Multi-modal energy management for GSI /FAIR

FG Energy Information Networks & Systems

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Integrating energy hungry accelerators into the Energiewende is possible!

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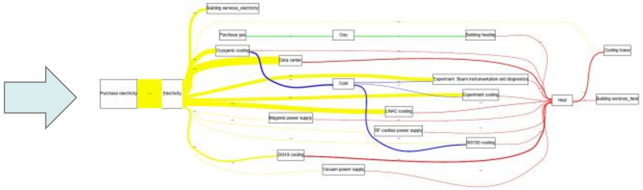
Starting Point

- Higher beam energy and intensity raise the energy demand for each new facility, e.g. FAIR extension of GSI will increase energy demand from ~60 GWh[1)] by a factor of 6-8

- Option 1: Reduce energy demand, e.g. energy recovering linacs
- Option 2: **Use energy when available** (while keeping accelerator operation constant)
  - ➢ This is an instance of industrial demand side management which has a decisive role in the Energiewende

Objectives and interests



- An accelerator facility is a complex system!
- Development of a multimodal energy system concept for GSI/FAIR
  - Electricity to cold via cryogenic cooling
  - Electricity to heat (cavities, data center, etc.)
- Optimization variables:
  - (Thermal) storages
  - Operation adjustments without impact on experiments
  - Energy purchasing and CO_2 accounting processes (CO_2 intensity is not flat over time)

➢ Possibly reducing carbon footprint and operating costs of GSI/FAIR or other future accelerators

➢ Accelerators as a forerunner of industrial DSM (Demand Side Management)

GSI FAIR

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1) C. Ripp Master's thesis: „Analyse des elektrischen Energiebedarfs der GSI" (2013)

Employ Industry 4.0 for energy system optimization and beyond

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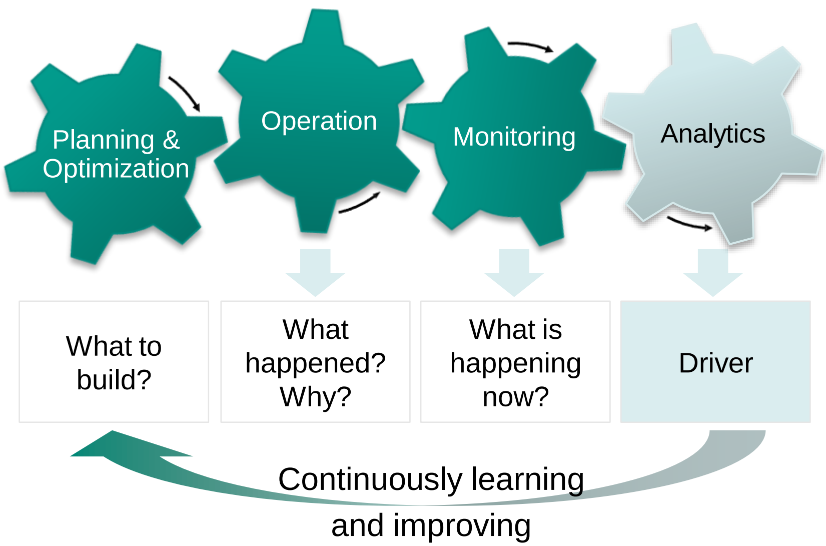
- Accelerators are large, (hopefully) modern factories
- They will produce massive operational data about components (aside from the experimental data!)

Components		Data
• Beam sources • Cavities • Coils	• Cryogenic cooling • Space heating • Data center	• Operation hours and modes • Energy consumptions and output • (Partial) outages

- **Learning statistical models** is the key to monitoring / planning / optimization
  - Our playing field: energy system optimization
    - What is the lifetime impact of up-/downregulating cryogenic cooling? Is it worth manipulating?
    - What is a typical energy foot print of cavities?
  - Second use: availability optimization
    - Why are coils suddenly use twice the energy as before? Is this an indicator of near end of life?



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