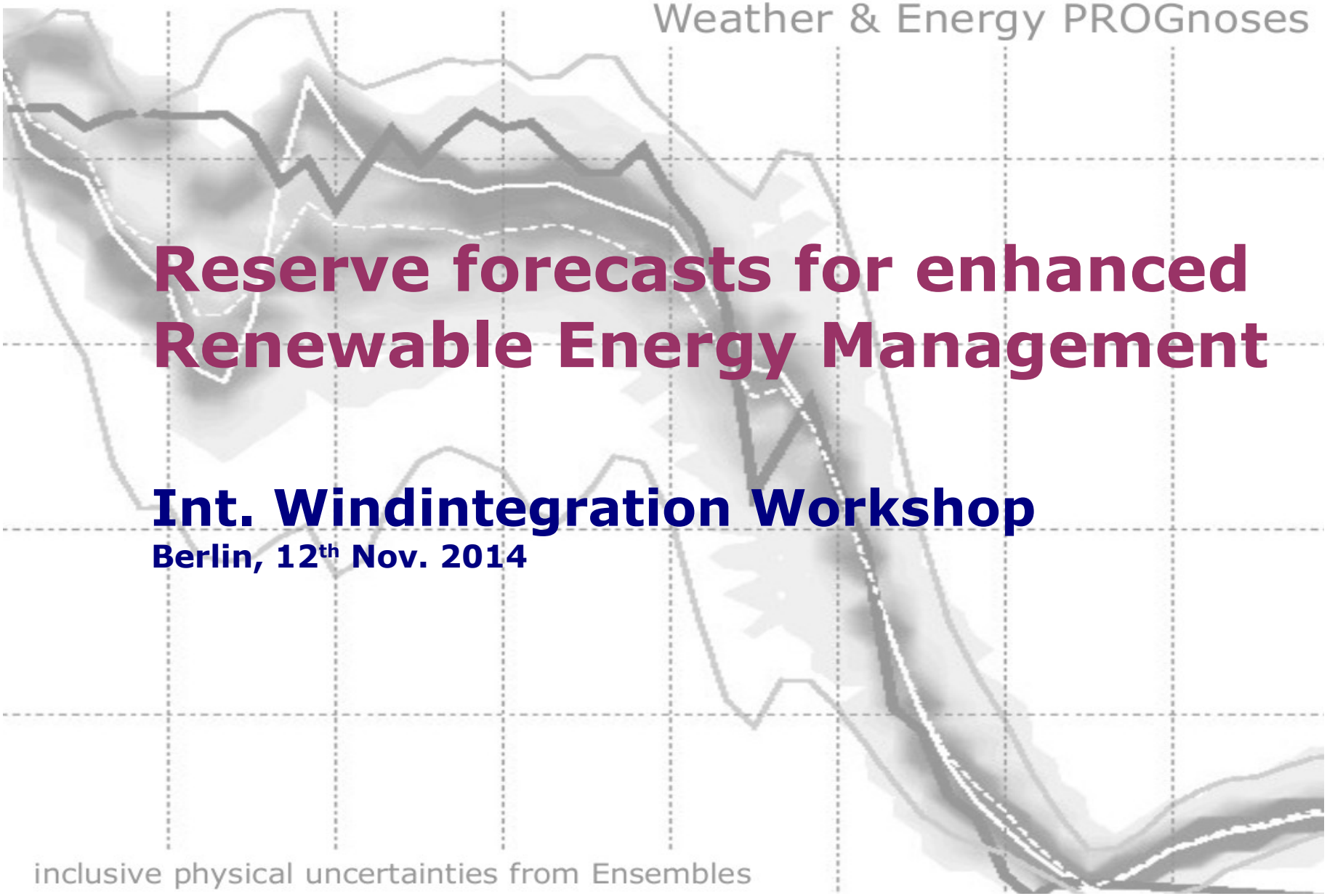
WEPROG

Weather & Energy PROGnoses



Reserve forecasts for enhanced Renewable Energy Management

Int. Windintegration Workshop

Berlin, 12th Nov. 2014

inclusive physical uncertainties from Ensembles

Table of content

Description and discussion of the challenges
of designing the right system for the user of reserve predictions

→ read our technical description of the computations
and technicalities of reserve predictions in our paper

Download the paper from our home page:
http://www.weprog.com/publications

Motivation and Prospects of Reserve Forecasting

1. Dynamic allocation of reserve opens up for a cost reduction
2. Ignorance on warnings can compromise system security
3. The TSO has most system information, but must still take assumptions
4. Reserve forecasting increases situational awareness
5. The discussion of cost versus system security has not started yet

The shared balancing volume because of practical

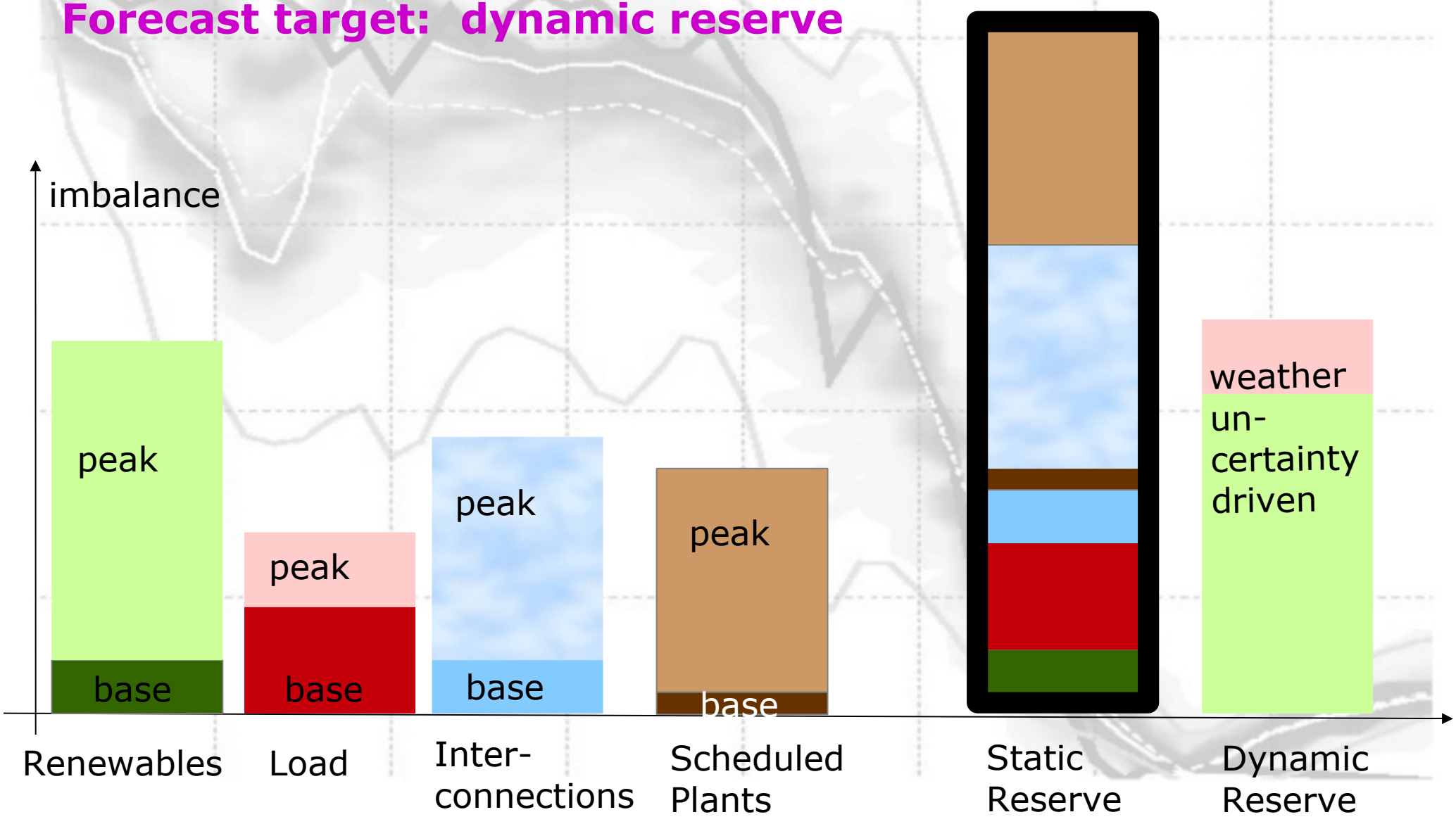
Impacts

is likely to remain nearly static limitations and risks

1. Incentive for market to utilize intra-day trading to reduce imbalance
2. Static reserve allocation can be reduced
3. More capacity will be 24x7 in the market
4. The daily day-ahead auction will be used strategic by stakeholders

Decomposition of reserve

Forecast target: dynamic reserve



Background on Reserve requirements for Renewables

Considerations for a TSO/ISO/Utility/BRP:

Obligatory and political Task

- obligatory reserve requirements for "largest single plant failure"
- availability of inter-connections
- obligatory reserve from inter-connections
- load considerations

Considerations for a TSO/ISO/Utility/BRP + Trader:

Optimisation Task

Reserve requirement is dependent on

- ramping of Renewables in the control area
- congestion issues
- primary reserve availability
- market structure
- load considerations and uncertainty

Examples of Reserve allocation strategies

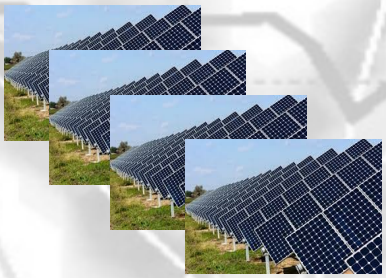
Traditional approach: Static Allocation strategy
- a constant reserve allocation for upward and downward ramping

New approaches:

Security allocation strategy
Difference between MIN and MAX of the Ensemble
determines the band for reserve allocation

Dynamic / Economic allocation strategy
Optimisation of uncertainty bandwidth with percentiles
(e.g. P20:P80, P30:P70) to reduce unused reserve allocation

Requirements and Pre-Requisites for Reserve Forecasts

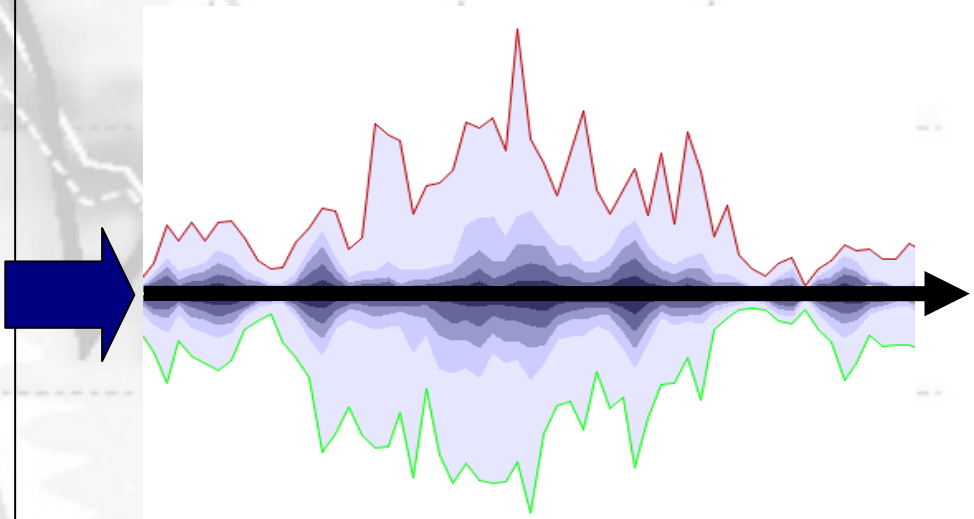


forecast engine

Ensemble Forecasts

Load forecast

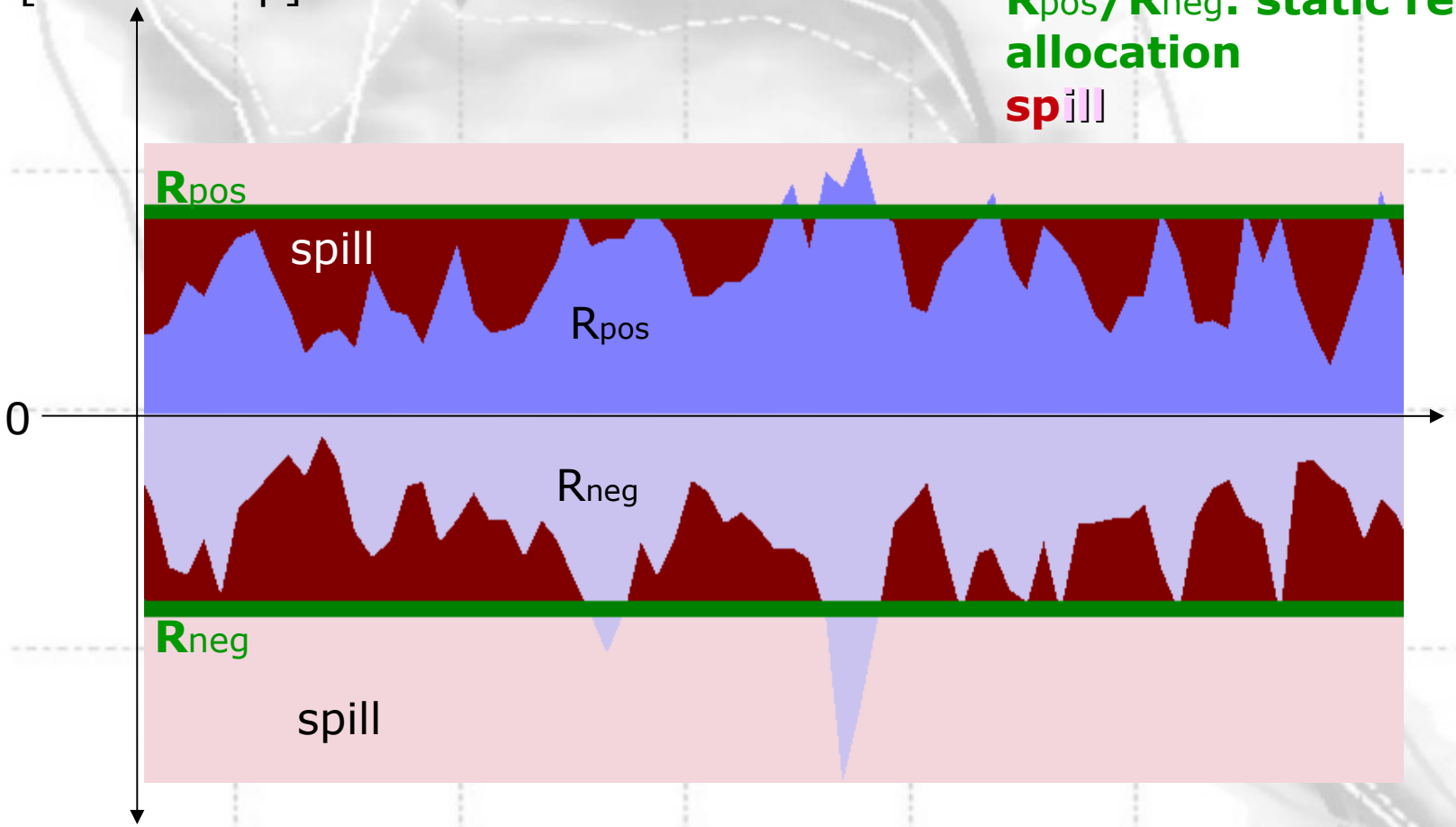
other inter-connections imbalance sources



Allocation of reserve with a percentile band or "min-max"… dependent on the target

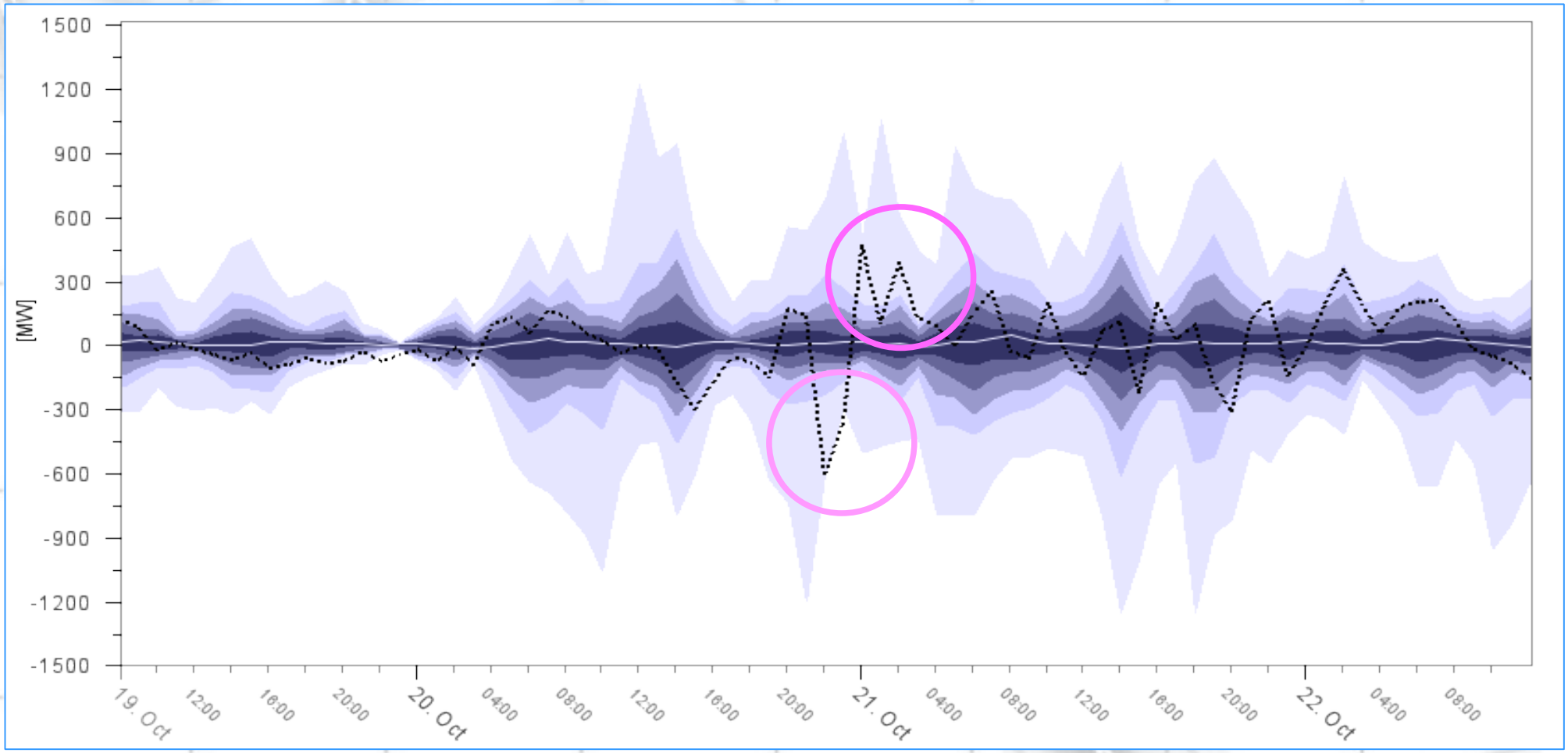
The way a reserve forecast is built and how it “looks”

Rpos: dynamic positive reserve
Rneg: dynamic negative Reserve
Rpos/Rneg: static reserve allocation
spill



Amount of reserve spill is dependent on the “allowed” false alarms

Interpretation of Uncertainty Bands for Reserve Forecasts



Forecast Uncertainty is variable in each hour:

Only MIN-MAX band covers near 100% of the required reserve

(P10:P90) or (P20:P80) do not cover ALL, but MOST reserve requirement!

Selection of the best suitable band is dependent on allowed error tolerance

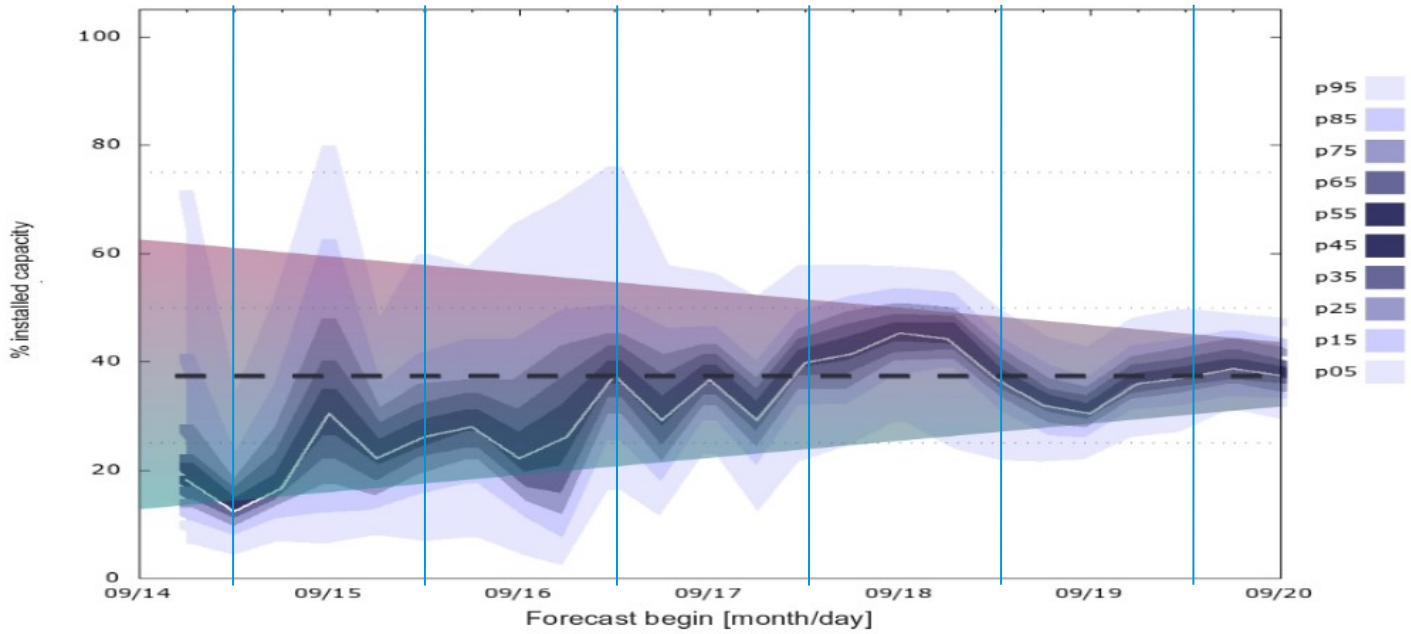
Why are Ensemble forecasts essential for Reserve Forecasts ?

Weather uncertainty is the generator of forecast errors

A deterministic reserve forecast can only "define" the difference between a previous forecast and the latest forecast

Reserve forecasts are not only a short-term phenomena

To schedule reserve via a tender the forecast horizon needs to be >48h



Example:
Change of forecast uncertainty over 6 day-ahead forecasts

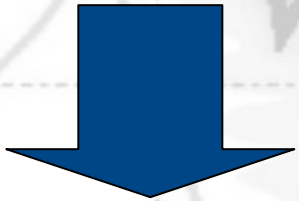
=> it is the uncertainty of the weather development that is required to estimate the error - reasonably "long" in advance

Definition of Error Conditions for Reserve Allocation

Without defining the target for the error allowance,
forecasts of reserve will disappoint...

The **most simple reserve forecast** is a constant wide reserve band, which implies:

100% success
high costs
possibly non-available reserves



Questions to be asked for the design of reserve forecasts:

How many failures can be tolerated ?
What is the allowed maximum error ?
Which frequency of reserve under-prediction is allowed ?
What is the cost of spilled reserve ?

What is the best way of evaluating a reserve forecast ?

Standard Statistics does not provide answers:
it's not the error of 1 forecast any more...
it's whether the allocation was sufficient and
cheaper than allocating with a constant "security" band

With Contingency Statistics we can ask the right questions:

Hits and Misses Analysis can show how much of the time was my band too small

Positive and Negative Reserve can be split to reflect Tertiary Reserve allocation instead of Primary Reserve

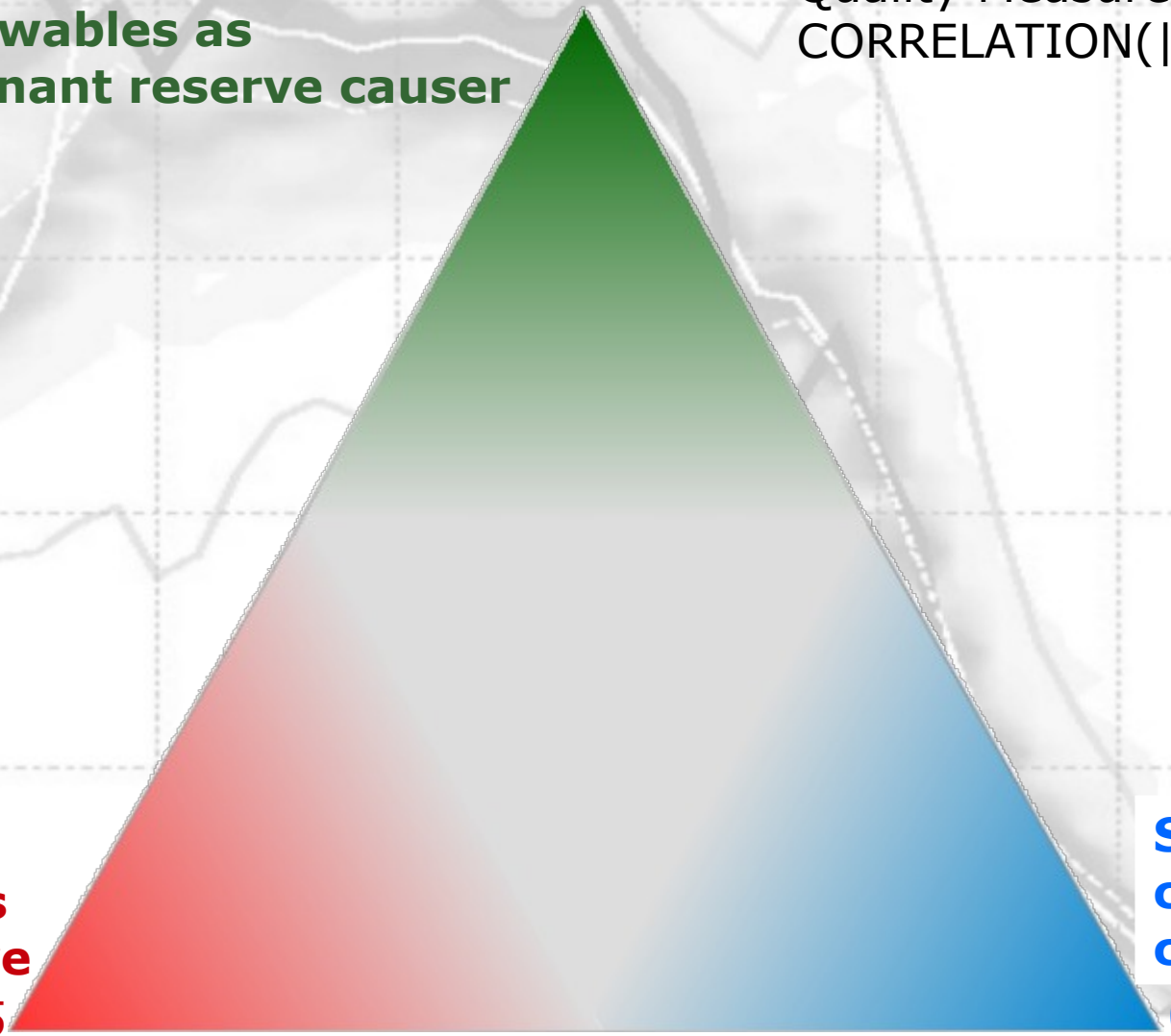
What we need is
a measure that shows the
dependency on the
fulfilment of a
pre-defined condition

What forecast quality is achievable

well-defined area and Renewables as dominant reserve causer

0.7

Quality Measure:
CORRELATION(|ERR|,Forecast)



Load causes most reserve

0.5

Strongly inter-connected system causing imbalance

0.2

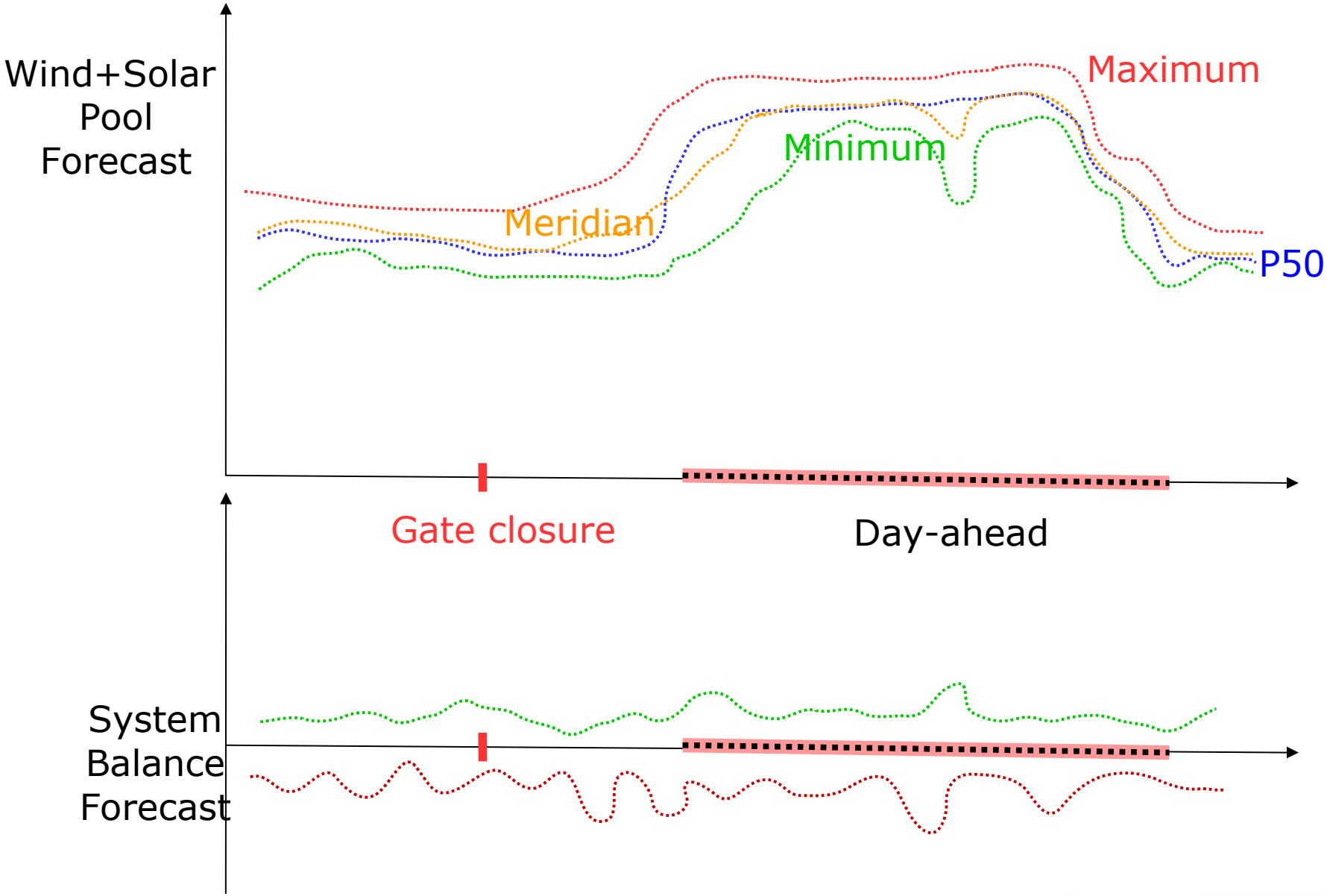
Strategic Daily Spot Market Bidding

1. Large Wind pools become often the main price maker
2. New forecast targets: Optimization for intra-day balancing
3. Bid based on a preliminary plan for the balance process
4. Less hours of negative prices

The impact of increased Intra-day Trading

1 Reduces the day-ahead schedule error with approx. 50%
2. Reduces the need of peak reserve
3. Reduces the volatility of balancing costs
4. More volume in the market
5. Small pools may not need to be 24x7 in the market

Reserve forecast application sample:
Early Detection of Balance Cost Volatility Risk



Summary and Lessons Learnt

When setting up reserve forecast it is important to:

have the correct type and amount of ensemble data input

- multi-model or multi-scheme approach
- deterministic reserves do not provide uncertainty
- it is the weather uncertainty that generates the errors

define the forecast objective very clearly

- which types of errors are critical
- what type of reserve fits to my objective:
  typical scenarios are: static, security or dynamic/economic

set the time scales that needs to be forecasted

- required ramping capabilities

use aggregated forecasts of all weather dependent sources & sinks

- built the uncertainty term on load+wind+solar

define a "noise term" to handle the non-local imbalances

- imbalances from interconnections (small system <-> large system)

Conclusions

We can conclude that <Reserve Forecasting>

- is possible
- can be used for system imbalances, area imbalances, pool imbalances
- is a paradigm shift in the way forecasting has been used so far
- has a great potential to increase efficiency in the way imbalances are handled with increasing amounts of Renewables
- enhances the way to use the "cheapest and most efficient source with lowest marginal costs" to handle imbalances

* see references

Thank you for your attention !

Contact:
Dr. Corinna Möhrlen
com@weprog.com

WEPROG Germany
71155 Böblingen
Tel. +49 7031 414279
Fax. +49 7031 414280

WEPROG Denmark
5610 ASSENS
Tel. +45 46 92 29 07
Email: info@weprog.com
Web: www.weprog.com

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