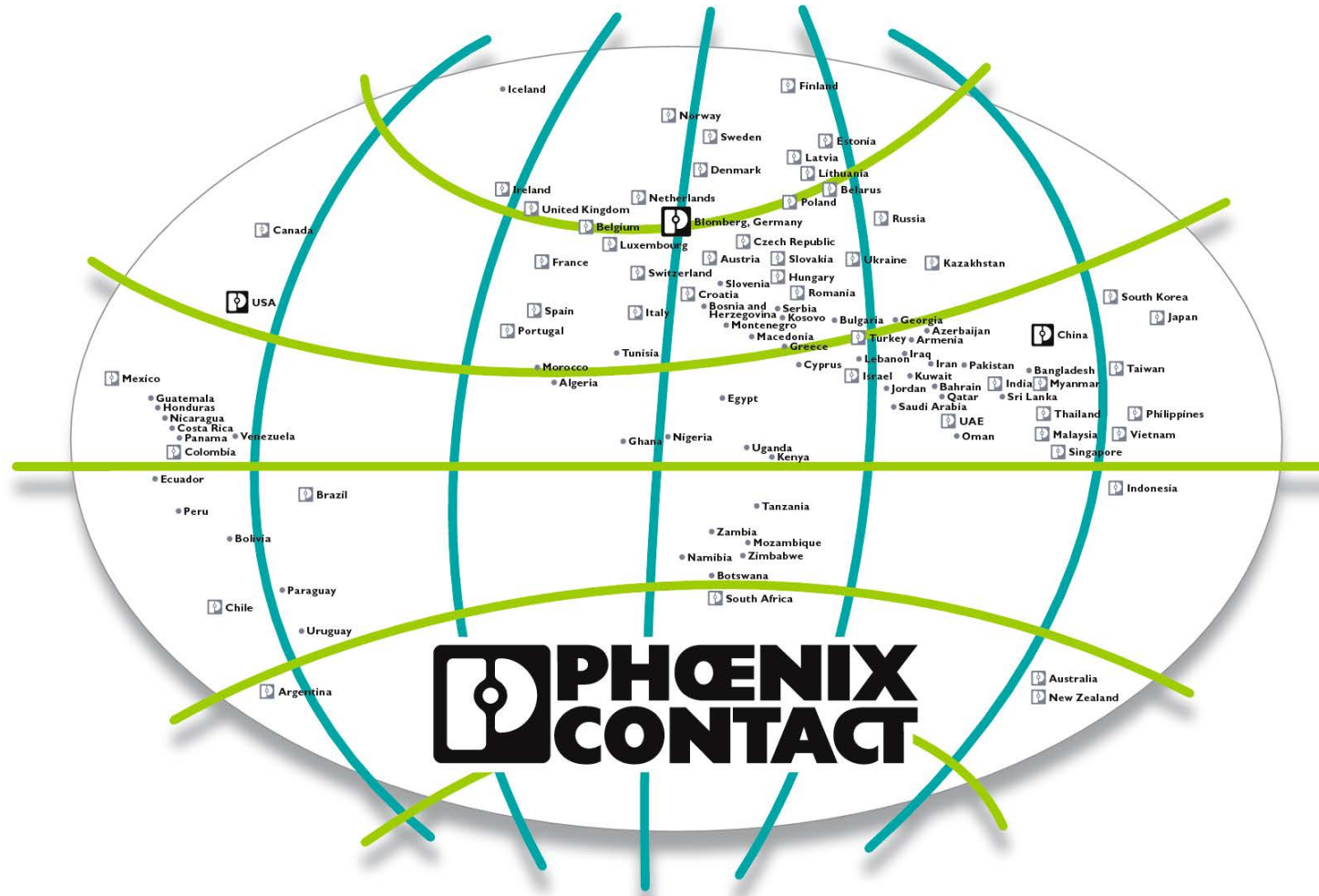


Load Management for Hybrid Energy Systems



Agenda

- Introduction
- System overview
- Model based design
- Conclusion

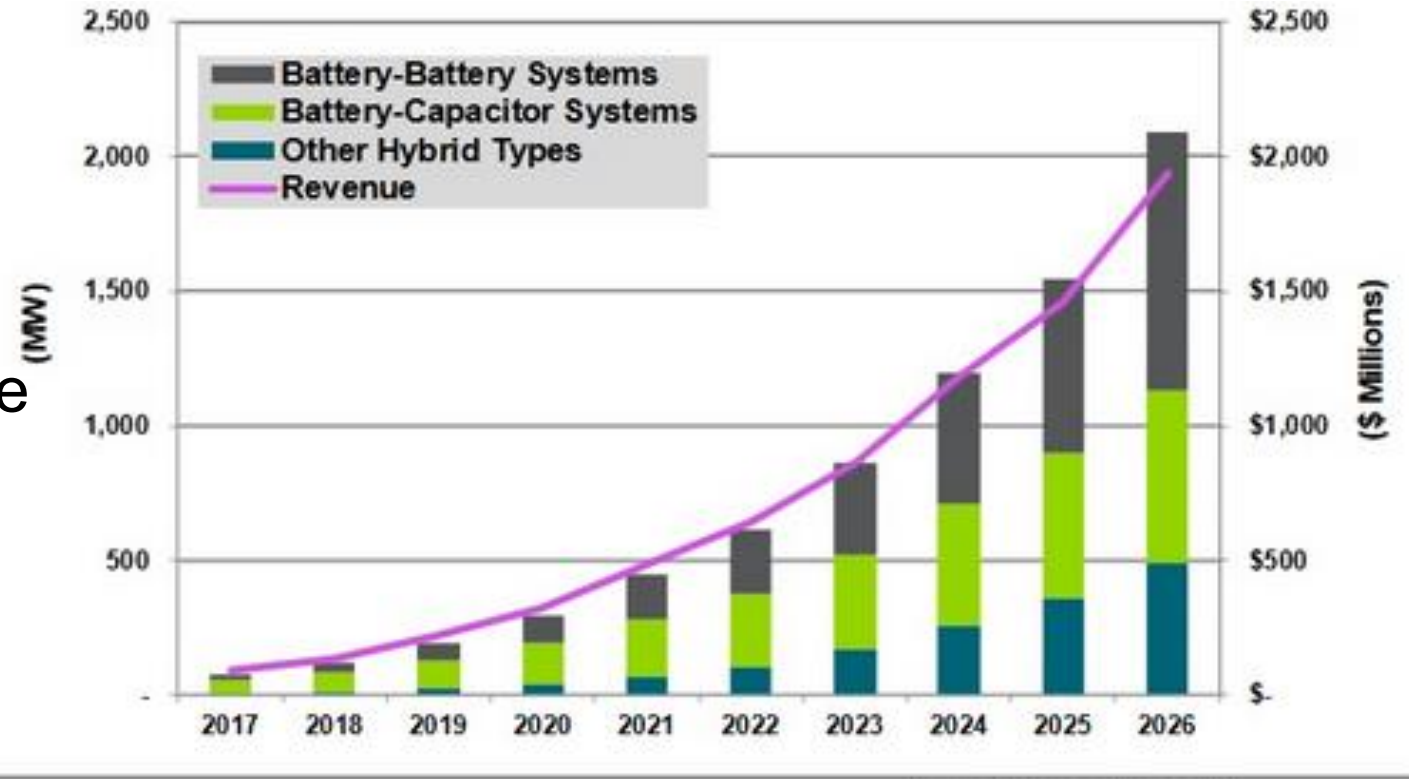


Hybrid Micro-Grid to power Ngarenanyuki School in Tanzania

Introduction

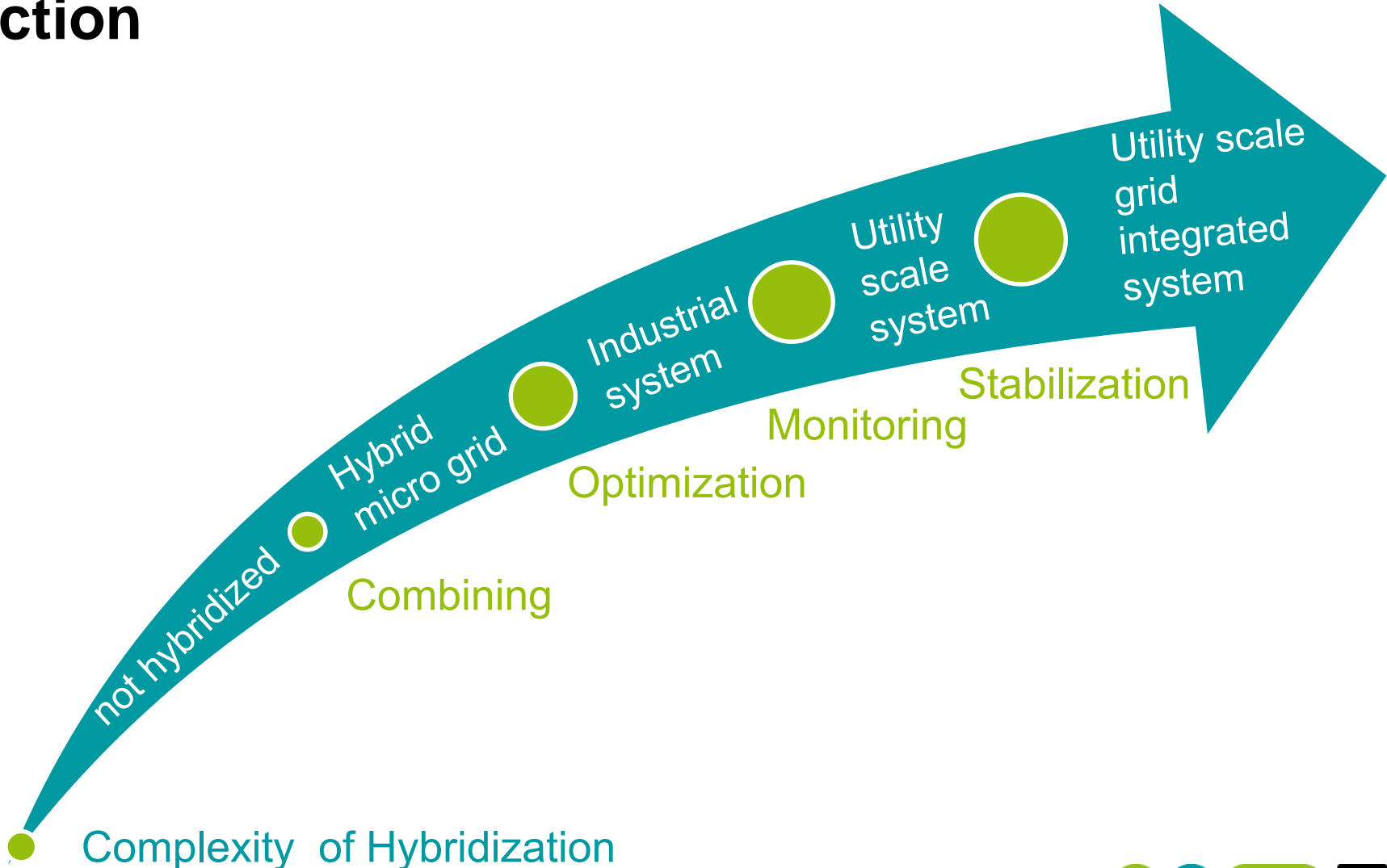
- Installed capacity of HESS will be 2.1GW in 2026
- 26 times more than today
- this corresponds to an increase of more than 2500 %
- Great potential for the entire industry

Outlook of installed hybrid energy storage systems (HESS) from 2017 to 2026 world wide

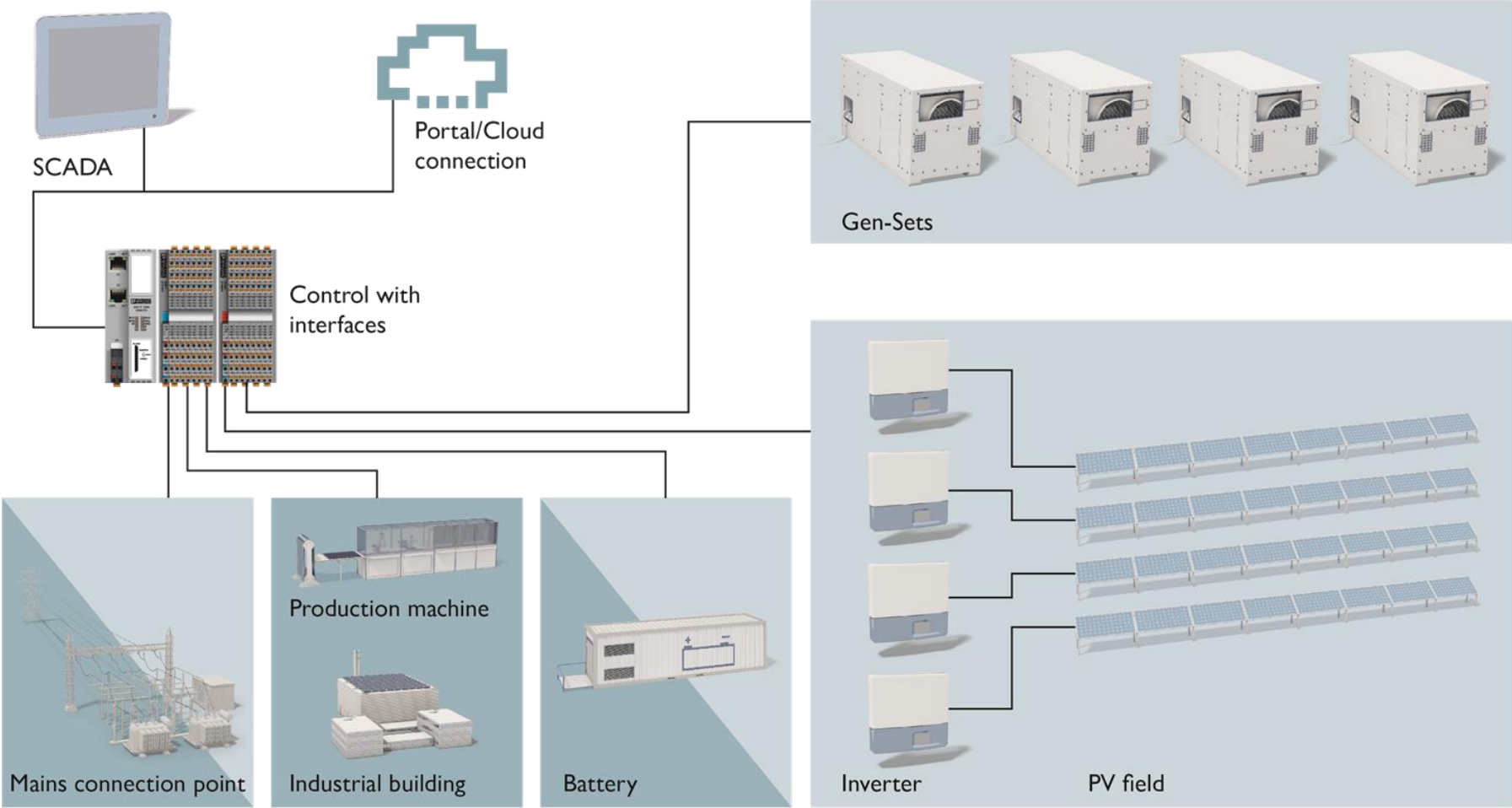


(Source: Navigant Research)

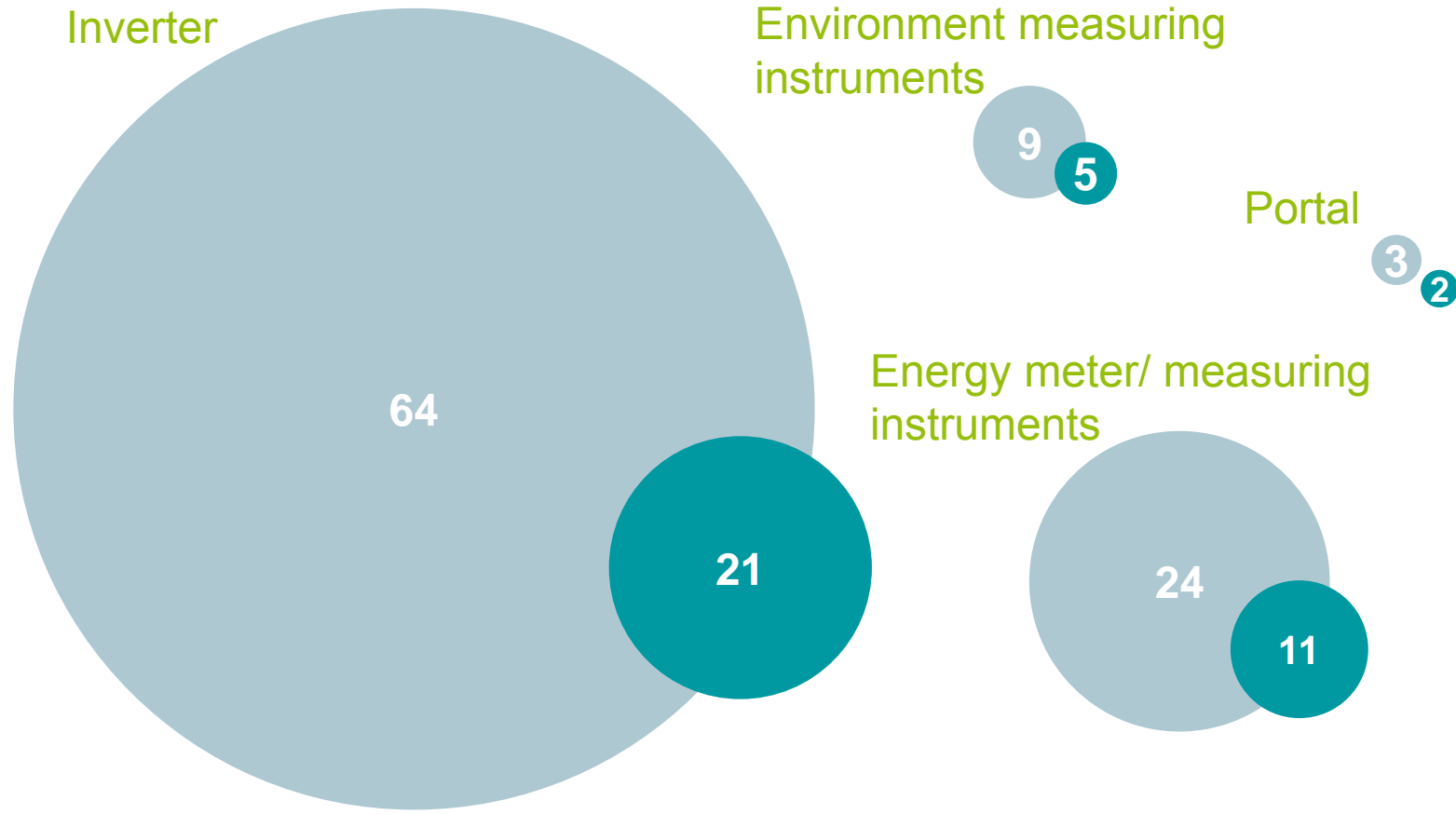
Introduction



System overview



Software drivers and function blocks



Gen-Sets/ Storage System

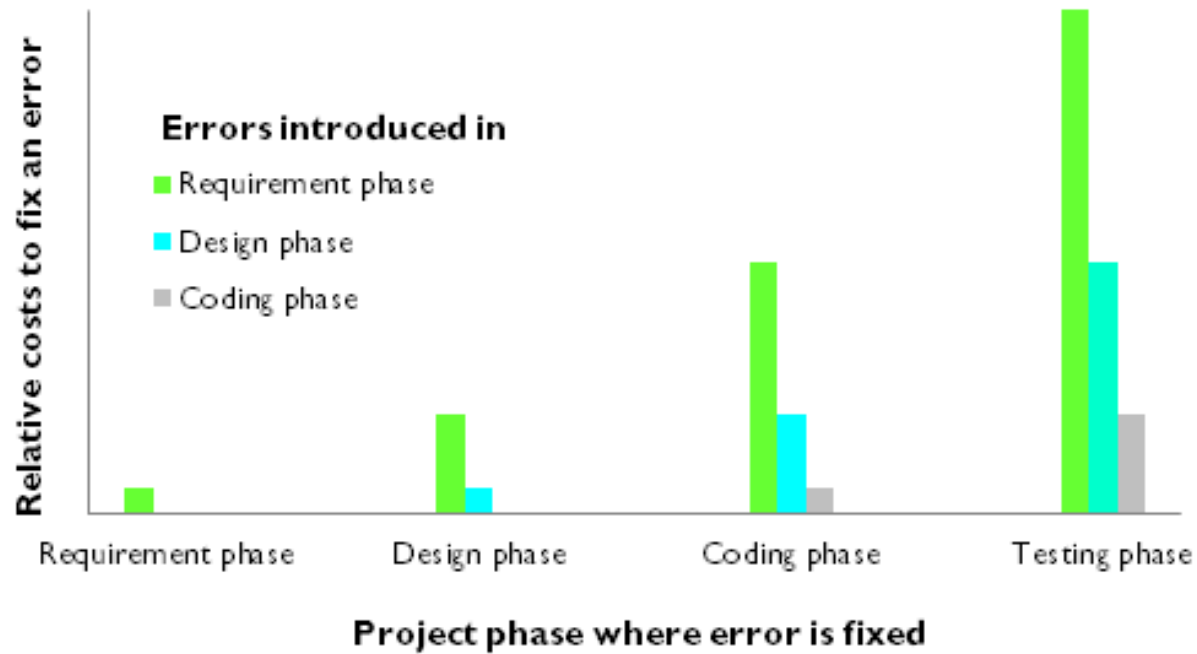


Compatibility table is available!

Model based design

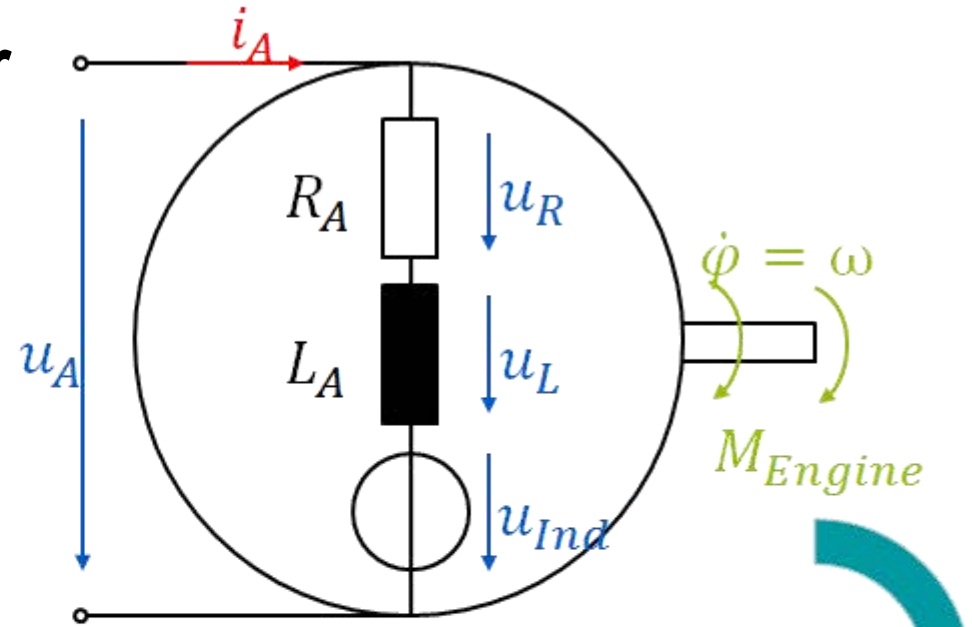
Cost reduction thanks to model based design

Project development costs in relation to error detection phase *)



Model based design

Exemplary model of an electric motor



$$u_A = u_R + u_L + u_{Ind}$$

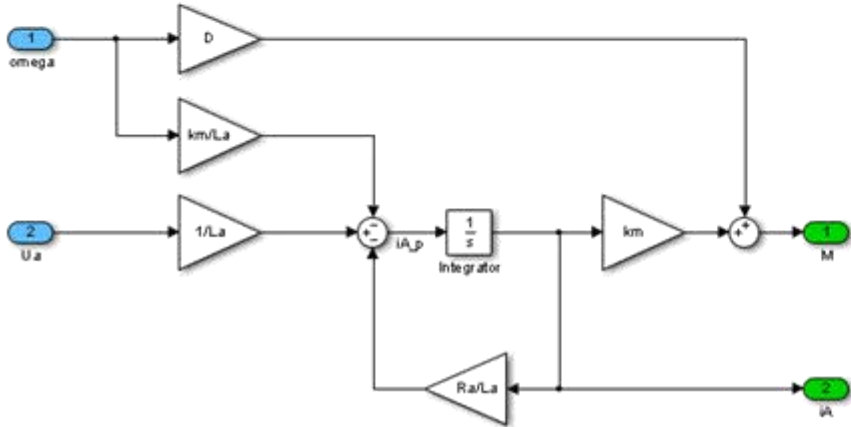
$$u_R = R_A \cdot i_A$$

$$u_L = L_A \cdot i'_A$$

$$u_{Ind} = k_m \cdot \omega$$

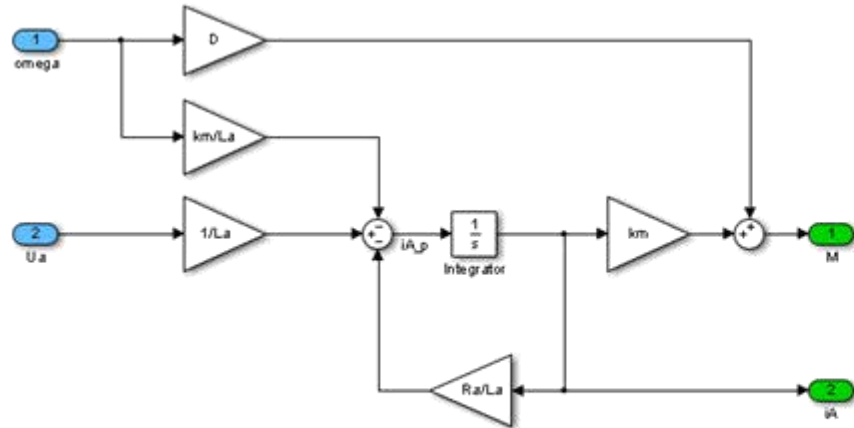
$$i'_A = -\frac{R_A}{L_A} \cdot i_A + \frac{1}{L_A} u_A - \frac{k_m}{L_A} \omega$$

$$\Theta_M \cdot \dot{\omega} = k_m \cdot i_A$$

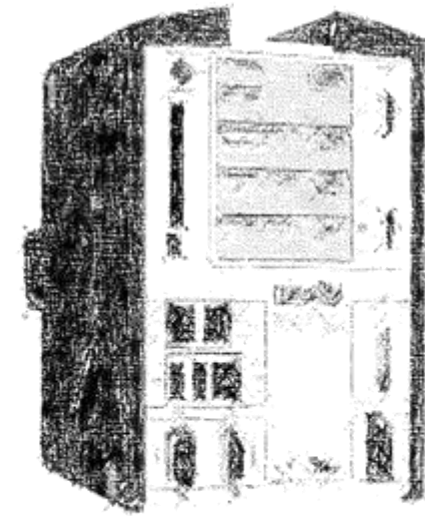


Model based design

Model transformation to the executable code

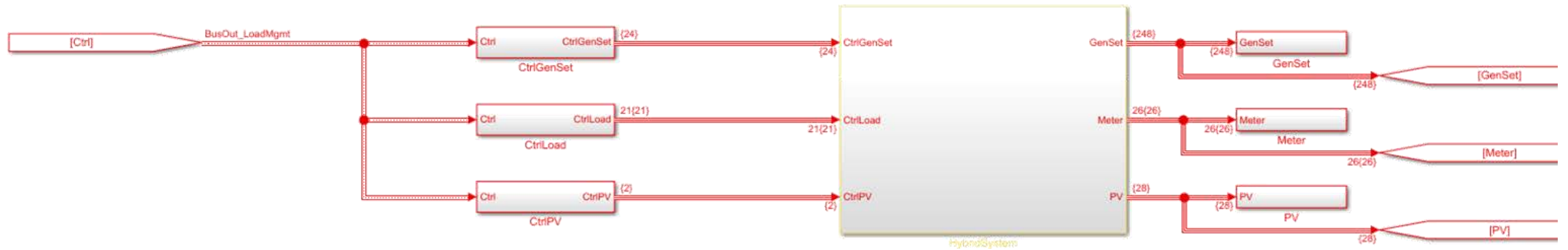
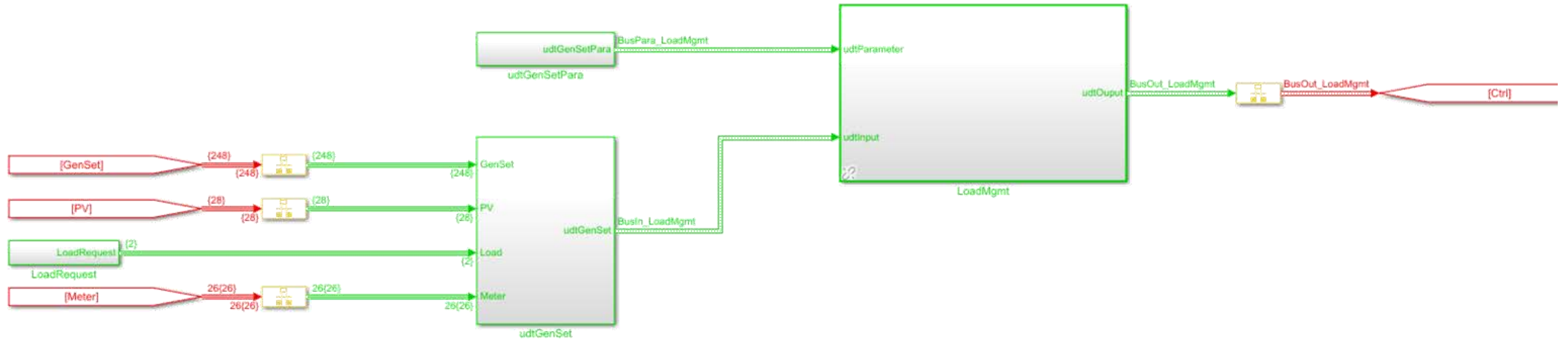


Model transformation



Model based design

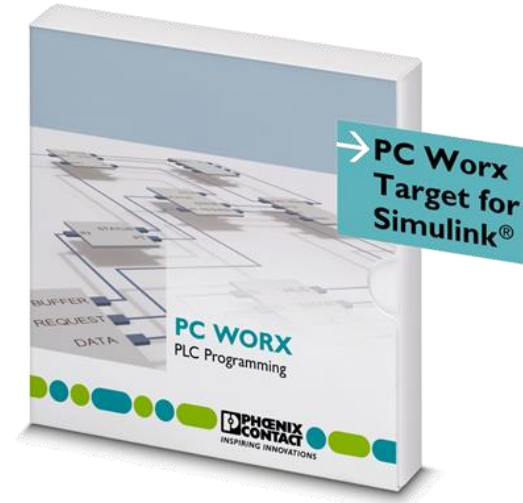
Exemplary model of a hybrid energy system



Model based design

PC Worx Target for Simulink

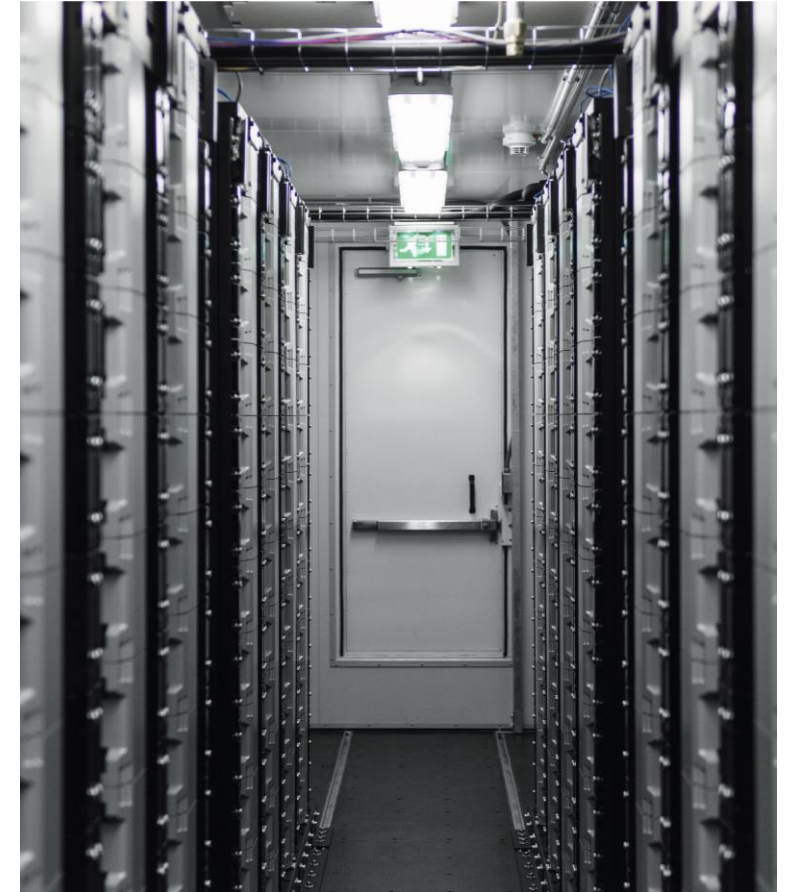
- Automatic conversion of MATLAB/Simulink models into device-specific code for the controller.
- Structured program implementation and simulation / verification in advance, thanks to model-based system design
- Early-stage system simulation and startup by means of “hardware in the loop”
- Quick and easy system testing by means of “Rapid Prototyping”
- Maximized system performance by means of gradual tuning by optimized controls
- Monitor and modify live parameters during model execution on the controller through external mode



Conclusion

Advantages of our solution:

- Cost-efficient engineering thanks to model based design
- Programming software standardized according to IEC 61131
- Fast and secure engineering, thanks to dedicated standardized function blocks
- Open control platform, all inverter, battery storage system, and genset types can be integrated.
- The hybrid energy system can be extended as necessary at any time.



The first Bavarian storage system to stabilize the power grid

Thank you