

Optimisation in Uniper

Colin Silvester, Uniper

We are Uniper **Facts & figures**

100 years' experience

€1.6 bn EBITDA

~34 GW Total generation

Our manpower

12,135 employees

Power generation, Storage, Services - Europe Engineering Services Commodity Trading, Energy Sales

Where we operate

40+ countries around the world4th largest generator in Europe





Data: Uniper Annual and Sustainability Reports 2019

We are Uniper **Facts & figures**

Our operations Power Generation | Commodity Trading | Energy Storage Energy Sales | Energy Services

Areas of Expertise





Energy : A Sector in Transition



Renewables have become a major component of the energy mix

- Renewables obligations and Feed-in-Tariff subsidies;
- Declining CAPEX costs for wind and solar.



Fossil generation discouraged by:

- Tightening legislation on NOx and SO2 leading to 'invest or close';
- Carbon taxes and permits;
- Reduced residual demand



Demand decline from:

- Energy Efficiency
- Weaker economic growth
- Self-generation, especially domestic PV

Energy Trading



Unit Commitment Description



Asset Constraints

Assets are also subject to a number of longer term constraints, including:

- Running hours and/or starts limits
- Min and Max fuel consumption limits
- Reserve limits
- Must Run Constraints
- Plant Outages
- Profit Targets



Portfolio Optimizer Overview





Asset Optimisation Use Cases





Combined Heat and Power

CHP units provide Power and Heat outputs.







Combined Heat and Power Systems





Hydro System Modelling

Integrated Modelling of a chain of reservoirs and generating units

- Reservoirs:
 - Predicted inflows from other rivers and precipitation
 - Optimized inflows and outflows from upstream & downstream.
 - Constraints on min and max surface levels
- Units:
 - Water flow to power relations
 - Flow limits (both min and max)
 - Generator costs and constraints.
 - Sometimes spillage is the most profitable decision

Time lags present difficulties in optimizing to price.



Nordic Hydro Modelling

Forecasts generation and also calculate the 'Water Value' of seasonal storage reservoirs.

• Shadow price of a constraint on the storage.

Swedish system is complex owing to need to model:

- water flows between reservoirs
- Min and max surface levels in reservoirs
- Time of transit between reservoirs can be several hours
- Spot and reserve products.

Our models also model pumped storage plants



Market Channel Optimisation





Cable Architect

Minimise costs of cabling wind farms taking into account:

- Wind turbine layout
- Substation parameters
- Cable Selection and Costs
- Cable Costs
- Installation costs
- Routing constraints





Cable Architect

Optimisation using an evolutionary algorithm





Optimisation reduced cable length by 7.5km Compared to built solution

uni per

A related product WindArchitect optimises the locations of Wind Turbines 16



- Worked as a specialist in optimisation tool development for 20+ years in Powergen, EON and Uniper.
- Based in Digital Engineering Solutions department based in Nottingham UK that provides services to all parts of Uniper and to external customers on a project basis.
- Developer of tools used by others as a part of their job, not a user of optimisation tools.
- My role is a combination of:
 - Delivery of bespoke optimisation solutions to energy customers (especially Uniper Global Commodities and Asset Strategy functions in Dusseldorf, Germany)
 - Support for existing tools
 - Creation of new cloud-based offerings in Optimisation through Uniper's Enerlytics platform
 - Technical leadership



Barriers to Success

- Customer lacks awareness of optimisation
- Customer protective of existing processes, sees optimisation as a threat.
- Customer has developed own heuristic solution (Excel)
- Lack of mutual understanding of problem and/or benefits of proposed solution.
- 'Solutions looking for problems'
- Lack of domain knowledge in optimisation specialist
- Lack of Involvement of customer in solution design
- Quality & Robustness of solution
- Support



Tailoring Solution Approaches

- Gain domain knowledge through secondments or customer workshops.
- Learn to understand customer's business and language
- Understand problems as real practical cases rather than idealised textbook problems
- Win customers over with demos that are:
 - Visually appealing
 - Solve relevant problems
 - Use realistic data.

Failure to get these things right distracts the customer from your presentation

Show how optimisation will make their jobs more productive and interesting, an opportunity rather than a threat.



How to Deliver Solutions and Support

- Optimisation solution is easy to use for a customer.
- Involve customers throughout the design and development of the tool so that they can shape it and avoid surprises on final delivery.
- Find the optimal trade-offs between optimisation performance, optimality and accuracy of problem representation
- Avoid embedding in systems you cannot change or access:
 - Limits opportunities for future enhancements
 - If this is unavoidable then think how to write the solution so that it can be run (and supported) independently of the larger IT system
- Use fast and robust solvers to give the best optimisation performance possible.
 - Whilst premium solvers are expensive compared with normal office tools, the potential value unlocked by optimisation can be orders of magnitude higher.
 - Put in place support agreements for the tools following delivery.



Thank you!

If you need any further information, please contact us:

Uniper SE E.ON-Platz 1 40479 Düsseldorf www.uniper.energy

Uniper disclaimer:

This presentation may contain forward-looking statements based on current assumptions and forecasts made by Uniper SE management and other information currently available to Uniper. Various known and unknown risks, uncertainties and other factors could lead to material differences between the actual future results, financial situation, development or performance of the company and the estimates given here. Uniper SE does not intend, and does not assume any liability whatsoever, to update these forward-looking statements or to conform them to future events or developments.

