pv based reserve power

PV FORECASTING CONFIDENCE INTERVALS FOR RESERVE PLANNING AND SYSTEM OPERATION

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Motiviation for the Provision of Reserve Power by PV

A. System support at times of high wind and PV penetration

In particular at moments of high PV and wind penetration , conventional generation is replaced. The conventional power fleet traditionally provides the balancing services to the TSO.

B. New revenue strams for PV systems

PV system/portfolio operators will face lower electricity market revenues in the future. System services are discussed as a new income stream.

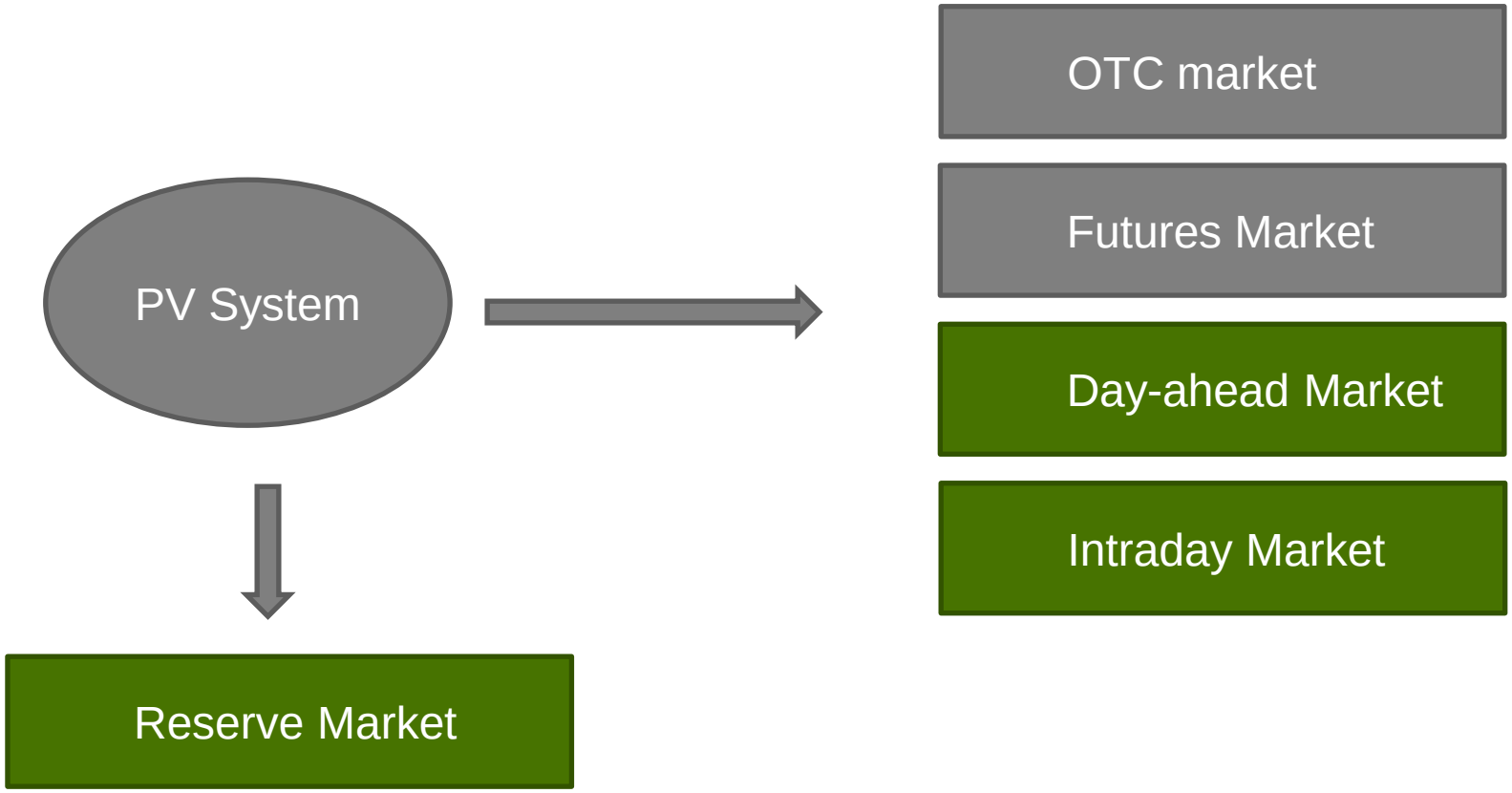
IEE Project Reservices

Focus of this pesentation

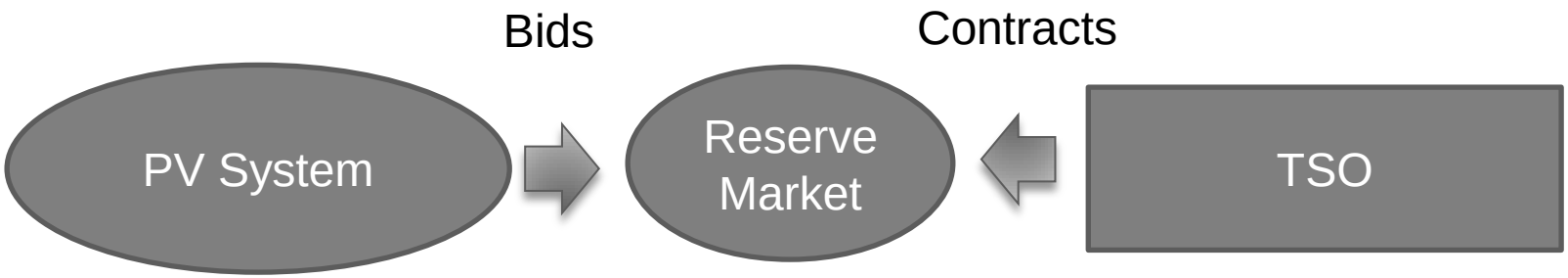
Frequency support	Voltage support	System restoration
Frequency Containment Reserve FCR (<5, 10 or 30 sec) Frequency Restoration Reserve FRR (<15 min) Replacement Reserve RR (15 min to hours)	Normal Operation: control of power factor, reactive power or voltage	Black start
Fast frequency response (synthetic inertia) (< 2s) Ramping margin (1, 3, 8 hours ahead)	Fast reactive current injection	Islanding

For more information on REserviceS visit www.reservices-project.eu

Valorisation of PV for this work



Reserve Power Market



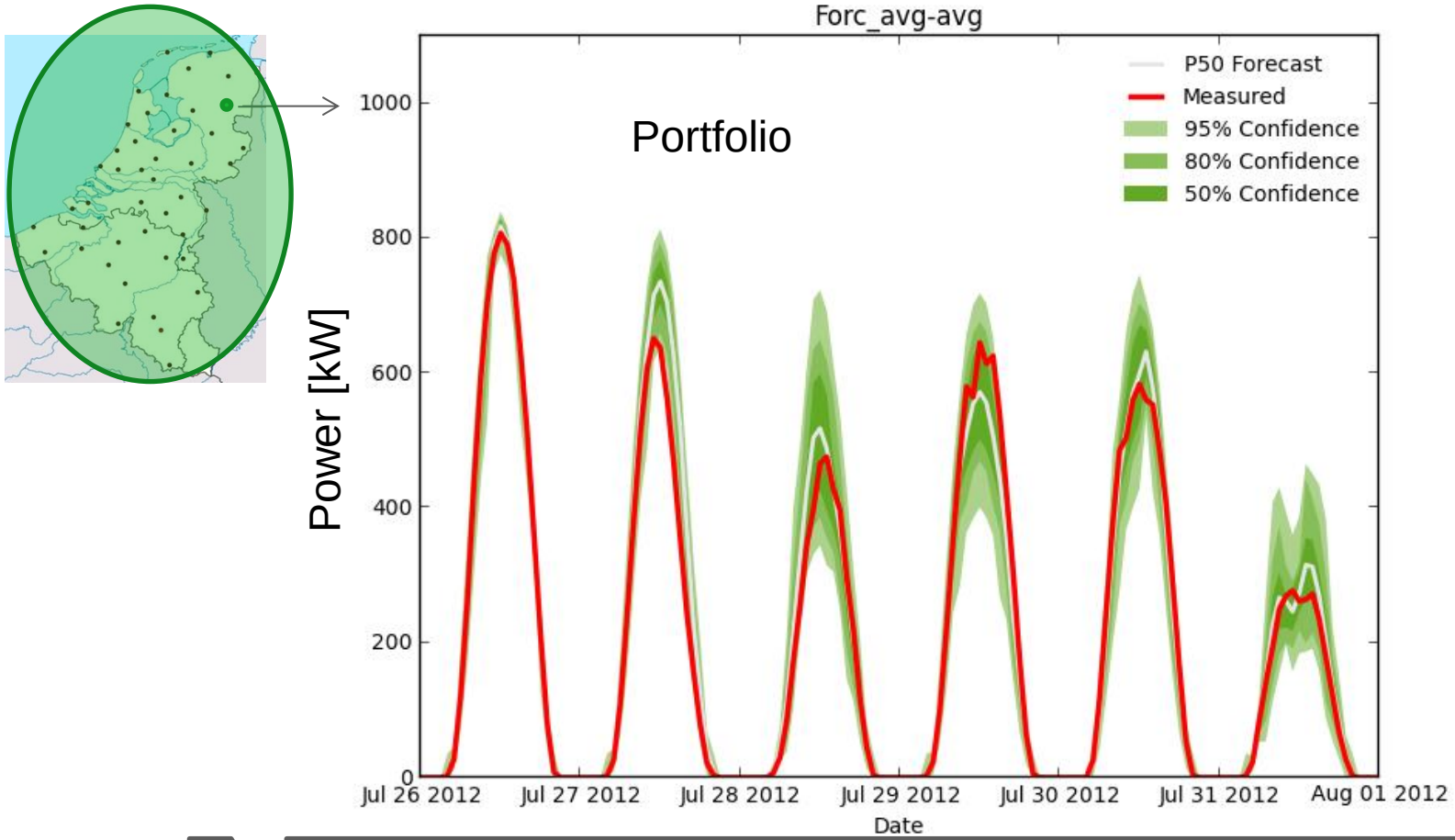
Main challenges:

- Market design:
  - Product types
  - Gate closure times
  - Availability

- PV System, Forcast uncertainty
  - Increases costs in particular for upward reserves
  - Asks TSO to change the contracting approach

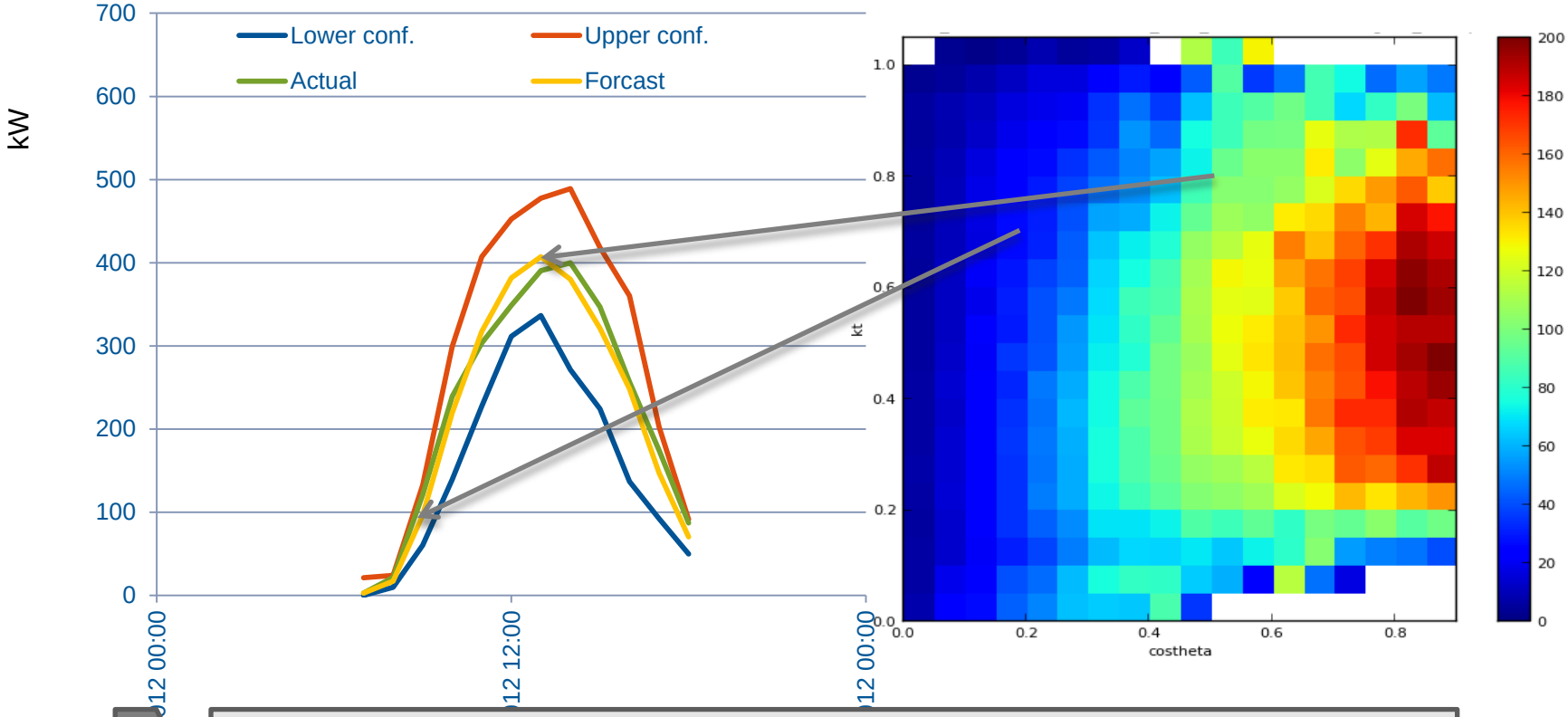
→ The market is historically designed for conventional power plants

Confidence Intervals – Benelux Case Study



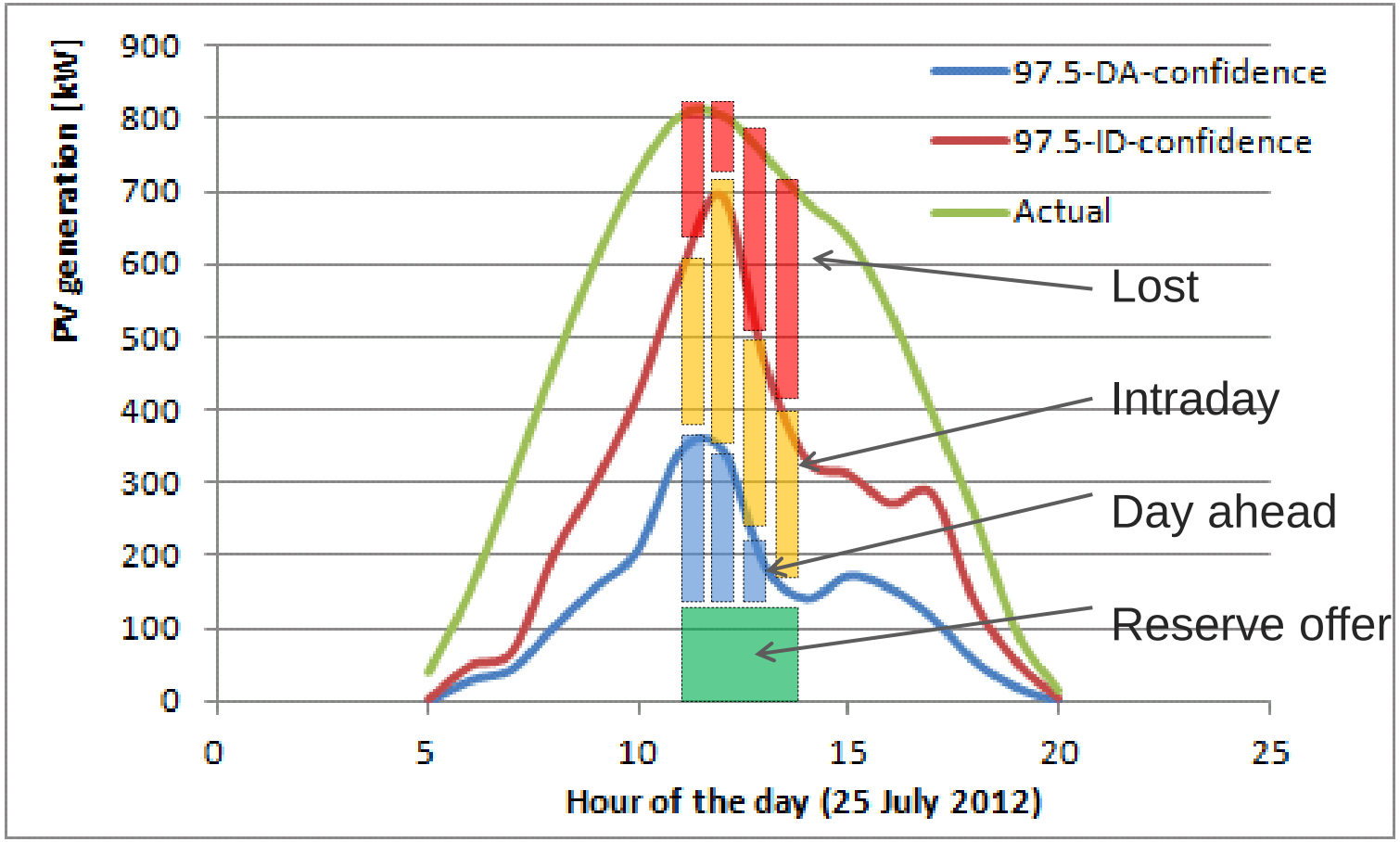
For reserve power provision the confidence level was set to 97.5% (availability of conventional plants according to dena I)

How to create a confidence intervall?



We took a non-parametric approach to develop the confidence itnervals. This approach showed higher accuracy than a distribution based approach.

Further Terminology – Lost Energy

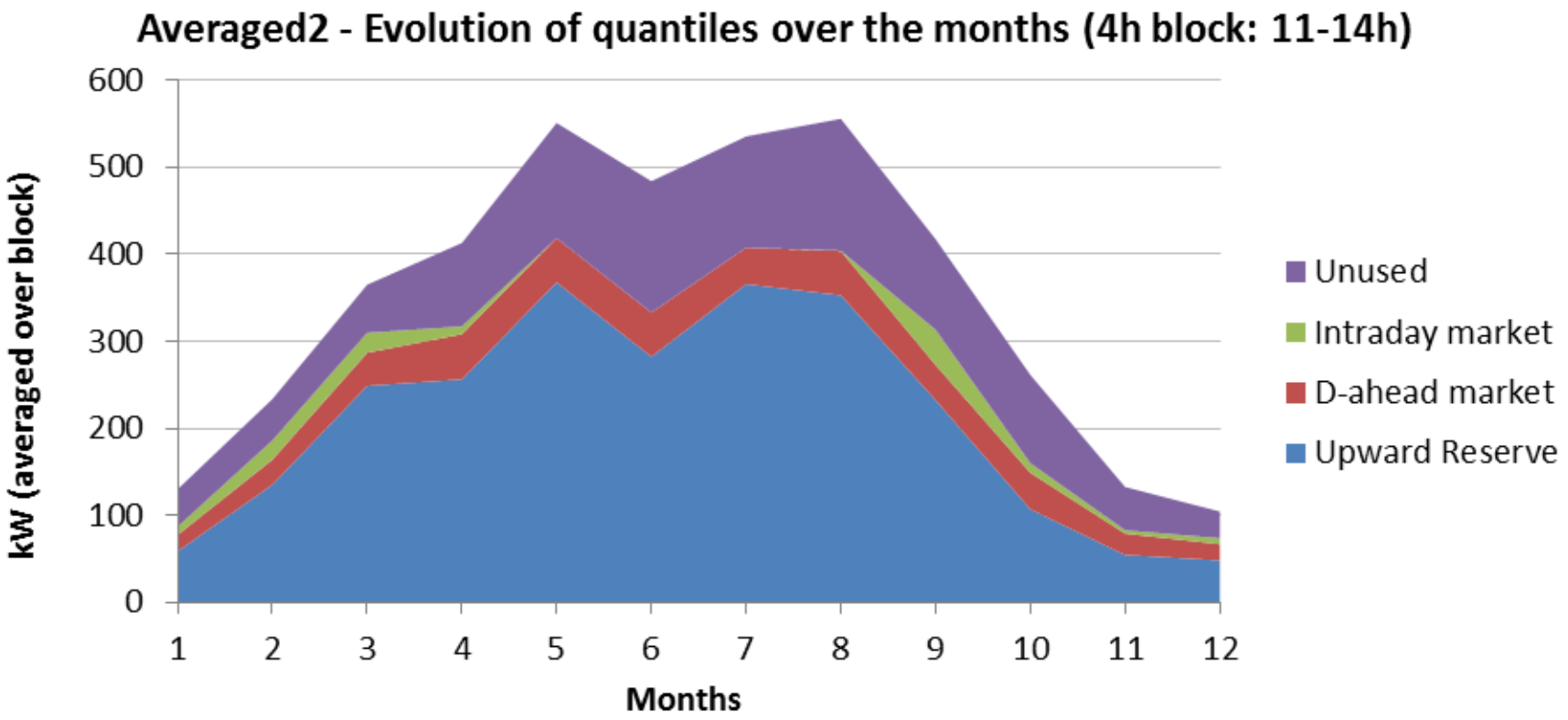


For downward reserve no energy is lost because it is fully valorized on the market.

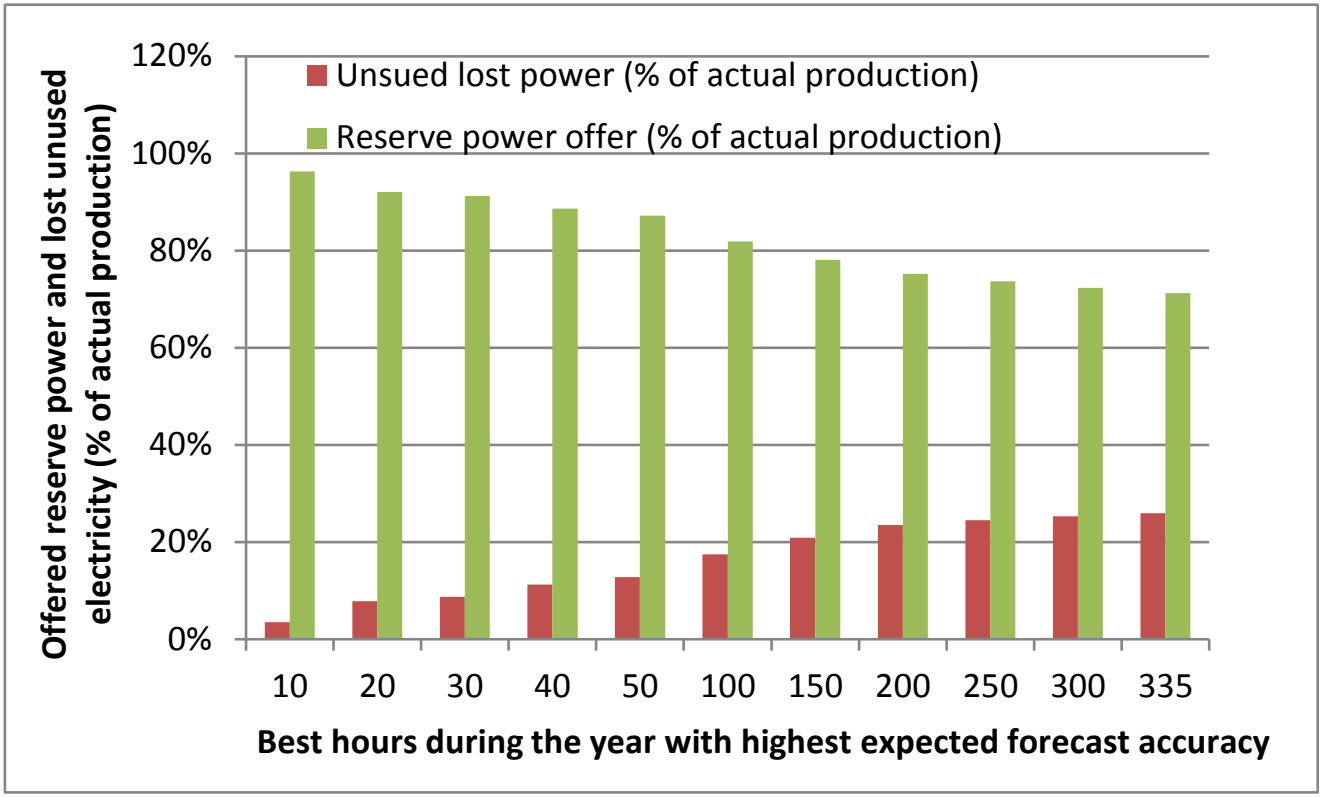
Cost of Unused Electricity for Upward Reserve Offers

- Upward reserve provisions by single sites is extremely costly
- For large protfolios these costs are reduced but still significant.

Readiness costs II



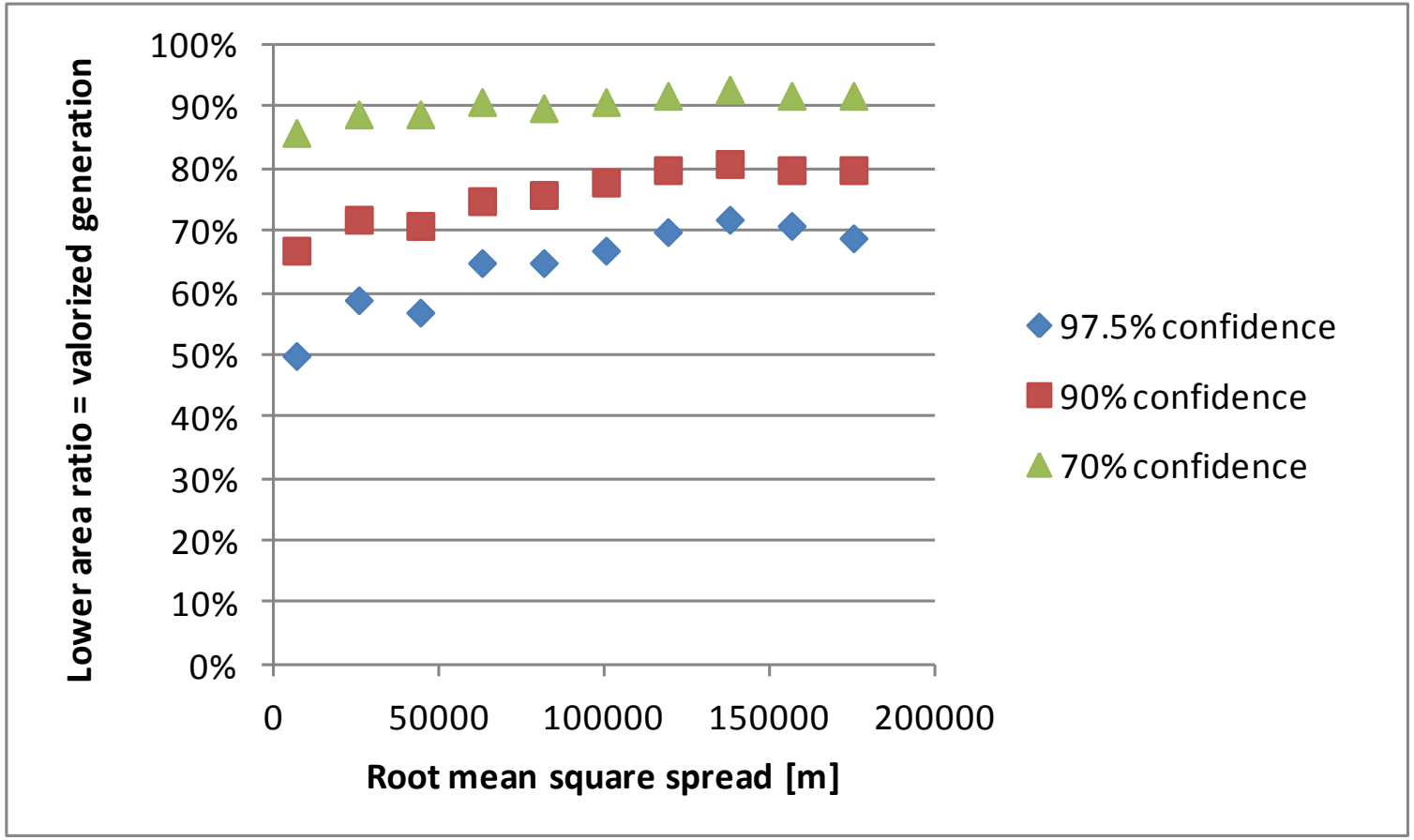
Reduce Readiness Costs – Selected Offers



Other cost reducing factors are:

- Forecasting accuracy
- Confidence level
- Portfolio spread
- Gate closure times (increasing offer)

Reduced Readiness Costs – Spread and confidence Level



REserviceS – Result Overview

- No technical challenge
- Technically challenging
- Not feasible

			PV system size			
			Residential	Commercial	Ground mounted	Portfolio
			≈ 4,5 kWp	≈ 200 kWp	≈2,5 MWp	100 MWp
Frequency Support	Challenge		Technically challenging	No technical challenge	No technical challenge	No technical challenge
	Investment		€€€	€€	€	€
	Readiness	Upward	€€€	€€€	€€€	€
		Downward	<€	<€	<€	<€
	Provision		<€	<€	<€	<€
Voltage Support	SVC		No technical challenge	No technical challenge	No technical challenge	No technical challenge
		Investment	€€	€	€	€
		Readiness	<€	<€	<€	<€
		Provision	<€	<€	<€	<€
	FRCI	Challenge	Technically challenging	No technical challenge	No technical challenge	<€
		Investment	€€€	€€	€	<€
		Readiness	<€	<€	<€	<€
		Provision	<€	<€	<€	<€

Conclusions

- Confidence intervalls seem to be an good tool to offer reserve power to the TSO.

- Downward reserve can be provided at very low (close to zero) costs.

- Upward resreve is still costly due to forecast uncertainty and large amounts of unused electricity.
- **Larger PV portfolios will be able to offer upward reserve with reasonably low lost energy costs– in particular when the portfolio is located in the southern Europe.**

- Main barriers to be surmounted:
  - PV friendly (non-discriminating) reserve market designs
  - ICT costs for large portfolios of smaller sized PV systems

Thank you

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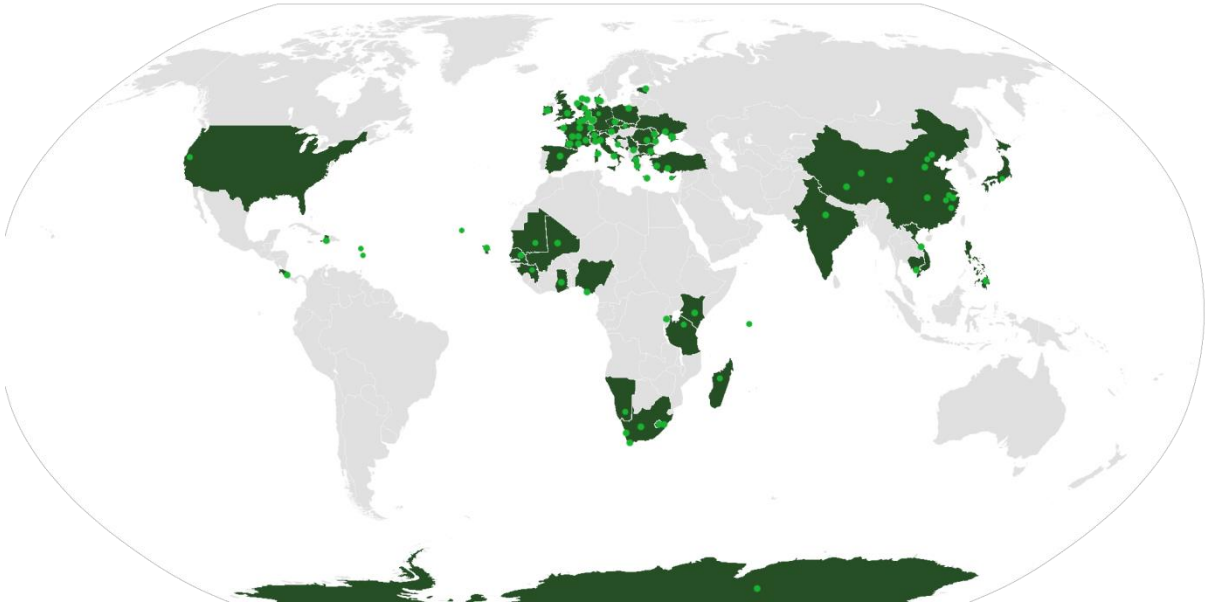

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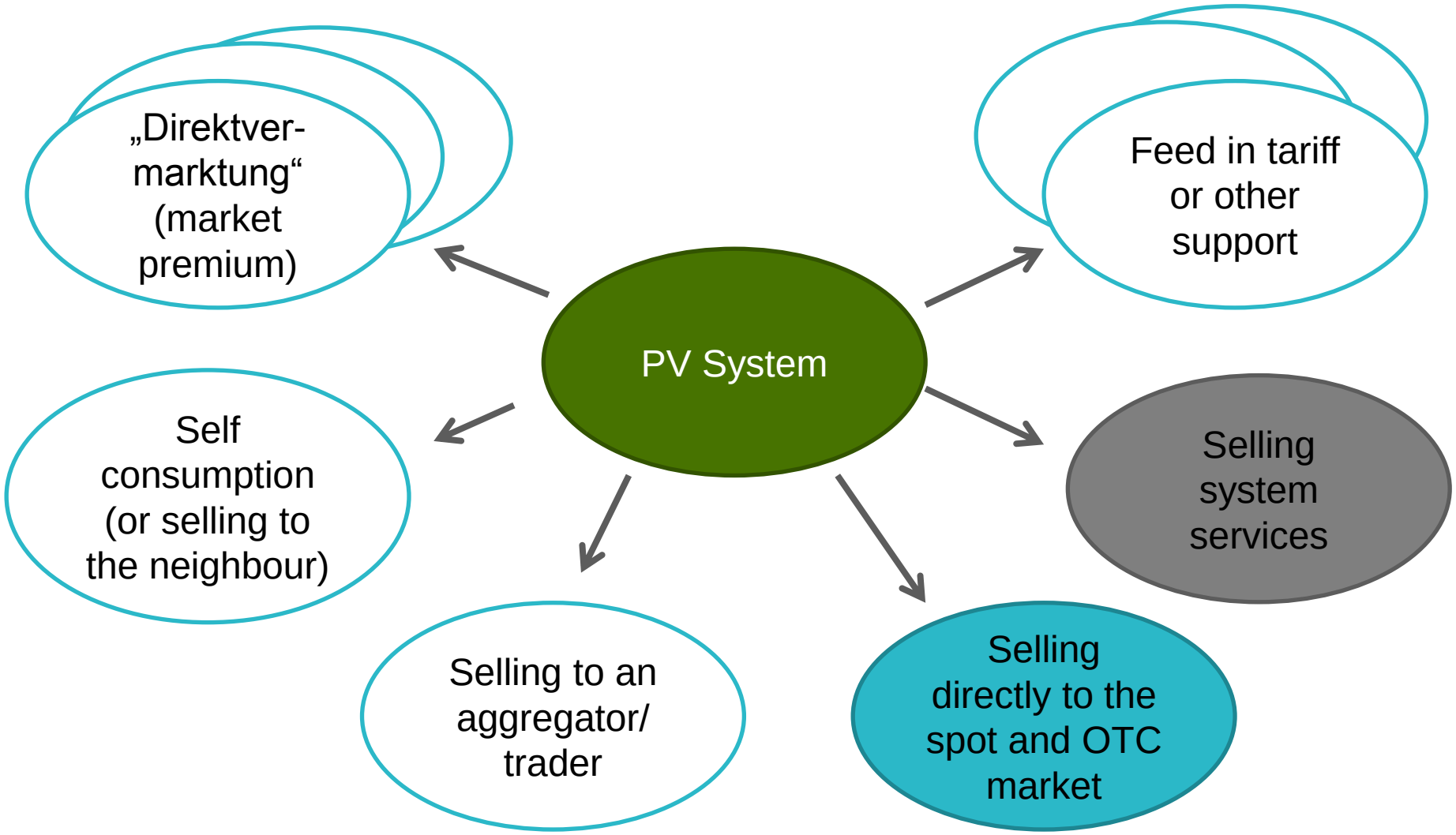
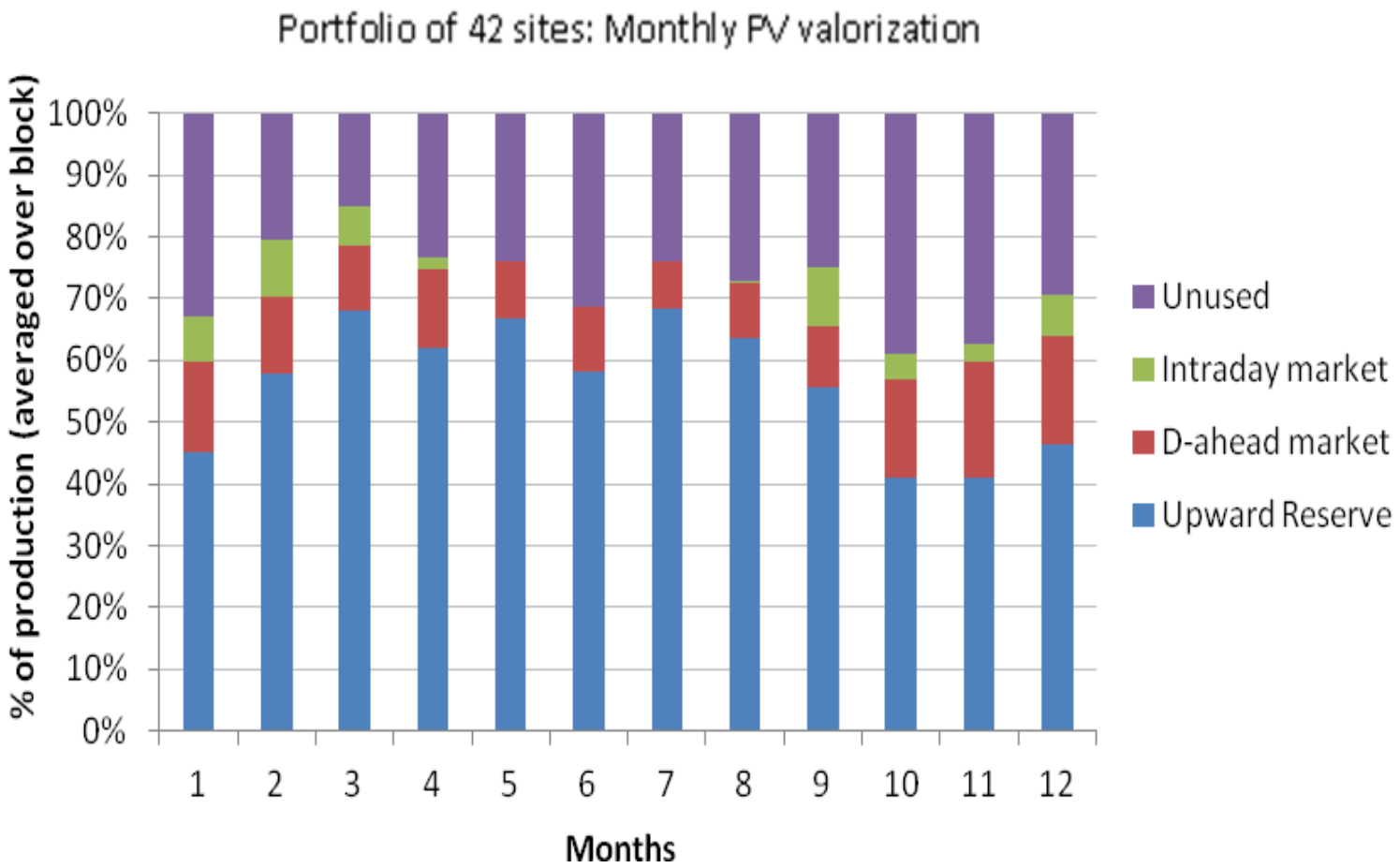
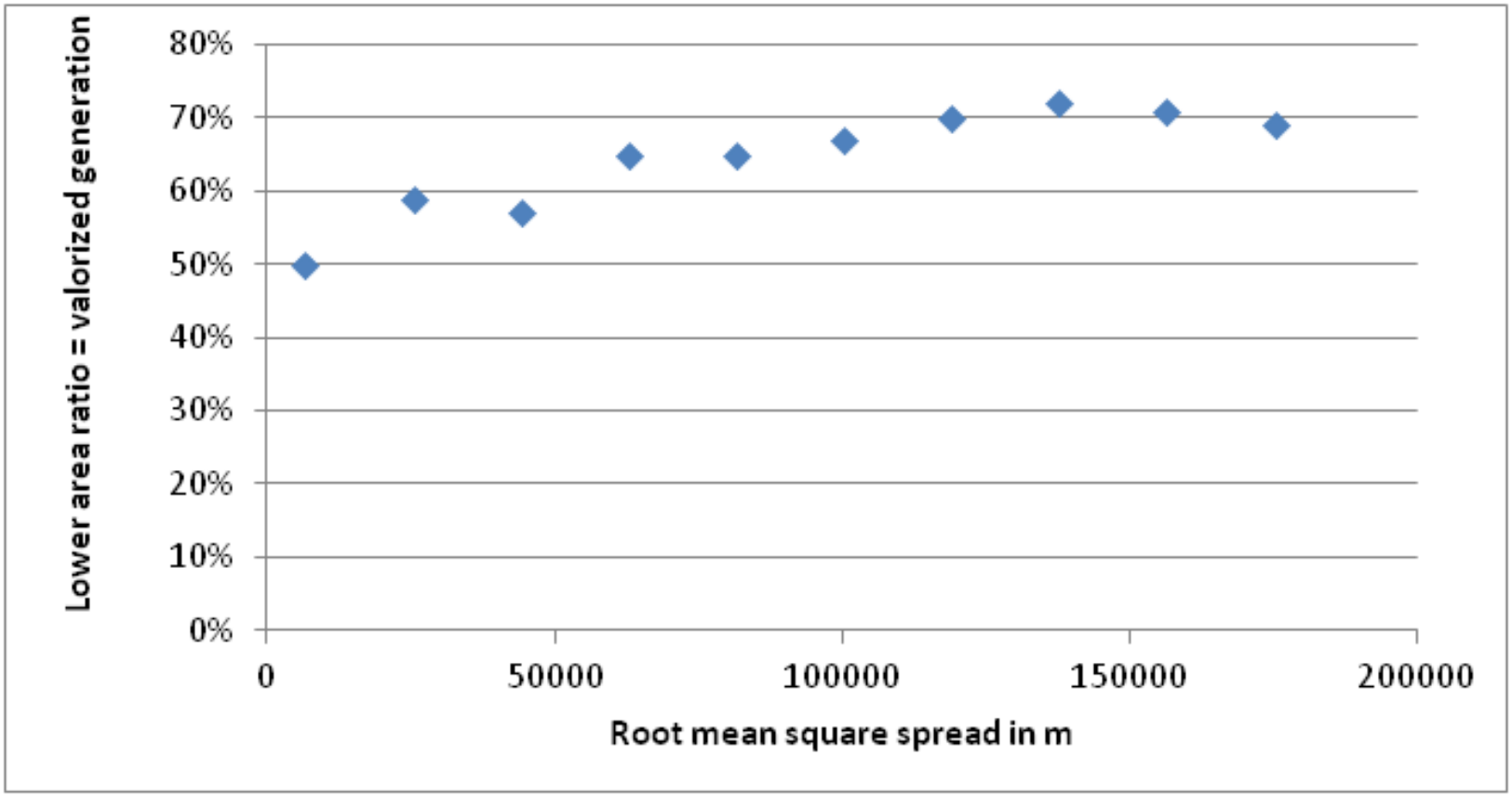
Motivation – Valorisation of PV



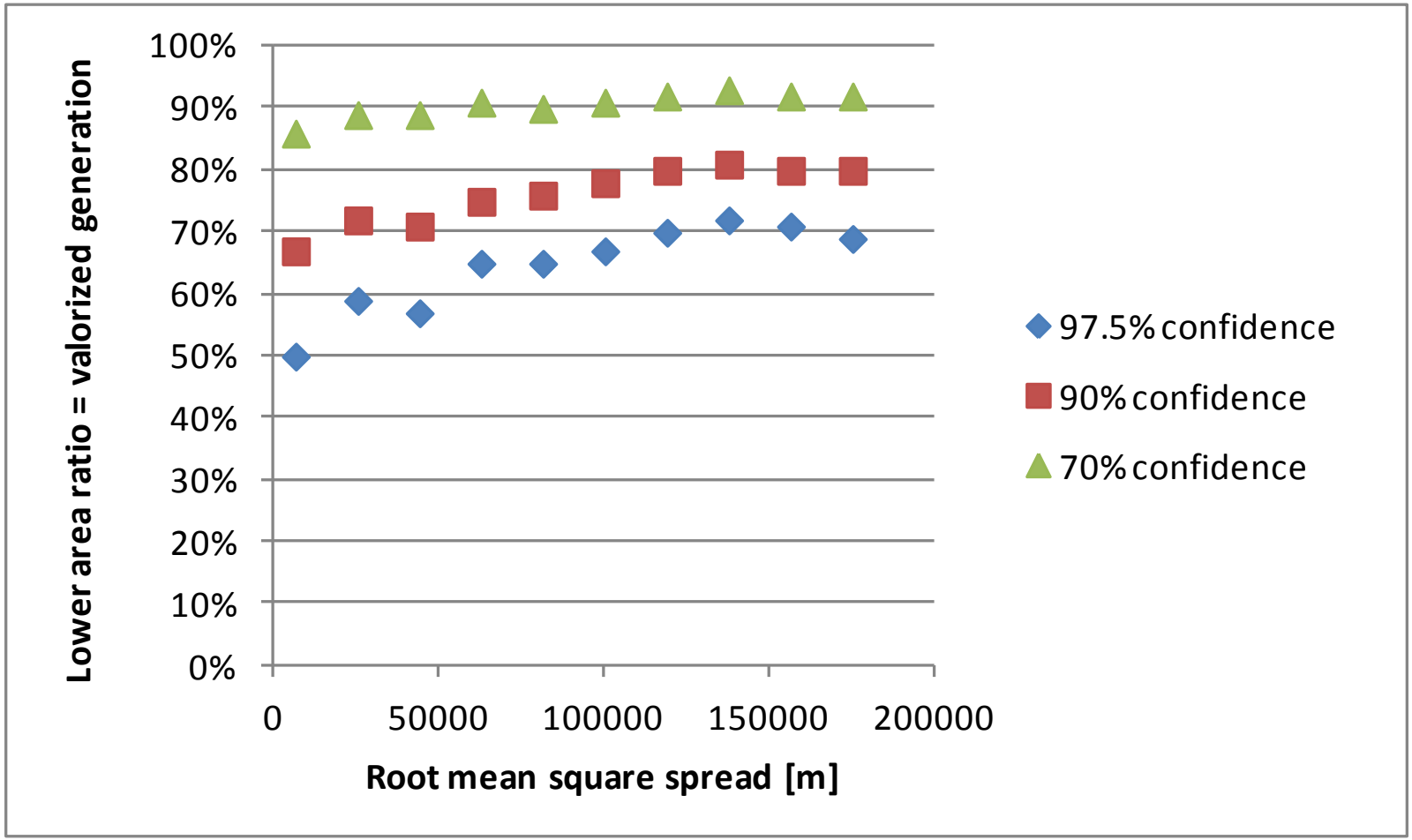
Radiness costs III



Readiness costs IV



Readiness costs V



Factors for the Costs of Upward Reserve Offers

- **Forecast error:** Future improvement of day-ahead and intraday forecast error are expected
- **Spread of the portfolio:** The wider a portfolio is spread the lower is the forecast error
- **Choice when to offer upward reserve:** When good forecasts are expected the costs for the offers are lower.
- **Location of the portfolio**: Portfolios located in the south can offer at lower costs as the forecast errors are significantly lower.

- REserviceS deliverable D4.1 analysed these factors in detail.
- A larger portfolio will be able to offer upward reserve with lost energy costs lower than 10% of the available generation – in particular when the portfolio is located in the south
- **Necessary actions to make such offers by PV possible**
  - Market adaptations allowing day-ahead reserve offers
  - Agreement with the TSO on process how such offers can be made ensuring the same quality as offers by conventional generation.