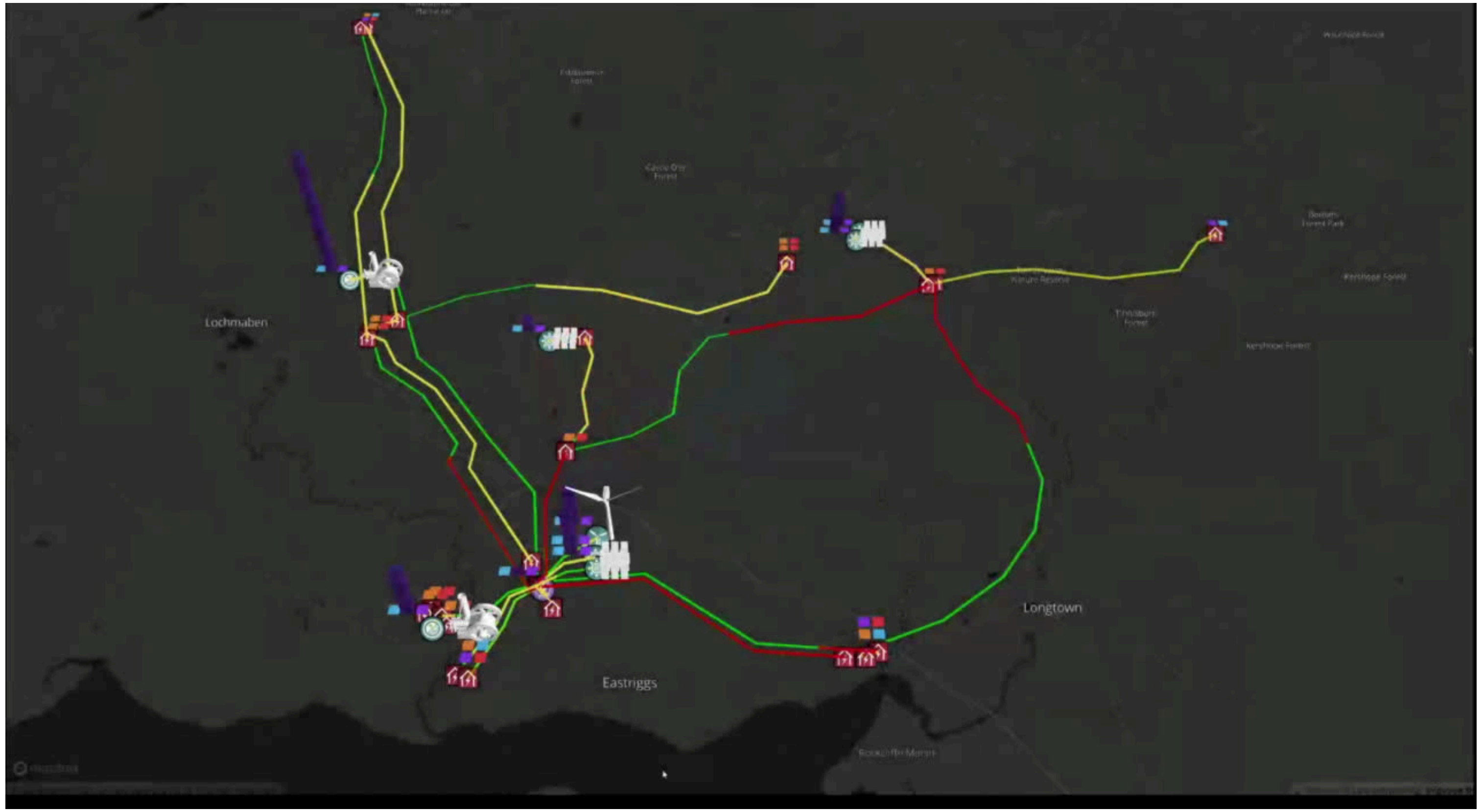
This project demonstrates a small rural distribution network with high penetration of renewable energy such as solar and wind farms and battery systems.

These ANM schemes are placed in network areas where there are constraints caused by high energy penetration, large demands, thermal ratings of lines or transformers, instability, etc. and helps the network operator to have full visibility of the network area with automated control.

The software, deployed at the control centre, receives real time inputs of the network state, and calculates setpoints to resolve any constraints, applied at the generators with local control hardware.

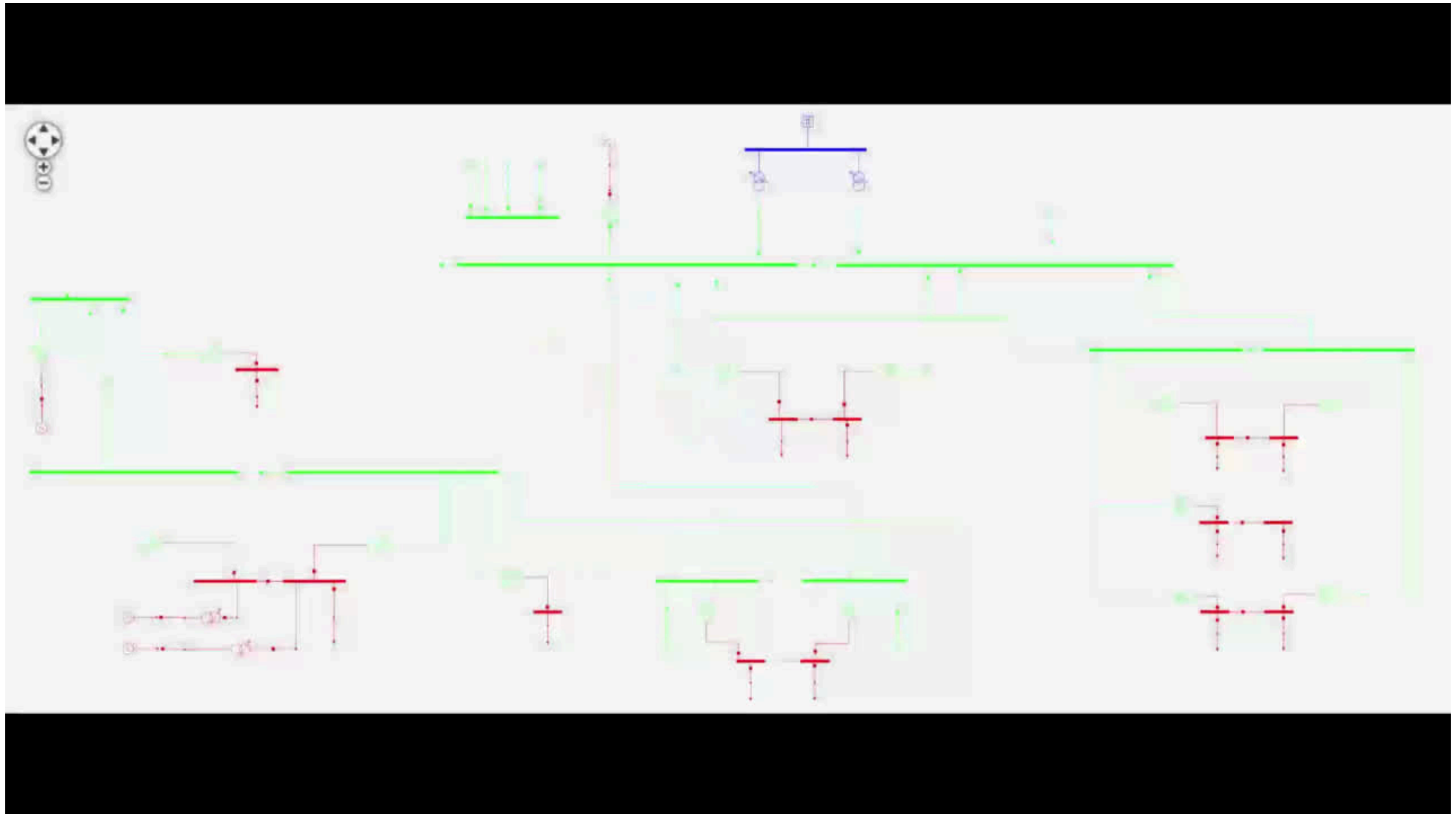
Depending on the size of the project and the quality of available data, a scheme can go from simple constraint management to voltage management, fault level and transient analysis, and prediction mechanisms to support energy markets and project planning.

Introduction



This project demonstrates a small rural distribution network with high penetration of renewable energy such as solar and wind farms and battery systems.

Network Model and Load Flow



A project requires a static network model and dynamic monitoring data for the software engine to analyse the network through load flow conversions every 5 seconds.

Network Model and Load Flow

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An automation scheme requires static data of the network area to model it into a single line diagram.

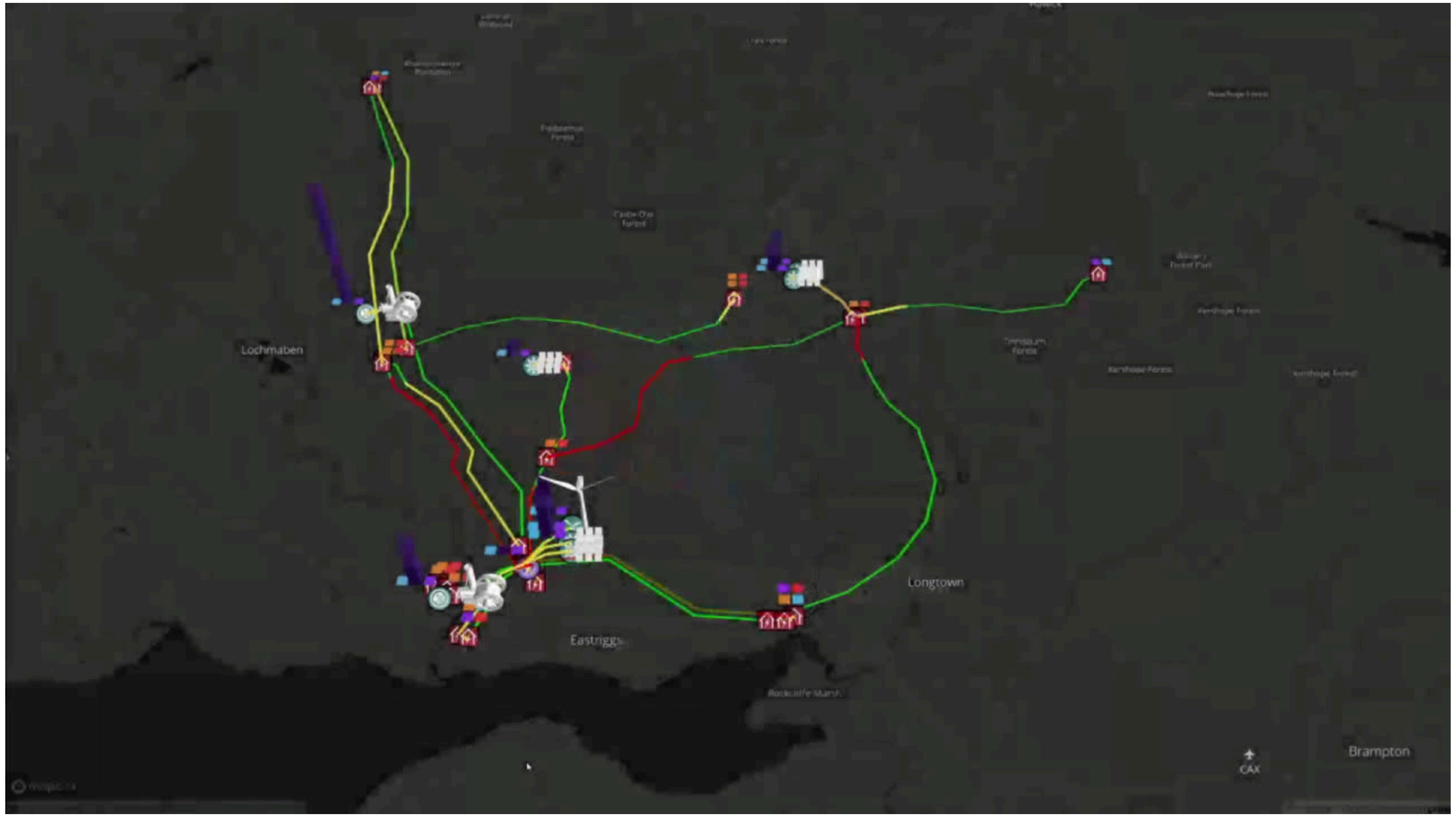
The grid infeed represents the connection to the high voltage transmission network.

The generators (or distributed energy resources - DERs) export active and reactive power into the network, causing forward powerflow.

The demands import active and reactive power, resulting in reverse power flows in the network. Due to these different flows, circuits in the network may have forward and reverse ratings.

ZIV Twin Grid also needs dynamic data to run the algorithm. The platform lays on top of the SCADA system, taking readings in real time of the network topology and power flows via remote terminal units at substations, which are fed into the analysis engine to produce load flow conversion and view constraint points. The algorithm calculates setpoints based on a priority stack to resolve these constraints. The engine runs approximately every 5 seconds, reviewing the state of the network and rearranging setpoints as needed to solve issues as quick and optimally as possible.

Generator Controls



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Many different types of generators can be modelled into these projects: solar and wind farms, tidal and wave generators, industrial and commercial power plants, domestic or community loads, etc. These are controlled with L1 local access controller (LAC) hardware.

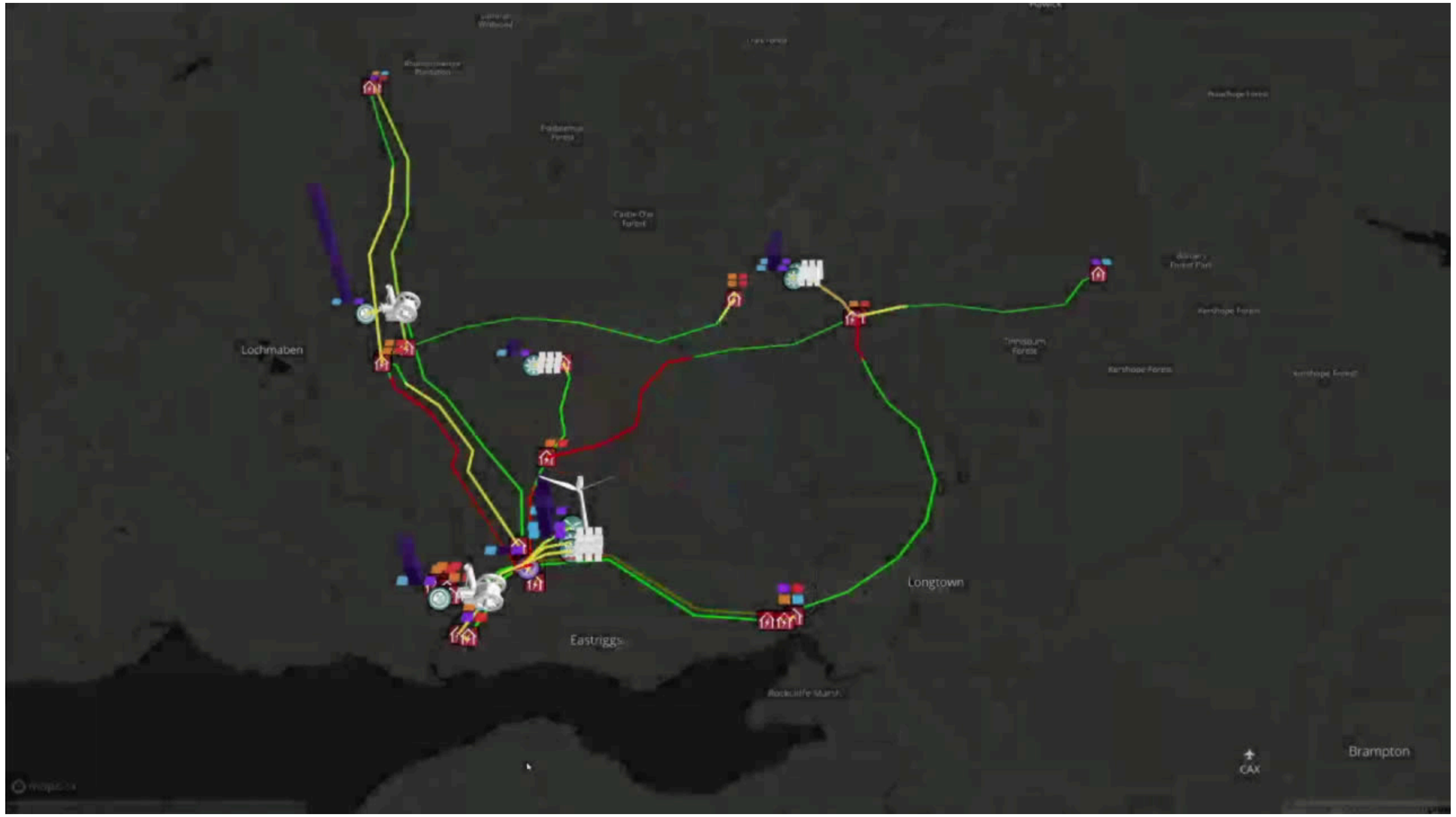
Any controlled DER will have a technical details dashboard where the owner can input the general details for the DER: name, location, generation type, MPAN numbers, etc.

The active power details contain MW ratings, ramp rates (rate of increase or decrease of power export in time), and the reactive power details show the voltage control mode of the generator, leading and lagging exports, power factor, etc.

The active (MW) and reactive (MVAr) power ratings can be represented by a PQ envelope. The power output of a generator will always fall within its PQ envelope, and they will look different depending on the energy source type and generator capabilities. Whenever a DER losses communication with the software, it will enter a comms fail mode and several timers and failsafe setpoints can be set for the DER to enter and exit this mode safely. A DER can also be set into local mode for maintenance reasons, or in SCADA mode if needed to be controlled by a SCADA panel/engineer.

A DER will be under automatic control in ANM mode, where the algorithm will send a setpoint depending on their position in a merit stack.

Constraint Management



The analysis engine observes the state of the network, identifies constraints, and the algorithm calculates setpoints to control the DERs to resolve issues in real time.

Constraint Management

The analysis engine observes the state of the network, identifies constraints, and the algorithm calculates setpoints to control the DERs to resolve issues in real time.

Any scheme can be accompanied by several user interface dashboards for user input and visual data output. This one shows an overview of the ANM system, listing all ANM controlled DERs in the network, their active and reactive output, ANM setpoints, and we can see they are all enabled to be controlled by ANM and inside the merit stack.

A simple topology change in a network – for example a circuit breaker going from closed to open due to maintenance – can lead to constraints due to the flow of power in a line being higher than its line MVA rating. These real time details are sent from the supervisory control at the substation (SCADA system) to the software at the control centre.

Once the constraint is identified, the algorithm will calculate the optimal way to resolve the constraint by curtailing the generation based on the merit stack, and send MW/MVAr setpoints to the DERs in the network to curtail the output power to resolve the constraint.

The dashboard displays the generators' active power as they curtail across time. Initially they will all reduce their output to clear the constraint, but they will be rearranged to export based on their merit stack position and ramp rates. The dashboard can also show timeseries for reactive power, power flows, or voltages.

ZIV TWIN GRID
LV SUPERVISION & AUTOMATION DEMO

- *How are you managing the addition of local decentralised generation?*
- *How are you integrating energy aggregators with the larger distribution system?*
- *Do your clients have EV, heat pumps, and other LV assets that can use some visibility?*

•Standard ANM (Optimise solution) in a low voltage network with localised generation

•Local DER and Aggregator integration

• Thermal Constraint Manager at low voltages

ZIV TWIN GRID
ENERGY MARKET DEMO

•*Would you like to forecast congestion issues in your network?*

•*Would you like to be able to forecast asset curtailment to prevent revenue losses?*

•*What tools do you have to plan and create market schedules?*

•*How are you planning on accommodating flexibility trading?*

•*Would you like to have a platform to facilitate energy trades between network operators and asset owners?*

Energy market placed in the South of England, with multiple networks with ANM schemes. The system operators enable the energy trade between Network Operators and asset owners. This demo covers Control, Optimise, Predict and Trade, as multiple networks under ANM schemes trade energy based on predictions.

•Integrate of demand and generation prediction, and congestion forecasting

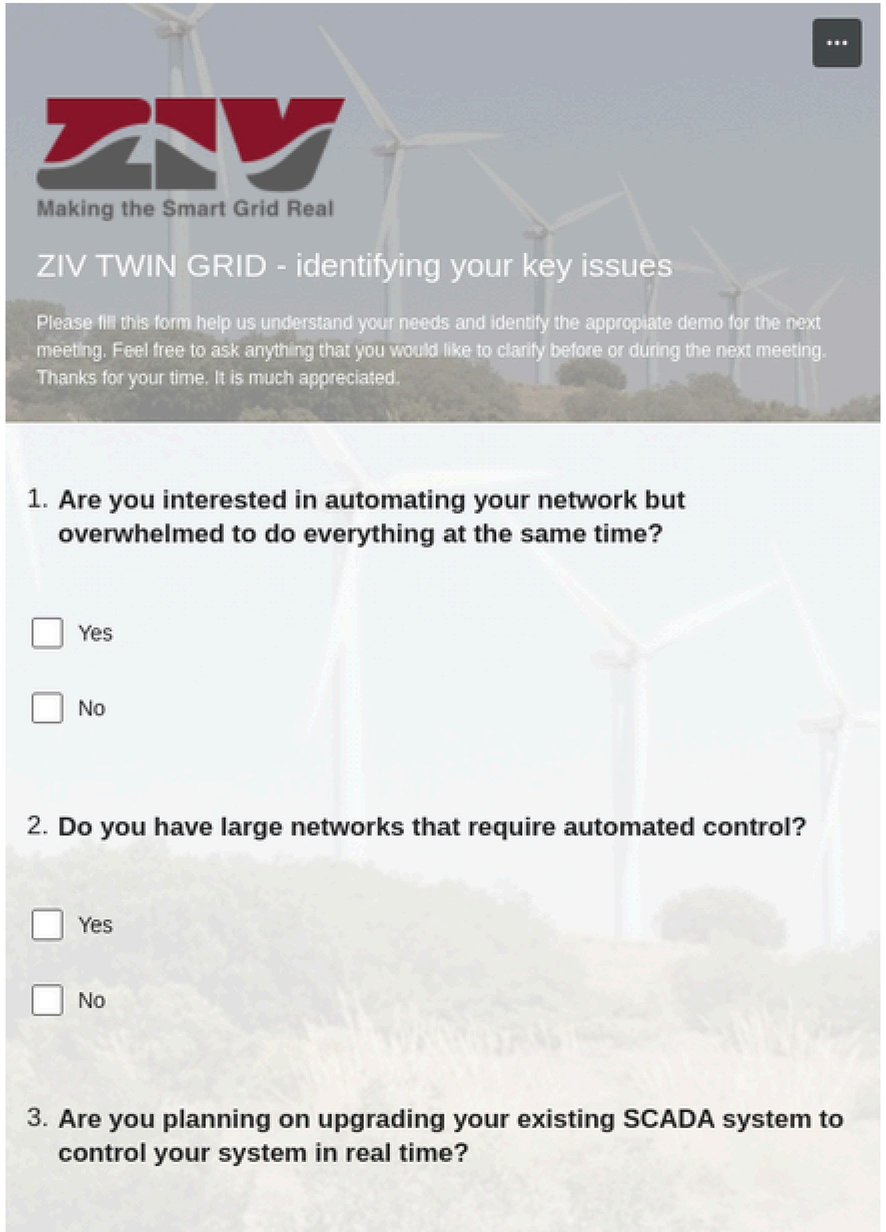
•Interface with different market participants

•Facilitate energy trading

ZIV TWING GRID - TRADE image

Making the Smart Grid Real

YOUR PARTICULAR ISSUES



Making the Smart Grid Real

ZIV TWIN GRID - identifying your key issues

Please fill this form help us understand your needs and identify the appropiate demo for the next meeting. Feel free to ask anything that you would like to clarify before or during the next meeting. Thanks for your time. It is much appreciated.

1. **Are you interested in automating your network but overwhelmed to do everything at the same time?**

- [ ] Yes
- [ ] No

2. **Do you have large networks that require automated control?**

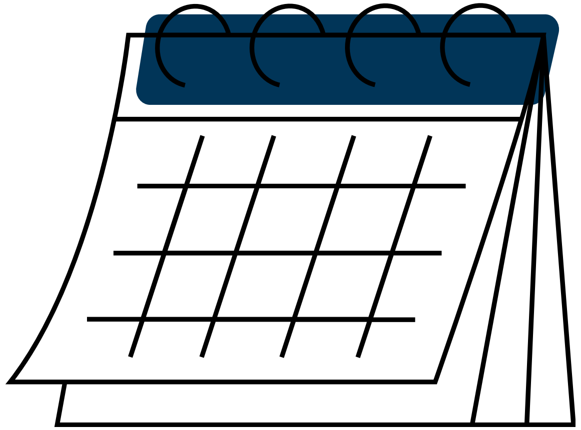
- [ ] Yes
- [ ] No

3. **Are you planning on upgrading your existing SCADA system to control your system in real time?**

ISSUES

- A. WHOLE SYSTEM
- B. RURAL GSP
- C. LV AUTOMATION
- D. TRADE

E. ...



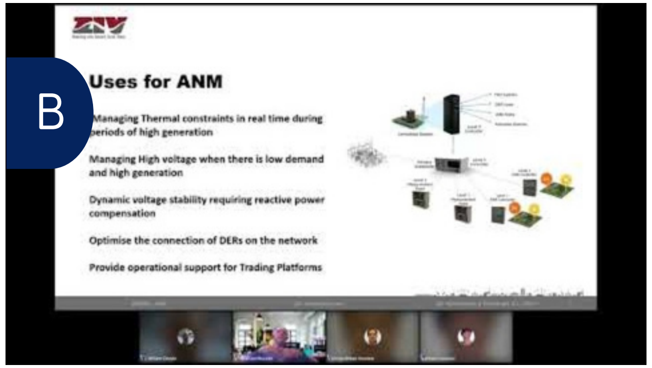
questions
next meeting

System Overview

How does the system work? Outputs. Architecture. How to Implement an ANM system

How does the system work?

[2’ system architecture & functionality]



System Benefits

[22’ ANM Webinar recording]

Does National Grid use
Active Network Management (ANM)?

https://www.nationalgrid.co.uk/our-network/active-network-management-anm

Making the Smart Grid Real

Utility Week
LIVE
2024

21-22 MAY | HALL 12
NEC BIRMINGHAM

SCAN ME / SCAN ME / SCAN ME / SCAN ME / SCAN ME / SCAN ME /

Contact us now for further information
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