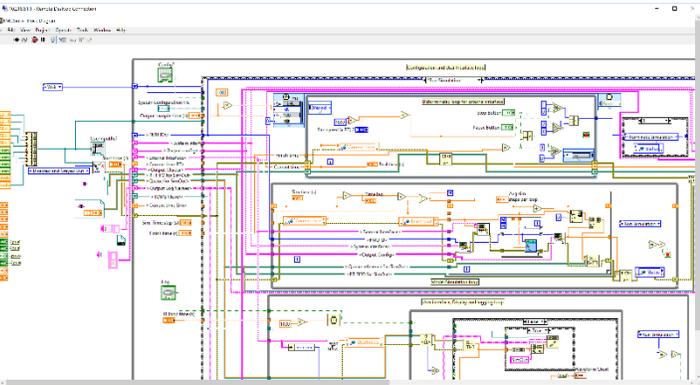
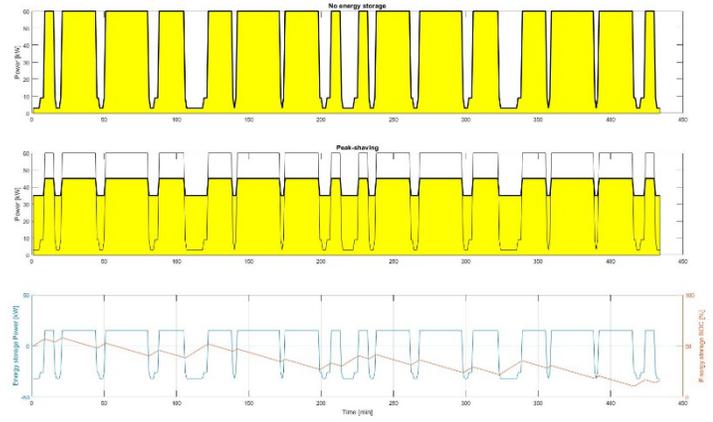


A composite background image showing a coastal scene with wind turbines on a rocky island, a large ship in the water, and a city skyline in the distance. The scene is set against a backdrop of snow-capped mountains and a clear sky.

THE MODEL- SIMULATION- EXPERIMENT TRIANGLE: A NEW CAPACITY IN HYBRID MARINE POWER SYSTEMS.

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Simulation

New,
tested
solutions

Modelling

Experiment



About models

**The only question of interest is:
Is the model illuminating and useful?**

*Remember that all models are wrong;
the practical question is
how wrong do they have to be to not be useful?*

Essentially, all models are wrong, but some are useful

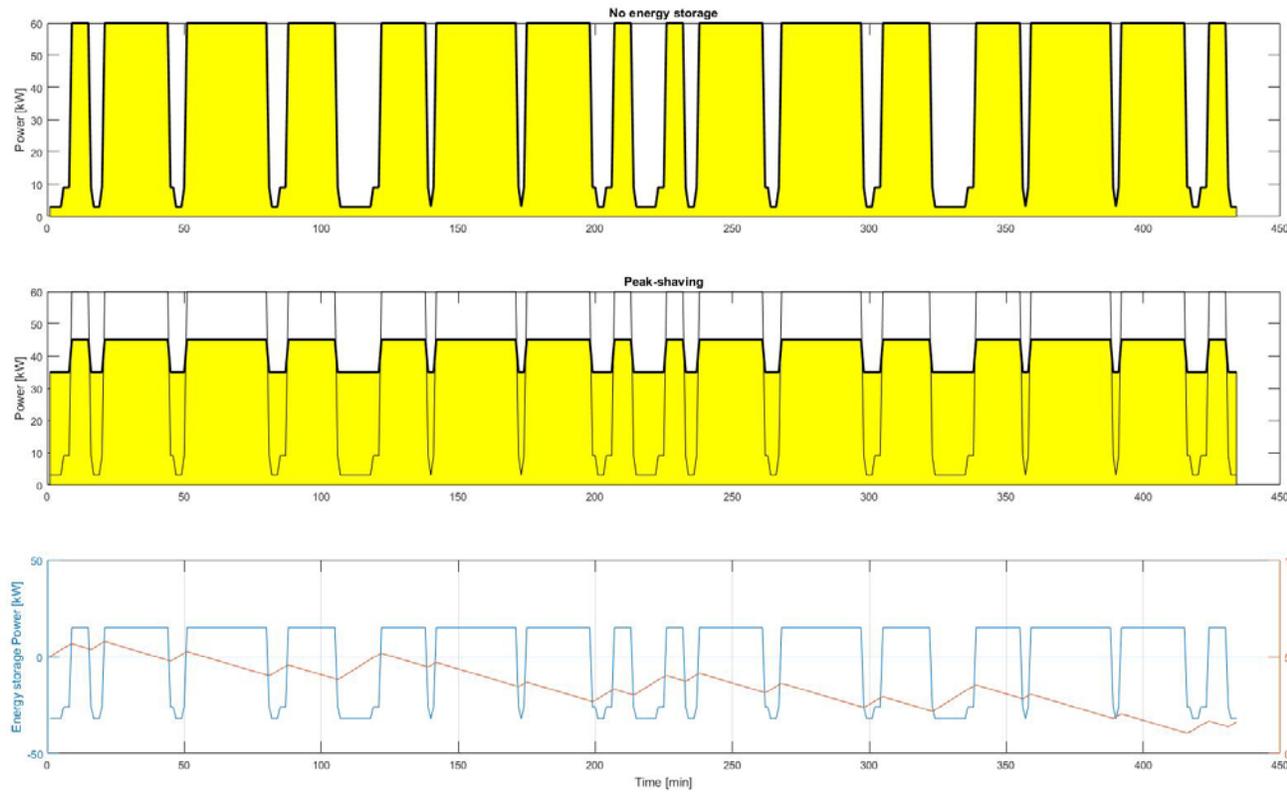
Power system models

- Short-term perspective on efficiency, transient operations
 - High definition models
 - Difficult processes: formation and control of gaseous and particulate emissions in internal combustion engines
 - Alignment of requirements – transients in ICEs on 0.1-1 second scale, transients in power electronics on 0.001 – 0.1 second scale
- Long-term perspective
 - Performance in 'real life'
 - Simplified models – how to stay accurate?

Autonomous power systems

- A transformation from heavy human interaction to no human interaction
 - Intermediate steps needed(?)
- Vessel control focused on required power
- Automated response to provide power at given constraints
- Example: controllable pitch propellers
- Main issue: Operational safety and maintenance!
 - Smaller vessels – modularized power system, onshore maintenance
 - Larger vessels – campaign maintenance?
 - Electric propulsion simplifies, but very restricted on range

About simulations



Power system simulations

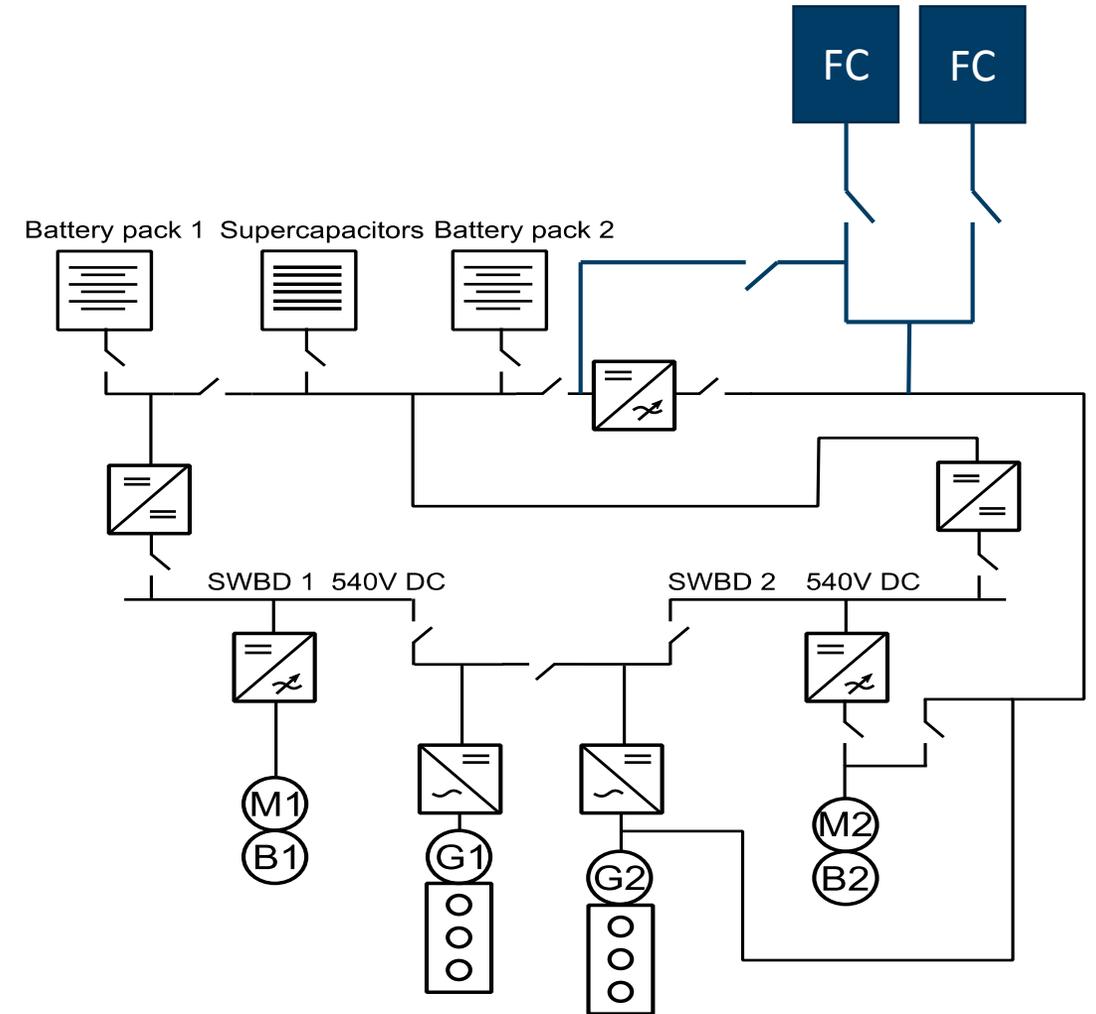
- System configuration – virtual prototyping of energy systems
- Understanding system behaviour – introduction of energy storage technologies
- Optimization of power plant – understanding operations
- Balancing act – power vs. energy applications
- Investigation of operational constraints related to unmanned operations

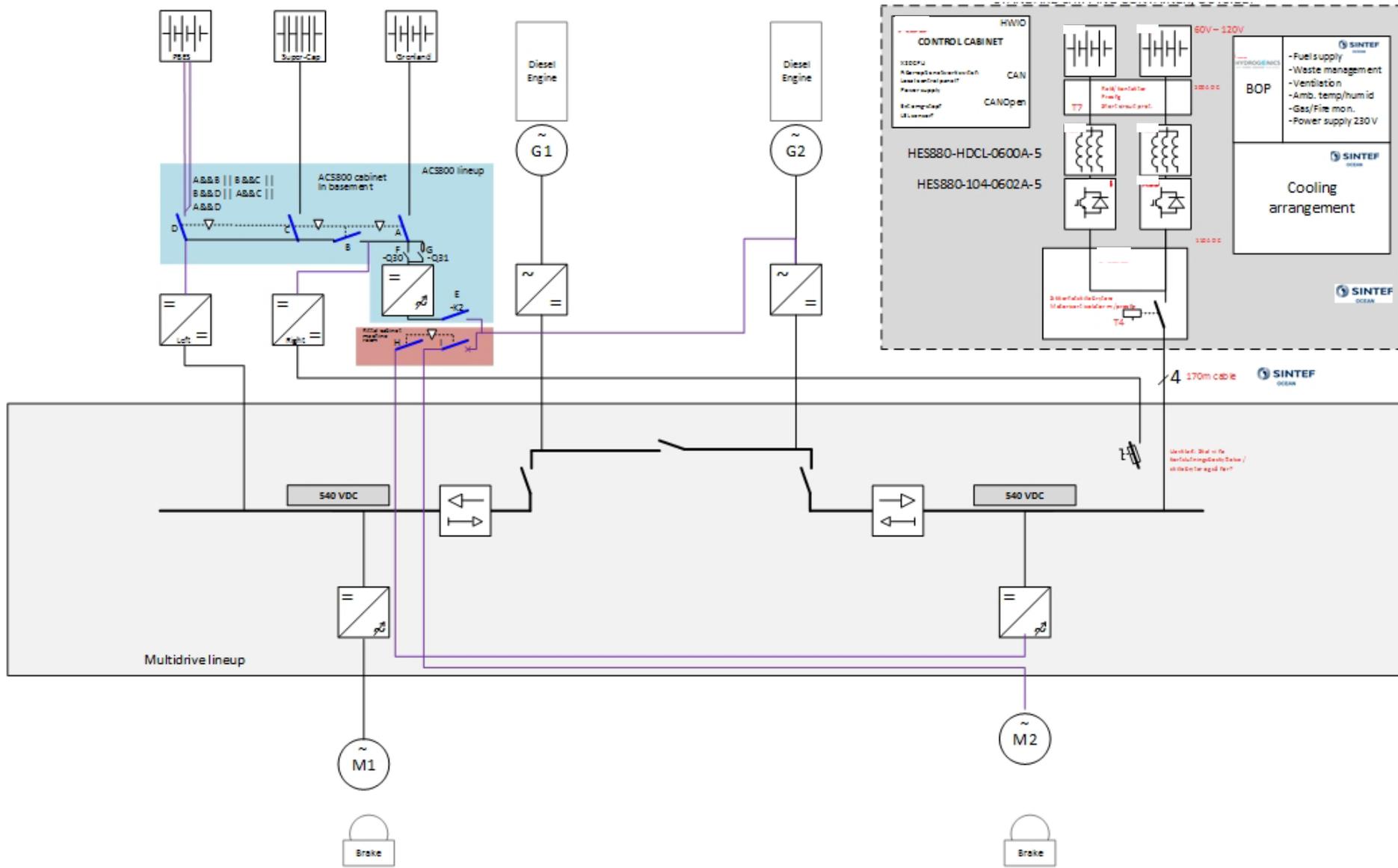
About experiments

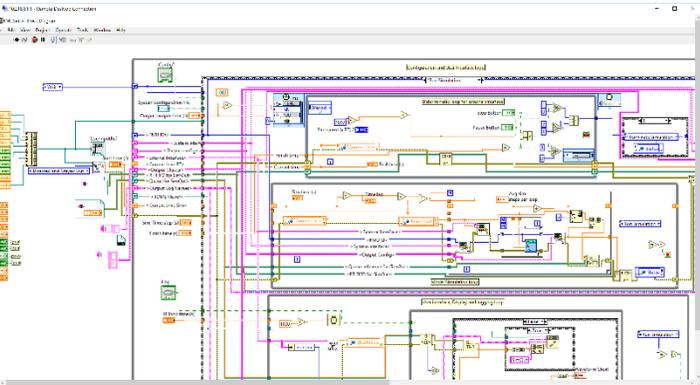
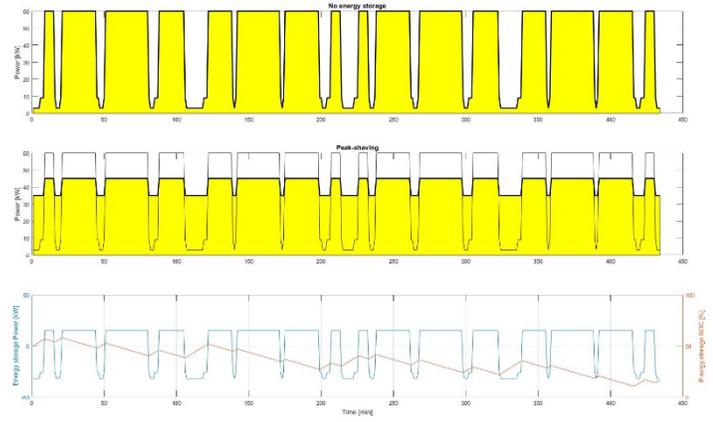


About experiments

- Experiments are the backbone of our activity
- Independent verification of models
- Complete marine powerplant
 - Diesel engines
 - Energy storage – batteries, capacitors
 - Fuel cells
 - Electric motors and brakes
 - Re-generation of energy (future)







Simulation

New, tested solutions

Modelling

Experiment





Teknologi for et bedre samfunn