Multi-Period Models for Dynamically Operating Water Treatment

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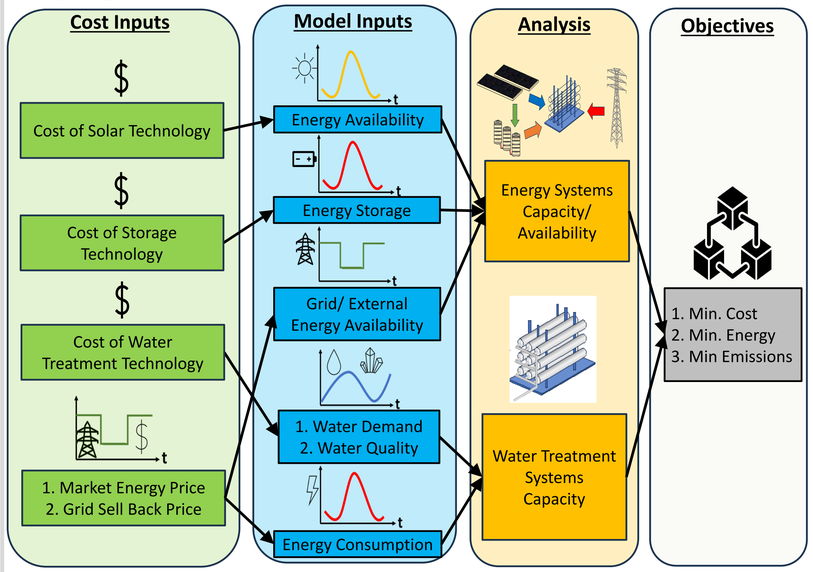
Motivation

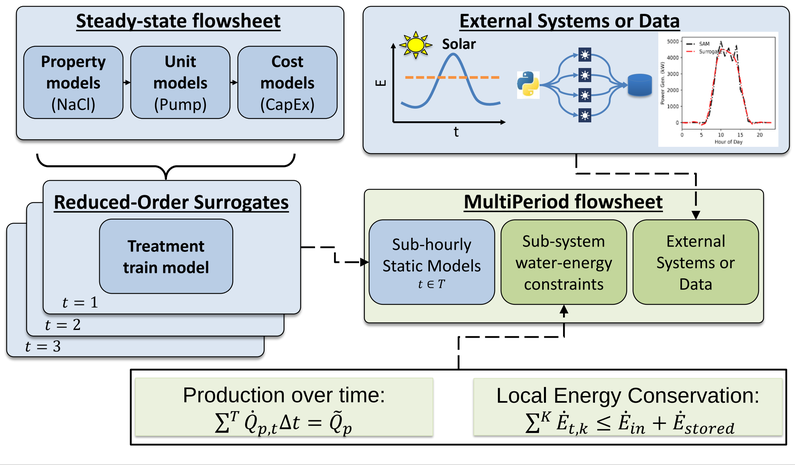
Water systems are constrained by multiscale, time-varying factors, modeled by non-linear dynamics



Multi-period modeling can simplify dynamic optimization problems and use existing steady-state models.

Multi-period Model Strategy

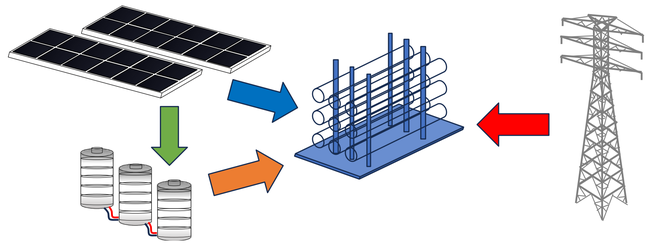
Links expressive, non-linear steady-state models over time with rate limiting constraints.

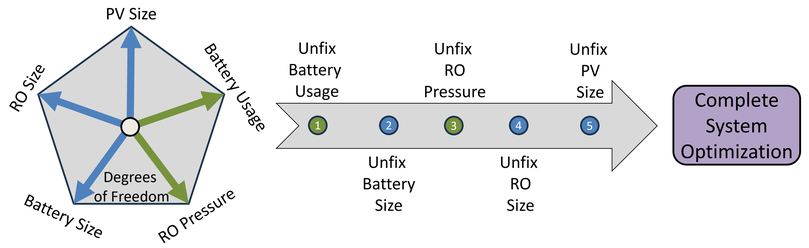


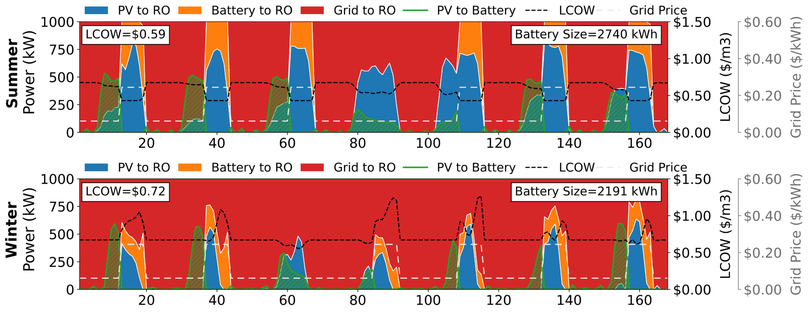
System-level Energy Management: Response to Changes In PV Gen. and Grid Prices

Multiperiod PV-RO-Battery Desalination System

- Multiperiod analysis on how desalination systems can respond to time-varying external inputs
- Includes energy management of the desalination system with energy flow optimization





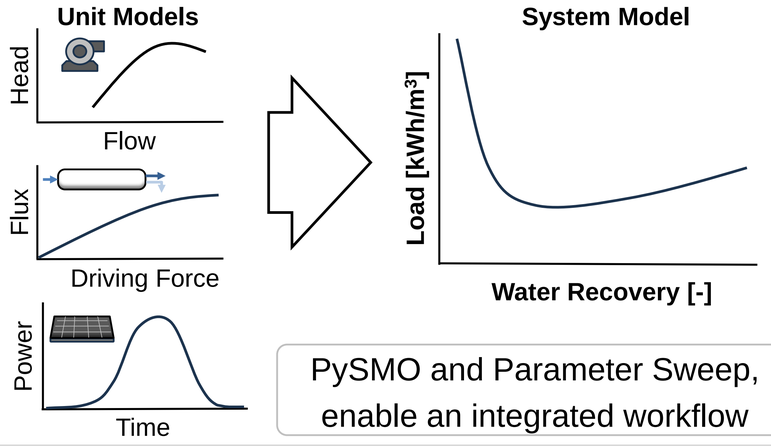


Key Findings:

- Battery charging is prioritized early in the day during reduced grid prices ($/kWh)
- PV + Battery (off-grid) operation during the hours of higher grid prices
- Days without higher grid prices prioritize charging batteries for future use

Reduced Order Surrogates

Surrogates condense system-wide non-linearities for tractable optimization over long time-horizons



PySMO and Parameter Sweep, enable an integrated workflow

Remarks and Future Work

- Technologies from several DOE-funded projects were used to achieve multi-period modeling (WaterTAP, DISPATCHES, SAM)

Future Work

- Model flexible desalination systems with shutdown
- Compare PV-RO with solar thermal desalination systems
- Consider various electricity price scenarios

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