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Adaptive Orchestration of Distributed Computing under Fluctuating Resource Availability

II. Institute of Physics, Working Group Quadt



Gefördert durch:

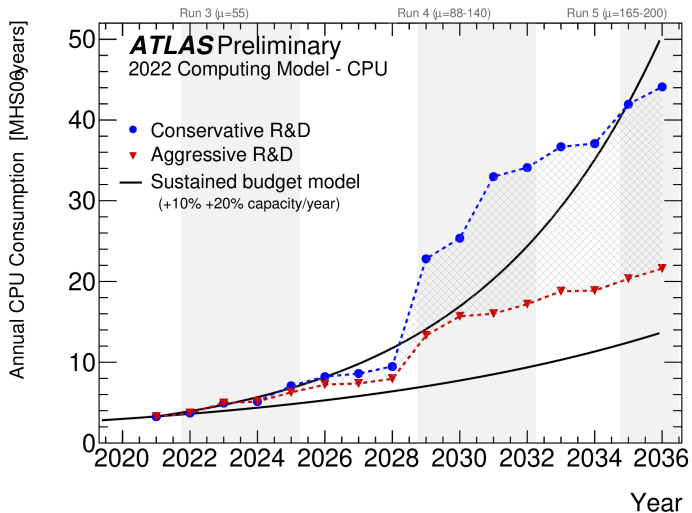


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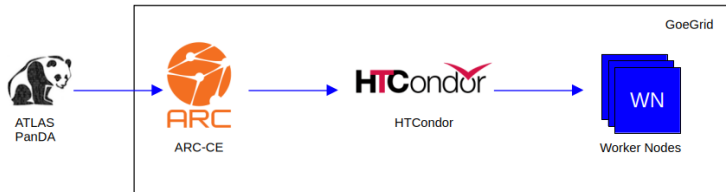
01.09.2026 - 11.09.2026

- SUSFECIT: Sustainable Federated Compute Infrastructures.
- Funded by BMFTR, project period 2025-2028.
- Goal: sustainable and reliable computing.
- 5 RAs: Forecasting, **Orchestration**, Accounting, Simulation, Education.

Computing Rise

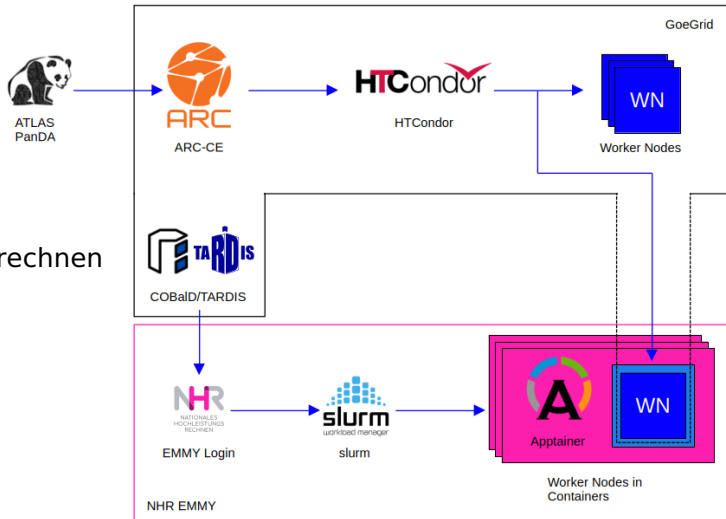


University Tier-2 in Goettingen - GoeGrid

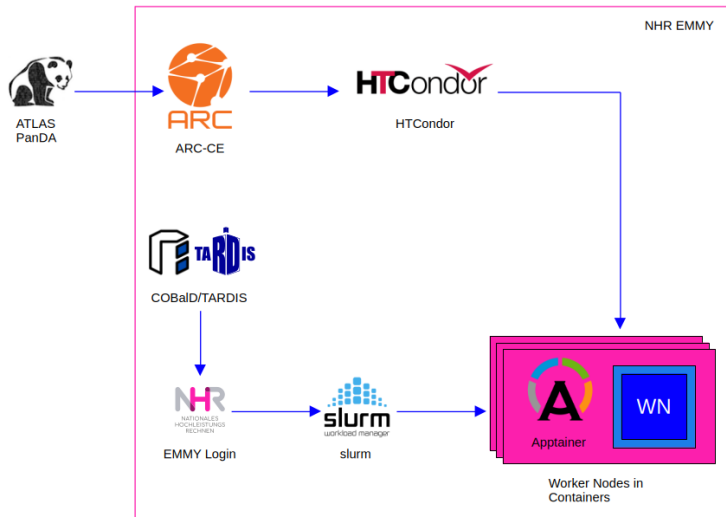


GoeGrid → NHR EMMY

NHR:
Nationales
Hochleistungsrechnen



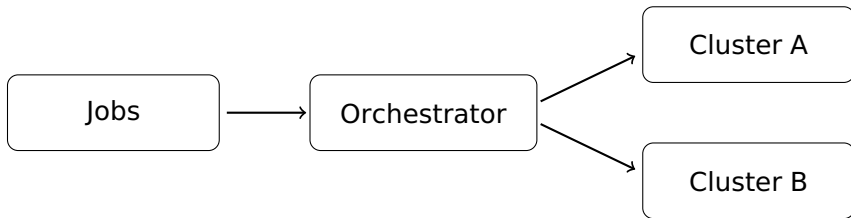
NHR EMMY



The Problem in Simple Terms

- The available resources fluctuate:
 - ▶ Busy cluster
 - ▶ Renewable energy dependent capacity
 - ▶ Technical issues
- Computing pledges have to be fulfilled.

What Is Orchestration?



- **Breathing Cluster:** renewable energy aware cluster operation.
- **Dynamic Limiter:** dynamically adjust resource limits to fulfil pledges.

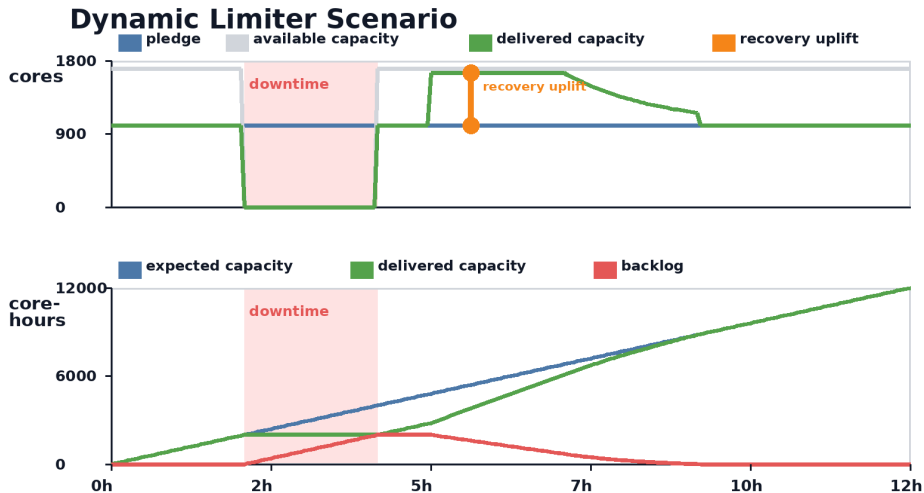
Breathing Cluster

- Dynamically adjusts available compute capacity.
- More renewable energy → more nodes accept jobs.
- Less renewable energy → fewer nodes accept jobs.
- Reduce CO₂ emissions while maintaining resource utilisation.
- Developed by KIT.
- Setup a Goettingen instance and perform experimental evaluation.

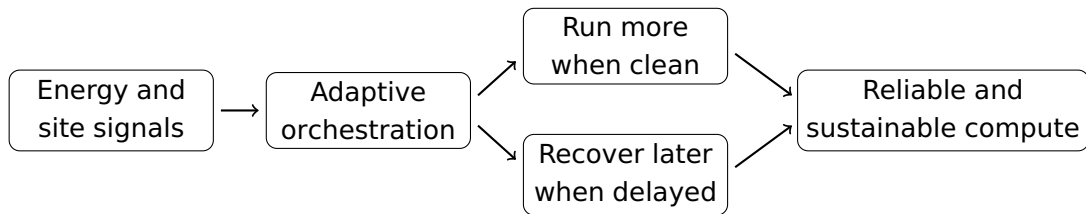
Breathing Means More Fluctuation

- Makes resources intentionally unavailable.
- Jobs have to wait.
- Pledged computing does not get fulfilled.

Dynamic Limiter



Overview of the Project



- Breathing Cluster changes active capacity based on the availability of clean energy.
- Dynamic Limiter keeps track of delayed delivery and recovery.

Current Status and Outlook

■ Ready:

- ▶ Dynamic Limiter model.
- ▶ Cluster-simulation for debugging.

■ To Do:

- ▶ Dynamic Limiter module for Orchestration software COBaID/TARDIS.
- ▶ Breathing Cluster setup on decommissioned nodes at GoeGrid.
- ▶ Experimental evaluation.