



CoordiNet -

Lessons learned from the Swedish demo 1

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INNOGRID 2020



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824414

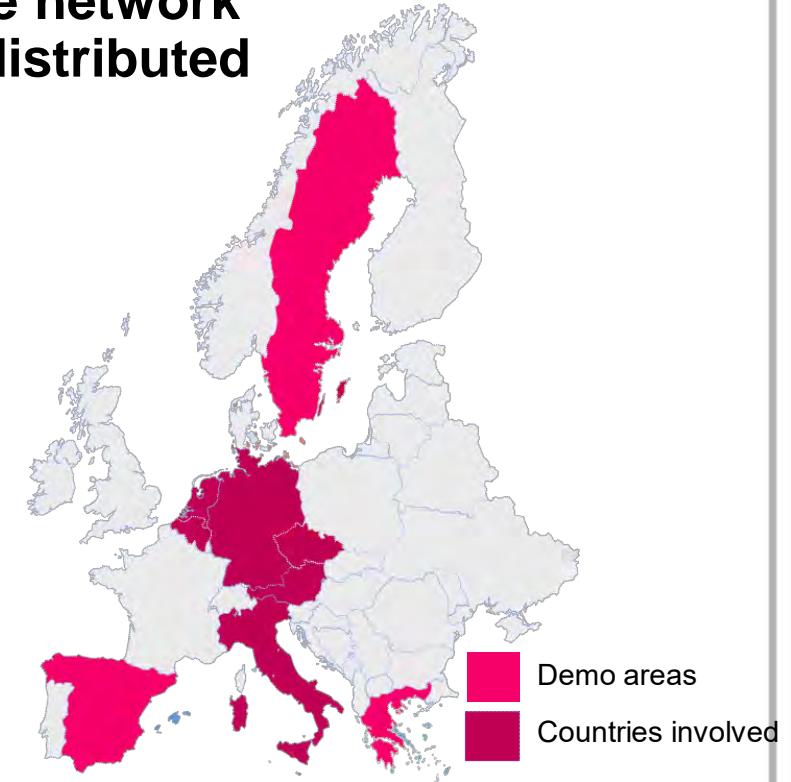
Horizon 2020-project

Large-scale TSO-DSO-Consumer demonstrations of innovative network services through demand response, storage and small-scale distributed generation

- Project Timeline: January 2019 – June 2022
- Project Budget and funding : 19.2M€ - 15.1M€
- Total number of partners: 23 + 10 Linked Third Parties

Objectives:

- Demonstrate the activation and provision of services through a TSO-DSO coordination
- Define and test standard products that provide services to the network operators
- Develop a TSO-DSO-consumer collaboration platform in demonstration areas to pave the way for the interoperable development of a pan-European market

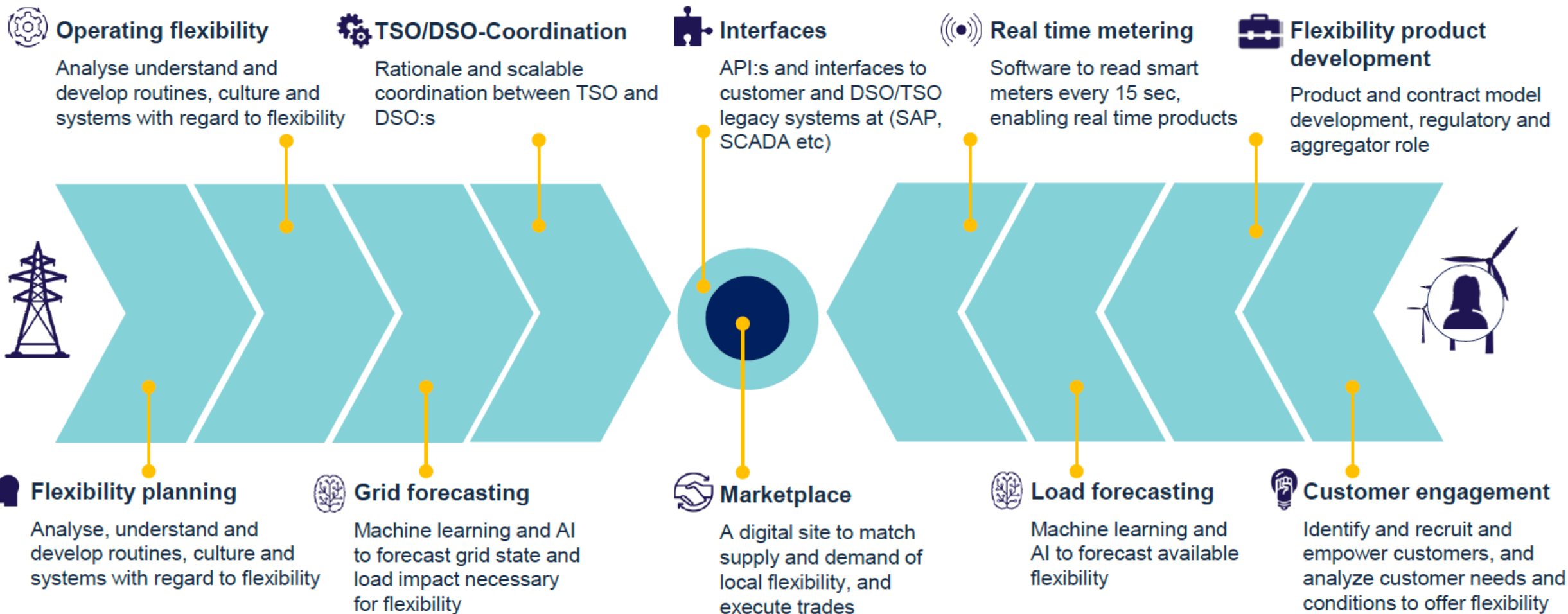


The Swedish demo

- DSOs, flexibility providers, actors in the energy society and authorities have participated in 60 well-attended dialogue meetings - 500 different people participating at the various meetings
- The Swedish CoordiNet demo showed a more dynamic and digitalized way for DSOs to utilize flexibility for the operation of the network
- The markets have demonstrated how to coordinate with and complement the existing markets for electricity trade

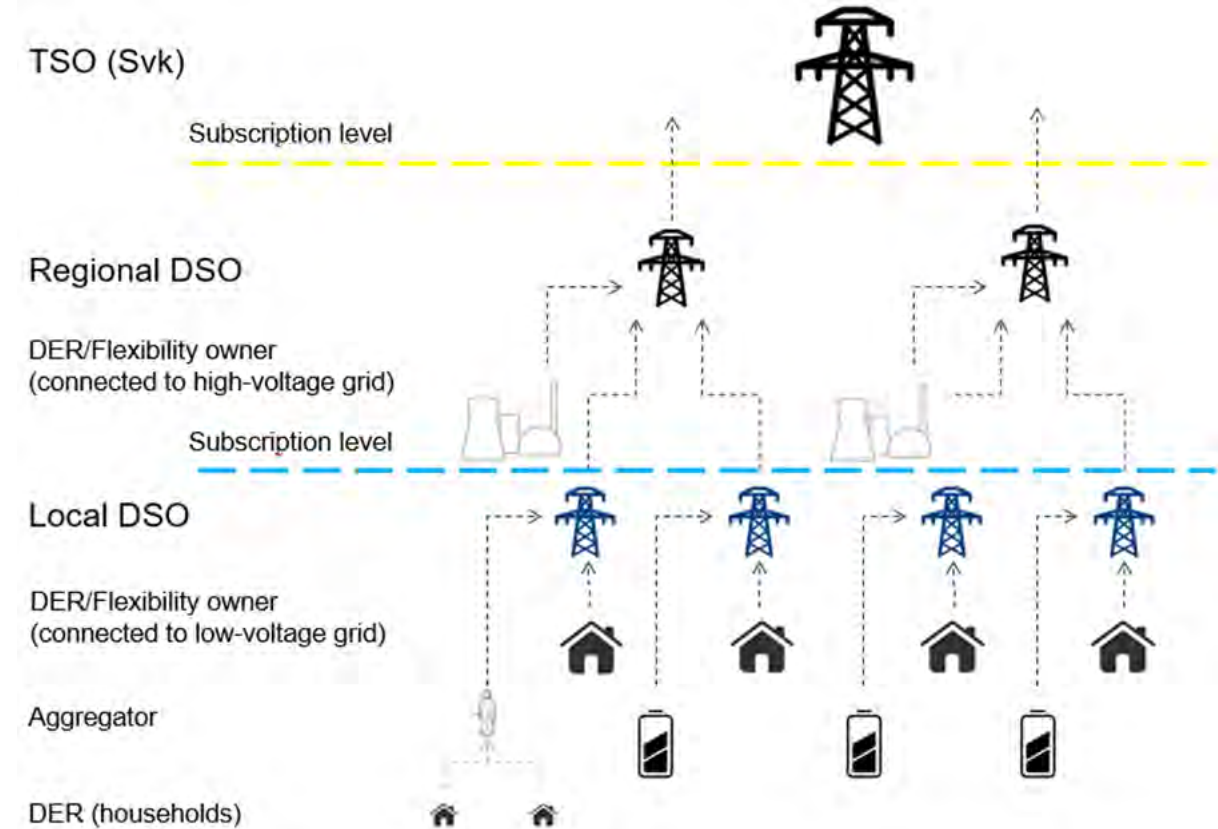


Local Flexibility – More Than a Marketplace

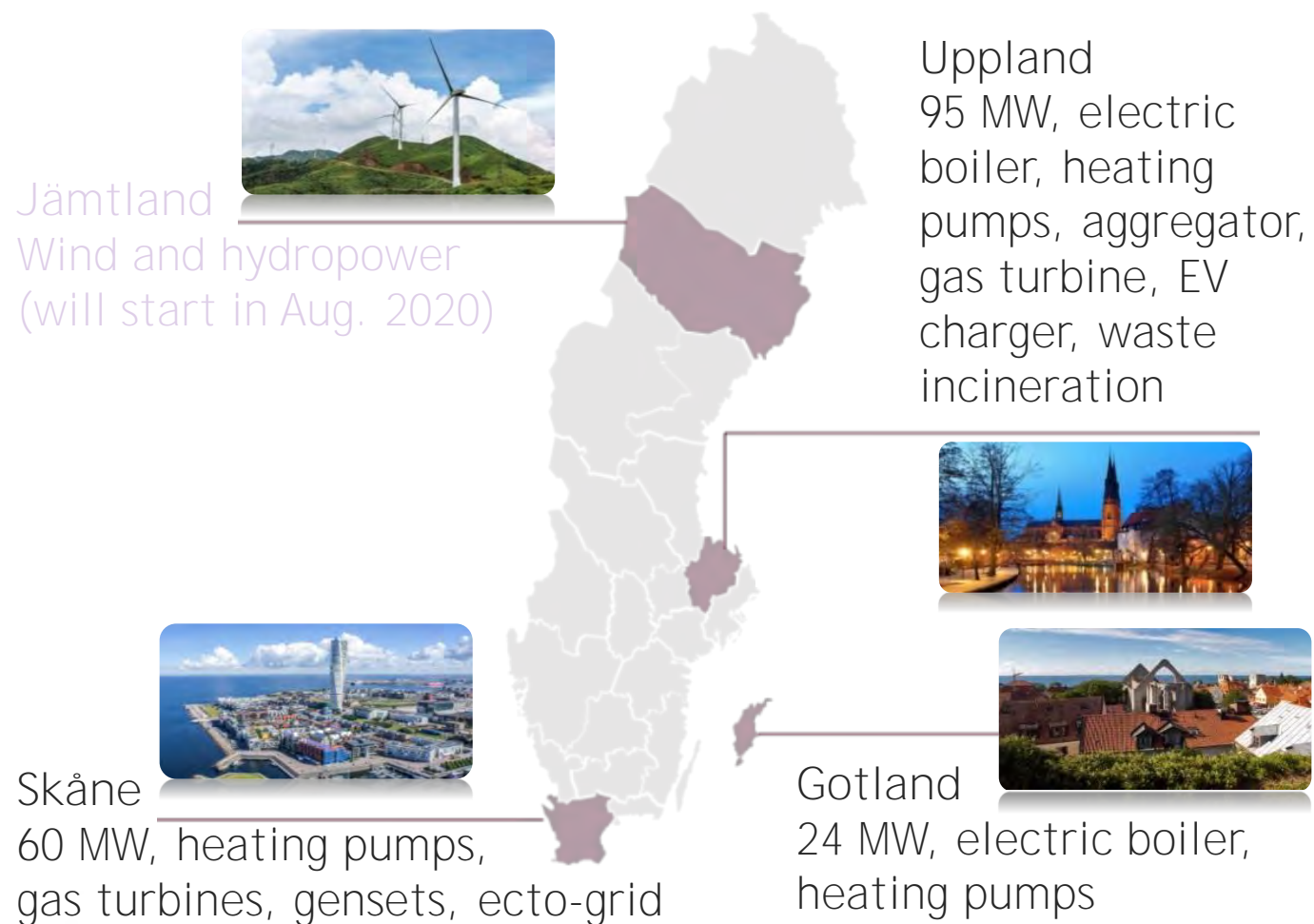


Business case demo 1

- Demonstrating the flexibility service for congestion management day-ahead in the winter of 2019/2020 on three demo sites
- The power level is limited by subscription levels between the local DSO and regional DSO and between the regional DSO and TSO. Violations of subscription limits subject to cost, and may be denied
- The DSO utilizes flexibility services to lower peak demand in the grid during the winter season November to March.
- A grid state forecast makes it possible to call for flexibility day-ahead working proactively to alleviate grid congestion that has strong correlation with temperature.
- The FSP sells its flexibility on a dayahead market that is coordinated with other markets



Flexibility providers in the Swedish demo



KPI 2019/2020	Skåne	Uppland Regional	Gotland
Flexibility providers FSP	5	5	2
Local markets	1	1	1
Resources	7	9 +340 houses (Aggregator)	3

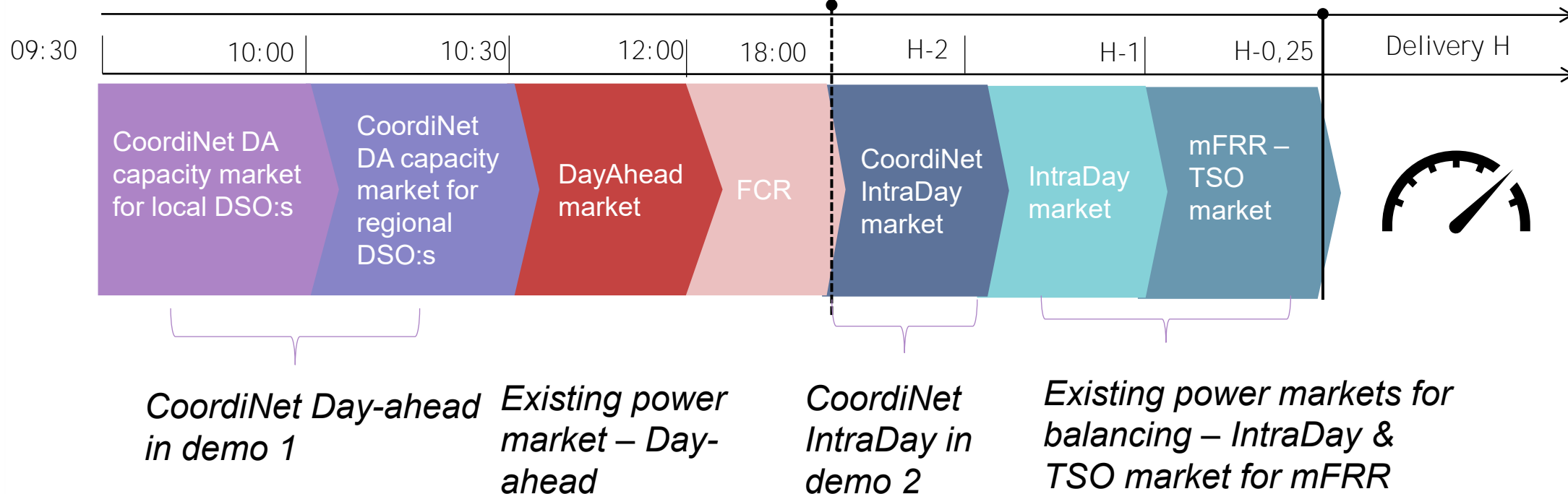
Coordination with other markets

- Nord Pool Day-ahead is the leading spot market for power trading in the Nordic countries

D-1

- CoordiNet intra-day market will forward unused bids to the mFRR market

D



- CoordiNet day-ahead takes place prior to the Nord Pool's in order for the BRPs of flexibility suppliers to adjust their energy production/consumption at the Nord Pool market

- TSO mFRR market is one of the frequency markets
- Closes 45 minutes before delivery time

Market platform

- FSP enter bids to website (also API in 2020/2021)
- Free-bids day-ahead (for 2020/2021 also intraday)
- Forecast of grid state from third-party provider
- DSO utilizes flexibility services to lower peak demand in the grid during the winter season November to March
- Platform proposes bids to clear based on impact factor and merit order list
- Platform receives measurement and production plans of major FSP resources, and can be used for evaluation and remuneration



Mon 9/3			Tue 10/3		
Min	Max	Price	Min	Max	Price
3	12	800	6	9	850
3	12	800	6	9	850
3	12	800	6	9	850
3	12	800	6	9	850
3	12	800	6	9	850
3	12	800	6	9	850
3	12	800	6	9	850
3	12	800	6	9	850
3	12	800	6	9	850

Market platform with bids



Market platform with recommended bids to be cleared

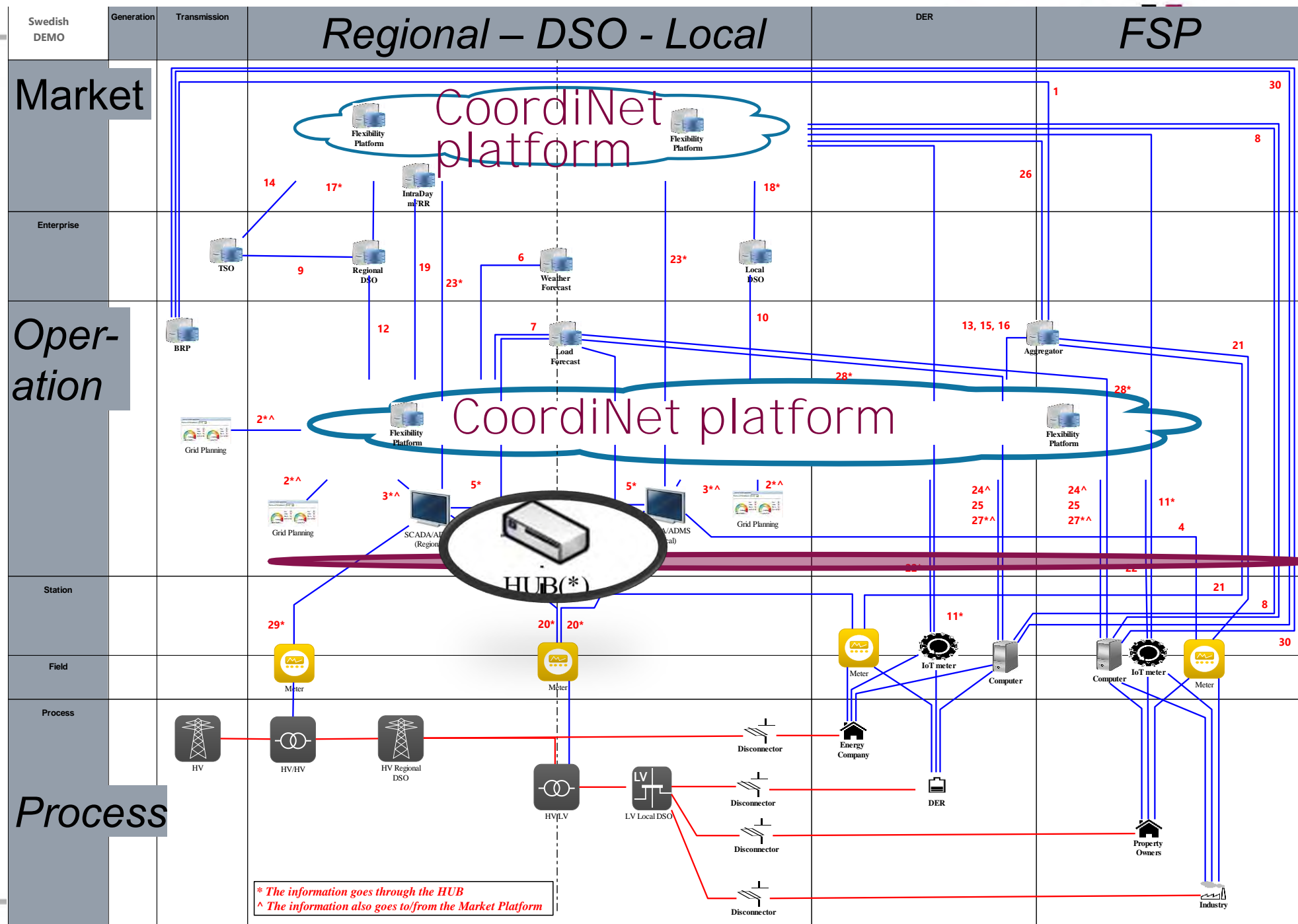
Market platform with dashboard for evaluation

Behind the scene:

Integrated market-operation platform

All data through common hub

SGAM component layer, Swedish demo (Tecnalia, RTWH Aachen, Vattenfall)



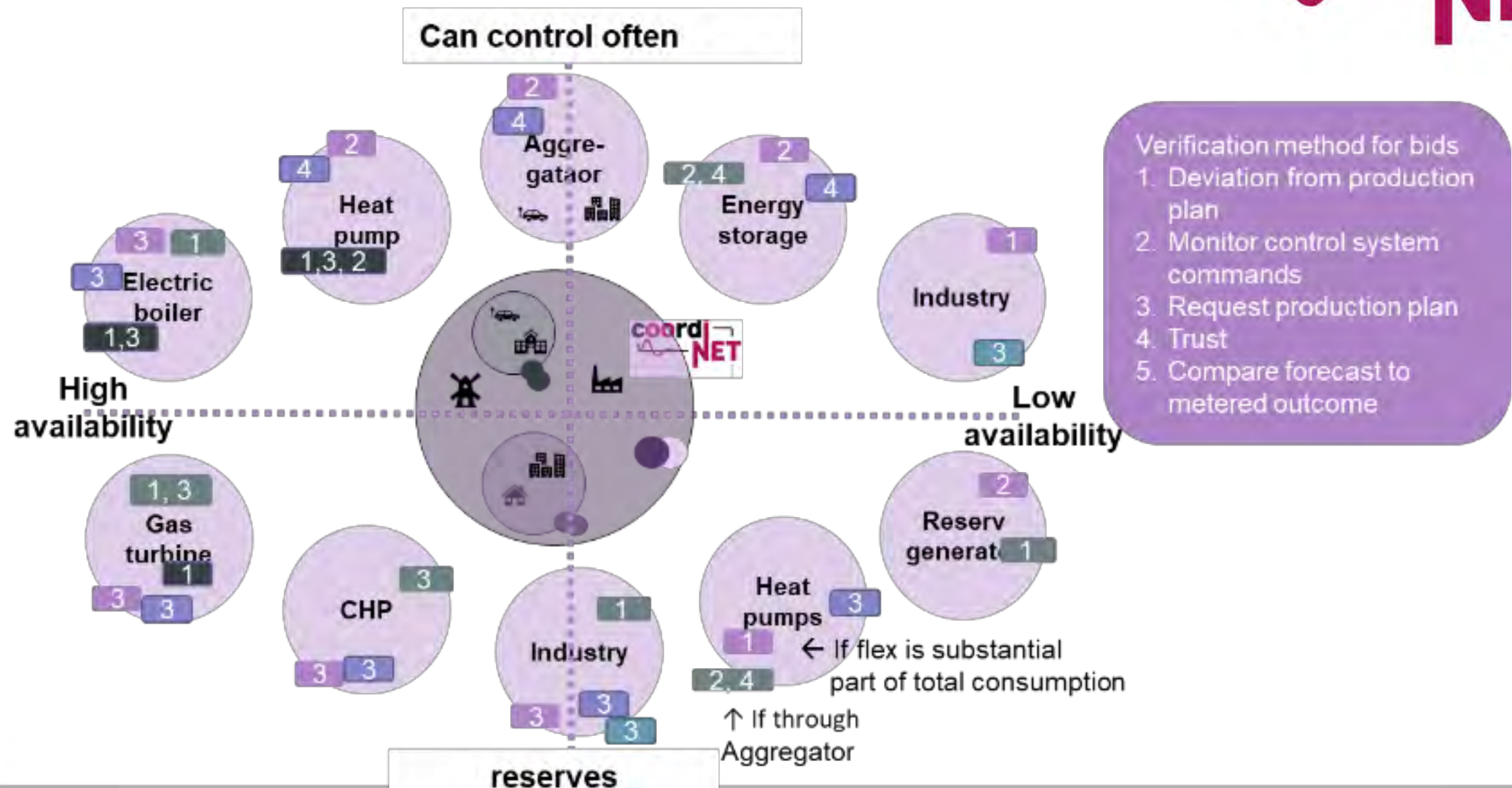
Impact factors

- First for DSO local grid in Uppland, impact factors for loads were computed (sometimes called coincidence factor)
→ To see if FSP is likely to have high load when grid congested
- Second for DSO regional grid, an impact factor is derived similar to the Power Transfer Distribution Factors (PTDF) used by ENTSO-E in flow based capacity calculation methodology for the day-ahead market.
→ To know how one MW reduction influences power flow through different substations

Flexibility resource	DSO regional grid			DSO local grid		
	TSO Con. 1	TSO Con. 2	TSO Con. 1+2	Upplands Energi	Uppsala North	Uppsala South
Electric boiler	51	34	85	0	0	0
Gas turbine	51	34	85	0	0	0
Waste combustion	51	34	85	0	0	0
Uppsala Hem	50	30	80	0	83	0
EV charger	48	31	79	0	83	0
GE Healthcare	47	32	80	0	100	0
Heat pump contract	51	34	85	0	100	0
Heat pump spot	51	34	85	0	100	0
Aggregator	67	18	85	90	0	0

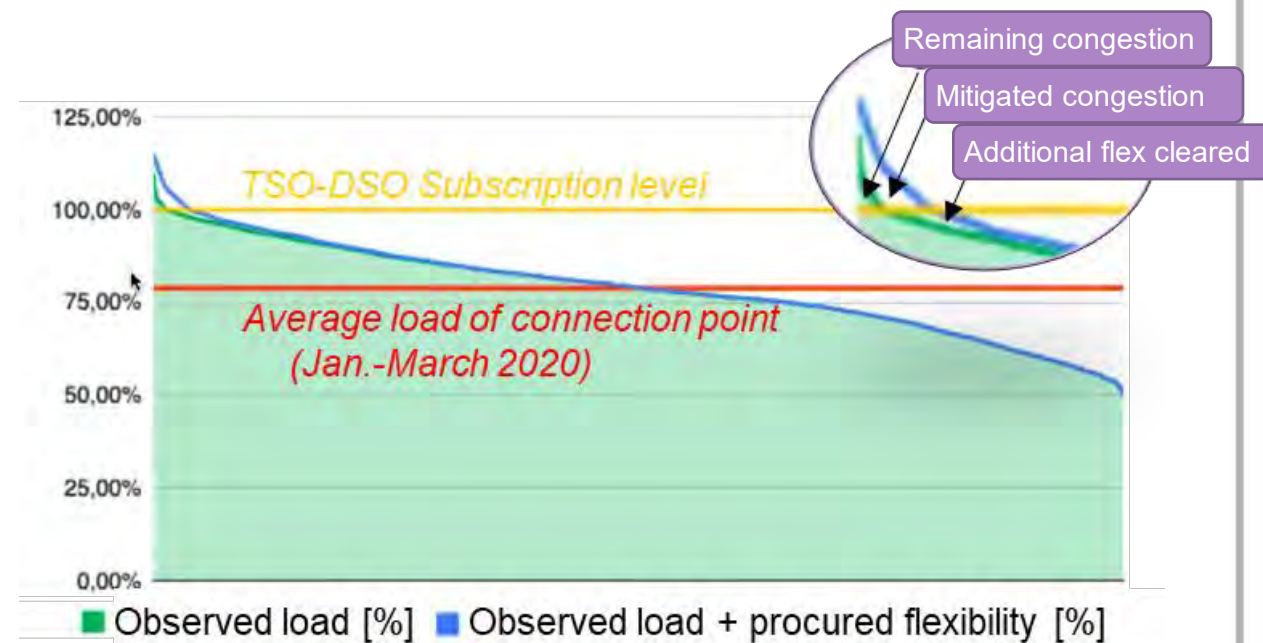
D4.5 Table 13: Impact factors for the resources in Uppland demonstration, all values are in percent

Remuneration



Overall results

- The use of flexibility has successfully alleviated network congestions
- This can be seen by the decrease of subscription levels violations between TSO and DSO during the times the market has been operating
- The platform has been developed in an agile way within the Swedish CoordiNet consortium
- Positive feed-back from both flexibility providers and DSO operators, praising the user-friendly applications fulfilling all basic needs to participate as well as informative and even enjoyable visualization
- The results will be published on <https://coordinet-project.eu/> in June 2020



Avoided congestion (MWh)

2019 / 2020:	88%
Target 2020/21:	90%
Target 2021/22:	95%

Overall results

Jämtland
Wind and hydropower
(will start in Nov. 2021)



Uppland
95 MW, electric boiler, heating pumps, aggregator, gas turbine, EV charger, waste incineration



Skåne
60 MW, heating pumps, gas turbines, gensets, ecto-grid



Gotland
24 MW, electric boiler, heating pumps



KPI 2019/2020	Skåne	Uppland Regional	Gotland
Flexibility providers FSP	5	5	2
Local markets	1	1	1
Resources	7	9 +340 houses (Aggregator)	3
Hours with accepted bids	26	172	58
Days with accepted bids	8	16	3
Average price per MWh (SEK/MWh)	1670	220	654
Highest bid (SEK/MWh)	4000	2500	2000
Volume cleared (MWh)	74 (test) (Nov-March)	3260 (Jan-March)	797 (test) (Jan-March)

Total 2019/2020: 12 FSP:s
Target 2020/21: 15 FSP:s
Target 2021/22: 18 FSP:s

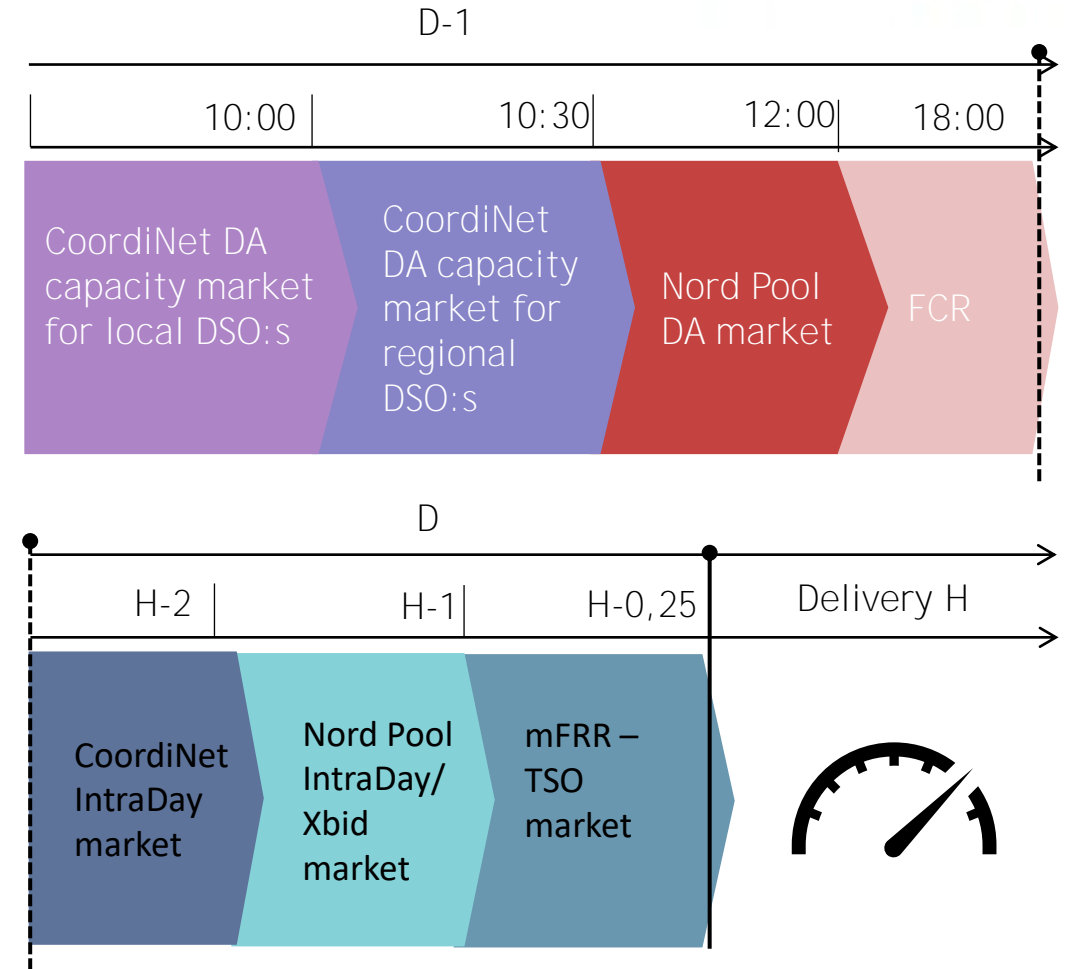
Learnings: Liquidity 2019/2020

- Small need for flexibility due to low power consumption as an effect of a historically warm winter
- Volume on the flexibility markets for congestion management was enough, but mainly due to participation of one big-scale flexibility provider
- Competition among bids was not good enough with lower level of bids available than hoped from some flexibility providers
- Better knowledge from the provider of control systems is needed for unlocking flexibility more widely



Learnings: Market design

- The coordination scheme with cascading market closing times worked well
- But to fully unlock the potential of flexibility the day-ahead market needs to be complemented with an intraday market
- An additional benefit during the project was that the dialogue between DSO and TSO created new values in understanding how better coordination can lead to a more efficient grid use



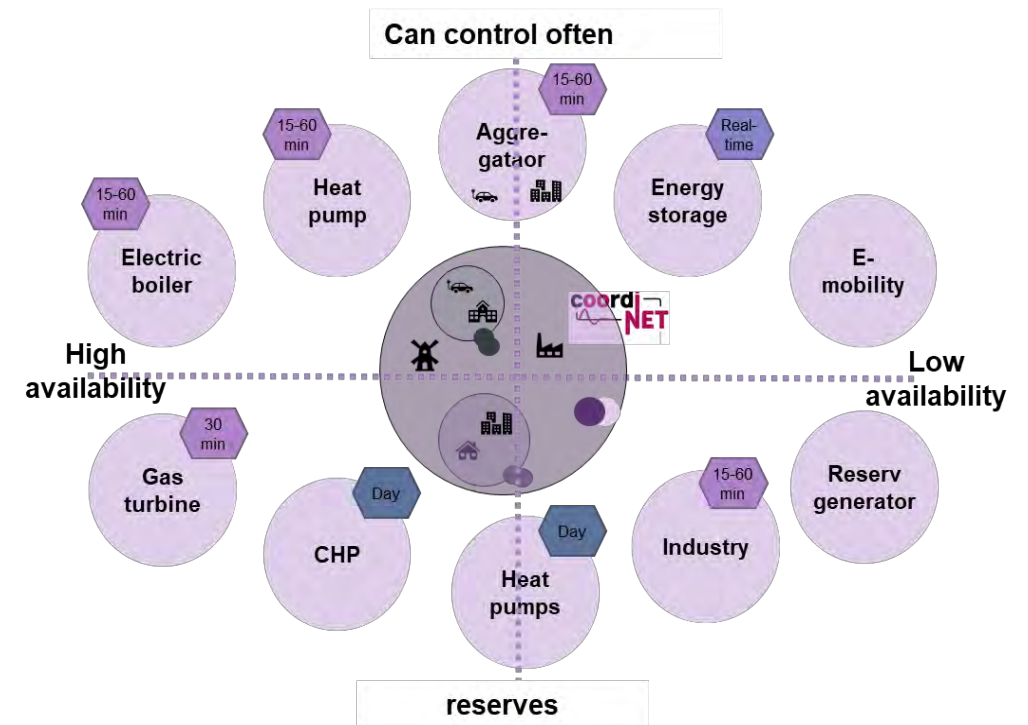
Learnings: FSPs

- Several flexibility providers underestimated the effort and time needed for preparation to provide flexibility
- Certain flexibility providers can only participate on a day-ahead basis
→ e.g. industries and district heating

Other flexibility providers prefer to provide flexibility closer to delivery hour

→ e.g. aggregators or energy storage

- Further digitalization, giving the possibility for bidding and calling through automated interfaces was asked for



Learnings: Business Case

- The volume of needed flexibility in Sweden varies heavily year from year due to weather.
- Compatibility with regulation required, for DSO to use flexibility services on market based terms.
- Flexibility providers need to know the investment in planning, process development and technical infrastructure will pay-off.
→ Business case with free bids insufficient for customers to invest time and money to become flexibility providers.
- DSO needs to know that the flexibility will be available when most required



We believe that a way to promote flexibility services maturity is to combine a market with bids with availability remuneration. Compensations to flexibility providers needs to be evaluated to find the right balance between availability and activation remuneration.

Learnings: DSO

- One of the more difficult and time demanding issues was handling data management and security, central hub for all data proved valuable
- Platform greatly increased visibility of the upcoming grid situation for control room operators
- Flexibility services day-ahead dependent on good grid state forecasting and requires production plans of major loads
- Developing and operating the platform as an integral part of the DSO grid planning and operations provides understanding for needs, changes and possibilities when acting DSO with higher level of visibility



The development of the platform and the flexibility market by a DSO has shown to be extremely valuable in competence development, mindset and culture understanding flexibility

Development for 2020-2022

- Intraday market,
- mFFR market in the platform
- Peer-to-peer market
- Block-chain test
- API for bidding and calling
- Improved load prognosis
- Improved remuneration methods for verification of cleared flex



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More information: <https://coordinet-project.eu/>



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