

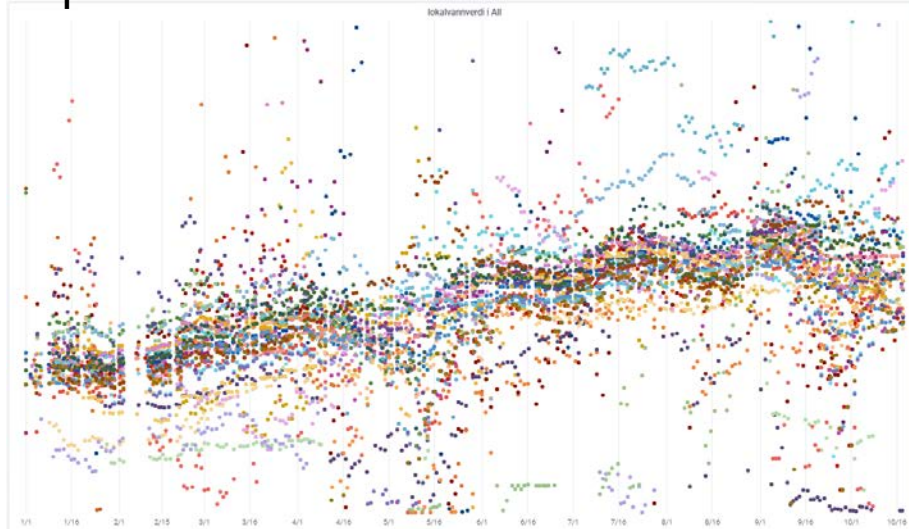
Intraday

Automated SHOP towards algorithmic intraday trading



Skagerak Kraft

- ▶ Average annual production: 5 732 GWh
- ▶ 49 fully and partly owned hydro powerstations



Partly owned Fully owned

Motivation for automation

- ▶ Fear of missing out:
 - Increased complexity in the power market
 - Coordinated bidding
 - More sophisticated optimization and forecasting models
 - Different landscape for software (FOSS & proprietary)
- ▶ Greed
 - Need to be prepared for increased value of flexibility
- ▶ Increased compliance requirements
- ▶ Tighter gate closures and increased granularity
- ▶ Reduce cognitive load
 - Worst case : 20160 bids/day/optimization (35 Powerplants * 24 h * 4 quarters * 6 intervals)
- ▶ Stepping stone for algorithmic Intraday trading

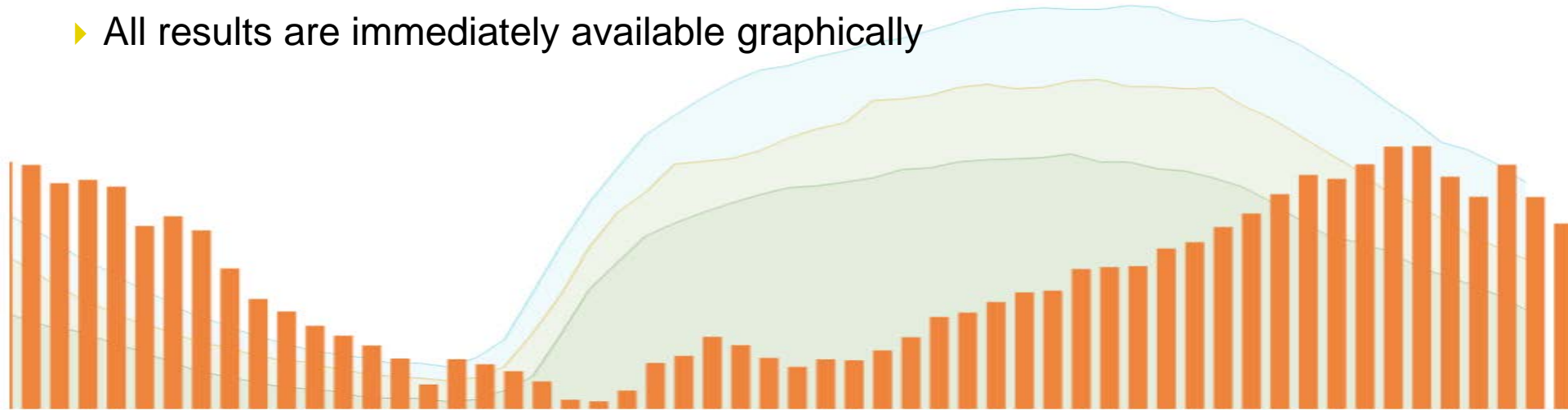
Our approach

- ▶ Have a goal
 - Identify key components needed to reach the goal
 - We needed to teach ourselves programming
 - Try to maintain the big picture
 - Pry open proprietary solutions
- ▶ Limited resources
 - Keep it as simple as possible
 - Modular development (add as you go)
- ▶ Flexible datastructures
- ▶ Frequent model runs
- ▶ Try to be inclusive
 - Sharing is caring

Long Term Model – Prodrisk



- ▶ Has started up at noon every day since 2015
- ▶ Tightly connected to SHOP
 - Try to keep the models as similar as possible
- ▶ Prodrisk portfolio deviates less than 2% from actual annual production
- ▶ All results are immediately available graphically





Short term model - AutoSHOP

- ▶ SHOP-API in conjunction with python
 - Runs a script or as a web-service
- ▶ Heavy use of dirty tricks
 - Use results from iterations as input for penalties and limits
- ▶ Is called as a webservice from an eventlistener
- ▶ All results are immediately available graphically

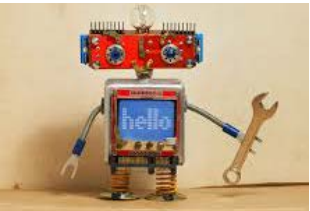
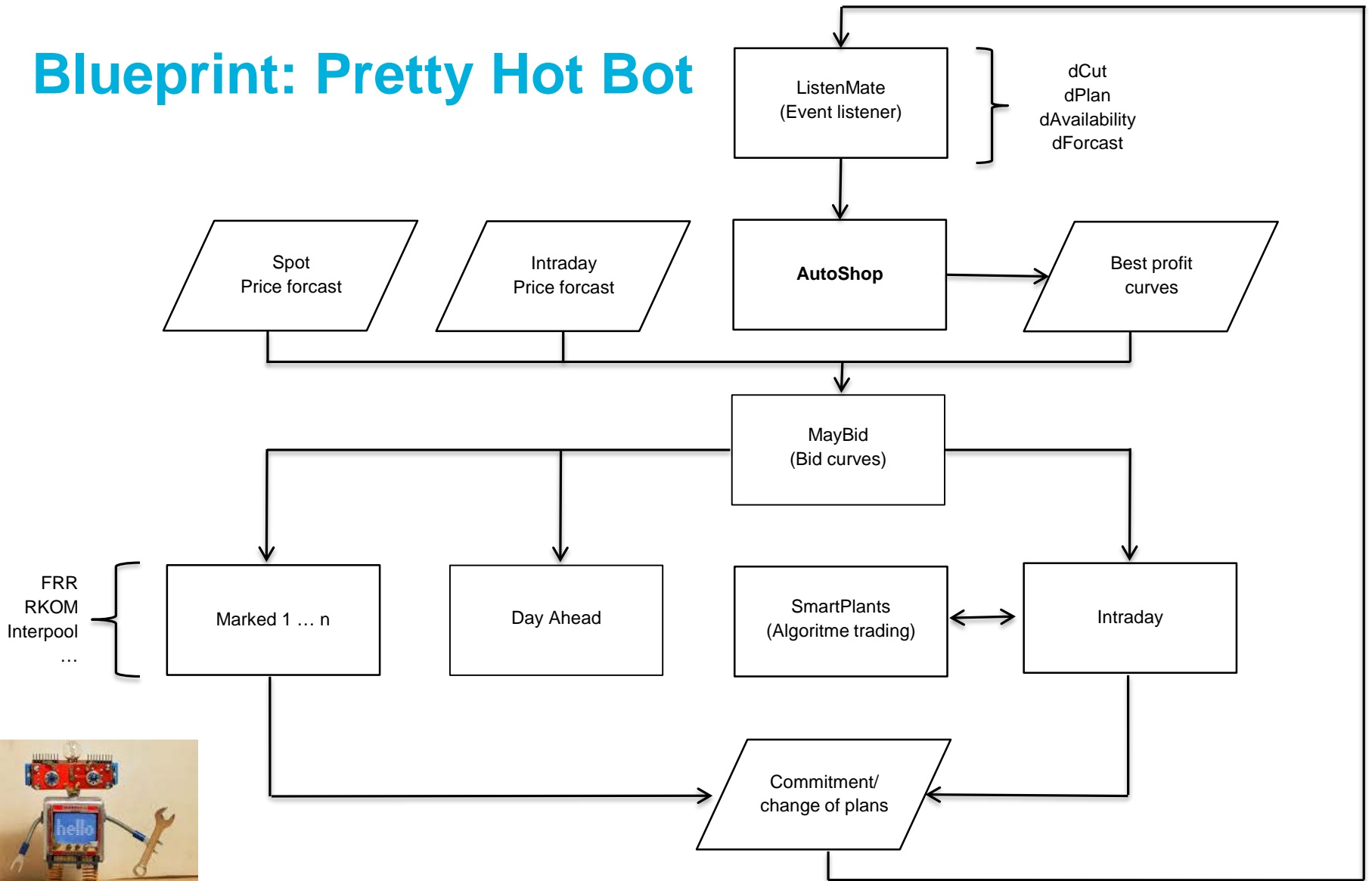


EventListener - ListenMate



- ▶ Developed in-house
 - Checks for changes in files and databases
 - Calls the webservice for SHOP (AutoSHOP)
 - Alerts if something goes wrong
 - Logs callevnt and response
- ▶ Currently checks for changes in
 - Results from Prodrisk (files)
 - Price (database)
 - Inflow (database)
- ▶ The hardware for the database has stopped us from checking
 - Availability, dispatch, reservoir level, gates

Blueprint: Pretty Hot Bot

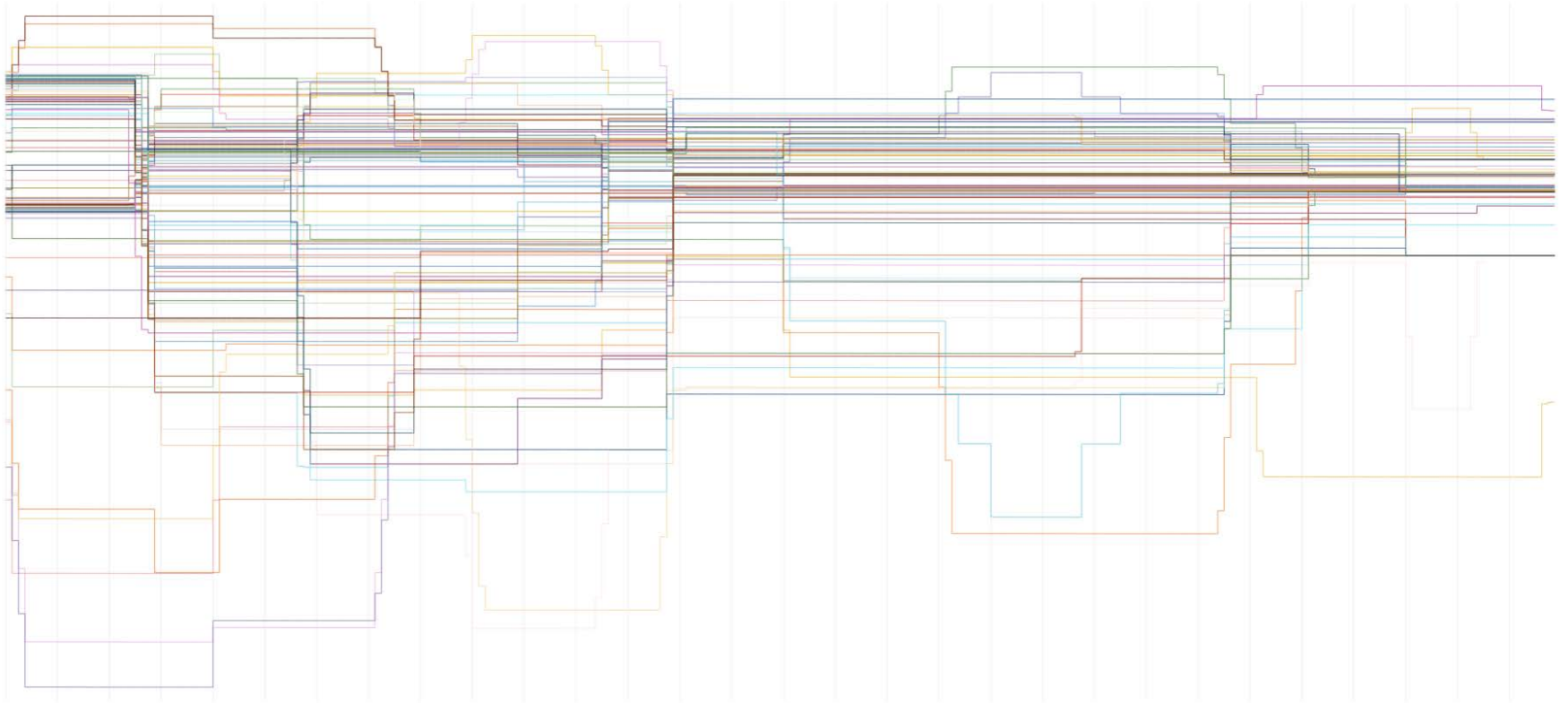


Coordinated bidding - MayBid



- ▶ Try to split bidding between day-ahead and intraday using Best Profit curves
- ▶ Challenges
 - Lack of intraday price prognosis
 - Lack of stochastic short term price prognosis
 - How to deal with uncertainty
- ▶ Exploring uncertainty using all 50 inflow ensembles
 - Will the uncertainty be represented by the Best Profits curves?
 - Use weighed clusters? Pick one? Use MultiSHARM? Give up and use deterministic results?
- ▶ Ongoing project with eSmart

Local increment cost [€/MWh] from SHOP



Algorithmic trading - SmartyPlants



- ▶ Receive BP-curves and volume to do algorithmic trading
- ▶ Try to have a feedbackloop with SHOP
 - Run SHOP if a trade is initiated
 - Update bids if BP-curves has changed
- ▶ Method is being tested for algorithmic trading by master students Ane Dideriksen & Susanne Sekkesæter (Finished June 2019)
 - Find a partner to develop if method is valid and useful

Experiences so far...

- ▶ SHOP-API works really well with the open source ecosystem
 - Is an important component if digitization is important
- ▶ Easy to make it run
 - Very hard to make it robust
 - Our solutions are often emulations of multiSHARM
- ▶ Easy too seek advice and discussion partners for intraday
 - Sintef, NTNU, other power producers
 - Problems are still hard



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