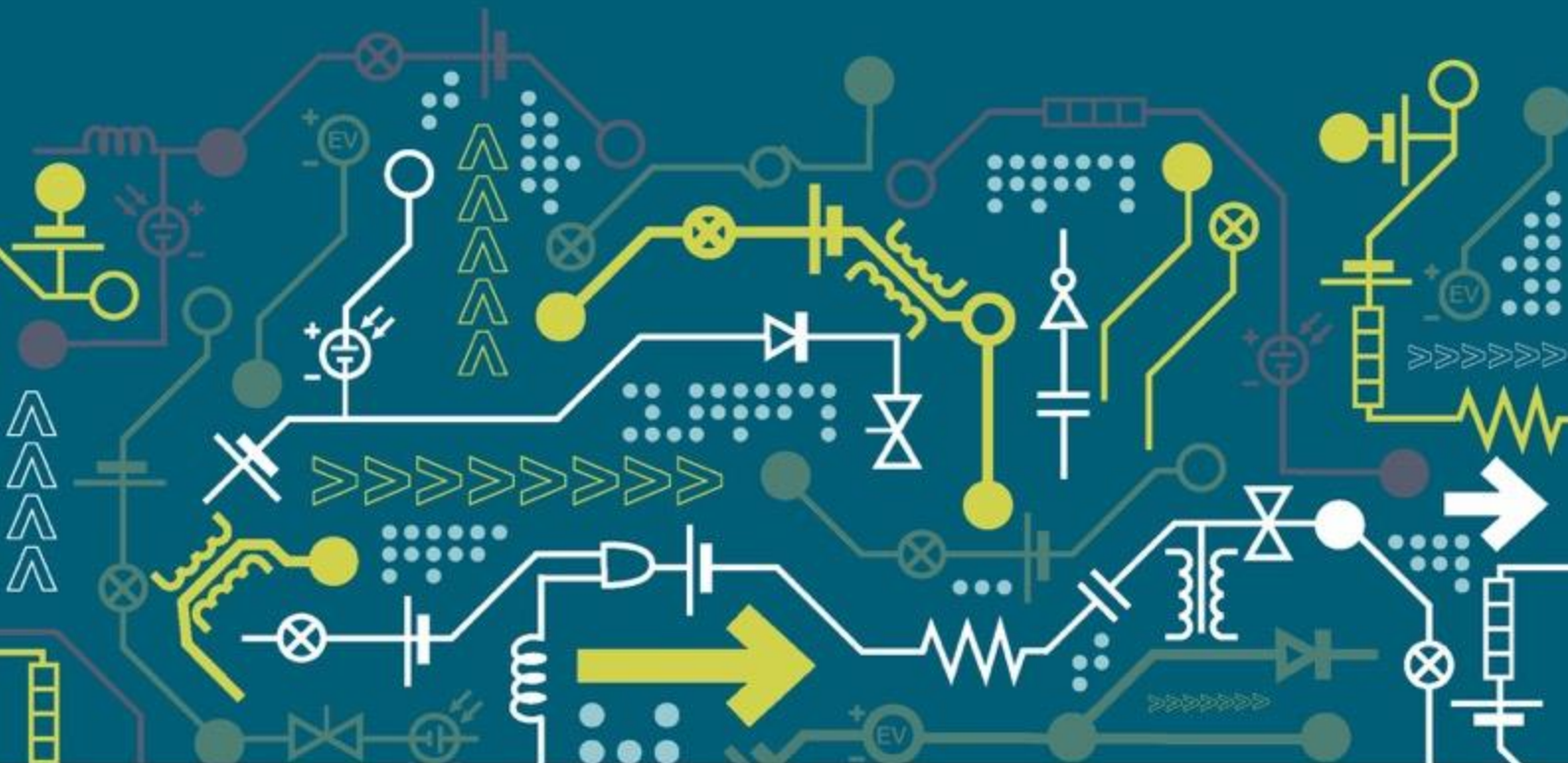


Technical Overview

IntraFlex Project

Summarising the planned technical development for the trial



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1 Project Overview

1.1 IntraFlex project aims

The IntraFlex project is looking to test a short term market for Distribution Network Operator (DNO) flexibility which actively accounts for the imbalance it creates in the electricity market.

To do so, the project will trial the NODES market place.

NODES is an independent marketplace for a sustainable energy future where grid owners, producers and consumers of energy can trade decentralised flexibility and energy. NODES is owned equally by the Nordic and Baltic Transmission System Operators and the energy company Agder Energi. More information is available on: www.nodes.energy

The market design has been developed bottom-up and allows flexibility to be traded in various constraint zones at any voltage level of the grid. Grid locations will be defined by the DNO and may or may not be part of a larger grid location at a higher voltage level thus enabling the DNO to model any constraint in the regional or local grid. The NODES market design allows for technical aggregation of flexibility up to the transmission grid making this flexibility available to the Electricity System Operator (ESO).

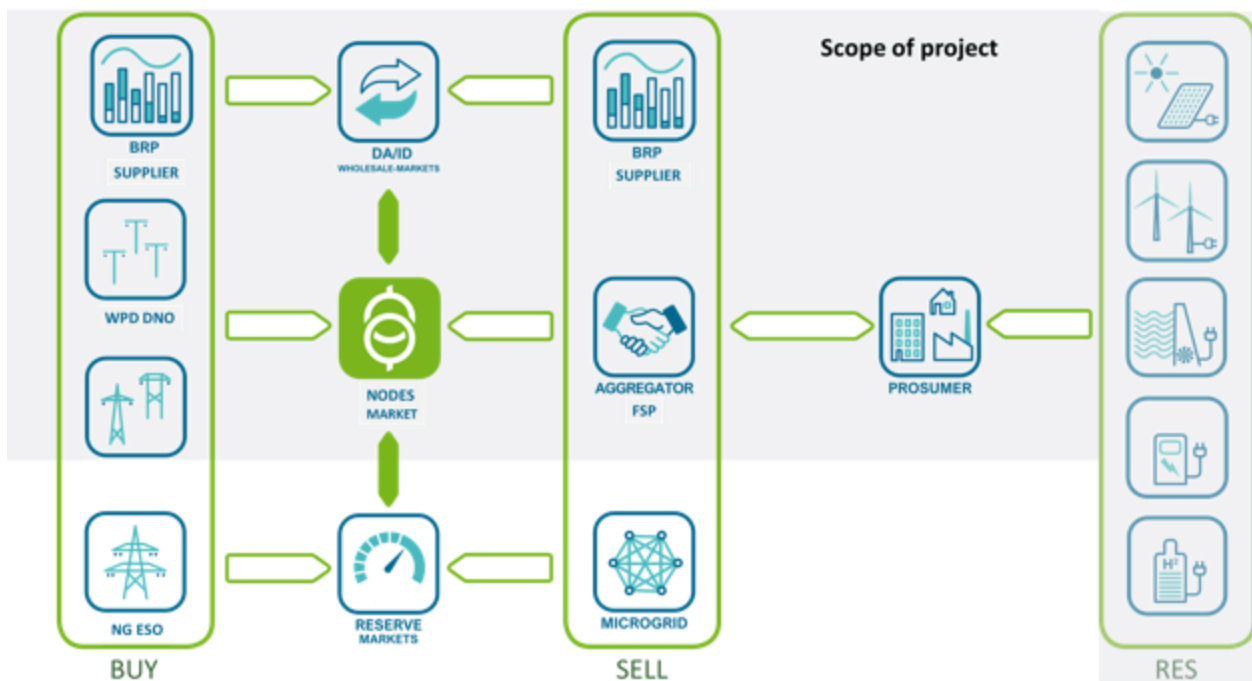


Figure 1: NODES market design

The IntraFlex project will test a part of this market design, specifically the link into the Day Ahead and Intraday energy markets. This is a first and has not been trialled elsewhere in the UK.

1.2 Proposed Solution

The NODES market is a continuous market that can be accessed at any timeframe.

- WPD will use the NODES market after the current Flexible Power week ahead acceptance timeline;
- NODES will provide an information service to BRPs. Originally this run up until intraday timeframe on any activation already committed by the DSO. Following stakeholder feedback, we will consider extending the information service throughout the day of delivery up until gate closure on NODES.

- NODES will provide automatic rebalancing service in the intraday timeframe for trades that are being activated in the daily timeframe.
- Discussions with Elexon have highlighted the opportunity to operate the intraday service up to the Delivery Period. However, following discussions with the ESO, we initially agreed to close all procurement ahead of Gate Closure (1 hour ahead of the Delivery Period). This was to reduce the risk of conflicting with ESO services. We also received feedback from stakeholders that the NODES within day results need to be available at least 30 minutes ahead of Gate Closure to allow results to be integrated into bid strategies for the balancing mechanism. We have therefore resolved to introduce a Gate Closure on NODES 90 minutes ahead of real-time.
- We will also endeavour to avoid making trades over the same time period as the day ahead and intraday auctions. Again this will allow participants to accommodate results from on market into the other.

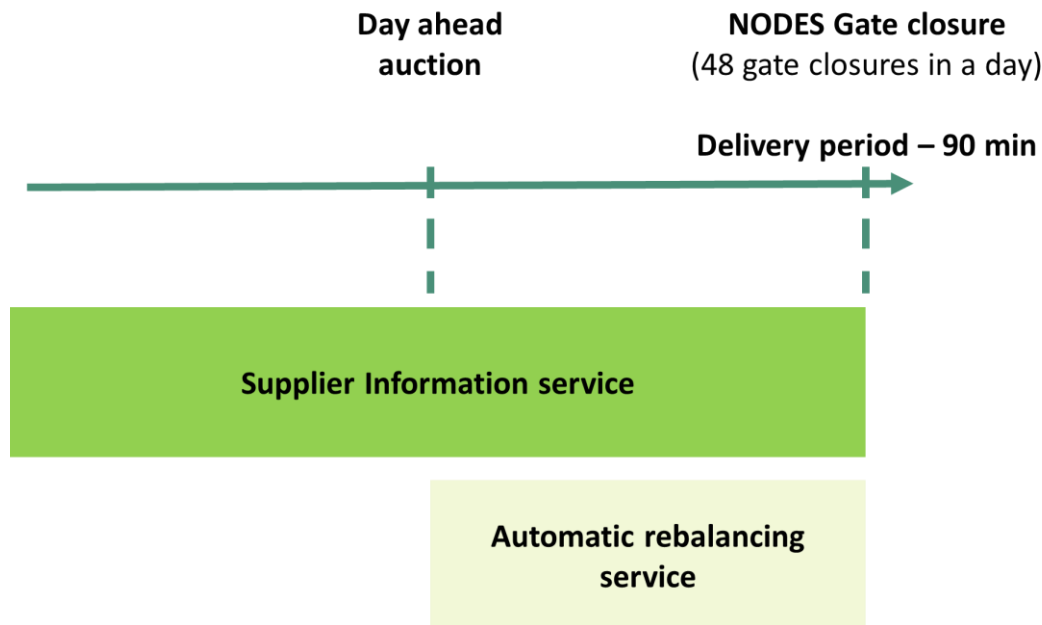


Figure 2: Market Timelines

We anticipate that beyond the trial, these markets would operate in parallel with existing procurement timelines and other markets being developed. DNO procurement strategies would look to procure across the timeframes to balance the benefits of improved forecasts and alternative participants closer to real time against the risks of price uncertainty. This will depend on the levels of liquidity of each market.

It should be noted that we are only considering Pre-Fault Constraint Management services (equivalent to the Secure service). This is simply due to the nature of the services and their required dispatch timelines. Scheduled Constraint Management requirements should be understood within these market timeframes, whilst any Post-Fault services are typically deployed with 15 min notice, which is post gate closure.

More details can be found in the associated market design document.

1.3 Proposed Trial

We plan to trial the design in two phases. An initial trial will be conducted in August and September 2020 and will simply test the procurement of services closer to real time as well as an initial version of the information service. This will not trial the auto rebalance service, but will be used to trial the basic technology and processes. A second trial will then be held in April and May 2021 testing the full range of capabilities.

To facilitate these trials, two rounds of trial participant recruitment will be held over the summer and winter of 2020.

It is anticipated that the trials will run in areas of current Flexible Power procurement (either already live or in procurement); however, the trials will be help out of actual requirements. This will allow existing Flexible Power providers to participate as well as removing any operation risk associated with potential service non-delivery.

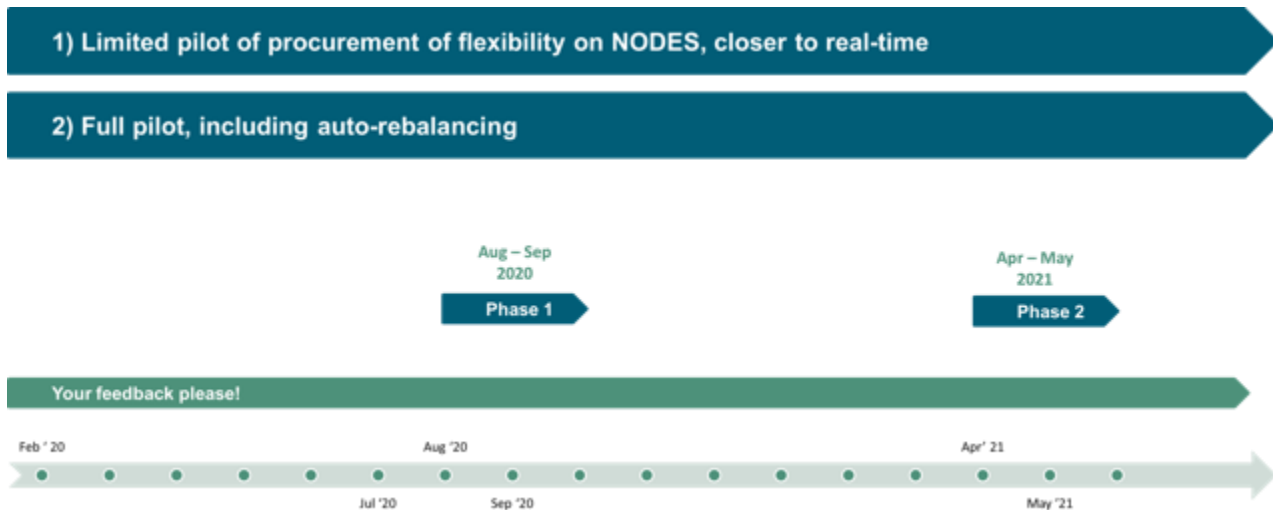


Figure 3: Project Timeline

1.4 Project team and responsibilities

The project is funded by Western Power Distribution (WPD) under the Network Innovation Allowance (NIA). WPD’s interest in the project is as a potential buyer of flexibility on the platform. It is hoped that the provision of the new services will increase the amount of flexibility available to WPD and ultimately deliver value to DNO customers.

NODES will further develop and operate the market. They will own the primary customer relationship and will operate the platform as an intermediary between buyers and sellers.

Smart Grid Consultancy (SGC) will support the project in a number of key ways including: Project management, Technical support and Customer support (where more detailed support is required).

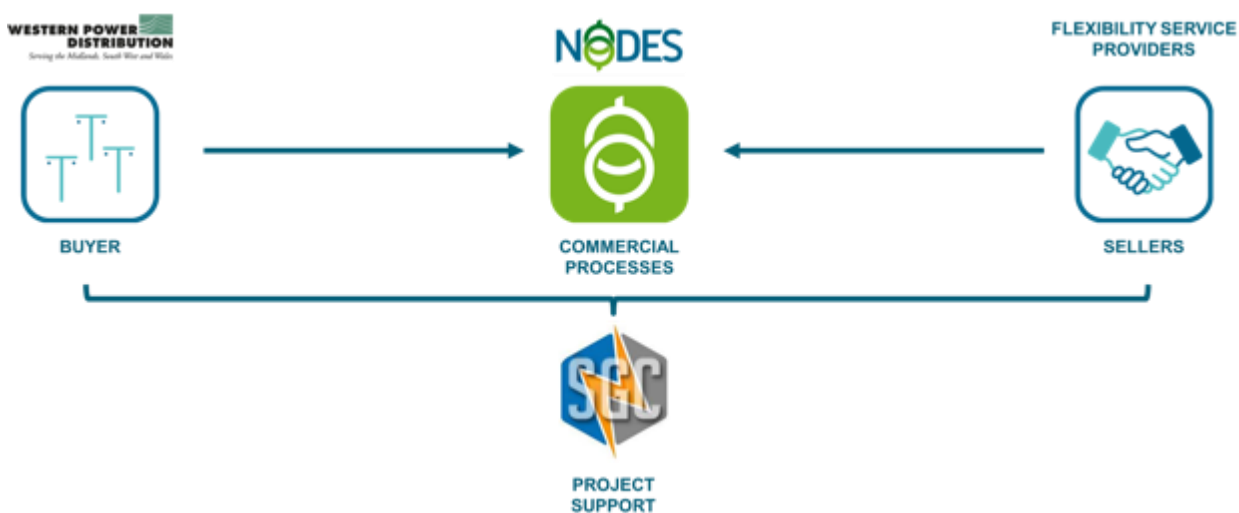


Figure 4: Project Responsibility Split

2 Systems Overview

2.1 Systems Overview

To enable the market to function, a number of systems and interfaces are required. These are intended to balance the requirement for simplicity whilst providing the required level of functionality. These are highlighted in Figure 5 below.

The primary systems are those owned and operated by NODES. These focus on the commercial relationship with the participant. This will be supplemented within the trial by a few technical systems provided by WPD.

For the trial the metering systems (the project metering and baseline calculations) functions will be provided through integration with existing WPD metering capability. This is to facilitate the timely deployment of the trial as well as the de-risking of the project rather than the mandated long-term solution. It is expected that beyond the trial, as the market for flexibility services matures, this function may be taken on by an independent operator (NODES or another party). The provision of metering services is a key discussion within Ofgem's Future Insights paper on Flexibility Platforms in electricity markets.

NODES will provide the commercial systems with participants able to interact via a Graphical User Interface (GUI) or Application Programming Interface (API). This will build on their existing market platform and will be supplemented with project specific development.

Throughout the process we are looking to balance the development of low cost trial enablers and longer term solution build to try and de-risk the project whilst also delivering a solution that could be easily rolled out.

2.2 Data overview.

It should be noted that within WPD's Flexible Power, a standard data structure is being implemented. This aligns well with the structures utilised in NODES. This structure is highlighted in Figure 6 below. Within the trial, due to the aim of aligning procurement with supplier imbalance, each Meterable Unit and Dispatch Group can only contain assets from the same BRP.

Some terminology is different between the two organisations, the equivalence is highlighted below.

Table 1: Terminology equivalence

Flexible Power Terminology	NODES Terminology
Dispatch Group	Portfolio
Meterable Unit	Asset
Asset	N/A (this level is not explicit in the NODES structure)

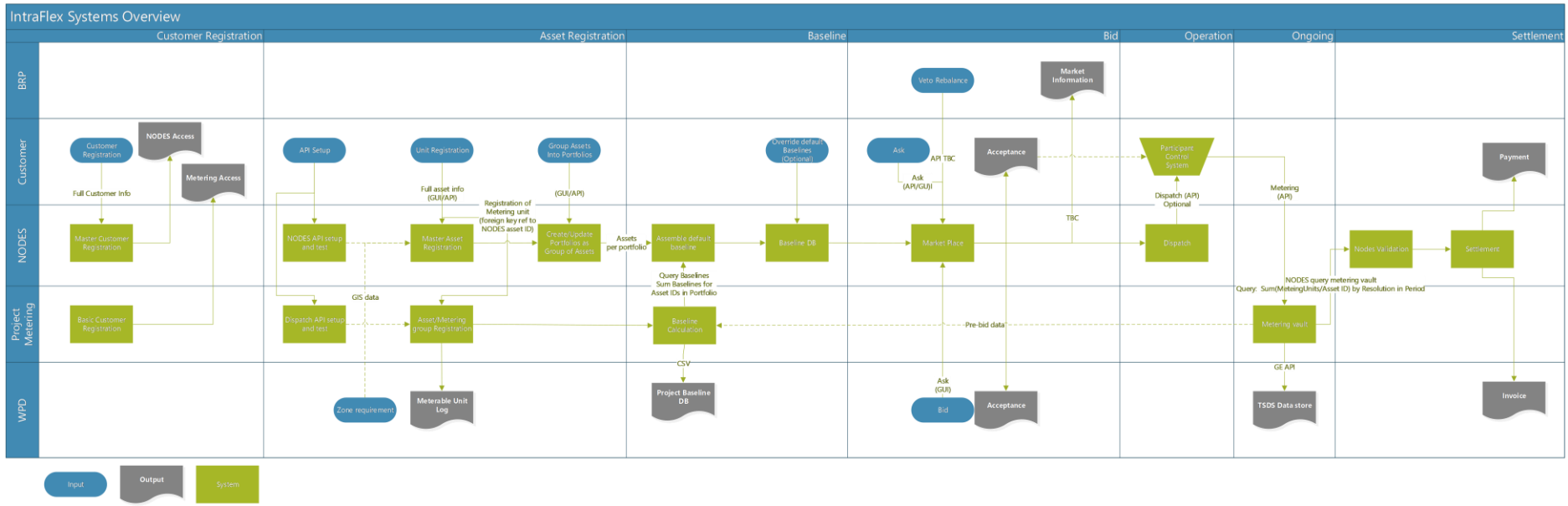


Figure 5: IntraFlex Systems overview

IntraFlex hierarchy

Phase

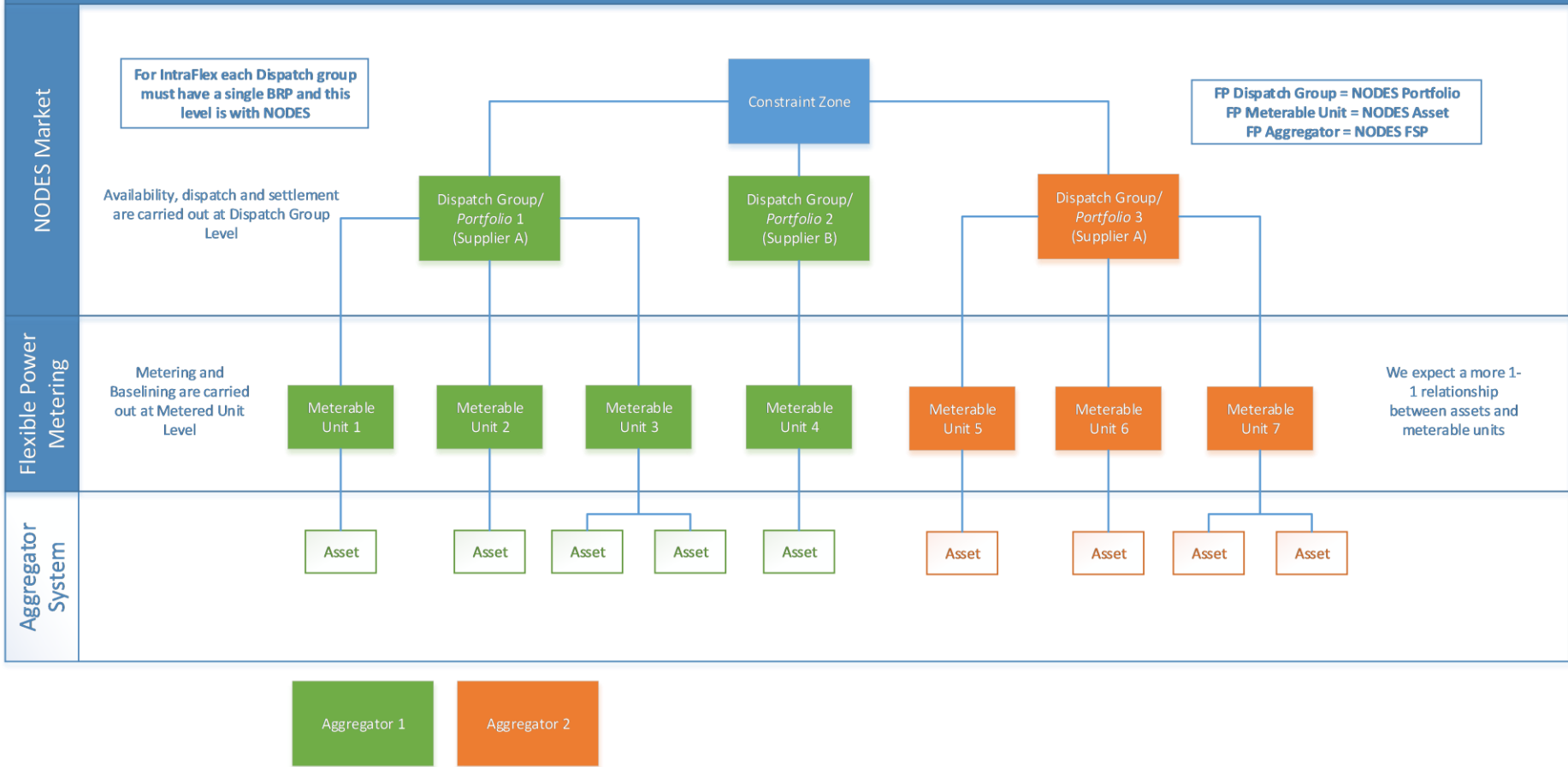


Figure 6: IntraFlex Data structure

3 Phase 1: Technical development

3.1 Phase 1: Timeline

With the Phase 1 trial scheduled for August, the required development work has been scoped out in the following section. These are broken down by tasks to highlight the work to be carried out. This should align with the recruitment timetable highlighted below.

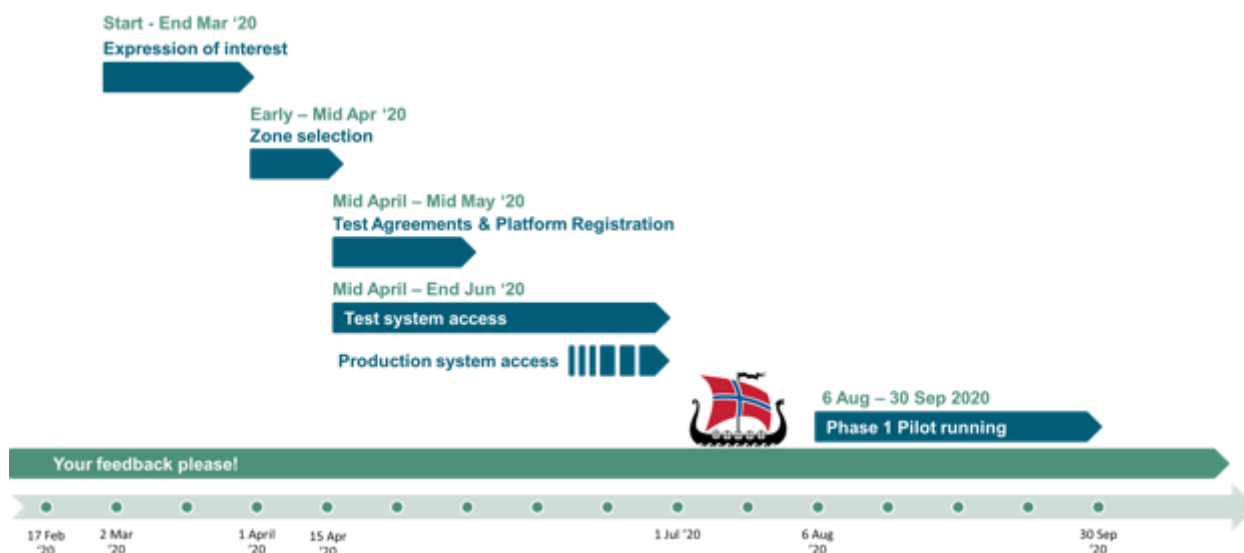


Figure 7: Project Recruitment timetable

NODES will carry out development of the below features from early April until end June, with testing planned during June and July. (Note that on-boarding and pilot project participant technical build and testing still takes place from the middle of April. That is, pilot project participants test all features apart from baselines, settlement and dispatch).

3.2 Flexible Power simplification and segregation

This initial piece of work includes the segregation of the project metering solution from the wider Flexible Power tools, to ensure a different look and feel for the trial.

Flexible Power development

As well as a different look, the project metering solutions will include the hiding of all non-necessary features within Flexible Power. This includes availability calendars and reporting features. A new URL will be used to show this is a distinct piece of work from the business-as-usual Flexible Power platform. This work will be carried out in by Kiwi Power in Late April.

3.3 Metering solution

This work is focussed on allowing the collection of metering data from the participating assets to allow for their settlement. As NODES do not have such capabilities, the project will utilise the existing Flexible Power capabilities to enable the trial to proceed. This has been called the Project Metering system. Once collected, this data must then be transferred to NODES for settlement.

Metering will be collected at a Meterable Unit/Asset level.

Flexible Power development

Each participant will need to set up a Flexible API to provide the metering information. This will be similar to the Flexible Power API, but will be targeted at a different end point.

Once metering has been collected on the Project Metering system, it must be available for transfer to NODES for settlement. This will be done via an API. This will be pulled by NODES on a monthly basis (aligned with the settlement cycle).

The request from NODES shall specify:

- The Meterable Unit required
- The time bounds of the data required.

It is expected that:

- Flexible Power will provide an API for NODES to pull meter reading data at Meterable Unit level.
- The API will be called post-dispatch event, which is to say it doesn't need to be real time.
- There will be no automated synchronisation of Meterable Units will exist between NODES and Flexible Power.
- Data Segregation will be needed to ensure that:
 - ensure NODES cannot see readings of participants that aren't part of the IntraFlex pilot
 - ensure NODES cannot see readings of participants from before they joined the IntraFlex pilot
 - existing Flexible Power participants may join the IntraFlex pilot and can continue declaring their assets in Flexible Power as normal. NODES will be able to see their meter readings from the date they joined the pilot onwards.

The work will include coding of the endpoint, additional API endpoint security, testing how much data can be queried without adversely affecting database & protecting the Flexible Power servers against requests for too much data.

This work is expected to be carried out in late April and will be tested with NODES to check data is being transferred correctly

NODES development

NODES Settlement will:

- query Flexible Power's metering vault for baselines for each metered unit in a portfolio; and
- query the metering vault for all metered units within the portfolio to get the sum of MWs for the traded Initial Service Period (ISP).

The details of these two functionalities are described below, in the respective sections.

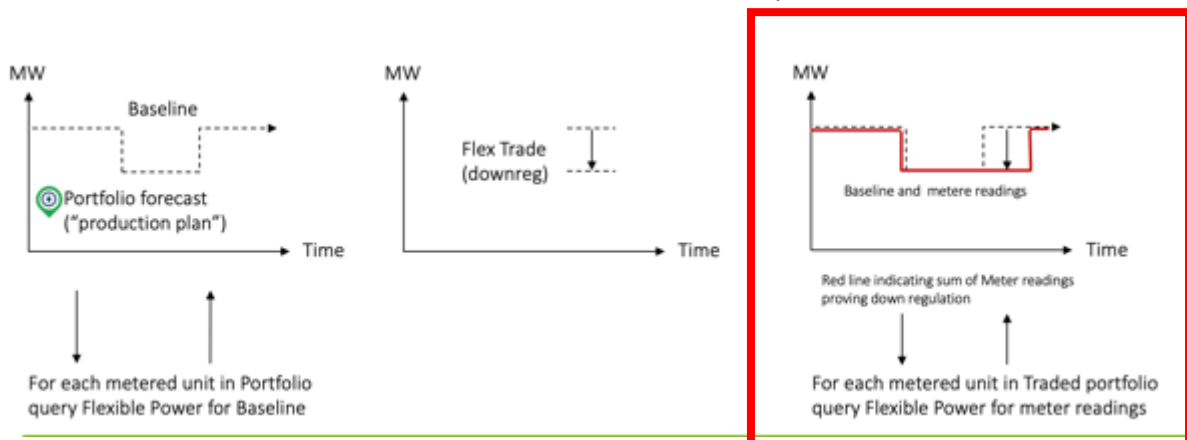


Figure 8: Nodes process: metering

This development work will happen in parallel with the Kiwi Power development work.

3.4 Baseline calculation and extraction

To support participants in the creation of a baseline for the project, Flexible Power will calculate a default baseline and pass this on to NODES at a Meterable Unit/asset level. NODES will then collate this at a portfolio level to aid Flexibility Service Providers (FSP). FSPs will have the option to override the baseline if they have a more accurate methodology. More details on this can be found in the Market Design document.

Flexible Power development

Flexible Power will use the metering data collected (as detailed in section 3.3) to determine baseline at a Meterable Unit level. This will then implement the agreed default baseline. At a high level this will calculate average the loading over the previous five completed working days for each half hour. This will produce 48 values, per Meterable Unit per day.

Once these values have been calculated, they will be pushed to and end point to be retrieved by NODES. This is expected to be done on a daily basis just after midnight.

In addition Flexible Power will create a simple baseline extraction routine to allow for weekly export of baseline data to WPD. This will be a simple Comma Separated Variable (CSV) export as it is purely for trial analysis and not expected to be an enduring process.

NODES development

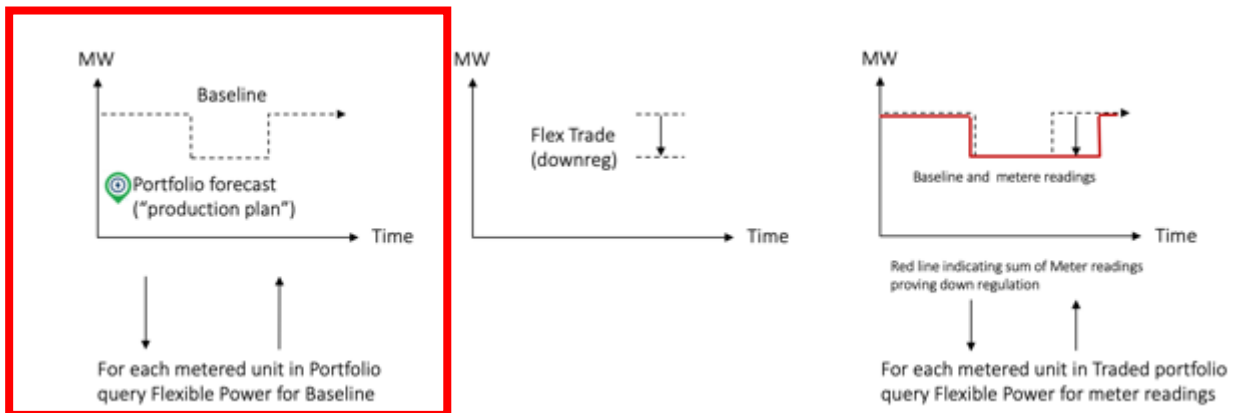


Figure 9: Nodes process: baselines

NODES will need to develop a custom IntraFlex service that sets default Baselines on a daily basis by querying Flexible Power for baselines at Metered Units level.

The routine will be:

- Flexible Power will calculate baselines for each registered metered unit on a rolling basis, updated at the midnight boundary of each day.
- NODES will query Flexible Power on a daily basis to reflect the updated baselines until a transaction is made.
- NODES will start pulling the data upon portfolio creation.
- NODES will specify that tradable portfolios will need to be “frozen” at a specific point in time i.e. flexibility service providers will not be able to add or remove assets from the portfolio from that point.

- NODES will gather the sum of metered units in each Portfolio by querying Flexible Power for the collective baselines.
- This will be stored in NODES' baseline data base as a default baseline for settlement.
- Participants can override these values by uploading their own baseline up until a trade has been made on a given ISP and portfolio. In that case, the participant's baseline would be used for settlement.

Example:

If a trade is matched at 9 am for 1 pm-1:30 pm, baselines can still be updated for the ISP 1:30 pm-2 pm in case this will be traded later the same morning.

3.5 Dispatch

Dispatch is an optional feature to help improve the reliability of delivery for participants. This will be developed by NODES.

NODES development

NODES will let flexibility service providers set their Dispatch configuration on a portfolio level in NODES, i.e. flexibility service providers select what action NODES is to take after a potential trade is matched.

The parameters are:

- Notification Type (None, SMS, Email, Http-get, Http-post):
 - None – FSP schedules their own dispatch according to Trade record received at time of matching
 - SMS – SMS message typically sent to asset owner if a manual dispatch is to be performed. Often this option is for portfolios with single assets.
 - Email – Like SMS
 - Http (Get/Post) – For immediate dispatch, where the FSP need to forward actual dispatch from within their portfolios given the parameters in the Http call-back
- Lead Time:
 - Seconds before ISP the Dispatch message is sent – Typically 15 minutes for SMS and 0+ minutes for URL call-backs. If ramping is required, FSP could then add this time in their call-back configuration
- Message/Parameters
 - Will add option to include parameters Portfolio, ISP, MW, Regulation Up/Down to the different notifications

Note that the dispatch functionality is already implemented at API level in NODES (the SMS channel will be needed in a Norwegian pilot during April/May in Norway).

3.6 Settlement

Settlement is the essential service of working out who should be paid what. Learning from previous projects has shown that this is non-trivial.

NODES development

As described in section 3.4 NODES will query the Flexible Power metering vault on a metered unit/asset basis and will aggregate these values into portfolios to validate delivery of flexibility orders that have been matched and dispatched.

The process for financial settlement will work as follows:

- Settlement data per counterparty is created by the NODES platform for the entire settlement period, which will be monthly
- NODES uses an integration platform called Snaplogic to connect to NODES settlement API and transforms the data into an invoice in the NODES Enterprise Resource Planning (ERP) system 24SevenOffice
- 24SevenOffice creates and issues invoices and takes care of the banking transactions
- Once the buyer has paid the invoice, the seller receives money on their bank account

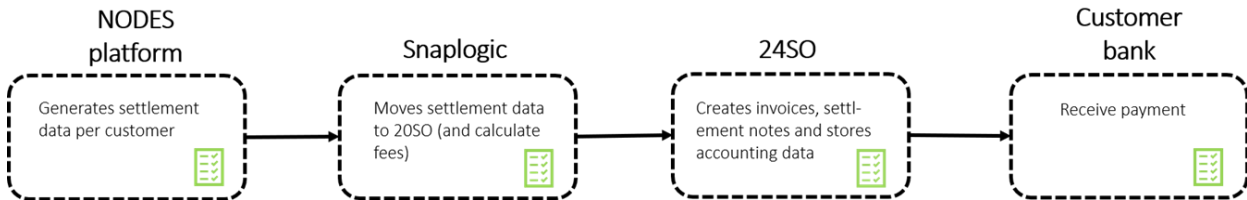


Figure 10: Nodes Settlement Process

3.7 Audit targeting tool

This task is aimed at the development of an audit targeting tool. This will verify delivery from project metering against settlement metering to identify any potential irregularities. Having such a tool, and a robust auditing process will allow participants to continue to use a wider range of metering whilst minimising under delivery risk to the DNO.

Flexible Power development

Flexible Power currently exists outside the WPD corporate environment. As part of existing Flexible Power development, an internal WPD database is being created. The project will build on this work to access the required metering data.

WPD development

WPD will develop an Excel based tool to compare the minute by minute data against settlement data. This will be developed by SGC and will focus on minimising the level of human intervention required. Where any abnormal behaviour is found, this will be flagged to a Flexible Power operative to follow up.

3.8 Information Service

This will build the first of the two services aimed at addressing supplier imbalances provided by the NODES platform for the trial.

NODES development

NODES will on an ongoing basis publish activated volumes on a per Balance Responsible Party (BRP) basis. (Portfolios can include assets only for one BRP at a time, so activated volumes can be isolated per BRP.) This information will only be available to the relevant impacted BRP. BRPs will also be able to pull this information via an API.

FSPs will be given an option to opt out of this service as part of sign up to the platform.

Phase two may include the publication of the activated volumes on a page in the NODES portal, accessible only to the relevant impacted BRP.

Development required includes developing the API (and including a field where FSPs register the Supplier for relevant assets).

3.9 Development not taken forward

A number of further developments were discussed as part of the initial design phase. Some were not taken forward for a variety of reasons as stated below.

FP dispatch

Original proposals included the development of WPD dispatch capabilities to facilitate the trial. Upon further work it was determined to have limited value beyond the trial where platforms would be expected to perform such functions themselves. In addition NODES added the development of their own dispatch capabilities removing any need for development.

Sign up integration

Original proposals included work to simplify the participant journey and link customer and asset sign up between platforms. As the scope was developed further, it was deemed that the complexity of producing such systems outweighed the benefits to the participant journey.

4 Phase 2: Technical development

As Phase 2 will build on the learning from Phase 1, the work has been loosely scoped to date. This will be tightened as learning is generated from Phase 1.

4.1 Information Service

This will build the first of the two services provided by NODES platform for the trial.

NODES development

The information service will be refined following learning gathered as part of Phase 1. This is expected to add more sophistication on data aggregation and anonymization.

4.2 Auto rebalance capabilities

This will build the second of the two services provided by the NODES platform within the trial.

NODES development

NODES will develop an optional link to the intraday market, which will enable BRPs to have their energy accounts flattened automatically. That is, the energy volume that corresponds to the activated flexibility for relevant BRPs will be transacted on behalf of the BRPs in the intraday market.

Detailed development steps will be outlined as part of Phase 2, at the latest by the beginning of August 2020.

4.3 Standardisation of the WPD/NODES interface

This work will look to understand and develop a more standard interface between WPD (via Flexible Power) and NODES. The details is very dependent on trial learning, in particular the outcomes of the procurement review being carried out by Osborne Clarke.

Flexible Power development

It is expected that work will be carried out to create a more standard interface with Flexible Power. This is expected to include dispatch and settlement of the NODES platform as a whole, effectively treating NODES as a single provider of flexibility. This will include Flexible Power being able to verify the billing provided by NODES. We will also look to align with the volume acceptance and dispatch function within Flexible Power, whilst acknowledging that it is far more complex via NODES as it can happen at varying timescales and includes more detailed pricing information. It is likely that this work includes integration with the NODES API.

NODES development

It is expected that the bulk of this work will be carried out on the Flexible Power side of things. However there may be changes required on the NODES side to align with a more standard approach.

Glossary

Abbreviation	Term
API	Application Programming Interface
BRP	Balance Responsible Party
CSV	Comma Separated Variable
DNO	Distribution Network Operator
ERP	Enterprise Resource Planning
ESO	Electricity System Operator
FSP	Flexibility Service Provider
GUI	Graphical User Interface
ISP	Initial Service Period
SMS	Short Message Service
WPD	Western Power Distribution

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