EAGE

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GEOTHERMAL ENERGY CONFERENCE

DATA SHARING IN THE GEOTHERMAL SECTOR OPTIMIZING PLANT OPERATION AND MAINTENANCE

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MOTIVATION

- Geothermal plants have annual O&M costs ranging from 3% to 8% of CAPEX.
- Improved monitoring can provide timely information, making operators more proactive in O&M decisions.
- Potential savings include early detection of issues like clogging, material loss, and pump failures, reducing OPEX over the asset's lifetime.

Current Challenges

- Underutilized Data: Production data is not fully leveraged for optimization.
- Effort Required: Creating valuable information from raw data is challenging.
- Standardization Needed: Generic workflows reduce costs and facilitate data sharing.

OBJECTIVE AND EXPECTED RESULTS

Objectives:

- Enhance the operation and design of geothermal installations through better data utilization and acquisition.
- Calculate and benchmark Key Performance Indicators (KPIs) for geothermal plants, focusing on overall performance and critical components.
- Investigate and qualify options for improved data acquisition, providing an overview and assessment of monitoring options.

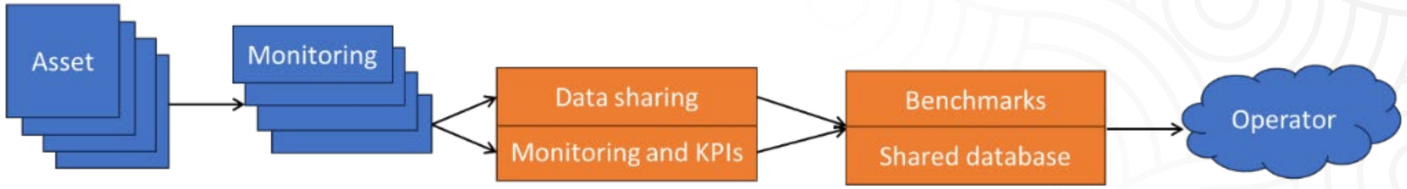
Expected Results:

- Standard templates for critical components and their key characteristics.
- Benchmark database for doublet performance and energy consumption.
- Shared database on equipment performance and failures for better decision-making.
- Overview and assessment of data acquisition and monitoring options.

APPROACH

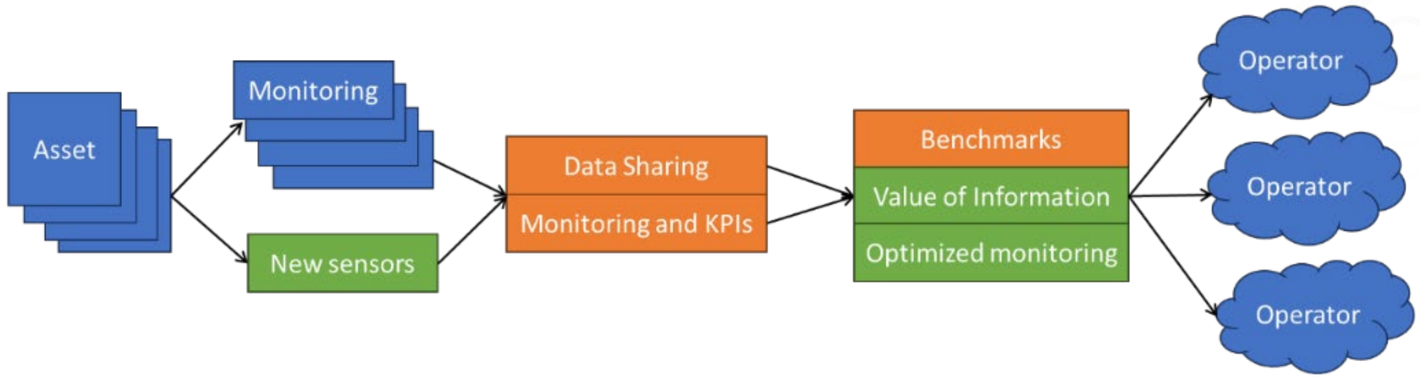
Existing Data

- Define KPIs for geothermal plants (available data).
- Standardized template for data collection
- A shared database on performance/ failure of equipment and components and NORM.



New Data

- Overview of monitoring options
- Improve the monitoring by installing new sensors
- Value of Information study



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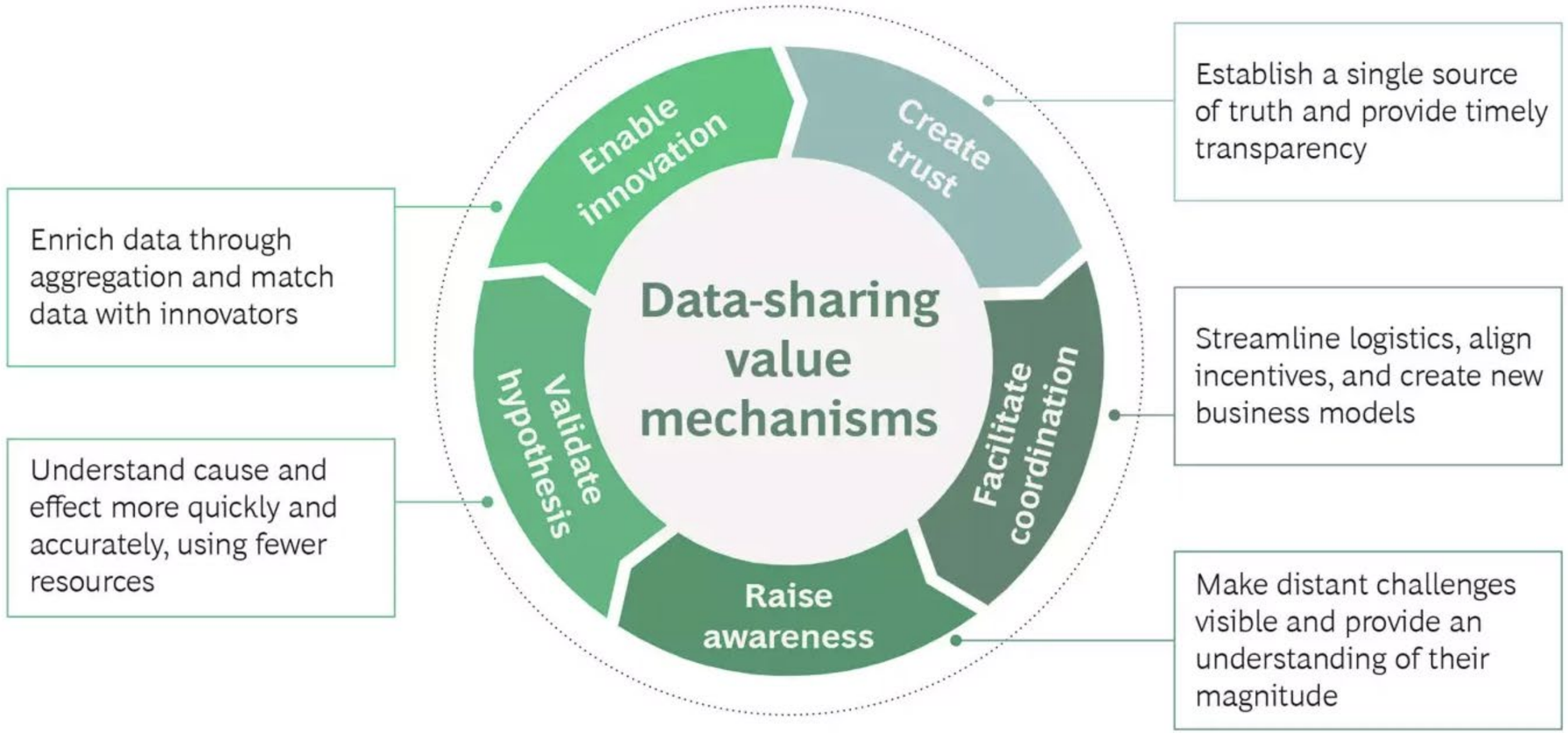
DATA SHARING: THE VALUE



Source: Sharing Data to Address Our Biggest Societal Challenges | BCG

DATA SHARING: THE MAIN CHALLENGES

Privacy
Who gets to access , view and/or use the data? To what extent ?

(Cyber)Security
How safe/protected is the data against potential breaches or leaks?

Ownership
Who is reponsible for the data? Who possesses the information?

Willingness to Share
Why should I share my data?!

Standards
How to deal with different data from various sensors/systems?
How to address inconsistencies in data accuracy and precision across sources?

DATA HANDLING

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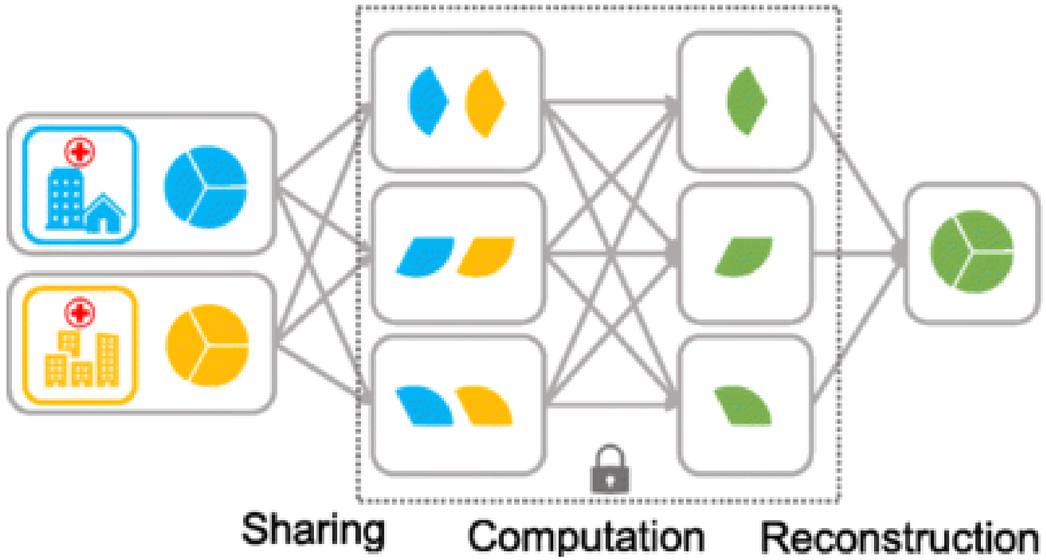
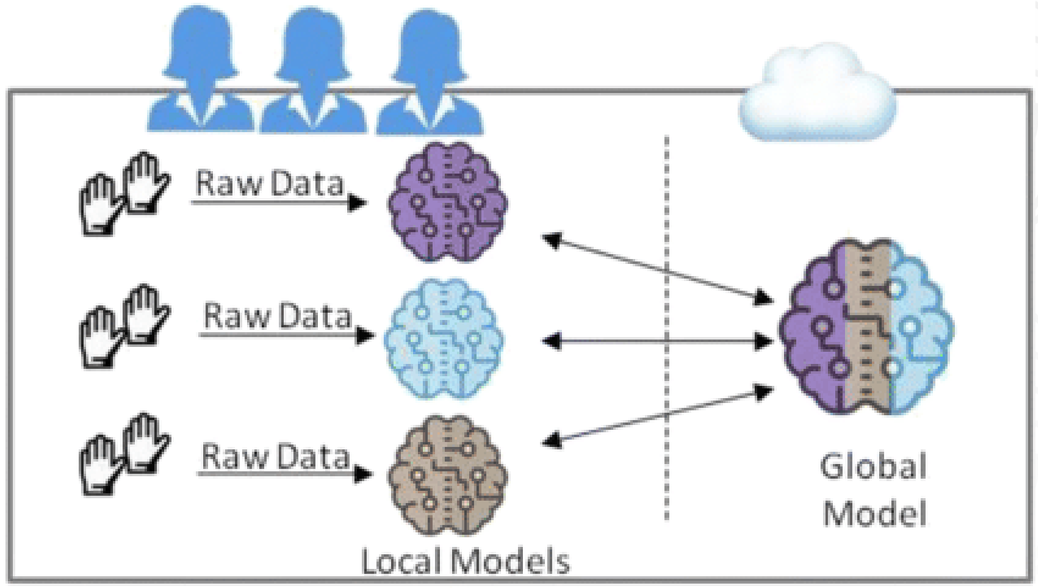
OVERVIEW OF DATA SHARING TECHNOLOGIES



Secure Multi-Party Computation (SMPC)

a cryptographic technique that enables multiple parties to perform a computation on their private inputs without revealing their inputs to each other



Federated learning (FL)

a decentralized technique that enables learning a secure global model from distributed data sets that should remain local, on nodes (data owners)

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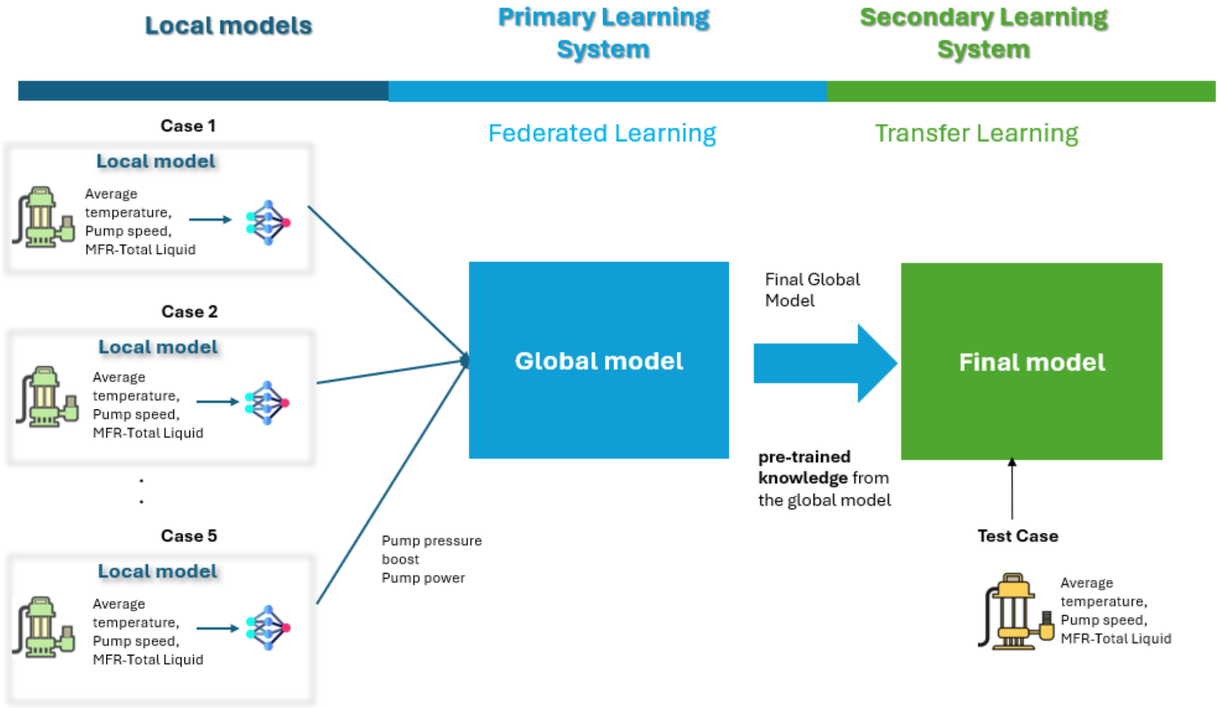
WHAT COULD DATA SHARING BRING?
A SYNTHETIC CASE STUDY

- Applied a data-sharing workflow (federated learning) on a synthetic geothermal dataset to explore its operational value.
- Demonstrated how shared data can support real-time monitoring and performance tracking in ESPs.
- Local models trained on data of single ESP, global model trained on the joint dataset (federated learning)



Shoeibi Omrani et al., 2025 (SPE 225497)

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WHAT COULD DATA SHARING BRING?
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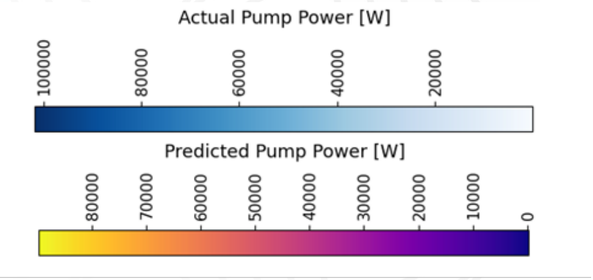
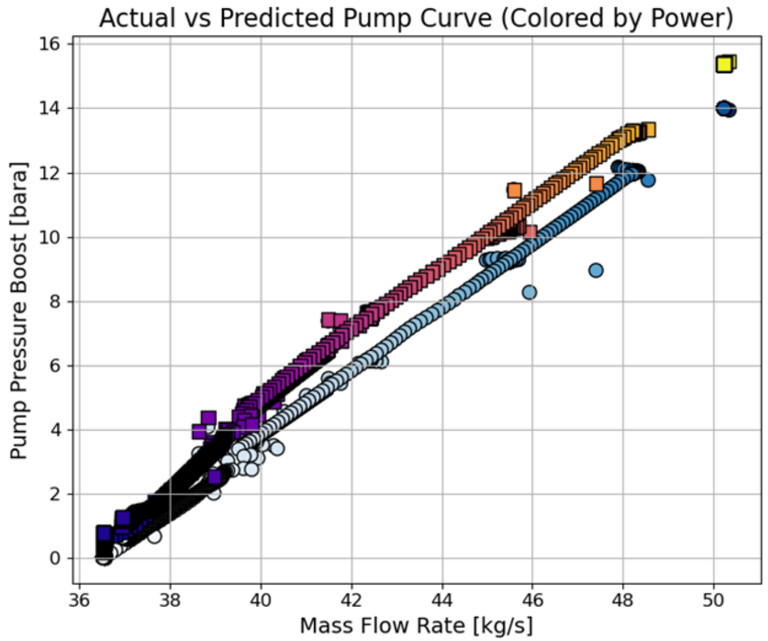


- Global model improved the monitoring of ESP performance by ~ 20.7%

  (in terms of pump curve estimation on the test well)

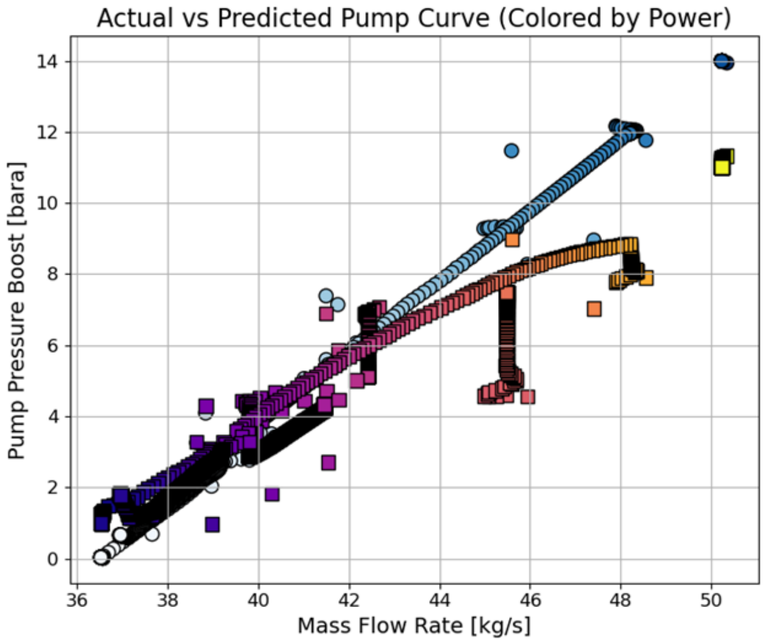
ESP X Trained on Well 1

Tested on Test Well



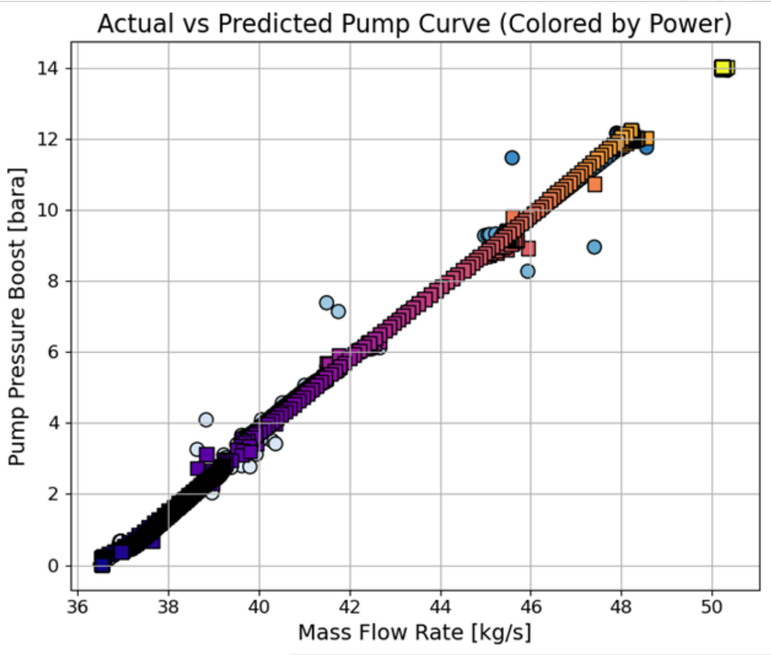
ESP X Trained on Well 2

Tested on Test Well



ESP X Trained with Federated learning

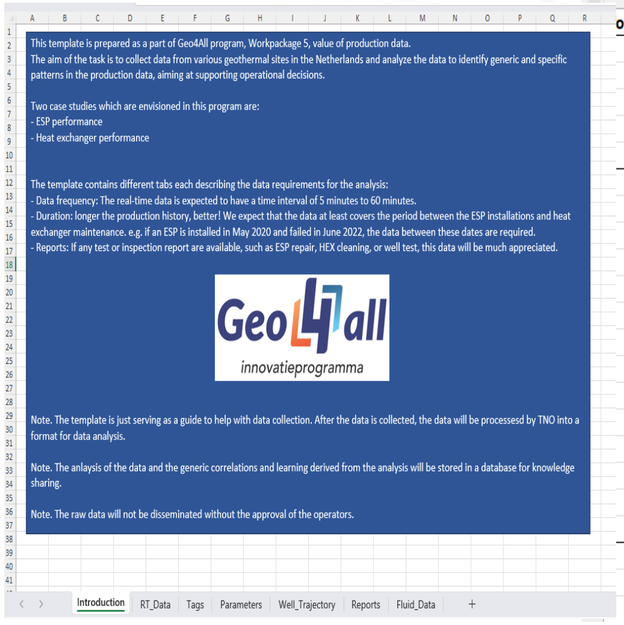
Tested on Test Well



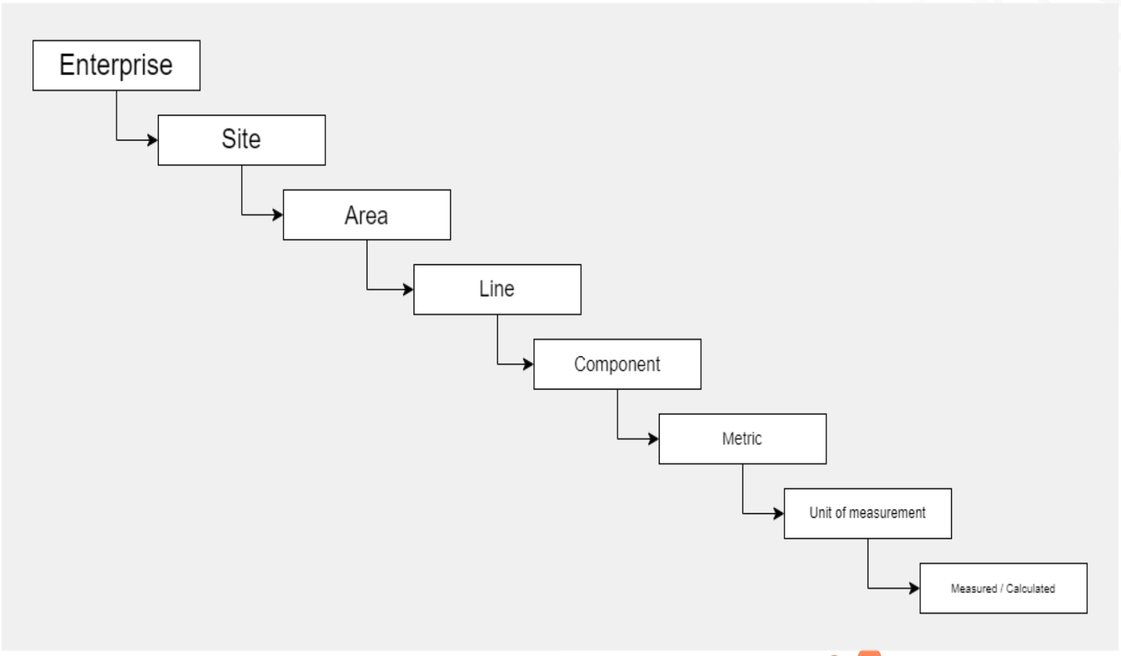
Shoeibi Omrani et al., 2025 (SPE 225497)

CURRENT STATUS

- Three case studies are selected:
  - ESP and pump performance monitoring
  - Heat exchanger performance
  - Naturally Occurring Radioactive materials (NORM)
- KPIs have been defined for geothermal assets & equipment: performance, reliability, and sustainability indicators
- Standardized template to define critical components and their key characteristics has been finalized
- Data gathered from 11 sites (more in progress)



omponents	Tag description	Tag name
Production Well	Wellhead pressure	GEOTHERMIE.G01.HPA.10.CP.030.MW
	Wellhead temperature	GEOTHERMIE.G01.HPA.10.CT.030.MW
	Flow rate	GEOTHERMIE.G01.HPA.10.CF.010.MW
	Downhole pressure	
	Downhole temperature	
ESP	Inlet pressure	GEOTHERMIE.YY1
	Inlet temperature	
	Flow rate	
	Outlet pressure	
	Outlet temperature	
	Motor temperature	
	Frequency	
	Voltage	
	Current	
	Pump head	
	Power Consumption	
	Vibration X direction	
	Vibration Y direction	
	Vibration Z direction	
Degasser	Pressure	GEOTHERMIE.XX1
	Level (%)	GEOTHERMIE.XX2
	Inlet liquid flow rate	GEOTHERMIE.XX3



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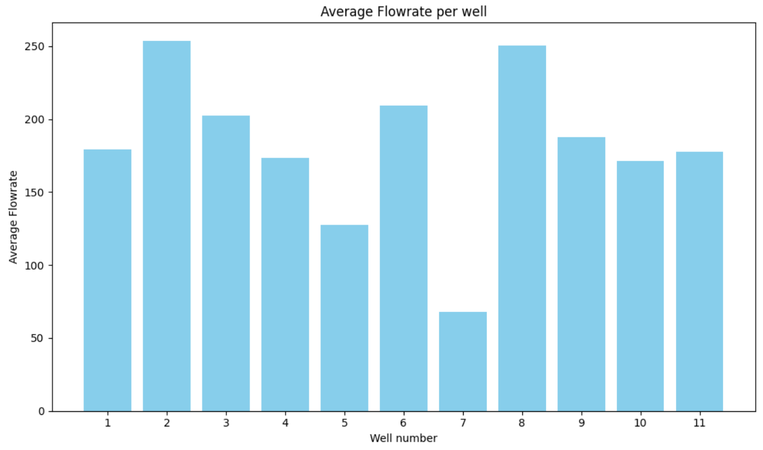
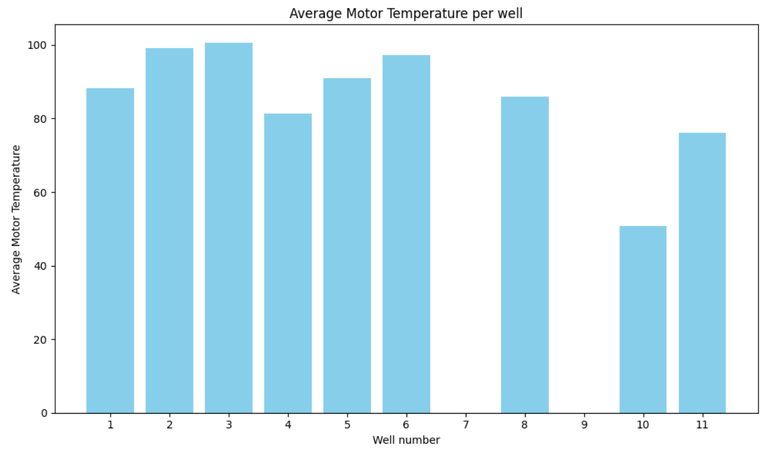
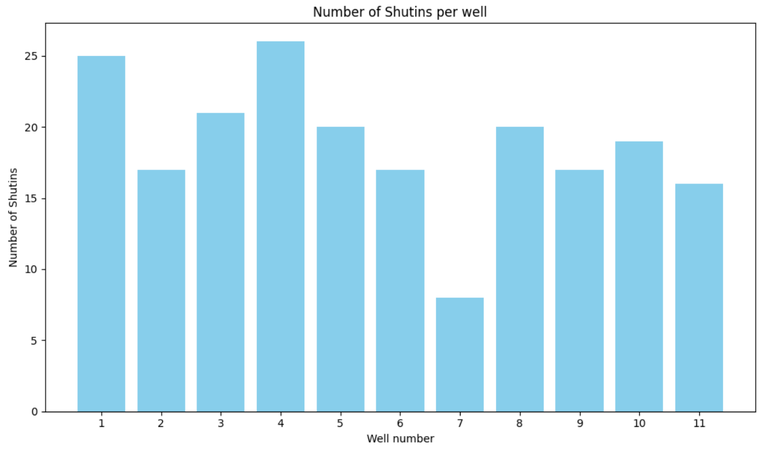
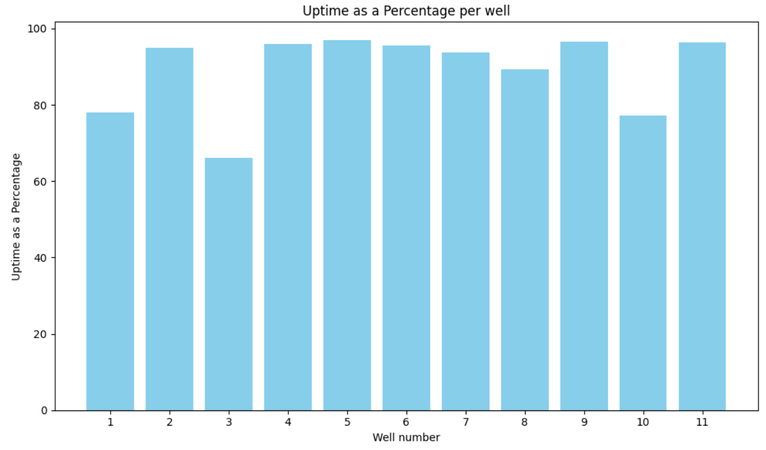
CURRENT STATUS

- Scripts are prepared to directly extract data from the database
- Mean, Max, Min and standard deviation of production history (flow rates, pressures, temperatures)
- Statistics of the ESP monitoring data
- Identify the ESP failure points
- Number of shut-ins, start-up
- Duration of the shut-ins/start-ups
- Change in the operation settings/pump settings

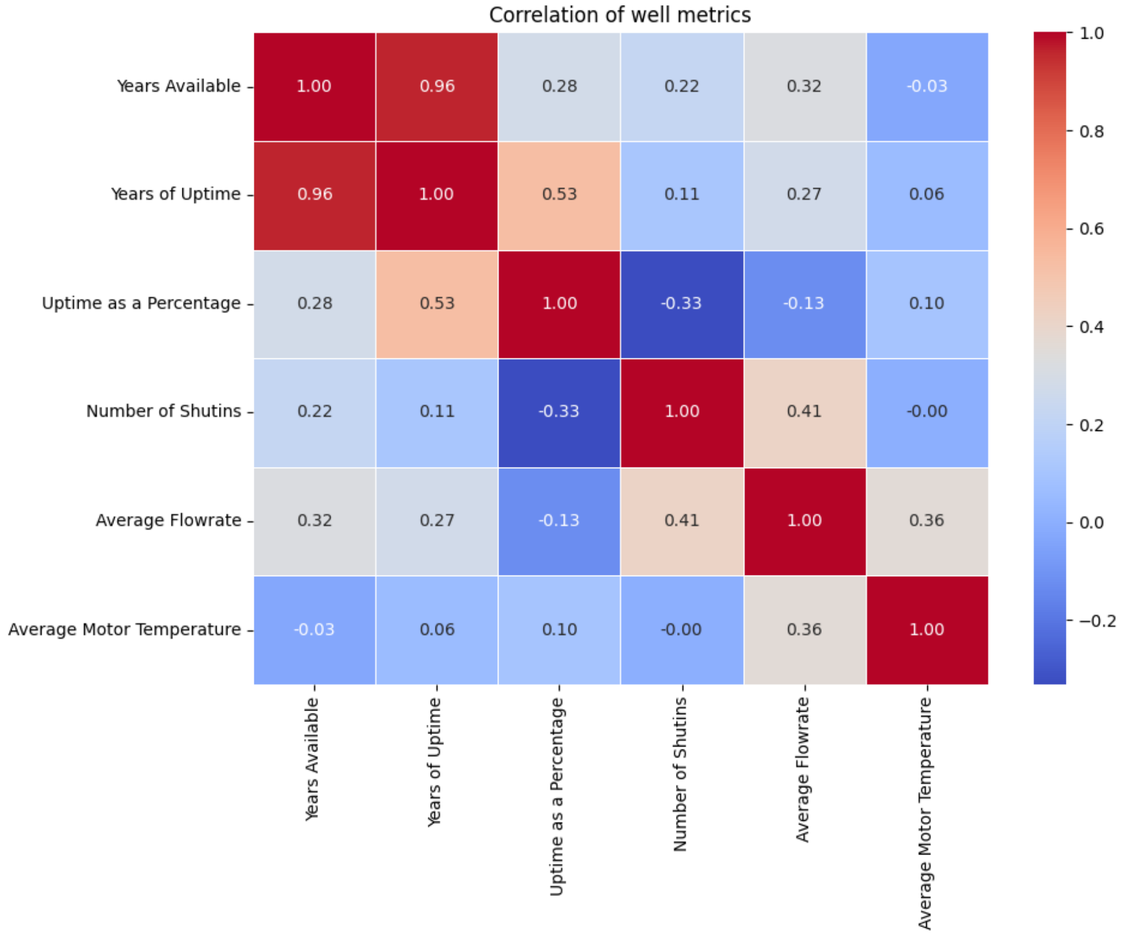


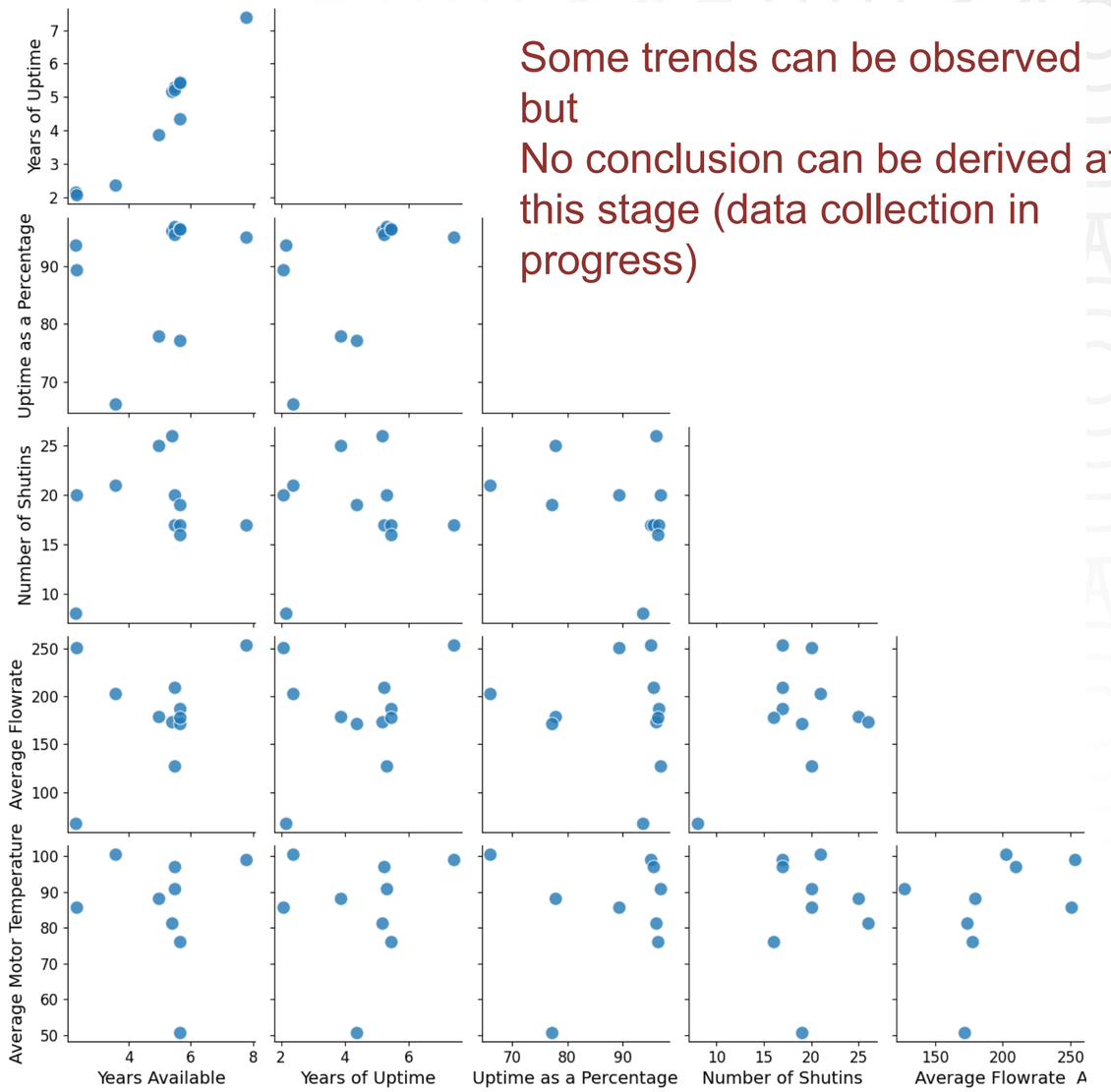






CURRENT STATUS





Some trends can be observed but
No conclusion can be derived at this stage (data collection in progress)

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SUMMARY AND NEXT STEPS

- Data sharing is a key enabler for smarter and connected geothermal operations.
- Even preliminary steps show how shared data can enhance operation and production efficiency.
- The added value for data sharing goes beyond the operation optimization.

Next steps

- Finalize the data collection and verification with operators
- Statistical and correlation analysis on the data and setting up the database

Thanks For Your Attention!

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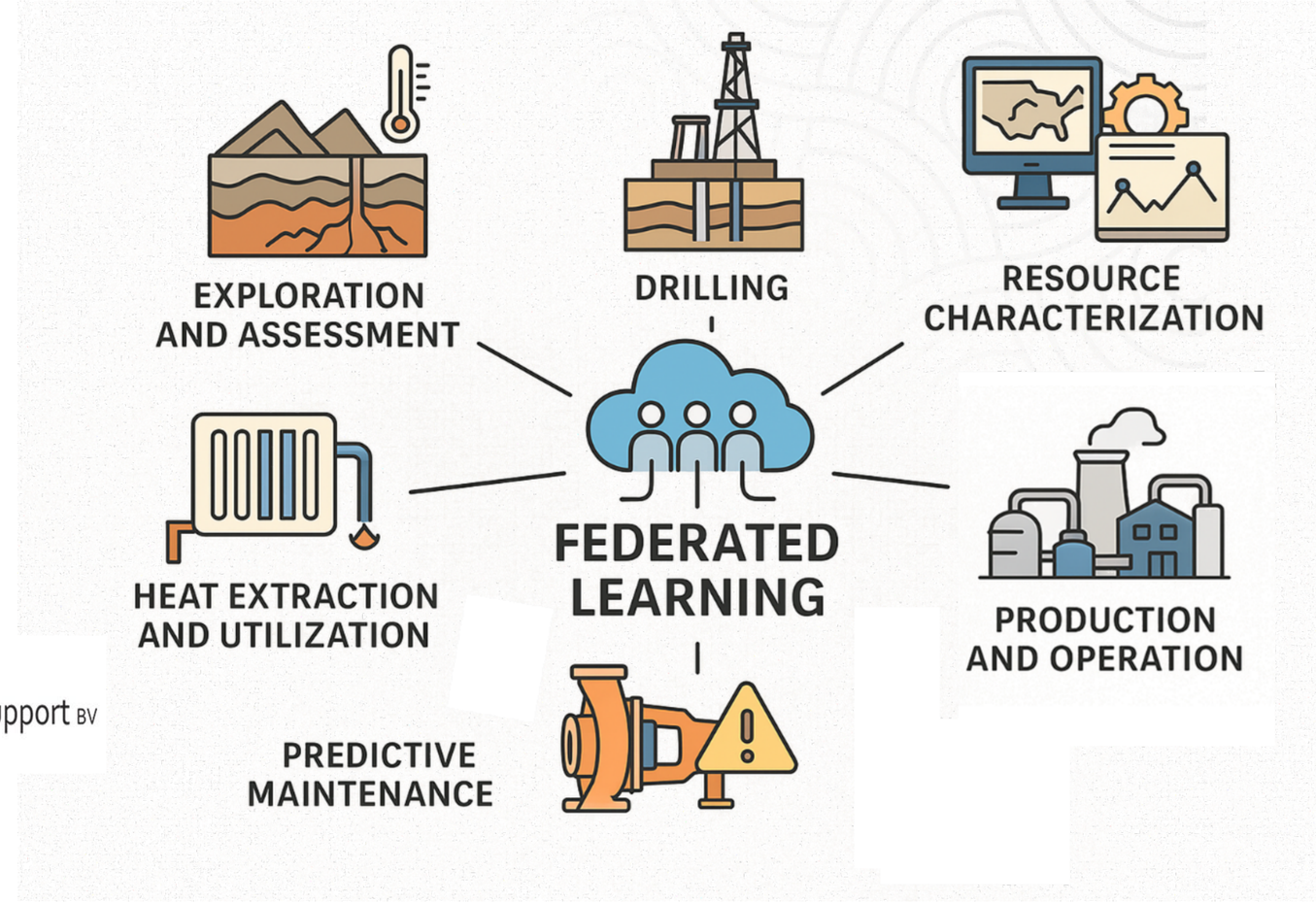

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