

# Building today's microgrids

*Popular perception. . .*



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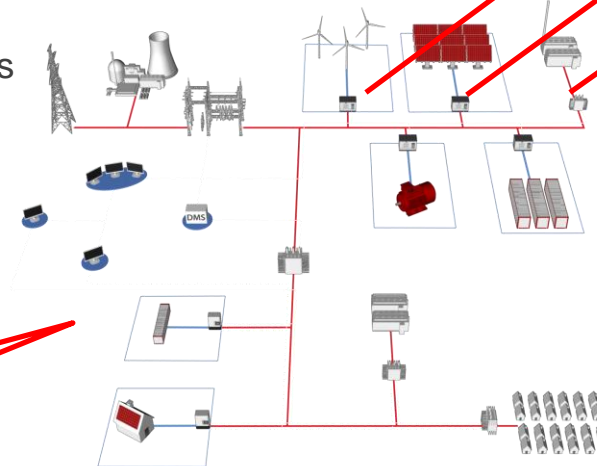
*Reality!*



# Digital power is more than “plug and play”

## System dynamics driven by power electronic converters

- Microgrids
- Smart converters
- distributed generation
- distributed control
- smart FACTS devices
- distributed storage



## Dynamic analyses

- Component interoperability
- Faults/protection
- Load shedding
- Transients
  - ☐ Pulse loads
  - ☐ Islanding
  - ☐ Black start
  - ☐ Brown start



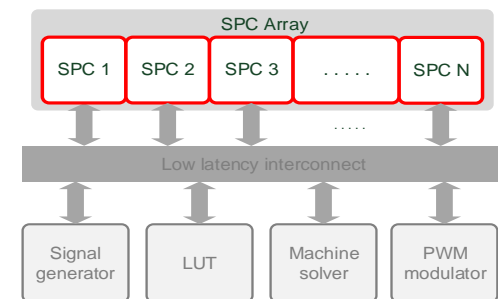
## Vendor component integration



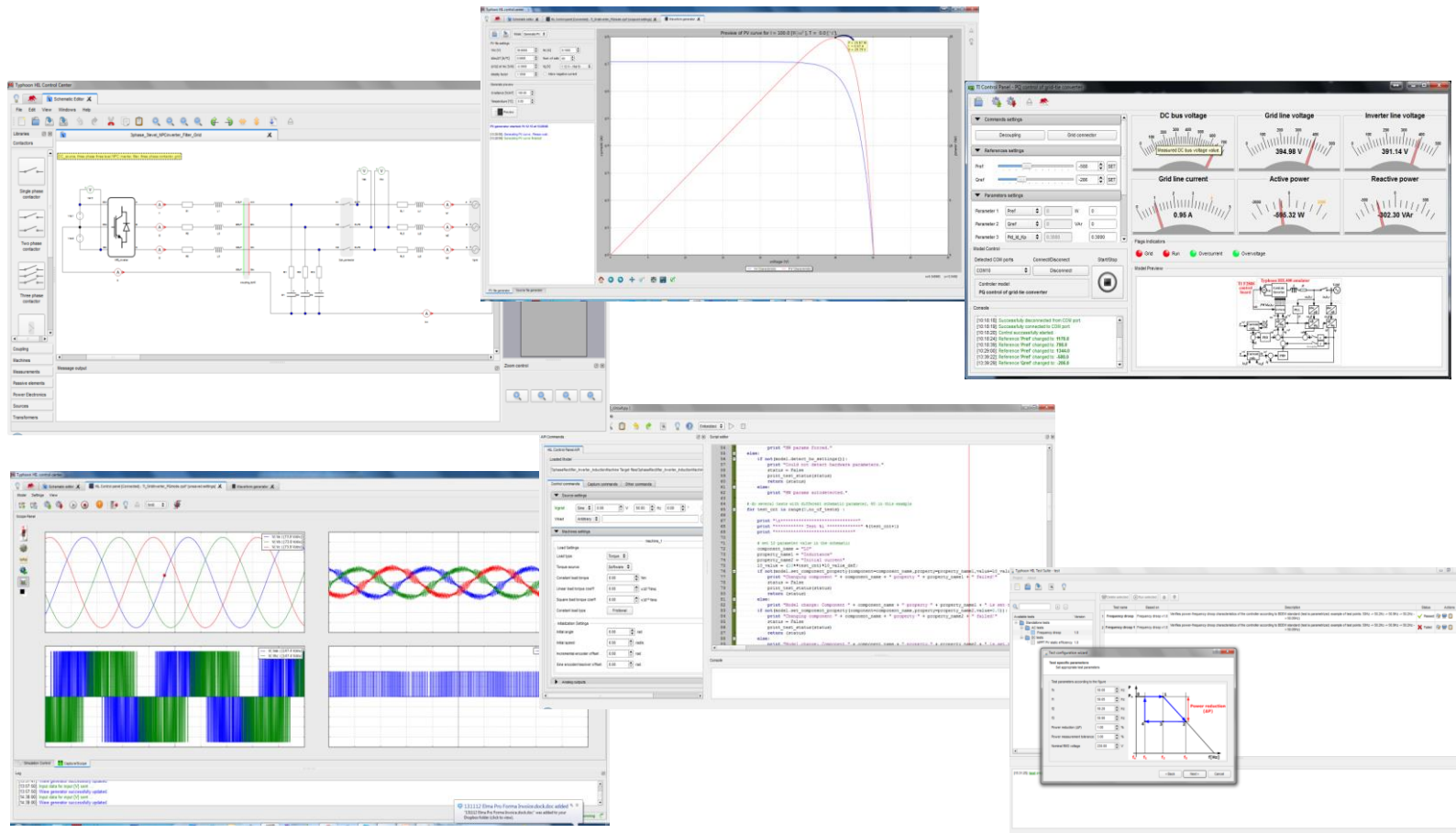
# Typhoon HIL Simulators

Made for power electronics and microgrid applications

- Modular design
  - Multiple units can be stacked together
  - Behave as a single large simulator
- FPGA based from entry level
- Use Typhoon scalable multi-core FPGA solver
  - On the market from 2009
  - Able to support large multi converter models
  - Sim step down to 500ns (1us typical)
  - Week long test runs
- Connectivity
  - High speed and high precision analog and digital I/O
  - Industry standard protocols



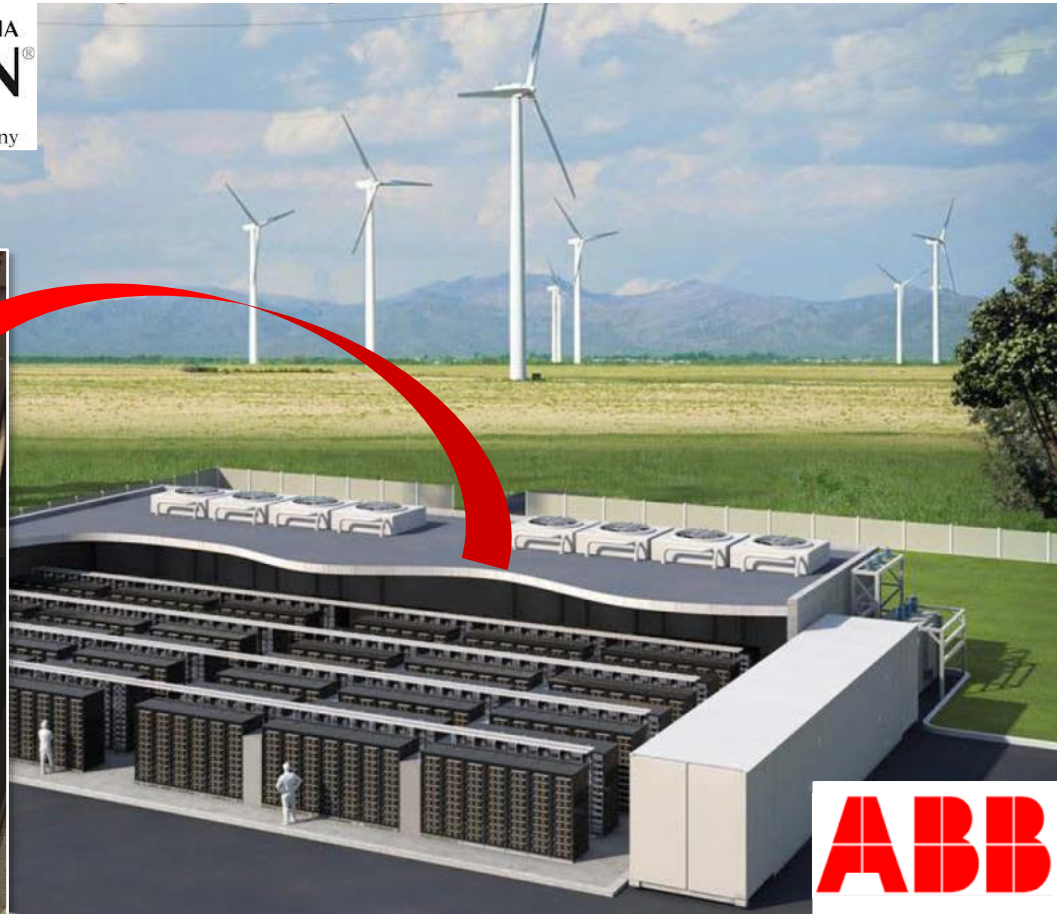
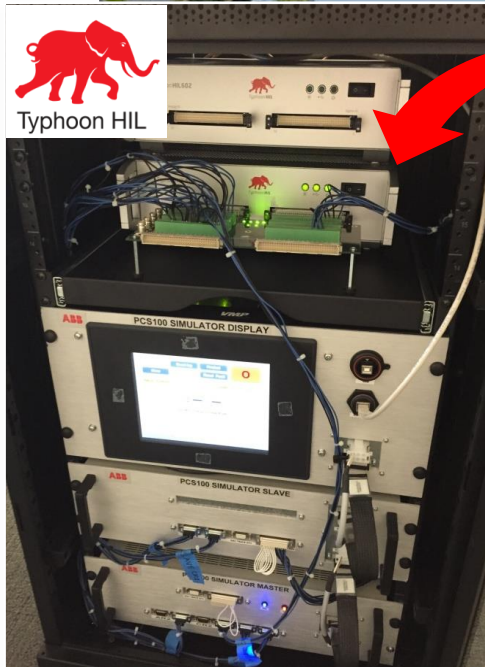
# Typhoon digital power integration: easy to build, customize, analyze and visualize



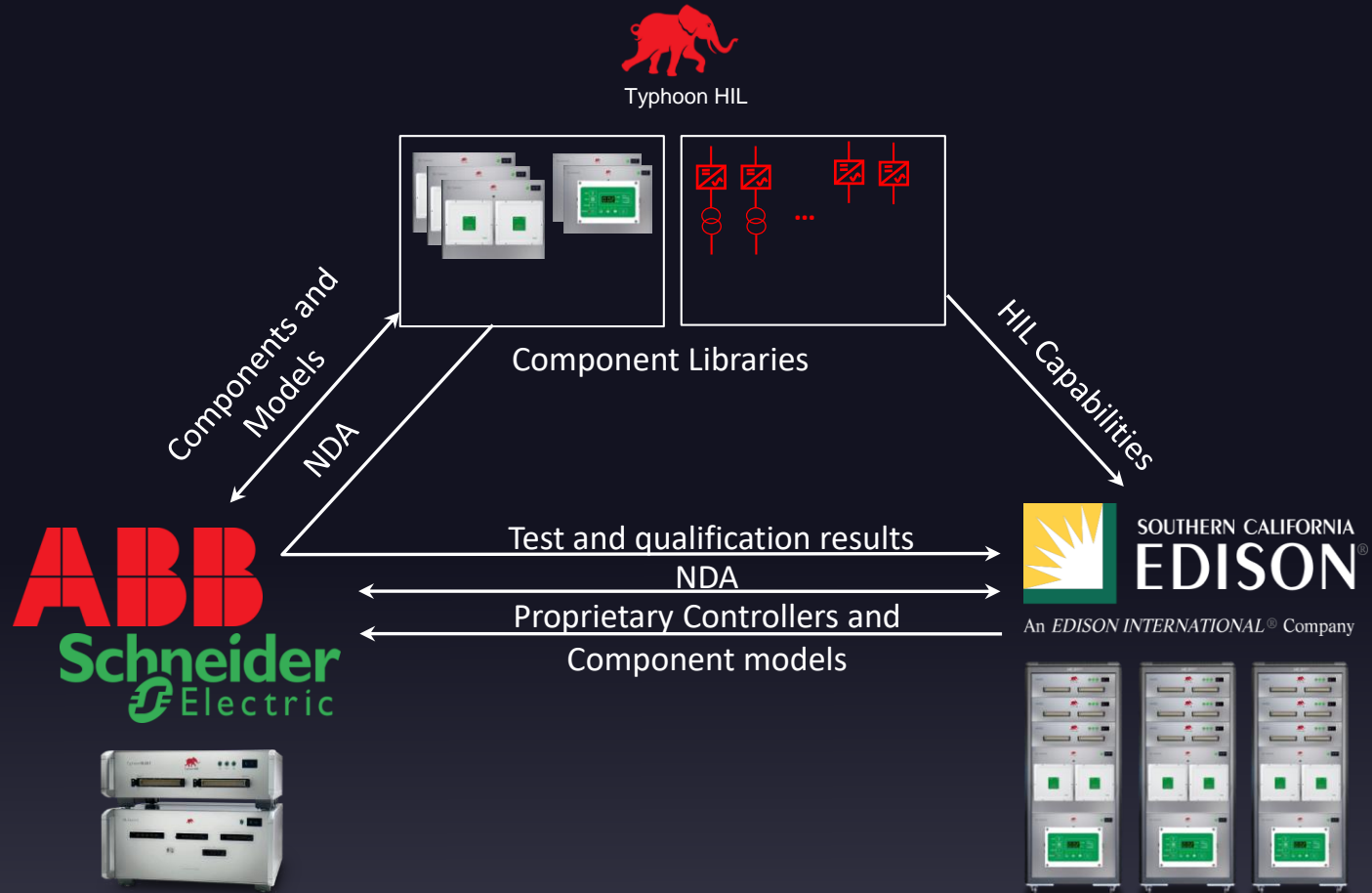


# Typhoon HIL 8 MVA Grid battery real-time simulation

## Tehachapi Energy Storage Project



# Sharing HIL Libraries



# Digital Model-Based Life Cycle Support

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## services

- Expert consulting by application engineers
- Technical support from product developers
- On-site and off-site training
- HIL software, firmware and hardware customization

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## software

- Vertically integrated system
- Graphical modeling of power circuits
- Custom test interfaces
- Test automation with open source Python
- "One click" grid codes pre-certification

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## hardware



HIL devices



HIL-Controller  
interfaces



Large scale  
simulators

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