

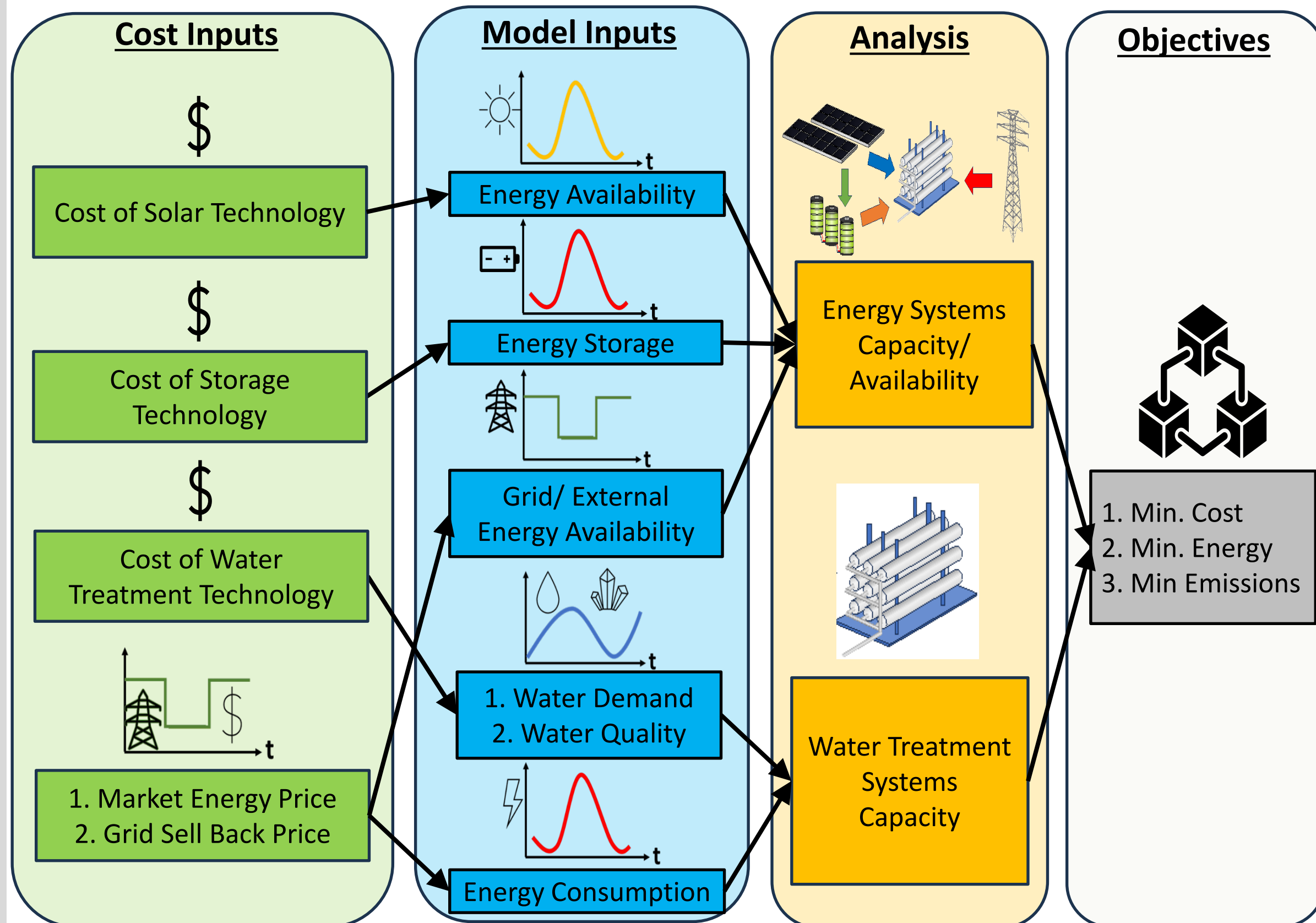


Multi-Period Modeling for Solar Thermal Driven Water Treatment

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Motivation

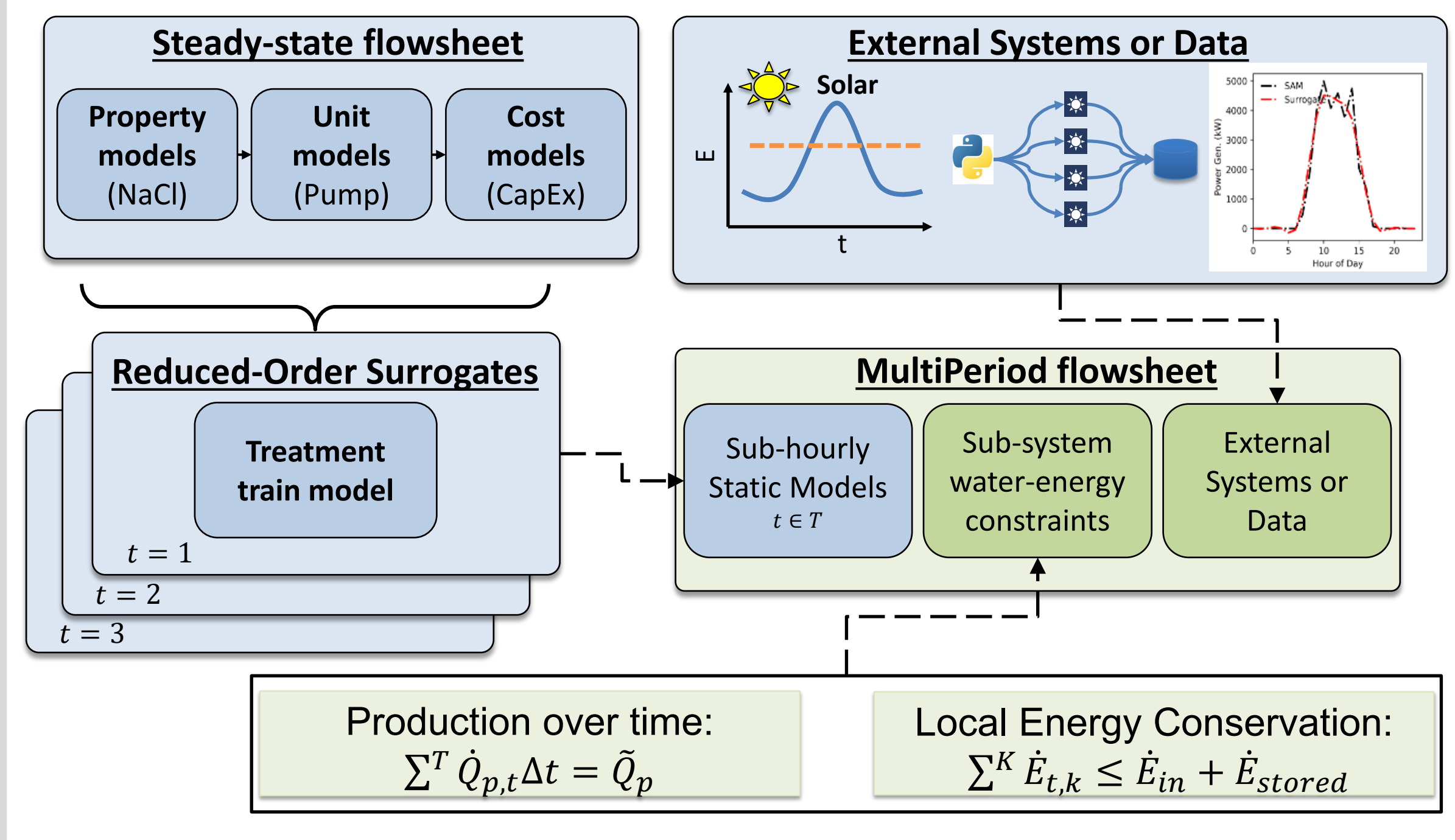
Water systems are constrained by multiscale, time-varying factors, modeled by non-linear dynamics



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

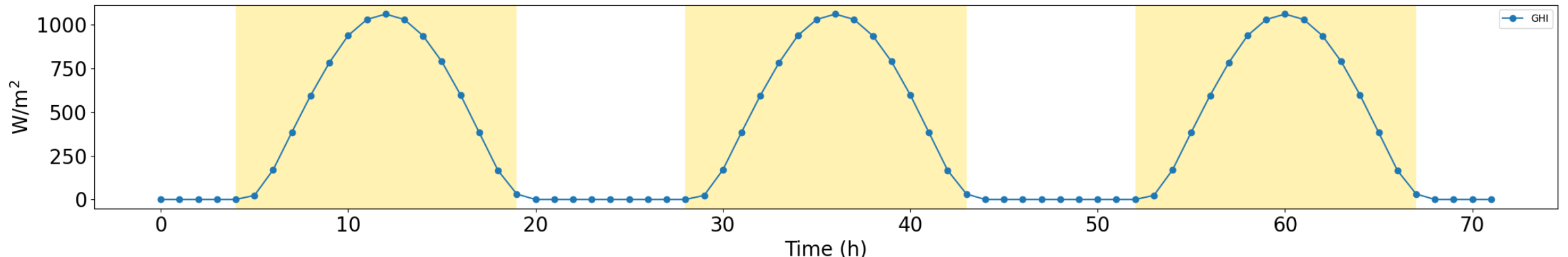
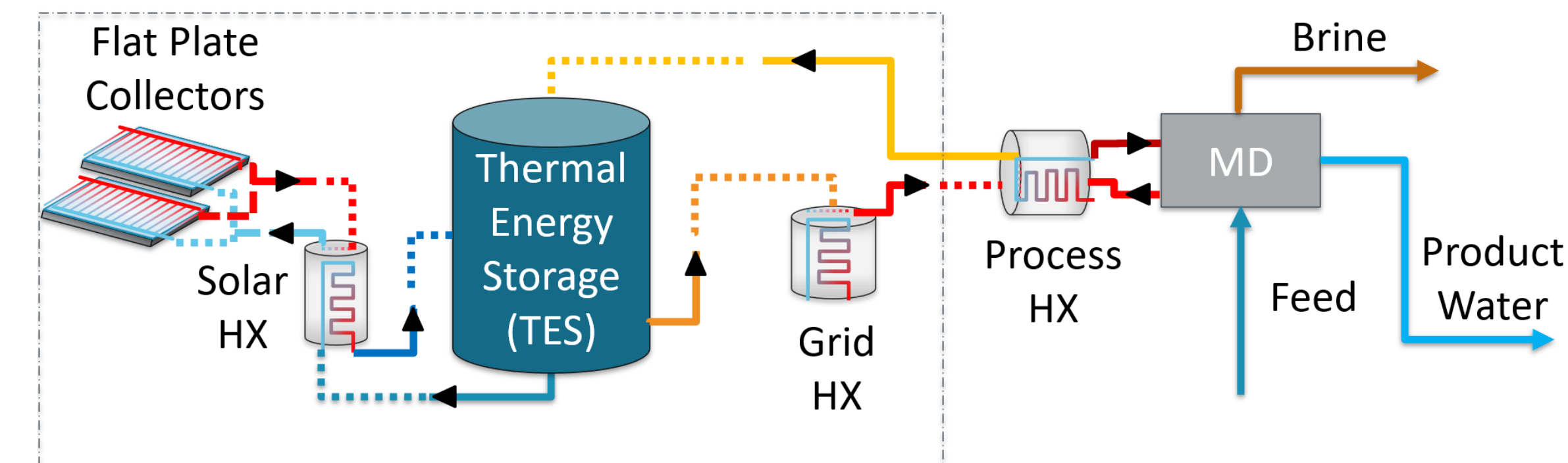
Multi-period Model Strategy

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

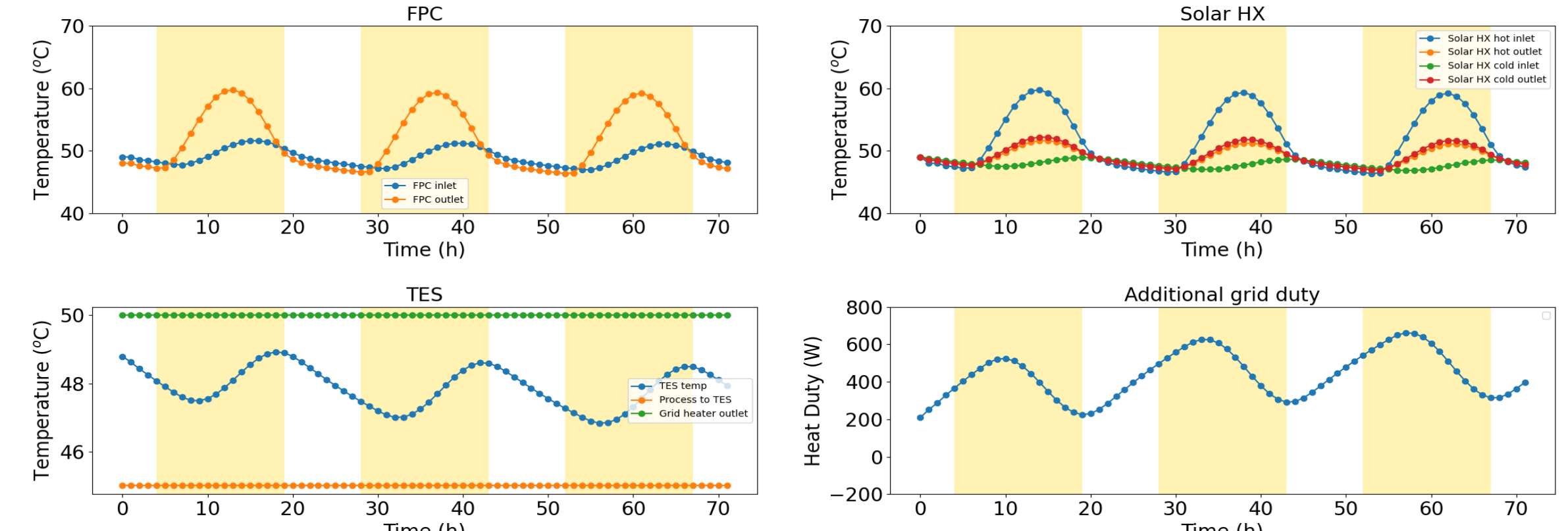


Multiperiod FPC-TES System

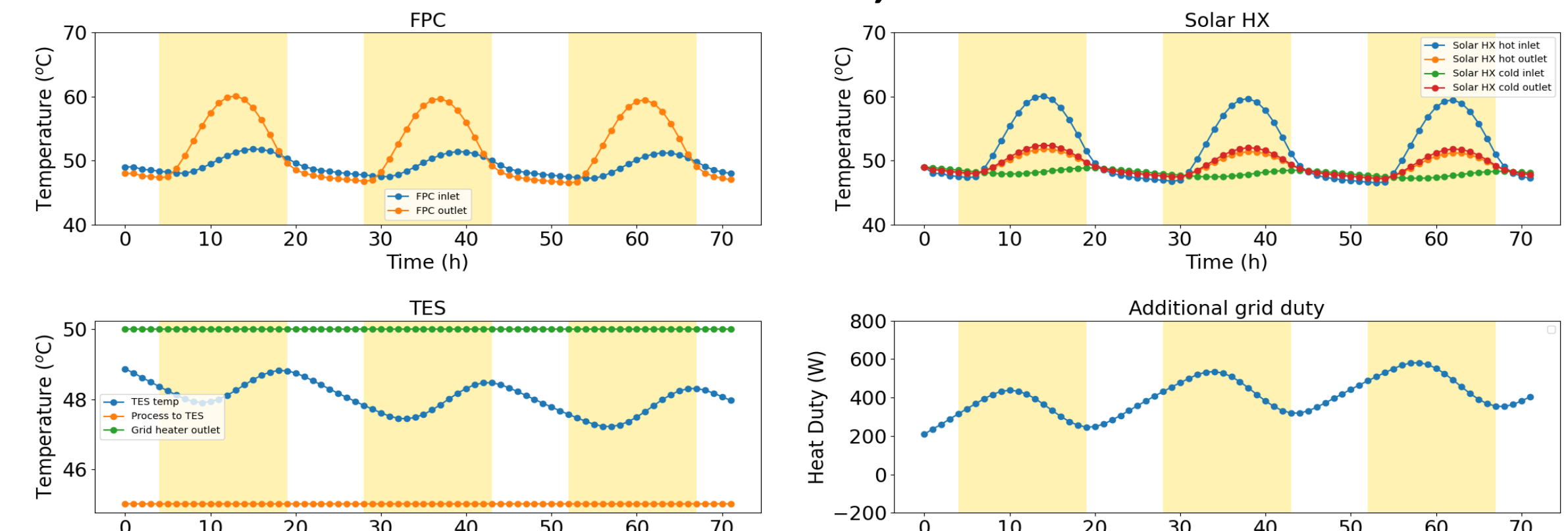
Multiperiod analysis on flat-plate collector (FPC) and thermal energy storage (TES) interaction with desalination systems responding to time-varying external inputs



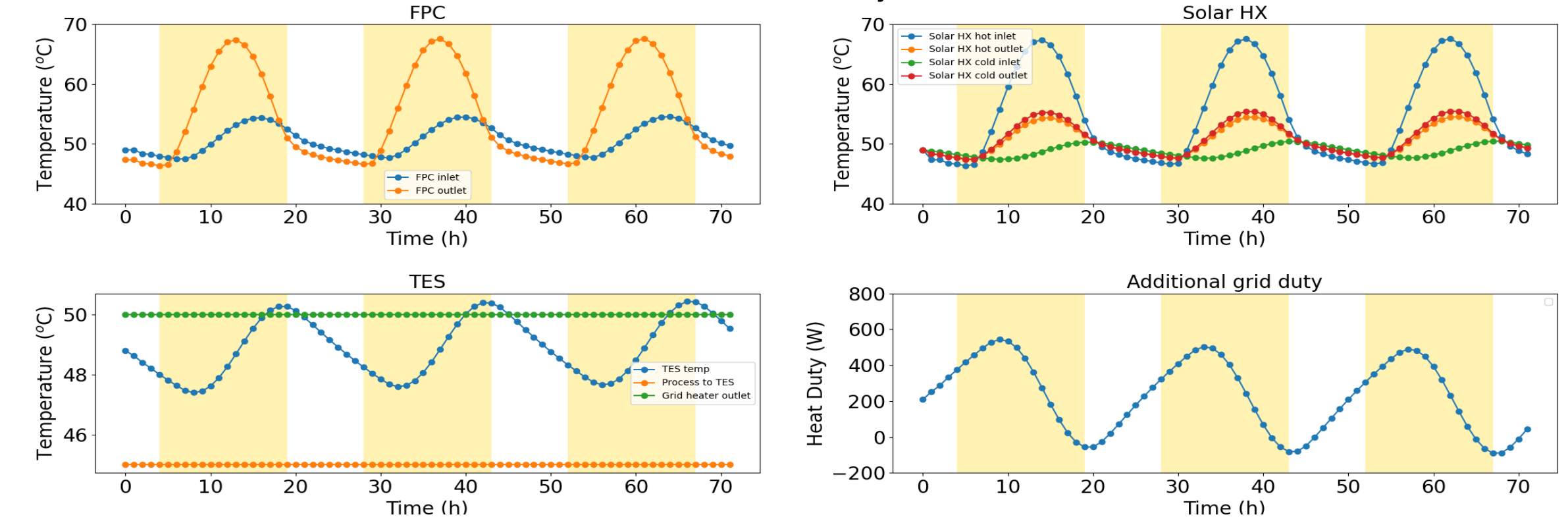
Case 1: FPC = 3 m², TES = 3 m³



Case 2: FPC = 3 m², TES = 5 m³

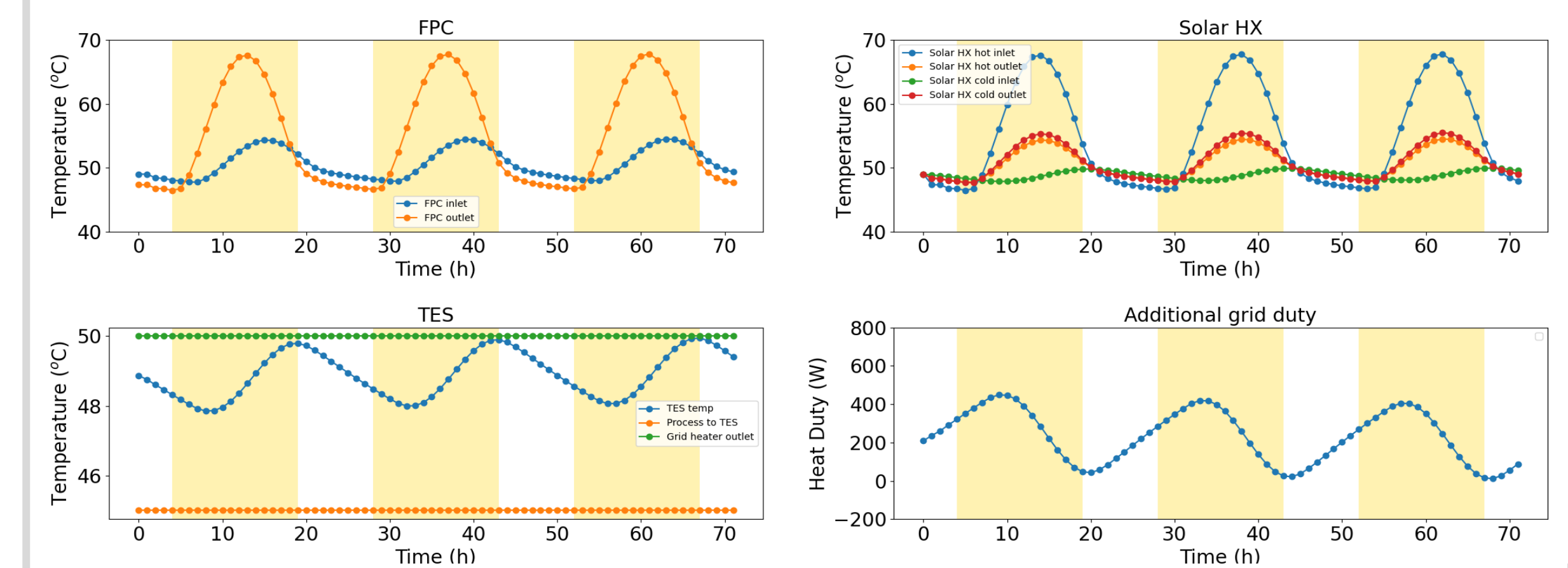


Case 3: FPC = 5 m², TES = 3 m³



Key Findings

Case 4: FPC = 5 m², TES = 5 m³



- A large TES tank decreases temperature oscillations
- FPC area should be a function of process heat required
- Negative heat duty implies a bypass line is required
- FPC area and TES can be optimized to minimize grid heat duty and minimize temperature oscillations

Remarks and Future Work

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



Future Work

- Model validation
- Optimize TES and FPC area to minimize LCOW and or grid energy consumption
- Include control logic with splitters and mixers to eliminate negative heat duty
- Simulate flow sheet with time-varying water treatment system demand/operation

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This material is based upon work supported by (i) the National Alliance for Water Innovation (NAWI), funded by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE), Industrial Efficiency & Decarbonization Office (IEDO), under Funding Opportunity Announcement Number DE-FOA-0001905 and (ii) the Solar Energy Technology Office (SETO), under Contract No. DE-AC36-08GO28308. **Disclaimer:** This presentation was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.