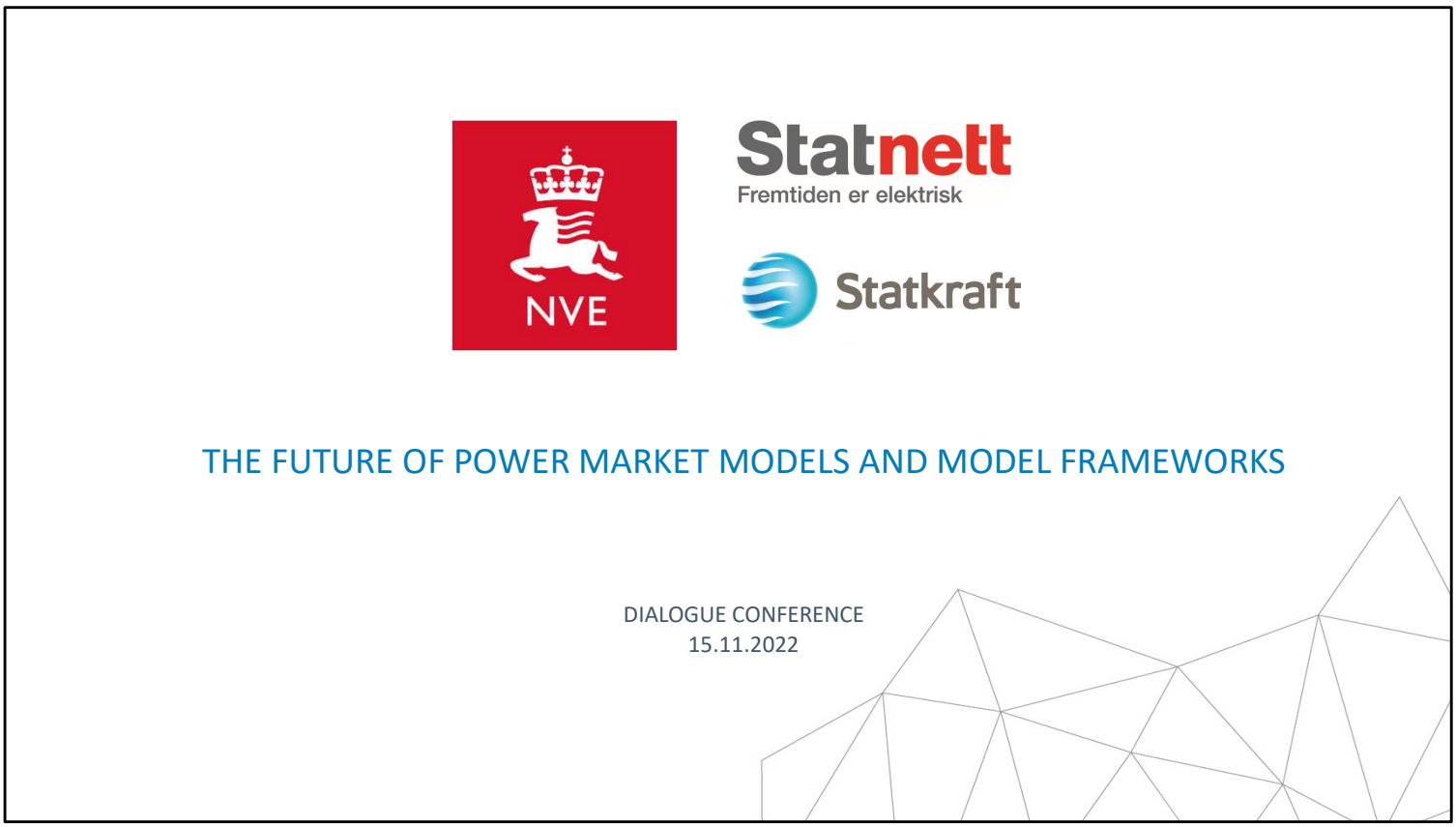


Hello and welcome to this dialogue conference on the future of power market models and model frameworks.
We are thankful that so many of you have chosen to spend your time here with us to discuss how we can meet current and future challenges in modelling the energy sector and working with energy models.

Agenda

- Introduction, welcome and purpose of the conference
- Presentation of the collaboration, issues and needs
- Questions and discussion
- Wrap up and the way forward

This session will be recorded.

Before we move forward I would like to inform everyone that this meeting will be recorded. This is to ensure that any public procurements is in accordance with the norwegian public procurement act. We will not show faces of the participants in person, and the people joining via Teams can choose to disable their cameras. The names of everyone attending will also be stored to ensure the same.

Introduction

- Welcome
- About NVE, Statnett and Statkraft
- The purpose of this conference
  - To present our common needs related to future power market models and a model framework
  - To discuss challenges and receive input as to different solutions and the best way to fulfill these needs
  - To provide information and establish contact in front of written inputs and 1-1-dialogue
- We need your input!

Habberstad AS 3

We have gathered a broad selection of expertise from model and model framework users in all parts of the energy sector to developers, suppliers and other interested parties and we hope to facilitate a healthy and productive discussion. We have 41 different companies here, as well as the group attending in person in Oslo we have Y attending via Teams.
Before we move on to our presentation I would like to introduce the conference and the collaboration project.
This conference is a first step in a collaboration project between The Norwegian Water Resources and Energy Directorate, Statkraft and Statnett.

NVEs mandate is to ensure that the development of Norwegian hydropower is both environmentally friendly, as well as beneficial to the Norwegian society.
Statnett is the system operator in the Norwegian energy system and is responsible for securing the Norwegian power supply through operation and management of the power grid.
Statkraft is Europe's largest renewable energy producer and a global company in energy market operations, fully owned by the Norwegian state.

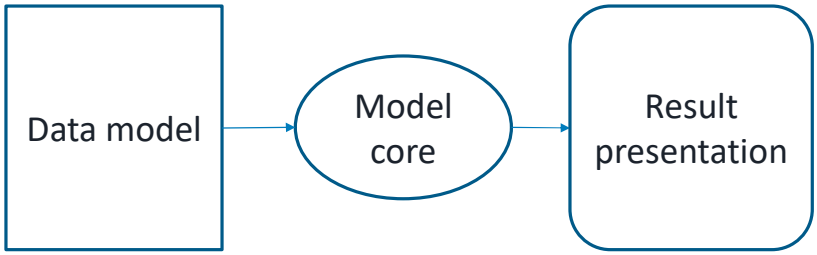
Together these three businesses have identified common needs for power market modeling today and in the future. These common needs form the basis of a cooperation project where cost, risk and work is shared. Through cooperation, the professionals in the business can learn from and build on each other and elevate the entire industry.

This collaborative project is in its early stages where different concepts for realizing our common needs are being considered. But as model users we don't have all the answers, which is why we have called this conference.

- We wish to present our common needs openly. We believe that an open, honest discussion about where we are and where we want to go will yield the best results.
- When we have presented our needs, we want your input. As I said we are in the early stages and no measures have been decided. We want to explore all possible roads towards the best possible future and believe in your expertise. We have an hour in the program for your inputs and discussion. We understand that some of you might want to keep inputs to yourselves due to competitive reasons, but we urge your to say as much as you can, and please join us for a 1-1-discussion afterwards if you have inputs you aren't able to share openly. We hope that a discussion between suppliers and users can give us all knowledge and insight.
- Lastly, we wish to give you all common information about us, our needs and the process going forwards and give you an opportunity to ask questions and make clear any uncertainties, both to ensure equal treatment of all parties and to ensure an effective process.

We need your input! That is why we are here. Please share your questions and thoughts with us after the presentation and thank you again for participating in this open discussion.

What is a power marked model?



A power market model is, in its simplest form, a “calculator”. They help us understand the power market by answering different questions we have and predicting results based on input parameters and clever algorithms.

The analysis starts with a data model – a way to describe what is going to be modelled. This can be a list of power plants with their estimated production level, power lines and their capacity, the weather or many other inputs.

The model core contains algorithms that take the input data and configurations from the data model and solve complex mathematical problems. Some models are deterministic, producing the same result for a particular set of inputs, while others are stochastic meaning they incorporate uncertainty or randomness.

After the input has been ran through the model core, the results come out and are presented.

Many models have more features than this – the most common being APIs to facilitate communication between programs, a user interface that increases user friendliness or a result presentation tool that generates graphical representations.

Power market models are important tools

- Short- and long-term prognosis
- Scenario analysis
- Power plant analysis
- Analyses and concession processing of changes in the power grid
- Market design
- Production planning
- Contingency planning

Vegard: Power market models are important tools for the three parties in the collaboration. I would now like to introduce Ane Bruvoll, Head of Section Energy System at NVE, who will say a few words about how NVE uses power market models.

Ane: In NVEs role as market regulator, licensing authority, professional advisor and responsible for power rationing we perform a variety of analyses and prognosis. We use models to help us understand the impact of various measures; increased electrification, consequences of offshore wind, energy safety, climate change, market abuse and scenarios from a single power plant to entire markets.

Vegard: Thank you. Next I would like to introduce Roy Syversrud, Head of Market Analysis in Statkraft.

Roy: As an energy producer, Statkraft uses power market models in four different ways – short term to plan production and maintenance of our power plants, market analysis related to trading, asset management and corporate strategy and analysis. Models are essential in all aspects of our business.

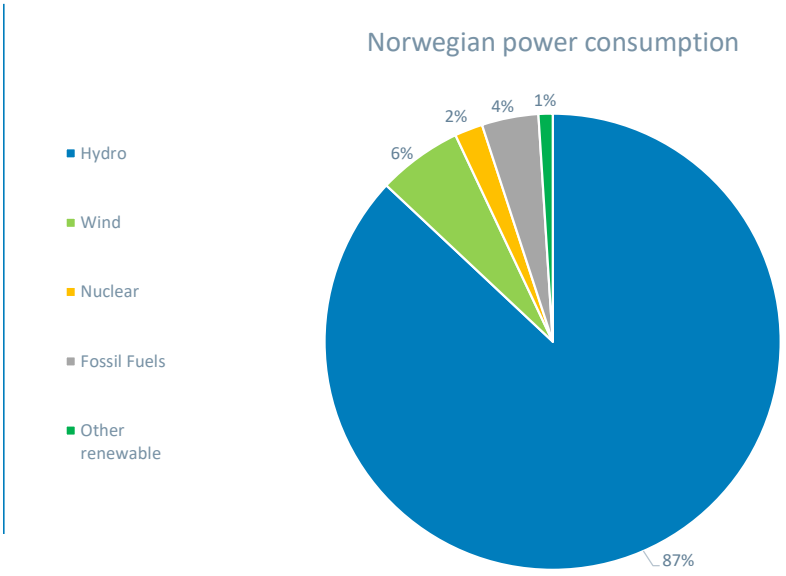
Vegard: And lastly, I would like to introduce Anders Kringstad, head of long term market analysis at Statnett.

Anders: Statnett is responsible for operating and managing the Norwegian power grid. To do this we need to understand bottlenecks, price differences, possible

challenges in power plant operations and the impact of changes before they happen. This presupposes good tools for analysis.

Vegard: As you can see, market models are very important tools. Our entire civilization runs on electricity and large sums are invested every year to keep this system running effectively and develop it according to our current and future needs. Through analyzing the power market and making predictions about the future, power market models help us make the right decisions.

Hydropower is in uniquely important in the Norwegian (and the Nordic) power market



Habberstad AS 6

Source: https://www.nve.no/nytt-fra-nve/nyheter-energi/stromforbruk-i-norge-har-lavt-klimagassutslipp/

One characteristic of the Norwegian power market is our large reliance on hydropower. The Norwegian waterfalls have been tamed to harness green and (historically) cheap power. This has both been good for power intensive industry like the metallurgical industries that produce metal alloys and for out citizens who have been able to warm their houses and charge their cars for a relatively low cost compared to other countries.

It's important to underline this because in order to analyze the Norwegian power market and help us make the correct decisions in all the different processes we previously showed, we need to understand hydropower, the value of water stored in hydro power reservoirs and the interconnectedness of hydro power-plants.

Water can be stored in reservoirs until needed, allowing for quick changes in production and low start and stop costs. Well-regulated reservoirs can provide short-term flexibility within an hour, as well as long-term flexibility over days, weeks and season. A unique characteristic of Norwegian hydropower is multi year reservoirs that can store more water than typically would fall into it in a year. To understand investment strategies for storage over several seasons is very important.

The green transition is changing the way power is created and consumed

- Stricter emission goals, domestic and in the EU
- Electrification
- More weather-dependent energy sources
- Closely integrated power markets
- Unstable gas deliveries from Russia

Habberstad AS 7

«The green transition is about how Norway will be a low-emission country by 2050. To achieve this, we must transform into a society where growth and development take place within nature's tolerance limits. It will be challenging, but it is possible».

That is how the Norwegian government starts its presentation of the green transition on its website.
It's not an exaggeration to say that the next decades will fundamentally change the way our society works. And to focus on the topic at hand, the way power is generated, transported, stored and consumed. To charge our cars, power our smart homes, facilitate our power intensive industry and continue living normally in the future, we need to make the correct decisions today.

Already the power market is changing quickly. Reliance on unstable energy sources like solar and wind power, coupled with gas, coal and nuclear plants across Europe being shut down, has created more weather dependent electricity prices.

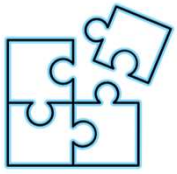
The last year, we have all felt the very real implications of that, as a closely integrated power market between the Nordic and mainland European countries. To paraphrase news reports from earlier this year, our power became more expensive a period because the wind wasn't blowing in Germany.

The terrible situation in Ukraine and Russia use of gas as a political tool has made the situation more dire. To summarize, power is important for our society, our

businesses and our way of life. And society, and the power market, is changing rapidly.

A rapidly changing power market requires models that can change with it

- The ability to analyze hydropower in enough detail along with new/weather dependent power sources, carriers, flexibilities and market interactions
- Modular architecture where level of detail can be changed and «parts» can be replaced over time
- An operating model that secures a continually evolving system, merging development and operations (DevOps)



Habberstad AS 8

As the power market changes so must our methods and tools for analysis. Current power market models help us understand todays power market and give useful information as the basis for decisions,.

However the currently used models were in large designed for a different time, and there is an uncertainty as to whether they will be able to accurately describe and predict trends in the power market of the future, as both known and unknown technological and societal changes will occur.

Earlier we used the example of a lack of wind in Germany causing higher electricity prices in Norway. This example scenario shows us how detailed modeling of the future power market needs to account for many more variables and interactions than we did ten or twenty years ago.

We know of many current trends. The use of weather-dependent power sources is a prime example. We can also predict that the use of energy storage, for example by using batteries, will be a greater factor in the future. However we do not know all the technological developments that will occur as our society transitions from carbon to clean energy. To make a «future-proof» model, it needs to be build to evolve. This can be solved with a modular architecture where different functions, algorithms and configurations can be updated, changed or replaced, having the bonus of allowing modules to be turned on or off, and different levels of aggregation chosen to allow different types analyses. Both slower, more detailed long-term analyses and faster,

aggregated short term analyses.

Being able to change and adapt is an essential characteristic of future power market models. As such, they need to be operated in a manner that facilitates change, and where changes in the model and its parts is a part of the business and its operating principles. As continuous improvement, research and development will continue to push the model towards even more accurate predictions, development and operations can’t be separate activities.

To evolve with the market, openness and collaboration is essential

- A new degree of openness is needed to facilitate academic research
- This will also increase trust in models and algorithms
- The road from research to functional new models or model improvements needs to be as short as possible

Habberstad AS 9

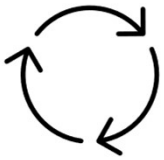
An important aspect of power market modelling is academic research. Many analysts with knowledge of power market modeling are PHDs, and research into power market modeling, models and algorithms is an important factor in finding new ways to describe complex systems mathematically or improving on existing methods.

The cooperation between academics and model providers/developers will be even more important going forward because as the power market changes, so must our models, algorithms and functions. To ensure that our models give an accurate understanding of the real world and the future, collaboration with academia and the facilitation of research is important. An important step in this regard is an increased level of openness with regards to how the model and its algorithms work. An added bonus of this openness will be increased trust in the model results, as analysts will be better equipped at explaining their findings.

As we already described, the power market models of the future need to be built to continually evolve. An important factor in this continuous improvement will be cooperating with researchers to find ways to improve the models. This means that researchers and model developers need to work together to take the theoretical findings and put them into practice. This can result in changes to models, algorithms and even new tools that can solve new problems. The principle of openness when moving forward will facilitate a continuously evolving knowledge base and tools that match this knowledge.

Current processes utilize several models iteratively

- No model can describe the entire market «perfectly»
- Different models have different data set requirements
- Manual administration of data sets, data set conversion between models and running models iteratively is manual and costly



Habberstad AS 10

The power market is a complex place. There are many different energy sources, carriers and markets, and the questions we need to ask in our analyses vary. And just like the power market and our need for understanding, the market for models is equally complex. There are many different models available today, from large models that attempt to answer many different questions you might have to smaller models focused on answering a single question in as much detail as possible.

These two points together means that no one model is used by itself. To fully understand the power market, the Parties all utilize several models. These are either used iteratively, the result from one model being used as the input for another, or in parallel to control that results are valid by running the same dataset with different algorithms.

Every power market model has different requirements for its input data or data set, from small syntax differences to larger structural differences. This means that every model needs its own data set. In cases where the same simulation is run in different models, this means that the same data needs to be configured and created, often manually, multiple times. This also means that output-data needs to be transformed before being used as input data in other models.

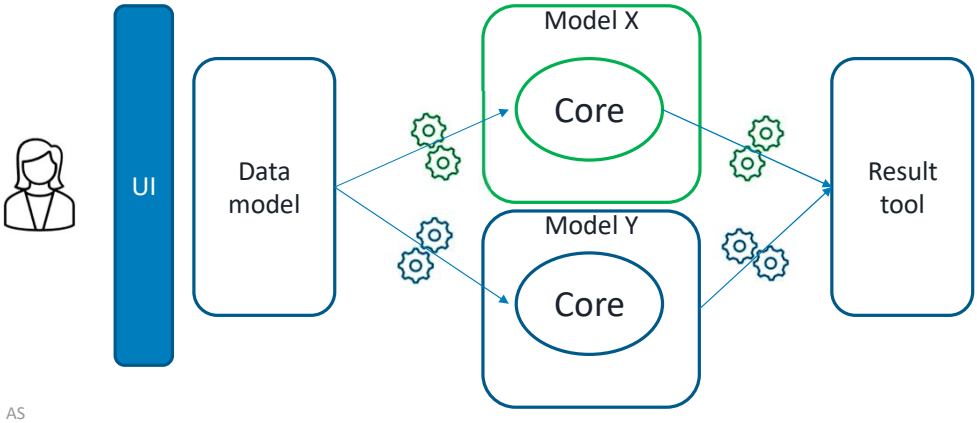
How this is solved today varies, some are done manually while some are done through custom made scripts made by the analyst or the company itself. Manual configurations always have the risk of manual error. Something as small as a comma

error can result in a misfired analysis, often not discovered until the model has run. The risk, as well as the resource demand of “misfired” analysis, is considered to be too high.

The common solution is to develop individual scripts, which is a “band aid”. It solves the immediate problem but introduces its own source of vulnerability and cost – what if the analyst who made the script is sick or finds another job? What of the cost to the industry if a model changes so much in an update that the scripts don’t work – and every company has to invest in updating their own, separate scripts?

Model frameworks – a layer between the analyst and the model

1. A common datamodel maintained through a modern user interface
2. Integrations that convert data and data sets between models
3. Standard components that facilitate model research and development



The solution to these problems is a model framework. Rather than manually converting data or maintaining analyst or company-specific scripts, a model framework would be an industry-wide tool maintained through collaboration.

If we can automate or streamline manual processes, resources can in stead be used to elevate the analyses in other, more productive areas. And if we can collaborate on maintaining the model framework between companies, the impact for each company when there is a need for changes can be reduced.

This will be an important step in lifting the entire industry, and foster collaboration between professional environments. As a bonus, an open model framework can further facilitate research and model development through the availability of standardized components for data sets, APIs and other features.

Summary

To summarize our presentation we will focus on three questions – Why, what and how?

Why: The future needs new power market modeling tools

- The power market is changing rapidly
- New sources of energy, changes in usage patterns, storage and integrated markets are already happening and will be more impactful in the future
- To understand the power market of the future, and make certain that our tools can evolve as the market does, we need models and model frameworks built and operated to evolve

We have presented the background for our collaboration. The power market is changing. Some changes have already occurred, some will be more impactful in the future and some we don't know of yet.

To be able to continue the important work that power market models contribute to, we need to establish new systems and operating principles that ensure a continuously improving ecosystem of collaboration, research and analysis.

What: High level needs for the future power market models and model frameworks

- Detailed hydropower modelling
- New energy sources, carriers and flexibility
- Interaction between Nordic and European power markets
- Openness to facilitate research, collaboration and trust
- A model framework that resource cost and risk
- Systems and operations built to evolve and optimized for change

To do this, and to continue to provide accurate and valuable insights to decision maker, we need to solve the following needs:

- We need to be able to model hydropower in enough detail, for instance by understanding individual water values and multi-year reservoirs
- We need to be able to combine this knowledge of hydropower with new variable energy sources, carriers and other sources of flexibility
- We need to describe interactions between the Norwegian, Nordic and European power markets
- The model need to have enough openness to facilitate research, collaboration and trust
- And manual tasks related to running several models need to be automated and streamlined across the industry
- As already stated, these systems must be built to evolve, from its systems architecture to its operations

How: Questions and discussion

Habberstad AS 15

As for the question of how, that is why we have invited you. We would love to hear your insights. To the people joining us via Teams, please either raise your hand or write a written question in the chat and we will attempt to include you all in order. We only have an hour and we have many guests who I'm sure have valuable contributions, so please keep your questions and answers as short as possible to allow everyone a chance to join in. We might remind you to keep it brief under way if an input turns into a presentation.

- Are there any questions as our presentations, any unclear points or uncertainties we should clear up before we move on to the discussion?
- Questions to facilitate discussion:
    - We have tried to draw a picture of a shifting energy sector and our needs for new tools to help us provide value for society in the future. **Do you share or disagree with our view of the current and future state of the energy market?**
    - Focusing on energy models first. As stated we have the need for a model that can model hydro power and that is open, modular and flexible. **What is the best way to reach this goal?**
        - Follow up – is this a need that can be solved through public procurement/existing models?
    - For modeling frameworks, the same question – **what solutions exist, is the «market» able to solve these problems?**
    - A need we have discussed is **openness** to facilitate research and

cooperation. **How does this fit into the business model of power market model providers?**

Wrap up and the way forward

- We need your input!
- Written input can be sent via Email before November 23rd (max 4 pages) – vegard.osthagen@habberstad.no
- 1-1-discussions with selected parties will be held between November 23rd and December 9th
- All inputs and discussions will be noted and kept to insure openness, neutrality and equal treatment

Thank you again.

As we have stated, no measures have been decided yet. We are still exploring. We hope this conference was usefull and appreciate everyones time here today.

Forward, first of all, we would like to invite everyone to send us written inputs as to how we should move forward. My email is written on the board, as well as in the invitation and in Teams. I will also distribute this after the conference.

We will hold 1-1-discussions with as many parties as possible in the coming weeks. Because we do not have unlimited time we can't guarantee we will have the chance to talk to everyone but we will prioritize all companies and sectors while trying to minimize «overlapping» or similar businesses.

All inputs both here through our recording, written inputs and inputs in 1-1-discussions will be made detailed notes of to ensure equal treatment, openness and neutrality going forward.