Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.
Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

NIA Project Close Down Report Document

Date of Submission

Jul 2025

Project Reference Number

NIA2_NGESO069

Project Progress

Project Title

The Implication for the ESO of 24/7 Carbon Free Energy Trading

Project Reference Number

NIA2_NGESO069

Funding Licensee(s)

NESO - National Energy System Operator

Project Start Date

May 2024

Project Duration

1 year and 1 month

Nominated Project Contact(s)

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Scope

The project's scope consists of 2 phases with defined work packages under each phase.

Phase 1 will take around 3 months and will be focussed on a series of workshops, discussions and case studies where the different market design options and modelling scenarios will be assessed, reviewed, agreed, and documented as outlined below:

Through a work package approach a number of case studies will be selected, defined, scoped and delivered. The Phase 2 scope will also be agreed and documented based on the outputs of the case studies.

The final deliverable of Phase 1 will be a Market Design Document including summary of feedback from participants, description of chosen bidding and auction design for Phase 2, draft market rules for phase 2, draft pricing principles (underlying drivers of hourly certificates) and a summary of implications and next steps.

Phase 2:

Phase 2 will develop models based on the key findings and analysis in phase 1. These will then be tested and further refined. This phase is approx. 8 months long. This phase it will look at the modelling scenarios with be developed while a trading pilot scheme takes place with the recruited market participants through a number of work packages:

Through a work package approach this phase will develop, test and refine a model based on initial results. Scenario integration and alignment will be documented.

The number of cases studies and sensitivities will be agreed but may include Scenarios of demand for CFE; Impacts of temporal mis-matching between consumption and production of CFE; Locational issues; Additional value streams; Inclusion of nuclear energy; Green hydrogen requirements.

The pilot design will be agreed with and then executed with stakeholders with results, learnings and implications for any future commercial roll-out detailed and provided.

Objectives

To evaluate the impacts on system operation:

- To better understand circumstances in which dispatch patterns could be impacted by 24/7 CFE trading, whether these changes will be beneficial for system operation or otherwise
- To identify the actions which ESO can take (directly or through influencing the design of the scheme) to ensure that the beneficial impacts are maximized and the non-beneficial impacts are minimised

To deliver insight on how 24/7 CFE trading will influence the market:

- To set up a pilot to explore potential trading arrangements, generating the first ever empirical data on green certificate price formation and insights for any future commercial roll-out detailed and provided

Success Criteria

We would consider the project successful upon the delivery of:

- A quantitative assessment that illustrates a comprehensive set of scenarios/case studies, comprehensive by testing a broad set of potential impacts/extremes
- A robust qualitative assessment of the potential interactions with centralised dispatch/scheduling
- Sufficiently robust insights that enable ESO to decide on actions and next steps with confidence
- Pilot auction results that provide sufficient confidence for implementation and scale-up

Performance Compared to the Original Project Aims, Objectives and Success Criteria

Context and Rationale - the background and reasoning behind the findings:

Energy Attribute Certificates (EACs) or Renewable Guarantees of Origin (REGOs) are used to support carbon reporting and renewable energy sourcing claims. EACs are used to offer optional ‘green tariffs’ to consumers when they purchase electricity. This directs consumer money into electricity system decarbonisation, by allowing consumers to choose Carbon Free Energy (CFE) or renewable electricity supplies.

In most markets, including the UK, certificates match on an annual basis. This has led to ‘100% renewable offers’ being discredited, as not aligning with the physical realities of electricity systems, with intermittent CFE sources not meeting consumption patterns in real time.

Changing to 24/7 (hourly or sub hourly) matching of CFE, via EACs, would address concerns of the credibility of certificates, by providing consumers with transparency in carbon free energy procurement. Current 24/7 CFE tariffs generally mean that consumers have to have CFE supply covering all consumption on an annual basis and reporting a high degree of matching (70% - 95%) on a granular basis. While some consumers, like Google and Microsoft, have committed to 100% matching by 2030, the target for most consumers will be to have a matched score that starts high and improves over time.

24/7 CFE EACs could also accelerate grid decarbonisation, by providing time-based signals for the use of CFE and demand side response (DSR). Furthermore, it could encourage investment and innovation. This could be particularly powerful in incentivising growth in storage solutions, like batteries, and automation of DSR. Currently storage and DSR are unable to participate in EAC markets, as the annual granularity does not create an ability to trade these certificates in a useful timeframe.

Demand and regulatory changes mean that 24/7 matching is expected to begin at scale within the next 5 years. Suppliers offering and consumers committed to buying 24/7 CFE have already emerged. There are already tariffs available for customers in Britain that show the percentage of time matched CFE supplies in addition to being carbon free at an annual granularity. Carbon reporting standards are likely to move away from annual reporting, with best practices already being granular reporting.

It is critical for NESO to understand the implications for system operation, market design and dispatch patterns of this change. The study considers NESO’s role and interactions with system objectives.

Key Points

The project was a success - project objectives were achieved. The supplier collaboration worked well. The project involved significant engagement with GB energy market stakeholders via webinars, DESNZ, Ofgem, Energy UK, etc. Additionally, NESO engaged with the Flex Group within the Energy Systems Catapult and Flexibility Roadmap team in DESNZ. The project developed potential trading

rules and proved through modelling that trading was possible.

A limitation of the study is that the future design of 24/7 trading rules are yet to be defined. While the project surveyed market participants, and developed a trading pilot based on possible rules, it is up to the market and the regulator to decide how the scheme would be implemented. Further work should be carried out, as and when the market design is being put into place.

Required Modifications to the Planned Approach During the Course of the Project

Project Deliverables and Achievements

- Phase 1 (April to July 2024) involved the development of scenarios and case studies, informed through a survey with stakeholders. Phase 1 deliverables were completed by August 2024.

- Phase 2 (August 2024 to January 2025) included scenario modelling and a trading pilot.
Scenarios (using BID3) were defined and modelled to study operational, and system impacts in GB. The electricity system was modelled to understand how pricing, dispatch, and investment decisions could be affected under a 24/7 Carbon-Free Energy (CFE) certificate system.
A reading pilot was conducted based on an auction framework which was informed by insights from stakeholder surveys. The trading pilot was conducted with recruited participants, including five leading energy companies in the GB electricity market (EDF, Npower Business Solutions, Field Energy, Good Energy) and one other.
Phase 2 deliverables were completed in June 2025.

- The project involved three public webinars between May and Nov 2024.
- The project involved significant stakeholder engagement, including meetings with Ofgem, DESNZ, Energy UK, and a survey of market participants.
- These activities provided strong evidence that the objectives set out at the beginning of the project were met.

Lessons Learnt for Future Projects

These were the positives:

- Weekly project meetings were held between representatives from NESO, AFRY, Granular Energy and NordPool.
- A project SharePoint site was used to for Significant interaction with the public and stakeholders.
- Significant interaction with the public and stakeholders

Using Phase 1 as a scoping phase worked very well. This meant that there was some flexibility in the approach for both the trading pilot and the modelling which were carried out in Phase 2. The scope and technical delivery were in line with the initial project expectations.

Areas to improve:

- The trading pilot had only 5 participants – it was difficult to get good participation in this new product and receive the requested input data from participants.
- The survey with market stakeholders could have had a wider reach. A knowledge gap by stakeholders meant that this was difficult and may have led to bias in participants' answers, driven by their specific interests.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

Study Key Findings:

- **24/7 CFE matching is coming soon**: In Britain, several energy suppliers are already offering time-matched 'green' supply tariffs to commercial, residential and industrial consumers. Several leading consumers, including AstraZeneca, Google, Microsoft and Vodafone are committed to buying 24/7 CFE. Carbon reporting standards are likely to become more granular. 24/7 CFE could be accelerated transparently and efficiently through a 24/7 CFE EAC trading scheme, which could be implemented within a few years.
- **Trading of 24/7 CFE EACs is viable:** Leading players in the energy market participated in the trading pilot. An ex-post system was modelled, which is consistent with current allocation of REGOs. The contract was defined with stakeholder input. The pilot successfully demonstrated that price formation would be possible, with results that were in-line with expectations from modelled output. The price duration curves showed a green premium, which depended on the required matching score, with prices rising sharply after 75% CFE matching levels.
- **Incentivises CFE investment particularly in storage and DSR**: 24/7 CFE trading enables the transfer of premiums paid by

consumers for 24/7 CFE EACs to support various CFE technologies with the most flexibility, benefiting the most. The additional revenue would be a benefit for CFE assets that cannot currently access REGOs, notably DSR and storage. Time matched certificates would allow storage operators to access a new revenue stream, by purchasing granular EACs and storing energy when certificate prices are low and selling EACs and discharging when prices are high. Purchasers of 24/7 CFE EACs would have stronger incentives for demand side response than from electricity prices alone, creating shorter payback periods for innovations automating DSR.

- **24/7 CFE EACs enhance value of flexibility in times of scarcity:** Shortage of CFE supply tends to occur at the same time as increased system tightness. In the GB system, shortages of CFE occur at times of low wind supply, and this is when 24/7 CFE EAC price would be highest. Conversely, at times of renewable curtailment, generally there is an excess of CFE supply and 24/7 CFE EAC prices will typically be very low or zero. During periods of scarcity, 24/7 CFE EACs provide a stronger price signal for carbon free power than energy prices alone. This was shown in both the modelling and trading pilot.

- **A 24/7 CFE EAC market would support the transition to a net zero power system:** If accelerated, a move to 24/7 CFE EACs could support the goal of a net zero power system by 2030 by encouraging the matching of demand, storage and dispatchable CFE supply to the availability of weather-dependent renewables, through incentives for both investment and changes in behaviour.

- **Trading of 24/7 CFEs is mostly beneficial for system operation:** The emergence of 24/7 CFE is not foreseen to introduce any major risks and would provide behavioural benefits in the operational timeframe and significant benefits in the investment timeframe. -- **Beneficial for scheduling:** The stronger price signal in times of scarcity should lead to helpful behaviours, particularly for batteries and DSR.
Congestion would not be materially impacted: A 24/7 CFE market is not expected to lead to material changes to the level of constrained boundaries within a national GB system. Congestion is generally associated with windy periods, but when the CFE market is tight, there is usually low wind output. **Should not create significant additional costs for redispatch**: In theory, an additional revenue stream could add to redispatch costs. However, in practice, when CFE supply is being curtailed, there would be an abundance of CFE supply. When CFE supply is plentiful, certificate prices tend to zero. **Rules for storage need consideration:** A 24/7 CFE market would create a new revenue stream for storage. This should boost investment, particularly in long duration storage, which sees the biggest improvement in margins in modelled results. However, it is worth noting that the rules for batteries and other forms of storage do not yet exist. Simply, storage assets should purchase certificates when charging and transfer the certificate to the buyer when discharging (generating), less any loss due to round trip efficiency. However, careful rule design and monitoring should be put into place to ensure benefits are maximised. **Further work on implementation would be required:** Lack of liquidity, imperfect co-optimisation, and uncertain behaviours are risks that should be considered. Alongside Ofgem and DESNZ, it would make sense for NESO to be actively involved in forecasting and monitoring how granular certificates will impact market participant behaviour. Mandatory reporting and establishment of price forecasts for 24/7 CFE EACs could support liquidity. While this was not an implementation study, implementation would need careful consideration and monitoring to reduce risk of unexpected or intended consequences.

- **Impacts are amplified in the case of a move to a zonal market:** In a zonal energy market (a possible outcome of REMA), the ease with which CFE demand could be met varies significantly between GB zones. This would create zonal 24/7 CFE EAC prices, as well as zonal electricity prices. **24/7 CFE EAC trading could happen earlier than zonal pricing:** Based on experience in other markets, it is expected that 24/7 CFE EACs could be implemented within 2 years, whereas a transition to a zonal market is unlikely to happen at that speed.
EAC prices would vary by zone: In a zonal market the dominant factor for the ability to meet CFE demand is the wind generation output. Areas with a high penetration of wind will have lower EAC prices. Based on assumptions of zonal splits, Scotland and the East of England have lower prices over the year. Limitations to the transportation ability of CFE leads to areas with high EAC prices, particularly in the south of England and South Wales.
Encourages regional investment: A zonal market would see regional CFE prices which can encourage the locational siting of CFE and storage. Margins for storage would improve most in zones with CFE supply and capacity constraints.

- **Mandatory reporting of CFE supply in real-time would improve transparency:** Mandatory carbon reporting by all electricity suppliers to all consumers, could help improve transparency, aiding informed decision making for customers to decarbonise.

- **Analysis and monitoring are required:** The introduction of a new trading scheme can impact supply demand dynamics, so preparation by NESO and other market stakeholders would be important. Further work on to help such a scheme support decarbonisation goals.

- **Accelerated introduction is likely to optimise benefits and minimise risks:** Early introduction and adoption of 24/7 CFE EACs is recommended with monitoring and forecasting by NESO to improve visibility of participant behaviour and dispatch decisions. It is unlikely that consumers will be able to achieve 100% 24/7 CFE matching. The goal should be that consumers become aware of their matching score, and aim to improve this over time. Granular metered data should be used by Ofgem/the registry for 24/7 CFE EAC management, in place of the current REGO system.

Data Access

Details on how network or consumption data arising in the course of NIA funded projects can be requested by interested parties, and the terms on which such data will be made available by NESO can be found in our publicly available “Data sharing policy related to NIA projects (and formerly NIC)” and Innovation | National Energy System Operator.

National Energy System Operator already publishes much of the data arising from our NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already

been published.

Foreground IPR

IP includes:

- Survey result
- Modelling dataset and result
- Phase 1 report
- Final report
- Trading pilot rules
- Trading pilot outcomes

Planned Implementation

The study shows many potential benefits which can be gained from the implementation of 24/7 CFE trading. As these benefits may accrue for a wide range of stakeholders (consumers, electricity producers, storage operators and NESO), it is recommended that this innovation be further developed. These benefits will need to be validated through further work with the stakeholders identified in the report to ensure their validity in the context of other activities i this space (e.g. changes to carbon accounting guidelines by SBTi / GHG protocol).

Given the likely timeframes (by 2030) of changes to carbon accounting which may drive the demand for these products, it is recommended that Ofgem, as the current operator of the GB REGO regime, undertakes further research into this topic with a view as to whether, and how, to implement changes to the current REGO regime to accommodate 24/7 CFE trading. This should include a combination of:

- Further trading simulations to gather wider data sets across possible futures.
- Development of implementation options for 24/7 CFE certificate operations.
- Conducting further stakeholder engagement to further assess the benefits of such a scheme.
- Undertaking a comprehensive impact assessment of the introduction of 24/7 CFE trading (including stakeholders such as NESO).

While NESO is not directly involved in the issuance, trading, and operation of EACs, its position as the operator of the GB balancing mechanism may be impacted by the introduction of new schemes such as 24/7 CFE. As such, NESO's role will be critical in providing support and insight to Ofgem if it chooses to further develop this proposition.

Net Benefit Statement

24/7 CFE energy trading is likely to have significant benefits for many stakeholders. The main benefits are:

- Increase the transparency in CFE energy procurement by unlocking 24/7 carbon accounting and reporting.
- Accelerate grid decarbonisation by providing time-based price signals for the use of CFE.
- Encourage investment and innovation by creating incentives for flexibility solutions such as batteries and demand side response.

The study showed that:

- Trading of 24/7 CFE is feasible and leading players in the energy market were able to price certificates.
- While implementation would need to be carefully considered, the emergence of 24/7 CFE is not foreseen to introduce any major risks and would provide behavioural benefits in the operational timeframe and significant benefits in the investment timeframe.
- There is significant interest for the product from energy consumers and retailers.
- Further work on implementation would be required, involving Ofgem and DESNZ.

Other Comments

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Standards Documents

N/A