

Appendix 2 – Network Operation (March 2021)

Structure of the Appendix

This Appendix provides an initial overview of the Function, including the snapshot of the roadmap of the Function and some key statistics.

We then go through each activity and the unique steps that sit under the activity. With the term “unique” we indicate all Common Steps aggregated at organisation level, where possible, as well as steps which aggregate Individual Steps (see section 2.7.2 of the main document for reference).¹

We provide a summary table of each step which includes all the associated information as of the date of this publication. The fields of the table are explained below:

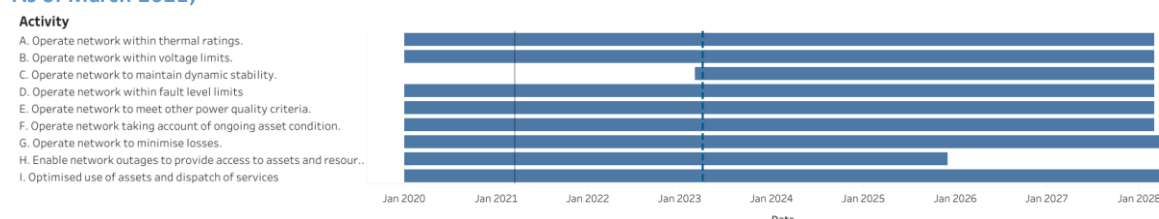
Step	Name of the step as included in the DSO Roadmap
Step type:	<i>Development / definition activity or network action or code change process or enabler/dependency.</i>
Description:	<i>Description of the step as included in the DSO Roadmap</i>
ENA ONP Product:	<i>Only relevant for steps which are associated to an ENA ONP Product.</i>
Timeline:	<i>Start date and completion date of the step. For aggregated steps, start date shows the earliest start date of the responses and completion date the latest completion date of the responses.</i>
Organisation type:	<i>Involved organisations who are responsible for delivering this step. If the step type is “Code change process”, then a delivery body which consists of a number of stakeholders (DNOs, Ofgem, TOs, ESO), is responsible for the code change process. In this case the step is allocated to the “Delivery body”.</i>
Progress:	<i>This field shows the number of organisations in each implementation level.</i>
Additional information:	<i>Additional information such as barriers, dependencies, good practices and links to public information is included in this field.</i>

Table 1 – Step table template, definition of the fields

Function 2

Function 2 consists of 54 unique steps, some of which are common across DNOs, T.E.F. projects and TOs or duplicated across different activities of this function. We received in total 165 contributions by the involved stakeholders (i.e. 165 steps by all organisations, which were aggregated to 54 unique steps where possible).

As of March 2021,



¹ If a step is relevant to the wider industry, it is called Common Step. A step which is required for individual organisation to implement DSO functionality is called Individual Step. Individual steps are aggregated into a single generic step combining all individual network actions and described only at a high-level, anonymised basis.

Figure 1 shows that the roadmap of the “Network Operation” Function will be completed by 2028. Please note that timescales are only relevant to steps that have been planned or being implemented by the involved organisations. There are no dates for steps that are at conceptual level, meaning that the organisations plan to implement the step but they do not know the timescale of the implementation (please refer to section 2.7.3 of the main document for reference).

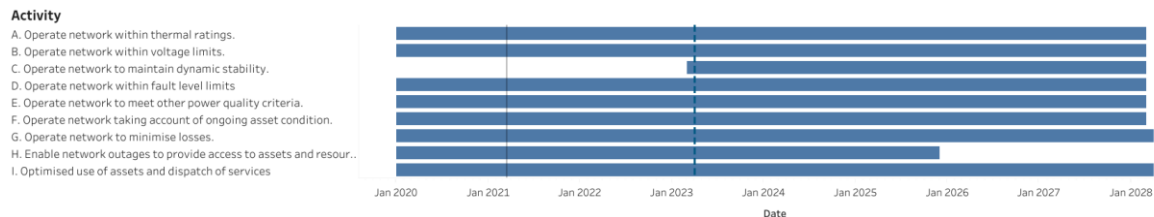


Figure 1 Network Operation Roadmap

Figure 2 shows the total number of steps by all organisations, prior to aggregation. More than half of the steps (~52%) of this function are in the organisations’ pipeline to implement but have not started yet (“Initiated”). Only few of them have been completed and just over a third of the steps is being implemented.

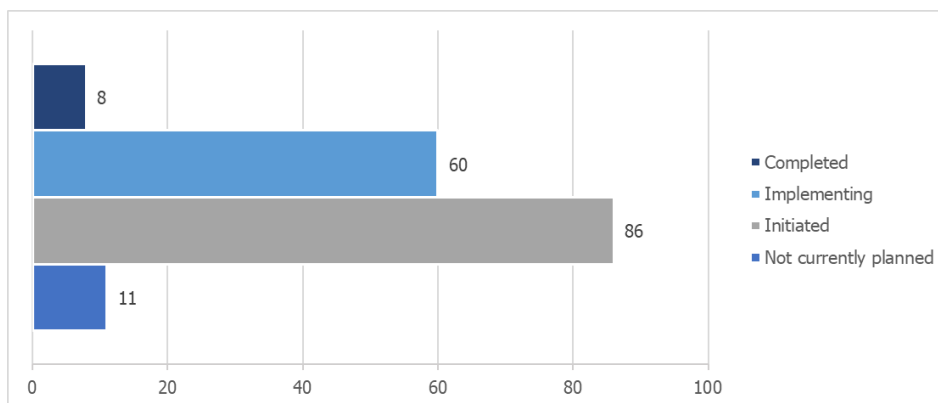


Figure 2 Progress against implementation of “Network Operation” Function (No. of steps-contributions of each organisation)

Figure 3 shows the number of unique steps that are led by each organisation type in the “Network Operation” Function. Most steps are led by DNOs, followed by T.E.F. steps. It should be noted that nearly 17% of the steps involve multiple organisations (e.g. DNOs, TOs, ESO). Details can be viewed in the Activities’ sections.

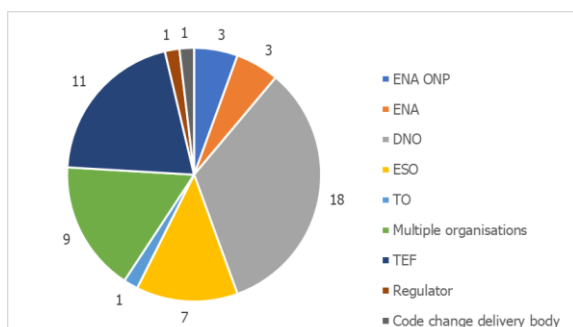


Figure 3 Number of steps led by organisation type in Function 2

Activity A: Operate network within thermal limits

Description: Use network asset rating and powerflow information and operate local distribution network assets within ratings.

Figure 4 illustrates the roadmap for activity A which consists of 12 unique steps:

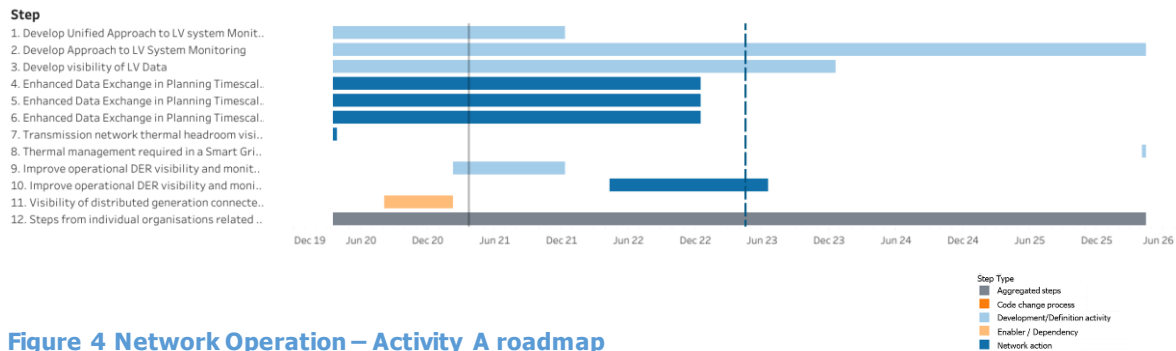


Figure 4 Network Operation – Activity A roadmap

Figure 5 shows the total number of organisations' contributions to the unique steps. As of March 2021 most steps (64%) of this activity are in the organisations' pipeline to implement but have not started yet ("Initiated"). Only 3 of them have been completed and just under 30% of the steps is being implemented.

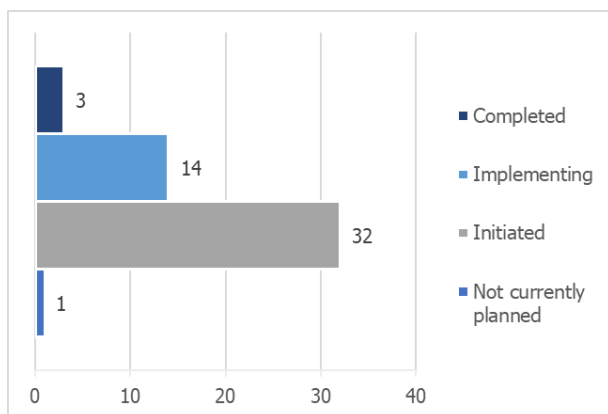


Figure 5 Progress against implementation of "Network Operation" – Activity A (No. of steps-contributions of each organisation)

The tables on the following pages provide detailed information for each step under Activity A.

Step 1

Step	Develop Unified Approach to LV system Monitoring and Visibility of LV Data
Step type:	Development / definition activity
Description:	The ENA Data working group will take forward recommendations from the Energy Data Taskforce and will focus on the digitalisation of the gas and electricity networks. This group will provide an overarching view across electricity and gas on the digitalisation strategy and network data requirements and this (further development and implementation planning) will be taken forward by the relevant working groups at ENA including the Open Networks project.
ENA ONP Product:	2018 WS3 P3
Timeline:	January 2018 - December 2021
Organisation type:	ENA(1)
Progress:	Implementing(1)
Additional information:	This step was identified by the Least Regret Analysis of the five Future Worlds, under Workstream 3 of ENA ONP. The implementation of the step is not in scope of the Open Networks. Link to the 2019 Least Regret Analysis document is found below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws3-p7-update-on-least-regrets-analysis.pdf

Step 2

Step	Develop Approach to LV System Monitoring
Step type:	Development / definition activity
Description:	DNOs to develop an approach for LV system monitoring that will contribute to more effective investment and operational decision making, using data from detailed, accurate system monitoring. Innovation projects such the WPD OpenLV and SSEN Low Cost Monitoring to provide findings and learnings for the development of the solution.
ENA ONP Product:	2018 WS3 P3
Timeline:	April 2015 - March 2028
Organisation type:	DNO(6)
Progress:	Initiated(3), Implementing(3)
Additional information:	This is a step for the DNOs, which was identified by the Least Regret Analysis of the five Future Worlds, under Workstream 3 of ENA ONP. This step is led by each DNO separately. DNOs have highlighted that enhanced monitoring and control will be assessed as part of ED2 submissions, which is also reflected in the timeline of the step (within RIIO-ED2). Smart meter roll-out has been mentioned as an enabler for this step. As per DNOs, cost effectiveness should also be considered when developing this step. Link to the 2019 Least Regret Analysis document is found below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws3-p7-update-on-least-regrets-analysis.pdf

Step 3

Step	Develop visibility of LV Data
Step type:	Development / definition activity
Description:	DNOs to develop an approach for enhanced visibility of LV data that will provide benefits to the network owner, customers, community and service providers. Innovation projects such the WPD OpenLV and SSEN Low cost monitoring to provide findings and learnings for the development of the solution.
ENA ONP Product:	2018 WS3 P3
Timeline:	January 2019 - December 2023
Organisation type:	DNO(6)
Progress:	Initiated(3), Implementing(3)
Additional information:	<p>This is a step for the DNOs, which was identified by the Least Regret Analysis of the five Future Worlds, under Workstream 3 of ENA ONP. This step is led by each DNO separately. DNOs have highlighted that enhanced monitoring and control will be assessed as part of ED2 submissions, which is also reflected in the timeline of the step (within RIIO-ED2).</p> <p>Barriers to the implementation of the step include but are not limited to lack of quality real-time data, limited or slow production capabilities, capabilities to meet strict security requirements, poor communications, cost of communications, data storage and third-party analytics. As per DNOs, cost effectiveness and data validation should also be considered when developing this step.</p> <p>Link to the 2019 Least Regret Analysis document is found below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws3-p7-update-on-least-regrets-analysis.pdf</p>

Step 4

Step	Enhanced Data Exchange in Planning Timescales - CIM Phase 1
Step type:	Network actions
Description:	Implementation of steps as per ENA ONP Workstream 1B Product 4 (2019) for Use of the IEC CIM standard for data exchange. Covers the implementation of the January 2020 ENA ONP Proposals for Implementation of Electronic Exchange of Network Planning Data. Step 1: Quantify data exchanges requirements. Step 2: Create the base profile using the ENTSOe CIM model.
ENA ONP Product:	2019 WS1B P4
Timeline:	March 2019 - December 2022
Organisation type:	TO(3), DNO(6)
Progress:	Initiated(6), Implementing(3)
Additional information:	<p>DNOs and TOs have planned to implement or are implementing this step. This step is also dependent on outcomes from the Data Working Group and Code Modification (GC0139), which is now considering the introduction of CIM. Outcomes of ENA ONP products can further inform the implementation of the step.</p> <p>Link to January's 2020 report below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws1b-p4-data-exchange-report.pdf</p>

Step 5

Step	Enhanced Data Exchange in Planning Timescales - CIM Phase 2
Step type:	Network actions
Description:	Implementation of steps as per ENA ONP Workstream 1B Product 4 (2019) for use of the IEC Common Information Model (CIM) standard for data exchange. Covers the implementation of the January 2020 ENA ONP Proposals for Implementation of Electronic Exchange of Network Planning Data. Step 3A: Each network company to assess their data and the implications of CIM adoption, Step 3B: Agree triggers for data exchange method.
ENA ONP Product:	2019 WS1B P4
Timeline:	January 2020 - December 2022
Organisation type:	DNO(6)
Progress:	Initiated(6)
Additional information:	This step is a continuation of step 4. ENA Data Working group activities and the Code Modification (GC0139) will inform this step. Link to January's 2020 report below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws1b-p4-data-exchange-report.pdf

Step 6

Step	Enhanced Data Exchange in Planning Timescales - CIM Phase 3
Step type:	Network actions
Description:	Implementation of steps as per ENA ONP Workstream 1B Product 4 (2019) for use of the IEC Common Information Model (CIM) standard for data exchange. Covers the implementation of the January 2020 ENA ONP Proposals for Implementation of Electronic Exchange of Network Planning Data. Step 4: Build and Test IT Solution.
ENA ONP Product:	2019 WS1B P4
Timeline:	January 2020 - December 2022
Organisation type:	DNO(6)
Progress:	Initiated(6)
Additional information:	This step is a continuation of step 4 and 5. ENA Data Working group activities and the Code Modification (GC0139) will inform this step. Link to January's 2020 report below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws1b-p4-data-exchange-report.pdf

Step 7

Step	Transmission network thermal headroom visibility
Step type:	Network actions
Description:	TOs to provide ESO with transmission network thermal headroom visibility based on asset condition. Submit health, criticality and risk factors of transmission network assets.
ENA ONP Product:	N/A
Timeline:	January 2019 - February 2020
Organisation type:	TO(3)
Progress:	Not currently planned(1), Completed(2)
Additional information:	This is a step relevant only for the TOs, which was agreed and identified during the Function Surgeries. The delivery of this step sits outside ENA ONP and is led by each TO. One TO is not planning to implement the step further, as there is no such requirement.

Step 8

Step	Thermal management required in a Smart Grid World
Step type:	Development / definition activity
Description:	Step draws on the data exchange and monitoring steps within this activity, testing whether they facilitate all future requirements of an established Smart Grid World. Thermal management Services to be developed in partnership with the ON-P (separate step under Service and Market). These will then be tested and a clearer understanding of the network impact determined through close working with industry actors (inc. Project LEO partners). This will include the exploration of "Emerging Market" impact.
ENA ONP Product:	N/A
Timeline:	N/A
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This is a step led by project TRANSITION. Timeline of the step is not available yet. More information on project TRANSITION below: https://ssen-transition.com/

Step 9

Step	Improve operational DER visibility and monitoring
Step type:	Development / definition activity
Description:	ENA Open Networks Workstream 1B Product 6 (2021) will define the needs cases for DER visibility and monitoring for the ESO and DNOs under a range of uses cases; define the functional specifications for these use cases; use these to derive a cost-benefit analysis framework for DER visibility and monitoring against the use cases; and undertake the cost-benefit analysis.
ENA ONP Product:	2021 WS1B P6
Timeline:	February 2021 - December 2021
Organisation type:	ENA ONP(1)
Progress:	Implementing(1)
Additional information:	For more information on this step please see the Projection Initiation Document (PID) link below: https://www.energynetworks.org/assets/images/Resource%20library/ON21-2021%20Project%20Initiation%20Document%20Pre%20Consultation-PUBLISHED.02.02.21.pdf

Step 10

Step	Improve operational DER visibility and monitoring
Step type:	Network actions
Description:	DNOs and the ESO to improve operational DER visibility and monitoring, based on outcomes of ENA Open Networks project (2021 workstream 1B Product 6). ENA ONP's work will articulate the uses and needs for DG and DER visibility. DNOs and the ESO to use these outcomes as an input into the roll-out and specification of monitoring equipment DER sites.
ENA ONP Product:	2021 WS1B P6
Timeline:	April 2022 - June 2023
Organisation type:	ESO(1), DNO(6)
Progress:	Initiated(7)
Additional information:	For more information on this step please see the Projection Initiation Document (PID) link below: https://www.energynetworks.org/assets/images/Resource%20library/ON21-2021%20Project%20Initiation%20Document%20Pre%20Consultation-PUBLISHED.02.02.21.pdf

Step 11

Step	Visibility of distributed generation connected to the GB distribution networks
Step type:	Enablers / Dependencies / Barriers
Description:	In August 2020, Ofgem published a call for evidence on DG visibility, clearly signalling their intention to establish a clear policy on DG monitoring requirements. Ofgem to publish their conclusions and next steps following analysis of industry's responses to the consultation
ENA ONP Product:	N/A
Timeline:	August 2020 - February 2021
Organisation type:	Regulator(1)
Progress:	Completed(1)
Additional information:	

Step 12

Step	Steps from individual organisations related to this activity
Step type:	Aggregated steps
Description:	This step aggregates steps required for individual DNOs or TOs to implement DSO functionality, but which have no wider industry relevance.
ENA ONP Product:	N/A
Timeline:	October 2015 - March 2028
Organisation type:	DNO(3)
Progress:	Implementing(3)
Additional information:	Individual steps added by DNOs will contribute to enhancement of network visibility, real-time control and implementation of dynamic asset rating solutions.

Activity B: Operate network within voltage limits

Description: Model network powerflows and operate distribution network assets within secure voltage limits.

Figure 6 illustrates the roadmap for activity B which consists of 9 unique steps:

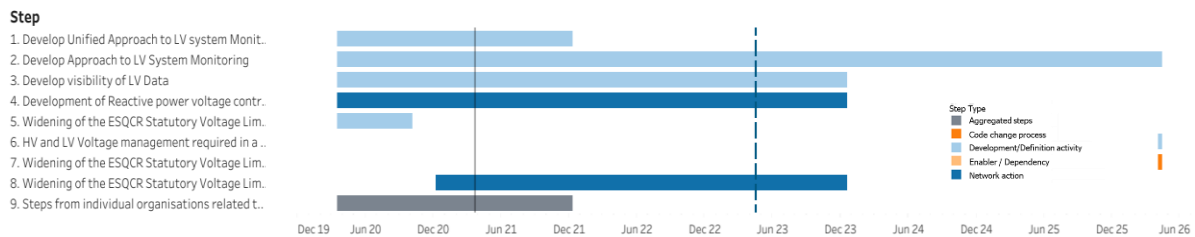


Figure 6 Network Operation – Activity B roadmap

Figure 7 shows that as of March 2021 roughly half (~52%) of the steps of this activity is in the organisations' pipeline to implement but have not started yet ("Initiated"). ~13% of organisations' responses show that they are not currently planning to implement the steps, while just over a third of the steps is under implementation.

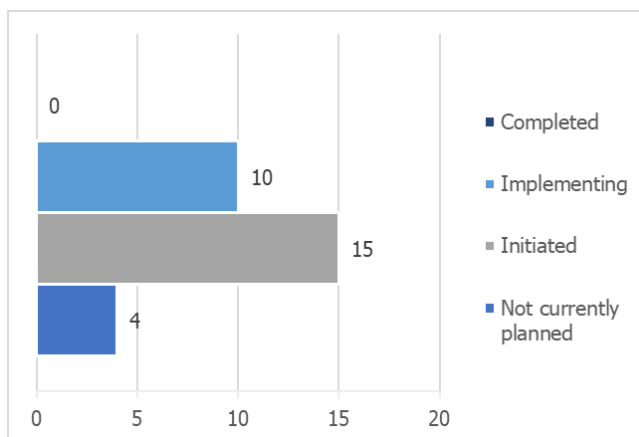


Figure 7 Progress against implementation of "Network Operation" – Activity B (No. of steps-contributions of each organisation)

The tables on the following pages provide detailed information for each step under Activity B.

Step 1

Step	Develop Unified Approach to LV system Monitoring and Visibility of LV Data
Step type:	Development / definition activity
Description:	The ENA Data working group will take forward recommendations from the Energy Data Taskforce and will focus on the digitalisation of the gas and electricity networks. This group will provide an overarching view across electricity and gas on the digitalisation strategy and network data requirements and this (further development and implementation planning) will be taken forward by the relevant working groups at ENA including the Open Networks project.
ENA ONP Product:	2018 WS3 P3
Timeline:	January 2018 - December 2021
Organisation type:	ENA(1)
Progress:	Implementing(1)
Additional information:	This step was identified by the Least Regret Analysis of the five Future Worlds, under Workstream 3 of ENA ONP. The implementation of the step is not in scope of the Open Networks. Link to the 2019 Least Regret Analysis document is found below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws3-p7-update-on-least-regrets-analysis.pdf

Step 2

Step	Develop Approach to LV System Monitoring
Step type:	Development / definition activity
Description:	DNOs to develop an approach for LV system monitoring that will contribute to more effective investment and operational decision making, using data from detailed, accurate system monitoring. Innovation projects such the WPD OpenLV and SSEN Low Cost Monitoring to provide findings and learnings for the development of the solution.
ENA ONP Product:	2018 WS3 P3
Timeline:	April 2015 - March 2028
Organisation type:	DNO(6)
Progress:	Initiated(3), Implementing(3)
Additional information:	This is a step for the DNOs, which was identified by the Least Regret Analysis of the five Future Worlds, under Workstream 3 of ENA ONP. This step is led by each DNO separately. DNOs have highlighted that enhanced monitoring and control will be assessed as part of ED2 submissions, which is also reflected in the timeline of the step (within RIIO-ED2). Smart meter roll-out has been mentioned as an enabler for this step. As per DNOs, cost effectiveness should also be considered when developing this step. Link to the 2019 Least Regret Analysis document is provided below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws3-p7-update-on-least-regrets-analysis.pdf

Step 3

Step	Develop visibility of LV Data
Step type:	Development / definition activity
Description:	DNOs to develop an approach for enhanced visibility of LV data that will provide benefits to the network owner, customers, community and service providers. Innovation projects such the WPD OpenLV and SSEN Low cost monitoring to provide findings and learnings for the development of the solution.
ENA ONP Product:	2018 WS3 P3
Timeline:	January 2019 - December 2023
Organisation type:	DNO(6)
Progress:	Initiated(3), Implementing(3)
Additional information:	<p>This is a step for the DNOs, which was identified by the Least Regret Analysis of the five Future Worlds, under Workstream 3 of ENA ONP. This step is led by each DNO separately. DNOs have highlighted that enhanced monitoring and control will be assessed as part of ED2 submissions, which is also reflected in the timeline of the step (within RIIO-ED2).</p> <p>Barriers to the implementation of the step include but are not limited to lack of quality real-time data, limited or slow production capabilities, capabilities to meet strict security requirements, poor communications, cost of communications, data storage and third-party analytics. As per DNOs, cost effectiveness and data validation should also be considered when developing this step.</p> <p>Link to the 2019 Least Regret Analysis document is provided below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws3-p7-update-on-least-regrets-analysis.pdf </p>

Step 4

Step	Development of Reactive power voltage control services.
Step type:	Network actions
Description:	Use Active Network Management to send dynamic set-points to voltage control relays
ENA ONP Product:	N/A
Timeline:	November 2019 - December 2023
Organisation type:	DNO(6)
Progress:	Not currently planned(2), Initiated(3), Implementing(1)
Additional information:	<p>This step is driven by the DNOs, outside the ENA ONP workstreams. Some of the barriers, flagged by DNOs, is the low participation in reactive power service markets and lack of learnings and standardisation.</p> <p>Two DNOs are not currently planning to implement the step on the basis that there are not such requirements yet.</p>

Step 5

Step	Widening of the ESQCR Statutory Voltage Limits
Step type:	Development / definition activity
Description:	The ENA's Statutory Voltage Group considers the widening of ESQCR statutory voltage limits in the UK. The group is currently running a project which is investigating the effects (on domestic appliances) of widening of ESQCR statutory voltage limits.
ENA ONP Product:	N/A
Timeline:	March 2020 - October 2020
Organisation type:	ENA(1)
Progress:	Implementing(1)
Additional information:	This is a step led by ENA. -The project aims to be completed by Oct. 2020, although things might slightly change due to COVID-19 and the fact that phase 2 will have to take place on site. This step is linked to steps 7 and 8.

Step 6

Step	HV and LV Voltage management required in a Smart Grid World
Step type:	Development / definition activity
Description:	Voltage management Services to be developed in partnership with the ON-P (separate step). These will then be tested and a clearer understanding of the HV and LV impact determined through close working with industry actors (inc. Project LEO partners). This will include the exploration of "Emerging Market" impact.
ENA ONP Product:	N/A
Timeline:	N/A
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This step was added by TRANSITION. More information on projects TRANSITION and LEO below: https://ssen-transition.com/ https://ssen-transition.com/dso/leo/

Step 7

Step	Widening of the ESQCR Statutory Voltage Limits
Step type:	Code change process
Description:	A code modification may be required following the recommendations of ENA's work on the widening of ESQCR statutory voltage limit.
ENA ONP Product:	N/A
Timeline:	N/A
Organisation type:	Delivery Body
Progress:	Initiated(1)
Additional information:	This step is dependent on Step 5. Potential timeline for completion is now known at this stage.

Step 8

Step	Widening of the ESQCR Statutory Voltage Limits
Step type:	Network actions
Description:	DNOs to implement changes for the adoption of the potential Code Modification related to the widening of ESQCR statutory voltage limit.
ENA ONP Product:	N/A
Timeline:	December 2020 - December 2023
Organisation type:	DNO(6)
Progress:	Not currently planned(2), Initiated(4)
Additional information:	This step is linked to Step 5 and 7. ENA Project on ESQCR Statutory Voltage Limits will inform next steps for DNOs. Inadequate understanding of impact on LV customer domestic appliances and legislation changes have been flagged as barriers by DNOs.

Step 9

Step	Steps from individual organisations related to this activity
Step type:	Aggregated steps
Description:	This step aggregates steps required for individual DNOs or TOs to implement DSO functionality, but which have no wider industry relevance.
ENA ONP Product:	N/A
Timeline:	January 2017 - December 2021
Organisation type:	DNO(1)
Progress:	Implementing(1)
Additional information:	One DNO has added a step for the development of Automatic Dispatch of reactive power from DER to provide DSO Voltage control services to ESO.

Activity C: Operate network to maintain dynamic stability

Description: Operate distribution networks such that the network and its connected resources (e.g. generators) remain stable for secured faults.

Figure 8 illustrates the roadmap for activity C which consists of 1 unique step:

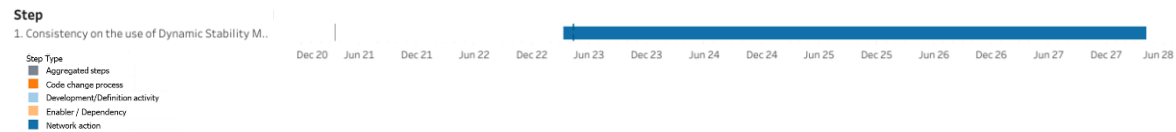


Figure 8 Network Operation – Activity C roadmap

The table below includes the details of the unique step that sits under the activity C.

Step 1

Step	Consistency on the use of Dynamic Stability Mechanisms
Step type:	Network actions
Description:	Develop consistent approach on the use of Dynamic Stability Mechanisms (to manage power quality) utilising ancillary services.
ENA ONP Product:	2018 WS3 P3
Timeline:	March 2023 - March 2028
Organisation type:	DNO(6)
Progress:	Not currently planned(3), Initiated(3)
Additional information:	<p>This is a step for the DNOs, which was identified by the Least Regret Analysis of the five Future Worlds, under Workstream 3 of ENA ONP. This step is led by each DNO separately.</p> <p>DNOs are still exploring what the requirements for delivering this step are. They also highlighted that they need to better understand practical solutions that can be provided by customers/DER.</p> <p>As per DNOs, this step is also dependant on telecommunications and ANM roll out.</p> <p>Link to the 2019 Least Regret Analysis document is found below: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2019-ws3-p7-update-on-least-regrets-analysis.pdf </p>

Activity D: Operate network within fault level limits

Description: Model network infeeds and contingencies to ensure that equipment and connected resources remain within short circuit ratings and within protection limits.

Figure 9 illustrates the roadmap for activity D which consists of 3 unique steps:

Step

1. Prevention and/or management of fault level ..
2. Use centralised and/or local management sys..
3. Steps from individual organisations related t..

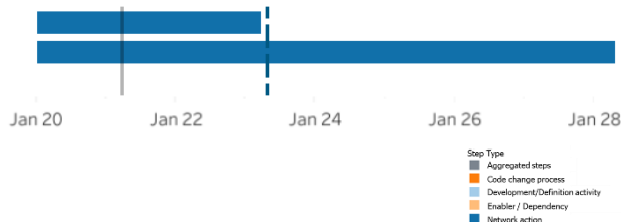


Figure 9 Network Operation – Activity D roadmap

Figure 10 shows the total number of organisations' contributions to the unique steps. As of March 2021 nearly half of the steps of this activity are in the organisations' pipeline to implement but have not started yet ("Initiated") and almost 40% of the steps are under implementation.

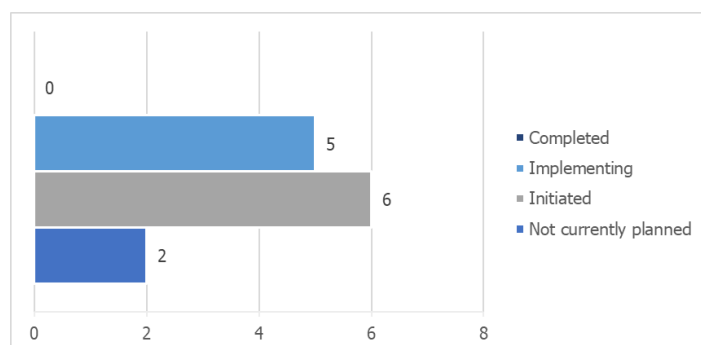


Figure 10 Progress against implementation of "Network Operation" – Activity D (No. of steps-contributions of each organisation)

The tables on the following pages provide detailed information for each step under Activity D.

Step 1

Step	Prevention and/or management of fault level issues through enhanced fault level monitoring.
Step type:	Network actions
Description:	Utilise fault level monitors to pre-empt and/or manage fault issues on the network, using proactive network operations.
ENA ONP Product:	N/A
Timeline:	January 2018 - March 2023
Organisation type:	DNO(6)
Progress:	Not currently planned(1), Initiated(3), Implementing(2)
Additional information:	This step is driven by the DNOs, outside the ENA ONP workstreams. One DNO has not planned for developing this functionality yet, but they will consider it in the future as a potential solution to future fault level issues.

Step 2

Step	Use centralised and/or local management systems to maintain fault levels.
Step type:	Network actions
Description:	When DNOs use solutions such as Power Electronic Devices to reconfigure the network, they can also use centralised and/or local management systems (e.g. ANM) to optimise the network and ensure fault levels are not breached.
ENA ONP Product:	N/A
Timeline:	December 2009 - March 2028
Organisation type:	DNO(6)
Progress:	Not currently planned(1), Initiated(2), Implementing(3)
Additional information:	This step is driven by the DNOs, outside the ENA ONP workstreams. Maturity of equipment and technology solutions were mentioned as a barrier. Innovation projects such as UKPN's Active Response could provide learnings for the implementation of this step.

Step 3

Step	Steps from individual organisations related to this activity
Step type:	Aggregated steps
Description:	This step aggregates steps required for individual DNOs or TOs to implement DSO functionality, but which have no wider industry relevance.
ENA ONP Product:	N/A
Timeline:	N/A
Organisation type:	DNO(1)
Progress:	Initiated(1)
Additional information:	One DNO is planning one step related to monitoring and limiting fault levels.

Activity E: Operate network to meet other power quality criteria

Description: Review and monitor potential for other power quality problems including harmonics and unbalance and operate network to avoid these.

Figure 11 illustrates the roadmap for activity E which consists of 1 unique step:

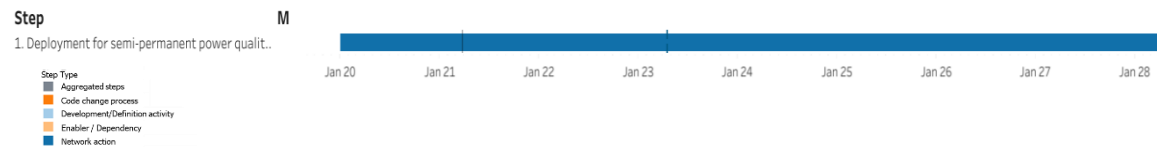


Figure 11 Network Operation – Activity E roadmap

The table below includes the details of the unique step that sits under the activity E.

Step 1

Step	Deployment for semi-permanent power quality monitoring.
Step type:	Network actions
Description:	The rolling out across the network of power quality meters, triggering power quality events proactively without waiting for customer complaints.
ENA ONP Product:	N/A
Timeline:	January 2017 - March 2028
Organisation type:	DNO(6)
Progress:	Initiated(4), Implementing(2)
Additional information:	This step is driven by the DNOs, outside the ENA ONP workstreams to address power quality issues related to the increase in the use of Low Carbon Technologies (LCT).

Activity F: Operate network taking account of ongoing asset condition

Description: Monitor the condition of assets and adjust operation on the basis of latest condition.

Figure 12 illustrates the roadmap for activity F which consists of 4 unique steps:

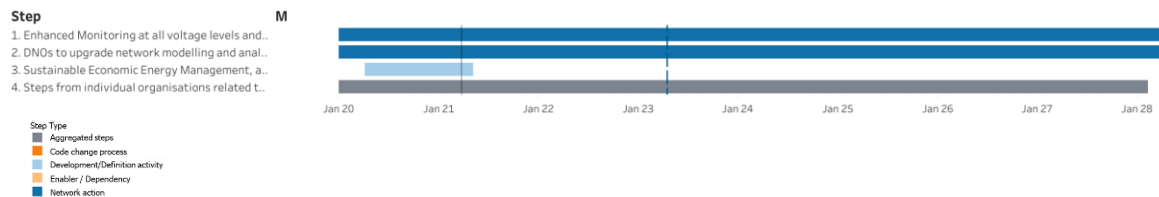


Figure 12 Network Operation – Activity F roadmap

Figure 13 shows the total number of organisations' contributions to the unique steps. As of March 2021 40% of the steps of this activity are in the organisations' pipeline to implement but have not started yet ("Initiated"). The remaining 60% of steps are being implemented.

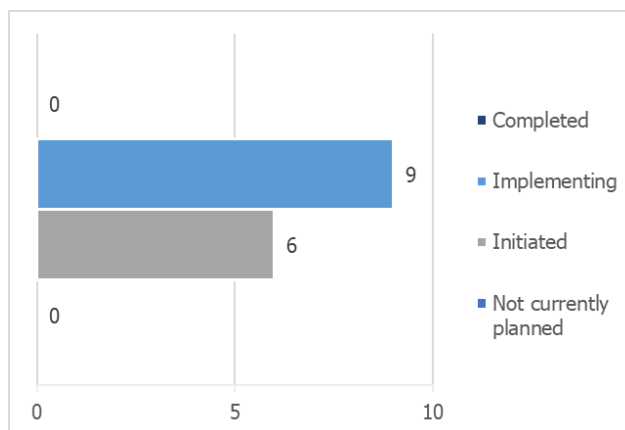


Figure 13 Progress against implementation of "Network Operation" – Activity F (No. of steps-contributions of each organisation)

The tables on the following pages provide detailed information for each step under Activity F.

Step 1

Step	Enhanced Monitoring at all voltage levels and integration with core systems.
Step type:	Network actions
Description:	Installing additional network monitoring equipment linked via SCADA to network control systems e.g. CTS, VTs, Temperature sensors, humidity sensors.
ENA ONP Product:	N/A
Timeline:	April 2015 - March 2028
Organisation type:	DNO(6)
Progress:	Initiated(2), Implementing(4)
Additional information:	<p>This step is driven by DNOs, outside the ENA ONP workstreams. Some of the barriers that DNOs raised are the high cost and complexity of this action, the implementation of which could be completed within RIIO-ED2 funding period. As per DNOs, current control systems cannot support new monitoring equipment or updated cyber security rules.</p> <p>This step can be a key enabler to Active Network Management (ANM), flexible services, flexible connections, peer to peer trading, investment planning, forecasting and data exchanges.</p>

Step 2

Step	DNOs to upgrade network modelling and analysis capability.
Step type:	Network actions
Description:	Upgrade network modelling capability (new tools, data quality issues fixed) in order to support increased functionalities for design and operational purposes (new) at all voltage level. New purposes include prediction of electrical load, real time management of power flow, CIM where appropriate for data transfers, and integrated asset monitoring with ANM or central control system.
ENA ONP Product:	N/A
Timeline:	January 2019 - March 2028
Organisation type:	DNO(6)
Progress:	Initiated(1), Implementing(5)
Additional information:	<p>This step is driven by DNOs, outside the ENA ONP workstreams. Update network management systems (NMS), enhanced network management capabilities (ANM) and network modelling tools will enable the implementation of this step.</p>

Step 3

Step	Sustainable Economic Energy Management, assessing viability over time.
Step type:	Development / definition activity
Description:	MERLIN (accessible via the TRANSITION project) is testing possible approaches to ongoing management of services from an economic perspective. The solution may still be technically sufficient, but financially unviable. Changes to the network including asset condition are to be considered.
ENA ONP Product:	N/A
Timeline:	April 2020 - May 2021
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This step was added by TRANSITION Project. For more information on project TRANSITION, see link below: https://ssen-transition.com/

Step 4

Step	Steps from individual organisations related to this activity
Step type:	Aggregated steps
Description:	This step aggregates steps required for individual DNOs or TOs to implement DSO functionality, but which have no wider industry relevance.
ENA ONP Product:	N/A
Timeline:	April 2015 - January 2028
Organisation type:	DNO(2)
Progress:	Initiated(2)
Additional information:	Individual organisations' steps are related to integration of asset monitoring devices with ANM/Central Control Systems and developing capability to drive ANM at LV level.

Activity G: Operate network to minimise losses

Description: Model network powerflows to ensure that losses on distribution network are minimised.

Figure 14 illustrates the roadmap for activity G which consists of 3 unique steps:

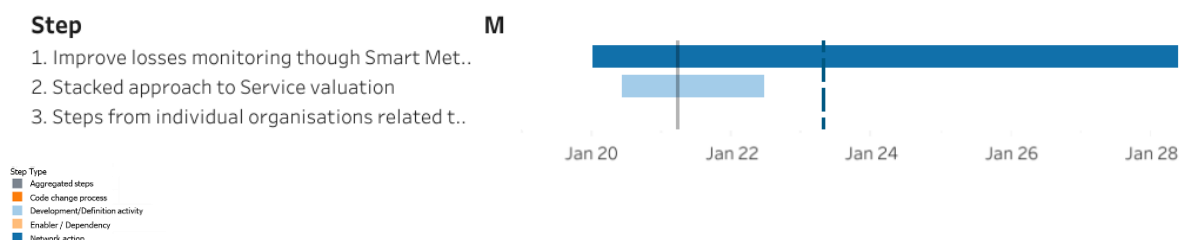


Figure 14 Network Operation – Activity G roadmap

Figure 15 shows the total number of organisations' contributions to the unique steps. As of March 2021 half of the steps in this activity are being implemented, and the other half are planned.

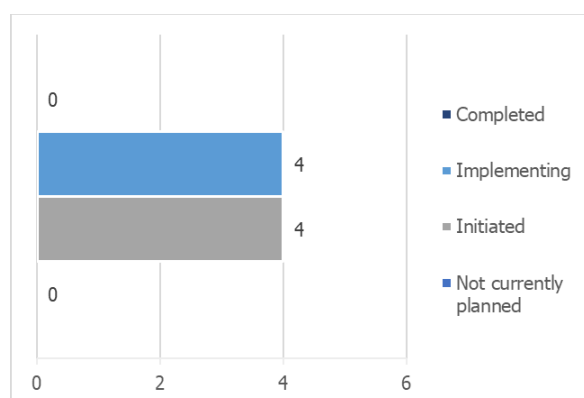


Figure 15 Progress against implementation of "Network Operation" – Activity G (No. of steps-contributions of each organisation)

The tables on the following pages provide detailed information for each step under Activity G.

Step 1

Step	Improve losses monitoring through Smart Meter and LV data.
Step type:	Network actions
Description:	DNOs to use Smart Meter and LV monitoring data to track and understand losses.
ENA ONP Product:	N/A
Timeline:	April 2015 - April 2028
Organisation type:	DNO(6)
Progress:	Initiated(2), Implementing(4)
Additional information:	The roll-out of Smart Meters would be a key enabler to this step, as low density of Smart Meters does not facilitate the development of the step. Some other challenges raised by DNOs are the data availability, time synchronisation, computational power and cost effectiveness. 2017 CIRED publication 'Analyzing the ability of Smart Meter Data to Provide Accurate Information to the UK DNOs' is relevant for this step. The publication can be viewed at http://cired.net/publications/cired2017/pdfs/CIRED2017_0654_final.pdf

Step 2

Step	Stacked approach to Service valuation
Step type:	Development / definition activity
Description:	Stacked approach to Service valuation for the longer term when markets are more developed. Inclusion of layers such as losses. Specifically, via TRANSITION and its inclusion within the Oxfordshire Programme which comprises of TRANSITION, Project LEO and MERLIN.
ENA ONP Product:	N/A
Timeline:	June 2020 - June 2022
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This step was added by TRANSITION. More information on the projects can be found below: https://ssen-transition.com/ https://ssen-transition.com/dso/leo/

Step 3

Step	Steps from individual organisations related to this activity
Step type:	Aggregated steps
Description:	This step aggregates steps required for individual DNOs or TOs to implement DSO functionality, but which have no wider industry relevance.
ENA ONP Product:	N/A
Timeline:	N/A
Organisation type:	DNO(1)
Progress:	Initiated(1)
Additional information:	One DNO is considering a step related to Smart Meters and LV monitoring, although they step is not currently planned for implementation.

Activity H: Enable network outages to provide access and resources

Description: Forward planning and ongoing operation to ensure that network security is maintained during network outages and outages of key DER.

Figure 16 illustrates the roadmap for activity H which consists of 8 unique steps:

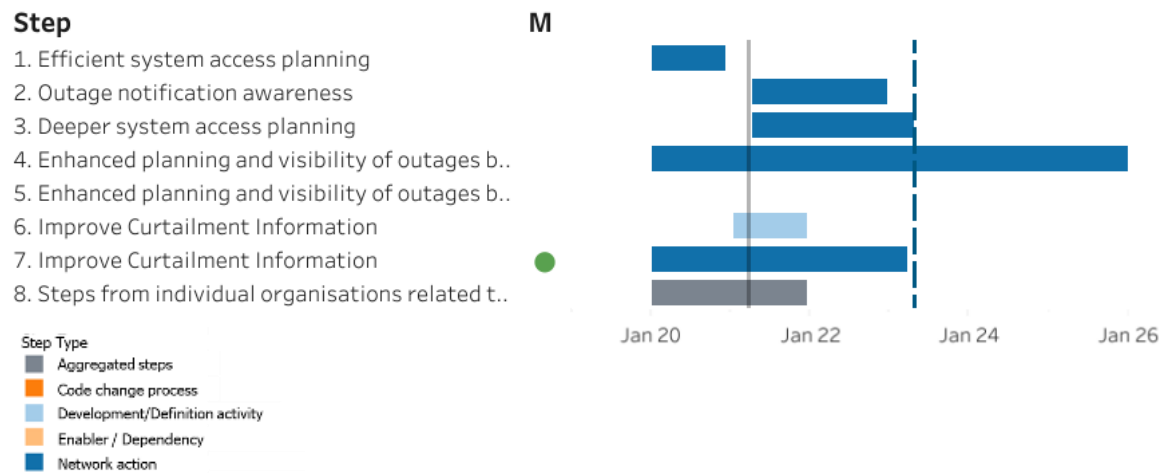


Figure 16 Network Operation – Activity H roadmap

Figure 17 shows the total number of organisations' contributions to the unique steps. As of March 2021 just under 45% of the steps are in organisations' pipeline for implementation. Roughly 38% of steps are being implemented and 2 steps have been completed.

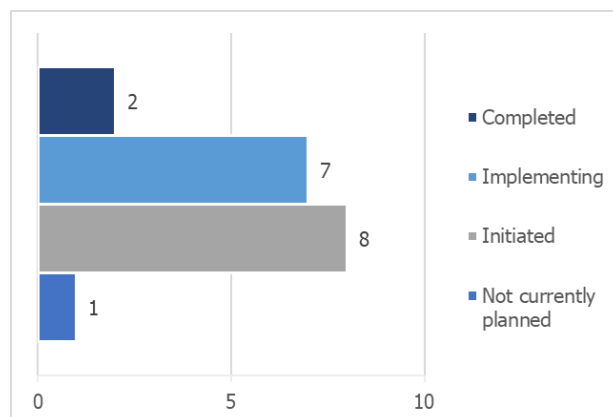


Figure 17 Progress against implementation of "Network Operation" – Activity H (No. of steps-contributions of each organisation)

The tables on the following pages provide detailed information for each step under Activity H.

Step 1

Step	Efficient system access planning
Step type:	Network actions
Description:	Develop ways to work more efficiently with network stakeholders (leading to fewer outage cancellations and less re-work) which will lead to a more efficient use of time for the ESO and network licencees.
ENA ONP Product:	N/A
Timeline:	April 2019 - December 2020
Organisation type:	ESO(1)
Progress:	Completed(1)
Additional information:	This Is an ESO-led step included in the ESO forward plan: https://www.nationalgrideso.com/document/166441/download

Step 2

Step	Outage notification awareness
Step type:	Network actions
Description:	Widen the scope of outage planning notification tools ensuring that affected customers connected to distribution networks are aware of any transmission restrictions. This will also facilitate the development of DER markets to facilitate network outages.
ENA ONP Product:	N/A
Timeline:	April 2021 - December 2022
Organisation type:	ESO(1)
Progress:	Implementing(1)
Additional information:	This is an ESO-led step included in the RIIO-2 Business Plan: https://www.nationalgrideso.com/document/158051/download

Step 3

Step	Deeper system access planning
Step type:	Network actions
Description:	Work more closely with DNOs and distributed energy resources (DER) to facilitate network access. Extend existing operational planning practices with DNOs to ensure coordinated procurement of DER services facilitating efficient release of network assets for construction and maintenance requirements.
ENA ONP Product:	N/A
Timeline:	April 2021 - April 2023
Organisation type:	ESO(1)
Progress:	Implementing(1)
Additional information:	This Is an ESO-led step included in the ESO forward plan: https://www.nationalgrideso.com/document/166441/download

Step 4

Step	Enhanced planning and visibility of outages based on data analytics and contingency analysis.
Step type:	Network actions
Description:	Publish timely and consistent outage data based on data analytics and contingency analysis. Using outages as part of the active network management function to be able to execute active control actions in enabling more access to customers. Long term (12mths) and short term (1-5 days) load and generation forecasting will be required to inform the process.
ENA ONP Product:	N/A
Timeline:	January 2015 - December 2025
Organisation type:	DNO(6)
Progress:	Not currently planned(1), Initiated(2), Implementing(3)
Additional information:	This is a step led by DNOs, outside ENA ONP workstreams. Smart meters roll-out is an enabler to this functionality. Lack of quality monitoring at a sufficient granularity is a potential barrier to quantity and quality of shared data. Outcomes of UKPN'S NIC KASM project and T.E.F. projects could inform developments in this step. Some DNOs already provide both live and planned outage data on their website.

Step 5

Step	Enhanced planning and visibility of outages based on data analytics and contingency analysis.
Step type:	Development / definition activity
Description:	DNOs lead this step in the short term, T.E.F. to develop and test innovative approaches for the longer term.
ENA ONP Product:	N/A
Timeline:	N/A
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This step is linked to Step 4 and will inform next steps for DNOs for the longer-term.

Step 6

Step	Improve Curtailment Information
Step type:	Development / definition activity
Description:	2021 WS1A P9 will consider the approach to delivering accurate and timely curtailment information that is more granular, provided more frequently, and available at individual asset level. It will set out the initial approach to developing a curtailment information strategy with phased delivery of improved curtailment information ahead of ED2.
ENA ONP Product:	2021 WS1A P9
Timeline:	January 2021 - December 2021
Organisation type:	ENA ONP(1)
Progress:	Implementing(1)
Additional information:	For more information on this step please see the Project Initiation Document (PID) link below: https://www.energynetworks.org/assets/images/Resource%20library/ON21-2021%20Project%20Initiation%20Document%20Pre%20Consultation-PUBLISHED.02.02.21.pdf

Step 7

Step	Improve Curtailment Information
Step type:	Network actions
Description:	Based on 2021 WS1A P9 outcomes, DNOs to implement plans to delivery improvements in the provision of curtailment information. Implementation to take place 2022 and to be completed ahead of ED2.
ENA ONP Product:	2021 WS1A P9
Timeline:	January 2019 - March 2023
Organisation type:	DNO(6)
Progress:	Initiated(5), Implementing(1)
Additional information:	For more information on this step please see the Project Initiation Document (PID) link below: https://www.energynetworks.org/assets/images/Resource%20library/ON21-2021%20Project%20Initiation%20Document%20Pre%20Consultation-PUBLISHED.02.02.21.pdf

Step 8

Step	Steps from individual organisations related to this activity
Step type:	Aggregated steps
Description:	This step aggregates steps required for individual DNOs or TOs to implement DSO functionality, but which have no wider industry relevance.
ENA ONP Product:	N/A
Timeline:	March 2019 - December 2021
Organisation type:	DNO(1)
Progress:	Completed(1)
Additional information:	

Activity I: Optimised use of assets and dispatch of services

Description: Utilise available resources in the most efficient way to operate within network limits.
Utilise available resources in the most efficient way to operate within network limits.

Figure 18 illustrates the roadmap for activity I which consists of 13 unique steps:

Step

1. Visibility of data at operational level
2. Enhance balancing capability
3. Enhance training and simulation with DNOs a..
4. ANM Implementation
5. Receiving and Understanding Flexibility Mark..
6. Visibility of data at operational level - EFFT
7. Visibility of data at operational level
8. Flexibility Market Data
9. Asset Data - D-Programmes
10. Control Centre architecture and systems
11. Network Control Transformation
12. Upgrade Control Centre Architecture
13. Steps from individual organisations related ..

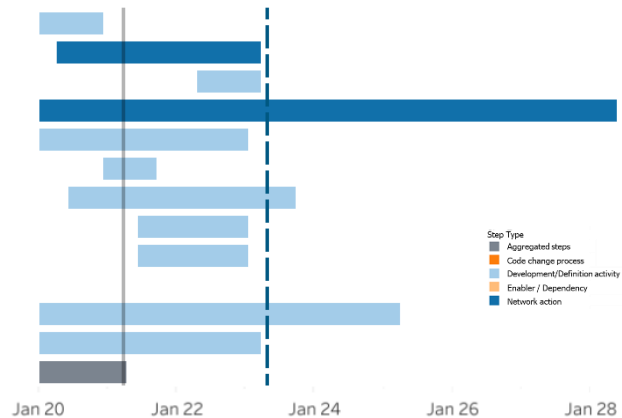


Figure 18 Network Operation – Activity I roadmap

Figure 19 shows the total number of organisations' contributions to the unique steps. As of March 2021 40% of the steps of this activity are in the organisations' pipeline to implement but have not started yet ("Initiated"). Three of the steps have been completed and 45% of the steps are being implemented.

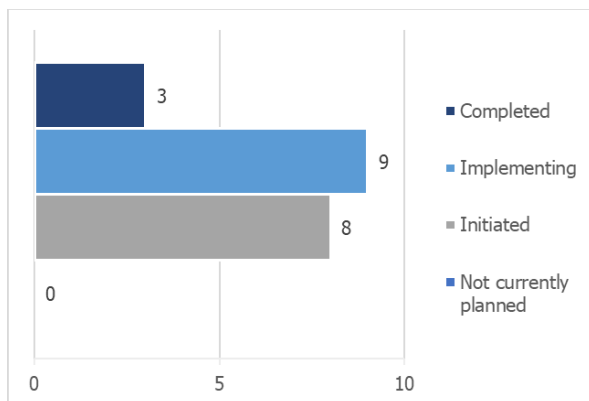


Figure 19 Progress against implementation of "Network Operation" – Activity I (No. of steps-contributions of each organisation)

The tables on the following pages provide detailed information for each step under Activity I.

Step 1

Step	Visibility of data at operational level
Step type:	Development / definition activity
Description:	ENA ONP Workstream 1B Product 3 (2020) covers Real Time Data Exchange & Priority of Actions and seeks to define and agree which data should be available and visible at an operational level.
ENA ONP Product:	2020 WS1B P3
Timeline:	January 2020 - December 2020
Organisation type:	ENA ONP(1)
Progress:	Completed(1)
Additional information:	<p>This is an ENA ONP-LED. More information can be found at the OTS Functional Design and Data Exchange Requirements Report, link below:</p> <p>https://www.energynetworks.org/assets/images/ON20-WS1B-P3%20OTS%20Requirements-PUBLISHED.23.12.20.pdf</p>

Step 2

Step	Enhance balancing capability
Step type:	Network actions
Description:	ESO to develop enhanced balancing capability in real time by scheduling and dispatching market participants in a cost effective way. Significant investment will be needed to deal with greater decentralisation of providers and to accommodate closer-to-real-time GB and European markets.
ENA ONP Product:	N/A
Timeline:	April 2020 - March 2023
Organisation type:	ESO(1)
Progress:	Initiated(1)
Additional information:	

Step 3

Step	Enhance training and simulation with DNOs and wider industry
Step type:	Development / definition activity
Description:	Engage with DNOs to understand how the ESO can provide the initial training for distribution system operation control room engineers. Provide training on modelling and training on whole system solutions and interfaces.
ENA ONP Product:	N/A
Timeline:	April 2022 - March 2023
Organisation type:	ESO(1)
Progress:	Initiated(1)
Additional information:	

Step 4

Step	ANM Implementation
Step type:	Network actions
Description:	DNOs have implemented ANM in BAU scenarios to maximise generation capacity availability in areas of constraint. Ongoing refinement has resulted in decreasing costs for connecting customers and increasing confidence for DNO's in the implementation of these systems.
ENA ONP Product:	N/A
Timeline:	December 2011 - March 2028
Organisation type:	DNO(6)
Progress:	Initiated(1), Implementing(3), Completed(2)
Additional information:	This is a DNOs-led step, outside the ENA ONP workstreams.

Step 5

Step	Receiving and Understanding Flexibility Market/ Asset Data
Step type:	Development / definition activity
Description:	DNOs to further develop the ability to receive and incorporate third party data from several sources into network planning and operation. This can include, but is not limited to, individual asset metering, settlement data, load/generation forecasts and data from other markets for co-ordination
ENA ONP Product:	N/A
Timeline:	January 2020 - December 2022
Organisation type:	TEF(3)
Progress:	Initiated(1), Implementing(2)
Additional information:	This is common steps for all 3 T.E.F. projects. More information on the project can be found below: https://www.westernpower.co.uk/projects/effs https://www.spenergynetworks.co.uk/pages/fusion.aspx https://ssen-transition.com/

Step 6

Step	Visibility of data at operational level - EFFT
Step type:	Development / definition activity
Description:	EFFT to inform consideration of data availability and visibility at operational level, through developing and testing data exchanges to support conflict identification and resolution.
ENA ONP Product:	N/A
Timeline:	December 2020 - September 2021
Organisation type:	TEF(1)
Progress:	Implementing(1)
Additional information:	This is a step led by EFFT. Outcomes of the project will inform step 1. More information on project EFFT below: https://www.westernpower.co.uk/projects/efft

Step 7

Step	Visibility of data at operational level
Step type:	Development / definition activity
Description:	Develop requirements for the visibility of operational data for a time when DSO Service and P2P markets are relatively mature. Such requirements will be tested through trials and are designed to build on the work of WS1B P3 where practicable.
ENA ONP Product:	N/A
Timeline:	June 2020 - September 2023
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This is a step led by TRANSITION. Outcomes of the project will inform step 1. More information on project TRANSITION below: https://ssen-transition.com/

Step 8

Step	Flexibility Market Data
Step type:	Development / definition activity
Description:	In order to optimise the use of assets and services, the DNO requires a clear picture of the flexibility market across a range of timescales. This may encompass multiple markets. FUSION will consider this as part of its trials.
ENA ONP Product:	N/A
Timeline:	June 2021 - December 2022
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This is a step led by FUSION. More information on the FUSION Project below: https://www.spenergynetworks.co.uk/pages/fusion.aspx

Step 9

Step	Asset Data - D-Programmes
Step type:	Development / definition activity
Description:	Consider/test the ability to receive and consume regular asset or aggregator D-programmes that allow for a more accurate market picture as part of system optimisation.
ENA ONP Product:	N/A
Timeline:	June 2021 - December 2022
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This is a step led by FUSION. More information on the FUSION Project below: https://www.spenergynetworks.co.uk/pages/fusion.aspx

Step 10

Step	Control Centre architecture and systems
Step type:	Development / definition activity
Description:	In addition to the visibility of data at operational levels, the control centre design at distribution level is being considered by T.E.F. as a consortium. Additional innovation through collaboration between SSEN, UKPN and the PNDC which will tie into T.E.F. over the coming years.
ENA ONP Product:	N/A
Timeline:	N/A
Organisation type:	TEF(1)
Progress:	Initiated(1)
Additional information:	This is a step led by TRANSITION. More information on project TRANSITION below: https://ssen-transition.com/

Step 10

Step:	Network Control Transformation
Step type:	Development / definition activity
Description:	Transform network control by building a new real-time situational awareness tool, enhancing network modelling capabilities, upgrading IT & Telecomms system and operational liaison with DNOs.
ENA ONP Product:	N/A
Timeline:	January 2020 - March 2025
Organisation type:	ESO(1)
Progress:	Implementing(1)
Additional information:	

Step 11

Step:	Upgrade Control Centre Architecture
Step type:	Development / definition activity
Description:	Upgrade control centre systems using digital twin technology, a sandbox environment and shadow control room to test and inform the development of our new balancing and control capabilities. ESO to develop also a central data platform.
ENA ONP Product:	N/A
Timeline:	January 2020 - March 2023
Organisation type:	ESO(1)
Progress:	Implementing(1)
Additional information:	

Step 12

Step	Steps from individual organisations related to this activity
Step type:	Aggregated steps
Description:	This step aggregates steps required for individual DNOs or TOs to implement DSO functionality, but which have no wider industry relevance.
ENA ONP Product:	N/A
Timeline:	January 2020 - April 2021
Organisation type:	DNO(1)
Progress:	Implementing(1)
Additional information:	One DNO has added a step which is driven by an internal project on ANM Centralisation, exploring how IT infrastructure can enable more efficient, cost-effective ANM Implementation on a scalable basis.