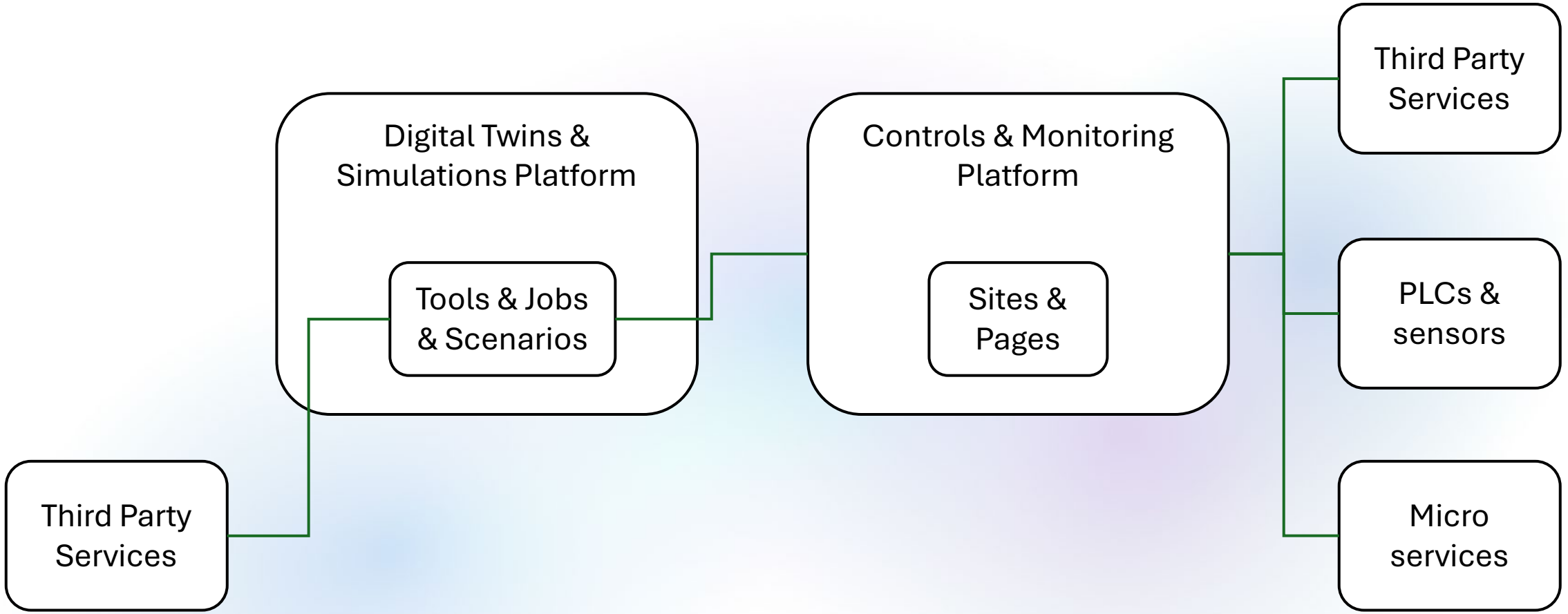
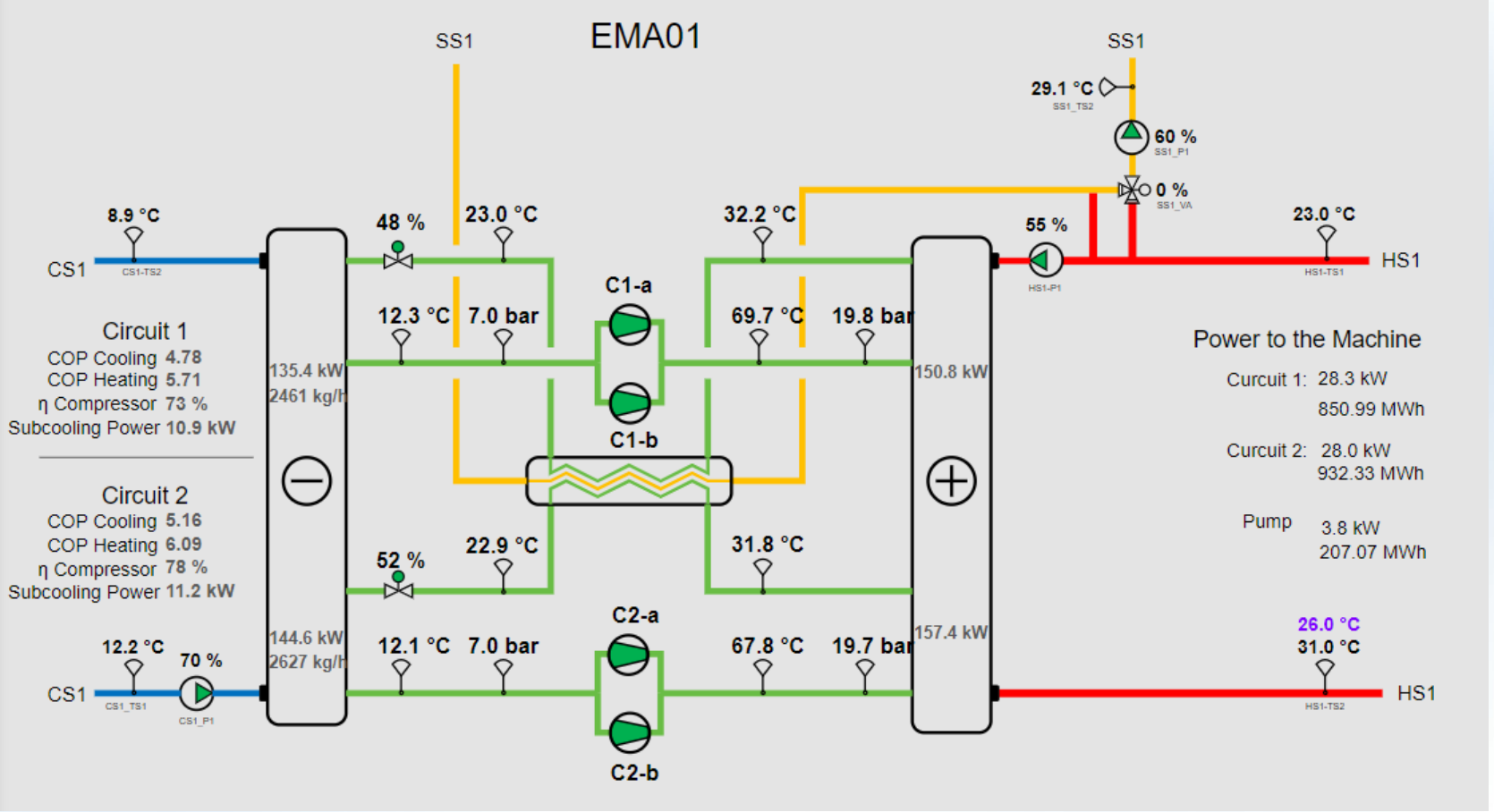
Scaling Digital Services for Heat Pump Systems

Lasse Thomsen, 04072024


Digital Twins & Simulations Platform
Tools & Jobs & Scenarios
Controls & Monitoring Platform
Sites & Pages
Third Party Services
Third Party Services
PLCs & sensors
Micro services

Numerous

Example 1: Energy Machines Verification (EMV) Micro Service

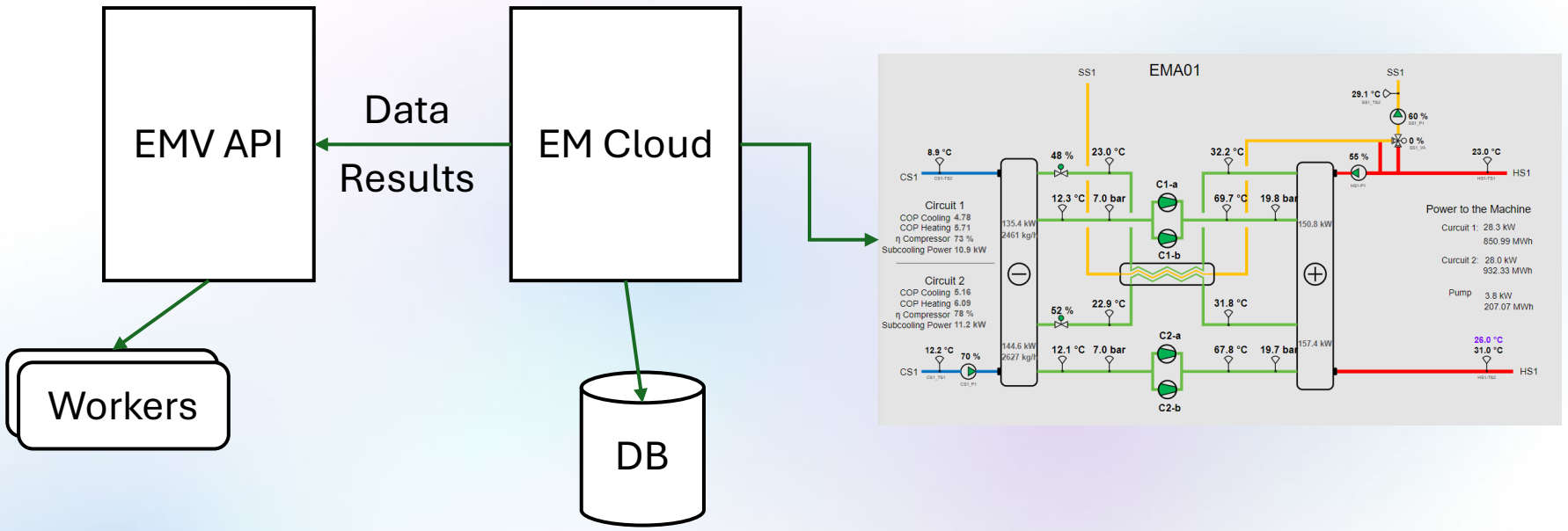


80 circuits online

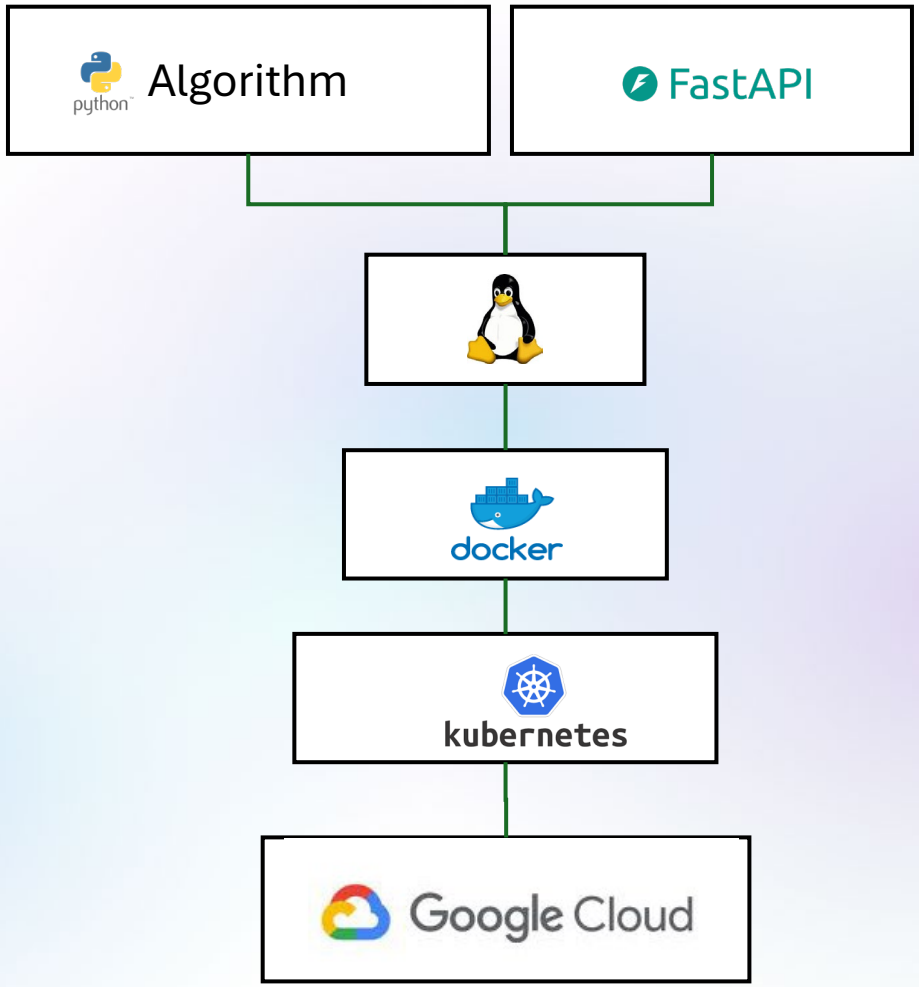
6 refrigerants

6 circuit types

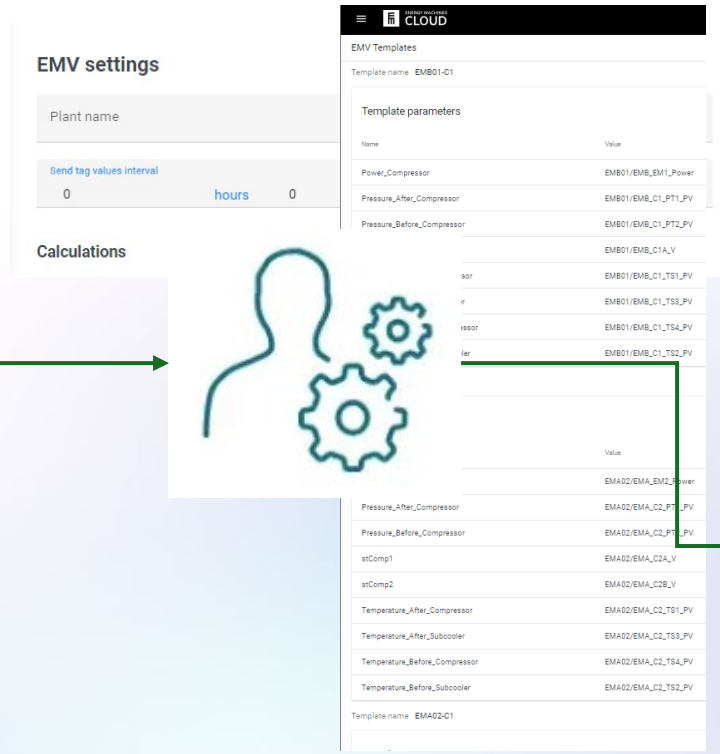
Numerous


EMV API
Data
Results
EM Cloud
Workers
DB
EMA01
SS1
SS1
29.1 °C
60 %
0 %
8.9 °C
CS1
48 %
23.0 °C
32.2 °C
55 %
23.0 °C
HS1
Circuit 1
COP Cooling 4.78
COP Heating 5.71
η Compressor 73 %
Subcooling Power 10.9 kW
12.3 °C
7.0 bar
C1-a
69.7 °C
19.8 bar
C1-b
135.4 kW
2461 kg/h
150.8 kW
Power to the Machine
Curcuit 1: 28.3 kW
850.99 MWh
Curcuit 2: 28.0 kW
932.33 MWh
Pump 3.8 kW
207.07 MWh
Circuit 2
COP Cooling 5.16
COP Heating 6.09
η Compressor 78 %
Subcooling Power 11.2 kW
52 %
22.9 °C
31.8 °C
C2-a
12.2 °C
70 %
144.6 kW
2627 kg/h
12.1 °C
7.0 bar
67.8 °C
19.7 bar
157.4 kW
26.0 °C
31.0 °C
CS1
HS1
C2-b

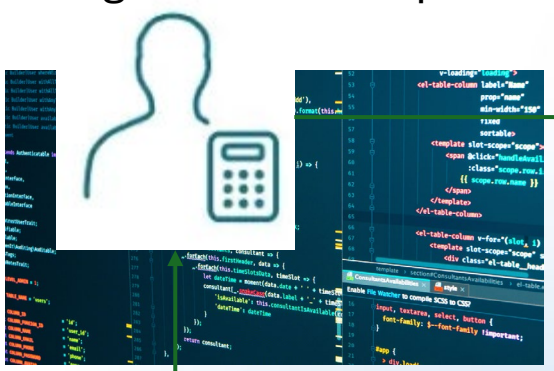
Numerous


Algorithm
FastAPI
docker
kubernetes
Google Cloud

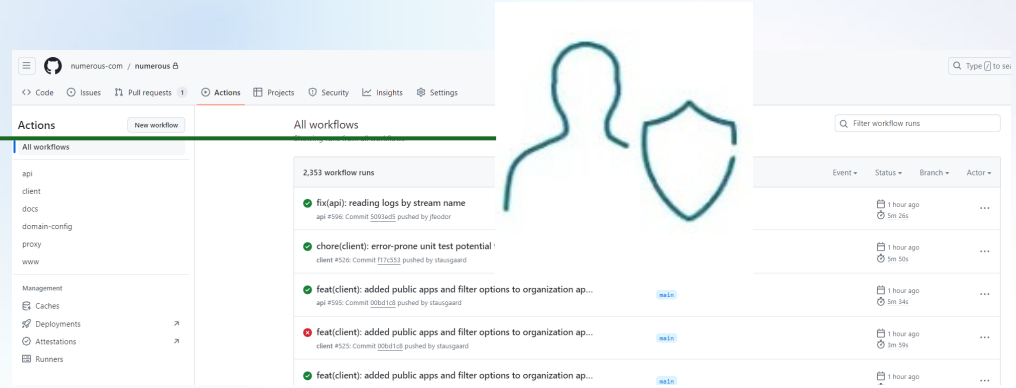
Application Engineer

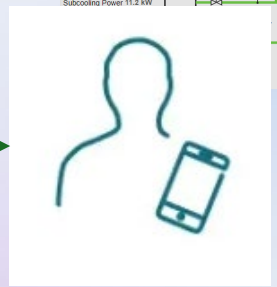


Algorithm Developer

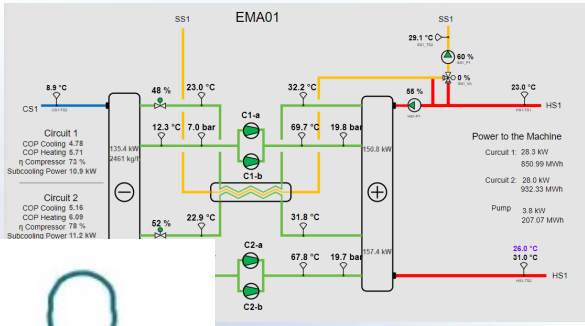


SW DevOps





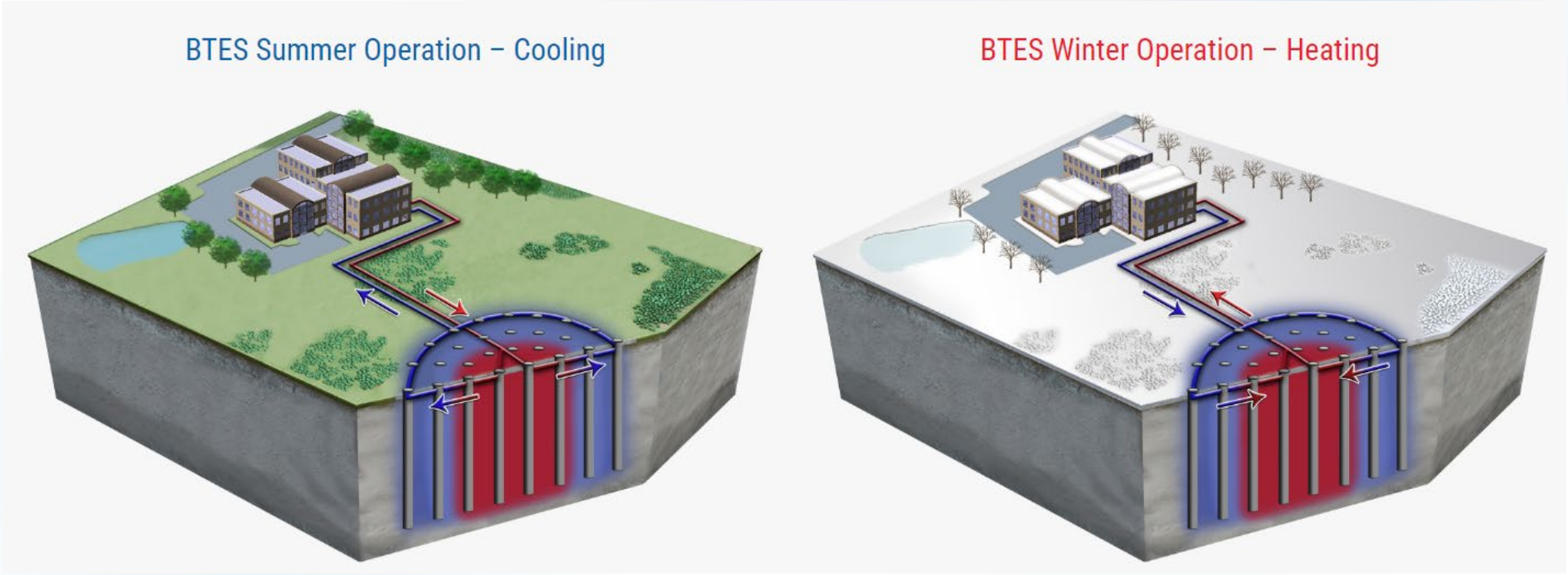
Operator/Client



Modularity

- The API can be used for offline processing, testing and validation
- The code base of EMV and the Controls Systems are separated
- The service is simple to integrate for third parties

Example 2: Monitoring Thermal Storage Performance



From underground-energy.com

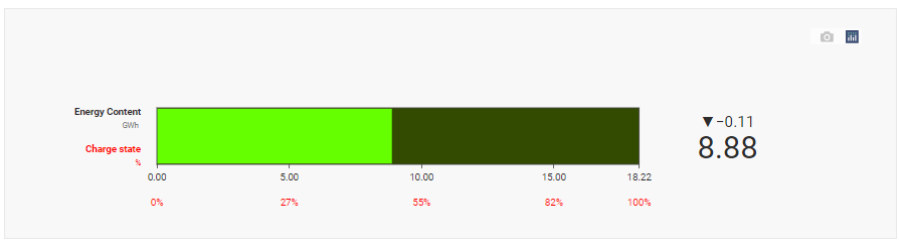
Numerous

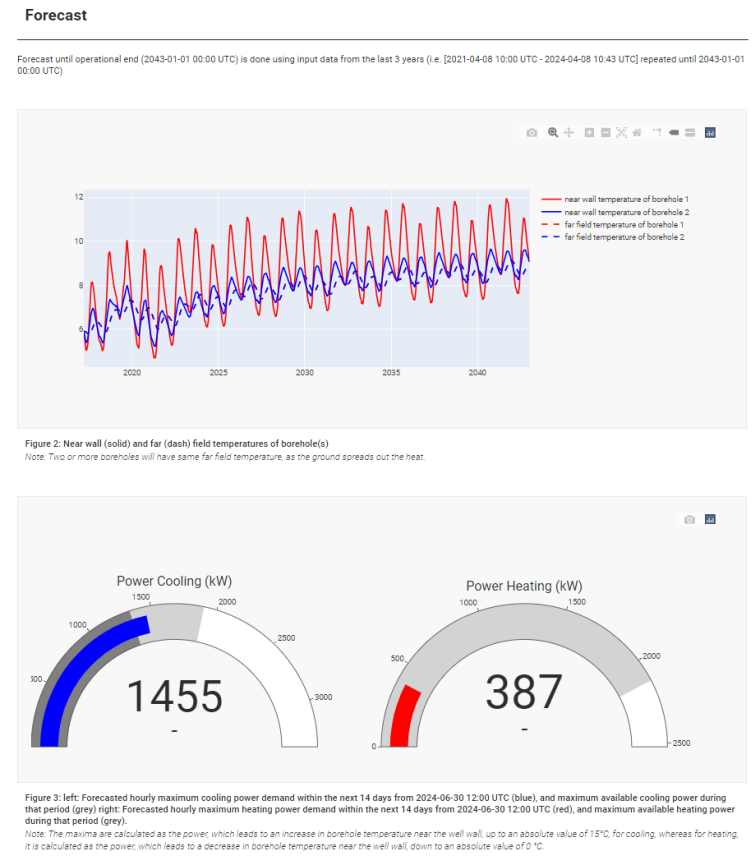
Value

- Monitoring operations and performance
- Ensuring sustainable operations for many years
- Analyzing potential in the storage
    - Possible cooling and heating loads

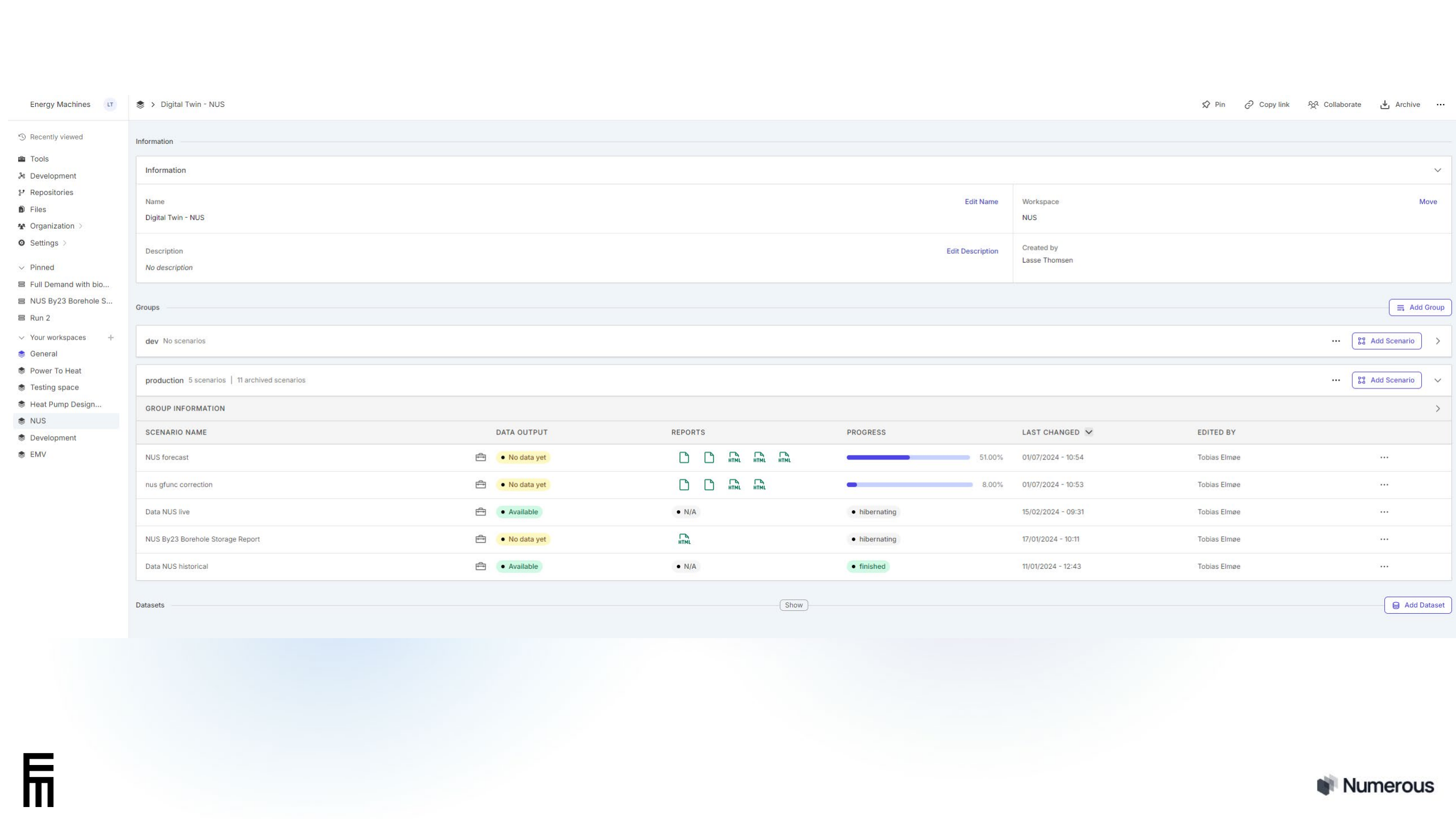
Service

Interactive HTML Report in Controls System updated Daily



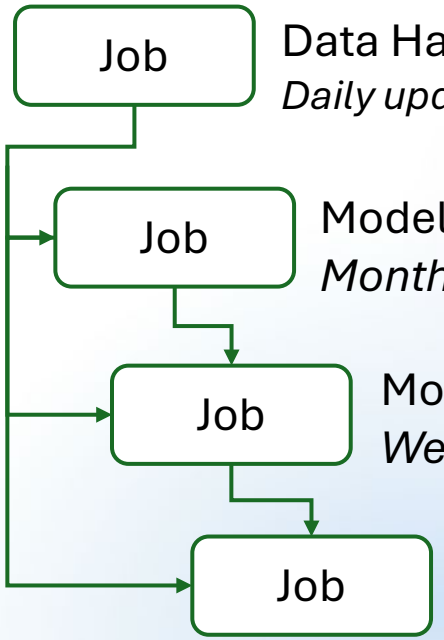


Numerous


Energy Machines
LT
Digital Twin - NUS
Pin
Copy link
Collaborate
Archive
Recently viewed
Tools
Development
Repositories
Files
Organization
Settings
Pinned
Full Demand with bio...
NUS By23 Borehole S...
Run 2
Your workspaces
General
Power To Heat
Testing space
Heat Pump Design...
NUS
Development
EMV
Information
Information
Name
Digital Twin - NUS
Edit Name
Workspace
NUS
Move
Description
No description
Edit Description
Created by
Lasse Thomsen
Groups
Add Group
dev No scenarios
Add Scenario
production 5 scenarios | 11 archived scenarios
Add Scenario
GROUP INFORMATION
SCENARIO NAME
DATA OUTPUT
REPORTS
PROGRESS
LAST CHANGED
EDITED BY
NUS forecast
No data yet
51.00%
01/07/2024 - 10:54
Tobias Elmøe
nus gfunc correction
No data yet
8.00%
01/07/2024 - 10:53
Tobias Elmøe
Data NUS live
Available
N/A
hibernating
15/02/2024 - 09:31
Tobias Elmøe
NUS By23 Borehole Storage Report
No data yet
hibernating
17/01/2024 - 10:11
Tobias Elmøe
Data NUS historical
Available
N/A
finished
11/01/2024 - 12:43
Tobias Elmøe
Datasets
Show
Add Dataset

Numerous

BTES Monitoring Service



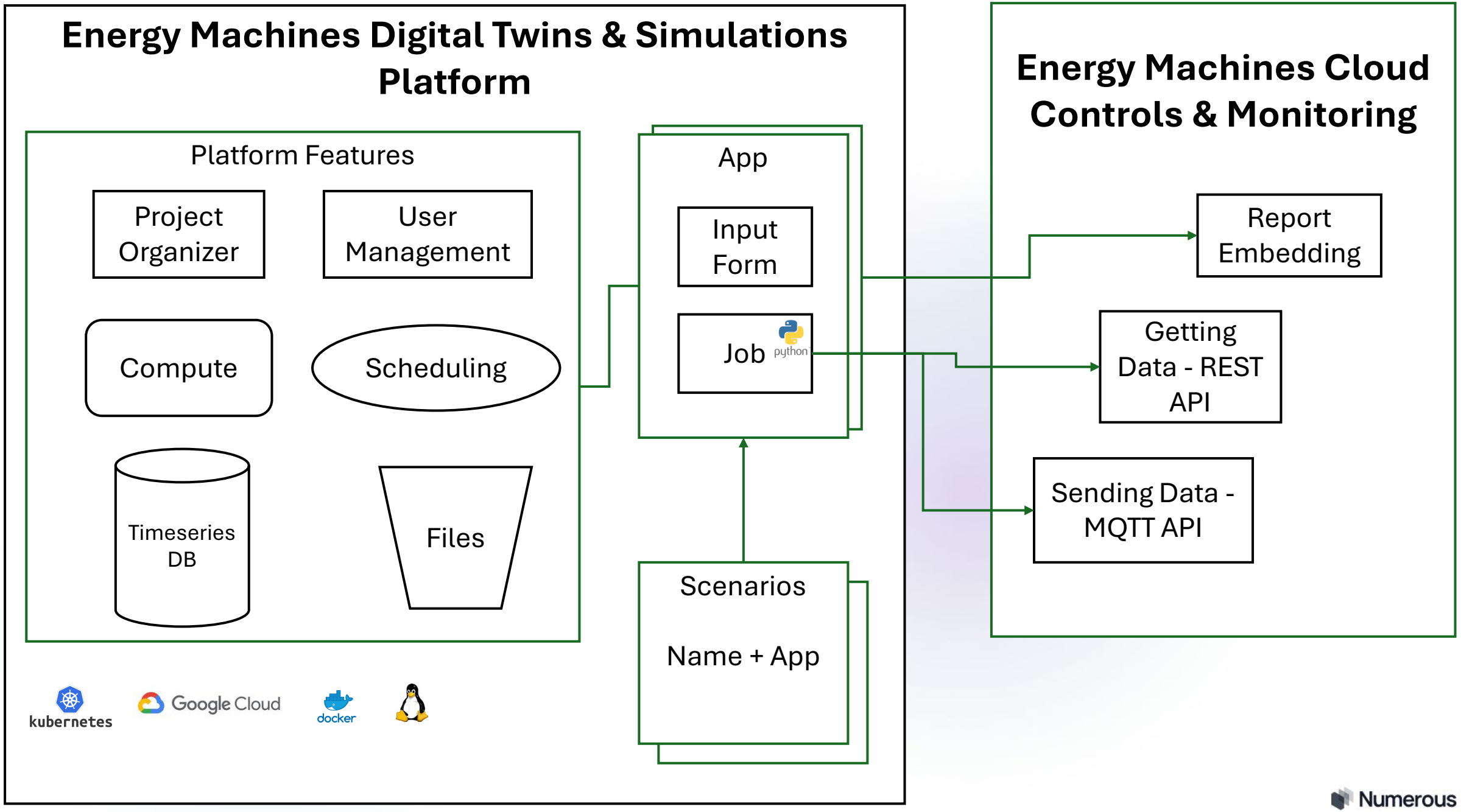
Data Harvester: Reading measurement data to timeseries storage
Daily update (5 min run time)

Model Correction: Updates model parameters based on data
Monthly update (10-12 hour run time) – report of coefficients and fitting

Model Forecast: Main simulation to forecast storage performance
Weekly update (1 hour run time) – report of simulation results

Analysis and Report: Performing data analysis on measured data and simulations
Daily update (5 min run time) – report for plant operators with high level analytics

Numerous

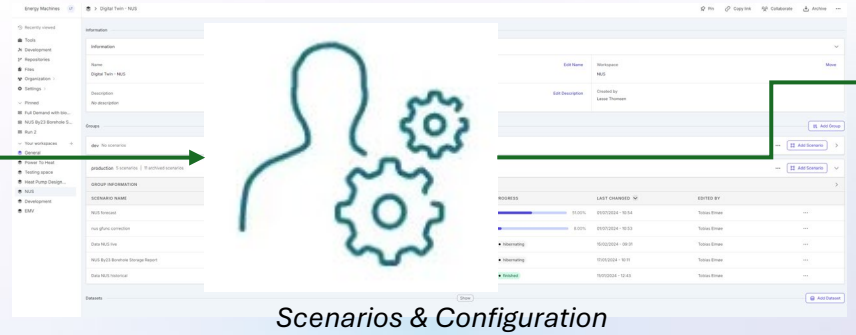

Energy Machines Digital Twins & Simulations Platform
Platform Features
Project Organizer
User Management
Compute
Scheduling
Timeseries DB
Files
App
Input Form
Job
python
Scenarios
Name + App
kubernetes
Google Cloud
docker
Energy Machines Cloud Controls & Monitoring
Report Embedding
Getting Data - REST API
Sending Data - MQTT API

Numerous

Algorithm Developer

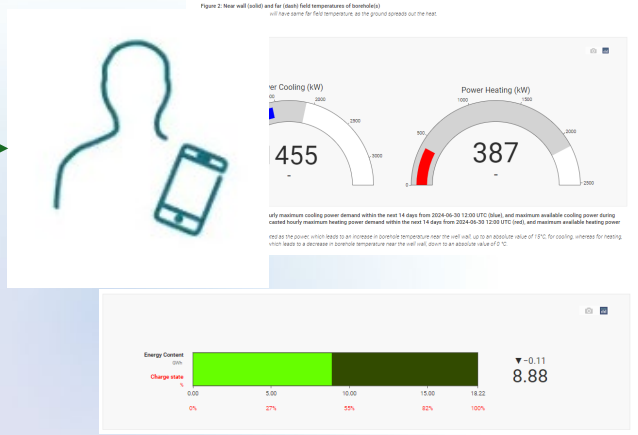
Apps & Jobs

Application Engineer



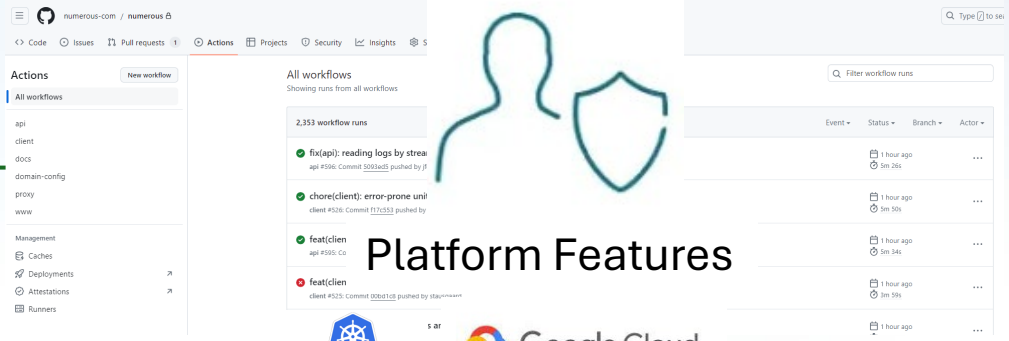
Scenarios & Configuration

Client



Report & Dashboard in Controls System

SW DevOps



Platform Features

kubernetes

Google Cloud

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Thank you for your attention!

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www.energymachines.com