Concepts and Uses:

Distributed and Decentralized Microgrid Control

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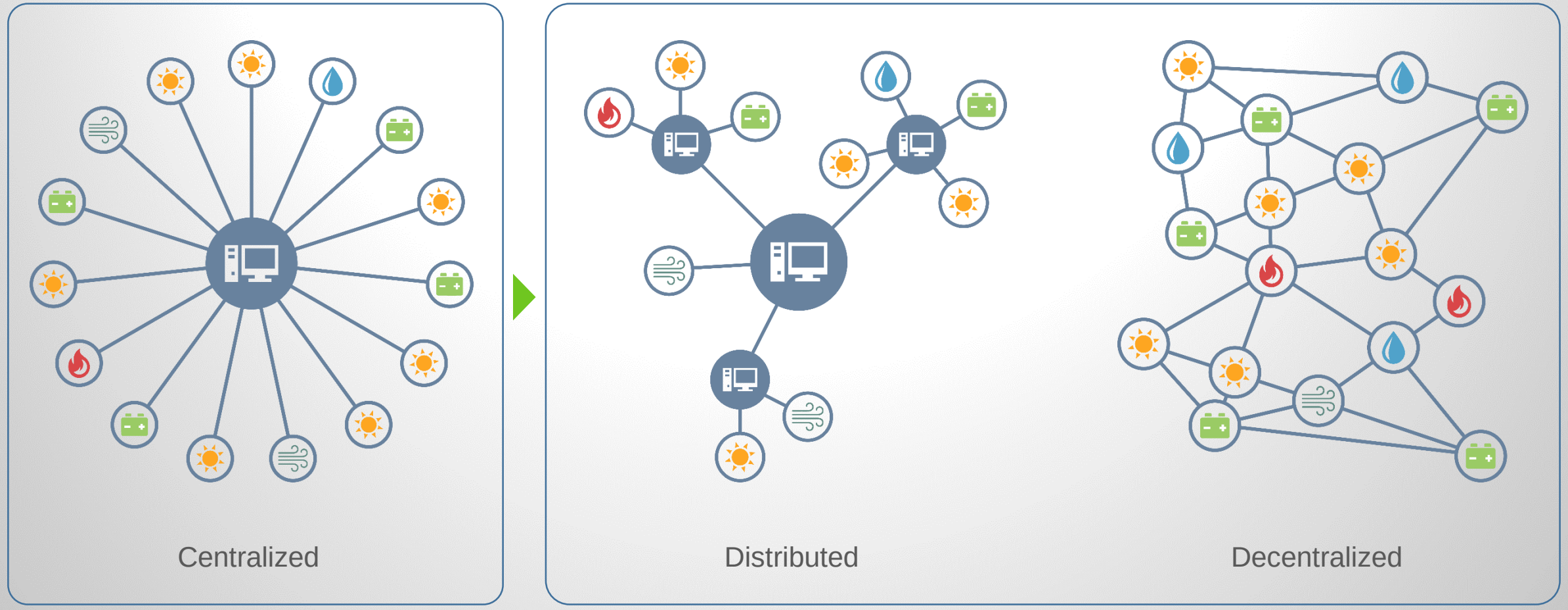
Distributed and decentralized control and optimization present a new paradigm of energy management



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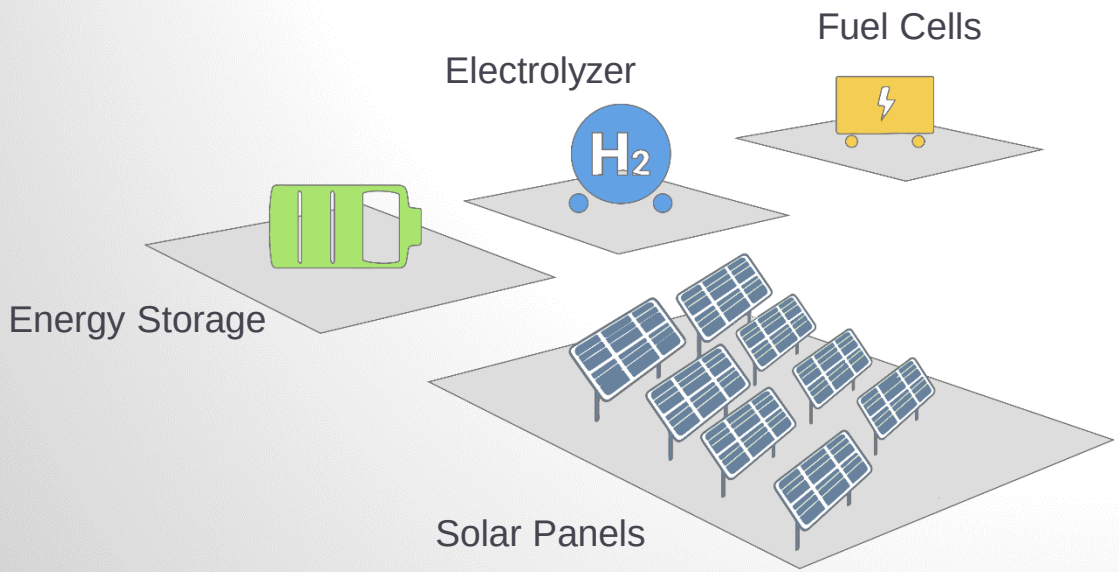
A Microgrid is a collection of disparate energy resources…

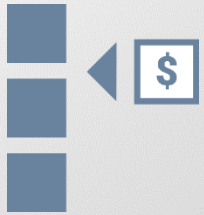


…that were not designed to work together

Challenges

Non-Standardized Ecosystem

Complex Systems



Rigid Structure

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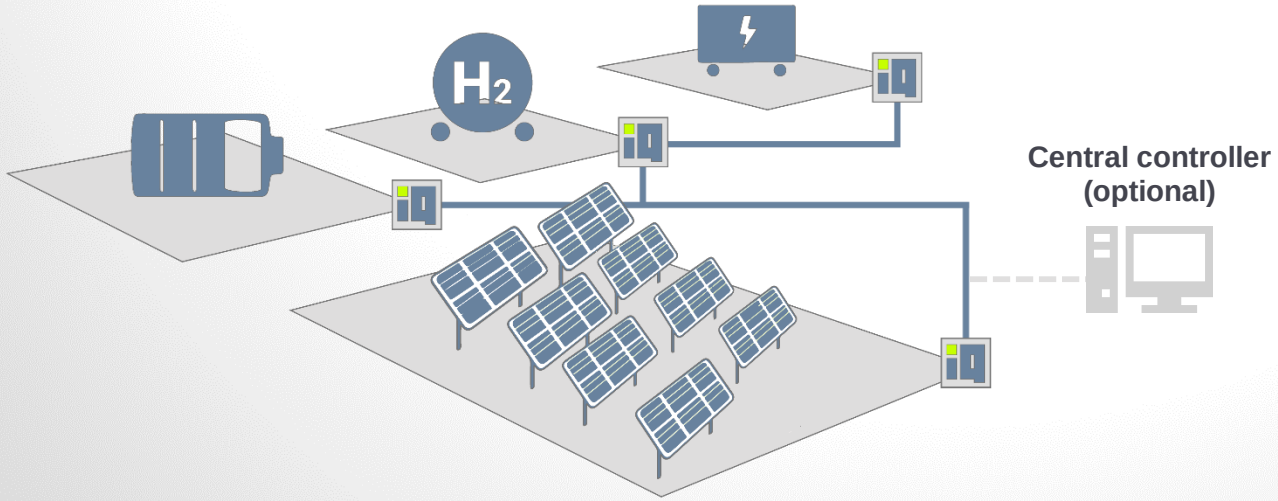
HEILA iQ® solves microgrids main challenges



Solutions

Create a common “language”

Encapsulate complexities by using data

Distribute decision making based on game theory

… by creating Microgrid “objects” or building blocks

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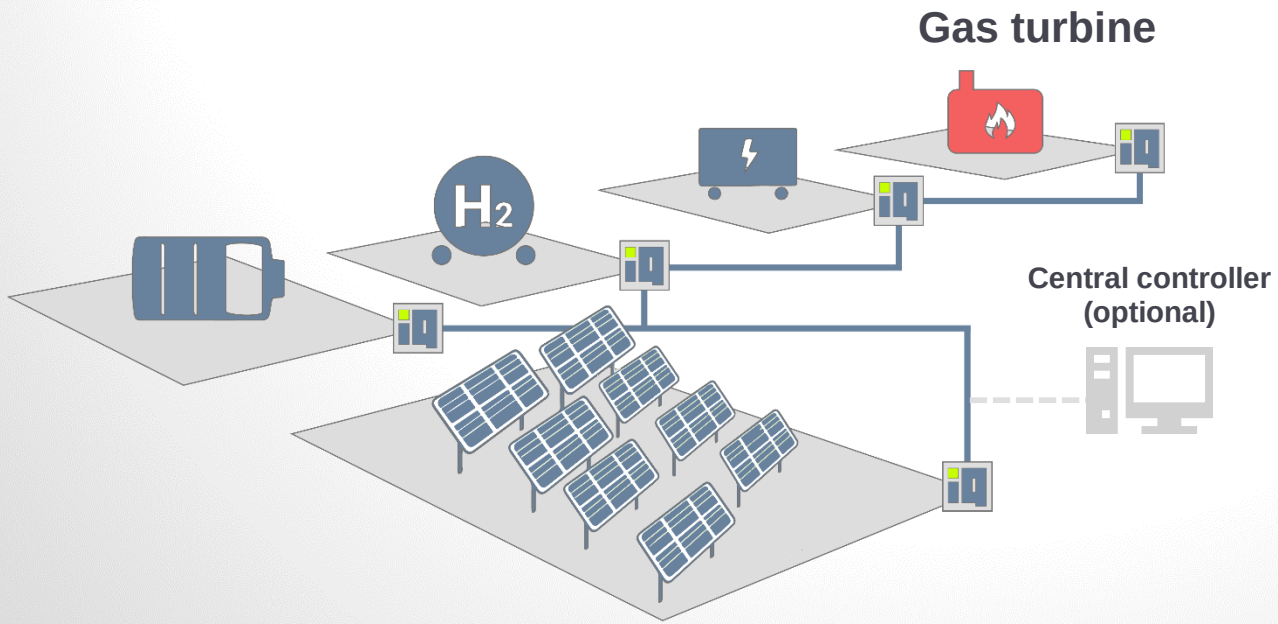
Simplifying the process to grow microgrids over time…



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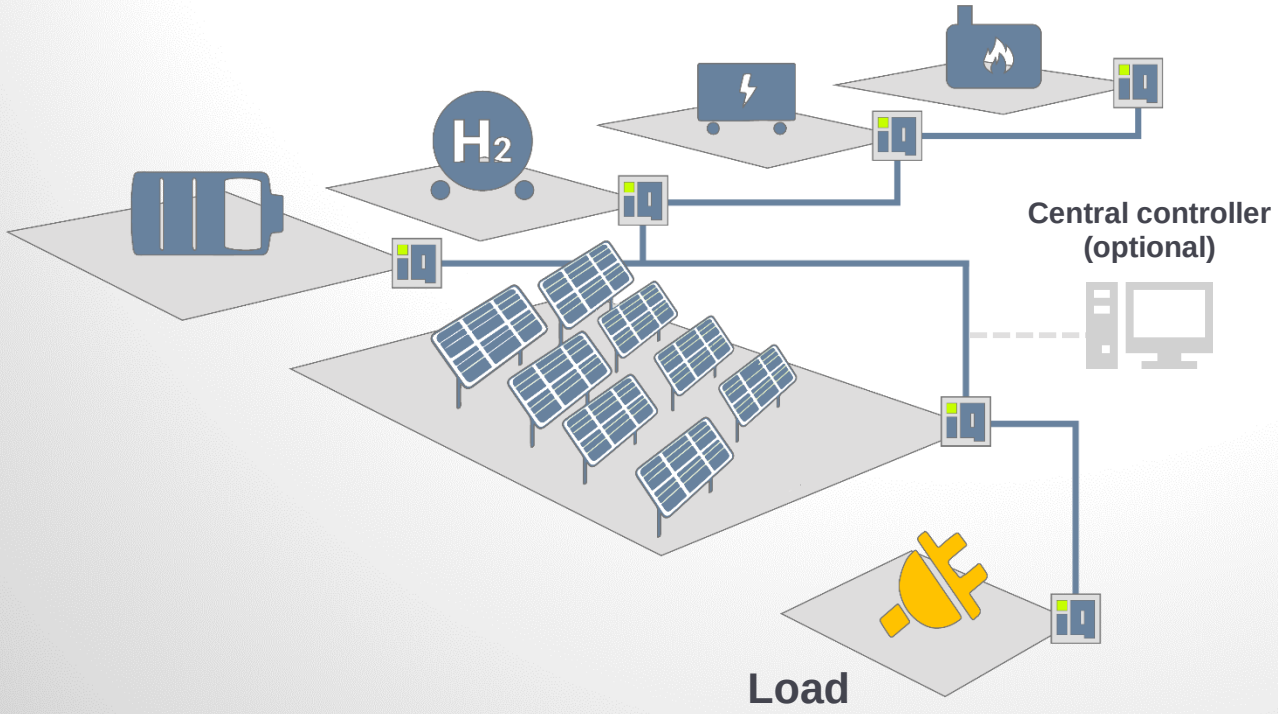
Regardless of the characteristics of the asset…



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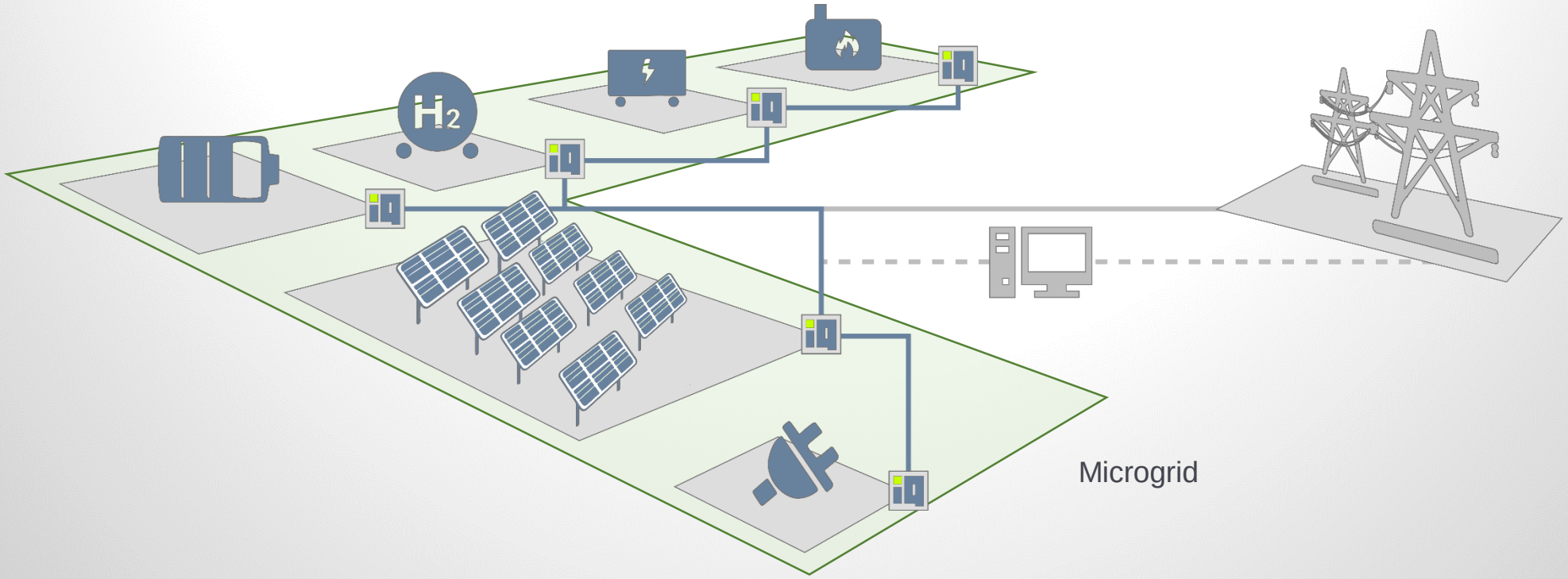
… And automating the management and optimization of the microgrid as a single entity…



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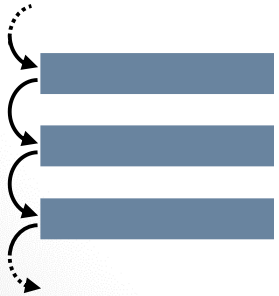
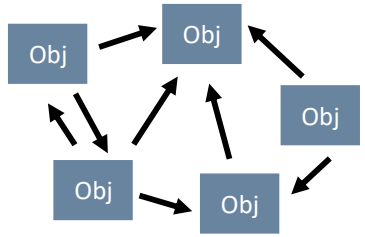
An interesting analogy of the “Microgrid Object”:

Programming paradigms



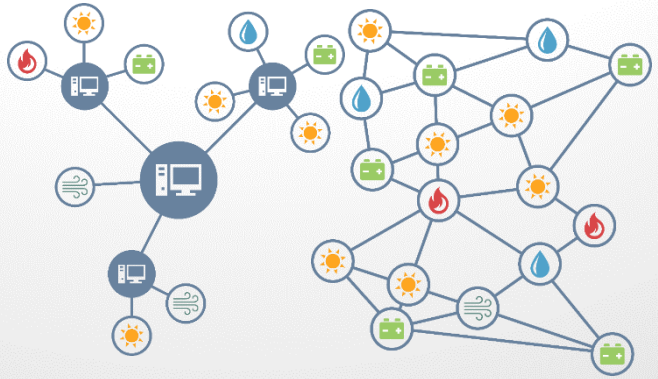
Procedural



Object-Oriented

Microgrid control paradigms

Centralized



Distributed / Decentralized

Advantages

- Separation of concerns
- Modularity / reusability
- Simpler Maintenance / Debugging
- Information / Complexity hiding
- Functions portability
- Easier collaboration

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HEILA's Microgrid object creator uses state-of-the-art software and ready-to-deploy hardware

HARDWARE SOFTWARE

HEILA NODE™

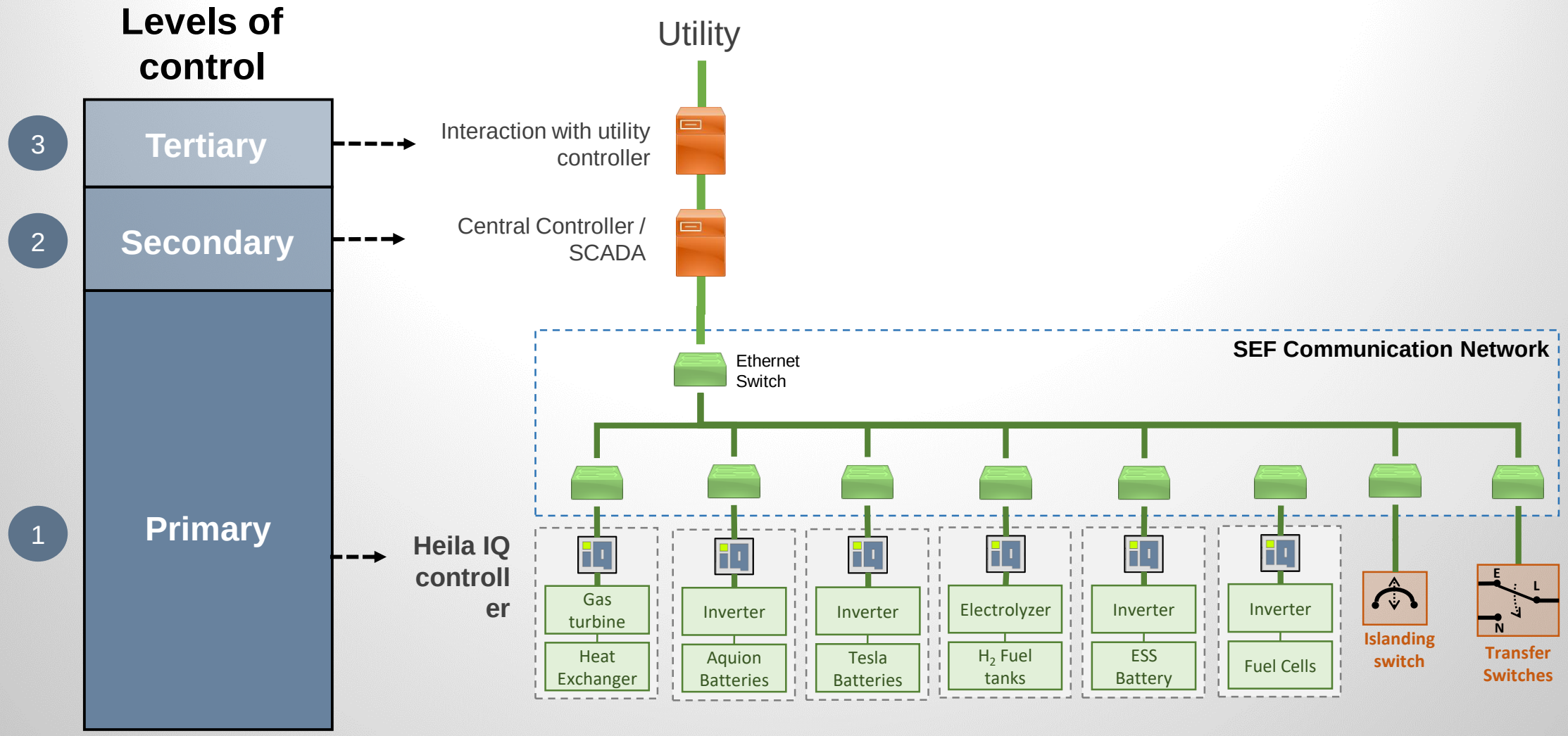
Designed for critical DERs. It turns disparate assets into uniform building-blocks for microgrids.

HEILA EDGE™

Designed for loads and non-critical DERs. It brings Heila's algorithms to smaller assets at the grid's edge.

1. **Technology Agnostic**
   Compatible with most industry standard protocols and interfaces, and capable of interfacing with any vendor
2. **Open-Source**
   Allow users to safely build new functionalities on top of its existing code.
3. **Multi-energy**
   Encapsulate the microgrid complexity behind sophisticated and robust algorithms by exploiting ***analogies***
4. **Enhanced Security**
   Separate asset control from communication channels, to provide a layer of security.
5. **"Selfish" operation**
   Each asset tries to maximize its own profits, inside a well-designed game-theoretical framework

Proposed Control Architecture for microgrids



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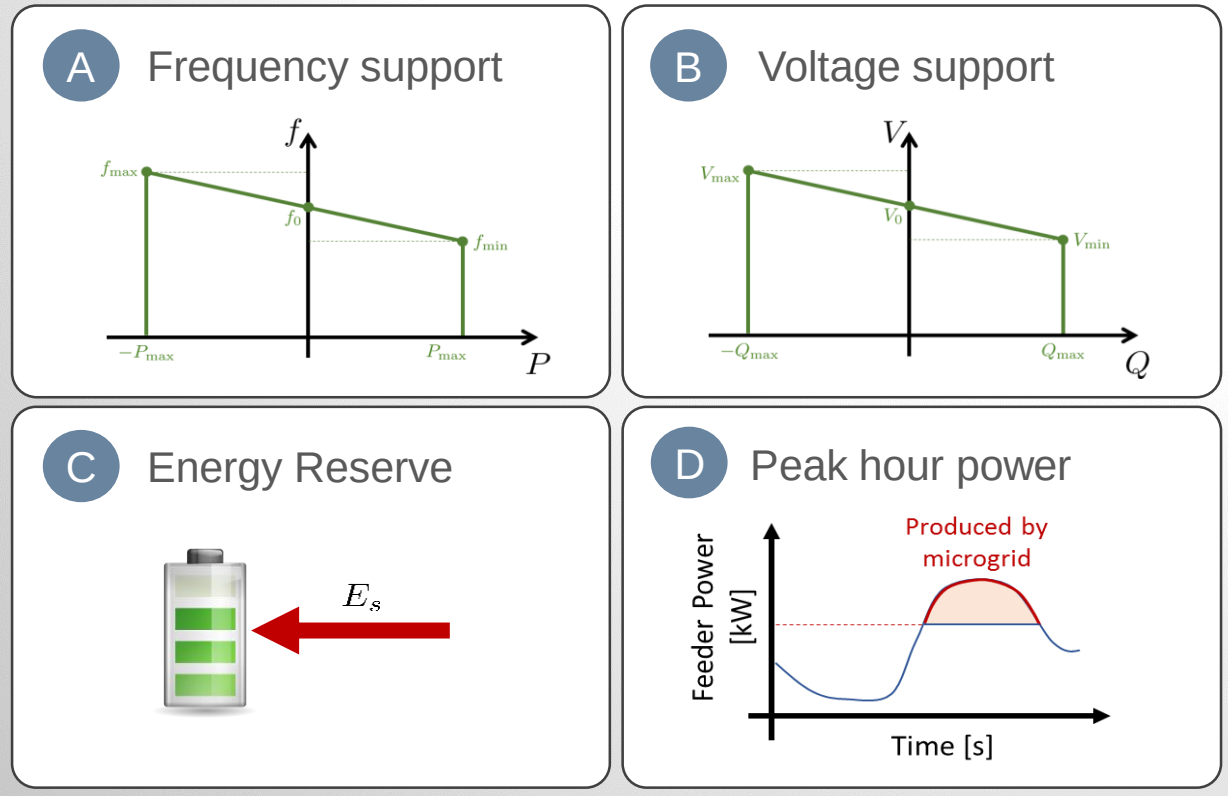
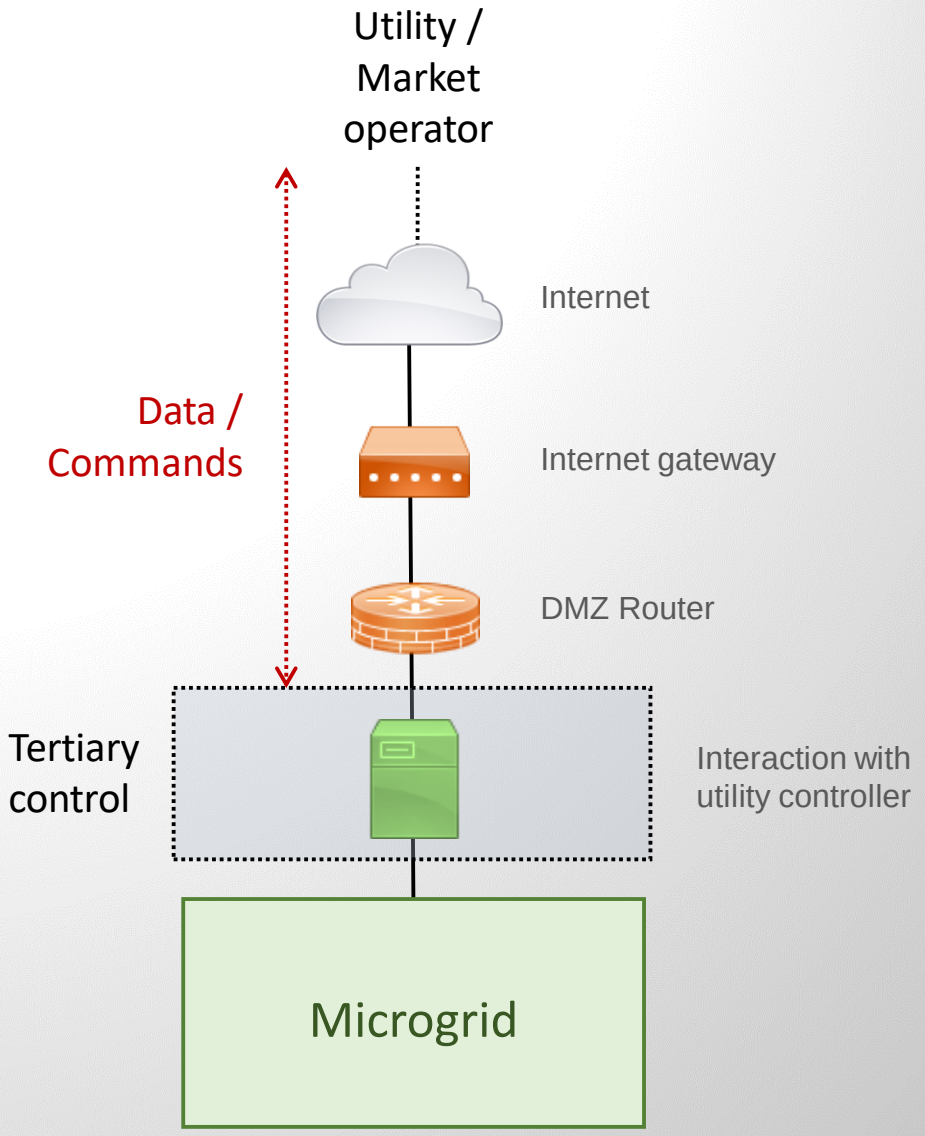
Microgrids controlled as a single entity

- ✓ Achieve system-level goals
- ✓ Use microgrids as resources for the utility:





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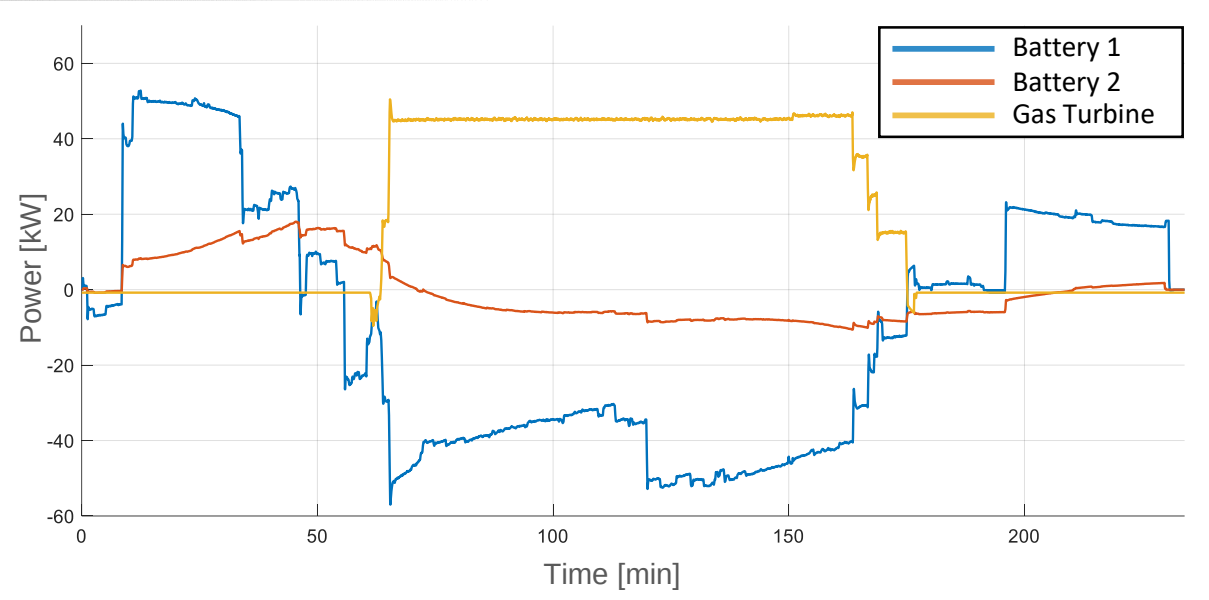
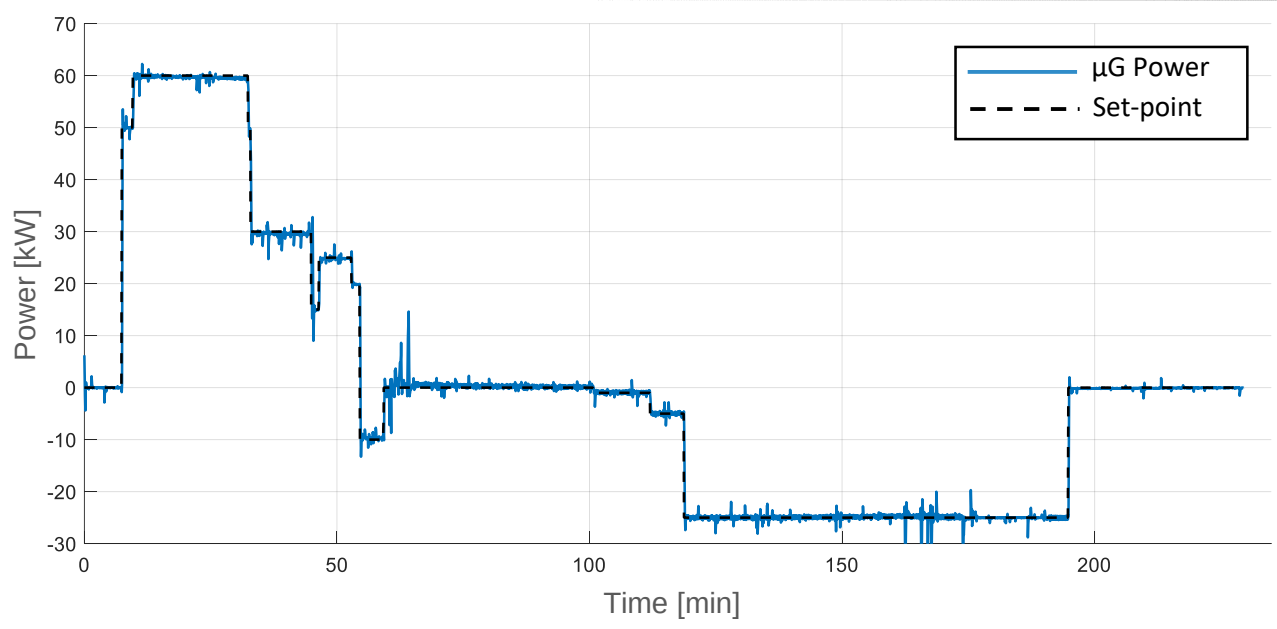
Use Case 1: Game-theoretical optimization

Assets make their own decisions about their operation…



… to control and optimize the microgrid as a single entity.



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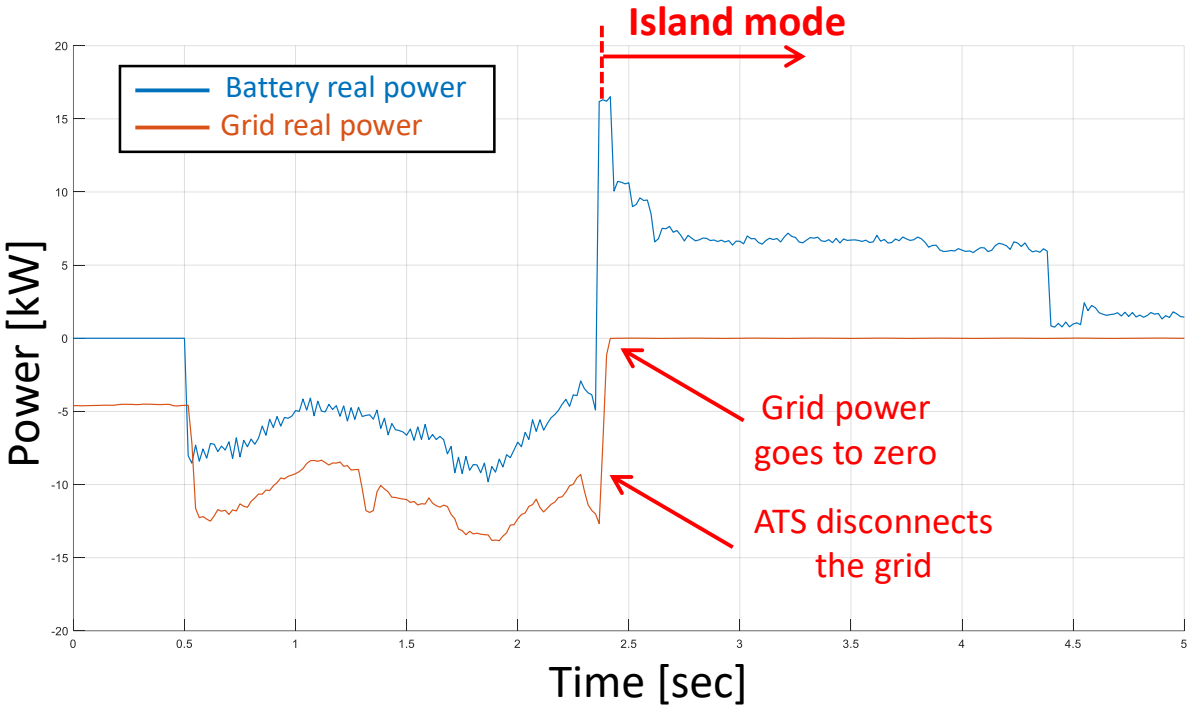
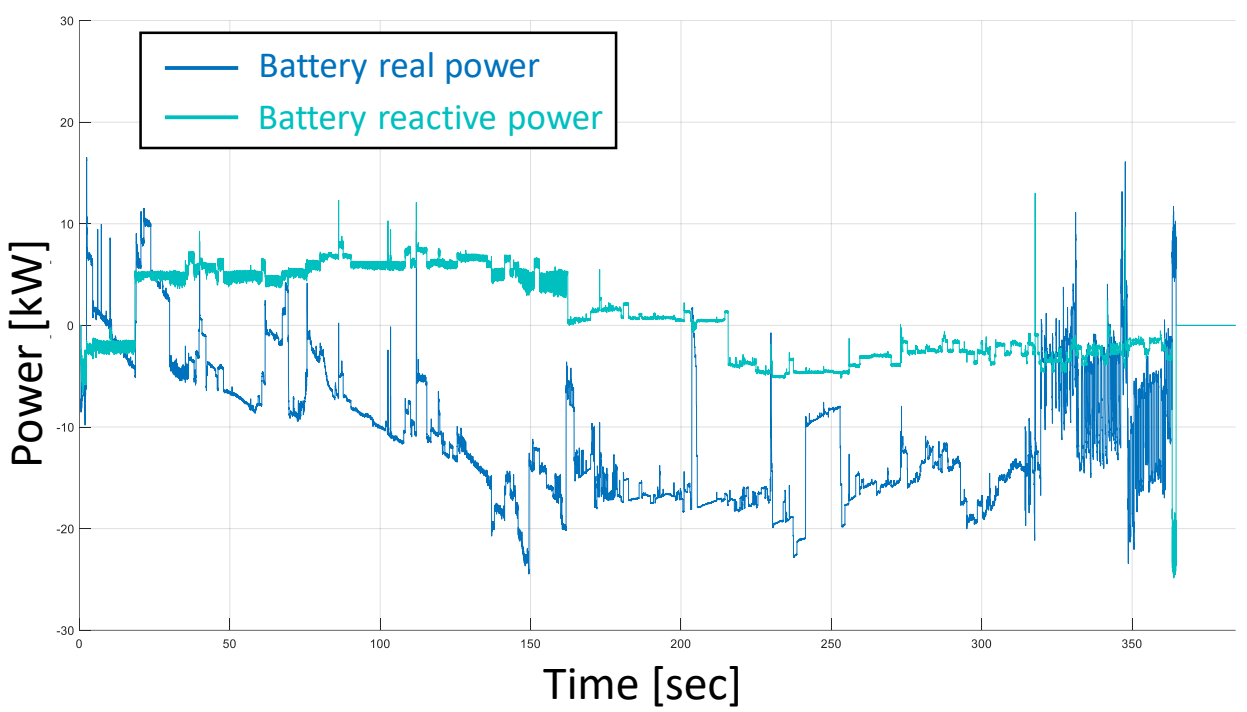
Use Case 2: Planned Islanding

Example of an islanding process and subsequent operation





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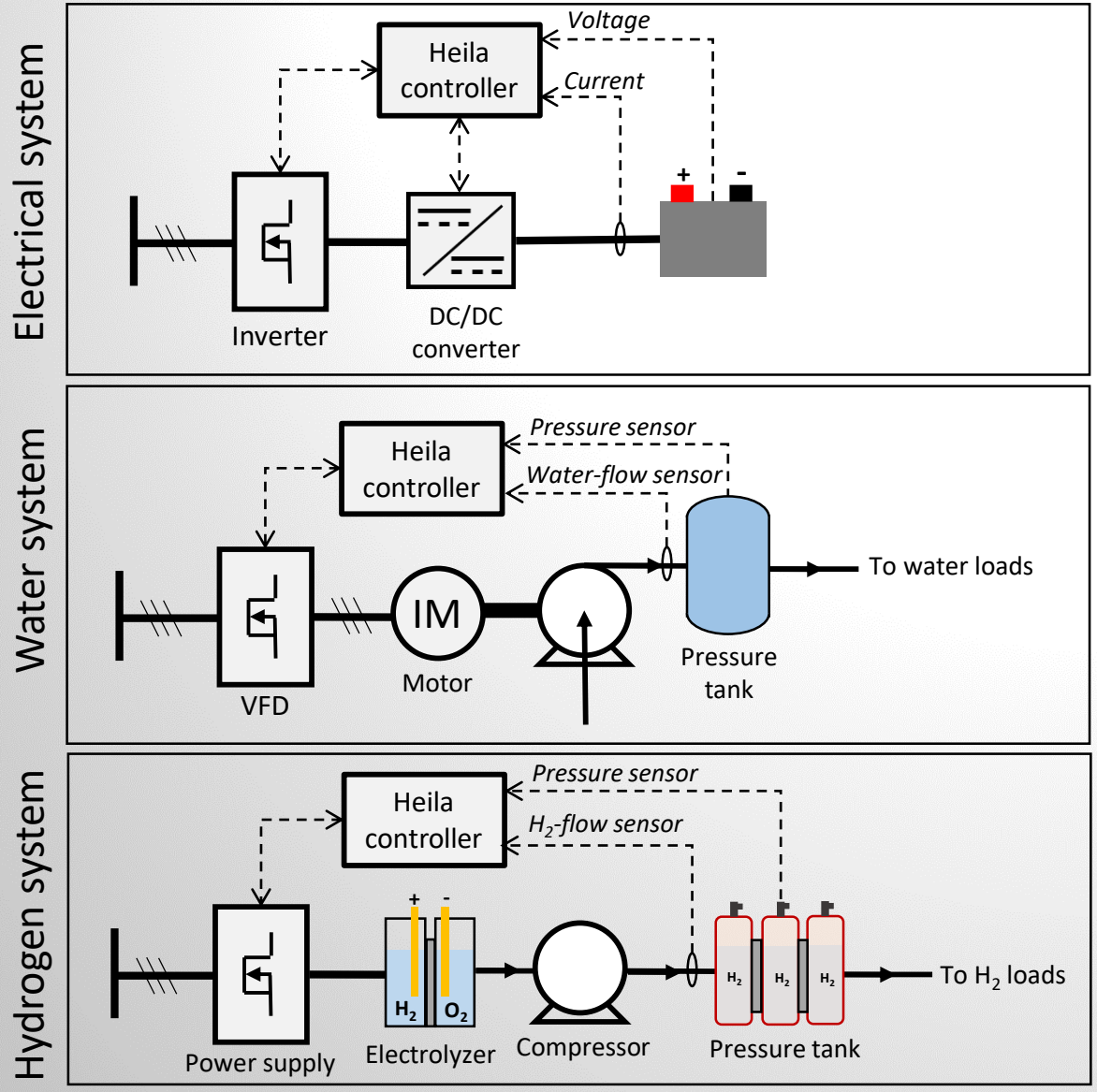
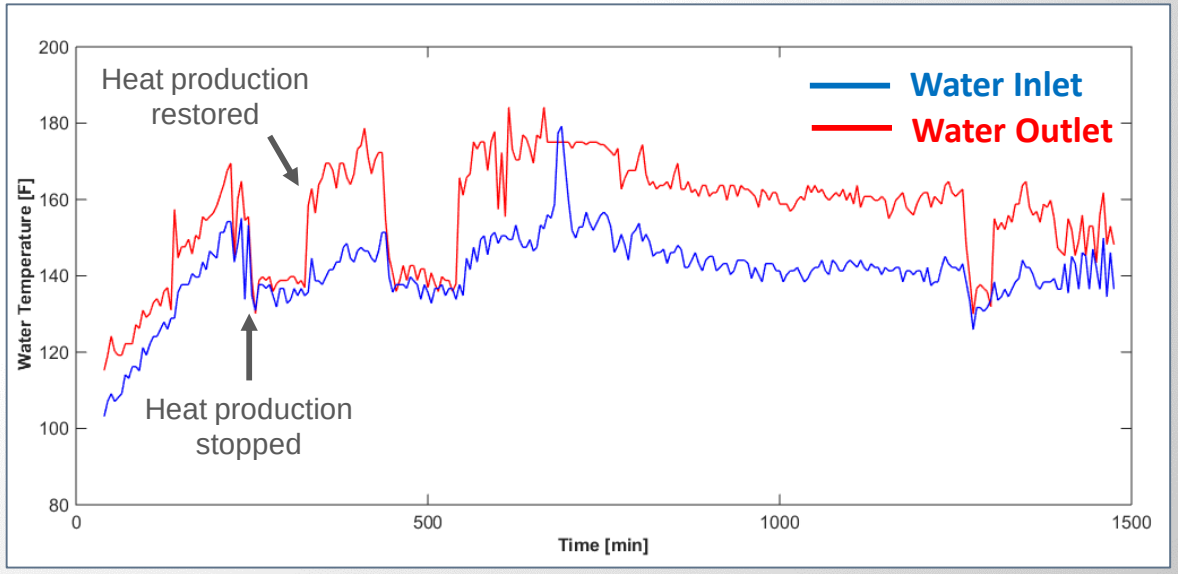
Use Case 3: Integration of variety of energy types



CHP System Control



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