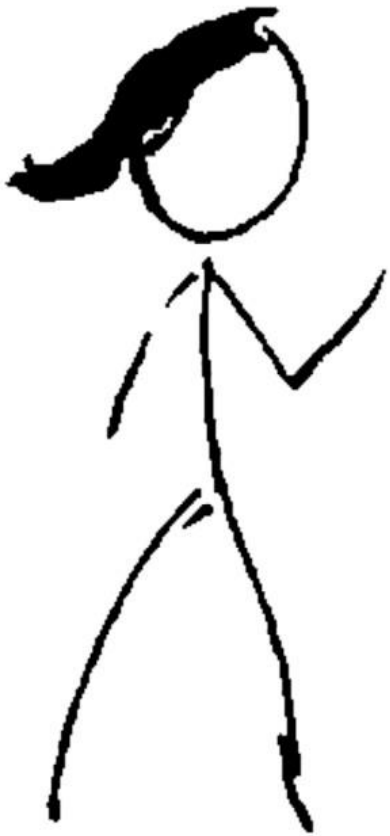


Digital Twins

for Power Systems

Peter Palensky
TU Delft

Let's go for a sustainable,
digital, connected ██████████ system!

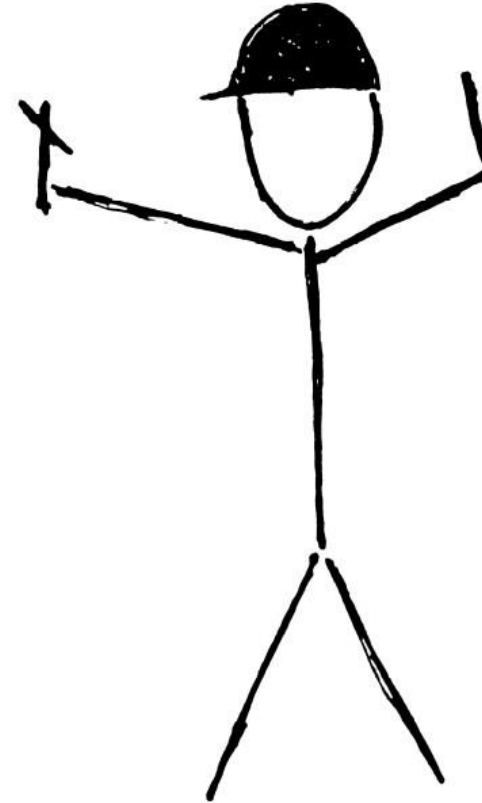


I believe we need
a digital twin...



Let's go for a sustainable,
digital, connected **power** system!

Behold Satan!

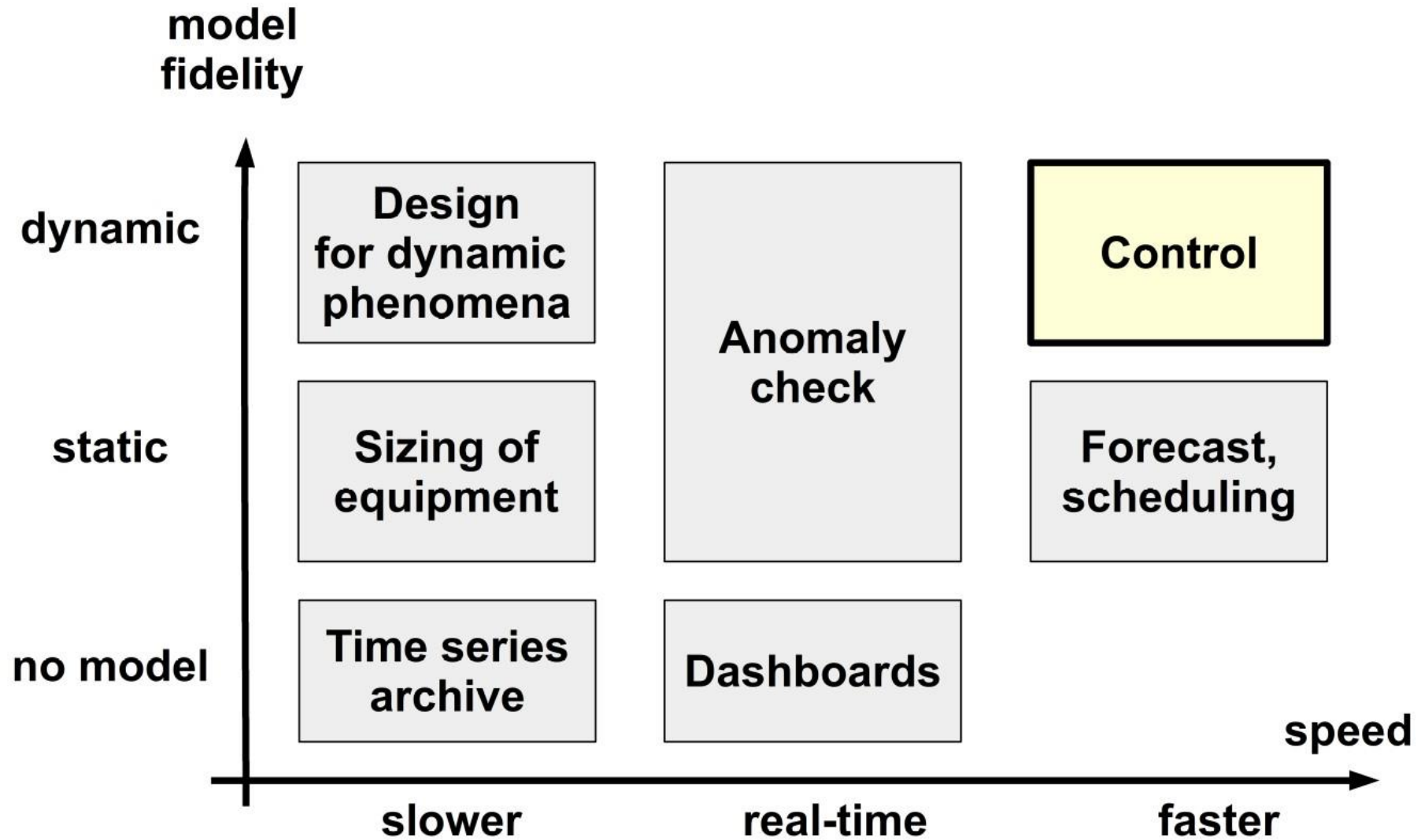


Defense,
Climate
Avionics,
Automotive,
Construction,...



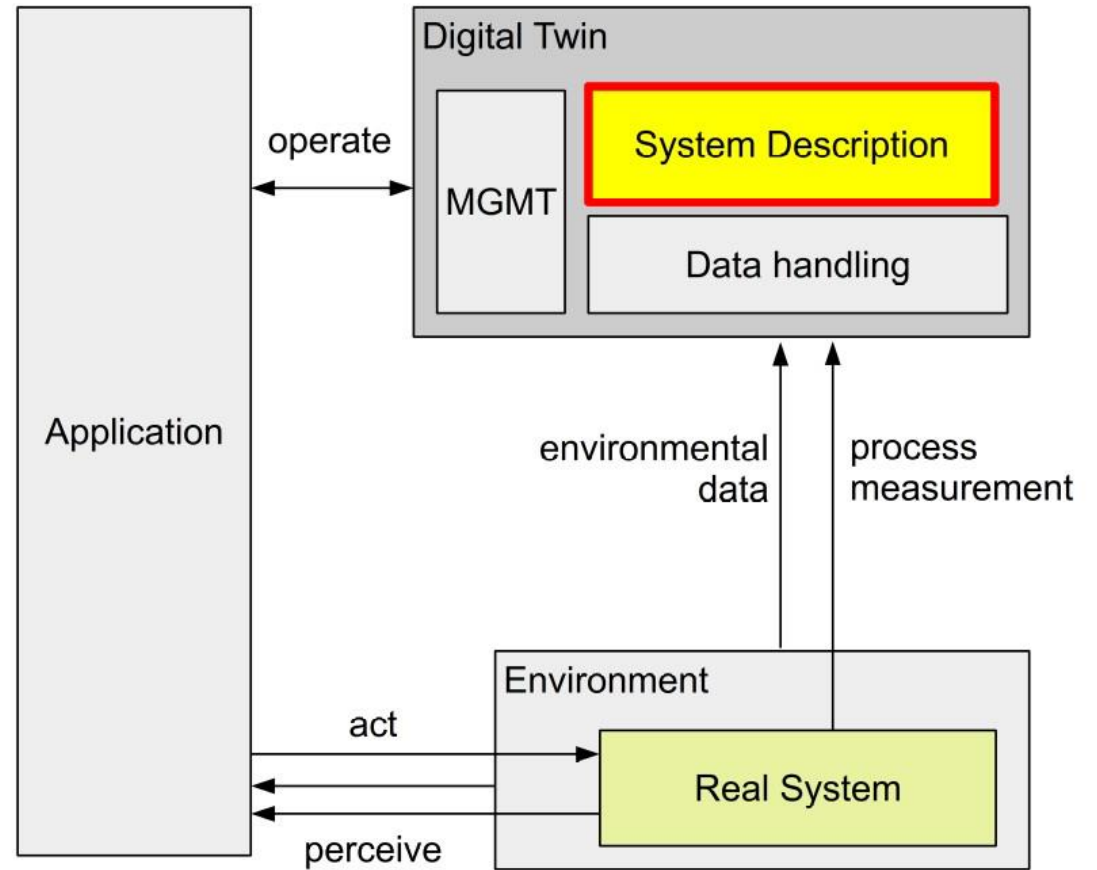
Up to now:
mostly offline...

But we need more...



Digital Twins

- Numerical Replicas plus **Workflow**
- Synchronized or not
- Now: Big, clumsy, expensive, manual
- Tomorrow: ubiquitous, cloud/edge

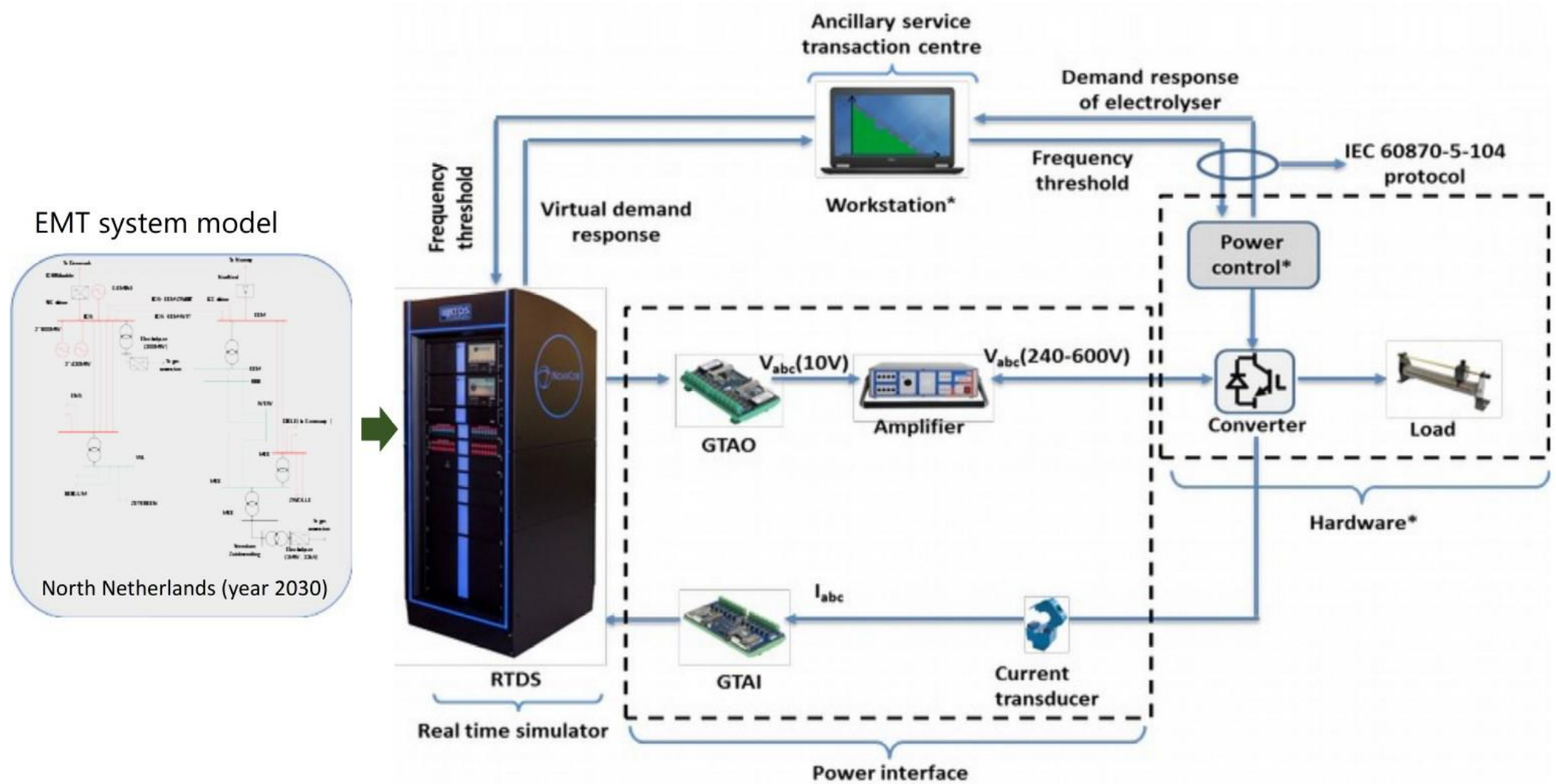


Real-time twins: hardware-in-the-loop

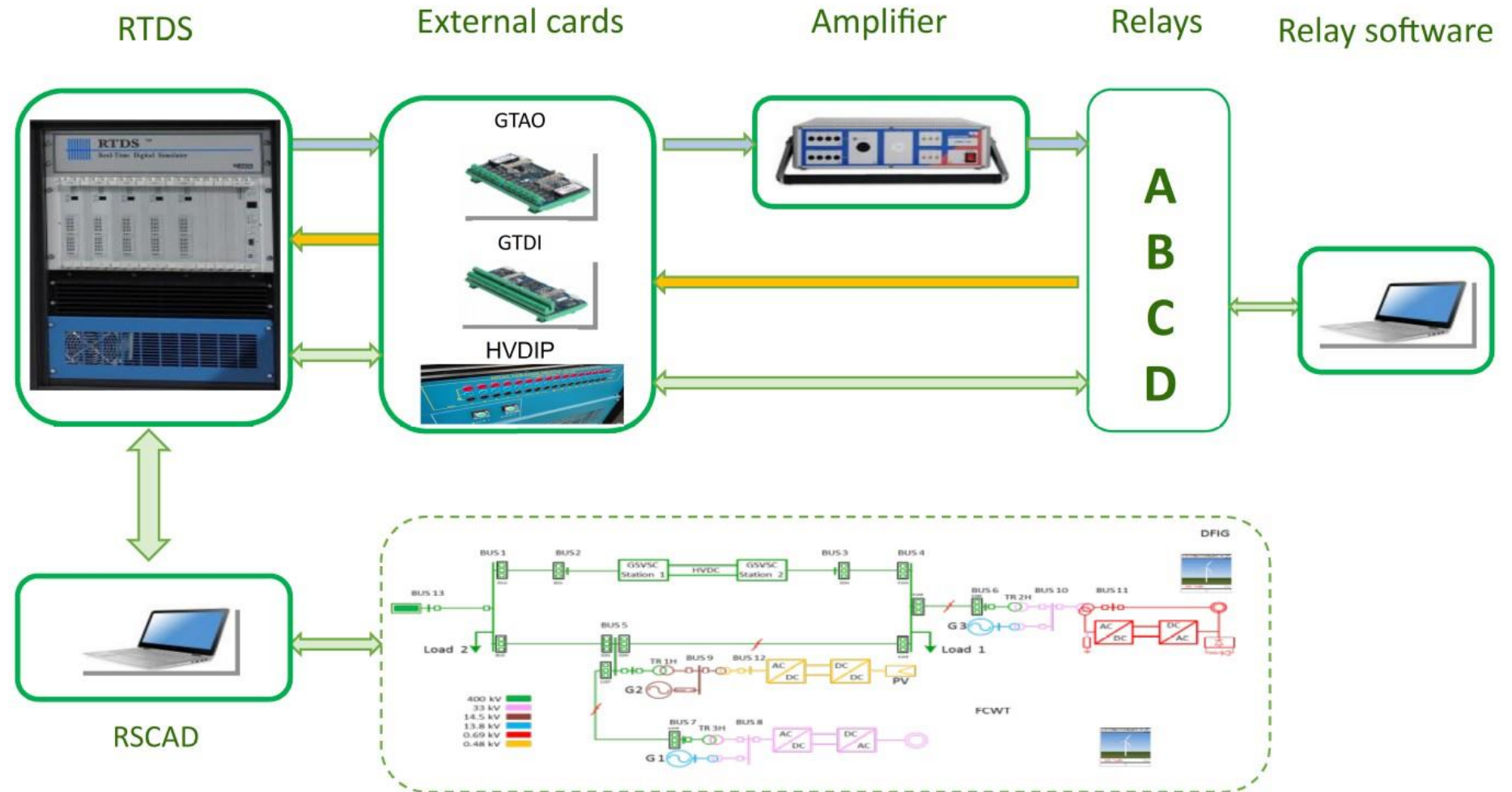
- Runs in real-time (not faster, not slower)
- In the loop
 - Controller
 - Power HW
 - People
 - Software



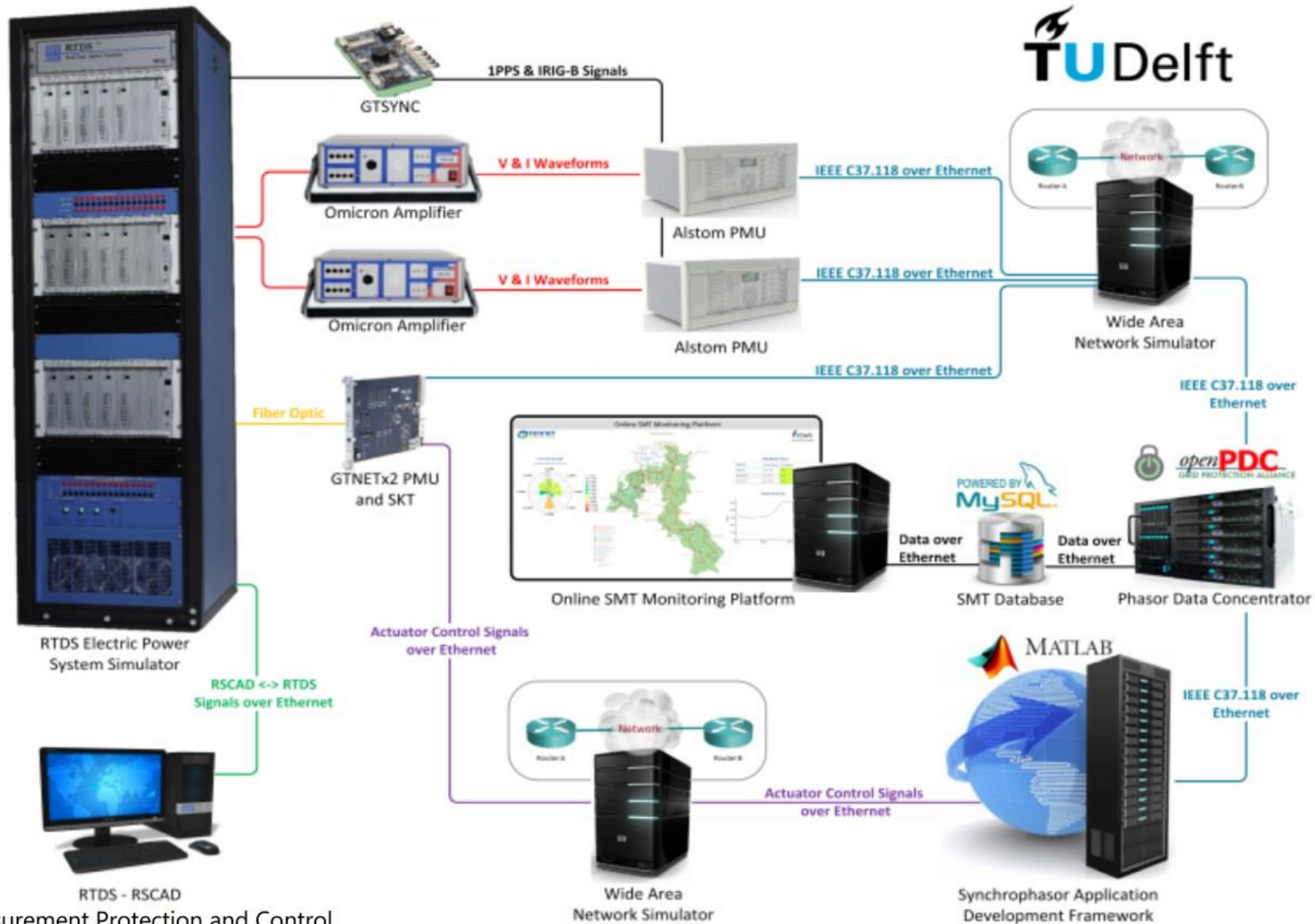
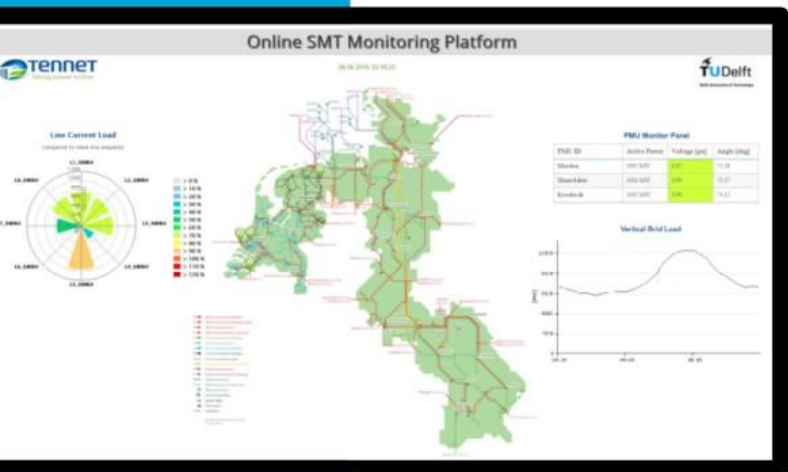
Ancillary Services of Hydrolyzers



Protection Relay assessment



Backup WAMPAC



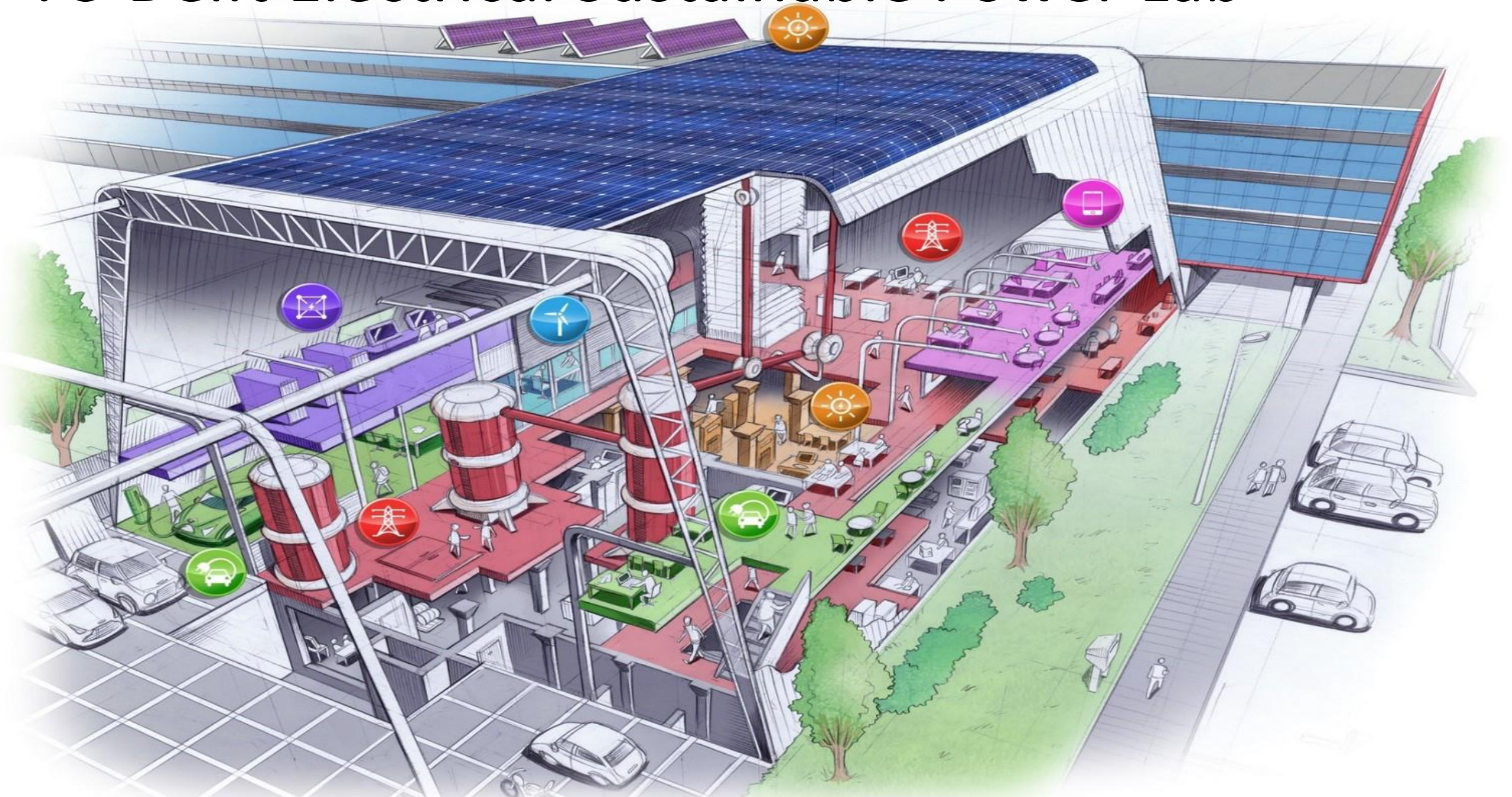
WAMPAC: Wide Area Measurement Protection and Control

Dutch Power System Real Time Digital Twin

- Transmission (400kV-150kV) in RTDS
 - HIL possible
- Distribution in PowerFactory
- SCADA System and control room
- Users, weather, etc. in data center
- Everything open source/access



TU Delft Electrical Sustainable Power Lab

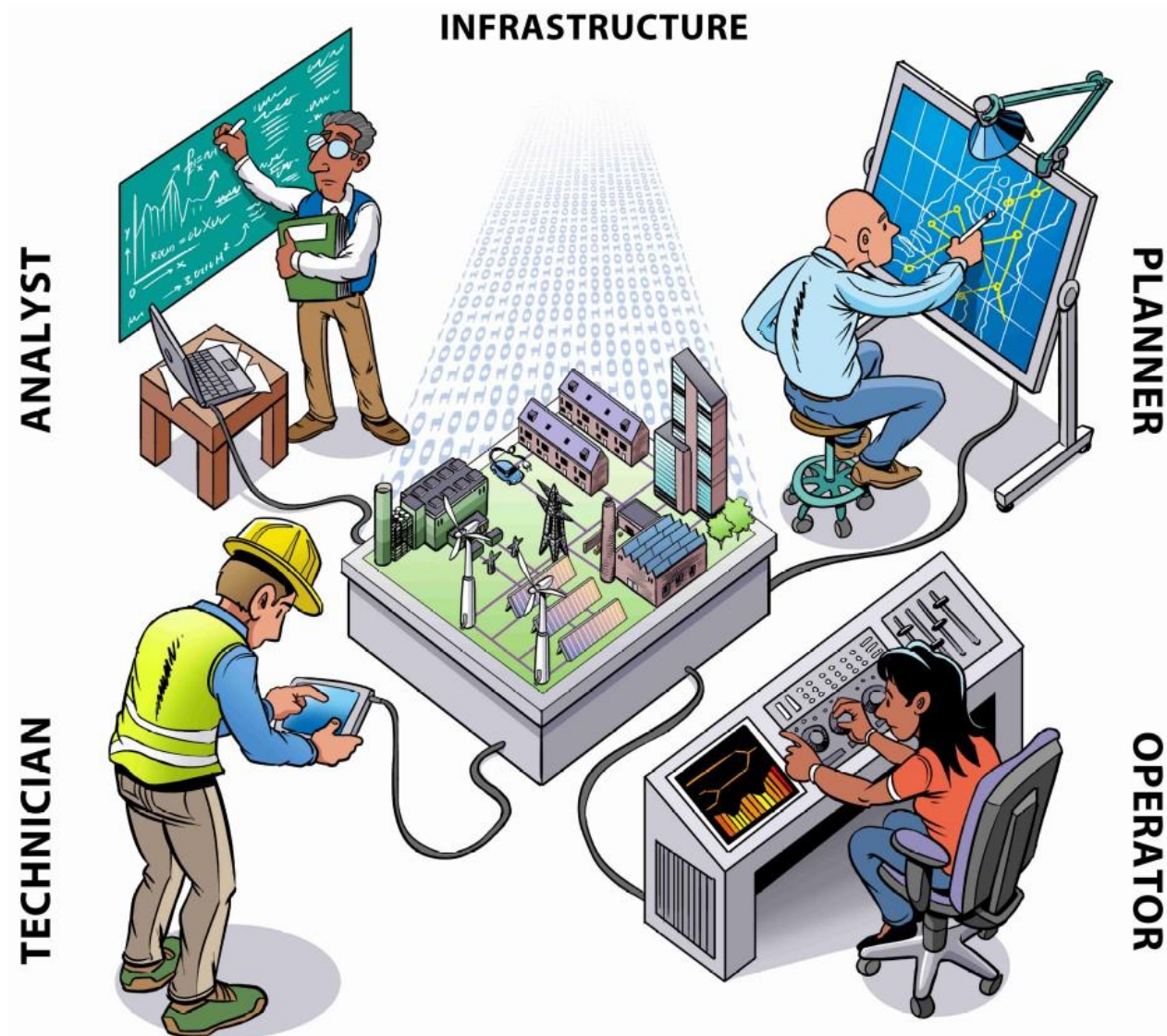


Control Room of the future

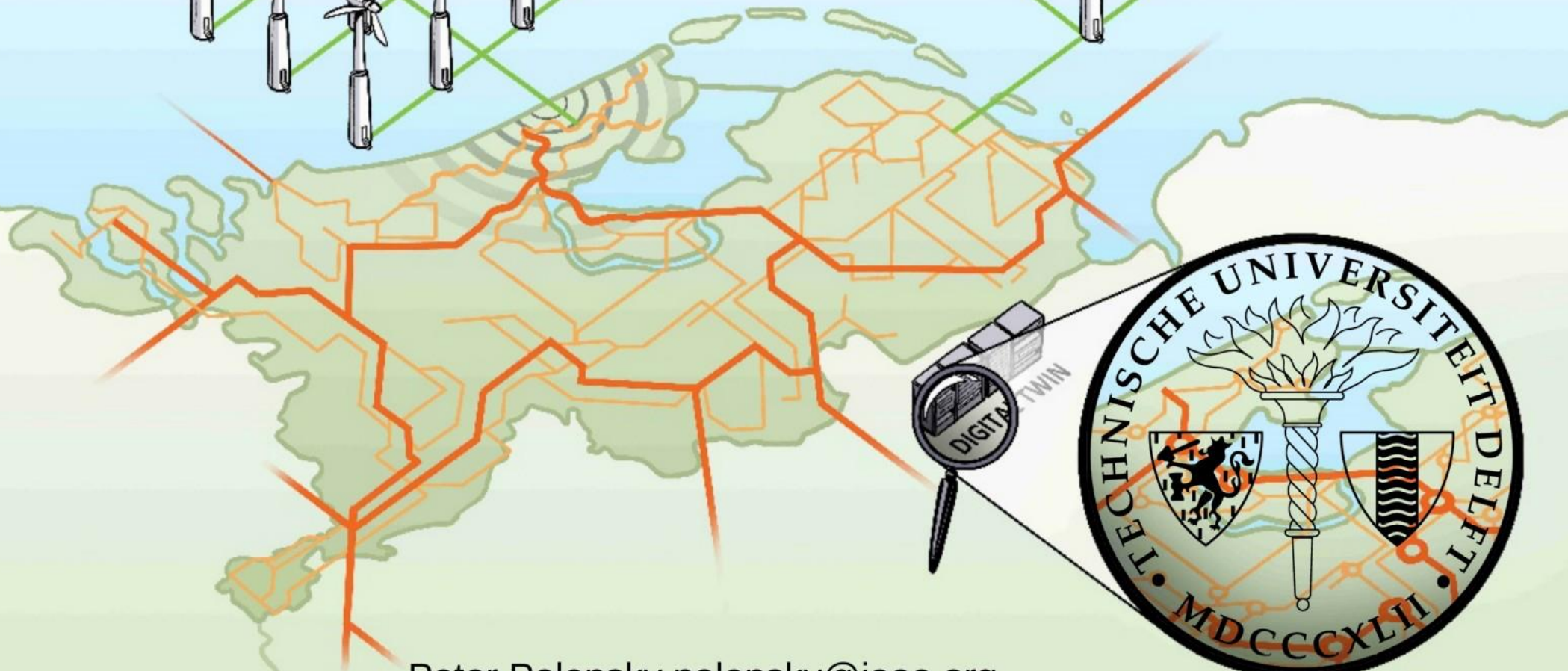


Power System Digital Twin Bottom Line

- Numerical vehicle + support SW around
- Stuffed full of data, equations, white and black box models, solvers,...
- Interacting with and learning from real system and people
- Assess complex systems
- → brings people together



Thank you!



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