



GAMMA
TECHNOLOGIES

SAFE & EFFICIENT ENERGY STORAGE

Creating a Greener Future with Simulation & Digitization for Your Energy Storage Systems

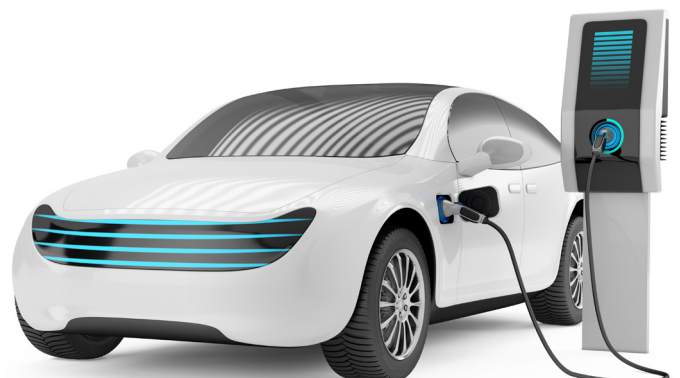
Using Simulation to Support the Transition to Sustainable Energy

Energy storage systems (ESS) With economic growth, higher demand for energies and the race to reduce carbon footprint, renewables will continue to become a stable partner in power production. However, renewable energies usually present an intermittent power production capability with dependency on ambient conditions. This is why energy storage systems (ESS) are becoming a much-needed asset to support power production from renewable sources.

Energy storage systems solve this issue by strategically storing electricity, safely and then delivering it back when needed into the grid but they also present a complex set of challenges that require testing and experimental assets to ensure efficiency and safety.

Gamma Technologies, the industry-leading Model-Based Systems Engineering (MBSE) solution provider, offers a holistic multiphysics solution to build any energy storage, production or power conversion system. Systems such as batteries, power supplies, combustion, renewables and power converters can be developed and chained together to constitute an optimized system.

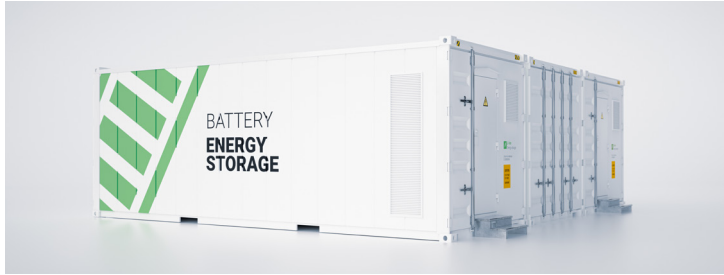
This makes Gamma Technologies and its simulation solution suite the ideal trusted partner for supporting transition towards sustainable energy.



Physics-based Modeling as a Backbone for ESS Digital Twins

POWER DENSITY & BATTERY / PACK DESIGN Starting from the choice of the battery chemistries, size and power properties, the battery ESS architecture needs to be optimized to the relevant application (peak and nominal load, footprint available, use cases). Cooling solutions for the cell racks needs to be accounted for as well, with corner cases evaluated such as thermal safety. Scalability also plays an important role when selecting the cells, since storage capacity and type of battery needs to be easily adapted to individual power and capacity requirements. For those reasons, putting effort early on into cell predictive modeling is recommended...thus limiting laboratory testing.

Gamma Technologies provides the most advanced battery modeling suite for cell design, aging prediction and integration with the electrical and thermal management systems.



DIGITIZATION & CONNECTIVITY ESS systems cater themselves to be prime candidates for data exchange, predictive maintenance and online optimization of control algorithms. GT provides industry leading system simulation solutions enabling digital twin creation from batteries, battery management systems (BMS), inverter choice to the complete HVAC systems for enclosure conditions stabilization. Systems and components can communicate together in the pre-design phase as well as during active deployment through the utilization of digital twins for condition monitoring and predictive analysis.

INTEGRATION AND THE IMPORTANCE OF MULTI-SCALE-MULTI-PHYSICS The key to succeeding in the energy transition journey is the right energy mix between gas, fuels, alternate fuels like H2 and ESS. Practically, this leads to engineering tasks such as sizing gas and diesel generators and ESS systems, while having a robust controller to orchestrate between the different energy sources as a function of demand.

This is where GT multi-scale physics solutions are valuable. A high-fidelity gas generator, for example, can be modeled with an ESS system. This allows investigation of the “time-to-load” and assess the right sizing between ICE and ESS for each particular client use case.



How GT-SUITE's System Simulation can help:

- Continuous thread from battery design and selection to system integration in the ESS
- Multi-physics solution to investigate a complete ESS design and performance including thermal effects on cells, thermal-runaway, aging, charge and discharge .
- Real-time, predictive models that can run SiL/HiL (Software and Hardware –in-the-loop) as well as on the cloud for live monitoring

Democratizing Simulations with GT-Play : A cloud-based solution



Key Takeaways:

- Model-based Digital Twin for component and system health monitoring
- Topology optimization driven by digitization
- Online controls optimization for minimal operating costs

Using GT Solutions to Optimize Microgrid Design

