RESEARCH BRIEF
Start Date: Apr 4 2022 | Duration:24 months

NAWI National Alliance for Water Innovation

Process twins for Decision-Support and Dynamic Energy Cost Prediction in Water Reuse Processes

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Challenge

Advanced data analytics methods have the potential to dramatically improve water reuse operations and reduce cost through modeling and optimization. However, there are challenges, including:

1. Data sparsity: water reuse facilities rarely have complete, accurate, and high-resolution data sets, including outlier events, that are needed for modeling and optimization;

2. Sensor issues: Sensors may be placed and maintained based on convenience, not for optimization, and can foul over time, leading to drift and inaccurate readings and;

3. Transferability: reuse facilities are influent- and site-specific, thus an algorithm learned for one facility may not transfer to another.

Research Approach

This project seeks to address the challenges of data sparsity, sensor issues, and transferability by 1) developing a hybrid model comprised of a digital twin and a physical twin that simulate an existing water reuse process, and 2) optimize this hybrid model to minimize power consumption. To this end, a digital twin - which is a computer-based model that is integrated with the hardware, using existing data from sensors - will be used to simulate a selected set of "What-If" scenarios. Because the datasets that inform the digital twin are limited and do not include rare, but possible, outlier events, the physical twin (a small-scale treatment unit/process that is a scaled down analogous to the full-scale system) will be used to generate datasets that fill in these gaps. Data collected through this physical twin will be used to (i) update the digital twin, (ii) test and validate recommended actions prior to full-scale implementation on a real-world system and, (iii) deliberately introduce rare events for model updating.

RESEARCH PARTNERS

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Impact

Successful completion of this project will demonstrate that digital twins, when validated by representative physical twins, can enhance process and energy modeling capabilities for full-scale facilities. Furthermore, this hybrid approach may be the key to enabling trust in digital twin technology for online decision-support, especially for remote or unstaffed operations or foreseeing unusual power events (e.g., brownouts or blackouts), leading to improved resiliency.

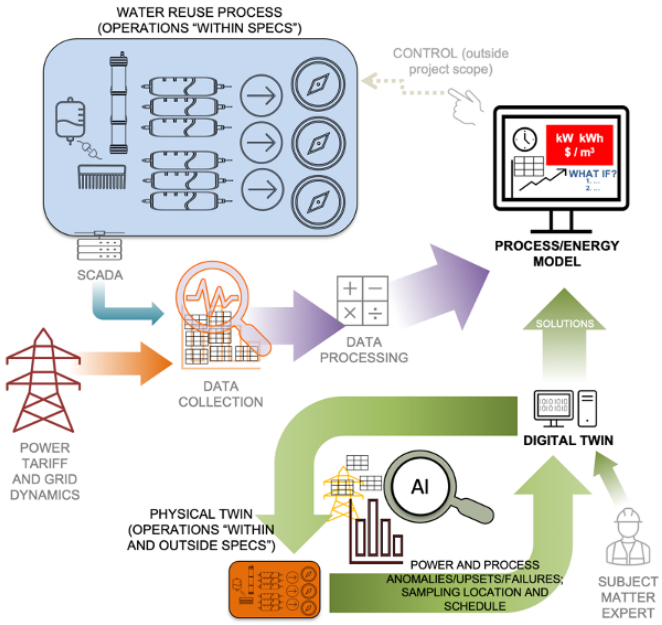

Figure 1. Illustration of the concept of digital + physical twins applied to a water reuse process.

REFERENCES

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This work was supported by the National Alliance for Water Innovation (NAWI), funded by the U.S. Department of Energy, Energy Efficiency and Renewable Energy Office, Advanced Manufacturing Office.

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