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Climate Services for Clean Energy

Climate services for clean energy

The S2S4E project

S2S Real Time Workshop

Albert Soret & Ilaria Vigo, Barcelona Supercomputing Center

This project has received funding from the Horizon 2020 programme under grant agreement n°776787.

Energy. Context and motivation

- Both energy supply and demand are strongly influenced by atmospheric conditions and its evolution over time in terms of climate variability and climate change.

Like 15M

Thursday, Aug 30th 2018 1PM 25°C 4PM 26°C 5-Day Forecast

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Britain's turbines are producing 40% less energy as wind 'disappears' for six weeks across the UK causing record low electricity production

- Britain got 15 per cent of its power from wind last year — twice as much as coal
- Since the start of June, wind farms have been producing almost no electricity
- The 'wind drought' has seen July 2018 be 40% less productive than July 2017
- In the still weather, solar energy has increased by 10% to help cover the drop-off

By JOE PINKSTONE FOR MAILONLINE

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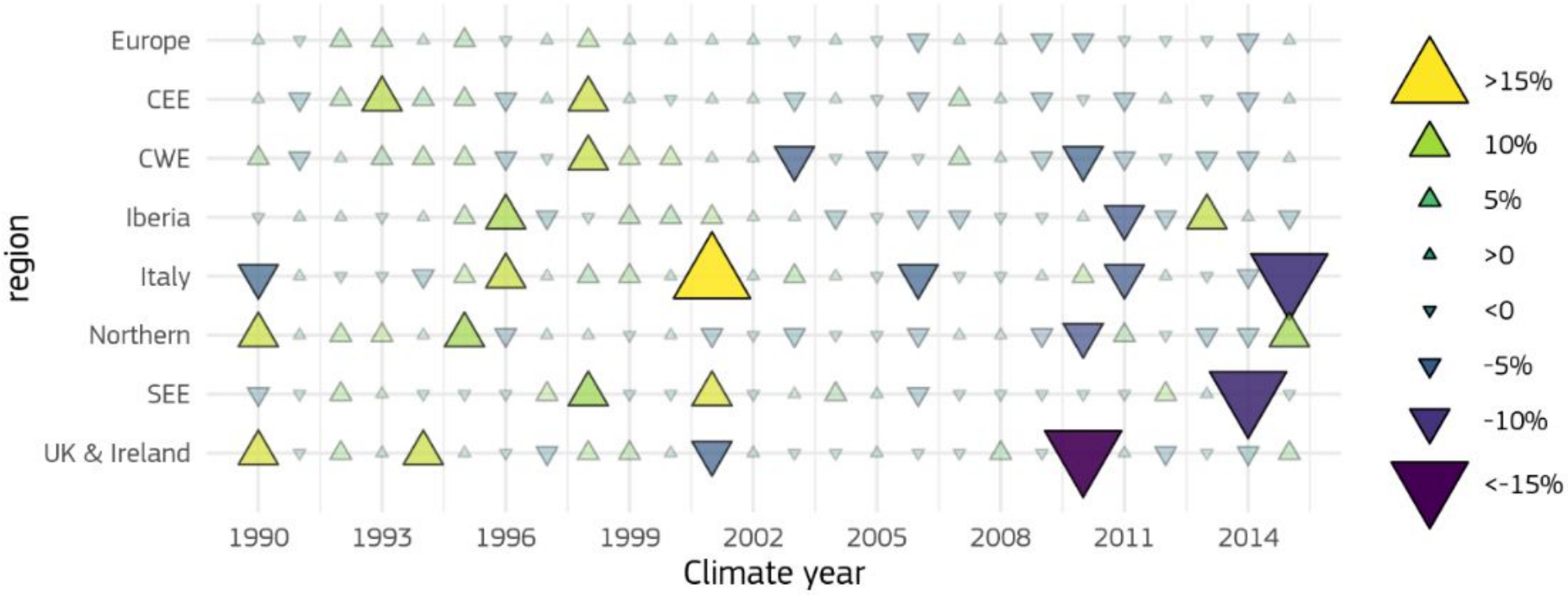
Energy. Context and motivation



Annual variability (percentage deviation from the average) of onshore wind resources in the 26 climate years for the considered regions. Source: JRC, 2020

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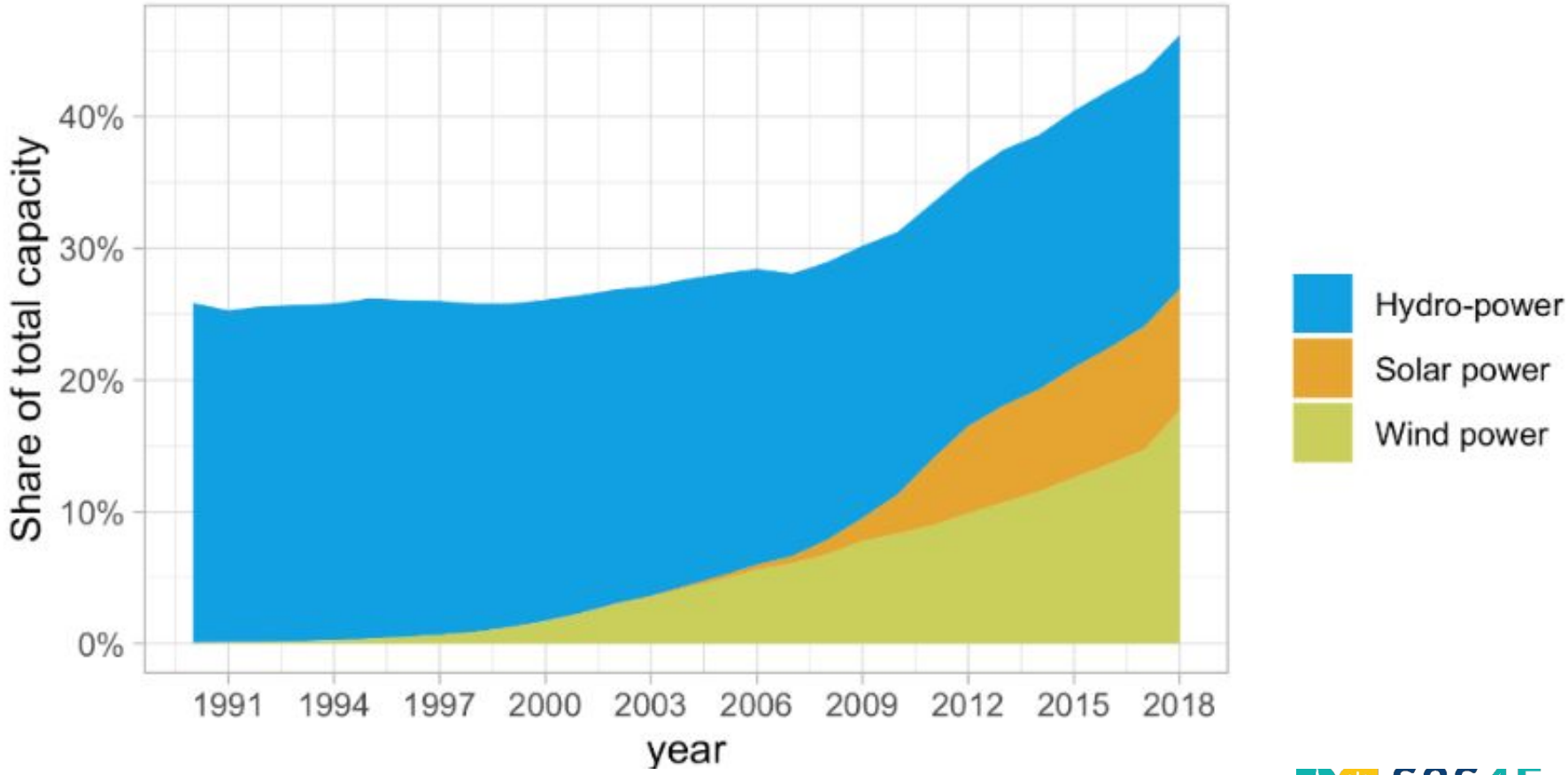
Energy. Context and motivation

- Renewable energy is growing fast to decarbonize the energy system.



Fraction of the hydro, solar and wind power capacities with respect to the total electricity generation capacities for the European countries. Source: EUROSTAT

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Energy. Context and motivation

- Energy sector routinely uses weather forecast up to several days. Beyond this time horizon, climatological data are used.

Met mast on Gwynt y Môr offshore wind farm (source: solar wheel)

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Applications

Weather forecast	Climate predictions		Climate projections or multidecadal
	Sub-seasonal / Seasonal	Decadal	
1-15 days	15 d-1 month / 1-6 months	1-10 years	20-100 years

Time

Applications for wind/solar/hydro generation

Post-construction decisions

Energy producers: commit energy sales for next day

Grid operators: Market prices and grid balance

Energy traders: Anticipate energy prices

Plant operators: planning for cleaning and maintenance

Post-construction decisions

Energy producers: Resource management strategies

Energy traders: Resource effects on markets

Plant operators: Planning for maintenance works, especially offshore wind O&M

Plant investors: anticipate cash flow, optimize return on investments

Pre-construction decisions

Power plant developers: Site selection. Future risks assessment.

Investors: Evaluate return on investments

Policy-makers: Asses changes to energy mix

River basin managers: understand changes to better manage the river flow

Applications for demand

Daily operation decisions

Grid operators: Anticipate hot/cold days. Schedule power plants to reinforce supply.

Energy traders: Anticipate energy prices.

Mid-term planning

Grid operators: Anticipate hotter/colder seasons Schedule power plants to reinforce supply.

Energy traders: Anticipate energy prices.

Long-term planning

Grid operators: Anticipate addition of more capacity. Adaptation of transmission lines

Policy makers: Plan addition of more capacity. Understand changes to energy mix

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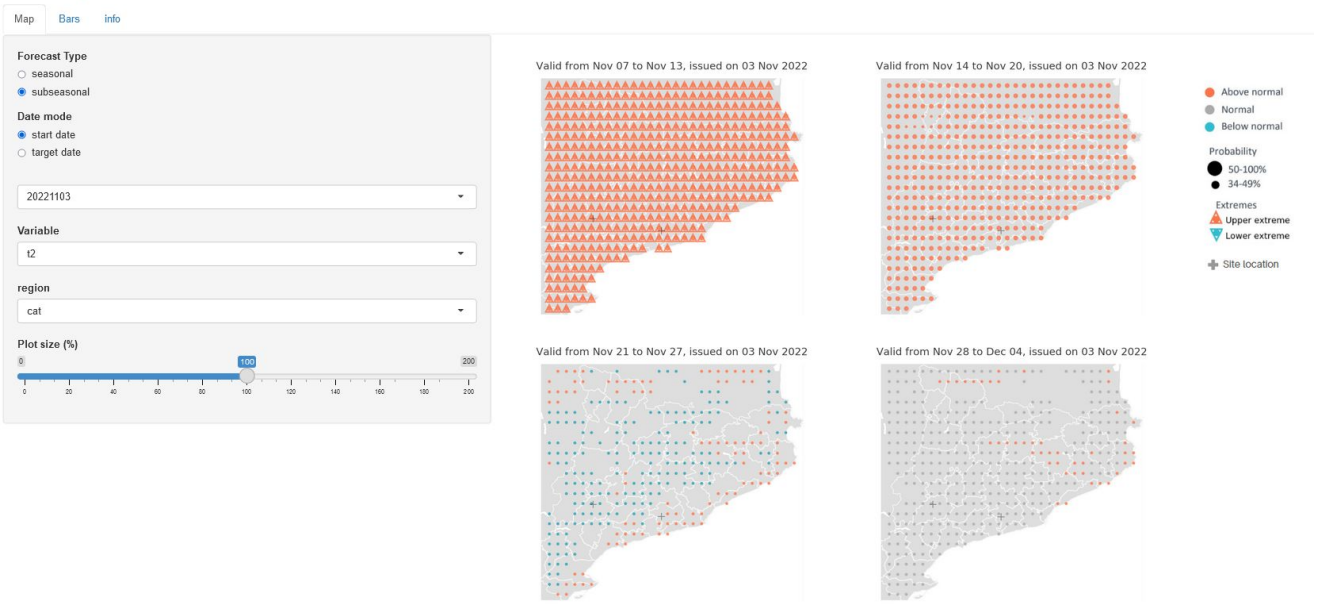
Why focussing on the energy sector?

- **Variety of study cases.** Both energy supply and demand are strongly influenced by weather conditions.
- **Impact of the research.** Main contributor to GHG emissions.
- **Advanced users**, in many cases with experience in meteorology, crucial for a climate services project.
- **Replicability**



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CASE STUDY

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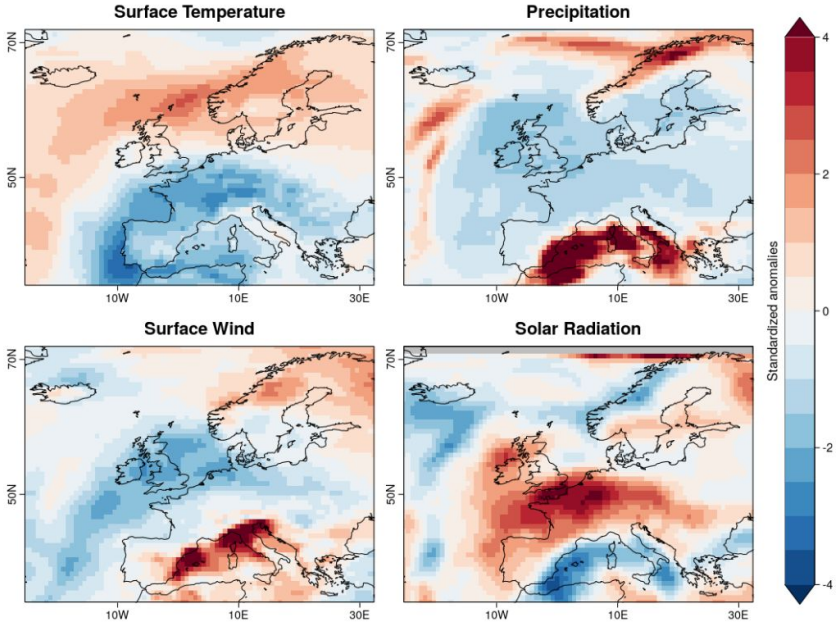
Cold spell and wind drought in Europe. January 2017

- A cold wave over Europe led to extremely low temperatures, which increased electricity demand for heating. Lower than usual wind speeds also resulted in a decrease in wind power generation and caused a high risk of energy imbalance in the energy grid.



Standardized anomalies of temperature, precipitation, surface wind and solar radiation for December 2016 through February 2017. ERA-Interim reanalysis.

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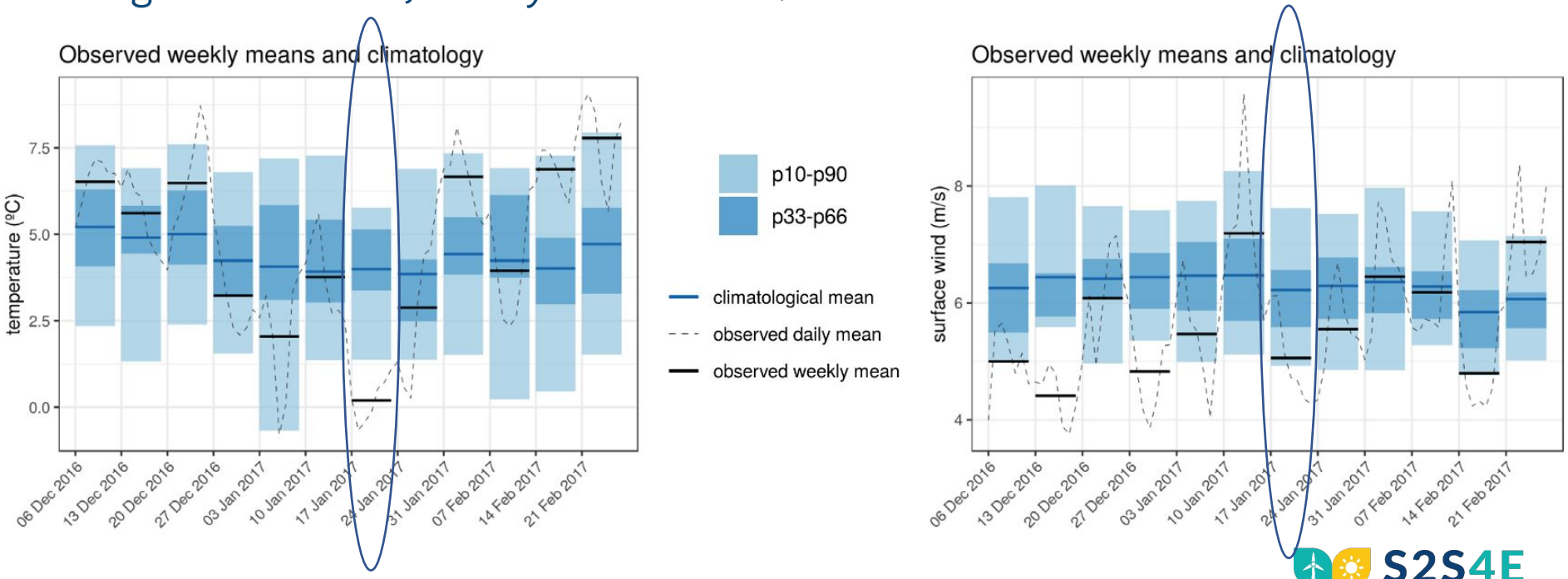
Cold spell and wind drought in Europe. January 2017

- The cold spell mostly affected areas in Europe. France in particular faced a shortage in energy supply due to planned maintenance outages in several nuclear power plants that coincided at the same time as the cold spell.
- The anomaly was observed during winter 2016-17, and was particularly significant from January 17th to 23rd, 2017.



Observed temperature means and wind speed for December 2016 through February 2017. ERA-Interim reanalysis.

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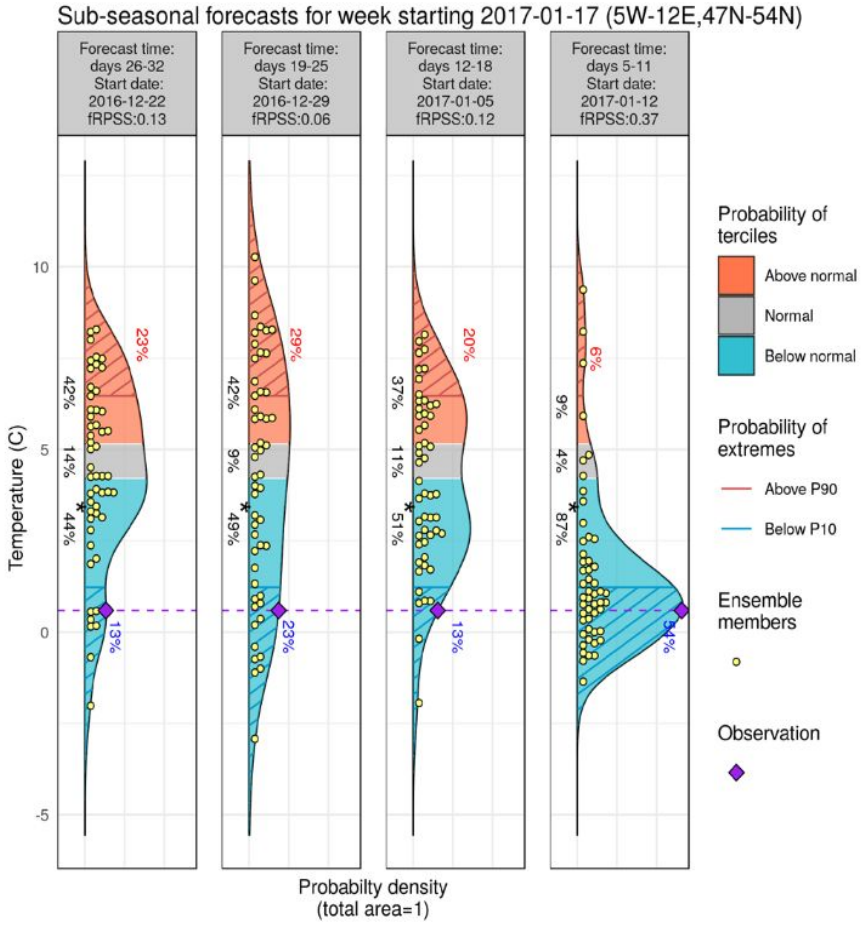
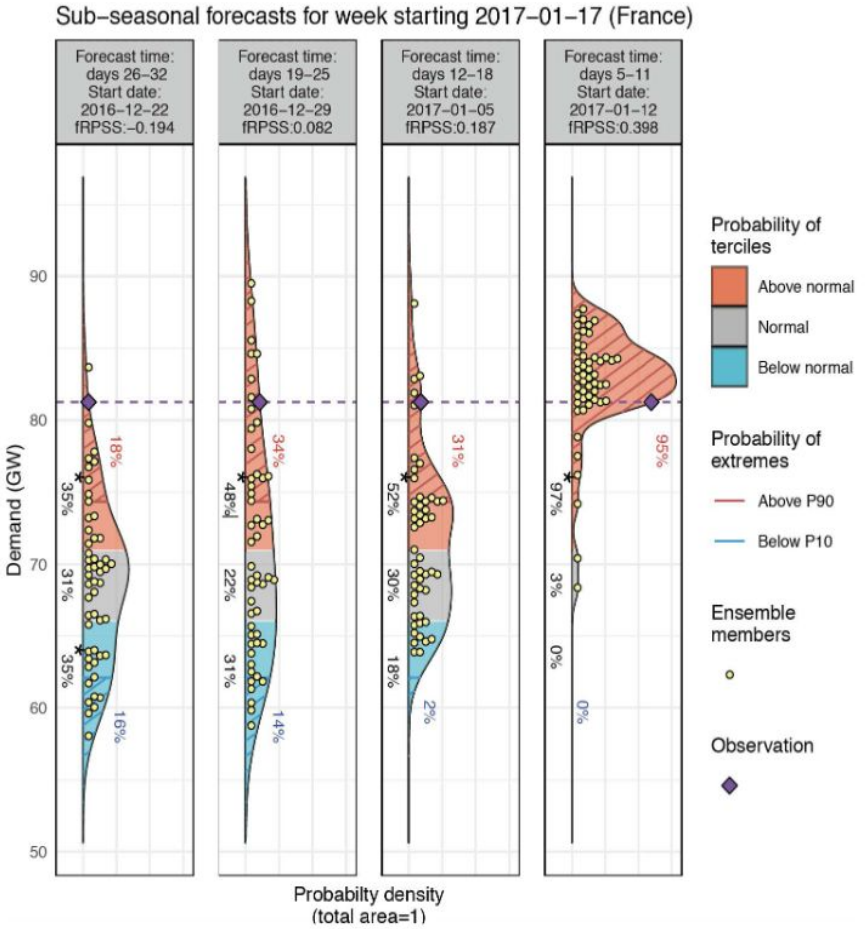
Cold spell and wind drought in Europe. January 2017





Sub-seasonal electricity demand and temperature forecasts for February 27th, 2018. Issued four, three, two and one week in advance.

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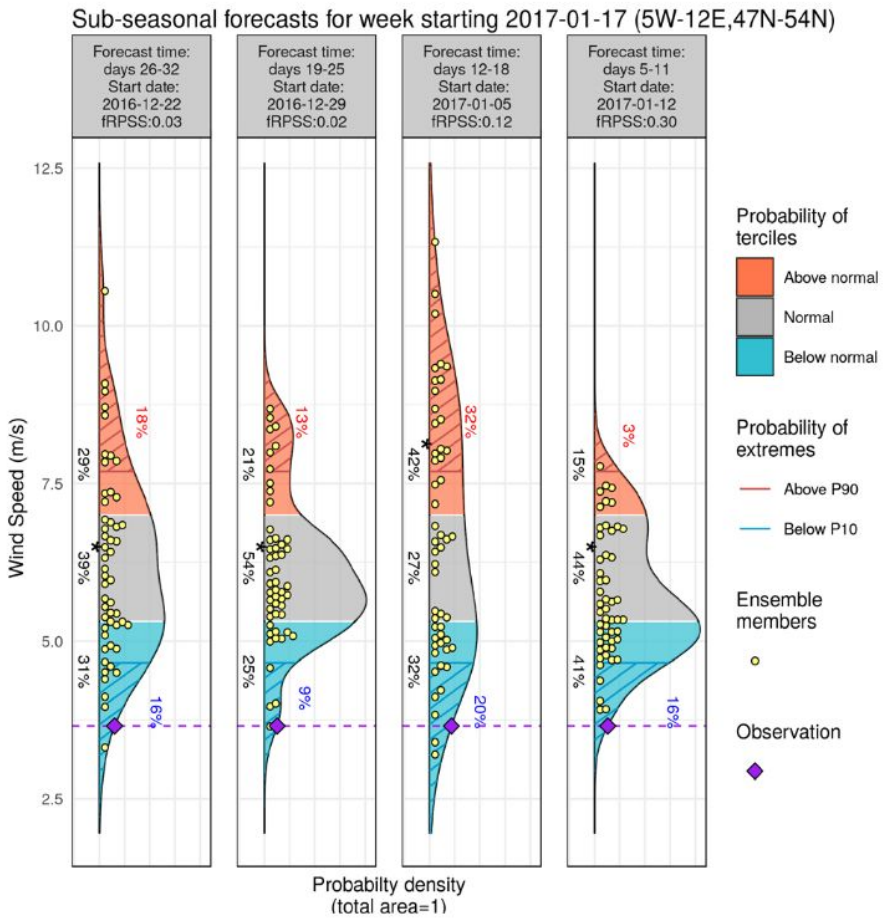
Cold spell and wind drought in Europe. January 2017



Sub-seasonal wind speed forecasts for February 27th, 2018. Issued four, three, two and one week in advance.

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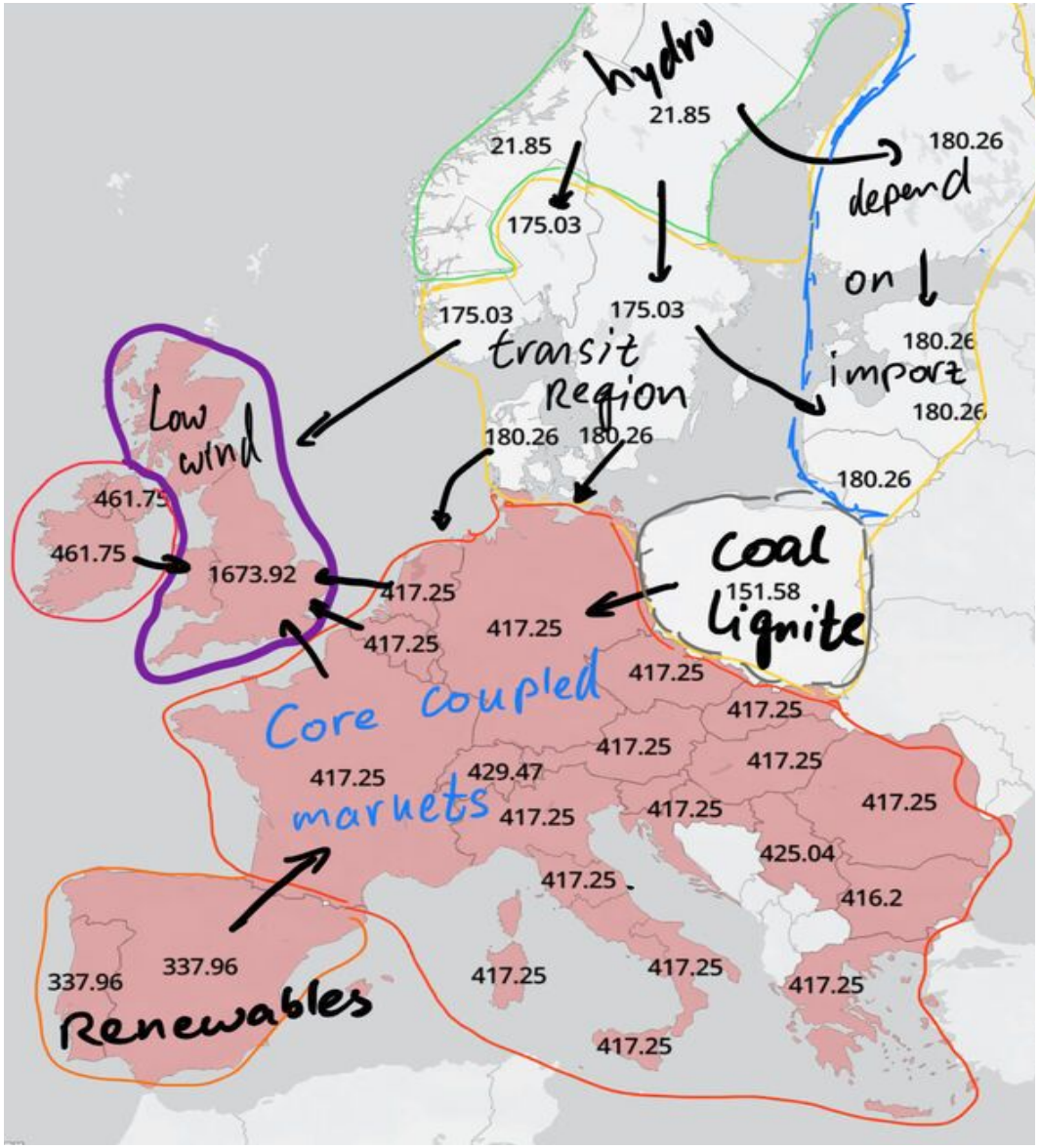
Users' perspective evaluation



Day ahead prices for 16/12/2021. Large differences across the continent, with a core region around 420 €. UK prices are the highest in Europe due to low wind energy production, while Iberian system prices are the lowest due to high wind resources (source: EnAppSys).

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DECISION SUPPORT TOOL

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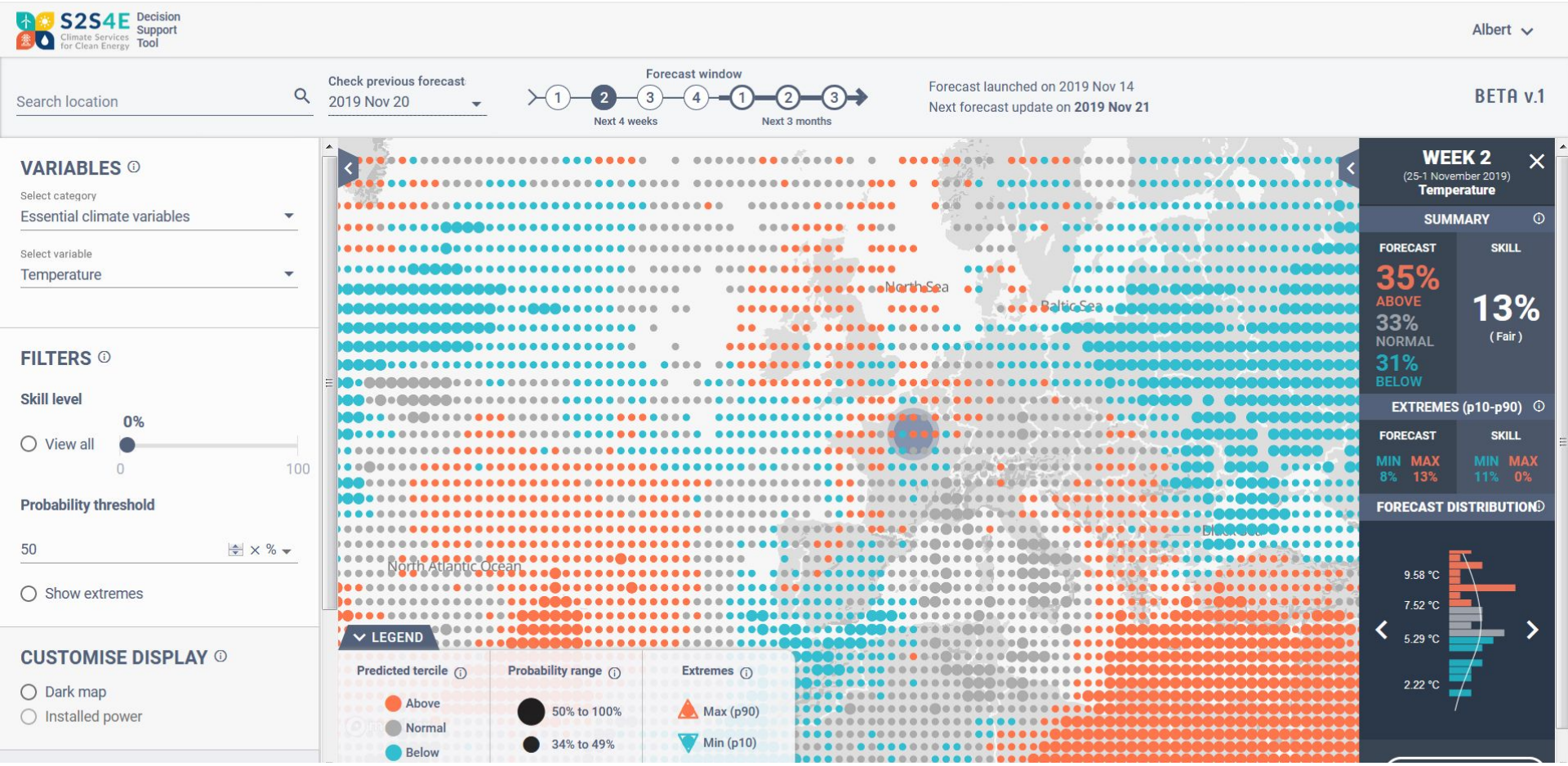
DST



https://s2s4e.eu/dst

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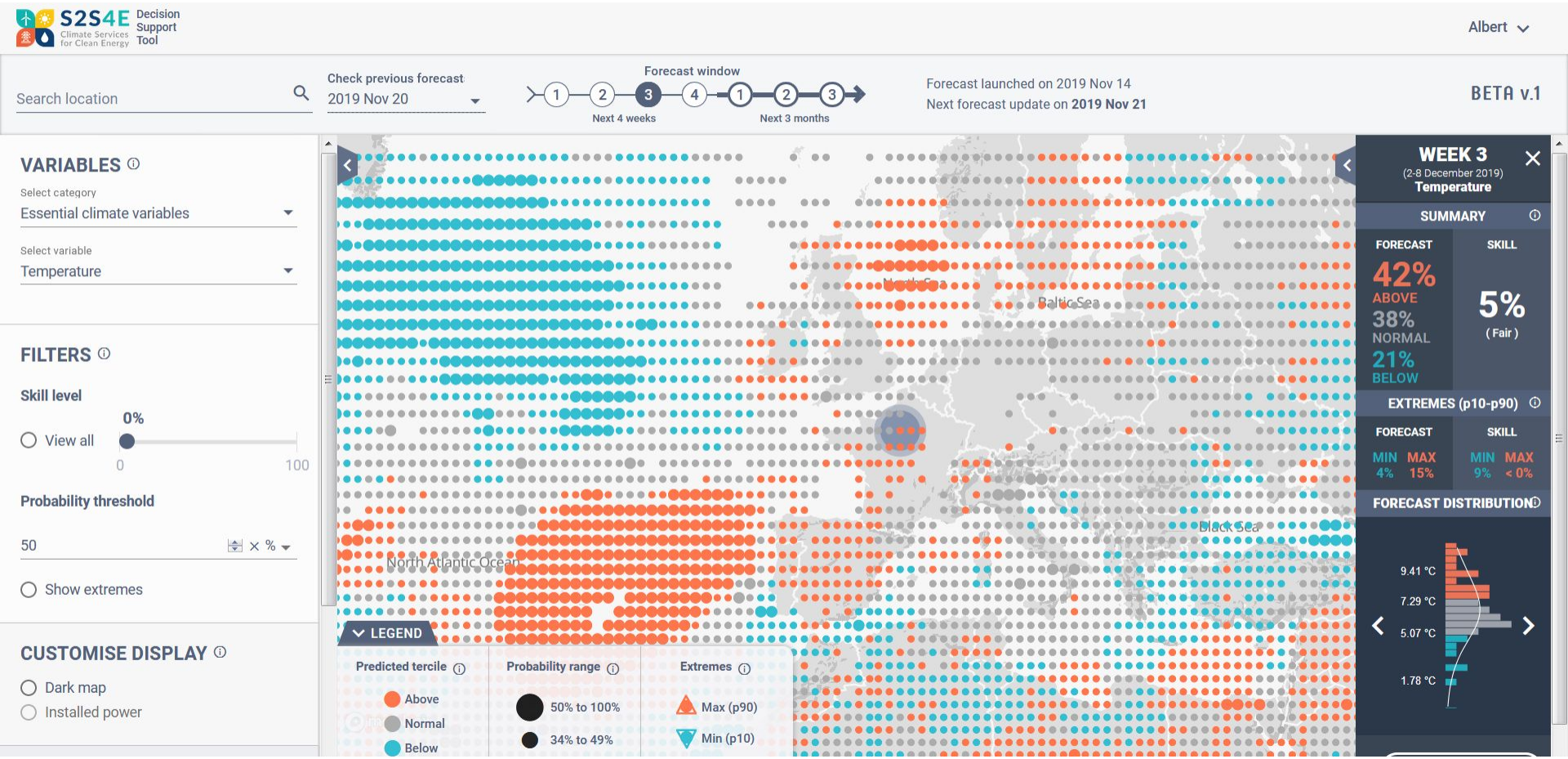
DST



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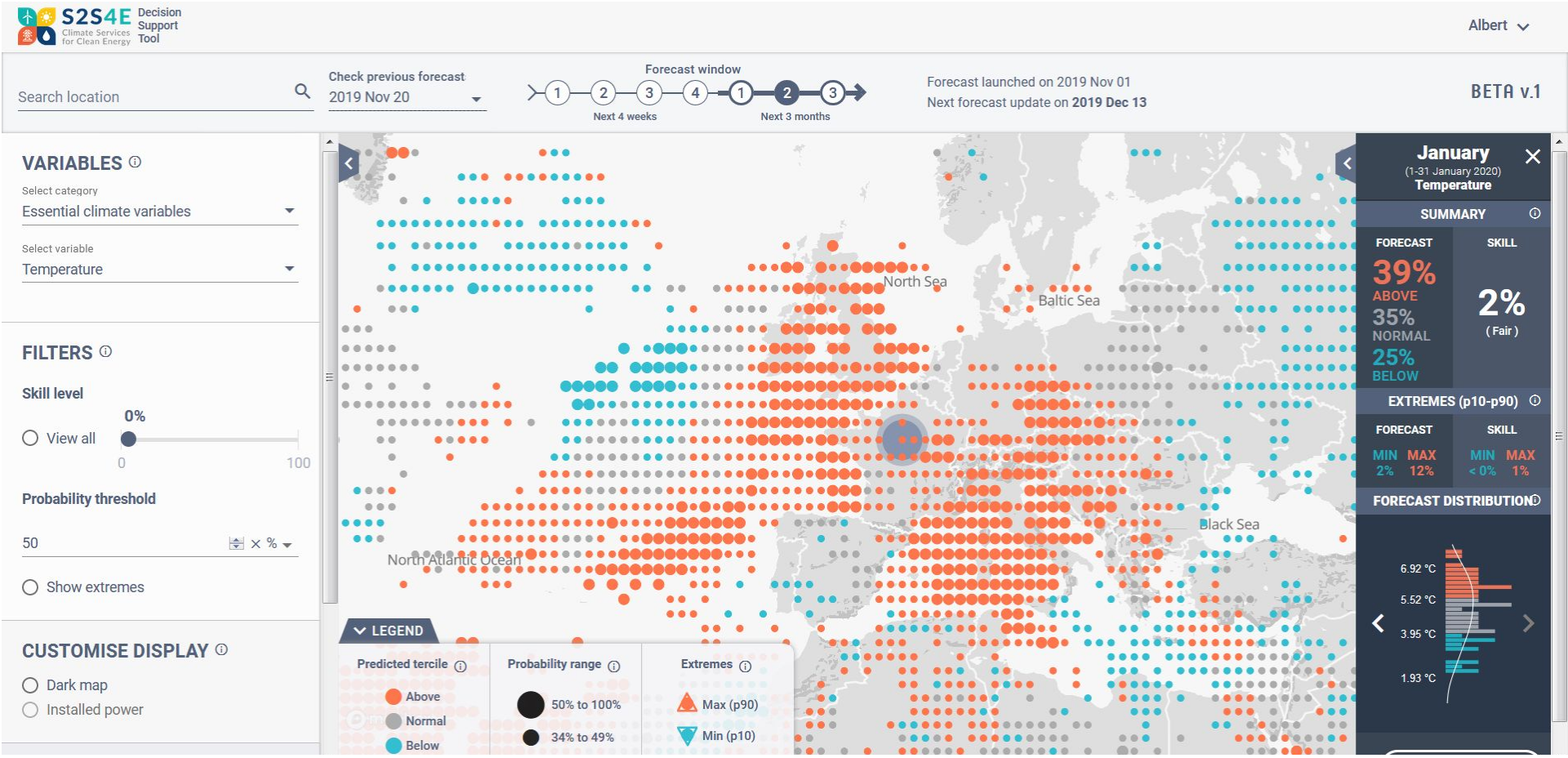

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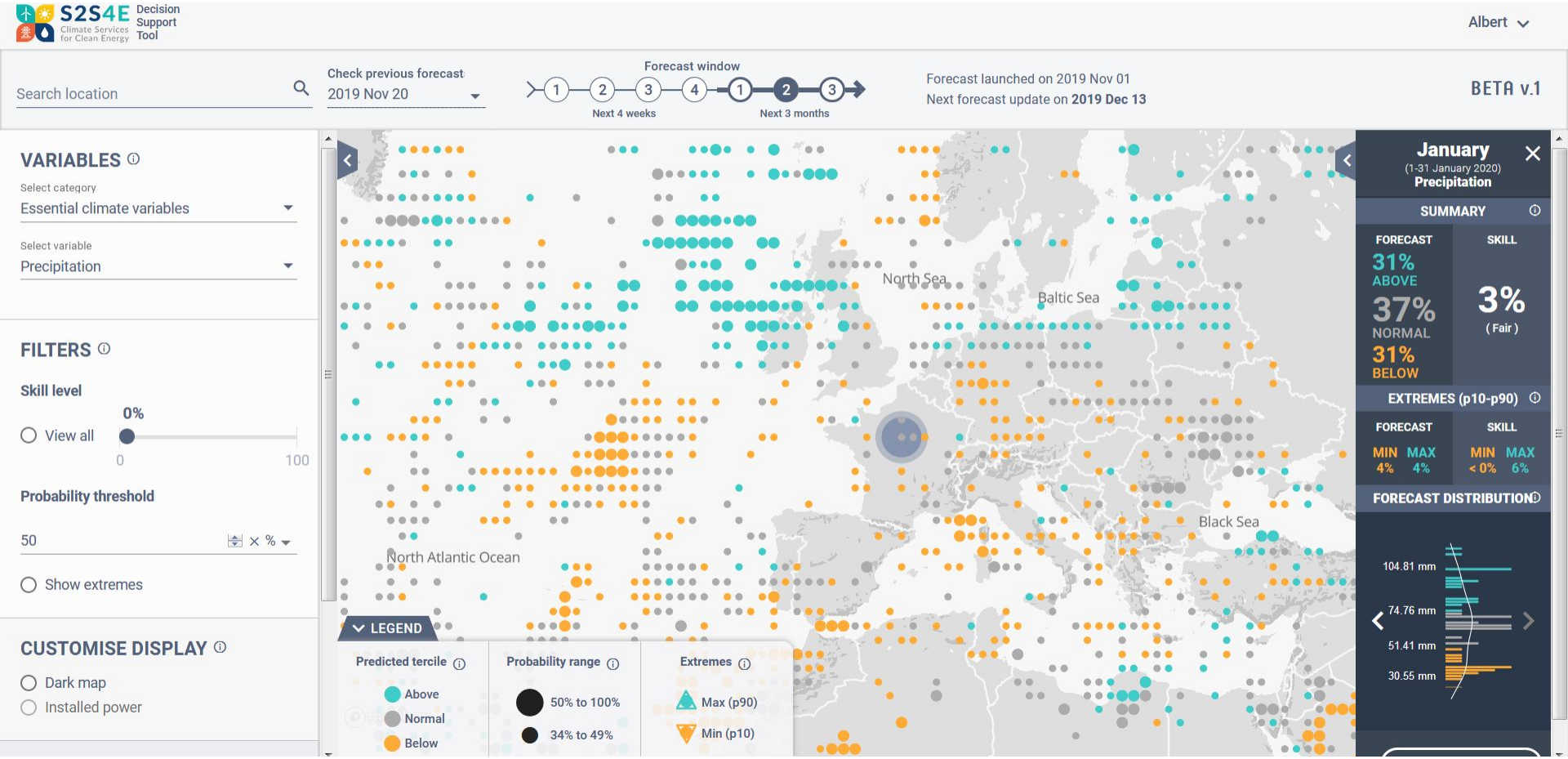
DST



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IMPACT EVALUATION

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Why ?

Showcasing Value

Climate Service's Improvements

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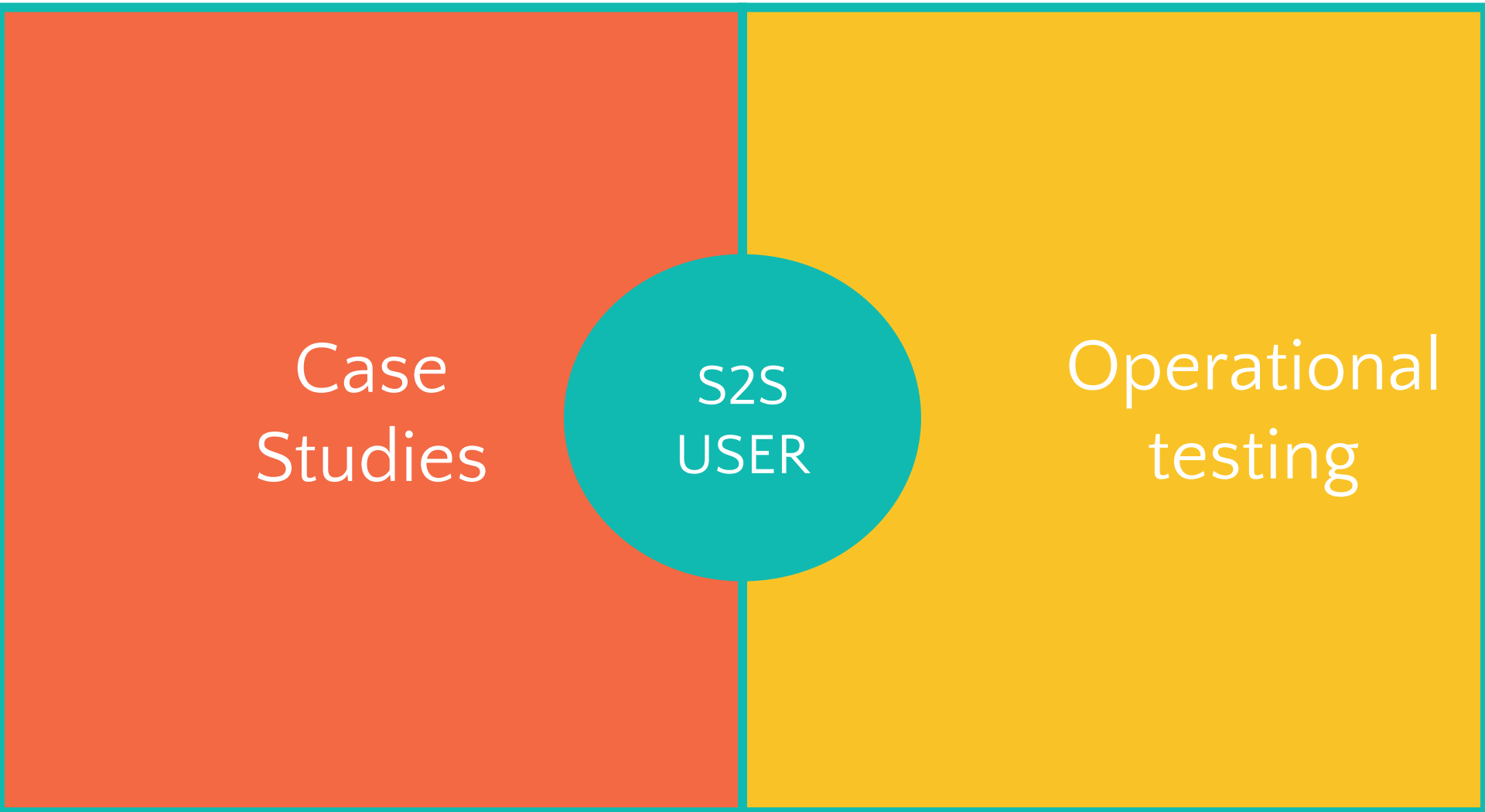
How?



CASE STUDIES

Decision Theory

- The user has to make a **decision**
- Users' goal: **max Payoff (∏)**

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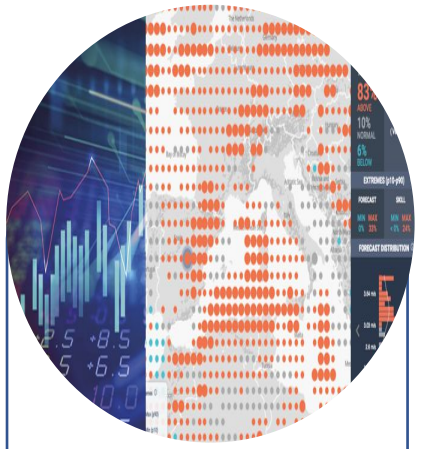
Cold Spell & Low Wind
France & Germany 2017

HEDGING

NO HEDGING

The trader buys energy on the day-ahead auctions

Hedging without forecasts



Hedging using

sub-seasonal forecasts

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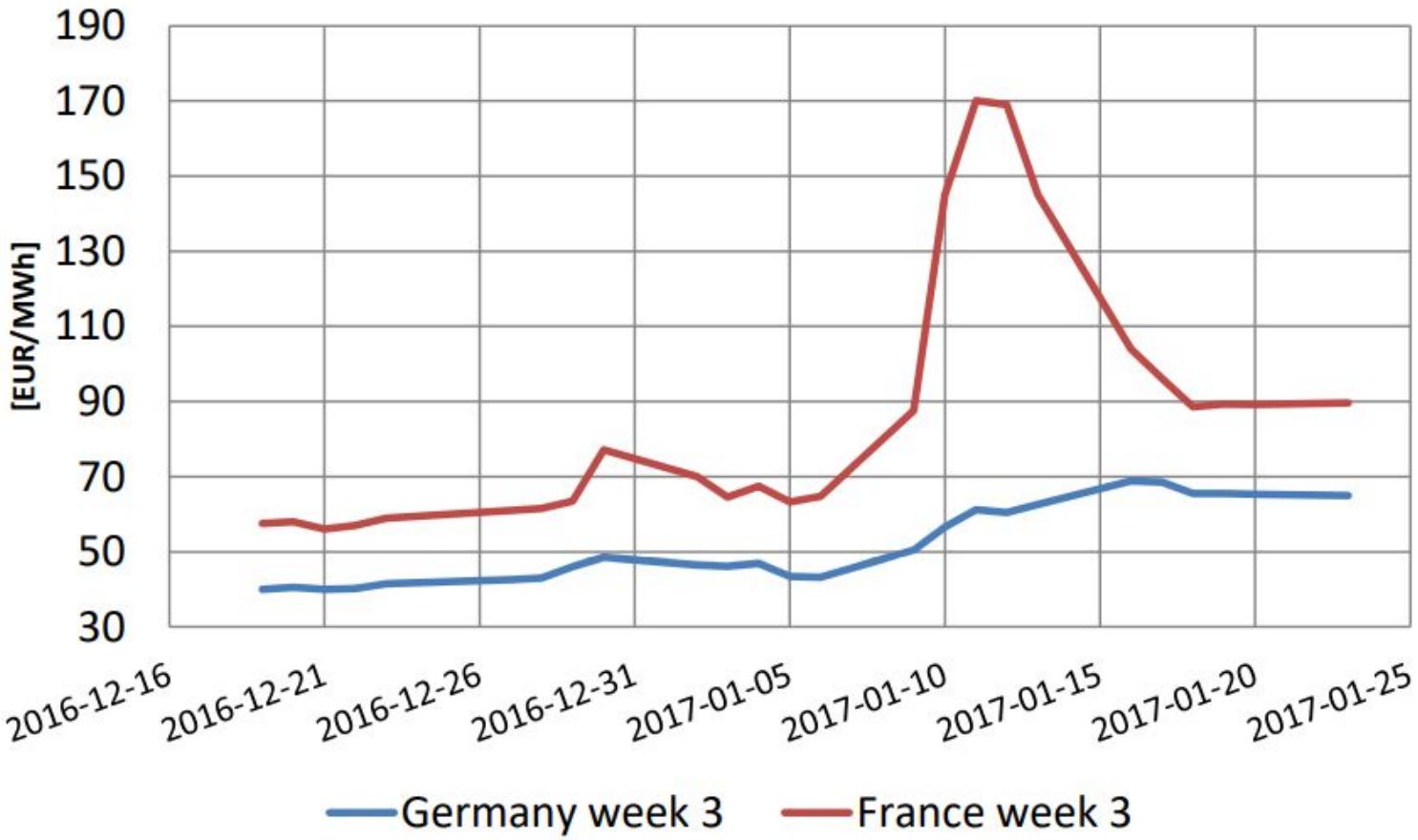
Week 3 baseload future settlement prices 2017



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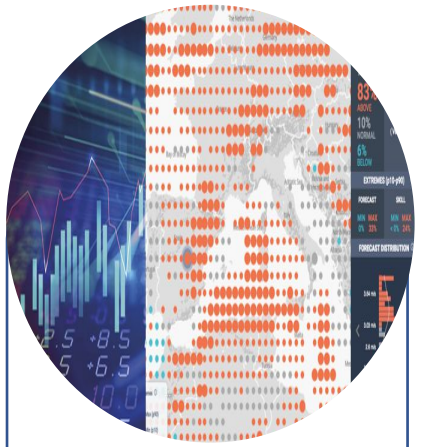
NO HEDGING



Germany	+21%	+33%
Baseline		
France	-14%	+29%

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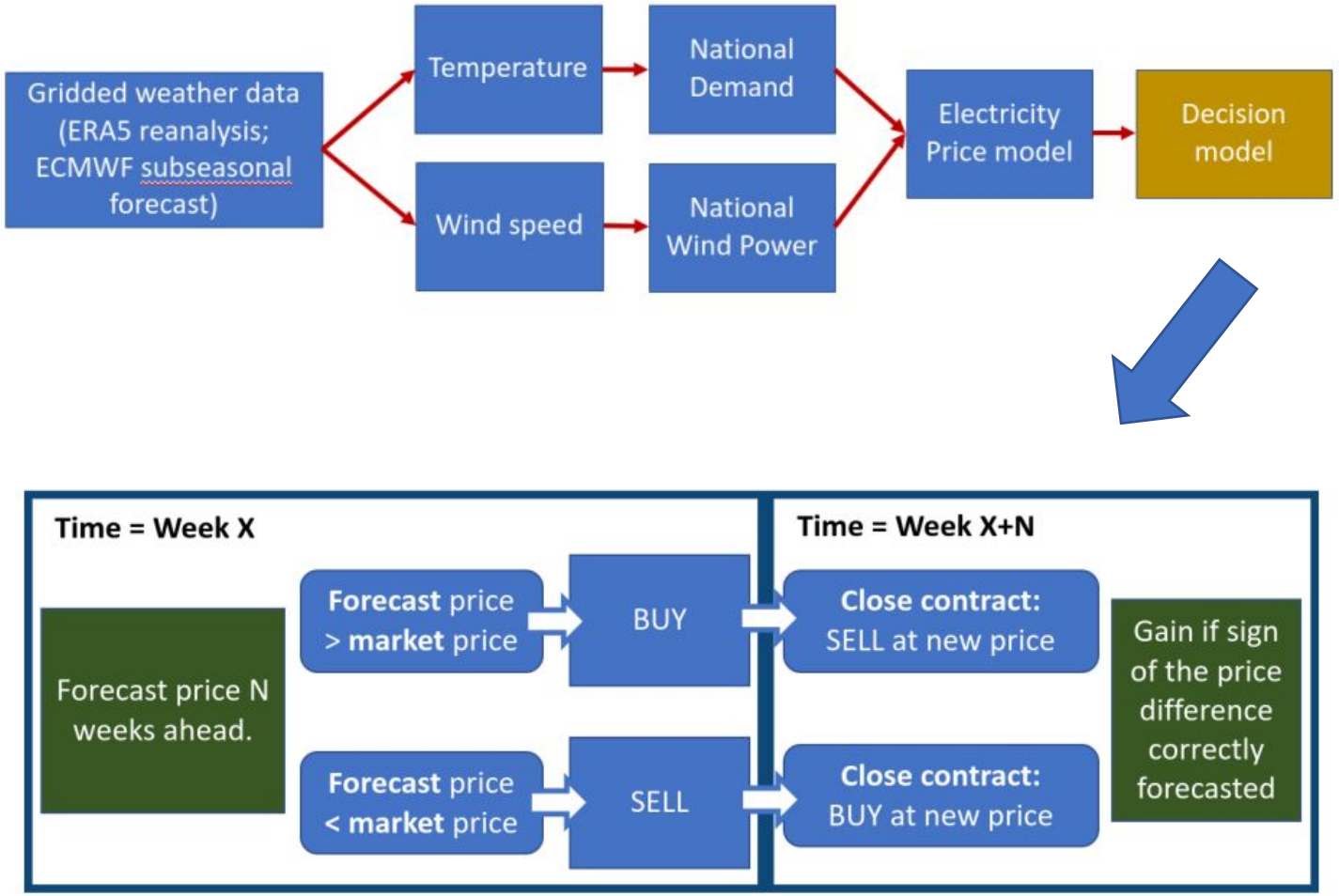
German Power Futures



Credits: David Brayshaw & James Fallon

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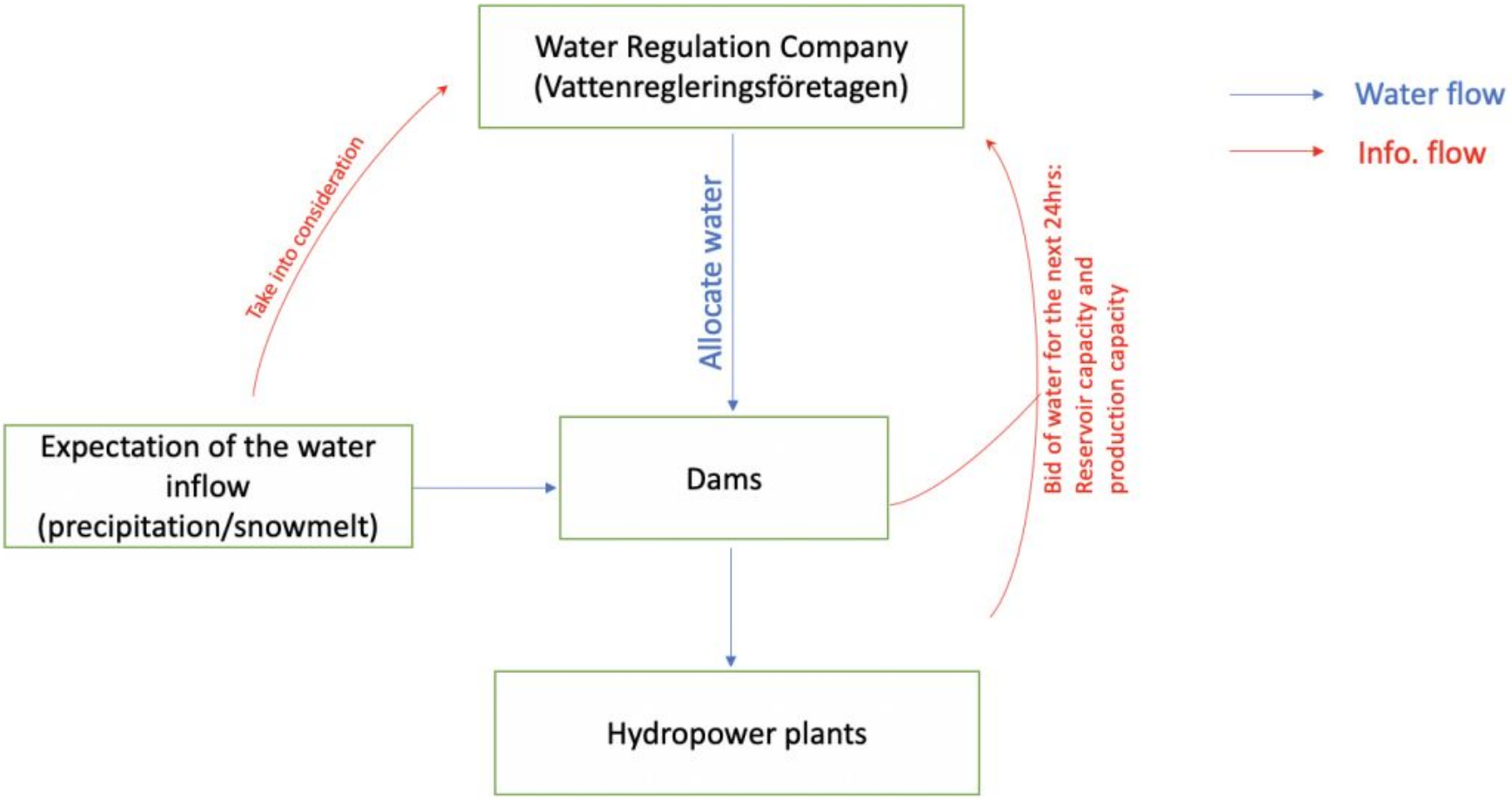
Hydropower in Sweden
Water Management 2013 -2015



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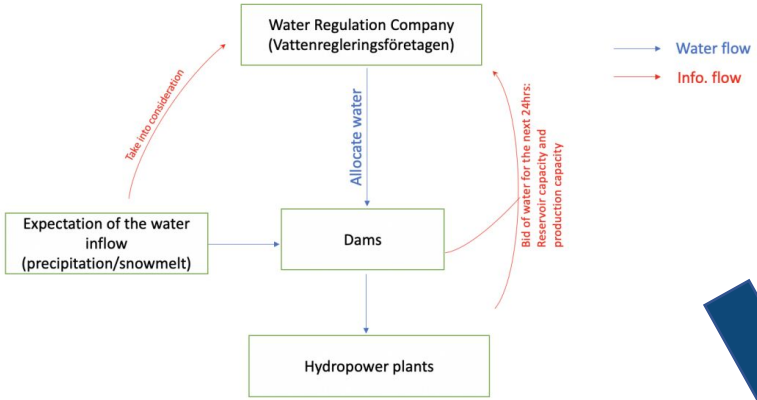
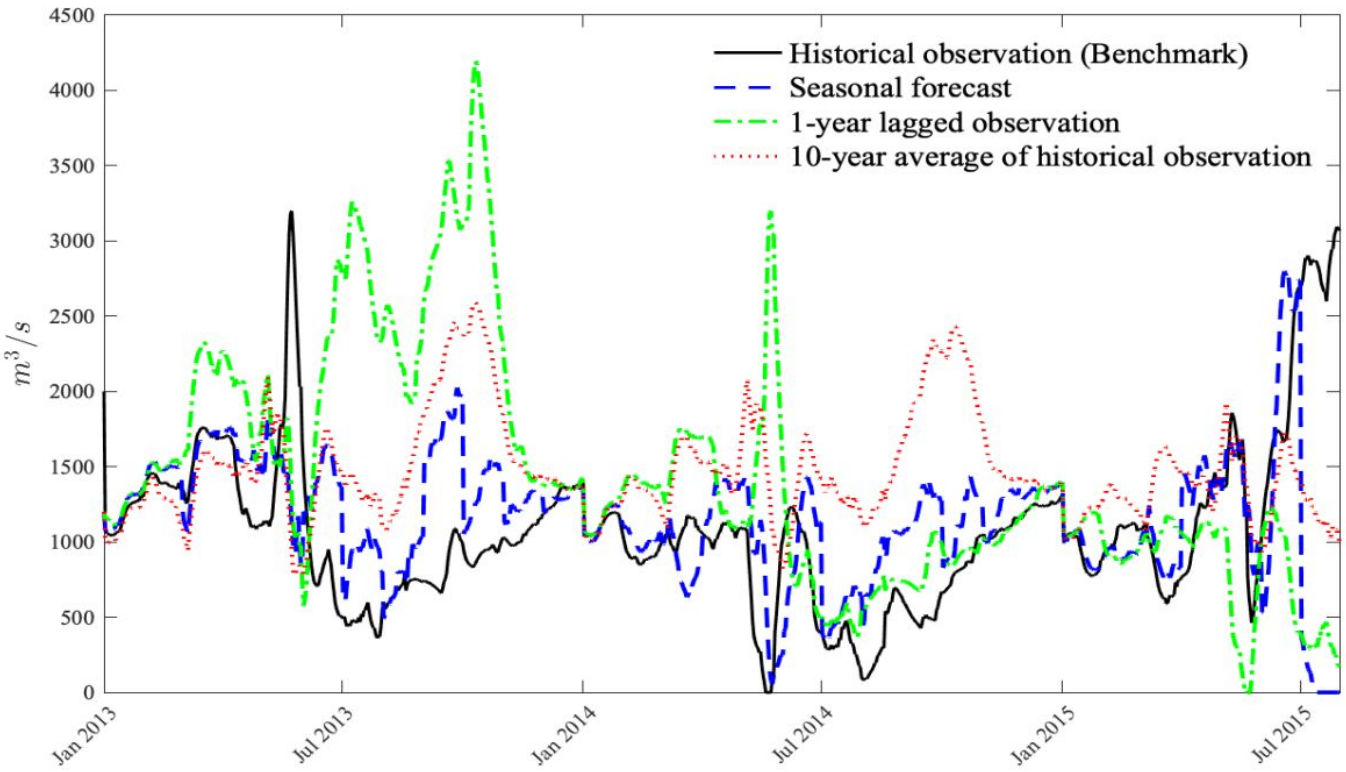


Revenue Increase
- 24% to 32%



Credits: Lin Ma

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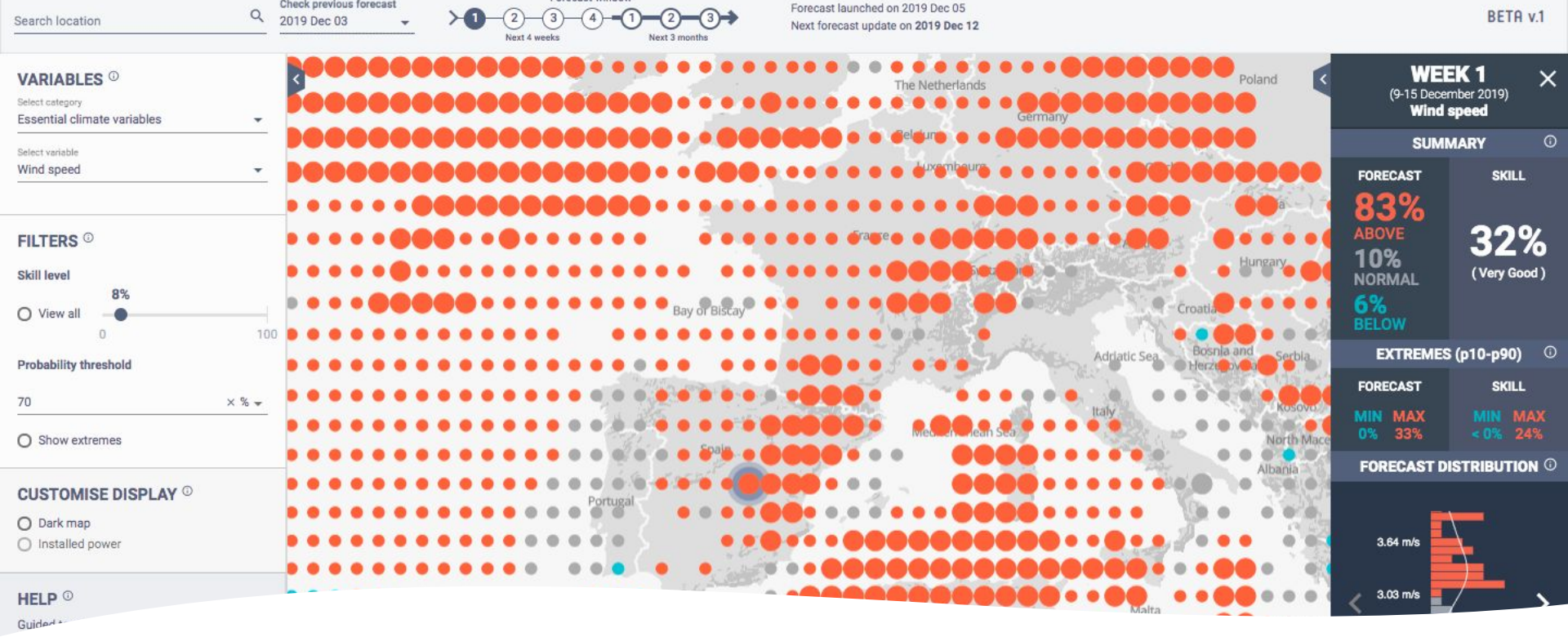

OPERATIONAL PHASE

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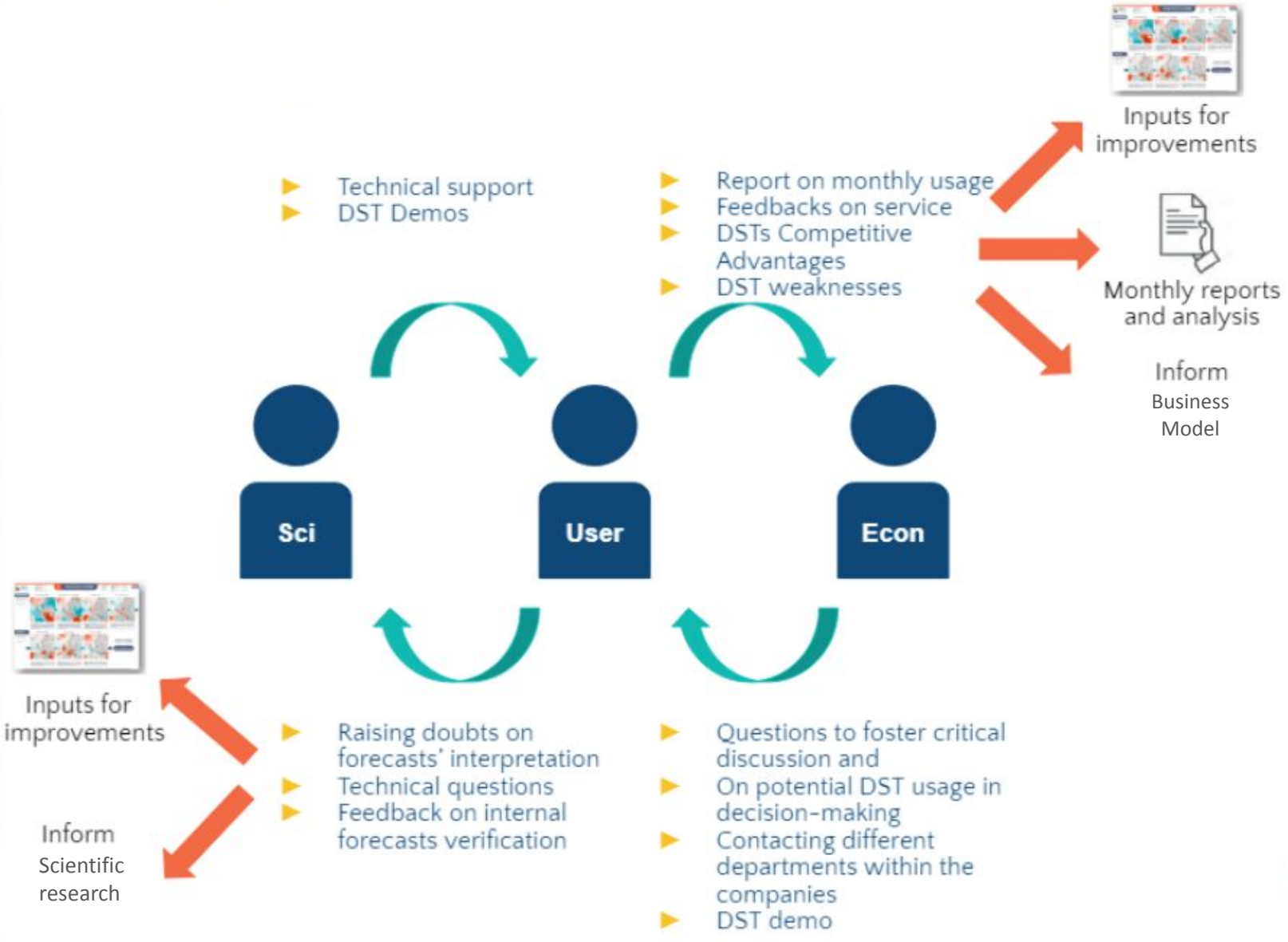

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Conclusions

- Same service,
  Different use values
- Users at the centre
- Next steps?

Thank you

Get in touch for more information!

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Public reports of the project will be available for download on the S2S4E website: **www.s2s4e.eu**

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Contact us: s2s4e@bsc.es

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Thank you !

www.s2s4e.eu

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