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Smartplant Hydro

A cloud connected powerplant

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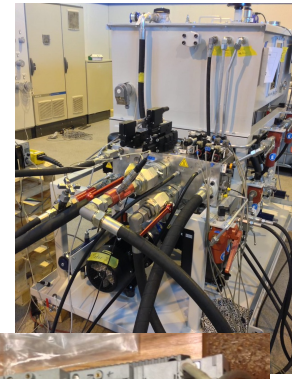
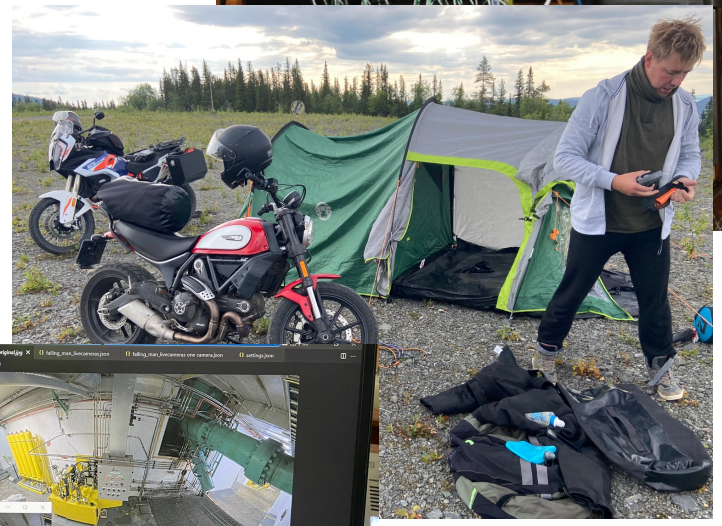
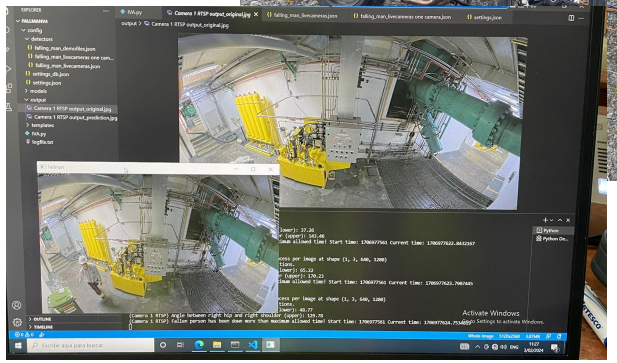
Who
Andreas Frid

- Digitalization Engineer / Digital Lead at Statkraft
- Background
  - Mechanic working with turbines and generators, Waplans Mekaniska Verkstad
  - Commissioning engineer, Andritz Hydro
  - Automation engineer, Nord-Lock
  - Digitalization engineer, Statkraft
  - Privat business owner
    - Electronics and embedded systems design and prototyping
- Östersund, Sweden







Why
Use technology as technology is intended in Statkraft

- Internal survey, focusing on small asset optimization
  - High costs and low contributing margins
- Pain points in Statkraft related to technology and asset digitalization.
  - Not using new and current technologies optimally in Statkraft
    - Internal requirements for infrastructure and security is limiting the use of technologies
    - Time consuming processes for implementation of new technologies
    - Security requirements with little or no flexibility
  - Infrastructure with high cost and low bandwidth
    - Limiting the use of high bandwidth technologies
  - **Restricted or no access to information and solutions for users**
    - Information not reachable for user
    - Complex login and security for accessing information
    - Inefficient tools for working with information

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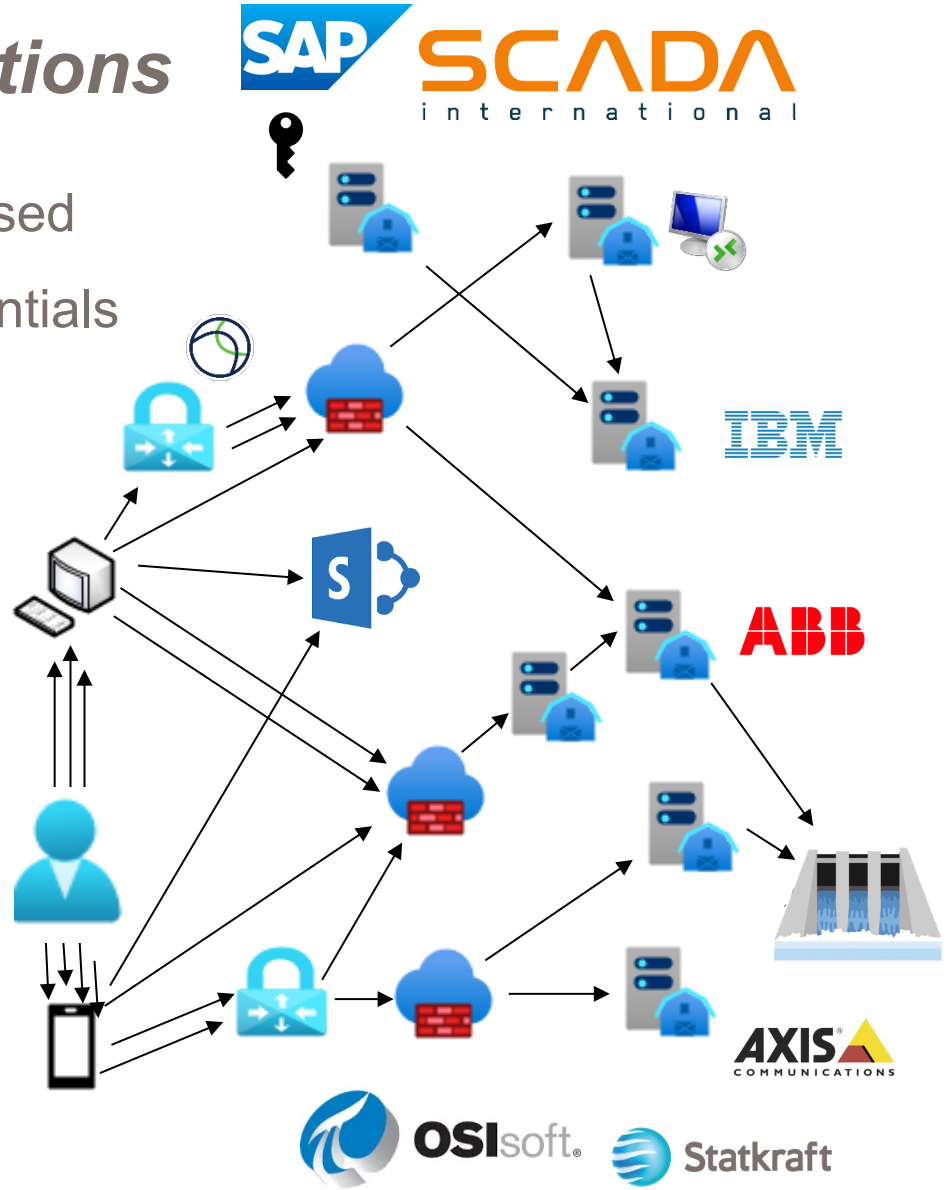
Why
Access and information – Current solutions

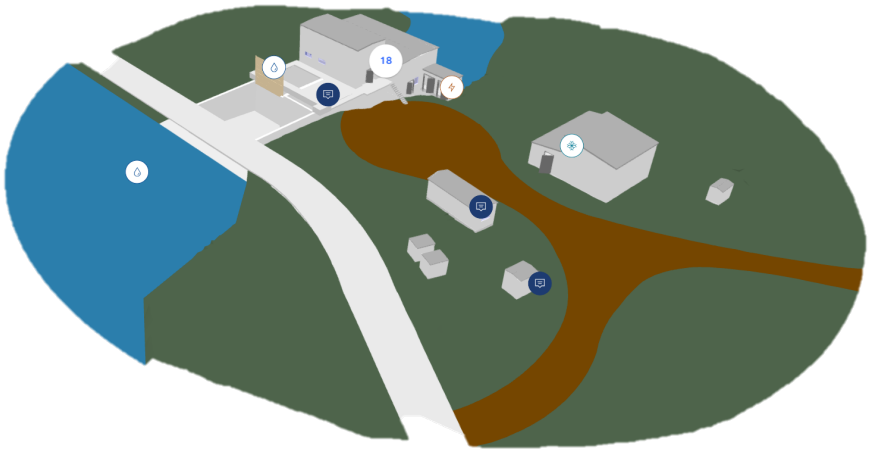
- Multiple systems where information is stored and processed
- Access to systems requires different solutions and credentials
- Different systems with different requirements
  - Locally installed clients on PC systems
  - Remotely installed solutions on remote systems
  - VPN and bridging solutions for connectivity
  - Multiple apps for user on end devices
  - Multiple MFA and token solutions for security
  - Complex license solutions and systems



What

Concept conditions for a development project

- Get access to a fully operational small hydro power plant for PoC testing
- Develop a baseline solution for continuing to run the powerplant safe
- Use the result from the survey and IT industry to design a new solution
- Develop this solution for further testing and expansion in future phases
- Develop this solution for testing technologies to be used in all categories of power plants later



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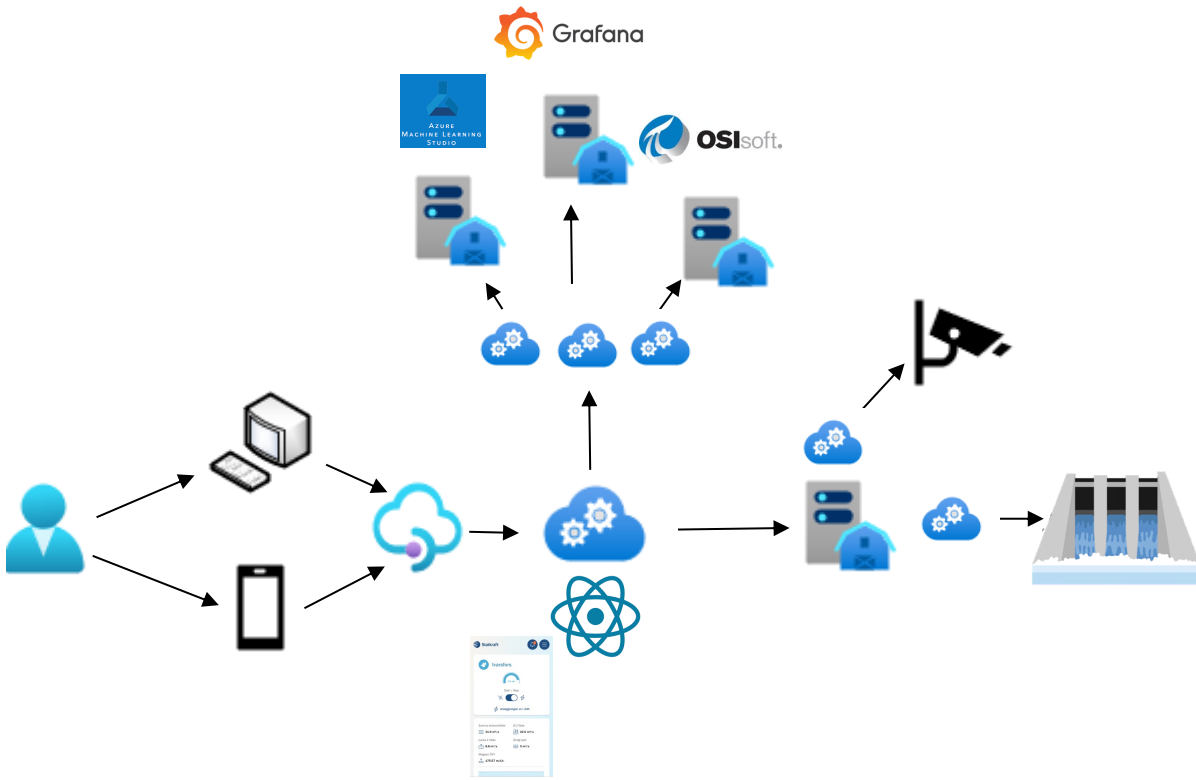
What
Solution concept

- Single user interface
  - Risk based authentication
  - Role based access
- Single Interface to multiple data sources and functions
- Centrally managed
  - Central solution management
  - Central User and security management
- Module based platform
  - Add or remove functions depending on plant or user
- Modern security and monitoring for solution
- Cloud deployment
  - Flexibility
  - Cost reduction



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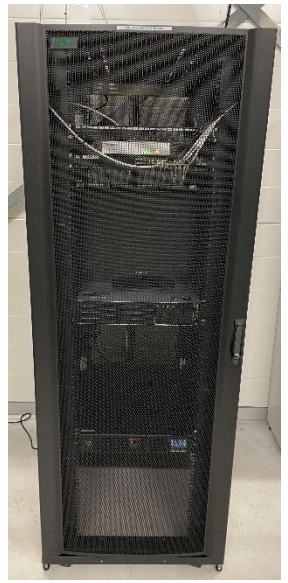
What
Requirements

- Internal requirements
  - Network and security
    - Internal requirements are connected to network, disconnect the power plant from Statkraft and start fresh
    - No risk of interference with other assets
- Operations
    - Full production as normal, no changes to the control system
    - Replaced old operations / SCADA interface with a modern API solution
    - Hybrid cloud solution. Plant will still run with no connection
- Connectivity
    - Redundancy with multiple standard 4G/5G/Local Fiber/etc. connections
    - High speed
    - Low cost
- Architecture
    - Zero Trust security architecture, for modern security



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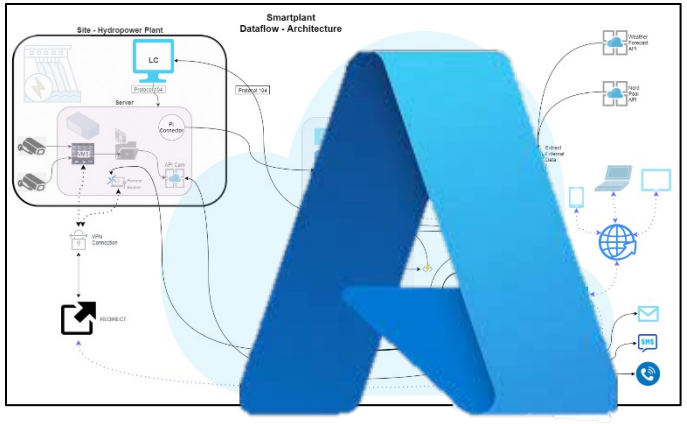
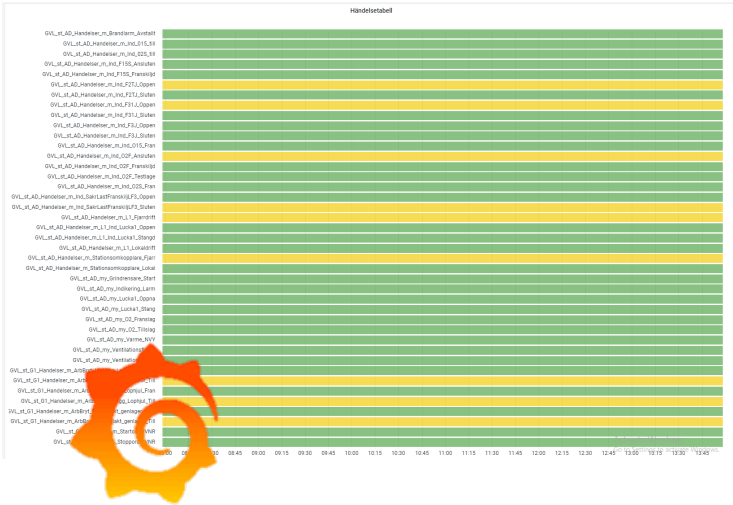
How
Toolset, same but different

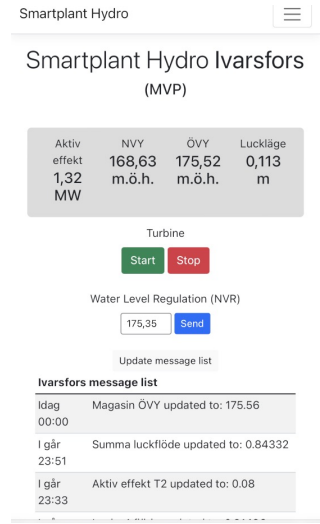
- Cloud platform, same as Statkraft
  - Microsoft Azure
    - Strategic partner
    - User management, use Statkraft resources for management
- Data collection with the same tools as Statkraft
  - Aveva PI suite.
    - Data collection and buffering
    - Data modeling / structuring
- Visualization, same as Statkraft
  - Grafana
    - Embedded graphing
    - Standalone interface for deep dive in data
- Wireless sensor network, same as Statkraft
  - LoRaWAN
    - Technology suited for power industry
    - Well-known and developed by leading suppliers





How
Development

- Small development team
  - Full-stack developer
    - Backend functions in cloud and in power plant
    - Front end application
  - Network architect
    - Development of virtual and physical networking
    - Monitoring and security implementation
  - UX designer
    - Initial interviews with users
  - Project management
- Development timeframe
  - 6 months from start of development to commissioning
  - Only one test on a powerplant before commissioning
- Smartplant Hydro operational December 2022



Azure DevOps

```
});

if (builder.Environment.IsProduction())
    builder.Configuration.AddAzureKeyVault(
        new Uri(builder.Configuration["AppSettings:KeyVaultUri"]),
        new DefaultAzureCredential(new DefaultAzureCredentialOptions
        {
            ManagedIdentityClientId = builder.Configuration["AppSettings:ManagedIdentityClientId"]
        }));
```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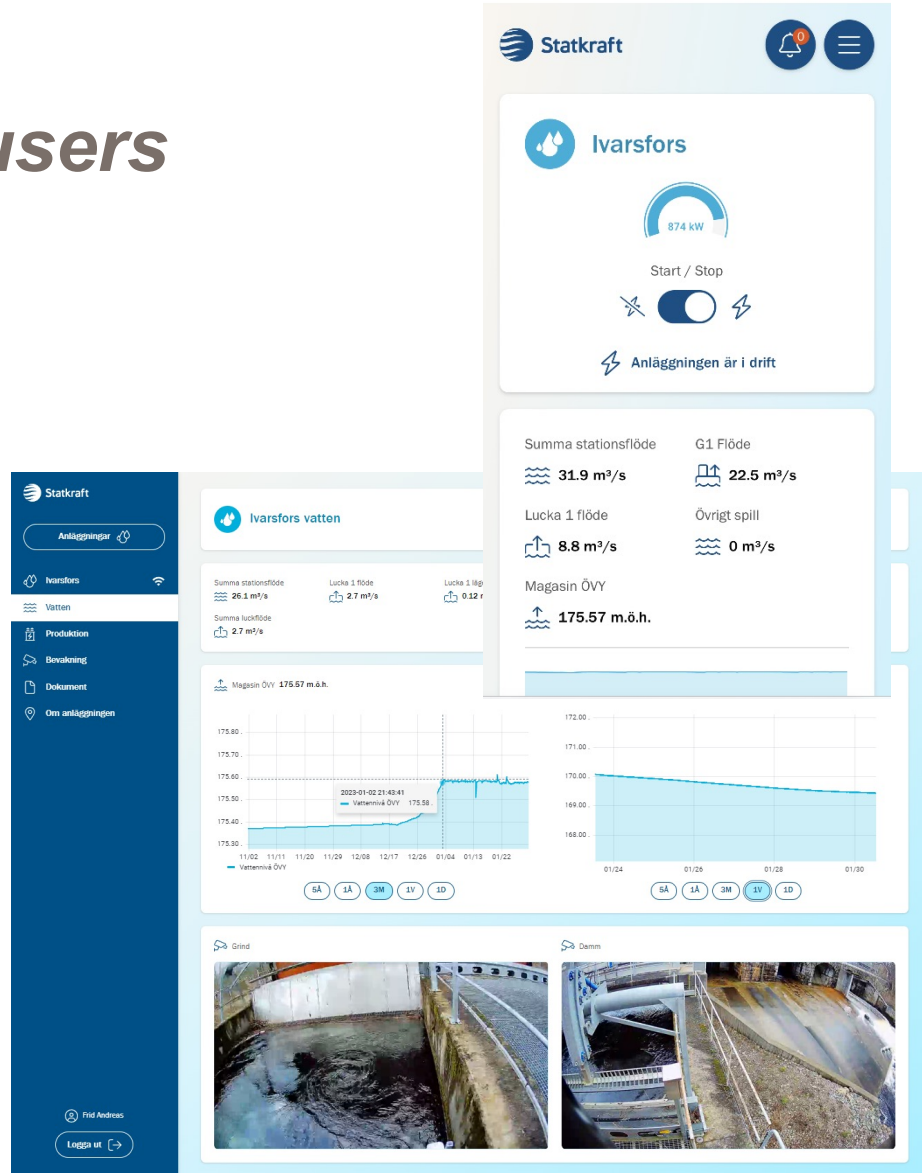
How

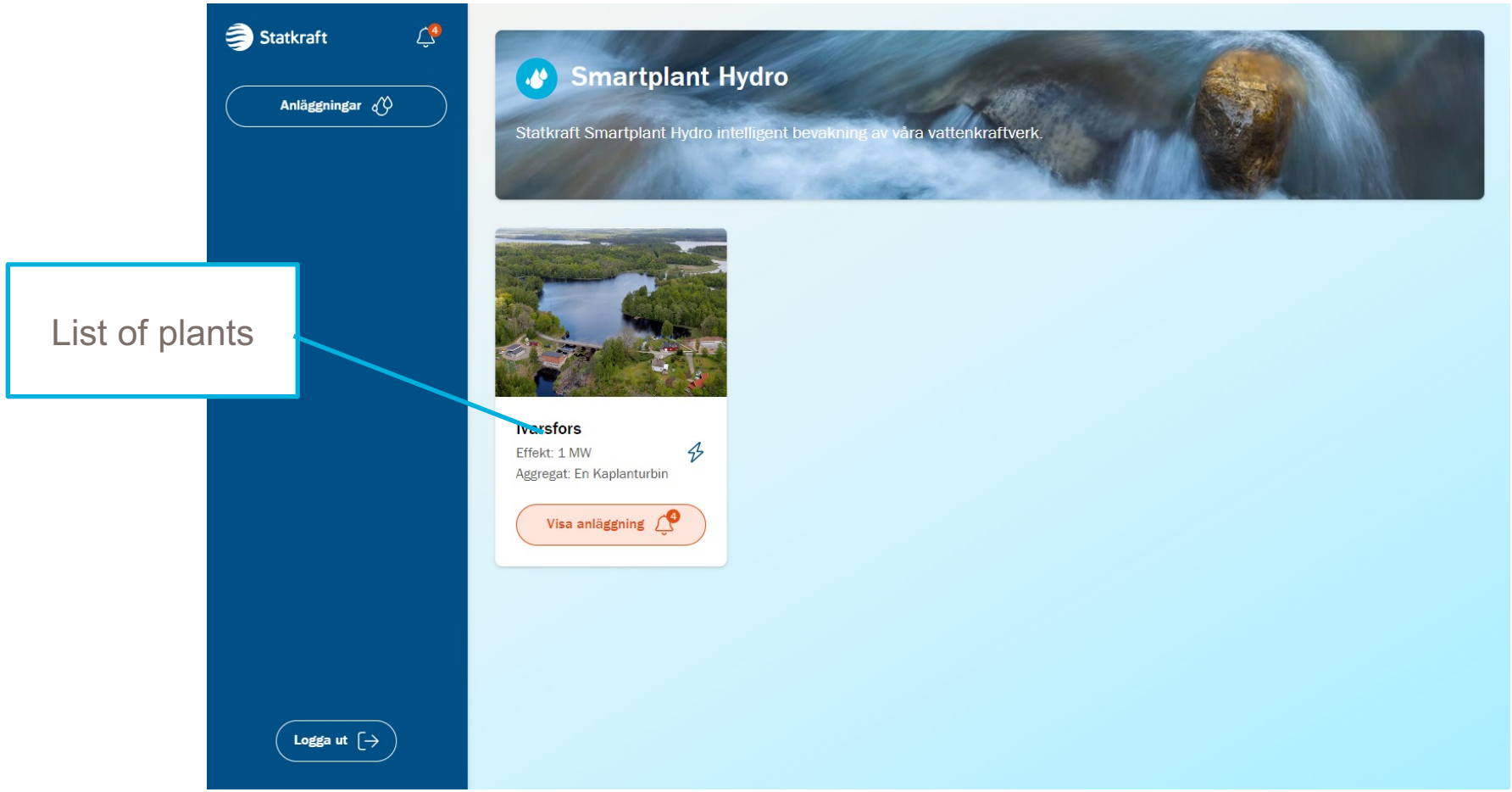
Result - information in the hands of the users

- A single app reachable from any type of device
  - Send commands to plant. Start/Stop, Setpoints, Control modes
  - View live values from production and sensors
  - Alarm and event logs with details from local control systems
  - Documentation and files related to asset
  - Live camera feeds from plant
  - Trends and historical values
- Notifications
  - Alarms and events is sent to users by SMS and Phone call
  - New setpoints sent to plant with information for verification and history
- Combination of data sources
  - Local sensor data and external data is stored in the same way



How
An easier way of using technology

- Plants overview



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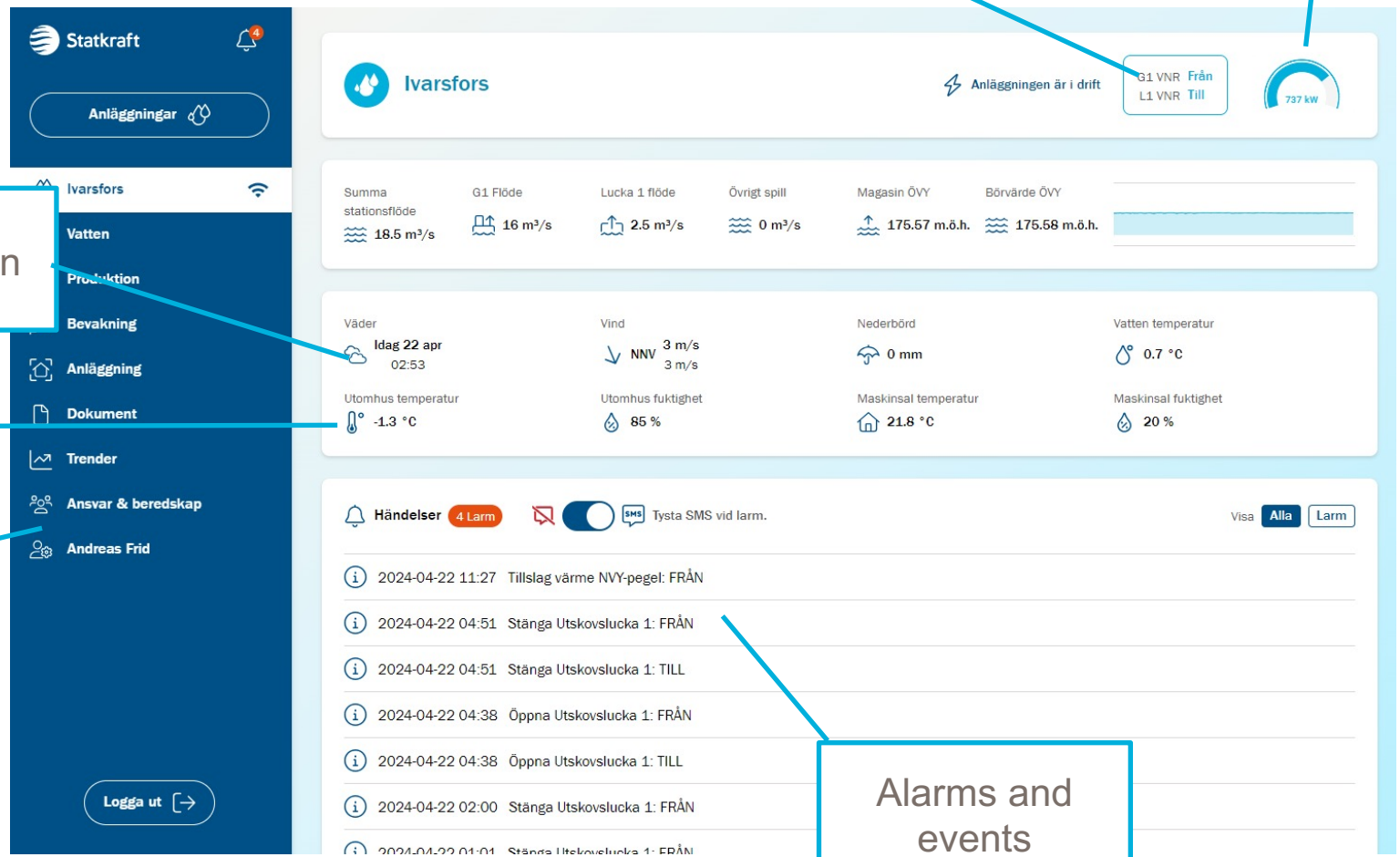
How

An easier way of using technology

- Plant main page
  Normal user



Control modes

Grafana Graphs

Weather prediction

Live external sensor values

User managment and roles

Alarms and events

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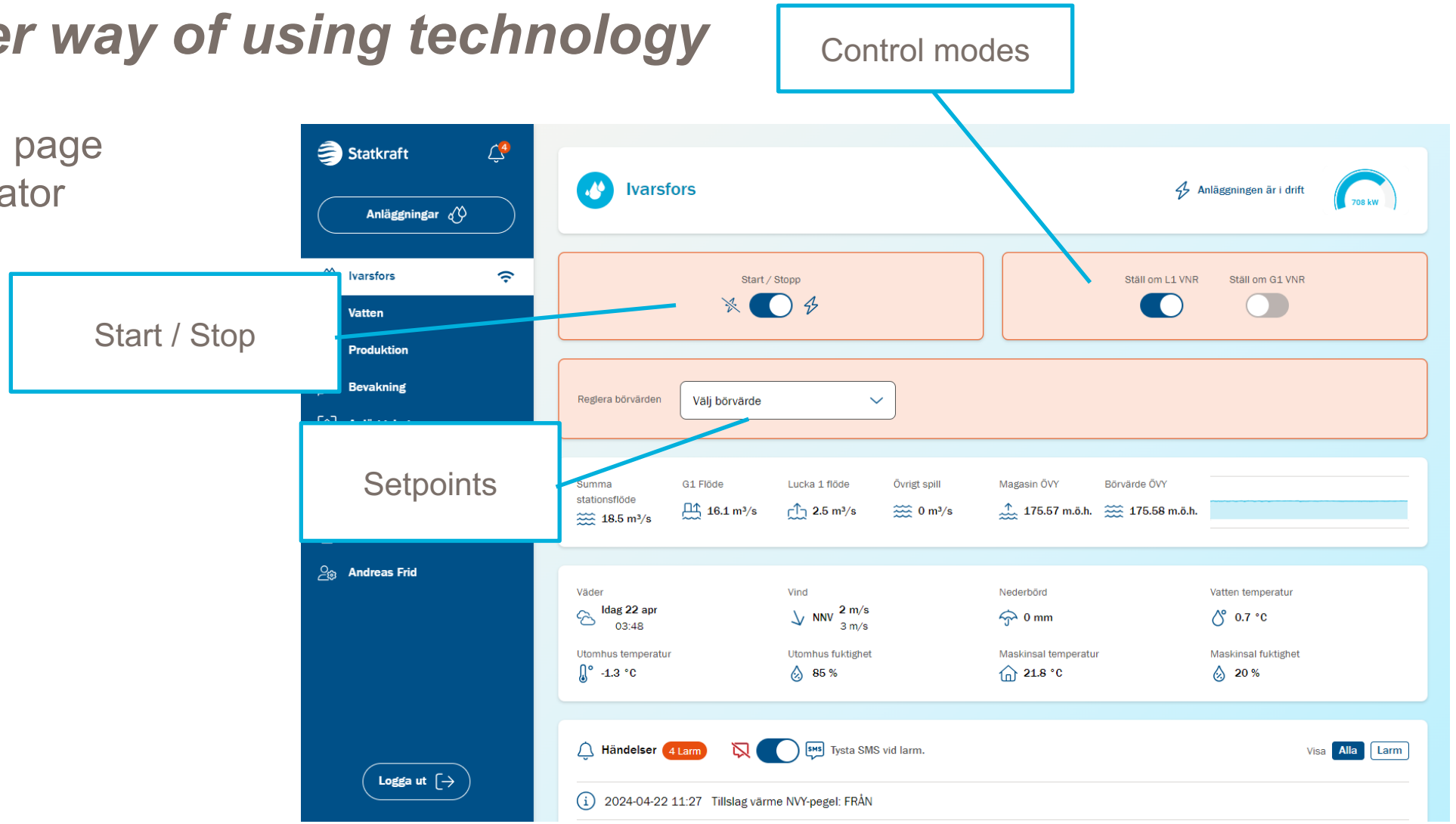
How

An easier way of using technology

- Plant main page
  Plant operator



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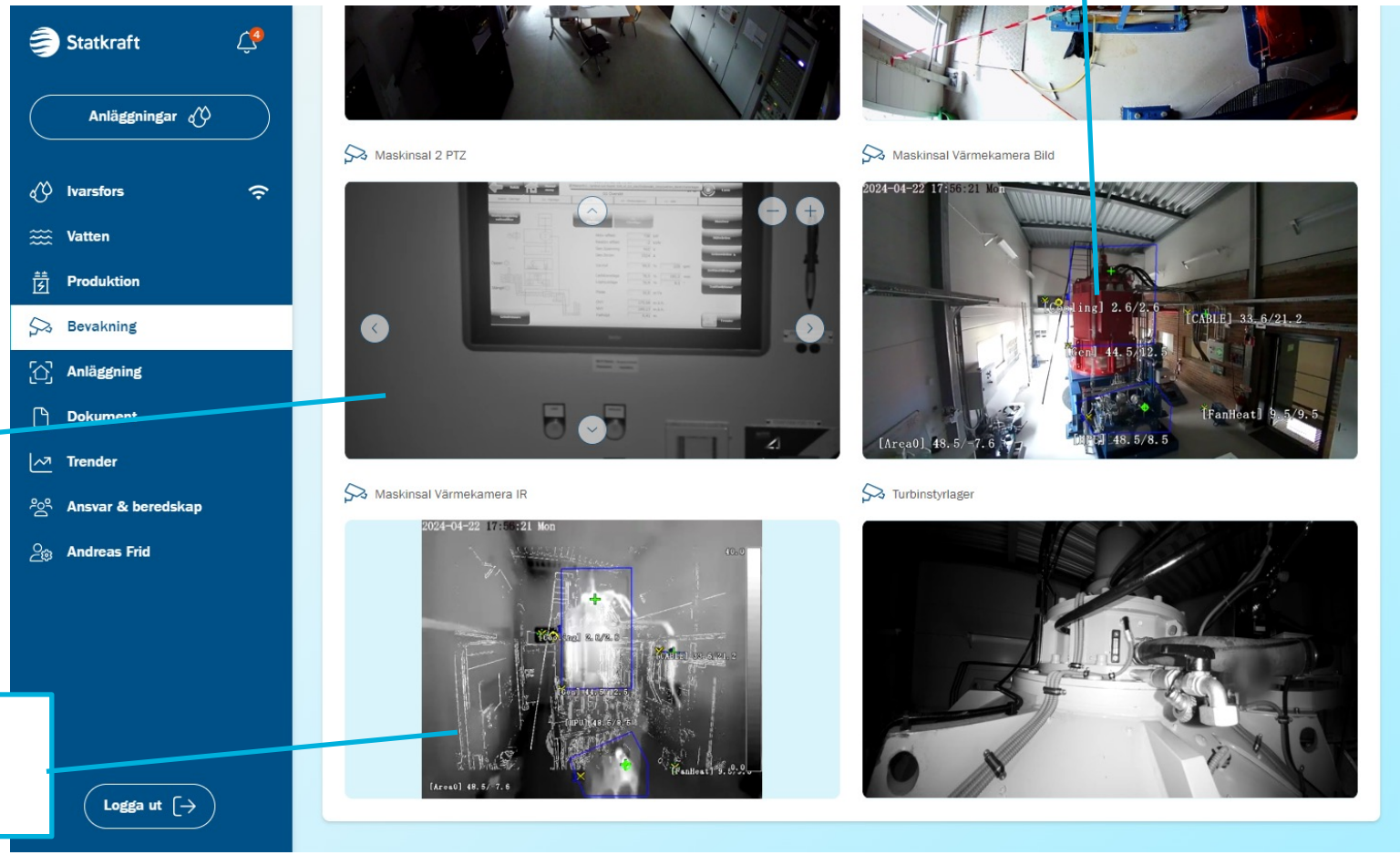
How
An easier way of using technology

- Camera feeds

Thermal camera overlayed image

PTZ Camera & controller

Thermal camera image



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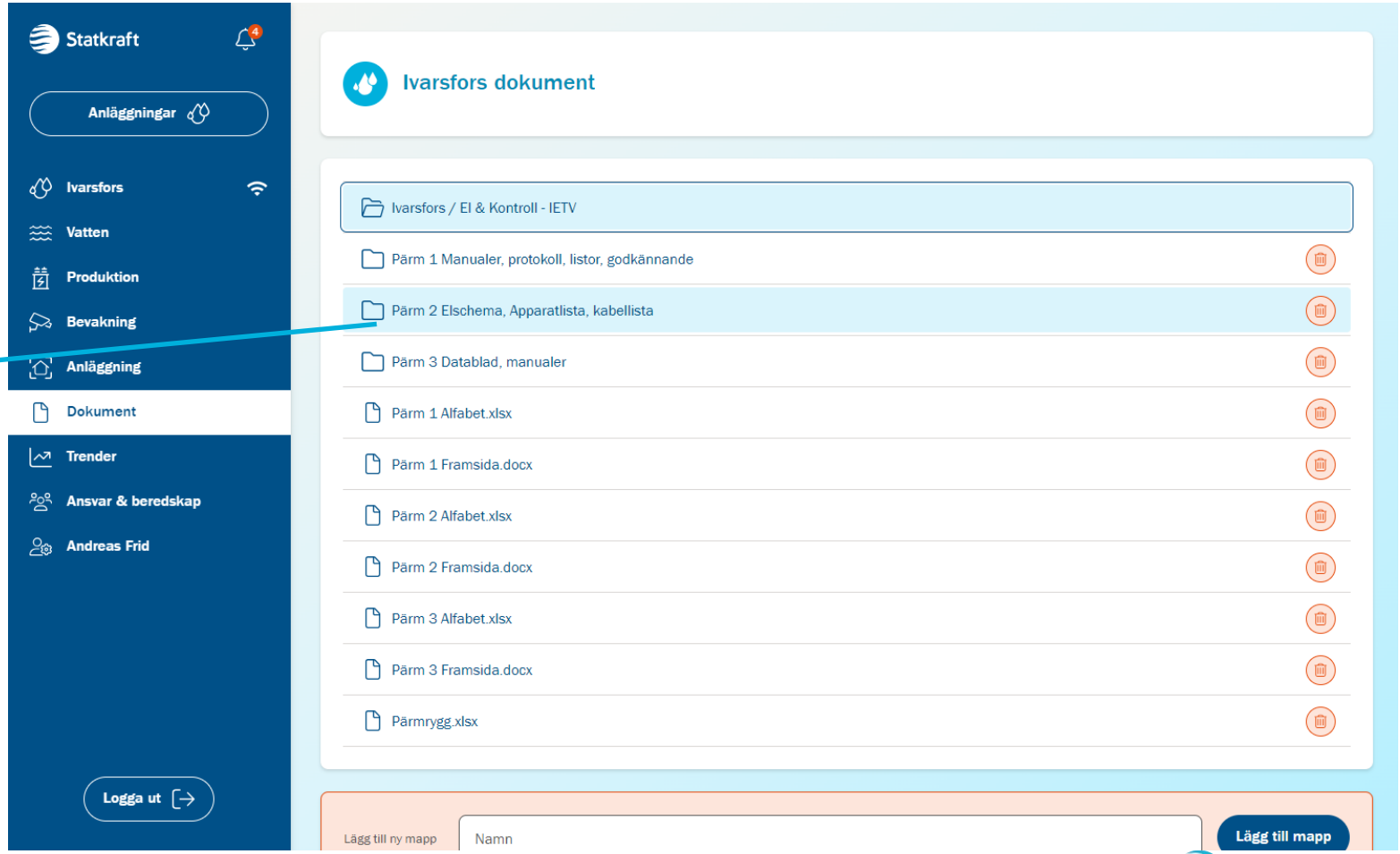
How
An easier way of using technology

- Document pages

Electrical schematics and documents



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How

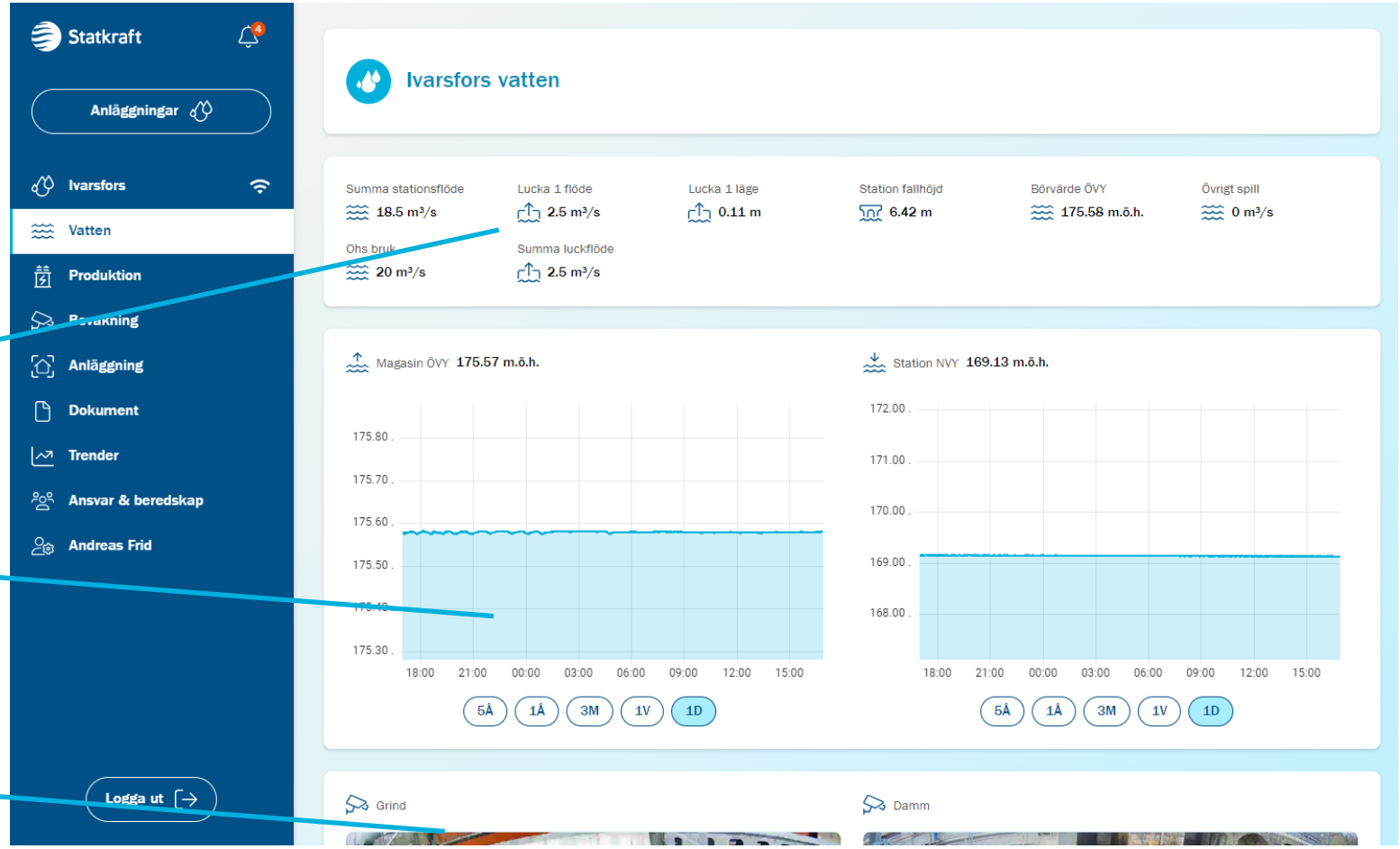
An easier way of using technology

- Water related live values , trends and cameras

Live values

Trending graphs

Related camera feeds



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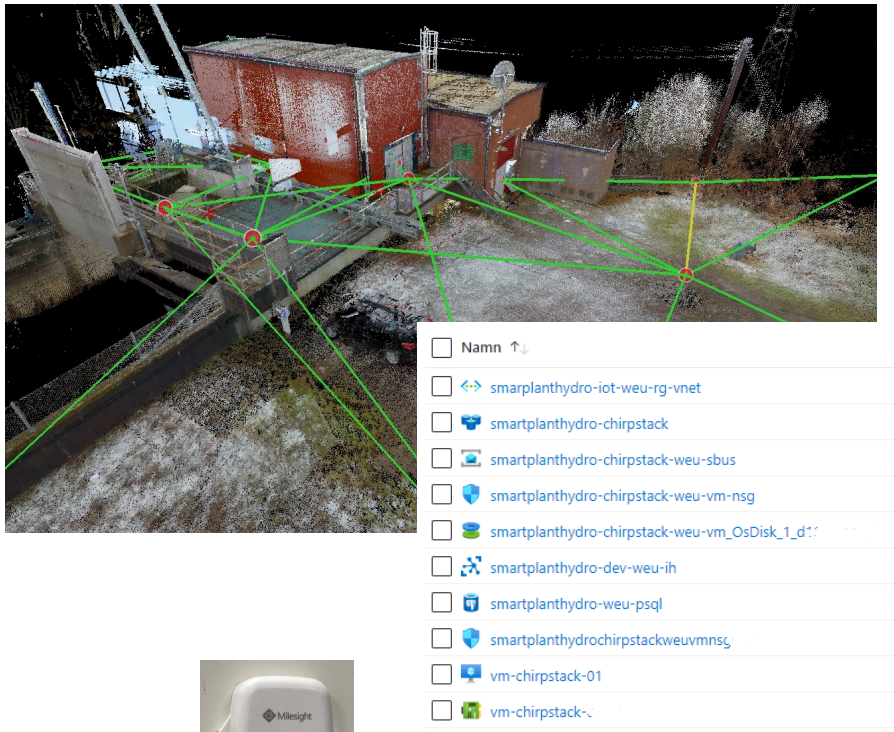
How
An easier way of using technology

- Easier access to systems and information
  - Better and faster decision making
  - Unified overview for all types of users
- Faster deployment of new and other technologies
  - Less engineering for implementation
  - Faster results
  - Less complicated requirements
  - IIoT standards for data transfer
- Power of cloud services
  - Fast and easy scaling
  - Easy deployment of new services and systems
  - Monitoring and security solutions included in cloud platform



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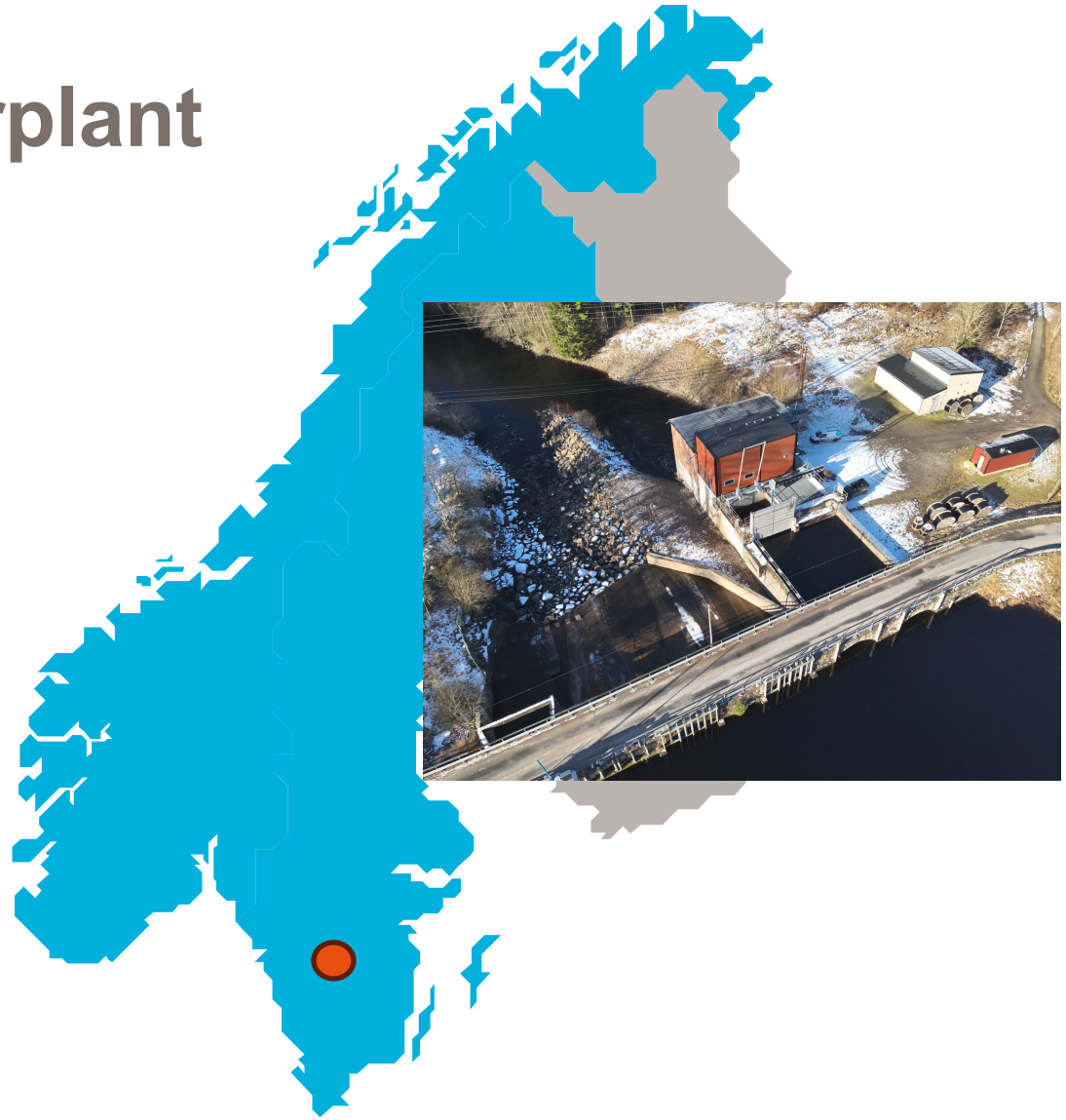
Where?
Ivarsfors hydroelectrical powerplant

- Selection criteria
  - Good technical status
  - Powerplant was refurbished 2018
    - New turbine
    - New generator
    - New local control system
  - Suitable turbine technology for optimization
    - Single Kaplan turbine, 1MW
  - Low contribution margin
  - Far away from other locations and plants
  - Dam is without classification according to RIDAS



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Next
Future development

- Smartplant 2.0
  - Semi disconnected power plant.
  - All benefits from the platform but without the disconnection from Statkraft
- Smartplant Lite
  - Electrical cabinet sized deployment on small assets (pumps, water level sites, camera)
  - Modular system
    - Cameras
    - Digital and analog input / output modules for connecting sensors directly
    - Standalone communication
- Production optimization for small hydro planning
- AI models on subsets of data
- Remote robotic monitoring
- Eel monitoring and analytics
- BIM 2.0

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