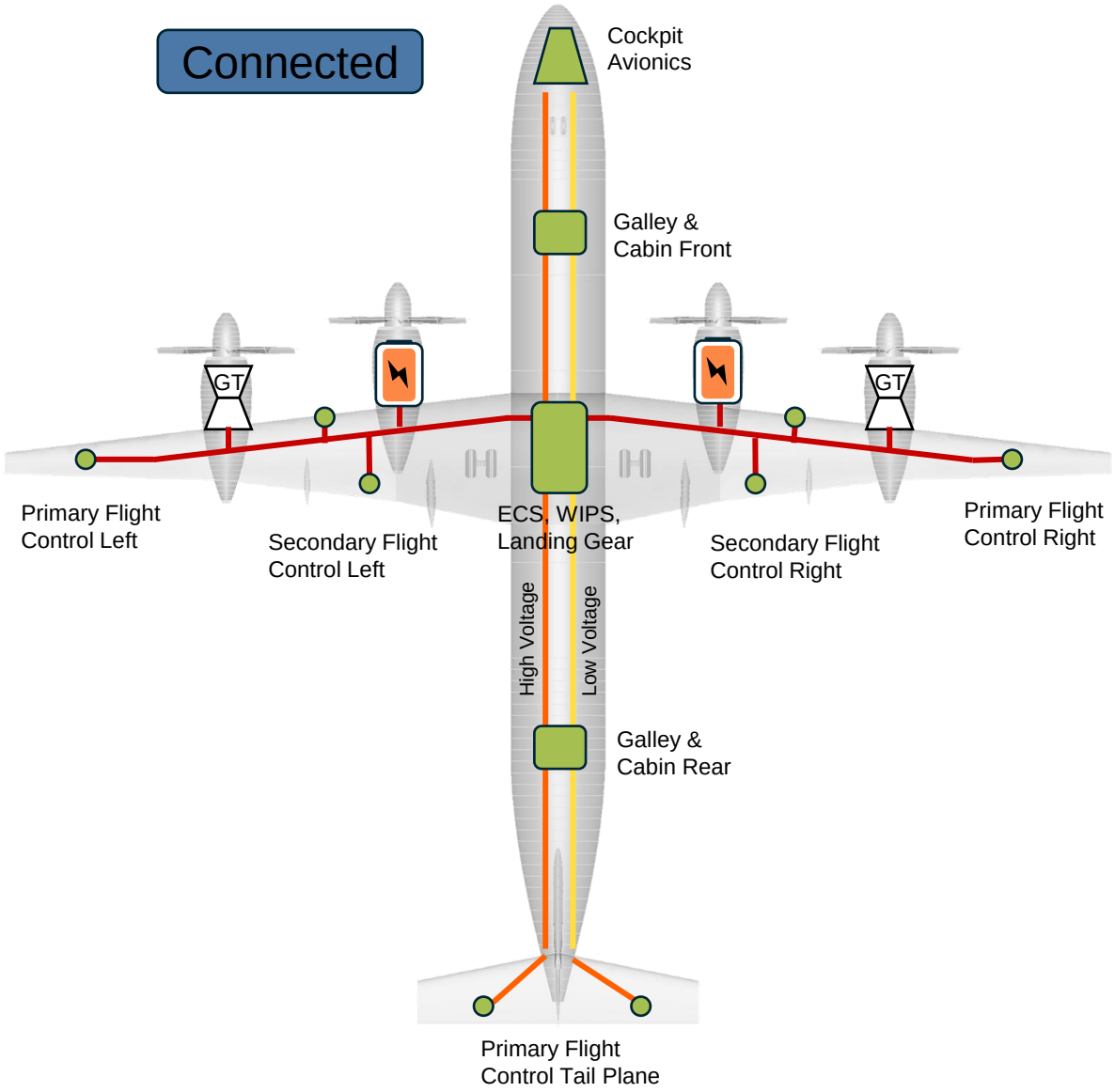
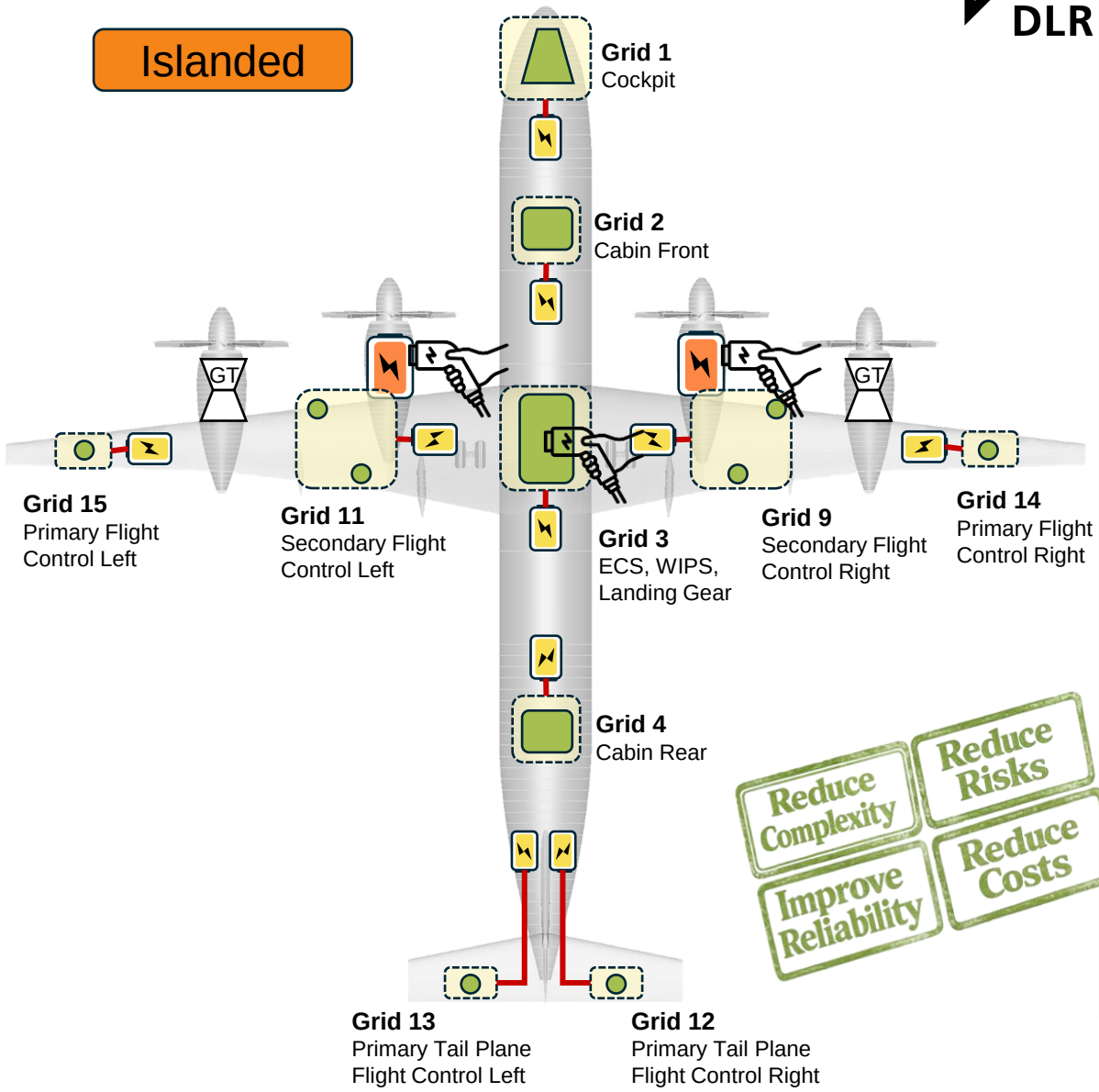
RECHARGEABLE BATTERY-INTEGRATED ISLANDED GRID ARCHITECTURES FOR HIGHLY ELECTRIFIED AIRCRAFT

Andrea Reindl, Georgi Atanasov, Franciscus van der Linden

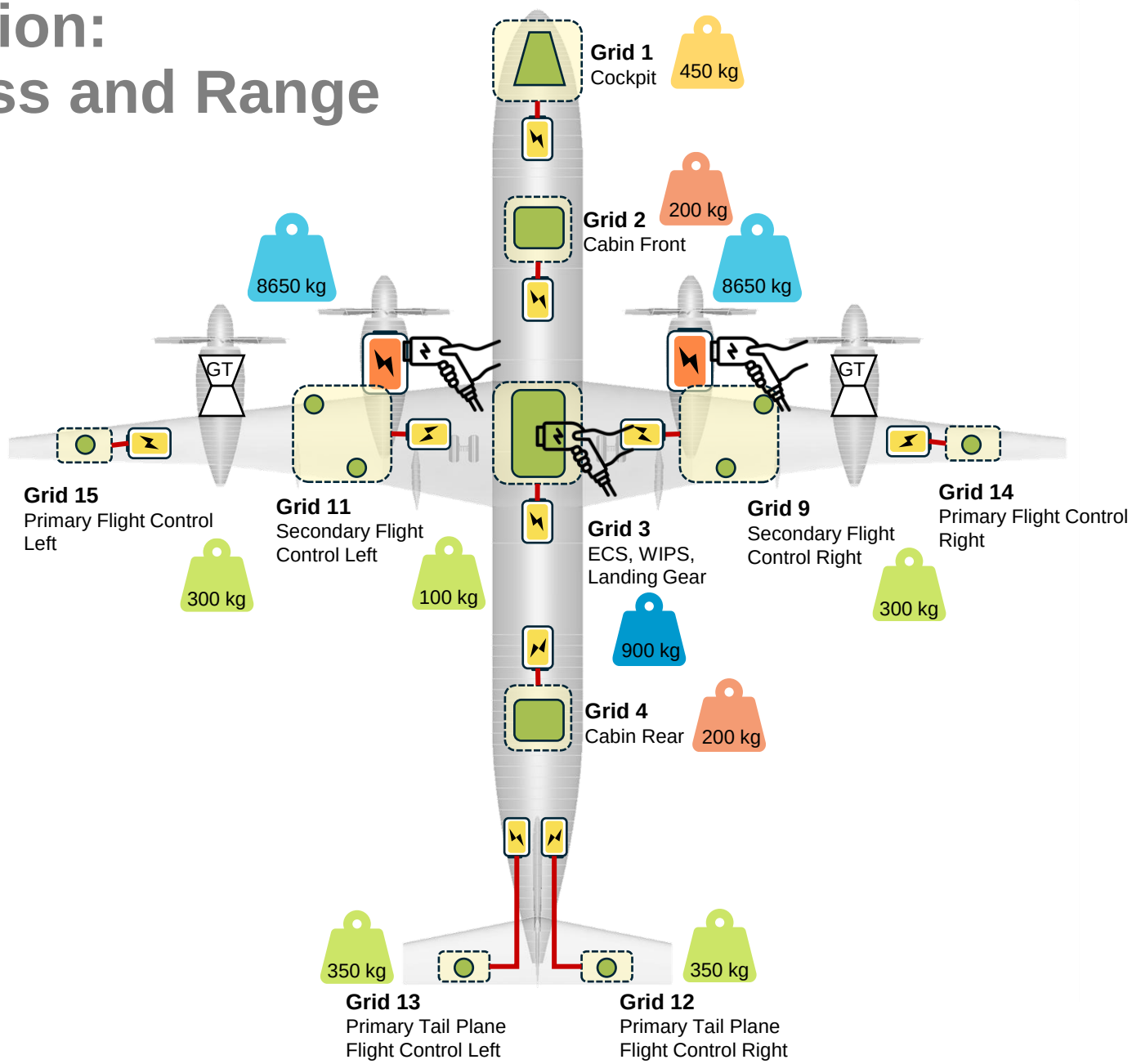
German Aerospace Center (DLR), Institute of System Architectures in Aeronautics

Electrical System Architectures





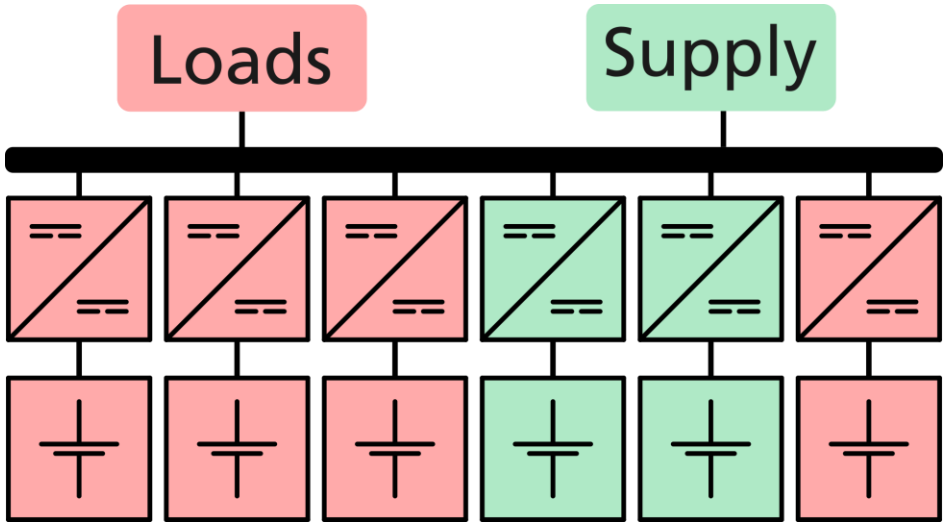
The Limitation:
Battery Mass and Range



Research Question

How can battery-integrated islanded grids be recharged in flight without compromising their electrical separation?

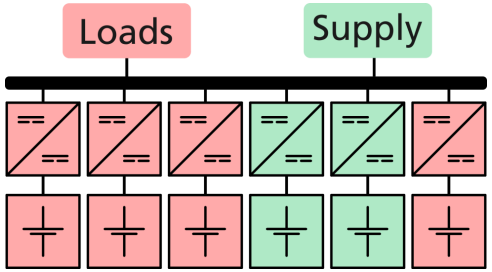
Conventional Architecture: Common Bus



Recharge Architectures

Conventional

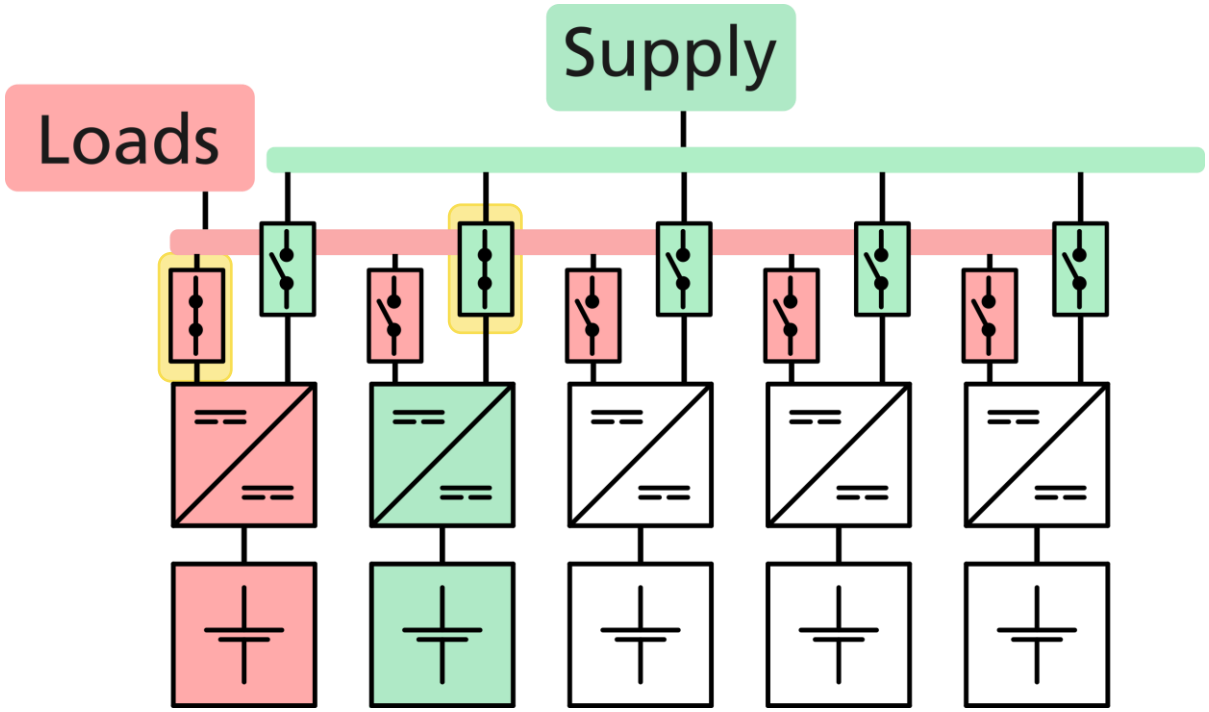
Common bus



+ Simple power sharing

⚠ Direct electric connection between generation and critical loads

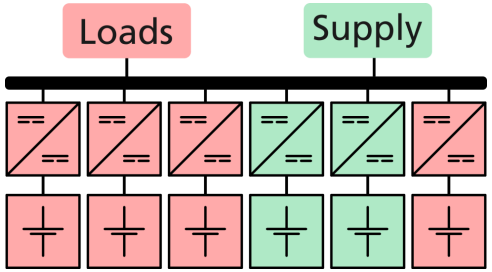
Intermediate Architecture: Sequential (Dis)Charging



Recharge Architectures

Conventional

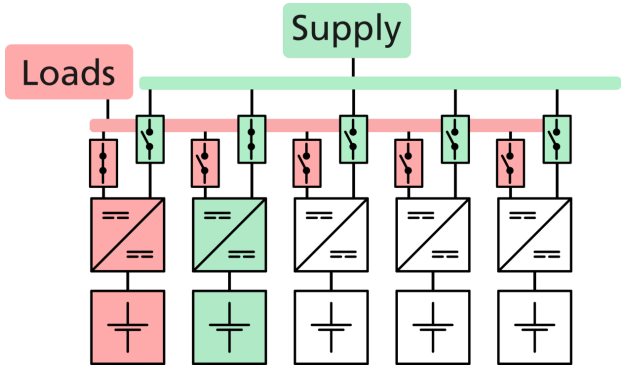
Common bus



- \+ Simple power sharing
- ⚠ Direct electric connection between generation and critical loads

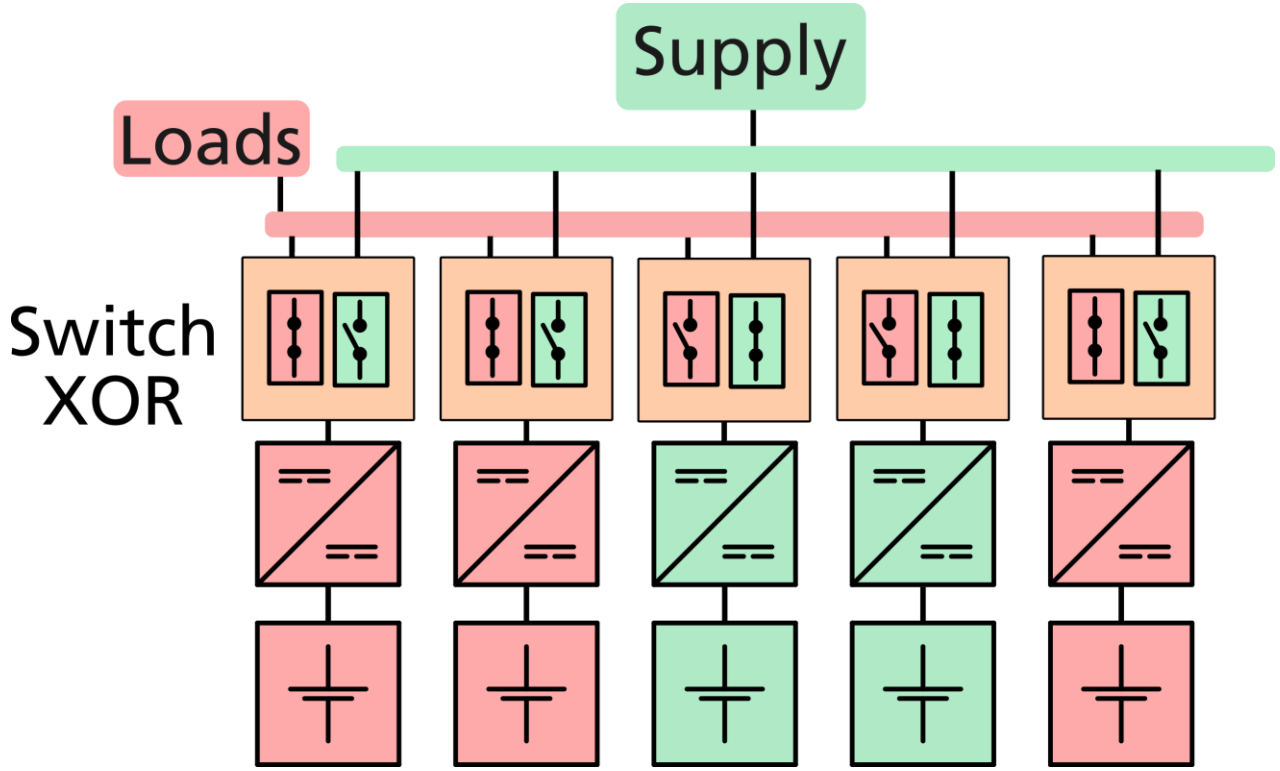
Intermediate

Sequential (Dis)Charging



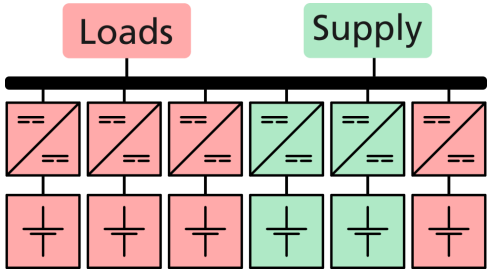
- \+ Simplified fault management
- ⚠ High (Dis)Charge Currents → Derating

Disruptive Architecture: Reconfigurable packs



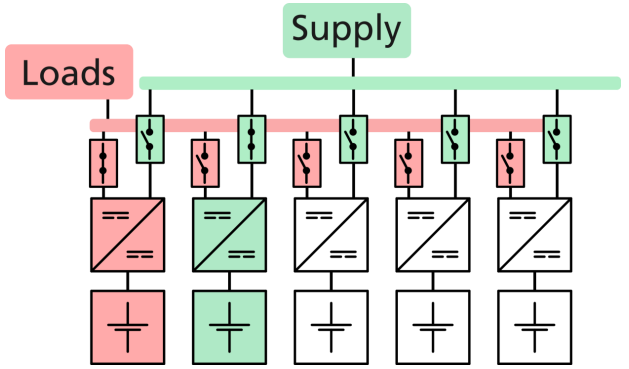
Recharge Architectures

Conventional
Common bus



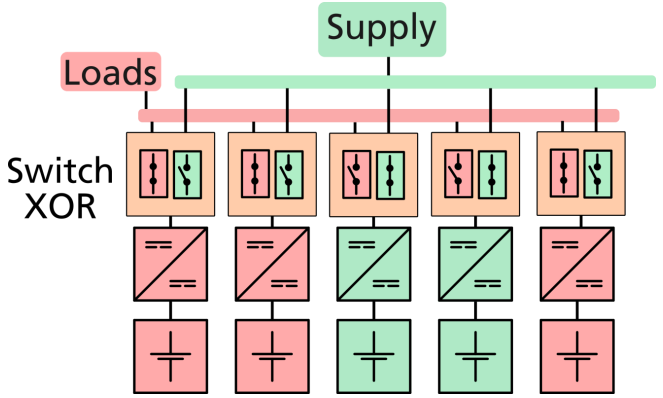
+ Simple power sharing
- Direct electric connection between generation and critical loads

Intermediate
Sequential (Dis)Charging



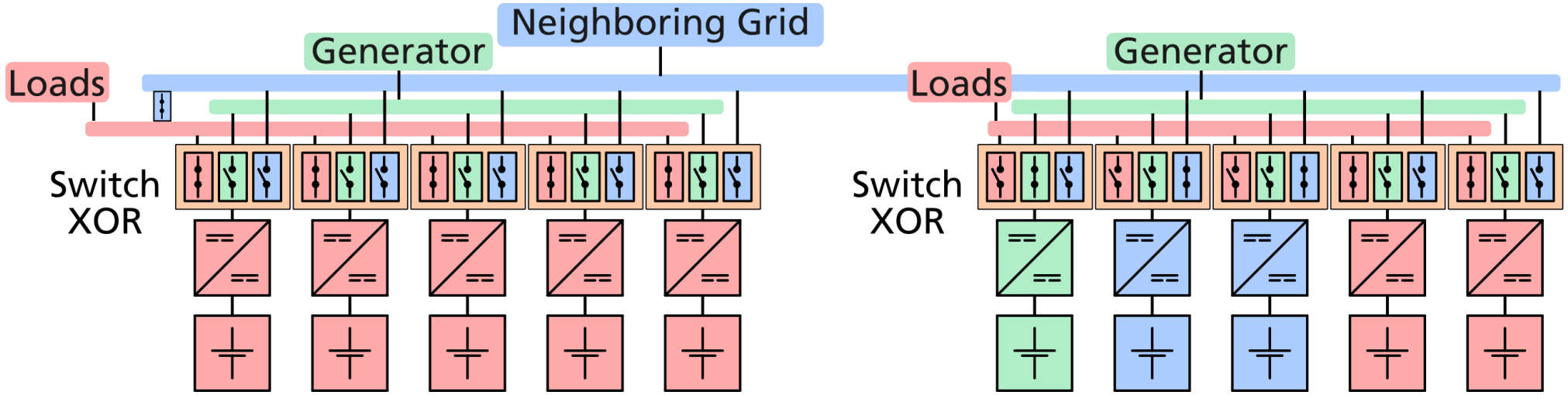
+ Simplified fault management
- High (Dis)Charge Currents
→ Derating

Disruptive
Reconfigurable packs

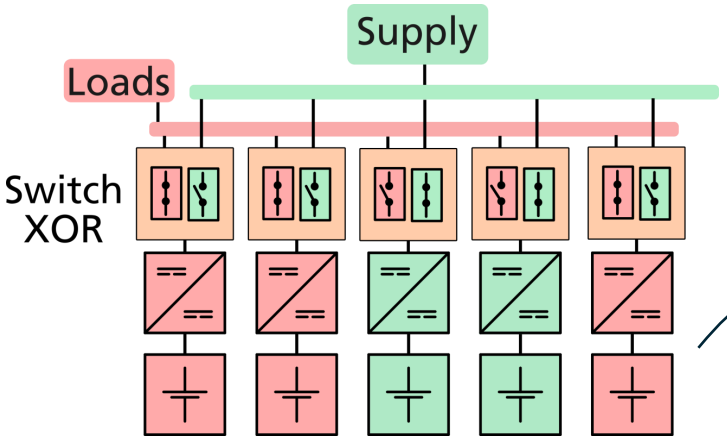


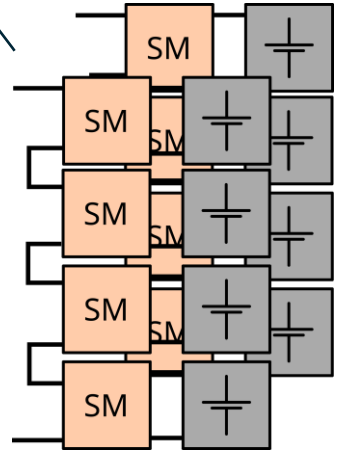
+ Current sharing

Coupling between Neighboring Islanded Grids



Reconfigurable Battery Architecture





Battery Packs with own power electronic (SM)

newsroom
Das Medien-Portal von Porsche

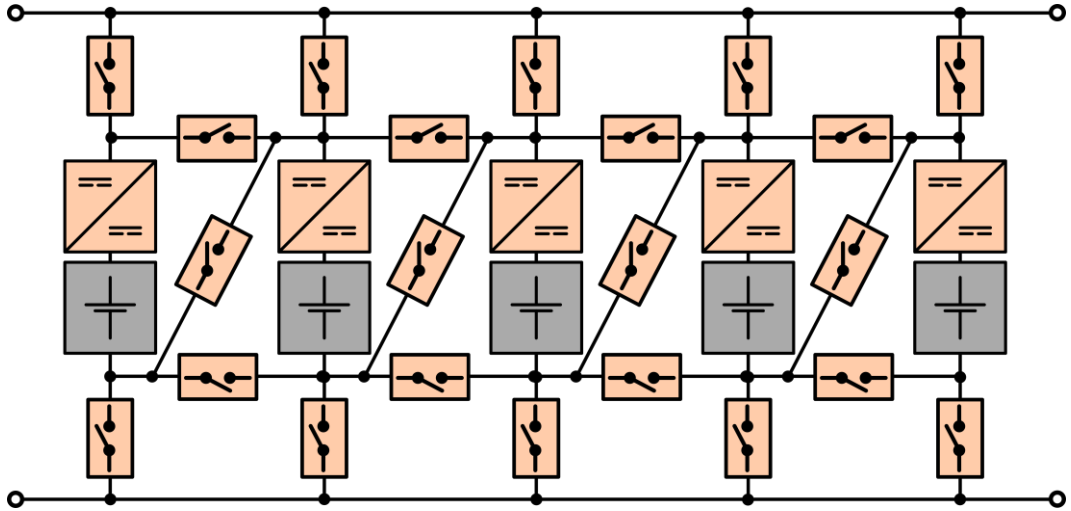
PORSCHE

Porsche Newsroom / Innovation / Modularer Multilevel-Inverter: Aus DC mach AC

Modularer Multilevel-Inverter: Aus DC mach AC

19.03.2025 - Porsche Engineering hat das Konzept einer „Wechselstrom-Batterie" für Elektrofahrzeuge entwickelt, die zahlreiche Komponenten in einem Bauteil vereint. Gesteuert wird sie von einem vereinheitlichten Steuergerätekonzept mit einer besonders leistungs- und echtzeitfähigen Rechnerplattform. Das System wurde im Rahmen einer Machbarkeitsstudie entwickelt, am Prüfstand erprobt und in einem Fahrzeug demonstriert.

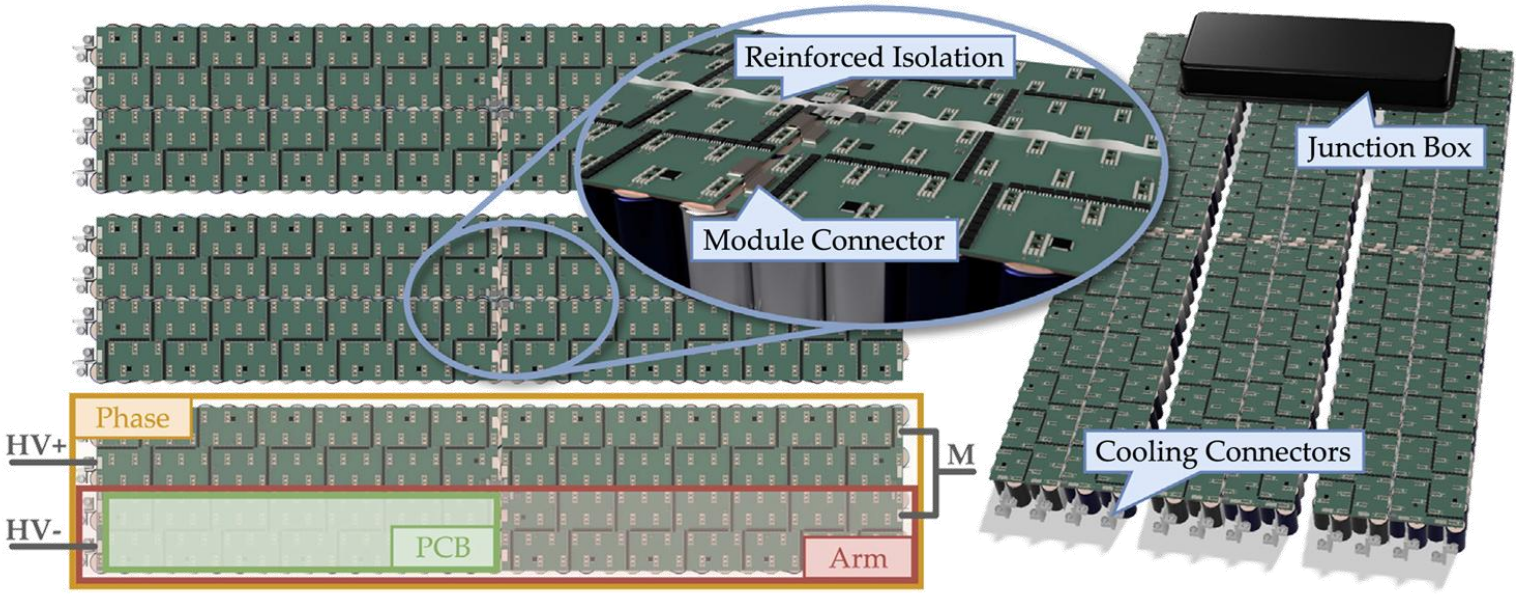
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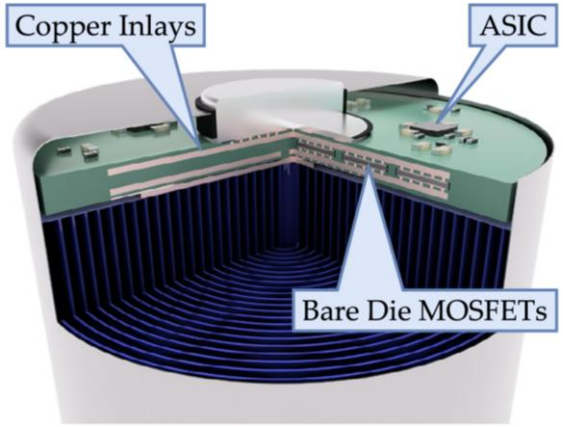
Controllable Switches at Cell Level

[1] https://newsroom.porsche.com/de/2025/innovation/porsche-engineering-multilevel-inverter-dc-ac-38386.html

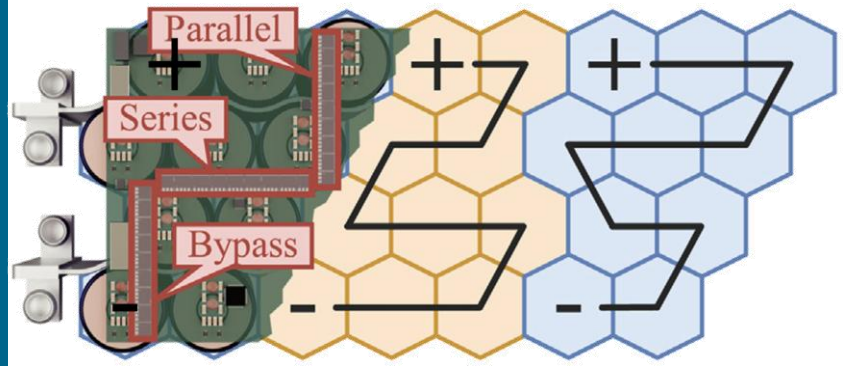
Reconfigurable Battery Architecture



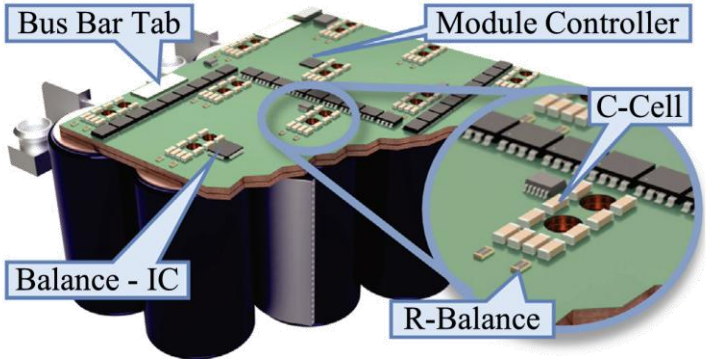
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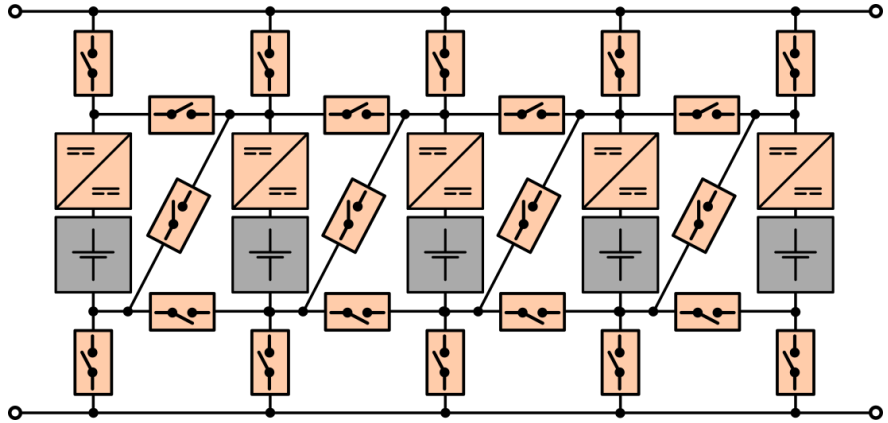


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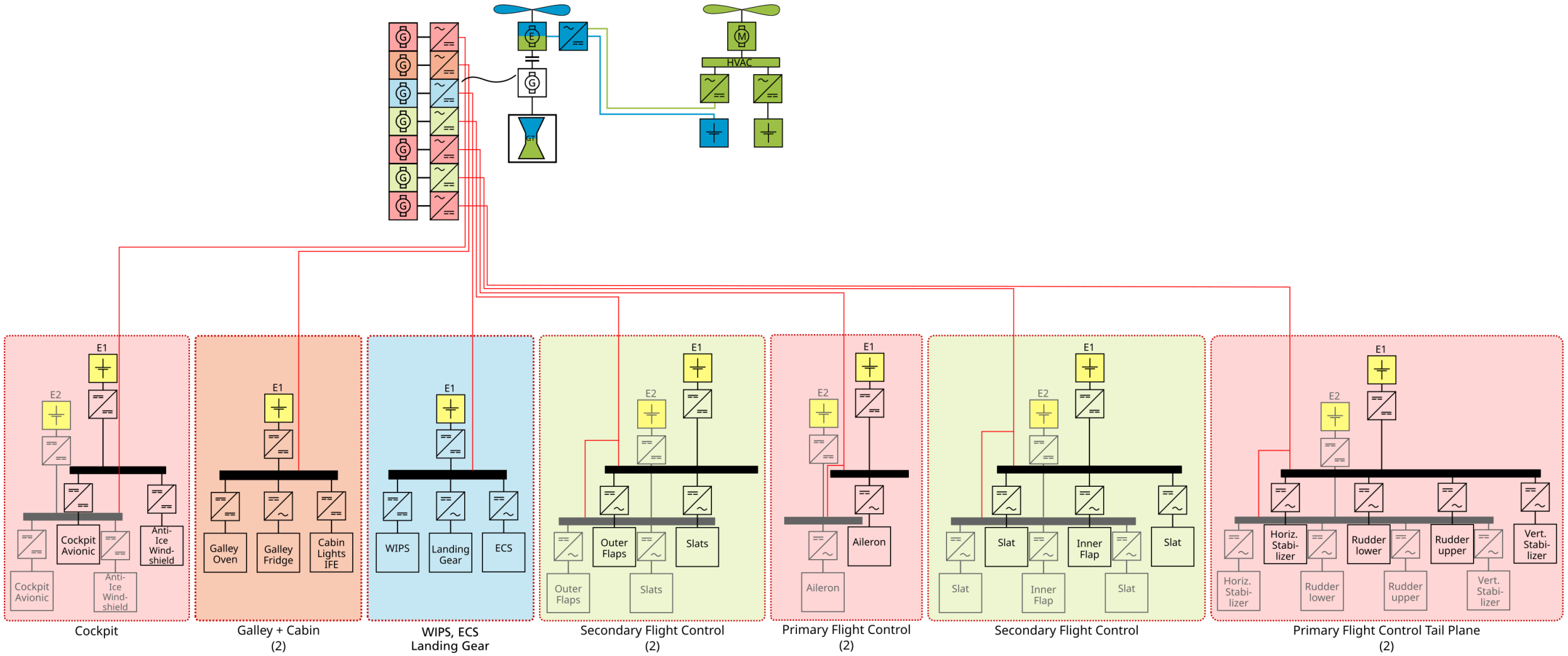
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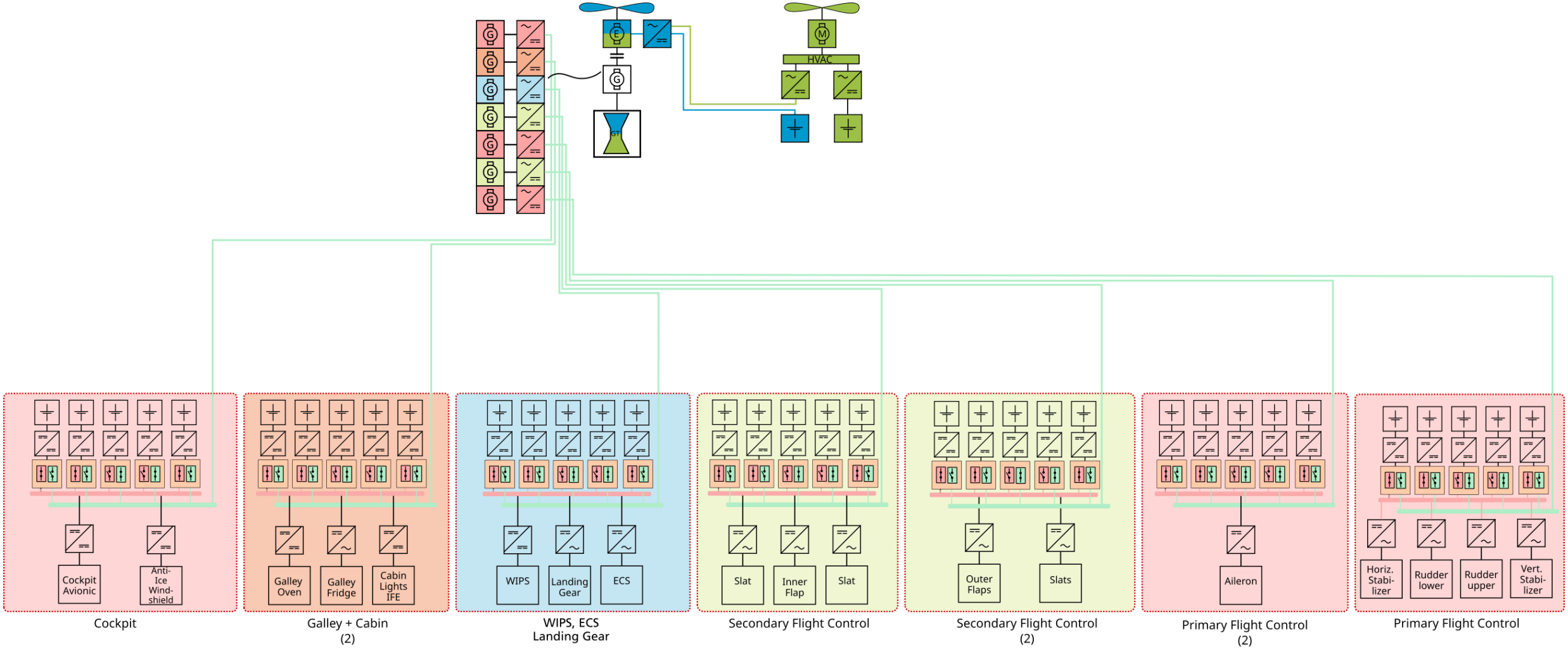


[1] WIEDENMANN, Andreas, et al. A reconfigurable battery system for a tesla model y: Package and efficiency analysis. *ETransportation*, 2025, S. 100464.

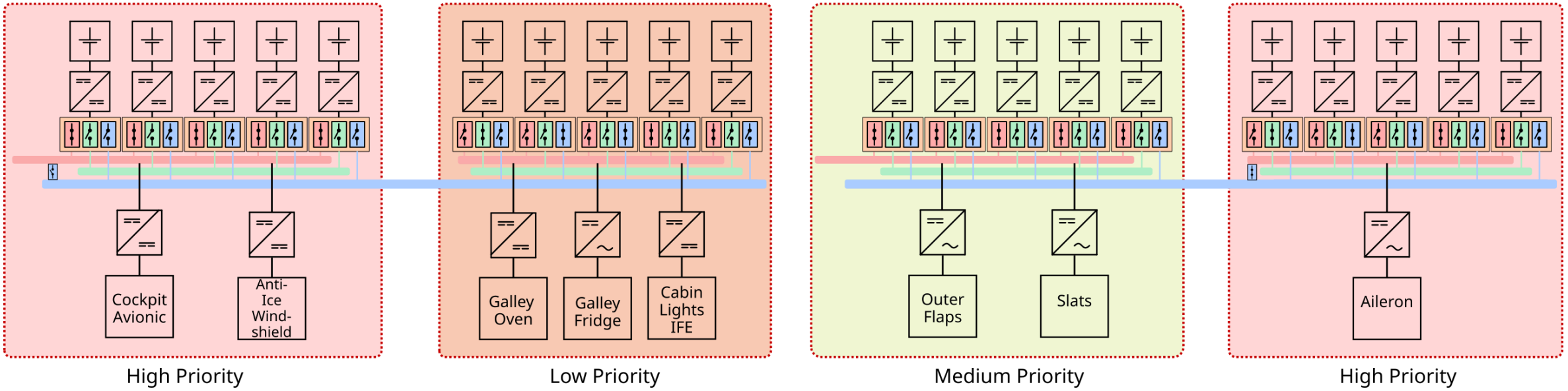
Conservative Islanded Grid Architecture



Intermediate Islanded Grid Architecture
Reconfigurable Packs



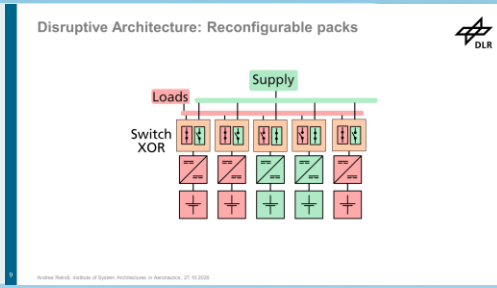
Intermediate Islanded Grid Architecture
Reconfigurable Packs & Neighboring Islanded Grids



Key Take-Away Messages

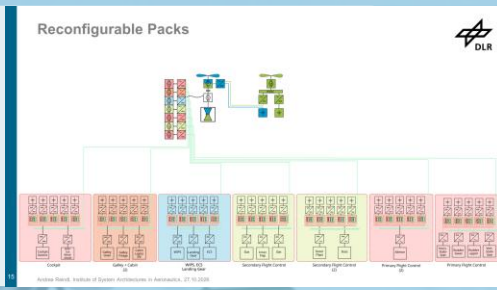
Separation remains the key design principle

Batteries act as both energy storage and decoupling interfaces between power generation and safety-critical loads.



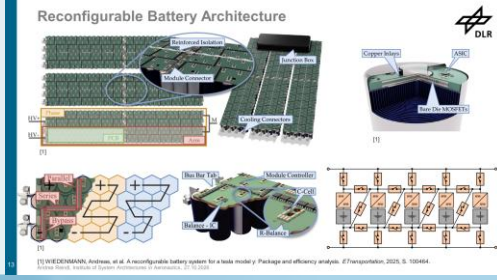
Recharging expands the applicability of islanded grids

Selective module charging supports longer-range applications and lighter battery systems.



Reconfiguration enhances fault tolerance and operational flexibility

Selective fault isolation, adaptive voltage control and current sharing reduce operational constraints.



Contact:

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