

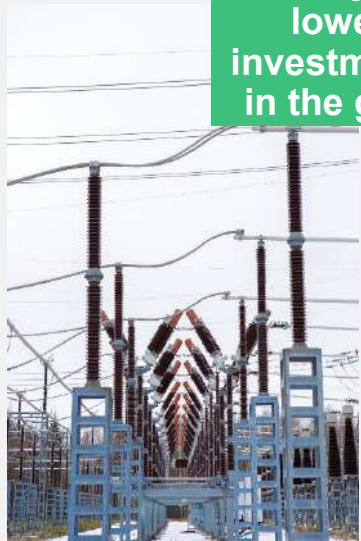
Use your hidden assets with FCR

- How much can you earn by selling your flexibility

Ronny Brunstad,
Andreas Espeving
2023.03.30

The need of flexibility

Quality in power delivery and lower investments in the grid.



Balancing of the grid



Production



Consumption



Intermittent power productions need more flexibility



Customer

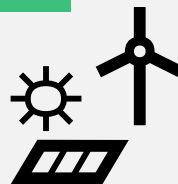
The value of flexibility

Direct income
from the sale
of flexibility



Contribute to
sustainability
goals and more
renewable
electricity
production

↓ CO2



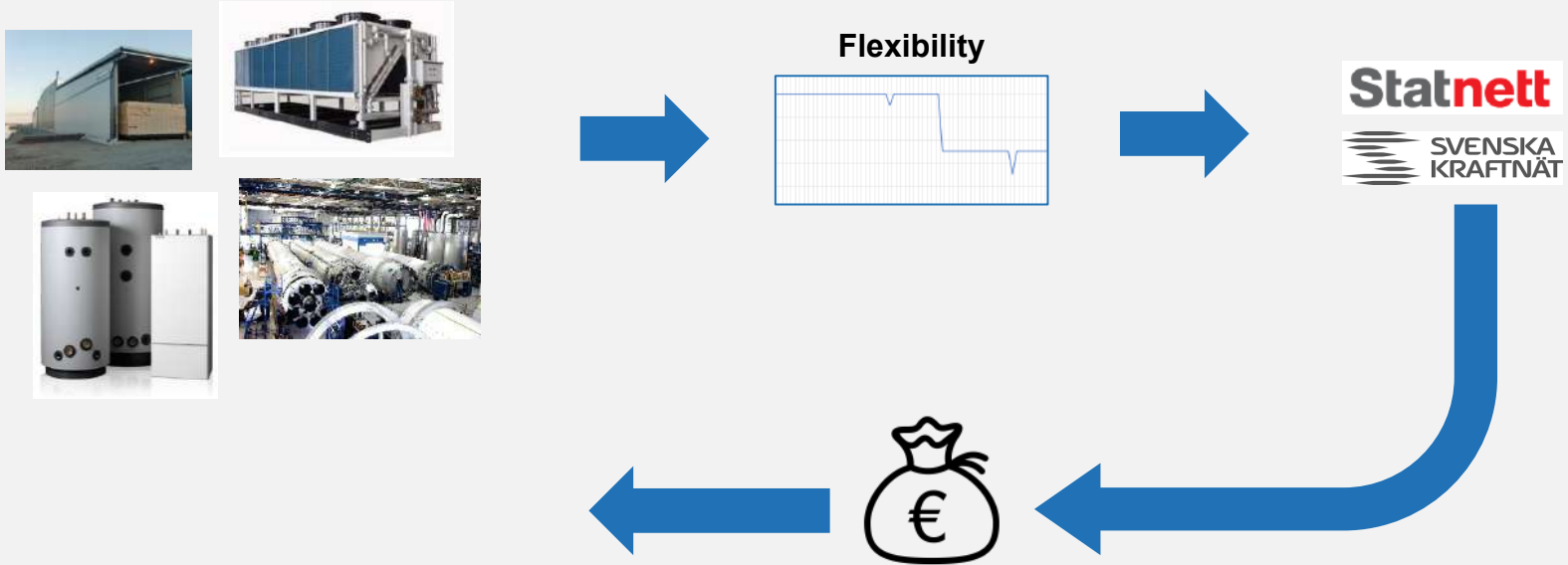
Help TSO
reduce its
costs → TSO
fees shall
reduce



Statnett

Access to the market and selling the flexibility

Vattenfall's offer



A "new" bi-product with a high "hidden" value

Flexible power consumption

Resource examples:

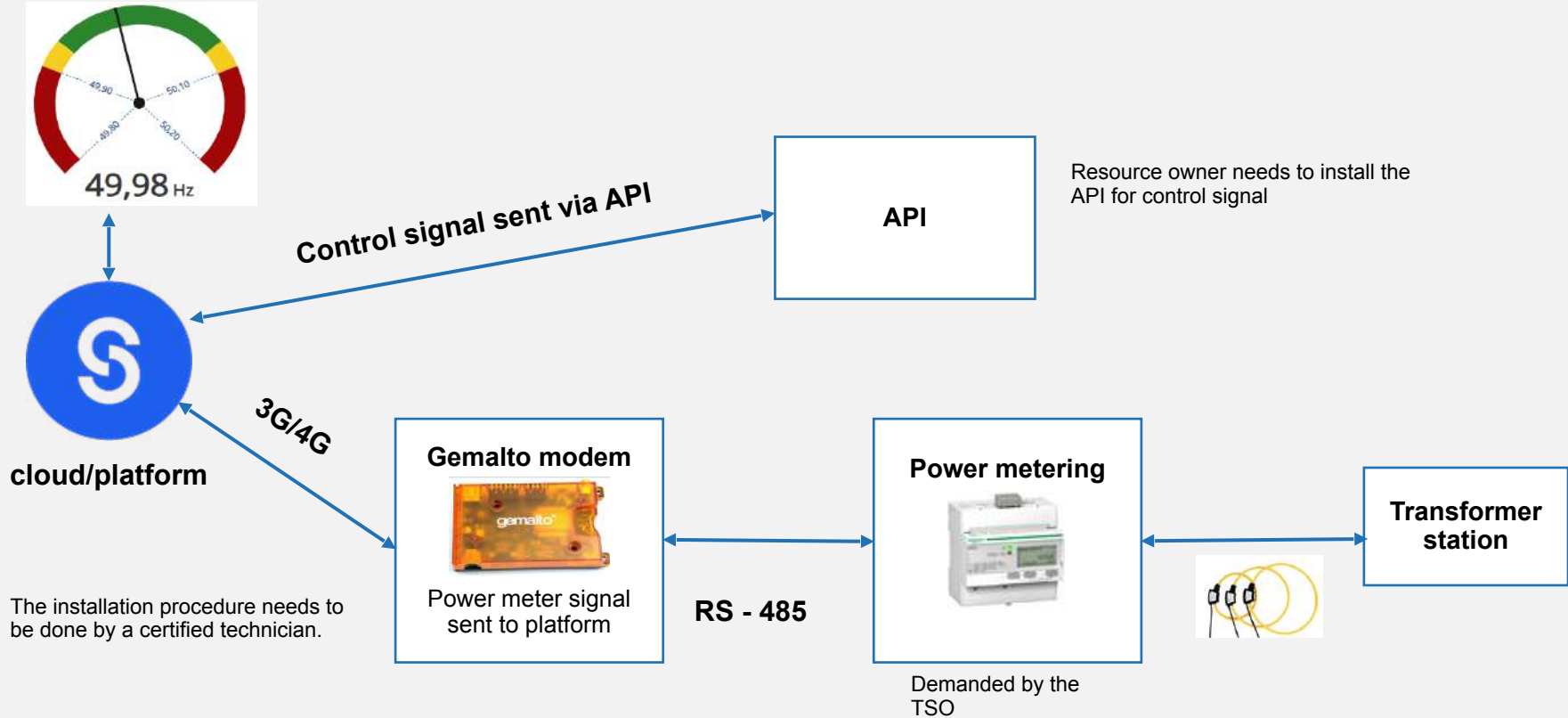
- **Pumps**
- **Fans**
- **Stirrer**
- **Compressors**
- **Grinders / Crushers**
- **Filters**
- **Electric boilers**
- **Blowing machines**
- **Mass dissolver**
- **Ovens**
- **Servers**
- **Batteries**

Technical requirements:

- Must manage shutdown / stop in 5-30 s
- Must be ready to be 20 min off (usually 3-6 min)



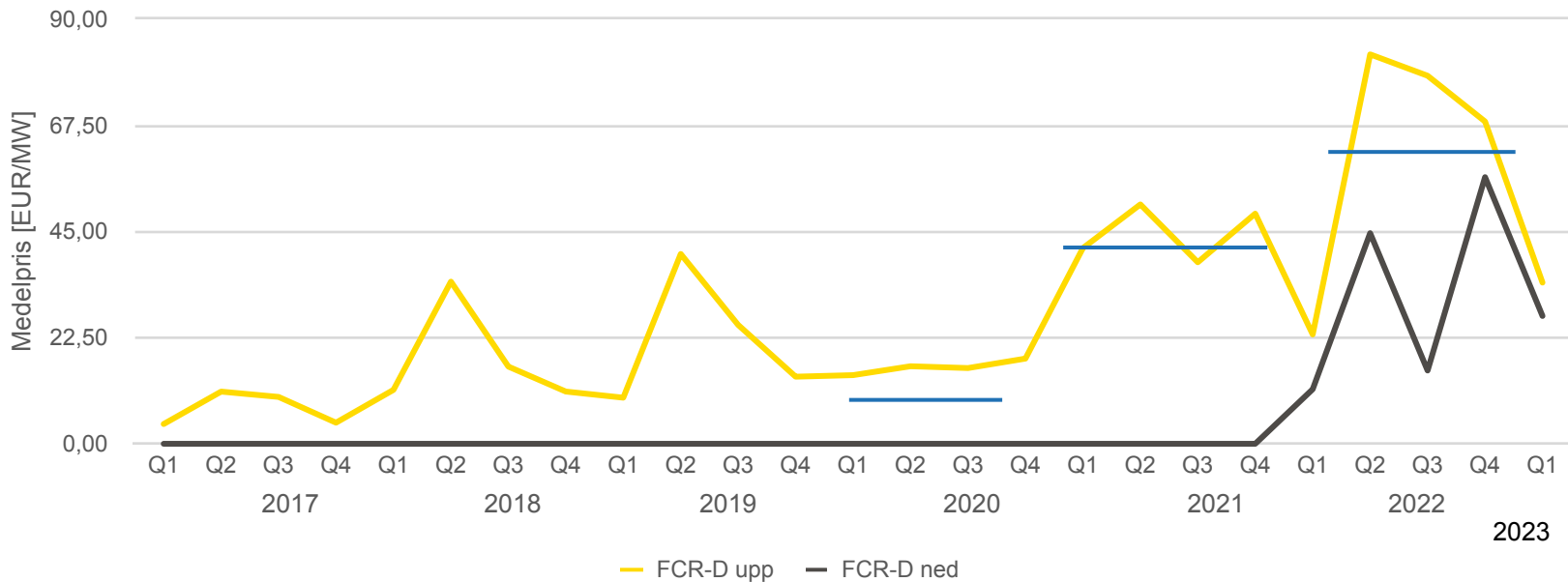
Installation overview



Business case consumption reduction

FCR - D

Marketprice



Source: <https://mimer.svk.se/PrimaryRegulation/PrimaryRegulationIndex>, uppdaterat den 24 Mars 2023.

Business case FCR-D up



Requirements

- Frequency Containment Reserve-Disturbance
- Reduce demand or increase production,
- Bid size from 0,1 MW
- Activation time 50% within 5 seconds, 100% within 30 seconds
- Endurance 20 minutes

Prices 2021

- **10 MW** reduction capacity
- **12 h/day** availability
- **460 SEK/MW** FCR-D up Average price 2021
- Profit split model

Potential
Income
20 MSEK

Prices 2022

- **10 MW** reduction capacity
- **12 h/day** availability
- **650 SEK/MW** FCR-D up Average price 2021
- Profit split model

Potential
Income
28 MSEK

Long term price

- **10 MW** reduction capacity
- **12 h/day** availability
- **125 SEK/MW** FCR-D up Average price
- Profit split model

Potential
Income
5 MSEK

How often will this affect my resources?



The number of frequency disturbances that has led to an activation of FCR-D resources is 50-60 per year

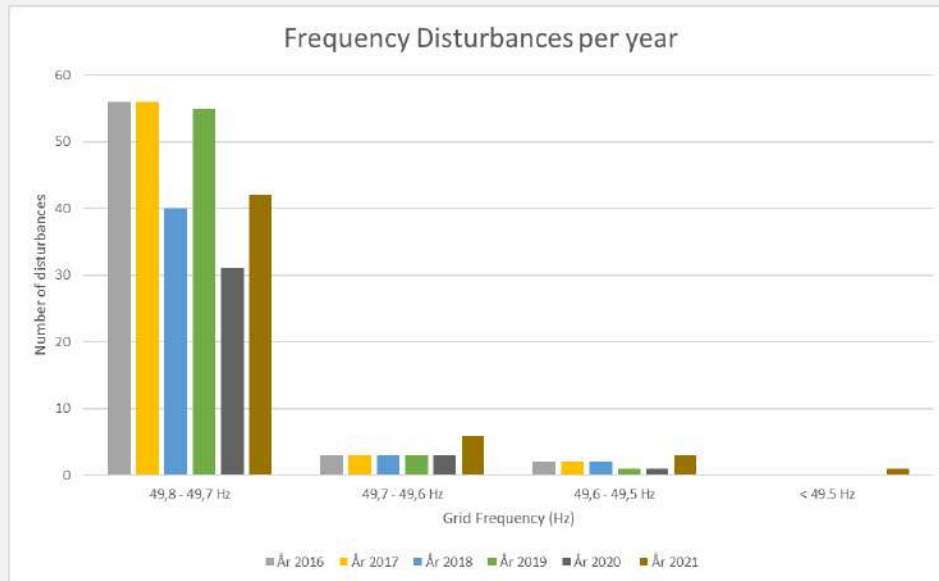
- ~90% smaller & shorter disturbances

Activation is alternated between all available resources in the portfolio

→ Single resource is normally activated

15 – 20 times per year

Activations typically lasts between 2 – 6 min



Business case - FFR FLEX-2023



- FFR Flex
- 1/5/23 – 30/10/23
- 10 MW capacity
- 400 hours ordered by Statnett on weekly basis
- Price 450 NOK/MWh

Income 1,8 mNOK





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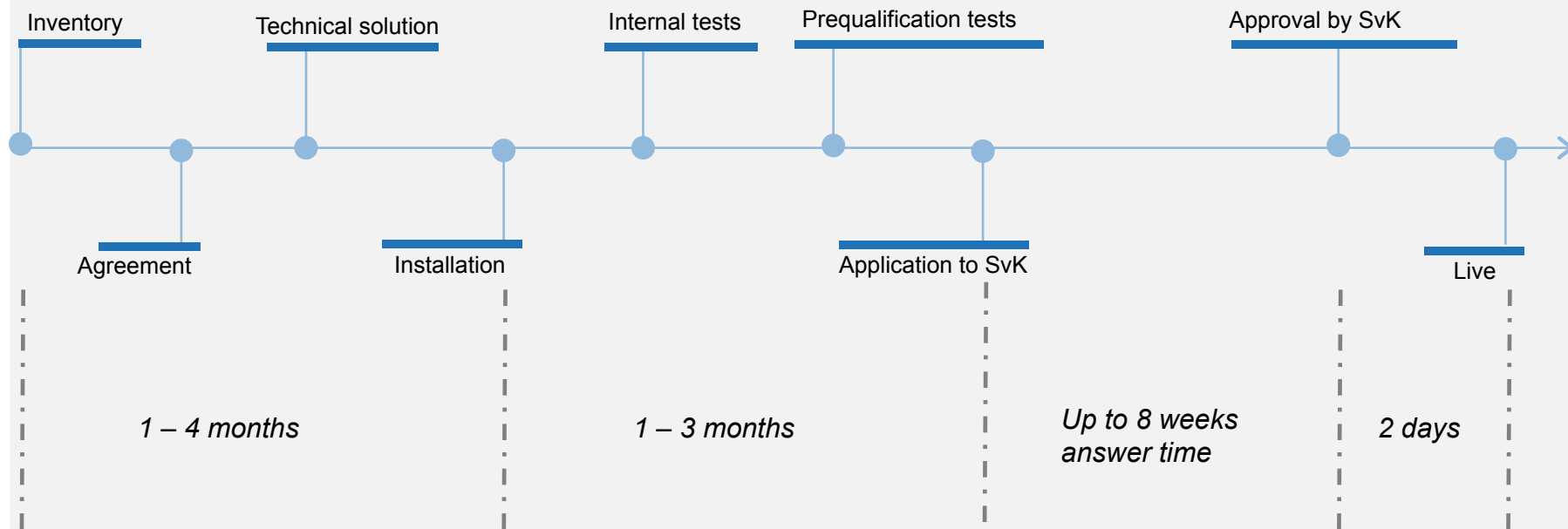
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Extra

Participation process

Timeline



Overview of requirements for reserves

FFR	FCR-N	FCR-D up	FCR-D down	aFRR	mFRR
Fast Frequency Reserve	Frequency Containment Reserve - Normal	upward Frequency Containment Reserve - Disturbance	downward Frequency Containment Reserve - Disturbance	automatic Frequency Restoration Reserve	manual Frequency Restoration Reserve
Min bid size: 0,1 MW	Min bid size: 0,1 MW	Min bid size: 0,1 MW	Min bid size: 0,1 MW	Min bid size: 5 MW	Min bid size: 10 MW (5MW SE4)
Activation: Automatically when frequency changes and low level of rotation energy.	Activation: Automatically when frequency deviation is within 49,9 - 50,1 Hz	Activation: Automatic linnear activation in frequency interval 49,9 - 49,5 Hz	Activation: Automatic linnear activation in frequency interval 50,1 - 50,5 Hz	Activation: Automatically with frequency deviation from 50,0 Hz	Activation: Manually on request from Svenska Kraftnät
Activation times: Three alternative for 100% * 0,7 sec (at 49,5 Hz) * 1,0 sec (at 49,6 Hz) * 1,3 sec (at 49,7 Hz)	Activation times: 63% within 60 sec och 100% within 3 min	Activation times: 50% within 5 sec och 100% within 30 sec	Activation times: 50% within 5 sec och 100% within 30 sec	Activation times: 100% within 120 sec	Activation times: 100% within 15 min
Volume need for SE: App 100 MW	Volume need for SE: App 240 MW	Volume need for SE: Up to app 580 MW	Volume need for SE: Up to app 560 MW	Volume need for SE: App 140 MW	Volume need for SE: na
Endurance: 30 sec alternativt 5 sec Ready for new activation within 15 min	Endurance: 1h	Endurance: Min 20 min	Endurance: Min 20 min	Endurance: 1h	Endurance: 1h
General requirements for all ancillary services: * Approved pre-qualification * Real-time measurement * Electronic communication					

How it works?

Integration process



Initial dialog

Technical discussion regarding the different resources and flexibility of the products that are suitable for your industry.



Offer

Analysis and offer, including proposals for a technical solution.



Installation

Our measurement and control system is installed together with an installer who is preferred by you.



Go Live

Pre-qualification test and application for approval by Svenska Kraftnät. After approval, the resources can be offered on the marketplace.

A "new" bi-product with a high "hidden" value

Flexible power consumption

HPC:



Bi-product:



Flexibility
from computing processes

This is Vattenfall

Basic facts

- One of Europe's largest producers of electricity and heat
- 100% owned by the Swedish state
- Main products: electricity, heat, gas and energy services
- Main markets: Sweden, Germany, Netherlands, Denmark and the UK
- Almost 20,000 employees

Key data

SEK bn	FY 2020	FY 2019
Net sales	158.8	166.4
Underlying operating profit ¹	25.8	25.1
Operating profit (EBIT)	15.3	22.1
Profit for the period	7.7	14.9
Return on capital employed, %	5.8	8.5
Return on capital employed excl. items affecting comp., %	9.7	9.6
Funds from operations/adjusted net debt, %	28.8	26.5
TWh	FY 2020	FY 2019
Electricity generation	112.8	130.2
Customer sales, electricity	118.2	119.0
Customer sales, heat	13.8	17.1
Customer sales, gas	56.8	59.2

¹ Operating profit excluding items affecting comparability

² Coal-fired generation at Moorburg has been discontinued as of year-end 2020

Location of our operations and major plants

