A new waste treatment technology for cleaner waters

PI System deployment to accelerate R&D on a pilot plant

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Developing world: a global sanitation and waste crisis

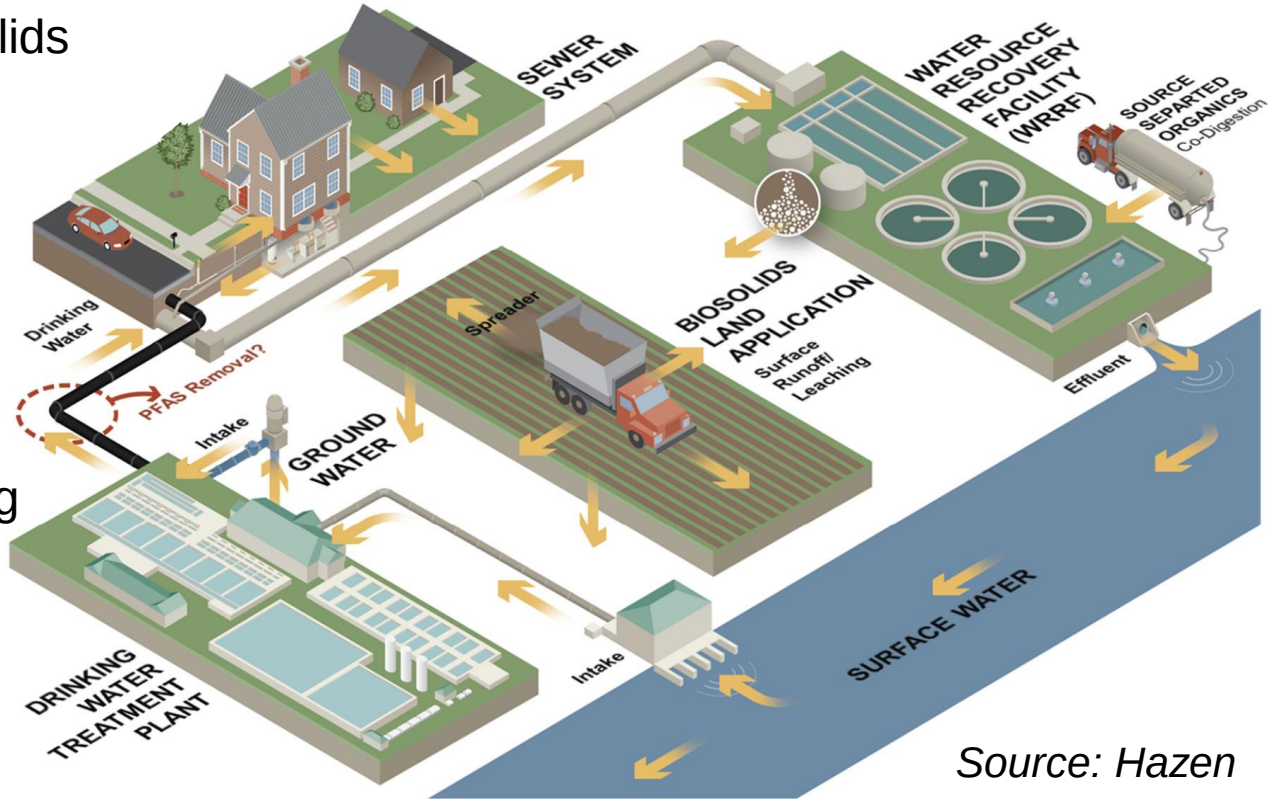
4.5 billion people lack access to safely managed sanitation

2nd leading cause of death of children under 5

90% of plastic polluting our oceans comes from just 10 rivers

Developed world: the threat of emerging contaminants

- WWTFs generate biosolids as by-product.
- Biosolids are generally land applied or landfilled.
- Non-biodegradable compounds accumulate in the environment, causing adverse health effects.



Source: Hazen

What do we do?

"We cannot solve our problems with the same thinking we used when we created them." Albert Einstein

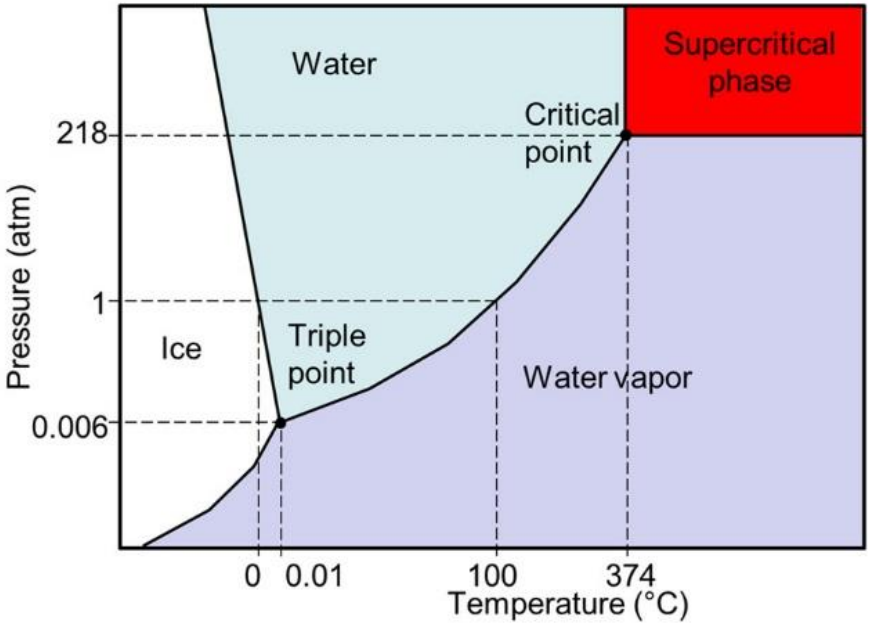
What if we had a superior waste treatment…

- … that could handle **sewage** sludge, **plastics, persistent contaminants** and **hazardous chemicals?**
- …that is suited for **decentralized** and **community-based** operations?
- …that allows for **by-products** and **energy valorization**?
- …that is very **compact**, containerized and suited for fast deployment?

SCWO is simple!

SCWO converts wet organic waste into clean water, heat, electricity and CO_2 in seconds!

Beyond the critical point… a new chemistry begins!



- Supercritical water has similar strength as acetone to dissolve organic compounds
- High concentration of free radicals makes it very reactive
- Oxygen is fully soluble in it

- **In supercritical water, hydrolysis and oxidation reactions are very fast!**

SCWO project at Duke University- Video

Outstanding benefits

► A fully functional prototype in a 20” container, with a capacity of **1 ton/day (fecal waste of ~1000 people/day)**

► The project started in 2013, funded by the **Gates Foundation** as part of the *Reinvent the Toilet* challenge

Primarily addresses 3 UN Sustainable Development Goals

- ✓ **Compact**
- ✓ **Complete elimination of pathogens and pollutants**
- ✓ **No odor and pollution**
- ✓ **Energy efficient, scalable**
- ✓ **Can co-treat hazardous waste**

Experience

Dewatered secondary sludge

Food waste

Waste activated sludge (WAS)

Primary sludge

- Isopropyl alcohol (IPA)
- Diesel
- Waste motor oil
- Vegetable oil, spent cooking oil
- Landfill leachate
- Plastic (PET, PE)
- FOG (Fat, Oil and Grease)
- Industrial wastewater (semiconductors)

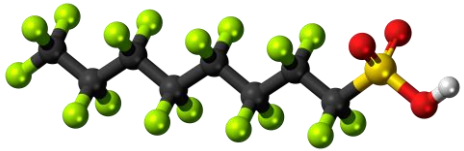
Typical removal efficiency

- Organics: 99-99.99%
- Total Nitrogen: 50-98%
- Total Phosphorus: 73-99%

Excellent treatment of persistent contaminants

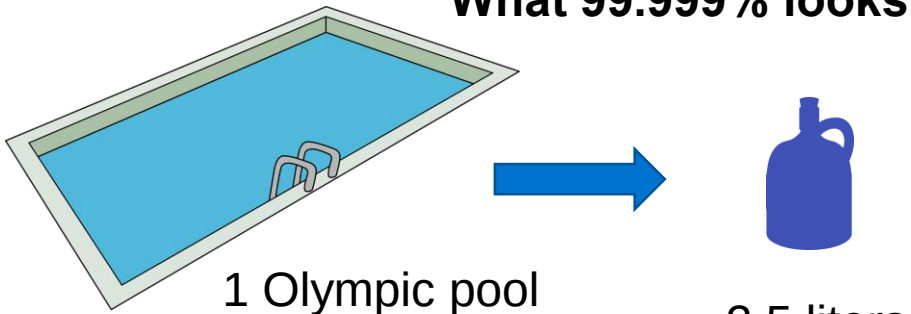
PFAS, aka “the forever chemicals”

Biosolids type	Primary sludge
Initial PFOS	748,000 ppt
Effluent PFOS	0.73 ppt
PFOS removal efficiency	**99.999%**
Total PFAS removal efficiency	**99.88%**



Perfluorooctanesulfonic acid (PFOS)

What 99.999% looks like.

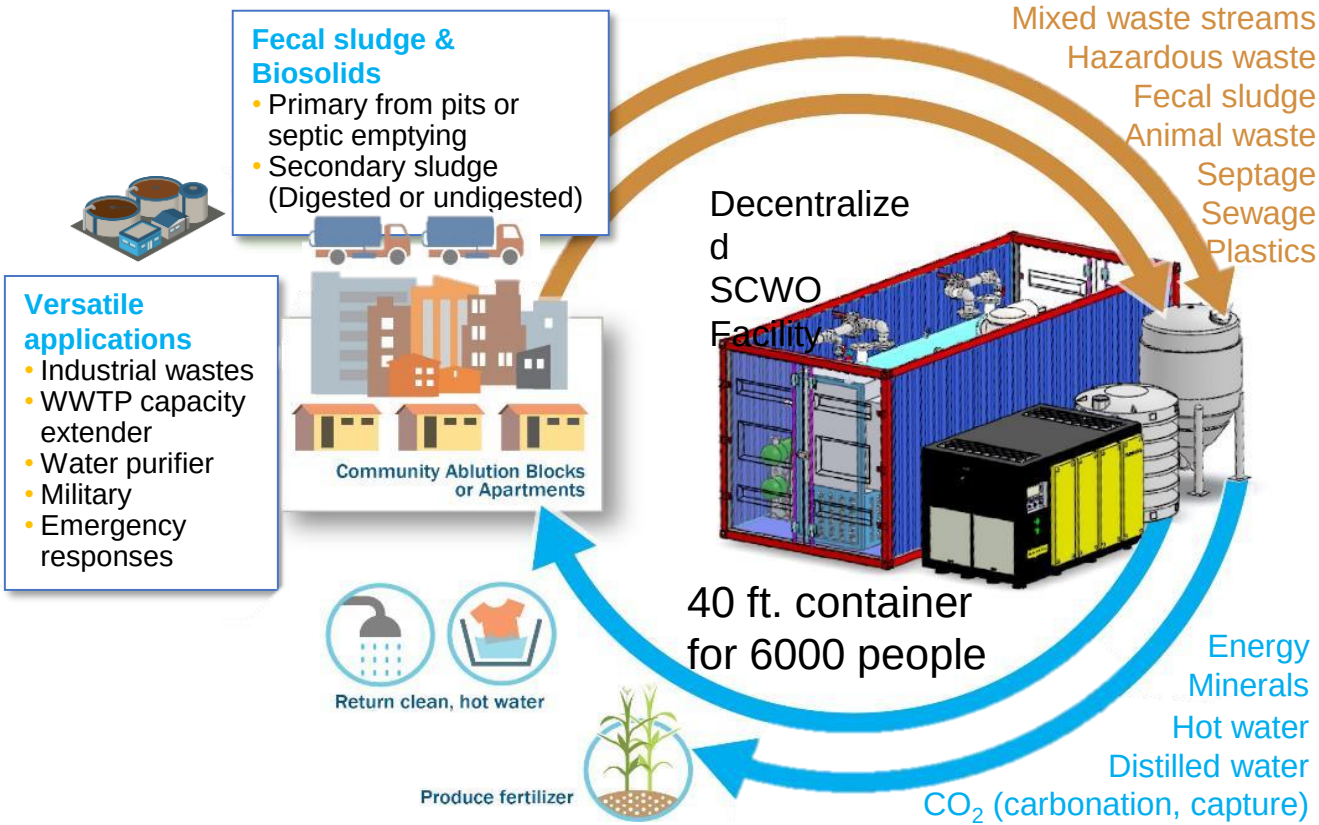


1 Olympic pool
660,000 gal

2.5 liters

- Superior treatment was also demonstrated with Ibuprofen, Acetaminophen and Triclosan (**> 99.9%** removal in all cases)

Medium term vision: decentralized superior treatment



History and feedback

- Contacted OSIsoft in **January 2019**.
- PI System was deployed by **April 2019**.
- Now in use for real-time process monitoring and post-run data analysis.
- The team loves the ease of use of PI Vision and PI Datalink.

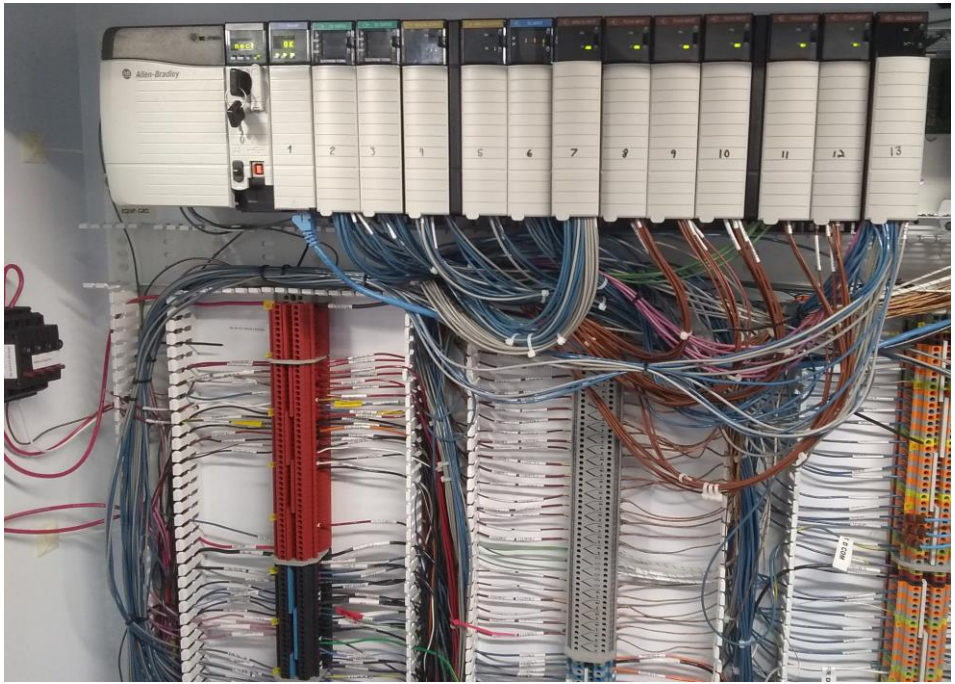
- **PI System makes the whole R&D process more efficient.**

Control and automation

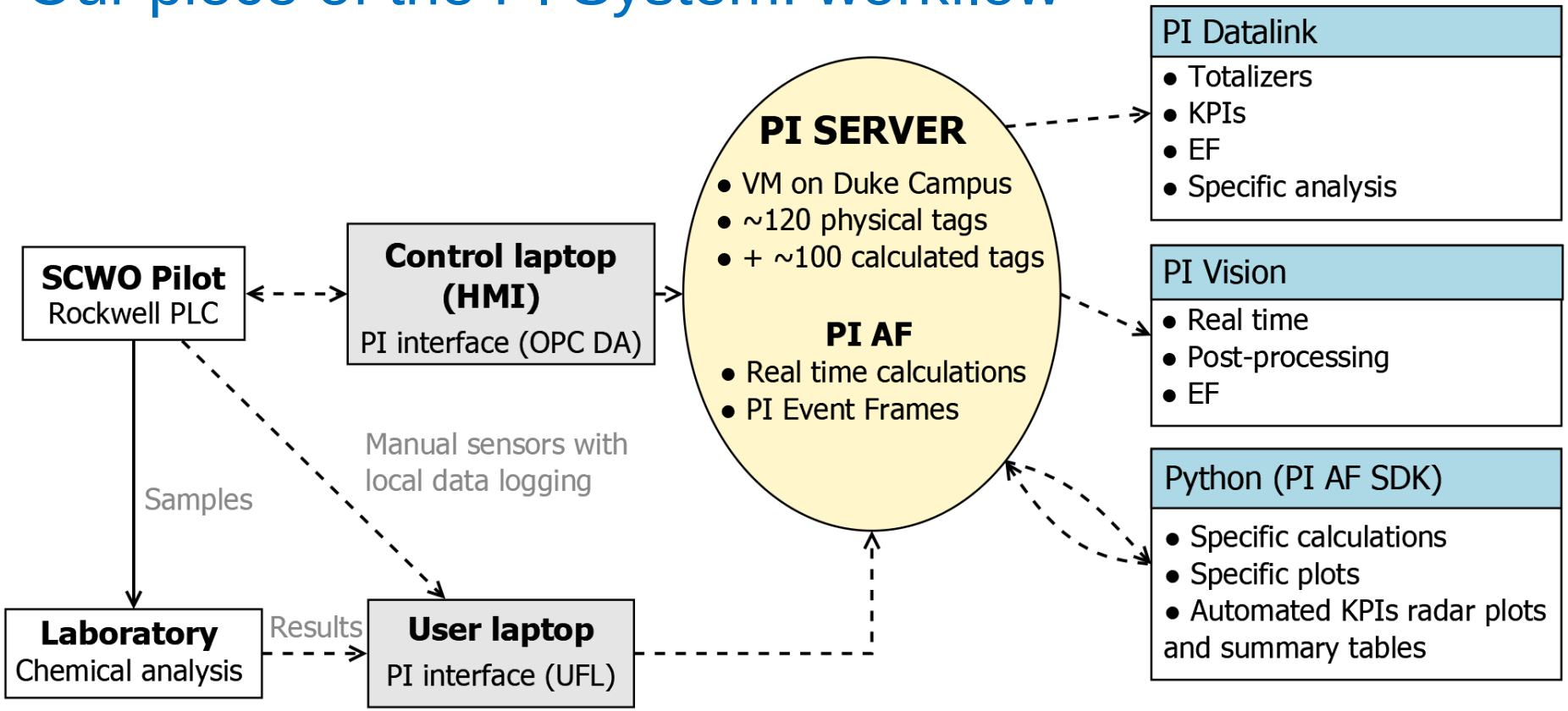
- **~120 physical tags**
  - Sensors (temperature, pressure, gas, levels)
  - Flowmeters
  - VFDs
  - Control valves and back pressure regulator
  - ON/OFF valves

- **Allen-Bradley PLC**

OPC DA interface with PI Server was swift to implement



Our piece of the PI System: workflow

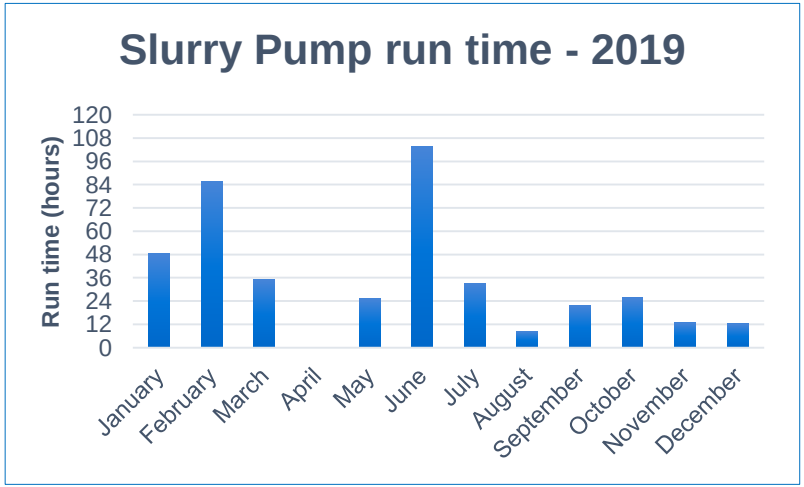


Dashboard for real-time and historical data visualization

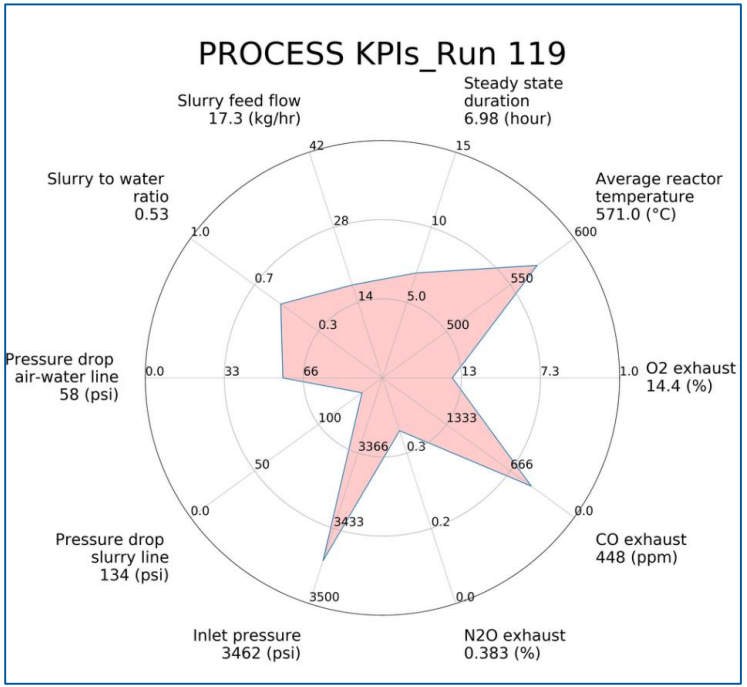
Chemical analysis: manually uploaded datasets

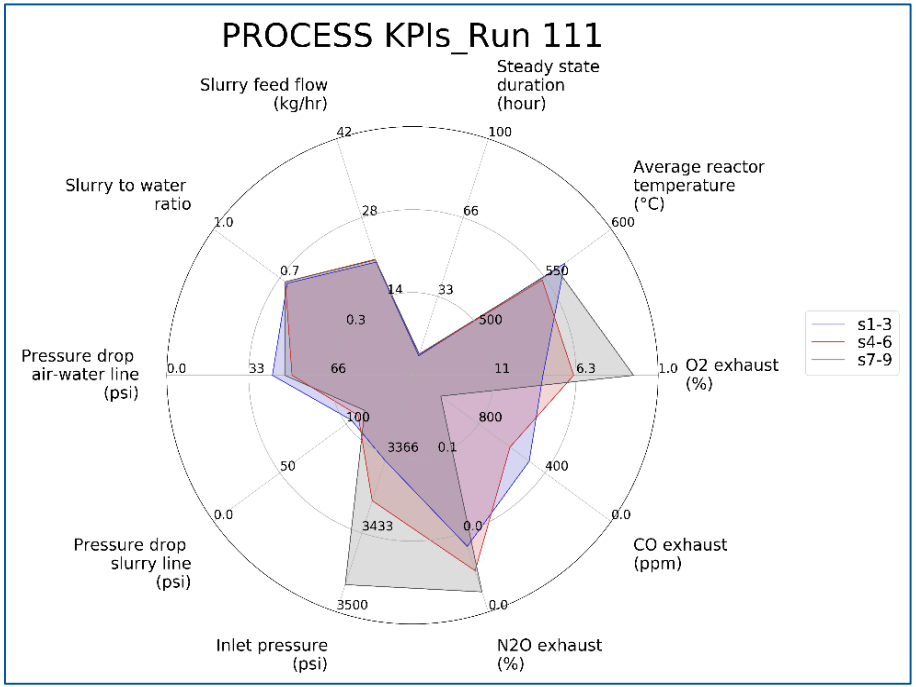
PI Event Frames: benchmark transient phases

- We use PI Event Frames to monitor transient phases
- PI Event Frames is also convenient to monitor equipment run time



KPIs: radar plots (PIthon & AF SDK)





Streamline data handling

CHALLENGES

- Process data was stored in csv files
- Data handling was manual and time consuming
- HMI did not allow for graphs display

SOLUTION

- Using PI System

BENEFITS

- SAVE TIME
- Complements the HMI
- Centralize and secure data storage
- Build up experience
- Automate data treatment

> We achieved major milestones in terms of process reliability, performances, understanding and know-how. The PI System was instrumental in this process.

Speaker contact

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Questions?

Please wait for
the **microphone**

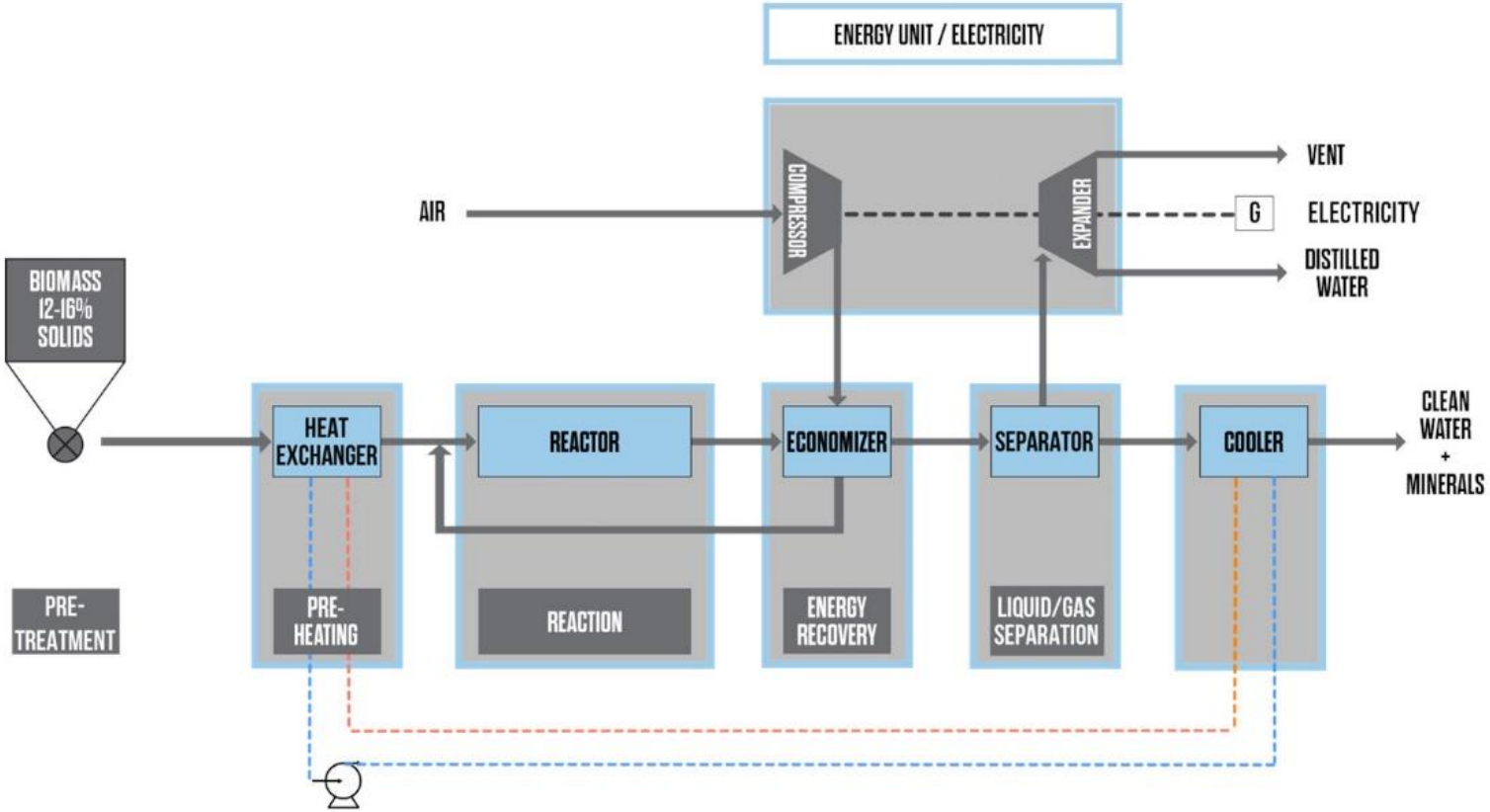
State your
name & company

Save the Date...

AMSTERDAM
October 26-29, 2020

OSIsoft.
PI World

A one step continuous process



Progress to date

2013

- Reactor design
- Electrical & control design
- Procurement

2014

- Operating & safety procedures
- Construction
- Commissioning

2015

- Liquids Testing
- Aspen Plus modeling
- Slurry handling

2016

- Solids testing
- New reactor design

2017

- Energy recovery investigation
- New slurry pump
- Prototype B design

2018-2019

- Reliability testing prototype A
- Commercial development

2020

- **Commercial development**
- Process optimization

374water