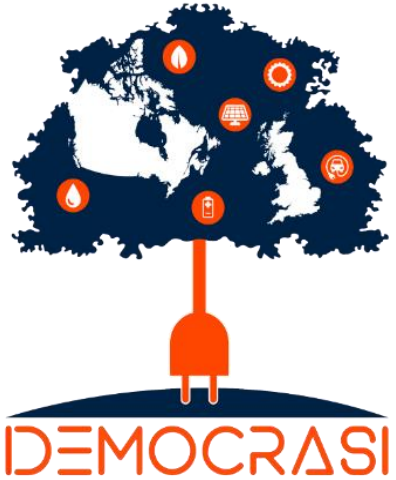
Maximising value from Distributed Energy Resources in GB



14.00-15.15 GMT
9 September 2021

Agenda

14.00 **Welcome**
Olly Frankland, project manager, Regen

14.05 **Overview of the latest Smart Systems and Flexibility plan**
Russell Jenkins, Senior Policy Advisor, BEIS

14.20 **The DEMOCRASI project case study**
[Company introductions by senior representatives]
Peter Ewald, Project Technical Lead, Lakeland Holdings Ltd
Kushal Shah, Product Manager, Opus One Solutions
Mike Paul, Business Analyst, Kiwi Power

14.45 **Panel discussion**
Joshua Wong, Chief Executive Officer, Opus One Solutions
Vince Kulchycki, Chief Operating Officer, Lakeland Holdings Ltd
Thomas Jennings, Head of Optimisation, Kiwi Power
Stuart Fowler, Innovation Engineer, Western Power Distribution

15.15 **Close**

Housekeeping

- Chat – discussion board
- Q&A – for direct questions (uprate those you like)
- Polls
- Recording and slides will be sent out

Smart Systems and Flexibility Plan 2021

Joint BEIS and Ofgem publication

Department for
Business, Energy
& Industrial Strategy

What is a smart, flexible energy system?

We need much more **flexibility** in our electricity system**.** The ability to shift energy in time or location to balance supply and demand is essential for decarbonising power, buildings and transport.

To meet the UK's target to have net zero emissions by 2050, we will have to shift away from fossil fuels to use low carbon sources of energy. This means:

- **More intermittent or inflexible generation**, particularly from wind and solar

- **Increased electricity demand,** as we electrify transport and heat.

To overcome these challenges the system should match energy from the wind and sun to these new sources of demand and harness assets across the system, from large power stations to local-based solutions.

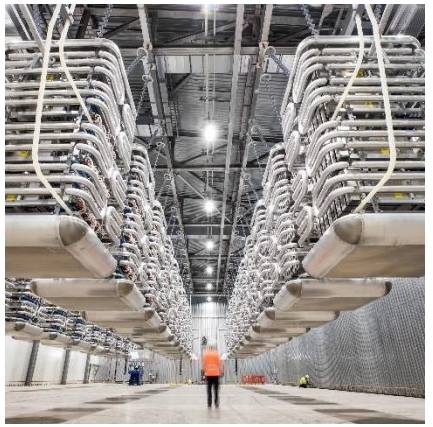
We need to use low carbon sources for flexibility. These low carbon sources will be used in a **smart** way – enabled by data and digitalisation.

It will be more affordable than a system with minimal flexibility, **giving consumers more control** over their bills, and more **security**. It will also create **jobs and exports** for the UK economy.

Electric batteries

Demand side response

Interconnection



Analysis: Low carbon flexibility is essential to meet net zero

We estimate that we will need around **30GW of low carbon flexible assets by 2030, which represents a three-fold increase on today's levels.**

By 2050, in our modelled scenarios, **around 30GW of combined short-term storage and flexible demand (DSR), and 27GW of interconnection could** .

- save up to **£10 billion per year by 2050** at 5g/kWh (high demand, no hydrogen scenario). by reducing the amount of generation and network needed to decarbonise
- reduce system costs between **£30-70bn from 2020 to 2050**.
- create up to **24,000 jobs**.

We assume around 15GW of storage (60GWh of storage capacity) and 15GW of DSR (but these are largely substitutable). We have **not explicitly modelled longer-duration storage**, or the role that flexibility could play in managing local network constraints. If these aspects were considered, it is likely that **additional flexibility** could lead to lower system costs.

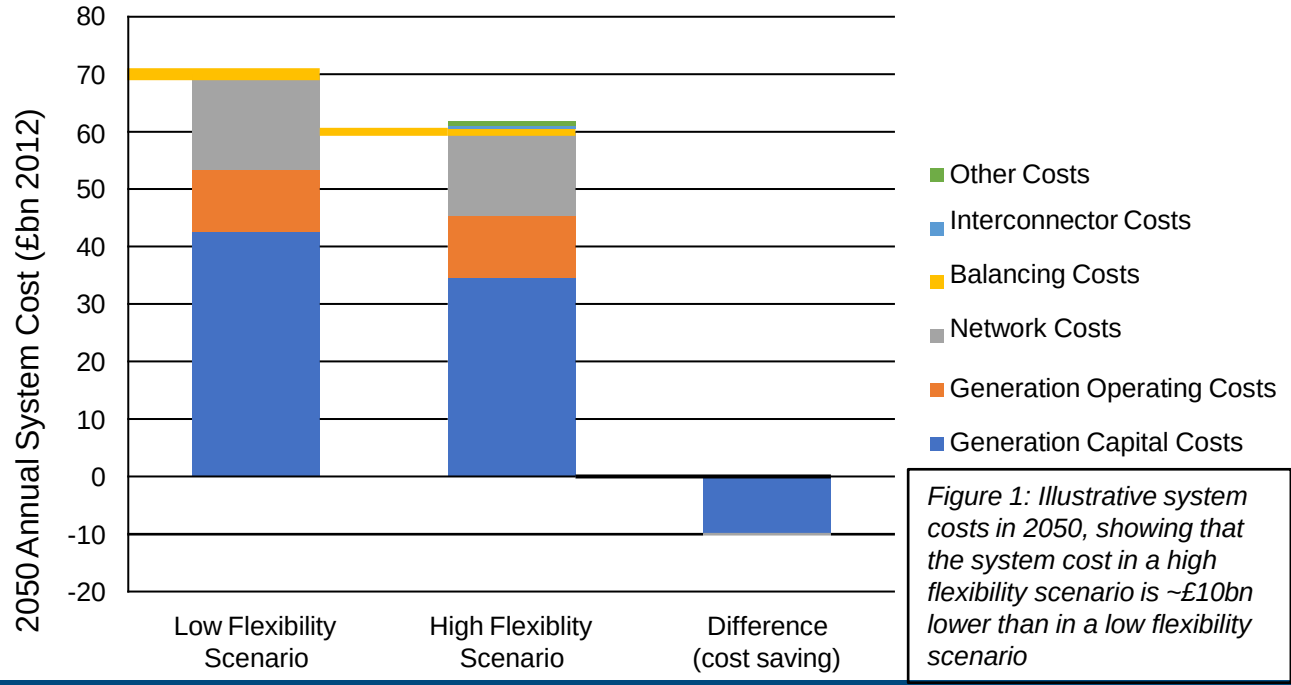


Figure 1: Illustrative system costs in 2050, showing that the system cost in a high flexibility scenario is ~£10bn lower than in a low flexibility scenario

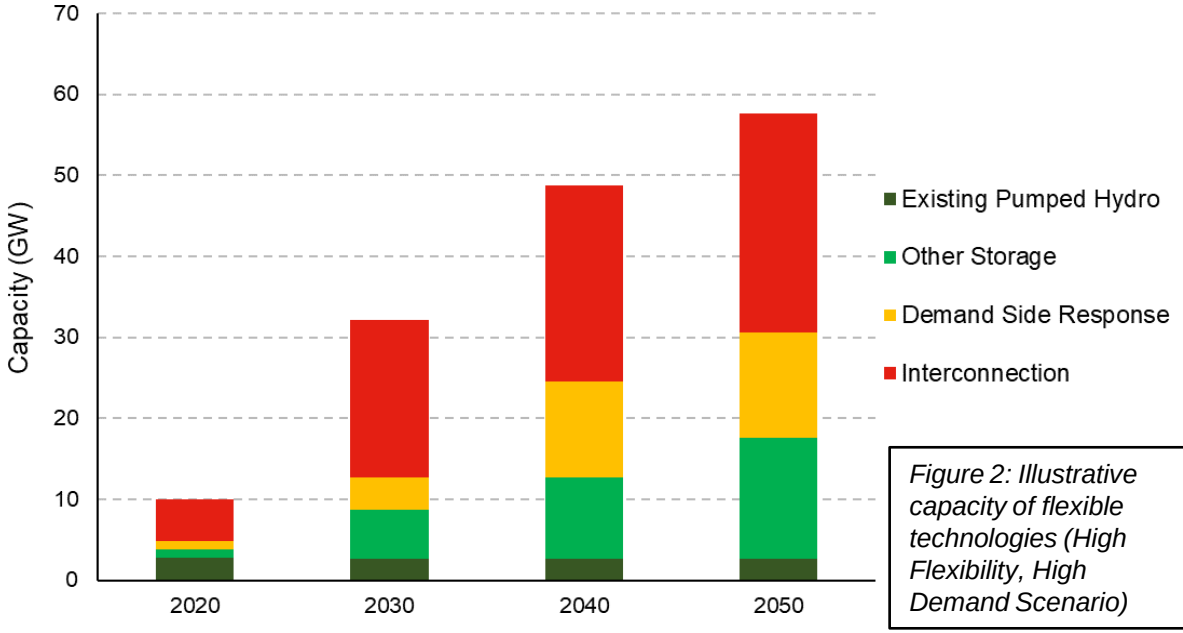


Figure 2: Illustrative capacity of flexible technologies (High Flexibility, High Demand Scenario)

Department for Business, Energy & Industrial Strategy

We need to.... 1) facilitate flexibility from consumers

VISION

Demand side response	Smart buildings	Electric vehicles
By the mid-2020s consumers will be able to provide flexibility to the system. Consumers will have access to interoperable secure smart devices. Consumers are protected and business models incentivised.	By the mid-2020s smart technologies will be incorporated across the government's energy efficiency, heat and fuel poverty policies.	By the mid-2020s drivers will choose to smart charge because it is convenient and economical. Vehicle-to-grid technology will be close to becoming a commercial reality for fleet operators

ACTIONS

- **Support the deployment and uptake of smart, digital technologies**
- **Develop the regulatory and technical environment for flexibility providers**
- **Embed a culture of cyber security**
- **Ensure right frameworks are in place to protect consumers**

- **Incorporate flexibility and smart technologies into energy efficiency and heat policies, including regulations, assessment methodologies, subsidy schemes and market mechanisms**

- **Develop a policy statement on maximising EV flexibility**
- **We will gather feedback on the potential value and challenges for vehicle-to-X in a call for evidence**
- **Continue to work with the Electric Vehicle Energy Taskforce**

2) ...enable deployment of all scales of storage and interconnection

VISION

Electricity storage

- All storage
- Large-scale, long-duration storage
- Domestic and small-scale storage

By the mid-2020s we will have created a best-in-class regulatory framework for storage at all scales. There will be a level playing field for domestic and small-scale storage. Customers will be confident in the benefits of and framework for installing storage in homes and businesses. First-of-a-kind longer duration storage technologies will be built.

Interconnectors

By the mid-2020s increased interconnector capacity will facilitate flexible access to cross-border markets across all timeframes. Any changes to the current arrangements for new interconnectors will have been implemented to ensure the full range of potential benefits and impacts have been captured. By 2030 operability frameworks will utilise the full potential of flexibility interconnectors can provide for the system, making it an essential part of the solution for an increasingly decarbonised flexible grid.

ACTIONS

- **Continue progress towards a best-in-class regulatory system –** including defining storage in primary legislation, considering charging treatment.
- **Facilitating the deployment of large-scale and long-duration storage –** including analysis on system need, call for evidence on barriers and interventions.
- **Removing barriers and distortions to domestic and small scale storage –** including future proofing health and safety framework, considering options for removing final consumption levies**.**
- **Increase interconnector capacity** – including multi-purpose interconnectors.
- **Enhance the role of interconnection as a flexibility asset internationally** via cross border market arrangements and management of interconnector flows **and domestically** via GB ancillary services and grid forming capability.
- **Ensure a consistent and scalable approach to interconnector operability** – ramping and methodology consistency.

3) ...design markets to fairly reward flexibility

VISION

Governance | **CFD and capacity market** | **Carbon** | **Price signals** | **National and local flex markets**

By the mid-2020s, greater utilisation of flexibility resources reduces curtailment of intermittent low-carbon generation. We will have incentivised more efficient and flexible network use.
A step-change improvement in DNO/ESO coordination will ensure balancing and constraint management services are optimised to maximise overall benefits to the system.
We will have stronger investment signals for flexibility in the Capacity Market (CM) and Contracts for Difference (CfD), and carbon reporting and monitoring will be business-as-usual in all markets.

ACTIONS

- **BEIS and Ofgem are now working together to address those issues through reforming the governance of the codes, published a consolation on the Future System Operator and Ofgem will undertake a review of electricity distribution system operation governance**
- **We need to reform markets so that flexibility is rewarded for the value it provides to the system.**
- **The government is building on the call for evidence on the future of renewable support schemes and aims to ensure that the full range of low-carbon technologies are valued.**
- **Initial steps to address the carbon intensity of flexibility markets including the development of a carbon monitoring framework**
- **The government will begin a strategic dialogue between consumers, industry and government on how to fairly allocate future costs as the UK transitions to net zero.**

4) ...drive digitalisation across the energy system, and

Energy Digitalisation Strategy

VISION

By the mid-2020s, we will ensure best practice is followed, regulatory frameworks are in place, and data is openly shared while privacy protected. New digital services will make it easier for people to know what data exists and how they can gain access to it.

These capabilities will underpin a secure decarbonised energy system, create market opportunities for information services, analytics, and insights, providing confidence to investors, supporting research and benefitting consumers from new products and services.

ACTIONS

- **Government Ofgem and Innovate UK will work in partnership to provide leadership and coordination by adopting and promoting a collaborative approach.**
- **We will ensure that the government's policies and Ofgem's regulatory expectations continue to incentivise the sector to deliver more and better-quality investment in data and digitalisation.**
- **We will work with industry to fund and develop innovative system-wide digital solutions and architecture.**

5) ...monitor flexibility to understand how the system is evolving

VISION

Monitoring Framework

Monitoring is an essential part of the policy cycle.

A framework will **track how markets and competition are developing**.

Monitoring can help us to **identify** both **where flexibility is successfully performing in markets** but also **where barriers still exist**.

ACTIONS

- **The government will work with stakeholders to develop the monitoring framework by identifying new indicators and data sources. We will gather stakeholder feedback and share an updated version of the monitoring indicators.**
- **We will decide the longer-term process for the monitoring framework, including which organisation should have responsibility for the strategy and how it should be shared with stakeholders.**

DEMOCRASI

Maximizing Value from DERs

Sept 9, 2021

Vince Kulchycki
Chief Operating Officer

Bracebridge Generation is the lead partner in the DEMOCRASI Project, and is one of the subsidiaries of Lakeland Holding Ltd., along with Lakeland Power and Lakeland Energy/Networks.

Bracebridge Generation maintains 9 Hydroelectric plants in Ontario and 1 in Quebec.

opus one solutions

Joshua Wong
Chief Executive Officer

Opus One Solutions is a software and solutions company with the vision of a digitalized, decentralized and decarbonized planet. Its intelligent energy network analysis platform, GridOS®, optimizes complex power flows to deliver operational time-frame energy management and integrated planning to distribution utilities and other managers of distributed energy resources. GridOS is modular, scalable, and integrates seamlessly with existing data systems to unlock greater potential for distributed energy resources, including renewable generation, energy storage, and responsive demand.

Brendan Wauters
Chief Executive Officer

Kiwi Power simplifies participating in power markets across the globe. Founded in the UK in 2009, we now operate globally, deploying our unique combination of technology and expertise to unlock distributed energy resource (DER) value and serve sustainable energy needs. The proprietary software Kiwicore™ connects power generation and storage assets to energy markets so distributed energy resource owners can participate and succeed in the new energy world. Our platform is active in over 10 countries, optimising and monetising over 1GW of DERs on behalf of our partners.

DEMOCRASI

Project Case Study

Agenda:

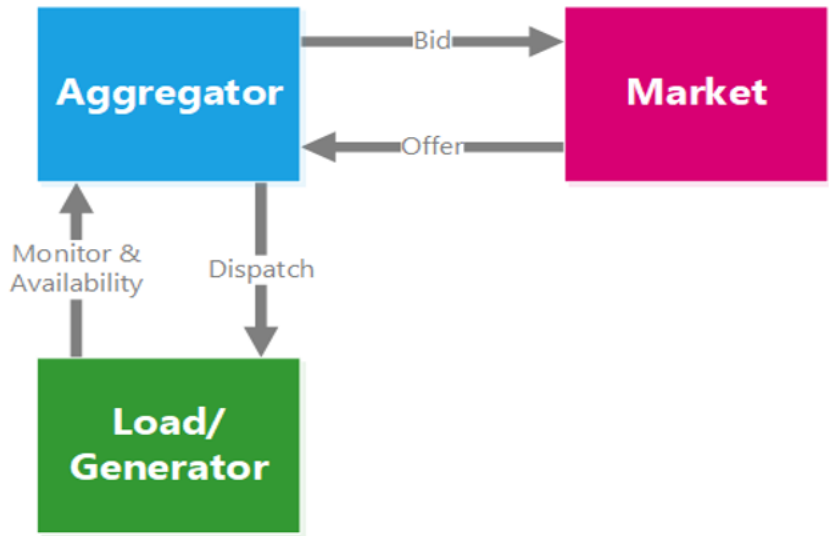
- Background
- Problem Statement
- Approach
- Outcomes
- Maximizing Value from DERs

Background

- DEMOCRASI: Dispatchable Energy Market Optimized Constraint Real-Time Aggregated System Interface.
- The Actors
  - Aggregator role
  - Customers (Domestic & Industrial)
  - Utility

Problem Statement

DER aggregators (flexible service providers) provide their services through the distribution network to the wholesale market at a cost to distribution network operator (DNO/LDC). This leads to **grid instability** and **asset degradation**, thereby increasing the need for **higher capital expenditures** borne by consumers.



Key Consideration

Modern grids should consider the local distribution network such that DER market activities do not degrade the state of the grid.

Solution Statement

- Providing visibility to LDCs (location, service type and asset dispatch schedules for bulk services driven by capacity and price)
- Empower LDC Optimization: minimizing local system constraints via dispatch of DER for bulk level services

Joint solution

The DEMOCRASI product solution formalizes the integration between the two software solutions, GridOS® and Kiwi Core™. GridOS® and Kiwi Core™ are software solutions built and owned by Opus one Solutions and Kiwi Power respectively.

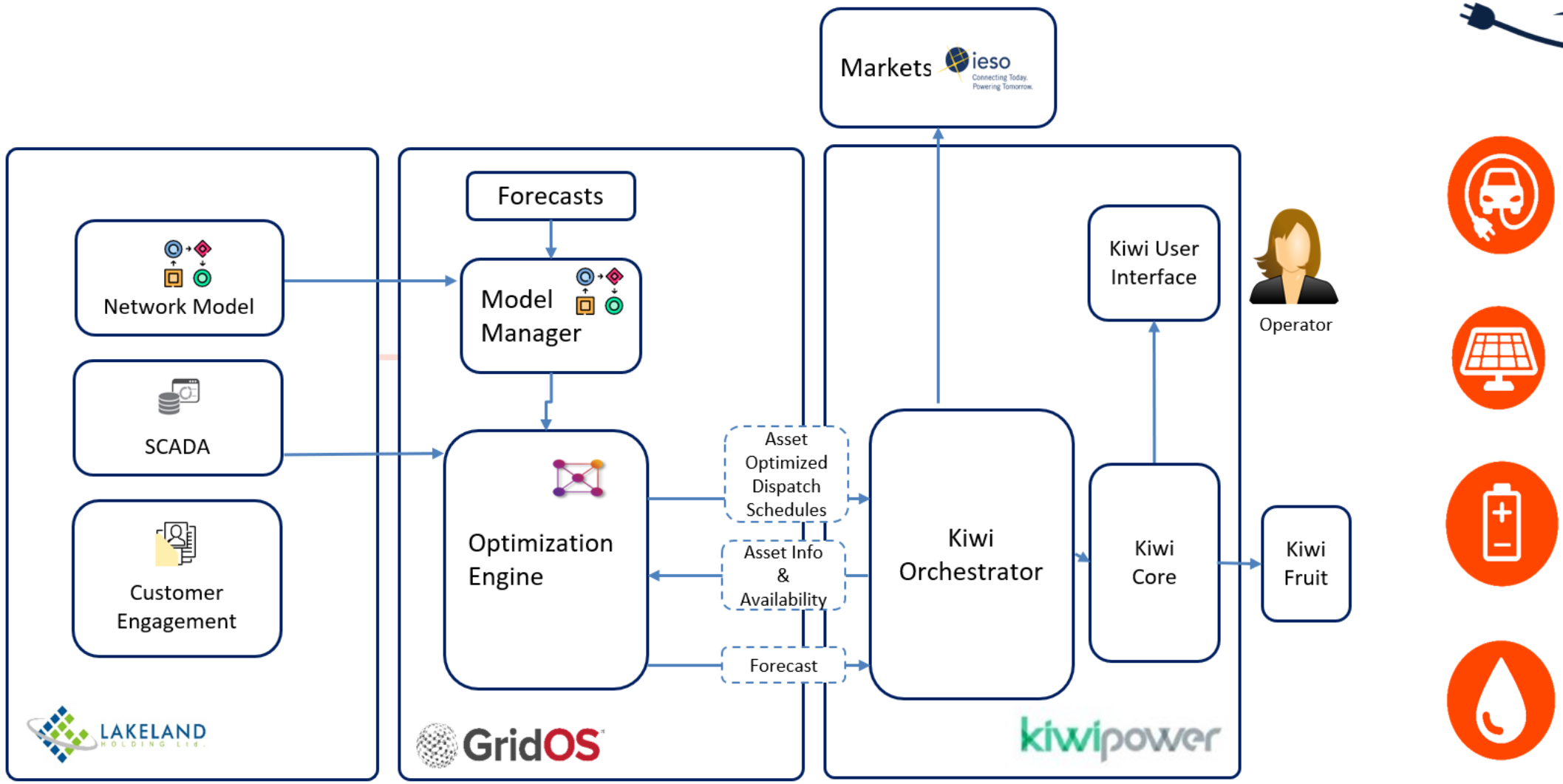
GridOS®

Provides the optimization functionality (example: *operating envelope optimization, bid fulfillment optimization, peak shaving)*. It performs three-phase unbalanced time-series optimization on distribution and sub-transmission networks.

Kiwi Core™

Provides the bulk system interaction, aggregator functionality and the under interface. It offers visibility and control of flexibility assets for effective participation in local and bulk markets.

Solution Architecture



The Project

Markets

- Wholesale Market Orchestration
  - Simulacrum
  - Business Rules
  - Process
  - Limitations
  - Settlements
- Local Flexibility Market
  - Co-optimization

Assets

- Existing Assets
  - DER and IoT
- New Industrial Assets
  - Municipal Owned Generators
- A variety of customers
  - Residential
  - Commercial
  - Industrial
- Network Model

Optimization

- Software Engineering for the Joint Solution
- Optimization Objectives – Wholesale market
  - Bid Update (operating envelope objective)
  - Bid Activation (bid fulfilment Objective
- Optimization Objectives- Local Flexibility
  - Peak Shaving Objective (Demand management)

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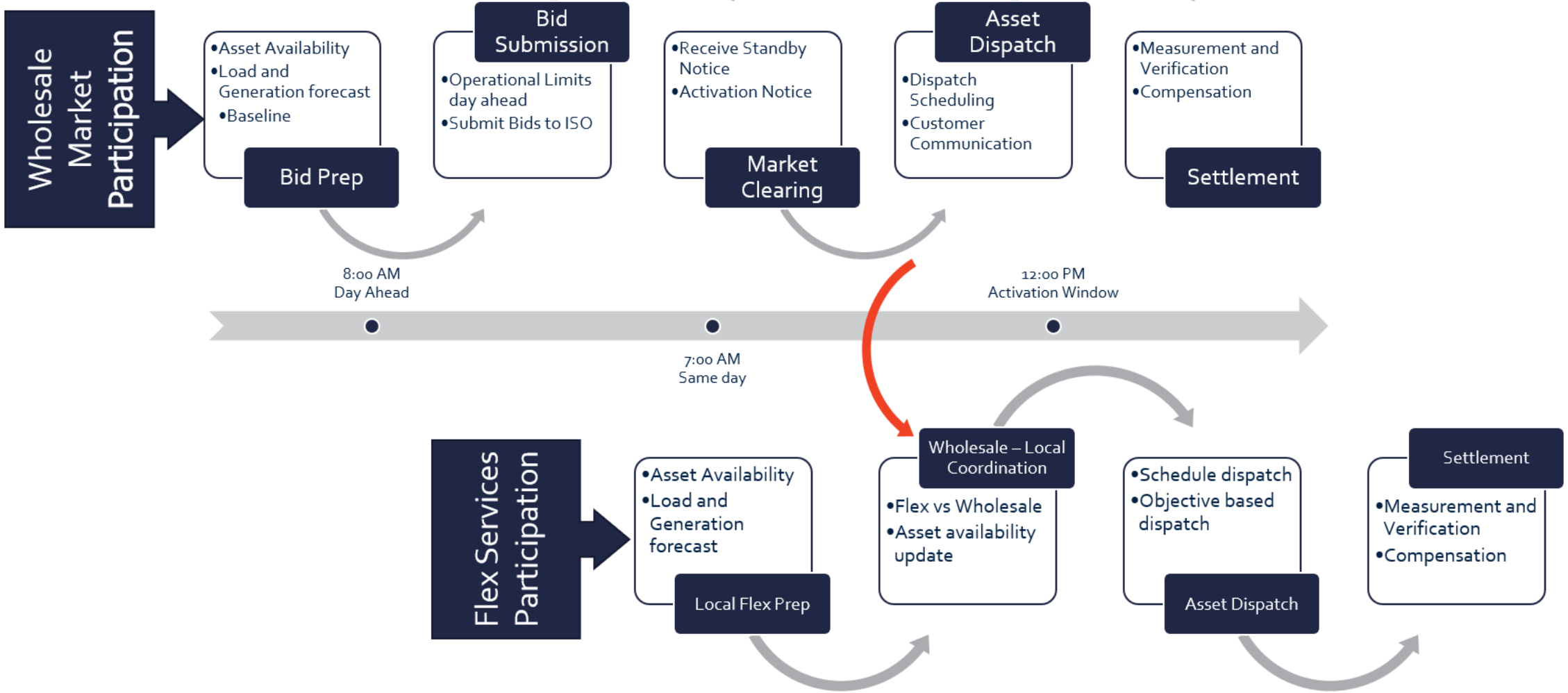
Wholesale Market and Local Flexibility Orchestration



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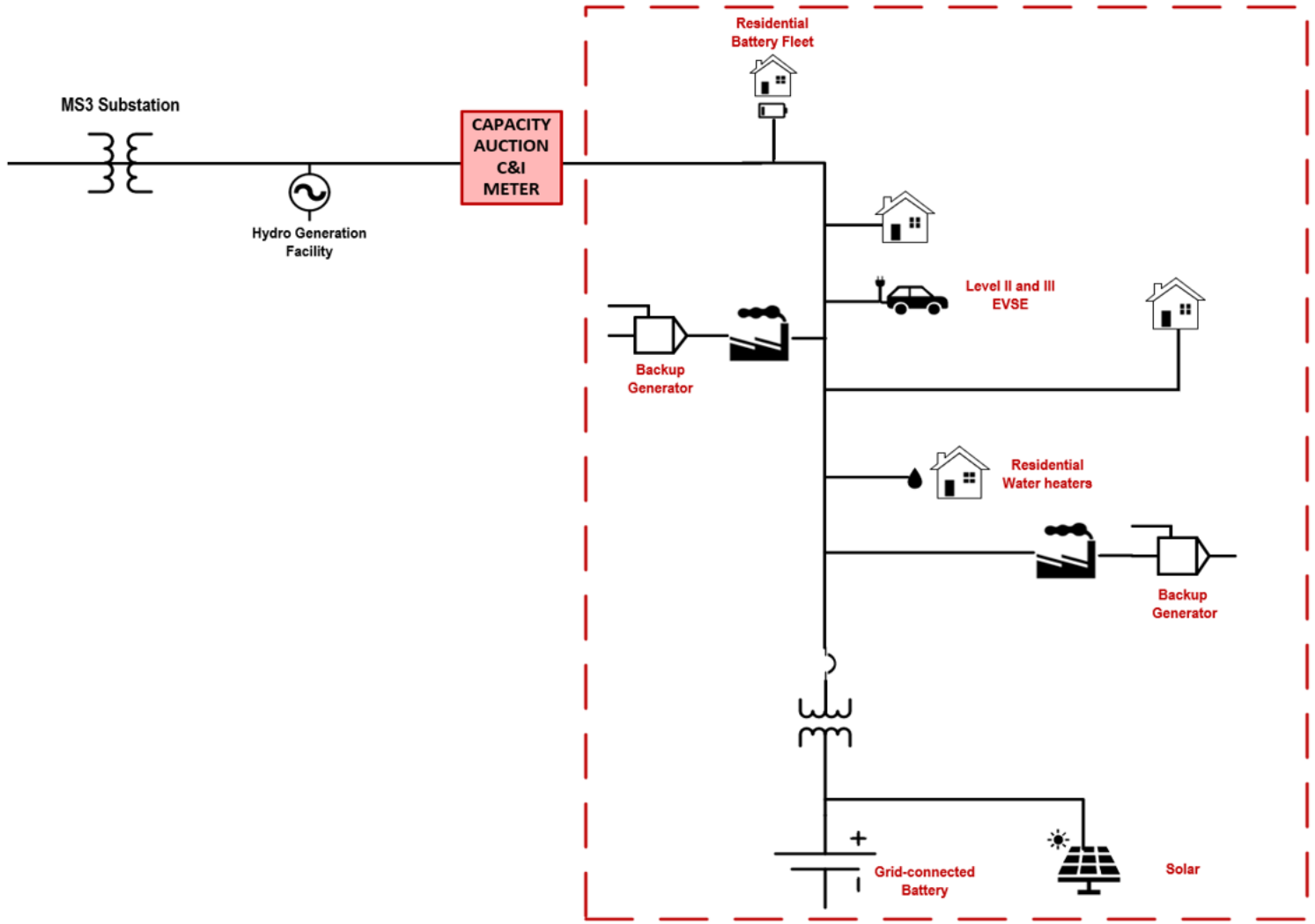
Canada

Simplified Network Model



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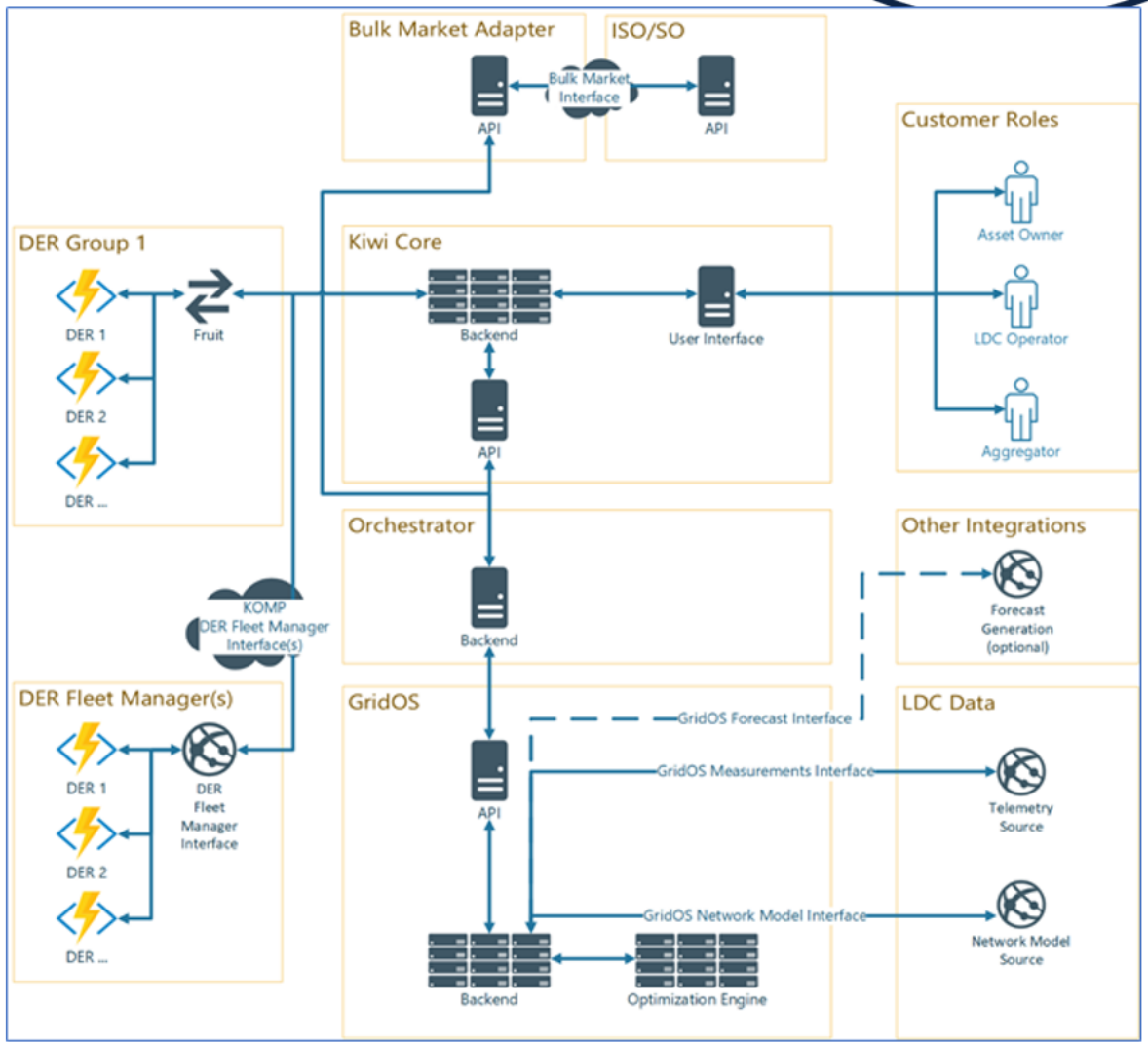
Software Engineering for Joint solution

Key Features

- Integrate with ISO
- Present user interface to Operator
- Dispatch and monitor DERs (Flexibility Resources)
- Optimization Objectives
  - Bid Update
  - Bid Activation
  - Peak Shaving
- Forecasting for Load and Generation
- Integrate with utility source systems

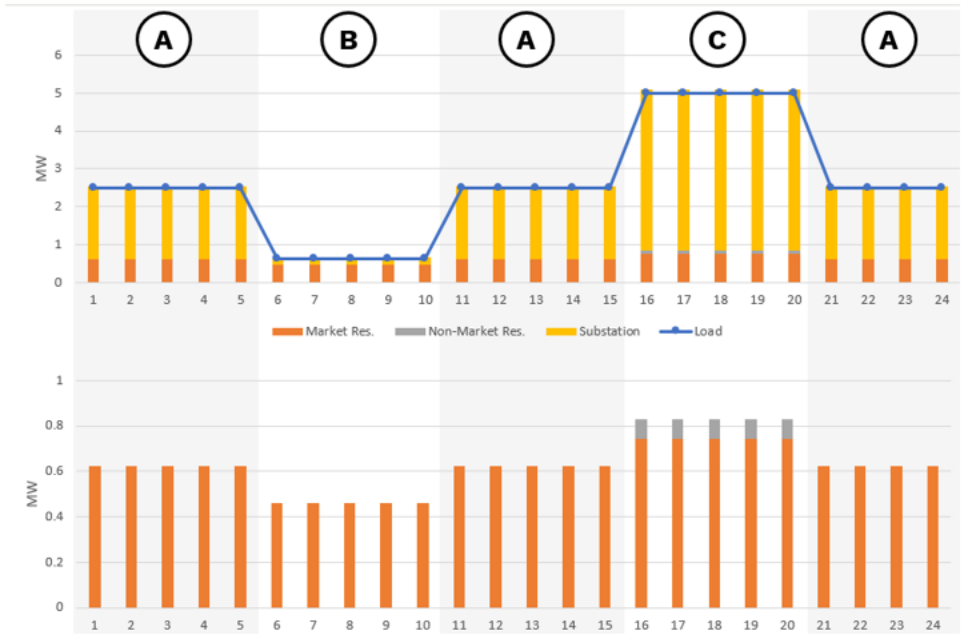


Optimization Objective – Bid Update (Operating Envelope)

- Operating Envelope are **Swim Lanes (min** and **Max** dispatch limit) for market resources that guide them to develop their bids for market participation without causing grid constraints
- Swim Lanes are determined by performing two optimizations:
  1. Determine the maximum export from the market resources at the substation
  2. Determine the maximum import to the market resources at the substation

Inputs:

- The Electrical Network Model
- The most recent load forecasts
- Market Participating Resources

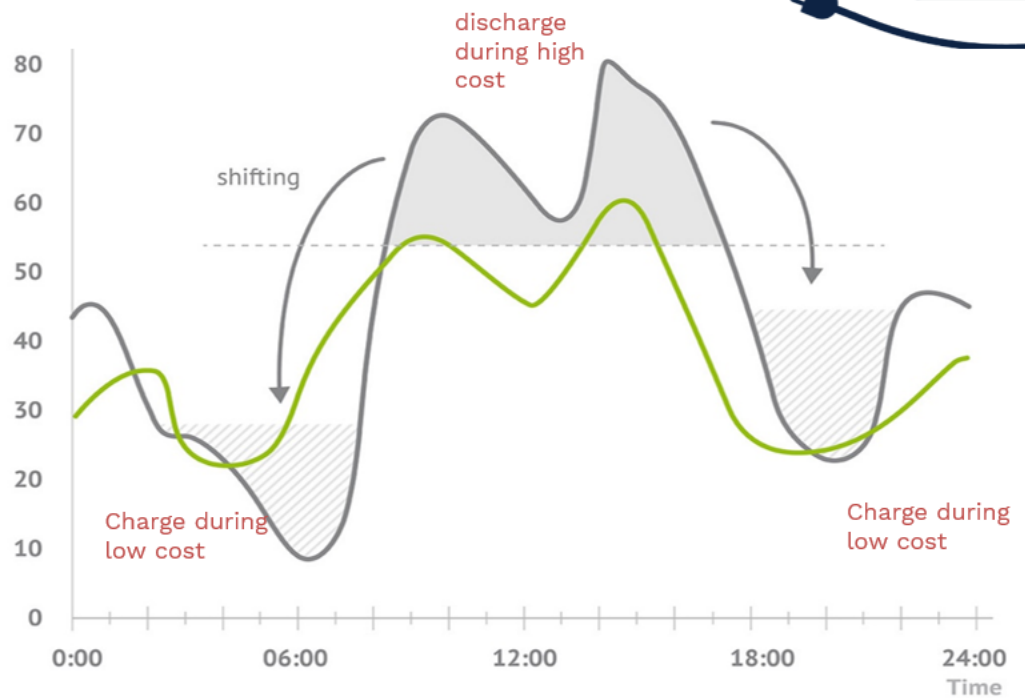


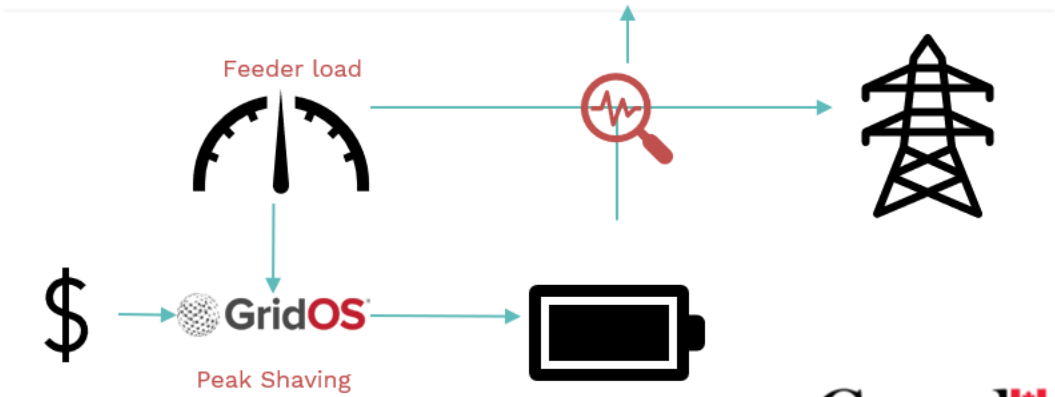
Optimization Objective –Peak Shaving (Local Flexibility)

- Peak shaving is an NWA ("non wires alternative") methodology utilized by the DNO/DSO/LDC to achieve benefits such as capital deferral, demand management while maintaining grid reliability
- Peak shaving schedules for participating assets are determined by performing a cost minimization / demand reduction optimization

Inputs:

- The Electrical Network Model
- The most recent load forecasts
- Local Market Participating Resources





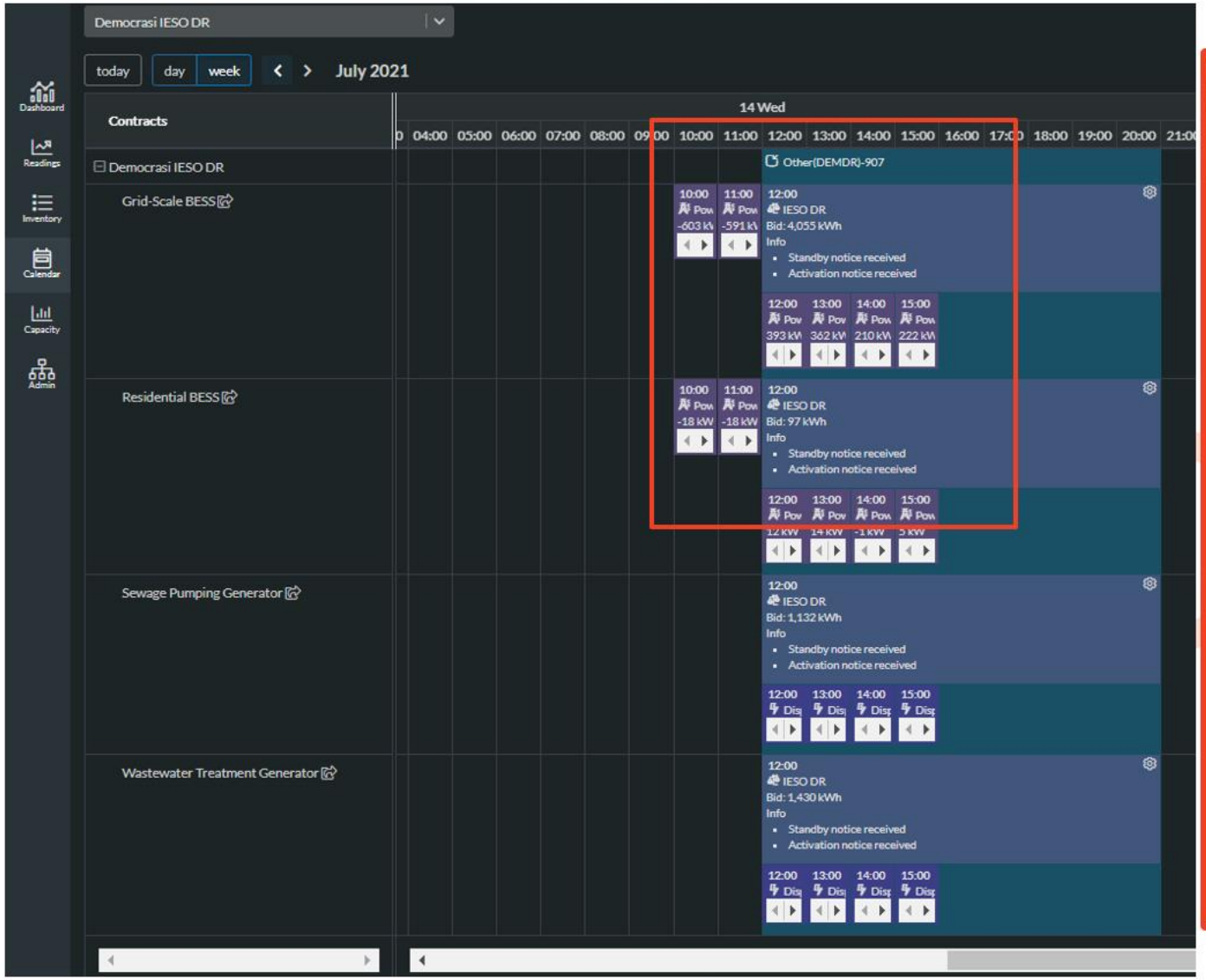
The Operational Pilot

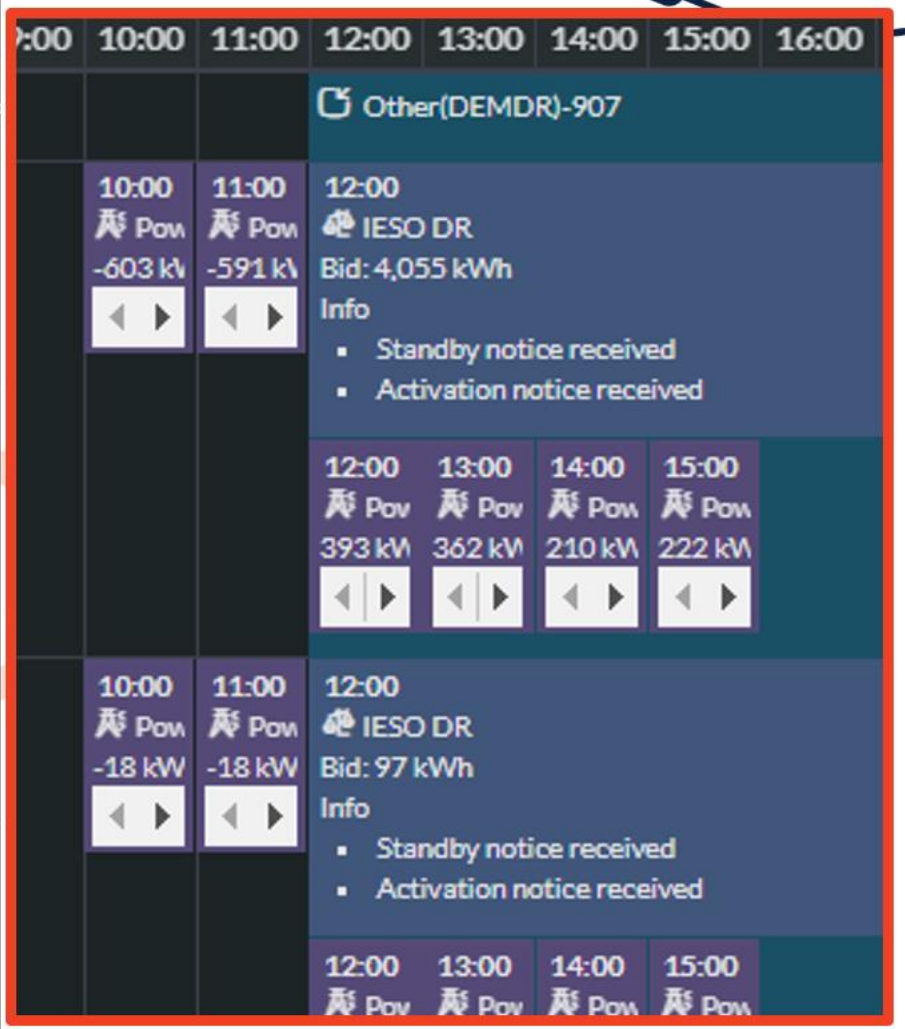
- Operational Period
  - 15 different "Market" scenarios over 45 Days
- Asset Coordination
  - Kiwi Core UI Availability Calendar
  - Asset Owner Scheduling / Communication
- Challenges
  - Network / API / Firmware Issues
  - Metering loss
  - Forecasting
  - Power factor
    - Local grid conditions

June & July 2021 – Schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 **G** Local Flexibility Participation without Standby Notice	2 **F** Local Flexibility Participation with Standby Notice	3 **F** Local Flexibility Participation with Standby Notice	4 **G** Local Flexibility Participation without Standby Notice	5
6	7 **B** Bulk Market participation without generators	8 **G** Local Flexibility Participation without Standby Notice	9 **B** Bulk Market participation without generators	10 **F** Local Flexibility Participation with Standby Notice	11 **H** Bulk Market Assets Unavailable, Bid Removed	12
13 **G** Local Flexibility Participation without Standby Notice	14 **A** Bulk Market participation with generators	15 **B** Bulk Market participation without generators	16 **D** Bulk Market participation with WTP Generator Only	17 **H** Bulk Market Assets Unavailable, Bid Removed	18 **G** Local Flexibility Participation without Standby Notice	19
20	21 **C** Bulk Market participation without generators and lower request	22 **I** Local Flexibility Market Assets Unavailable, Bulk Market Dispatch	23 **D** Bulk Market participation with WTP Generator Only	24 **E** Bulk Market participation with SPS Generator Only	25 **G** Local Flexibility Participation without Standby Notice	26
27	28 **L** Emergency Situation to Cancel Dispatch Following Full Day Peak Shaving	29 **C** Bulk Market participation without generators and lower request	30 **M** Emergency Situation to Cancel Dispatch Following Half Day Day Peak Shaving	1 **J** Local Flexibility Market Assets Unavailable, No Bulk Market Dispatch	2 **F** Local Flexibility Participation with Standby Notice	3
4	5 **C** Bulk Market participation without generators and lower request	6 **E** Bulk Market participation with SPS Generator Only	7 **A** Bulk Market participation with generators	8 **G** Local Flexibility Participation without Standby Notice	9 **A** Bulk Market participation with generators	10 **K** Emergency Situation to Cancel Dispatch Following Bulk Market Activation
11	12 **C** Bulk Market participation without generators and lower request	13 **B** Bulk Market participation without generators	14 **A** Bulk Market participation with generators			

Asset Coordination

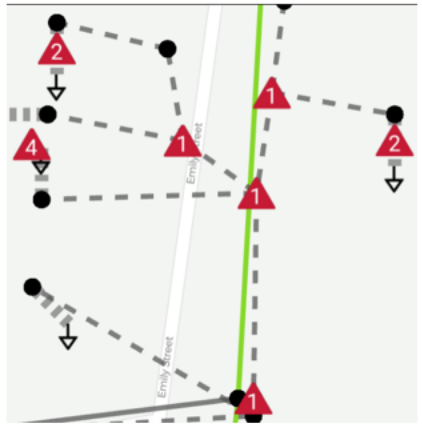


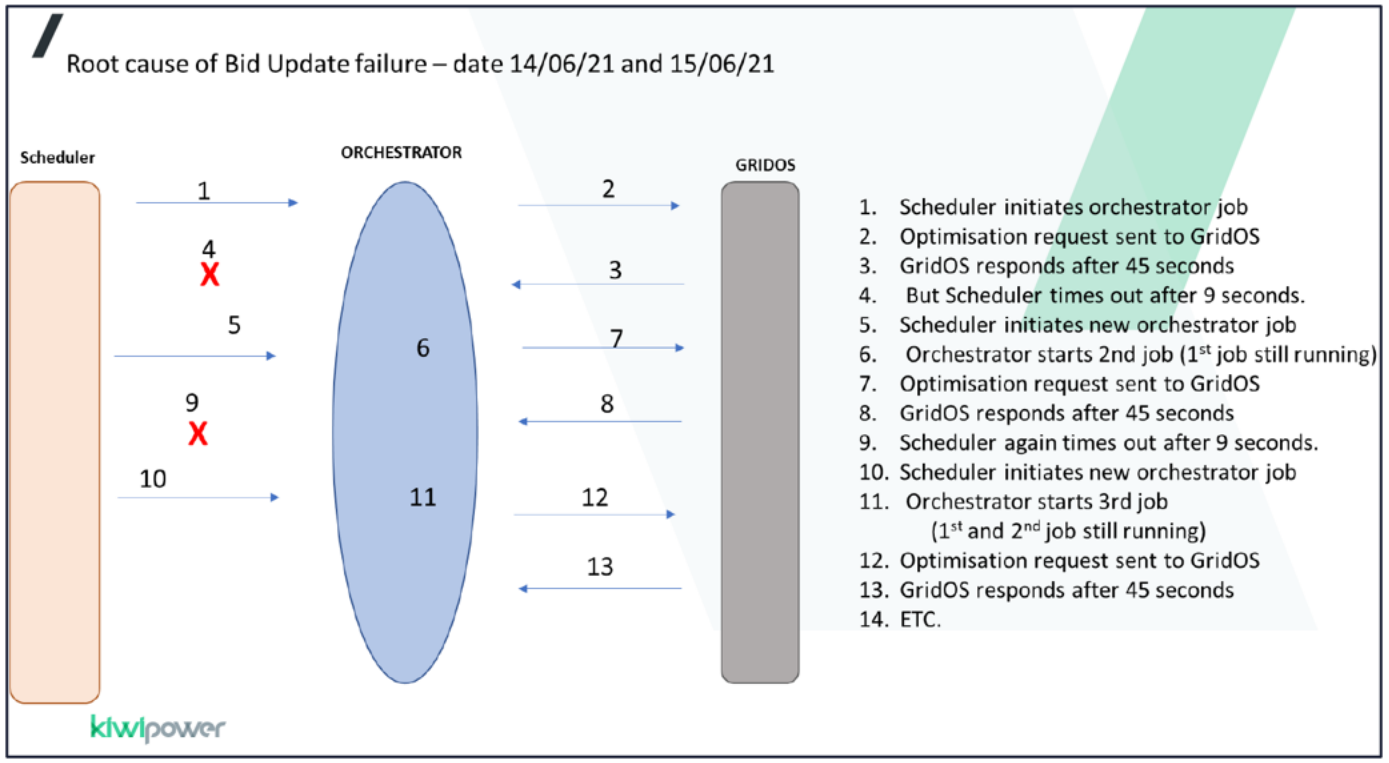


The Operational Pilot

Challenges

- Network / API / Firmware Issues
- Metering loss
- Forecasting
- Power factor
  - Local grid conditions





Technological Components

Flexibility Service (Local and System Operator)

Control various loads and generation sources

Interact with multiple communication interfaces

Compensate for Variable Renewable Energy Generation

Situational Awareness

OE engine provides full situational awareness in operational planning. GridOS® creates accurate 3-phase AC optimal power flows across network feeders which includes: per phase voltages; currents; real power; reactive power; real loss; reactive loss; power factors; etc. for the entire study period.

Data-Enabled Value Creation

The level of situation awareness and visibility by the joint product will allow for aggregators and energy service providers to potentially benefit from grid visibility to extend the viability of their product offerings to larger groups of customer classes.

Allow LDCs/DNOs to engage in the aggregation of their own assets in a manner to potentially bid them into the bulk services market.

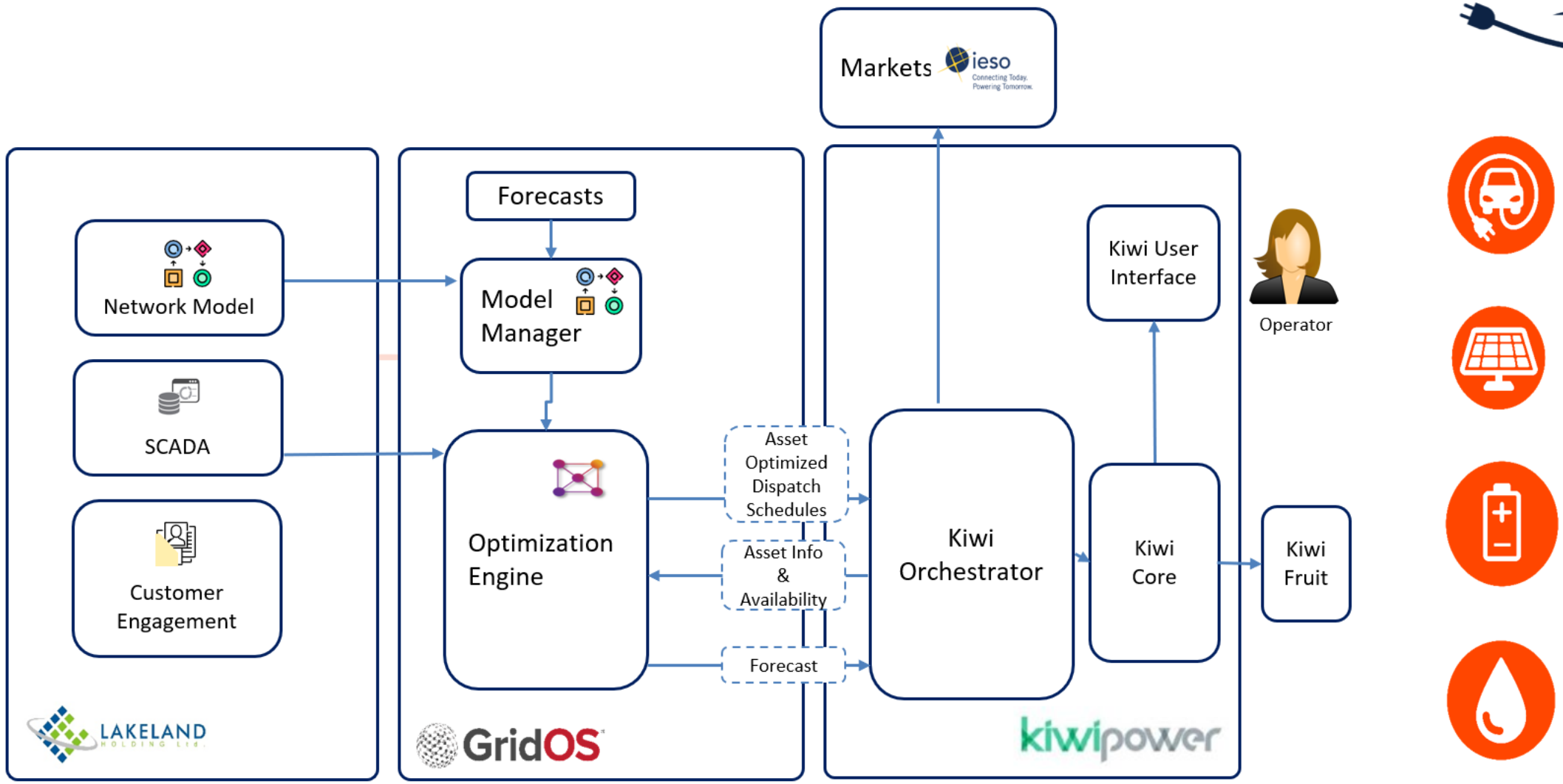
Cyber Security & Audit

Operational Security: ISO27001

Data Security: NIST 800

Market audit requirements

Interoperability



Maximizing **Value** from DER's

- The DEMOCRASI solution uses the LDC network model to **optimally dispatch assets**, balancing bulk and local needs.
- The solution provides LDCs/DNO with **visibility** over participating assets while also enabling them to procure **local flexibility** services from wholesale market participating resources.

Empowering the gate keepers

- One of the world's first utility implementation of an Optimization Engine (OE) & DERs with online optimal power flow (OPF)
- Empowering utilities to be able to plan, operate, optimize and create new business models
- Bridging DNO/LDC and TSO gap

New business models and value stacks

- Unlocking revenue opportunities for DNOs/LDCs and customers
- Reducing capital expenditures
- Facilitating non wires alternatives (NWA's)
- Increased visibility of asset utilization to improve asset health

DEMOCRASI

The Project Consortium would like to thank the following organizations.

Canada

LakelandPower
Powering our communities.

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Guidehouse

Department for Business, Energy & Industrial Strategy

Experience Georgian

regen
transforming energy

Panel Discussion

Joshua Wong
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opus one solutions

Vince Kulchycki
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LAKELAND HOLDING Ltd.

Thomas Jennings
Head of Optimisation

kiwipower

Stuart Fowler
Innovation Engineer

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