Date of Submission
23/02/2024

Network Innovation Allowance Project Completion Report

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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.

Project Completion Report

Project Title	**Project Reference**
InterCast	NIA2_NGESO058

Funding Licensee(s)	**Project Start Date**	**Project Duration**
National Grid Electricity System Operator	Oct 2023	6 weeks

Nominated Project Contact(s)

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Scope

This project will focus on forecasting the North Sea Link interconnector (NSL) flows through modelling the Norwegian electricity price. Any successes can be applied to models for the other interconnectors. NSL has been selected as the focus of this project as the ESO currently does not have a model to forecast the hourly Norwegian electricity prices. The project will focus on 5 main work packages and a final deliverable.

- An assessment of alternative techniques comparing 2 scoring techniques
- Build a PoC model
- Deliver a PoC and related documentation

Objective(s)

- Develop a PoC model in notebook form for predicting price at hourly level based on the future market price data.
- Develop a report on model validation, performance against current methodology and potential next steps, including applying the learning to the other interconnectors.

Success Criteria

The project will be deemed successful if:

- The new interconnector model delivers higher accuracy forecast in comparison to the existing NGESO model.
- The new interconnector model provides higher granularity output of GB Norway price spreads (target is hourly) than the existing NGESO model.
- The improved model is deployable in a way which meets NGESO's business needs (e.g., ease of use, run time, practicality, cost).
- NGESO will have an improved forecast of interconnector flows at a lead time of day ahead. An improved forecast will be defined based on a comparison of forecast error (forecast price against actual price) relative to the current ESO forecast model.

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

Overview

The project objectives and success criteria have been met. Alternative techniques to modeling future Norwegian energy prices were explored. These approaches varied in complexity and processing power requirements (utilizing modern cloud-based processing where appropriate). The progress of the project towards each of the objectives is given below.

The new interconnector model delivers higher accuracy forecast in comparison to the existing NGESO model.

The price forecast developed in the project showed a slight improvement relative to the existing ESO approach, particularly at a lead time of day ahead. An assessment as to whether this leads to an improvement in the interconnector forecast is currently being undertaken by ESO. The code developed by the project is being migrated on to ESO systems to enable this long-term comparison.

The new interconnector model provides higher granularity output of GB Norway price spreads (target is hourly) than the existing NGESO model.

Prior to the project, the ESO only had a single value for the day-ahead Norwegian electricity prices. This project has developed a methodology which enables ESO to convert this price to an hourly resolution.

The improved model is deployable in a way which meets NGESO's business needs (e.g., ease of use, run time, practicality, cost).

The model meets the business needs and can easily be integrated into ESO systems. It is written in Python and can be executed on the Azure platform. This project thus serves as an excellent pathfinder for future development. The PoC model has been developed in a Jupyter notebook, fulfilling the project objectives.

NGESO will have an improved forecast of interconnector flows at a lead time of day ahead. An improved forecast will be defined based on a comparison of forecast error (forecast price against actual price) relative to the current ESO forecast model.

This objective was achieved in alignment with the project aims and objectives. A benchmark model was defined (based on the models currently deployed by ESO) as an auto-regressive time series. Several advanced models were developed including Recurrent Neural Network (RNN) and Long Short-Term Memory (LSTM) models. Every model underwent training, testing, and validation, providing predictions at an hourly granularity. The models were compared to each other, and the accuracy metric of RMSE was utilized for measurement.

Handover of PoC and related documentation

All code and PowerPoint presentations have been handed over upon the completion of the project.

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

NA

Lessons Learnt for Future Projects

Working with cutting edge AI and Machine Learning datasets can bring fresh approaches to modeling problems. Using this external expertise to apply novel modeling methods allows a faster transition to alternative approaches in the ESO and the wider energy industry. For example, the LSTM PoC model is something we could apply to other time series forecasting projects within the ESO.

Additionally, working with market leaders in the field allowed ESO to learn key skills for ensuring the smooth running of data science projects. This includes new methods for logging data and how it can be efficiently stored.

The project also helped understand the limits of modelling in predicting price futures. Future projects may benefit from a greater understanding of the specific market and from stakeholder and SME interaction as there are limits to insights that can be gained from a data only approach.

The Outcomes of the Project

The project has delivered a model which allows the ESO to forecast the Norwegian electricity price at an hourly resolution. A series of models were developed and the best modelling technique was the LSTM modelling package. Although, thorough testing is ongoing, indications suggest some improvements could be made by considering some periodic elements in the model.

The project highlighted that the relationship between forecast prices and the intra-day prices are greatly influenced by external events. These insights provide excellent opportunities for model improvement and future study.

The project helped us to narrow down the options for future models. The techniques described, used and analysis have allowed NGESO to rule out many modeling approaches, allowing resources to be efficiently deployed in productive areas.

Foreground IPR

All relevant project reports will be published on the InterCast | ENA Innovation Portal (energynetworks.org)

Data Access & Quality Details

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 National Grid can be found in our publicly available "Data sharing policy related to NIC/NIA projects" and www.nationalgrideso.com/innovation.

National Grid Electricity System Operator already publishes much of the data arising from our NIC/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.

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.

Planned Implementation, recommendations or next steps

The models developed in this project are being migrated onto the ESO computing platform, where further testing will be carried out.

Net Benefits Statement

Enabled ESO to learn cutting edge data science techniques which can be applied to multiple projects in the organisation. This includes data logging, code control and machine learning models.

The project tested some approaches that would not have been easy for ESO to test due to high computational demands, and so it is useful to know that these more complex modelling approaches do not necessarily do better due to forecast costs.

Other comments

The Project outcomes and results contain confidential information and intellectual property rights that cannot be disclosed in this Report due to their proprietary nature. Should the viewer of this Report ("Viewer") require further details this may be provided on a case by case basis following consultation of all Publishers. In the event such further information is provided each and any Publisher that owns such confidential information or intellectual property rights shall be entitled to request the Viewer enter into terms that govern the sharing of such confidential information and/ or intellectual property rights including where appropriate formal licence terms or confidentiality provisions. Dependent upon the nature of such request the Publishers may be entitled to request a fee from the Viewer in respect of such confidential information or intellectual property rights.

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