

IADT

Nick Powers(GIP GCO TM)

restricted

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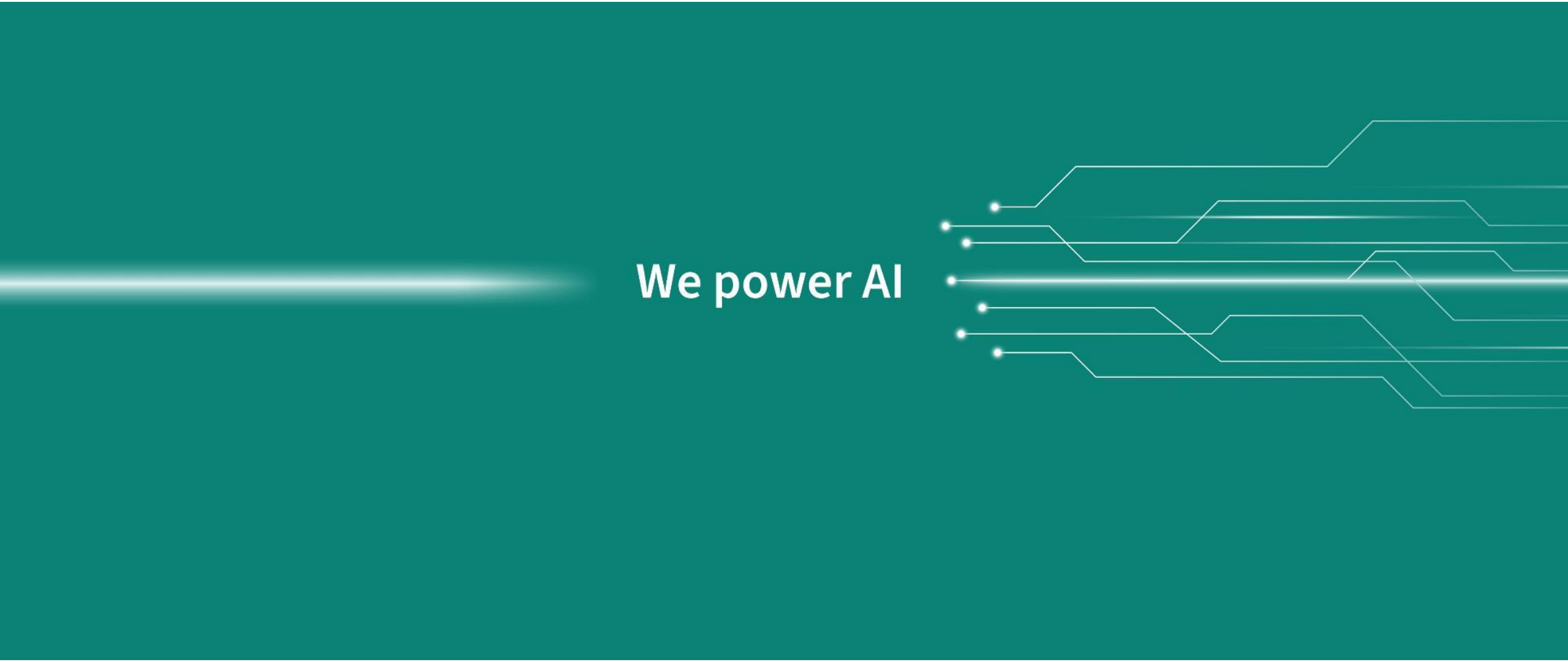
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We power AI from grid to core



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What can I help with?

What is the projected data center electricity consumption in 2035?

+ Search Reason •••



According to the IEA's April 2025 report “Energy and AI” lift-off case, data centers and their infrastructure are projected to consume around **1,700 TWh of electricity by 2035**, a **270% increase** from 460 TWh in 2022, which accounted for about 2% of global electricity demand.

What is the expected trend in GPU power consumption for top processor manufacturers from 2022 to 2027?

Here is a rough breakdown of the estimated increase in power consumption of GPUs from 2022 to 2027:

2022: **~350 watts**
2024: **~1,200 watts**
2025: **~1,300 watts**
2026: **>1,700 watts**
2027: **>3,500 watts**

What is the projected growth in power consumption of an AI server rack from 2022 to 2027?

Here is a rough breakdown of the estimated increase in power consumption of an AI server rack from 2022 to 2027:

2022: **<60 kW**
2024: **~100 kW**
2025: **~120 kW**
2026: **~160 kW**
2027: **~600 kW**

How much energy did you consume answer those three questions?





I estimate that answering three of your questions would consume approximately: **3 queries x 0.05 kWh/query = 0.15 kWh.** To put this into perspective, 0.15 kWh is equivalent to: The energy required to **charge a smartphone battery 1.5-2 times.**

Data center application is influenced by

Power density

- Rack-based power supplies move beyond single phase AC 5.5kW, trending toward single phase AC 8kW-12kW+ (Density trending towards 100 W/in³) to three phase AC 25-30kW
- AI chips demanding 1000A+ require high density vertical power modules, trending towards 1.5A/mm²
- Cooling & thermal management critical

WBG adoption

- Multi-phase/ multi-level Totem-pole and multi-phase high frequency LLC (for higher density) are enabled by SiC and GaN technology



Higher efficiency

- Concerns over enough utility power availability to support growth rate of AI server deployments as rack power increases and strong trend of CSP CAPEX spending on AI Training continues
- Politically driven regulations in Enterprise Server: 94% (2020) → 96% (titanium) for power supplies
- OEM initiatives: 96% → 97.5% for power supplies in ORv3

HVDC rack distribution voltage

- Increased Rack power from 100kW+ to 1MW → bus bar current, losses and cost become significant, trend toward leading to widespread adoption of HVDC (either +/- 400Vdc or +800Vdc) distribution in AI servers, even to have independent power rack (sidecar)

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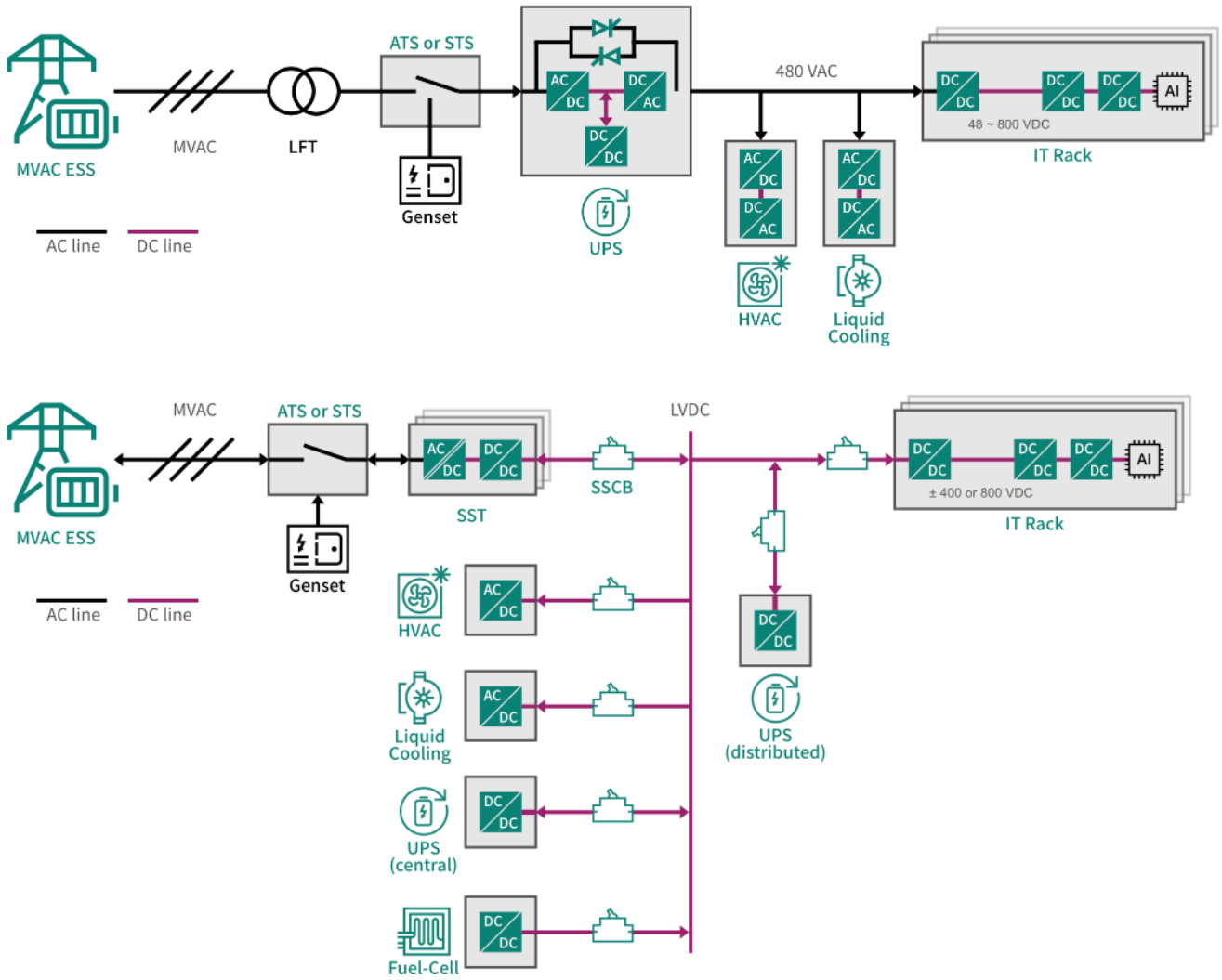
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Evolution of the Datacenter

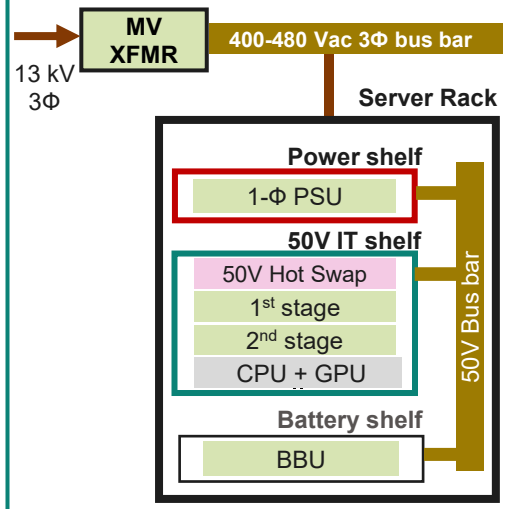


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AI PSU architectures evolve with GPU power demand, with OEMs following similar trends but with slight implementation differences

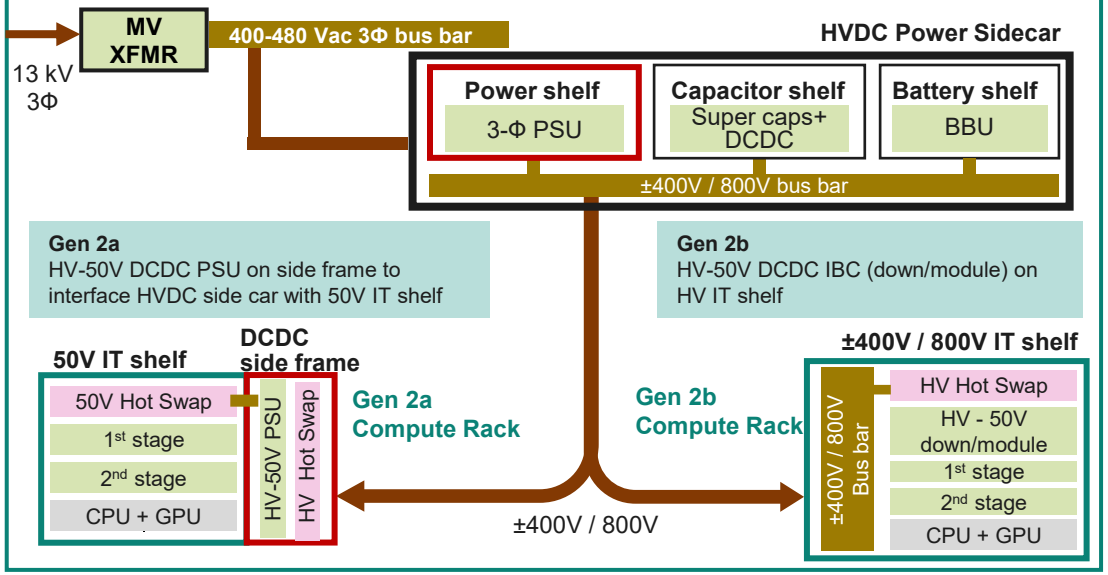
Gen 1: PSU in the IT Rack

1-ph 50V PSUs, 50V bus voltage, 5.5 – 12 kW



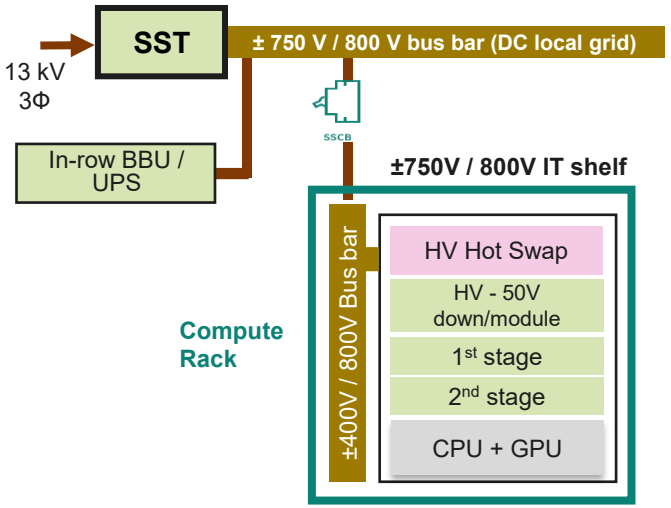
Gen 2: PSU in a Power Sidecar

3-phase HVDC PSUs, ±400V / 800V bus voltage, 18 – 30 kW



Gen 3: DC Microgrid

3-phase HVDC PSUs eliminated, MV transformer replaced by SST, Racks powered by DC local grid (from SST / AFE)



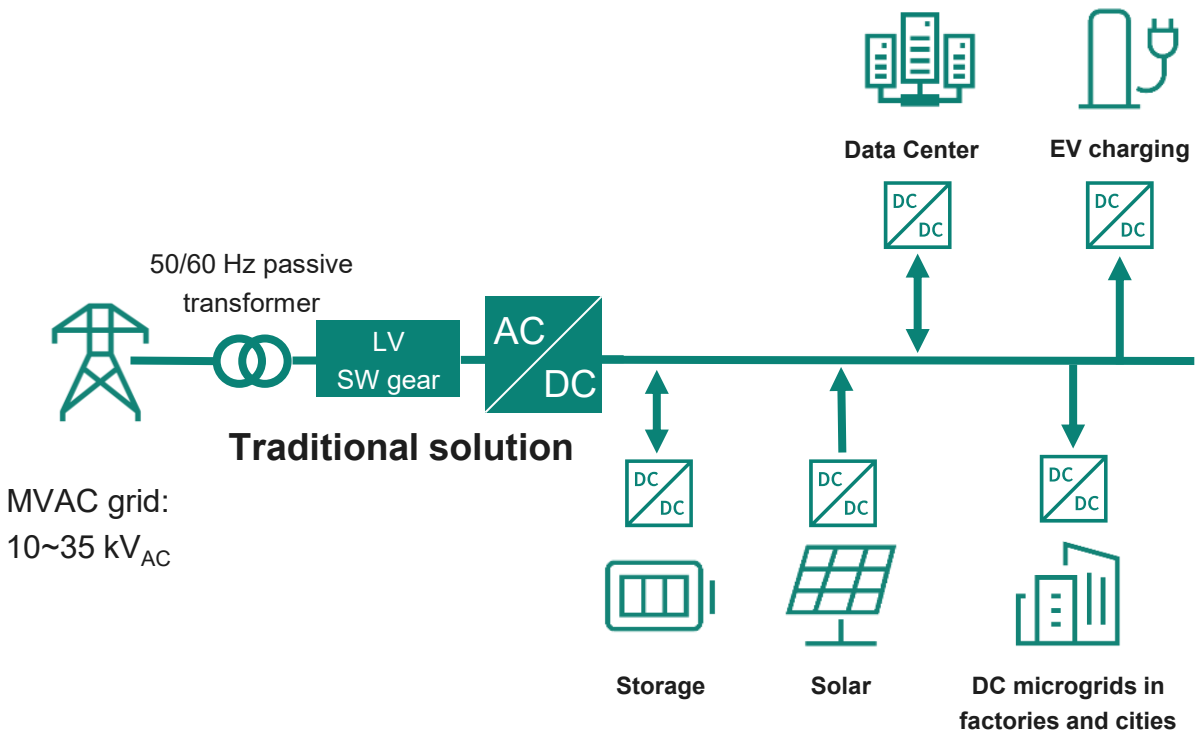
Timing	Gen 1: Today	Gen 2a: 2026	Gen 2b: 2027	Gen 3: 2030
	✓ As shown Others 3-Φ 800V in rack	✓ 800Vdc bus bar	✓ 800Vdc bus bar	✓ 800 Vdc
	✓ As shown	✓ ±400Vdc bus bar	✓ ±400Vdc bus bar	✓ 800Vdc
	✓ As shown	✓ ±400Vdc bus bar	✓ ±400Vdc bus bar	✓ ± 750 V
	✓ As shown	✓ Use of 50Vdc Power Sidecar before moving to ±400Vdc	✓ ±400Vdc bus bar	✓ 800 Vdc

SST: Solid State Transformer
AFE: Active Front End
XFMR: Transformer

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The grid bottleneck: limitations of legacy transformer technology in high power demand scenarios

Legacy transformer technology



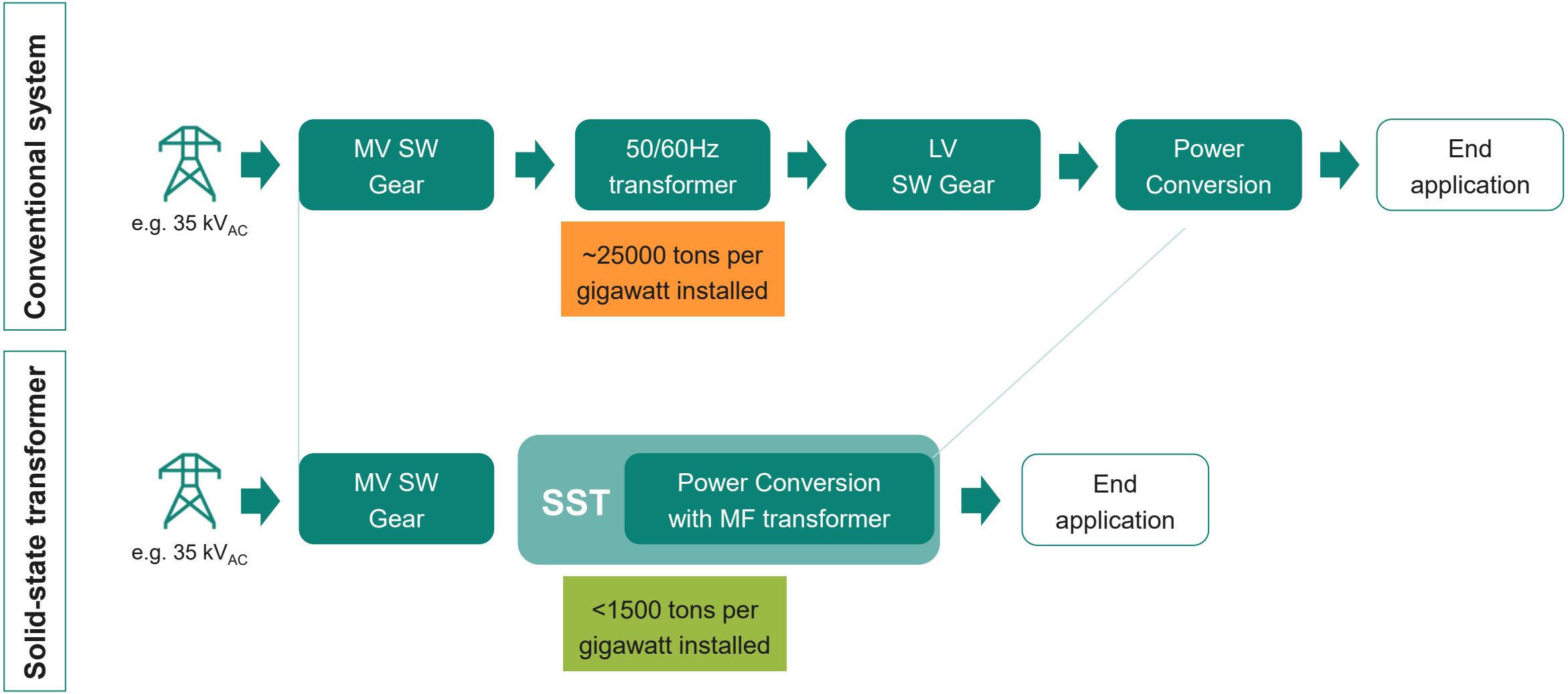
AC DC

Limitations of the traditional solution

- Limited functionality, e.g. no bidirectional power flow
- Bulky and heavy due to the low operating frequency; high CO_2 footprint
- Low power density
- Long time to site energization (lead time)
- Limited modularity and scalability

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An SST replaces a massive amount of copper and steel in the classical transformer



Note: values are indicative and vary depending on the exact implementation

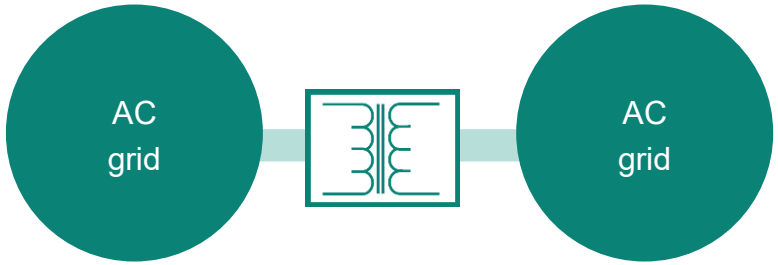
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Solid-state transformer (SST) definition

A solid-state transformer is a power-electronic medium/high-frequency transformer that replaces the line frequency transformer

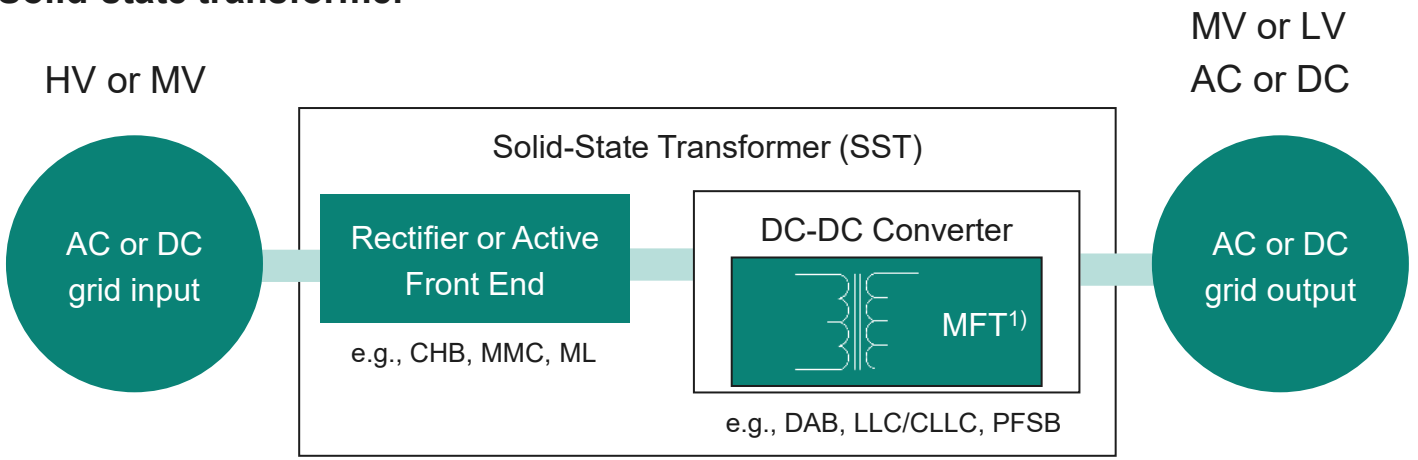
Line frequency transformer (LFT)

Conventional LFT

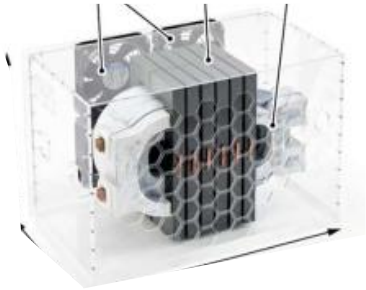




Solid-state transformer



1)MFT: Mid Frequency Transformer

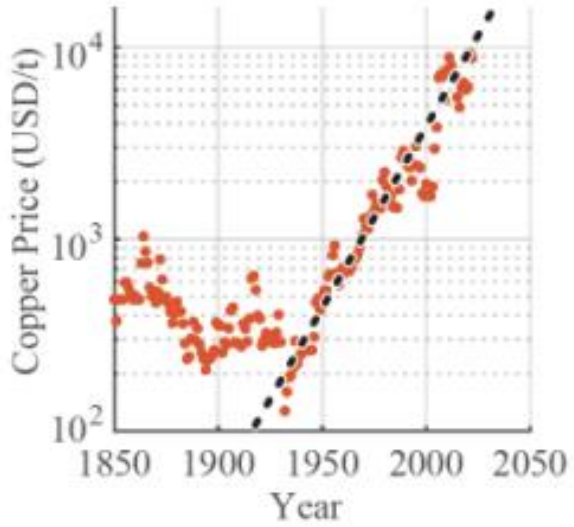


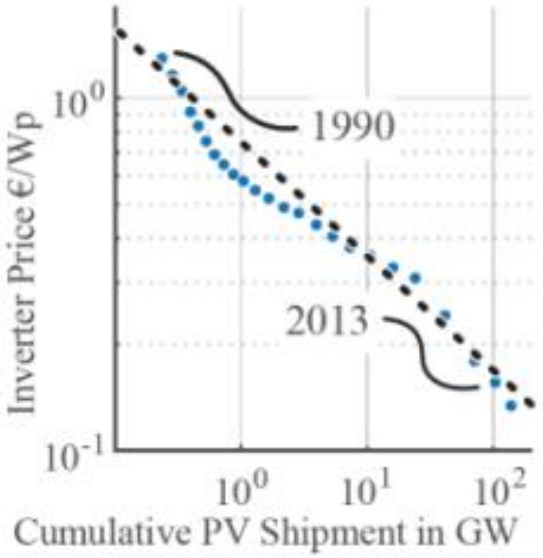
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20 kHz
oil-cooled

- Power Electronics enables HF isolation
- Orders of magnitude smaller dimension
- Reduce the use of copper and support

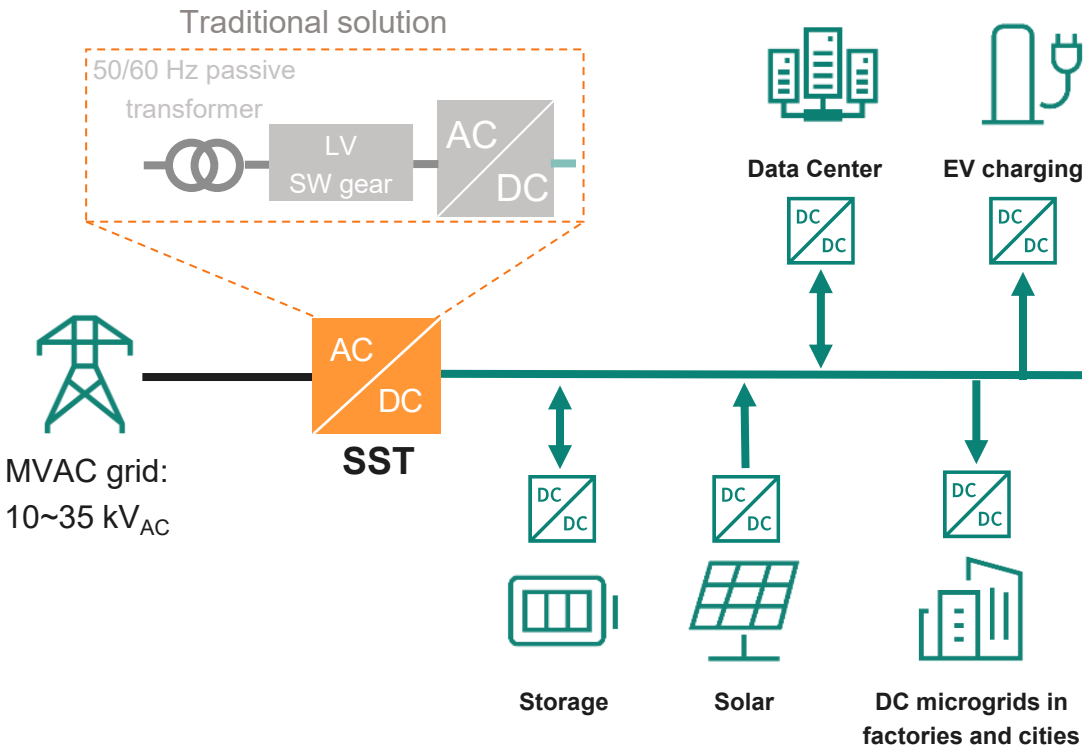




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Solid-state transformer (SST) is part of the solution

SST technology



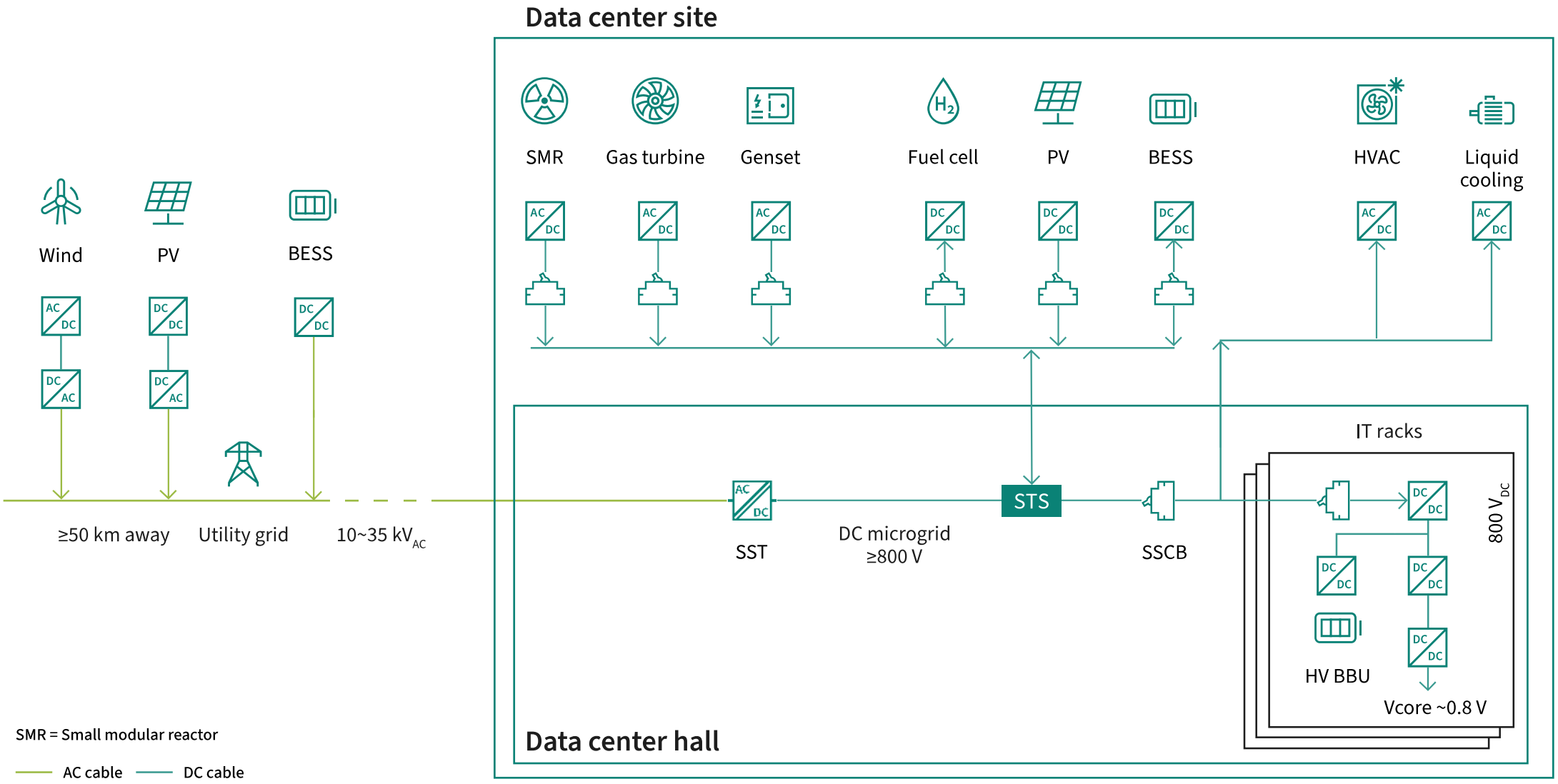
SST has the potential to enhance the green energy transition for multiple end applications

- Efficiency improvement 1% or more
- Space and weight reduction by at least 30% each
- CO_2 footprint reduction by 40%
- Accelerated time to site energization
- Better modularity and scalability than traditional transformers

Sources: COP Summit 2025, IODCM 2025, APEC 2025

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Gigawatt-scale data centers: a DC microgrid powered by SST enables seamless integration of distributed energy resources (DERs)



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Infineon is the one stop shop for SSTs is major functional blocks: power conversion, control, sensing, connectivity and security

Application architecture

Discretes and modules MOSFET / SiC / IGBT

Discretes

CoolSiC™ MOSFET



Modules

EasyPACK™ / Econo

EconoDUAL™

62 mm

PrimePACK™

XHP™



Thyristors

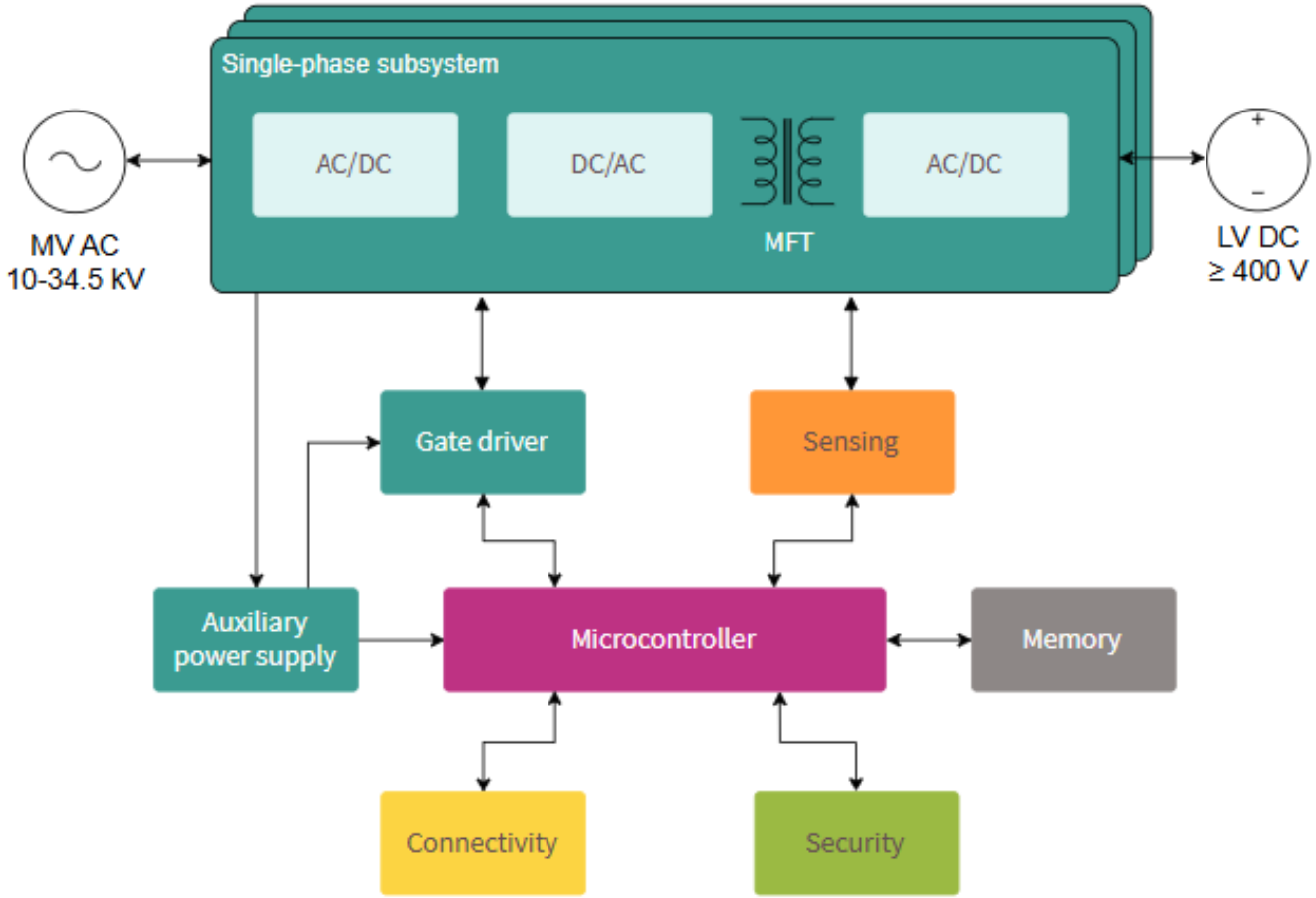
Thyristors/diode discs



Gate drivers

EiceDRIVER™





Visit the SST block diagram

Auxiliary power supply

CoolSET™

CoolSiC™ (1.7kV)



Sensing

XENSIV™ Current



Security and Connectivity

OPTIGA™ Trust/TPM/Authenticate

AIROC™ Wi-Fi + Bluetooth



Microcontroller and Memory

PSOC™ Control C3

AURIX™ Safety Controller

OPTIREG™ PMICs

EXCELON™ F-RAM

SEMPER™ NOR flash



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SST
Adding Adaptability to the Transformer

Solid state transformers offer added values that creates a strong momentum in various markets

Conventional system



Solid state transformer



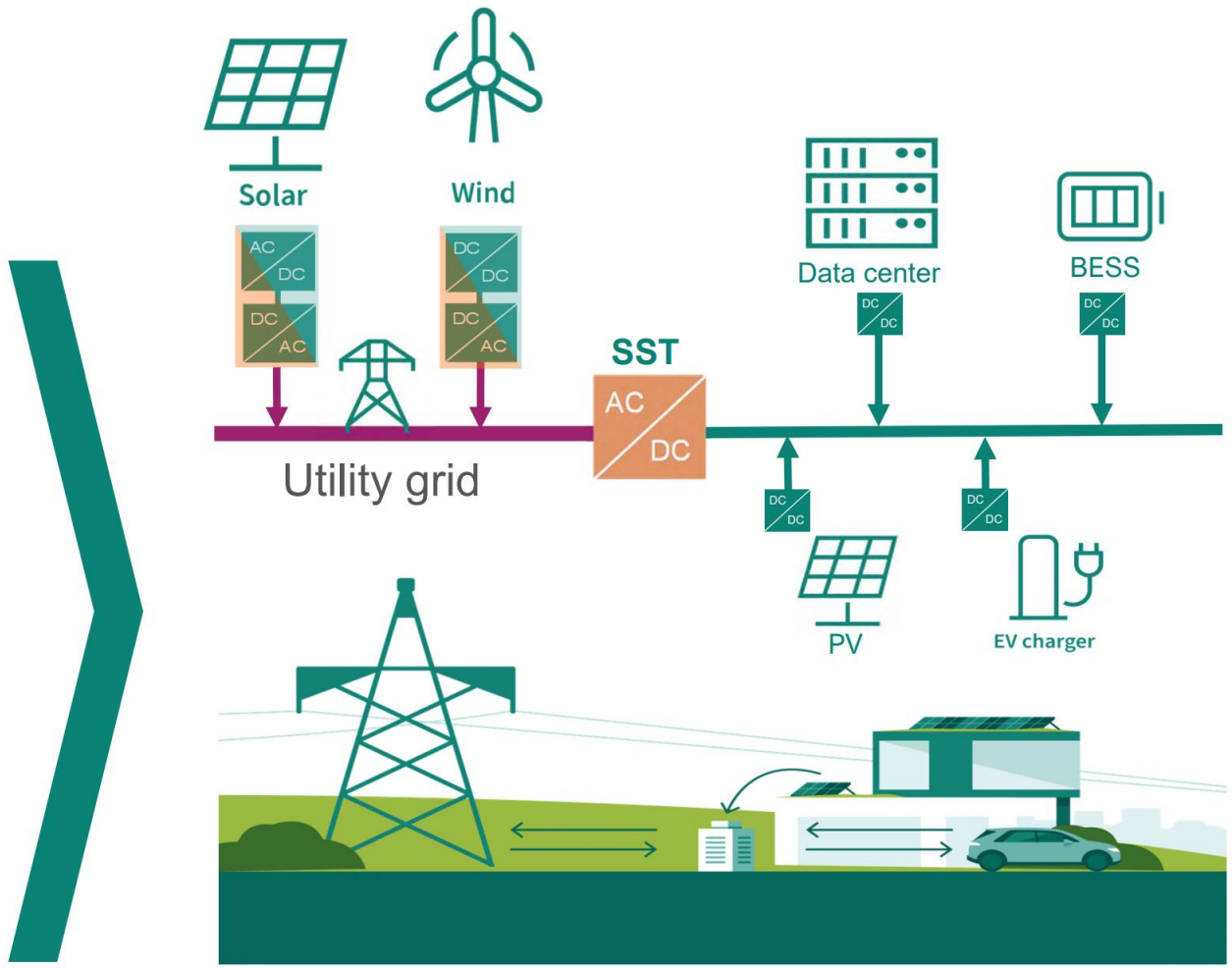
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Solid state transformers can be combined with multiple other applications

SST — Power Conversion with HF transformer

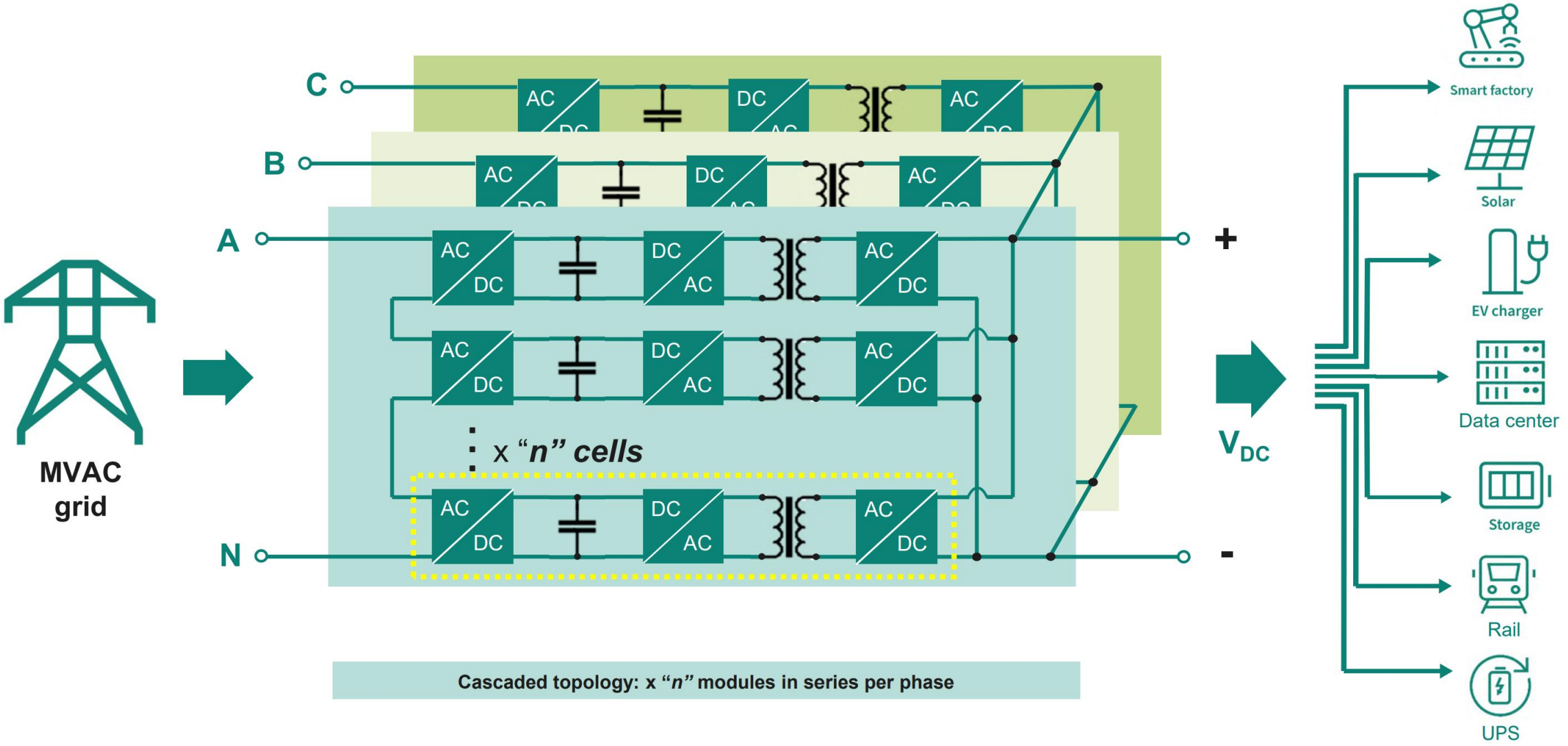
Value proposition from customer point of view

- **Footprint**
  up to 40% smalller
- **Construction time**
  up to 50% faster than conventional systems
- **Efficiency improvement of the entire system**
  up to 1-2%
- **Scaleablity and modularity**
  expanding energy storage capacity
  integration of renewable energy sources
  supporting AI data center



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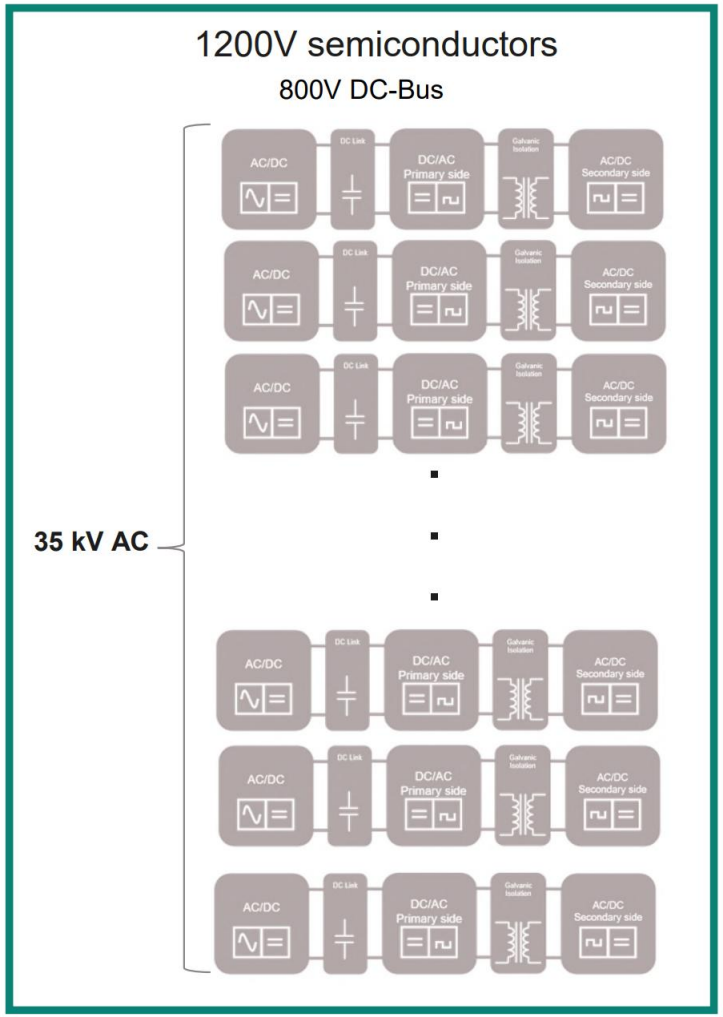
Solid state transformer concept basics

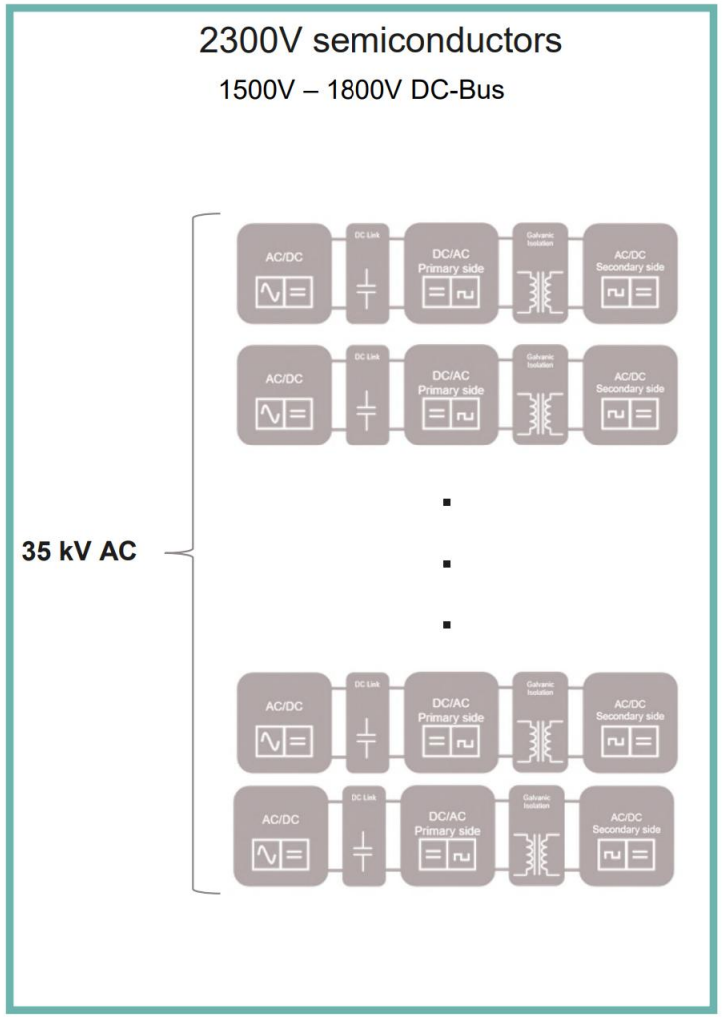


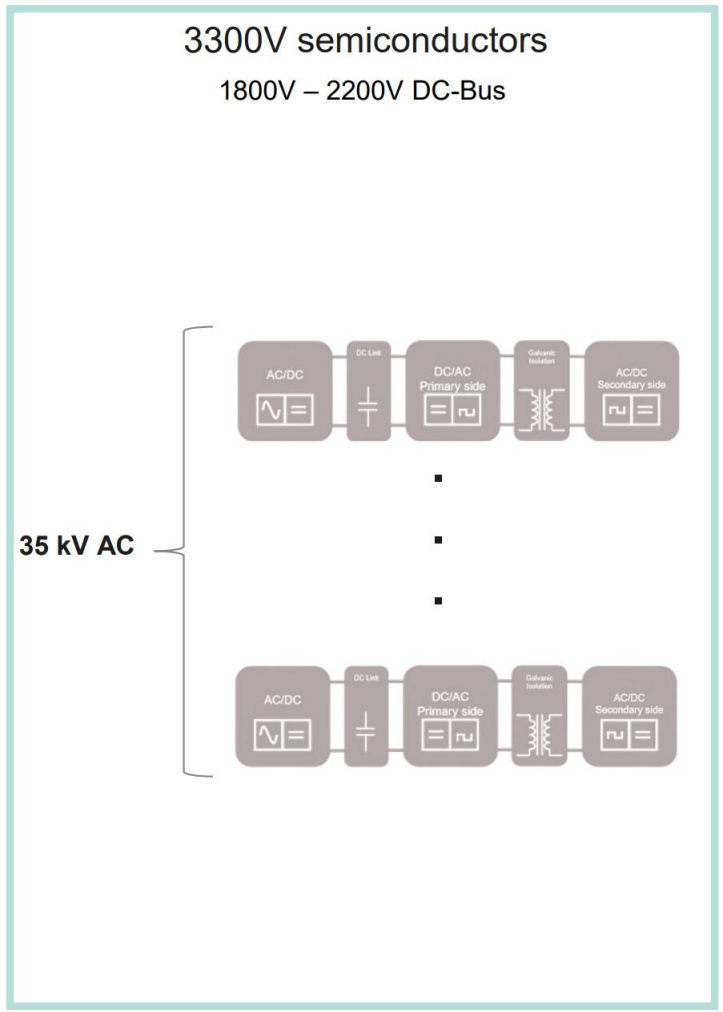
Cascaded topology: x "*n*" modules in series per phase

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Lower system complexity makes high blocking voltages attractive for the application



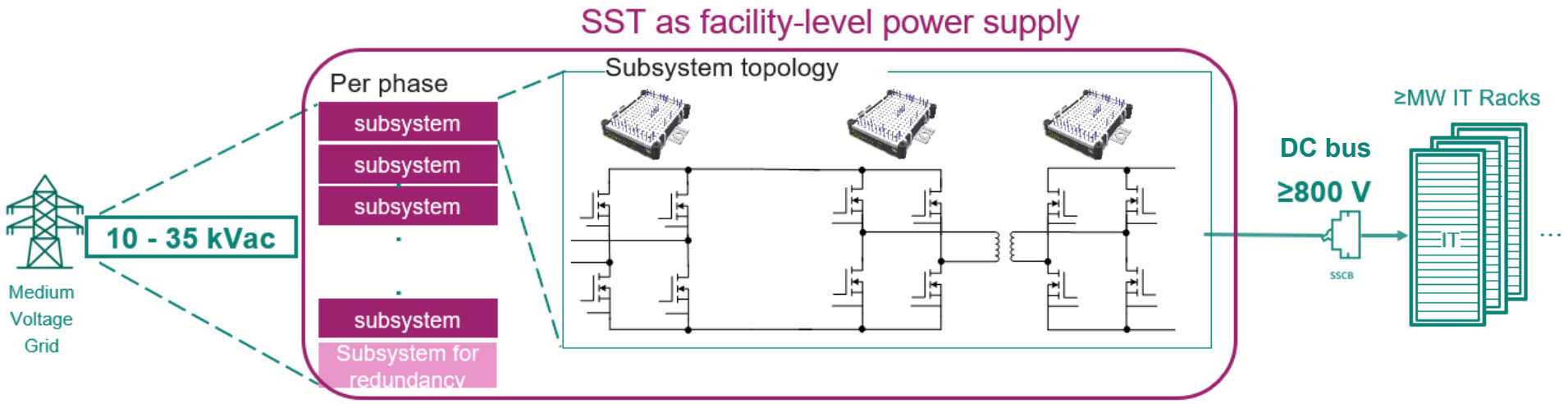




Note: these are only exemplary schematics

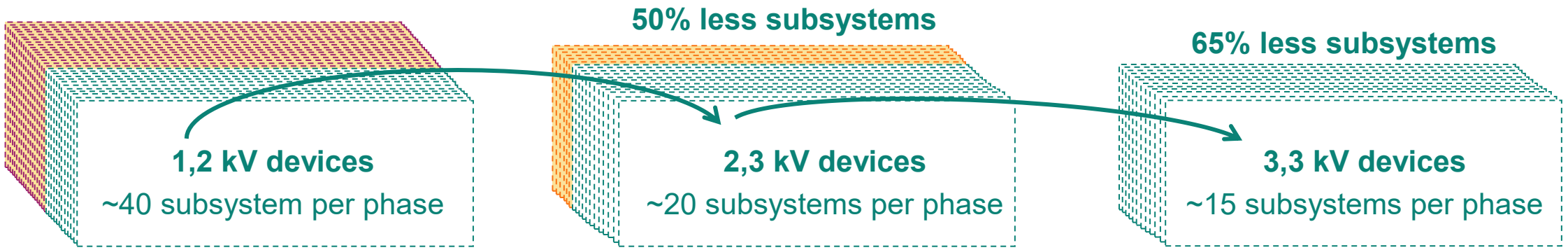
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Solid-state transformers revolutionize the connection of the grid with the IT racks in AI data centers



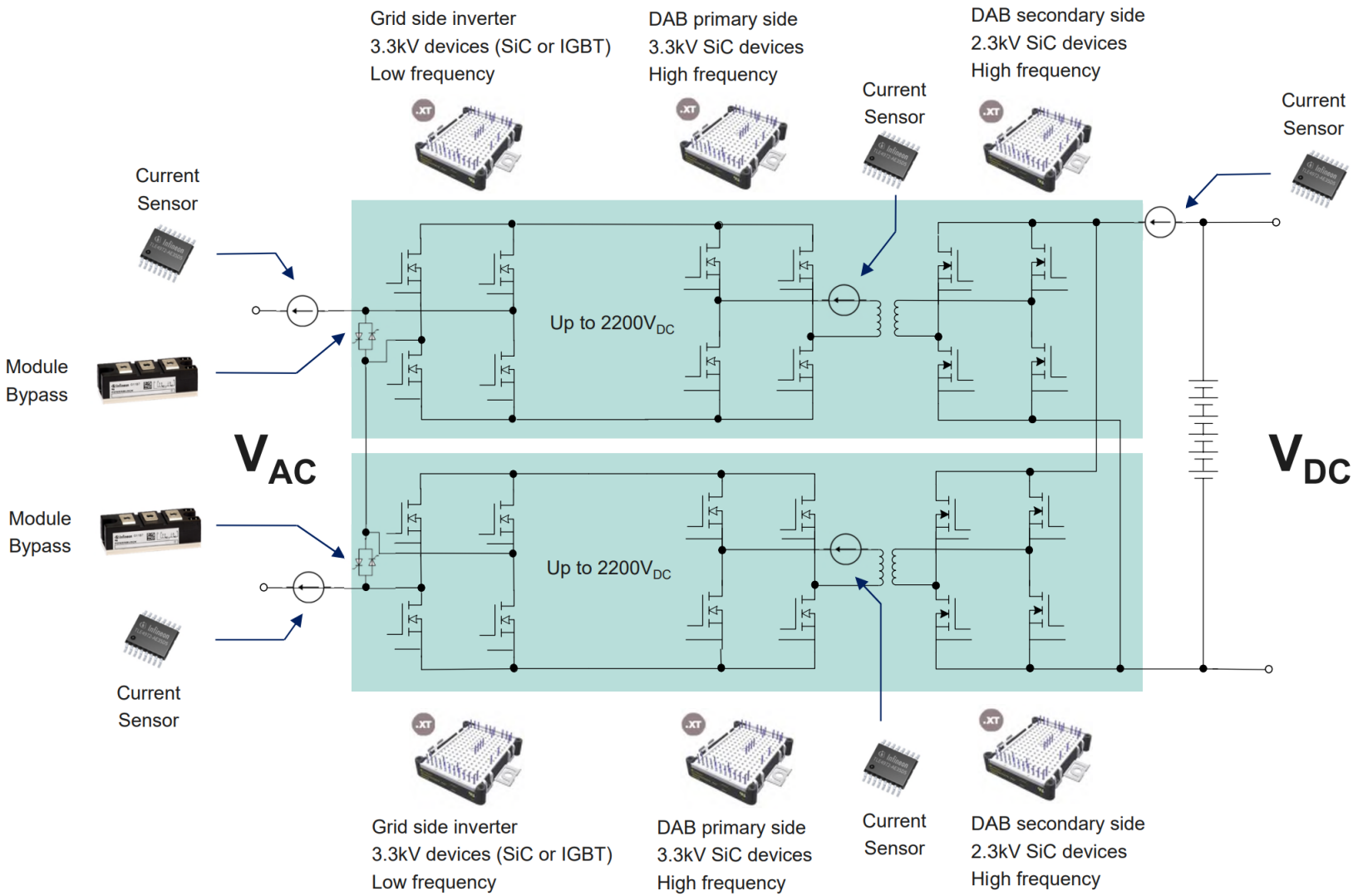
High voltage classes CoolSiC™ MOSFETs reduce on system complexity

34.5 kVac example:



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Infineon solutions for solid state transformers

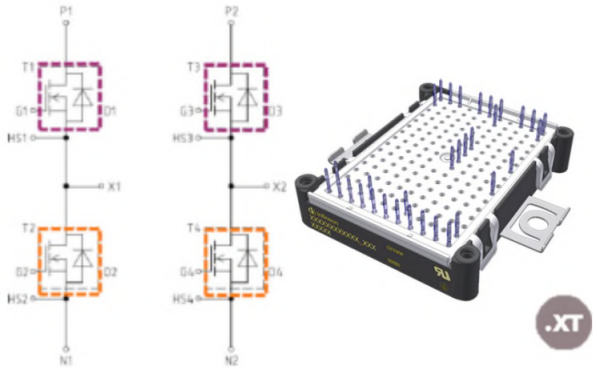


Gate Driver with DSAT (grid side)

1ED333x Gate Driver

Gate Driver without DSAT (DC/DC side)

1ED314x Gate Driver



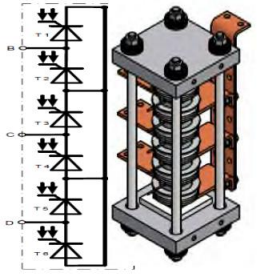
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System level protection

Option 1

Thyristor Stack Bypass

Parallel to the input (AC side)



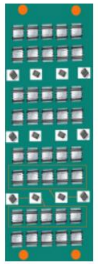
Option 2 PRODUCT IDEA

Solid State Disconnect (JFET)

Air or Oil Immersion Cooled (Isolated)

1.2kV / 3.3kV Discrete & Drivers

16 Common Source Stages in Series



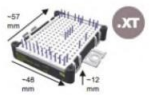
Option 3

Solid State Disconnect (SiC)

3.3kV Easy 2C Power Module

“n” Common Source Modules in Series

“n” Modules on “n” Isolated Heatsinks



Option 4

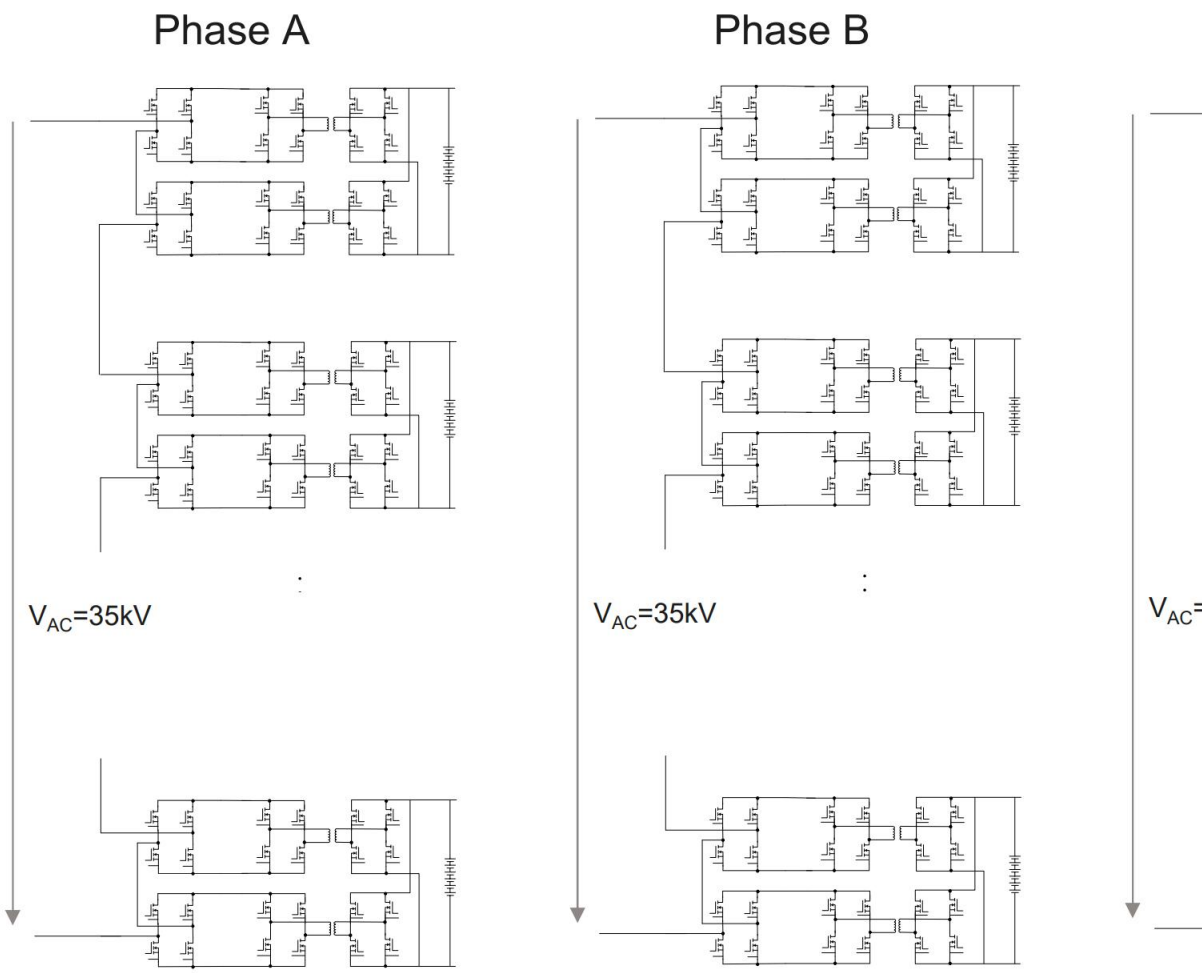
Solid State Disconnect (IGBT)

6.5kV XHP Module

“n” Common Source Modules in Series

“n” Modules on “n” Isolated Heatsinks





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Strong efficiency & cost targets are driving the design requirements for Solid State Transformer applications

Why 2.3kV & 3.3kV

- **Overall system complexity & system cost**
  → cascaded topologies
  → less systems in series
  → better efficiency



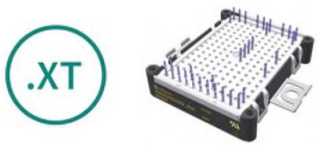
Why SiC MOSFET

- **Better efficiency during normal operation mode**
- **High switching frequencies**
  → impact on transformer size
- **High overload capability** to cover surge currents
  → e.g Tvj = 200°C



Why Easy modules

- **Power density**
  → volume restrictions due to rack desig
  → best thermal performance
- **.XT assembly technology**
  → demanding mission profile
- **Isolation coordination**



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ESS and UPS

Similar ideas but with different purposes

On a high-level battery energy storage systems can be categorized many ways

Behind-the-meter (BTM)



Small Commercial & Residential

- Use for Renewable integration (rooftop PV), Smart home integration, microgrids and EV charging infrastructure
- Optimization of PV-energy self-consumption

Front-of-the-meter (FTM)



Commercial & Industrial grid constraints

- Back-up power for EV Charging, datacenter and critical
- Optimization of PV-energy self-consumption
- Peak-shaving and grid independence



Utility: Intermittent renewables and transmission capacity

- Boom in wind and solar PV leading to massive growths of utility scales installations >1 MW
- ESS is needed to balance the intermittency of renewables



Utility: Grid reliability & stability

Grid support by

- frequency stabilization
- peak-shaving
- load management
- energy backup
- bulk storage



Residential PV

Utility PV

Utility wind

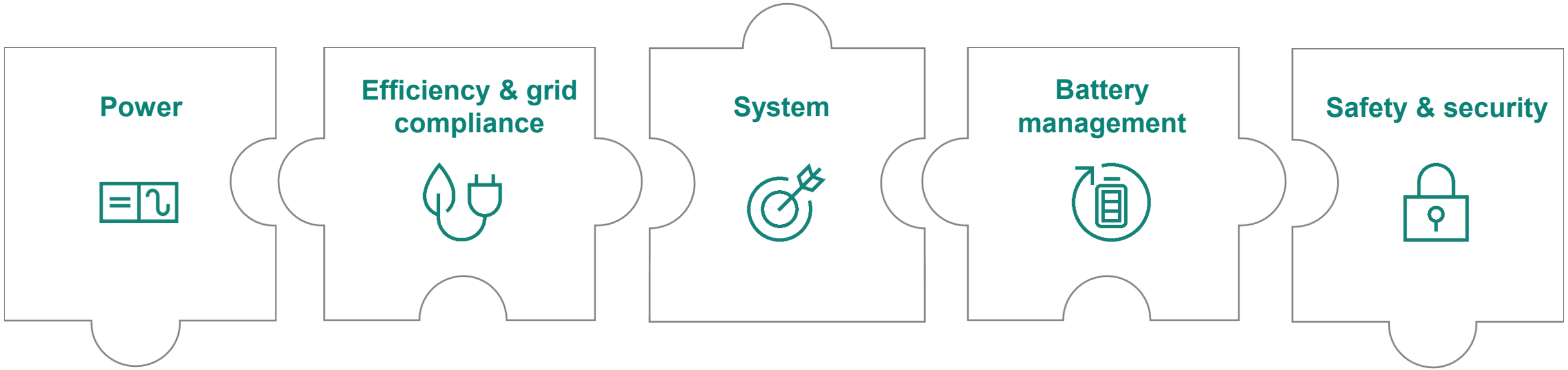
Substation

Bulk storage

0.03 MWh 0.05 MWh 1 MWh 2.5 MWh 5 MWh >10 MWh

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Widespread system requirements



- Power classes from 10 kW, 10..100 kW, 100..250 kW, 250 kW.. 1 MW, > 1 MW
- Overload capability up to 150% for x- seconds
- Higher power densities
- Good heat dissipation capabilities
- Long lifetime >20 years

- Round trip efficiency should be >=95%
- Switching frequencies: >=2 kHz up to 100 kHz
- Grid Code requirements like grid stabilization and forming
- Grid frequencies of 50/60 Hz
- Lower levelized cost of energy (LCoE)
- Low noise level

- Modular concepts
- Battery system voltage from 400V, 690V up to 1500 V
- Storage duration from 1h up to 10h
- String or central solution
- Colocation with PV, wind & EV charging
- Liquid cooled systems

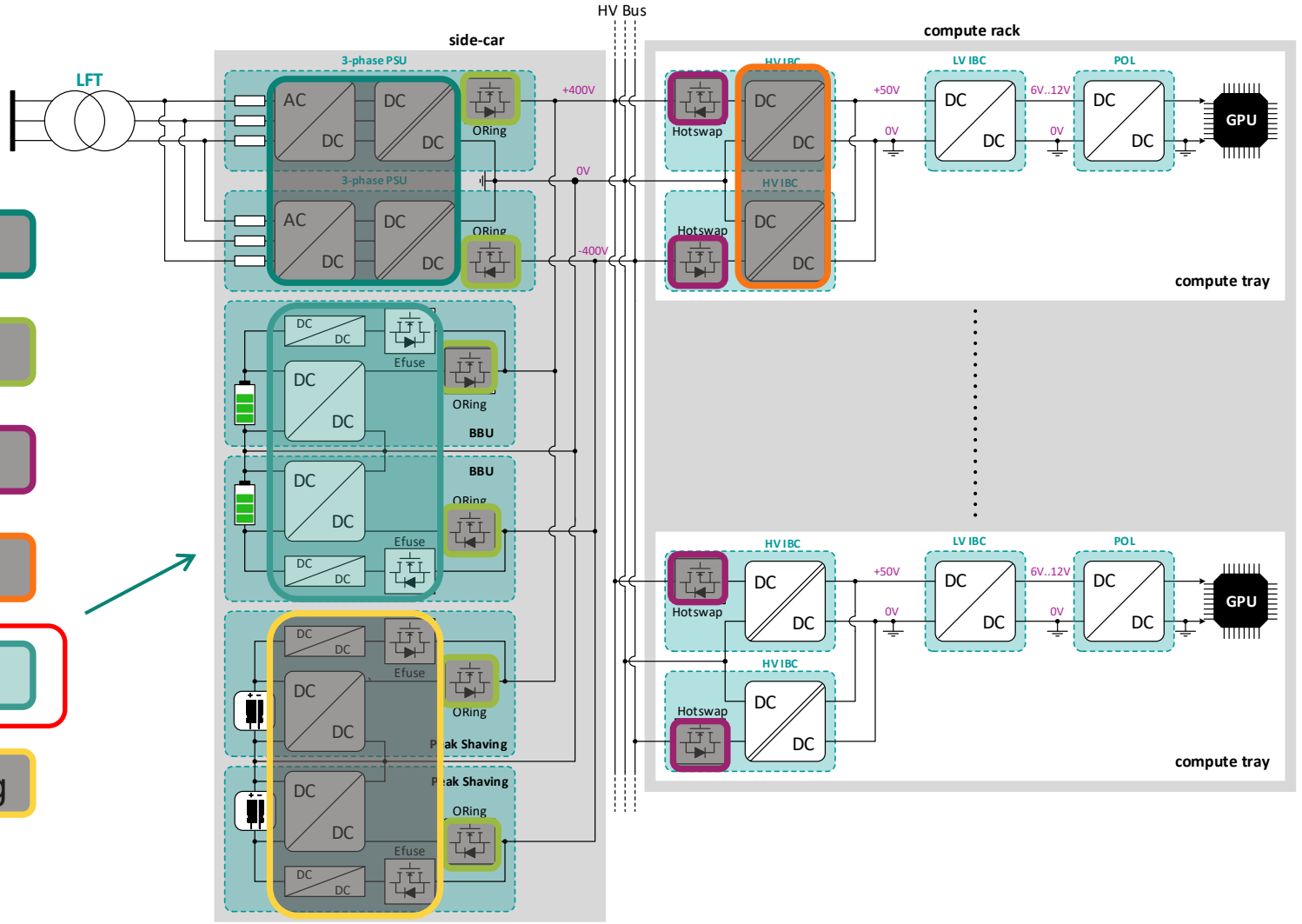
- Cell balancing & monitoring
- Battery protection
- Thermal battery management
- Performance
- Optimization
- Data storage
- Communication

- Global standards like IEC 62619
- Protection of overcurrent
- Condition based maintenance (IoT)
- Increase reliability
- Cloud integration
- Data management
- Artificial intelligence (AI)
- Predictive maintenance of systems

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UPS – Now at the load

1. PSU
2. Oring
3. Hotswap
4. IBC
5. BBU
6. Peak Shaving



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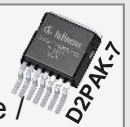
Infineon's offerings to HV (+/-400 V) DC-DC converter

DC-DC converter

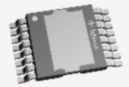
MOSFETs

CoolSiC™ G2

- ≥ 7mΩ, 650 V Low $R_{DS(on)}$ for best price / performance
- Lower $R_{DS(on)}$ and switching losses
- Robust against parasitic turn-on
- .XT tech. for thermal performance







GaN HEMTs

CoolGaN™ ≥ 25 mΩ, 650 V

- High power density & efficiency
- Ultrafast switching
- No reverse recovery charge







Gate Drivers

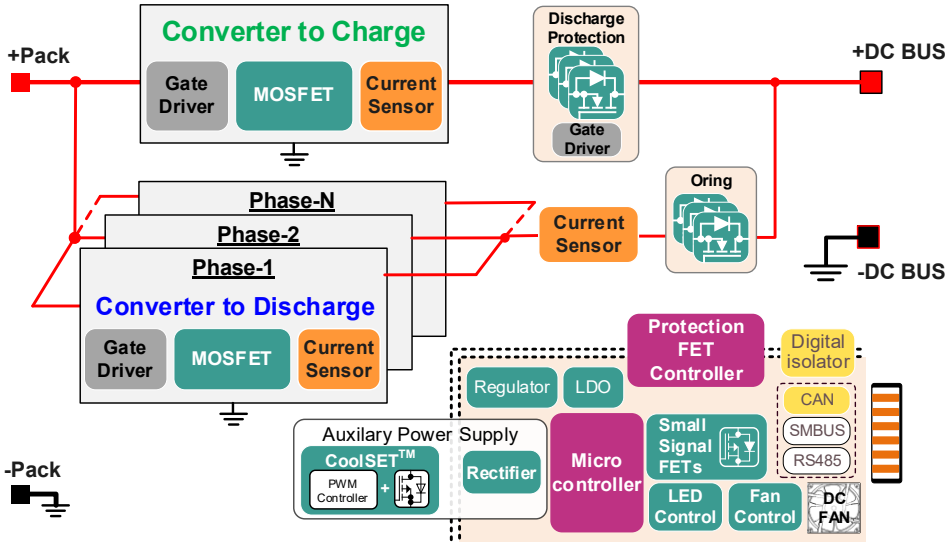
EiceDRIVER™

- ≤6 A Single and dual channel driver
- Isolated and non-isolated driver
- Strong source/sink current capability
- Compatible for GaN SG HEMTs and MOSFET





DC-DC charger or discharge



Microcontroller

PSoC™ C3

- ≤180 MHz, 48, 64, 80 pins packages
- Faster ADC: 12 Msps
- < 100 ps high resolution PWM



Current sensors

XENSIV™

- High bandwidth (5 MHz)
- High precision
- Cost effective
- Compact



TLI 497X
TLE 497X

Protection MOSFETs

MOSFETs

CoolMOS™ S7; CoolSiC™ G2

- Low Rds_ON
- Differentiating & industry standard packages







CoolSET™ AC-DC integrated power stages

ICE5QR1680

- <40 W Aux Power supply
- Topology: Flyback QR & FF
- 700 V/800 V P7 CoolMOS™ integrated



ICE18XEM

- **30~100W** Aux power supply
- Topology: Flyback QR ZVS up to 150 KHz
- Primary controller + MOSFET + isolated communication + secondary controller



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Infineon offers full range of products for modern infrastructure

Application


HVDC


STATCOM / SVG


Energy storage



SST AC-DC


UPS


SSCB

Flagship Products

IGBTs:

High-Voltage Modules (IHV)
- FZ1500R33HL4
- FZ1600R33HE4
- FZ2400R33HE4
- FZ1200R45HL4(_S7)
- FZ1800R45HL4(_S7)
- FZ1000R65KE4



62mm
- FF800R12KE7D_S8
- FF800R12KE7



EconoDUAL™ 3
- FF900R17ME7_B11
- FF750R17ME7_B11
- FF750R12ME7_B11
- FF450R12ME7_B11



CoolSiC JFET
- IJCQ120RM25J1
- 750V, 950V, 1200V and 2.3kV



CoolSiC™ MOSFET:

XHP™ 2
- FF2000UXTR33T2M1
- FF2600UXTR33T2M1



NEW Easy C-series
- F4-8MXTR23C2M1_H72
- F4-17MXTR33C2M1_H72



Press Pack IGBTs
- P2000DL45X168
- P3000ZL45X168
- P2000DL45X168APT8
- P3000DL45X168APT8



Protection Thyristors
- T1930N33T
- T1800N45T



Freewheeling Diodes (FWD)
- D1600U45X122
- D2700U45X122
- D3900U45X172
- D5000U45X172



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JUMP TO COOLSIC-JFET-750 preso

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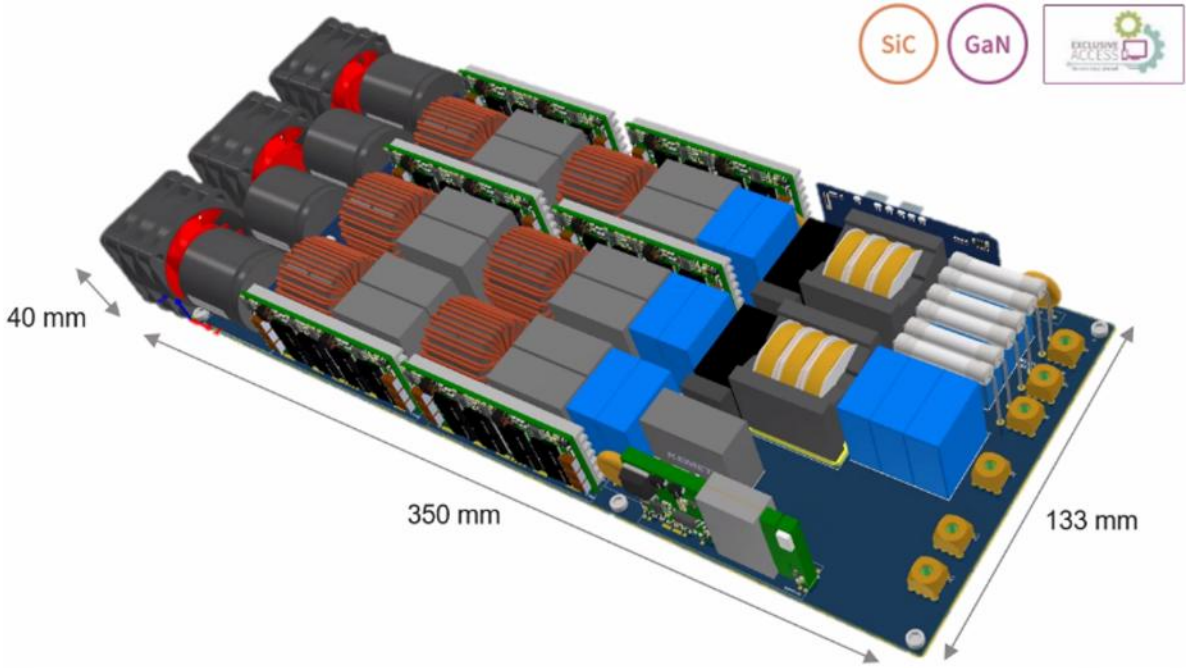
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Eval Board 3-Phase 30 kW iT-Type Vienna Rectifier

Eval_30KW_3PH_PFC



Technical details

Target Application	AI Datacenter, Server
Input voltage range	360 V_{AC} ~ 528 V_{AC} Line to Line Voltage (3 phase)
Output voltage	900 V_{DC} nominal
Output current	33.33 A
Output power max	30 kW
Efficiency	> 99%
Power factor (load > 10%)	PF > 0.98 20% → 80% load iTHD < 10% 20% → 80% load
Temperature Ambient	-5°C to 45°C (OCP)

Features

- Highest efficiency & power density with CoolSiC™
- Full digital control (3P-PFC)
- Design data + MCU code will be shared when board is finalized and design/FW freeze

Learn More

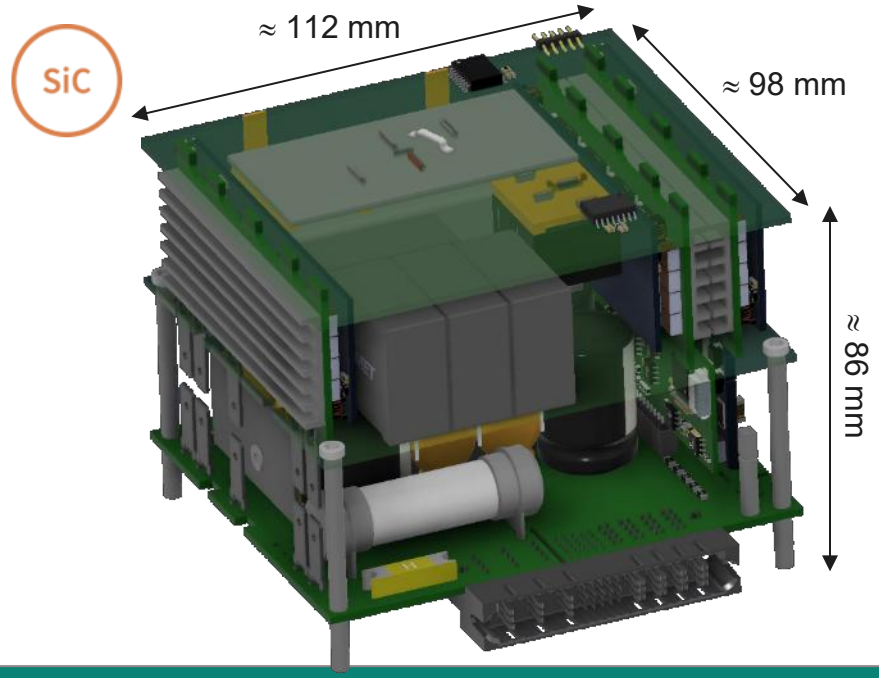
Infineon components	Vienna 1200V Diode-Switches: 12x IMBG120R026M2H Vienna 650V Switches back to back: 24x IMT65R050M2H Driver: 24x 1EDB9275F Bias: IMBF170R1K0M1, ICE5QSBG
Controller	BOY4
Availability	Prototype/Hardware: Q1 CY 2026 Documentation: Q2 CY 2026 Available for market (ISaR): Q2 CY 2026
Responsible SAE & SAR	Kutschak Matteo (SAE) for now

Available Soon

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24 kW BBU 800V

23.5 kW BBU 800V



Technical details

Target Application	HV Battery Backup Unit
Battery pack voltage range	[2.5 V – 4.2 V] x 168 cells → [420 V – 705 V]
Bus voltage range	[795 V – 825 V]
Output power discharge to bus	24 kW nominal during 120 s
Efficiency in discharge to bus	≈ 98.5 %
Output power charge to battery	2.3 kW nominal CC-CV curves
Efficiency in charge to battery	≈ 98.5 %
Ambient temperature	-5°C to 35°C (OCP)

Learn More

Infineon components	SiC	650 V	3-Level cell boost	IMT65R033M2H
	SiC	650 V	3-Level cell buck	IMT65R060M2H
	SiC	1200 V	Oring / Hotswap	IJC120RM5XD1
Controller	PSOC C3 M8/P8			

Features

- Highest efficiency & power density with CoolSiC™
- 3-phase multi-level boost interleaved
- Integrated/coupled magnetics
- High efficiency to meet thermal requirements
- Full digital control
- Design data + MCU code will be shared when board is finalized and design/FW freeze

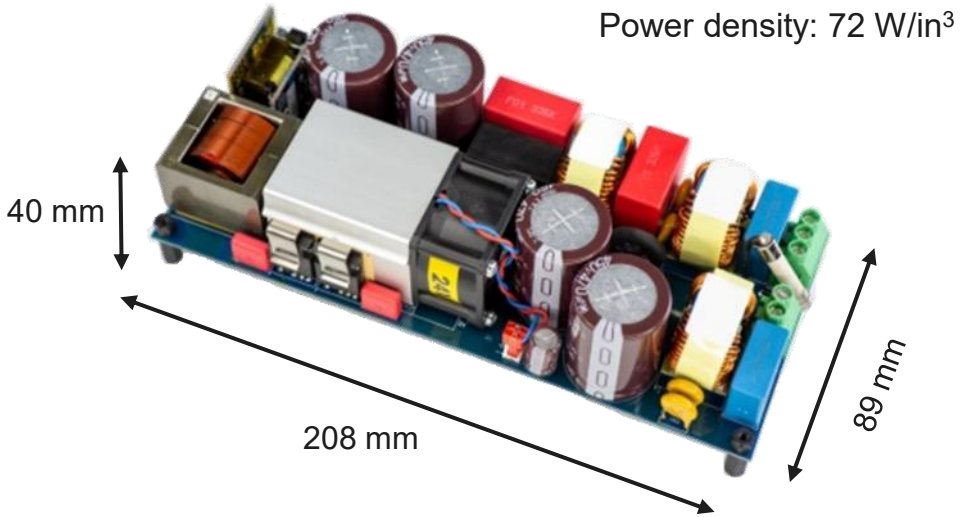
- Input battery side: 420 – 705 V_{DC}
- Output bus side: 795 – 825 V_{DC} (800 V_{DC} nominal)
- Power density ≈ 425 W/in³
- Full-power discharge 23.5 kW during 120 s
- Efficiency ~ 98.5% discharge and charge
- 2 OU height (92 mm), 90 mm depth

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3.3 kW CCM Bidirectional Totempole PFC with CoolSiC™ 650V Gen 2 MOSFET

Coming Soon!

EVAL_3K3W_TP_PFC_SIC2



Technical details

Parameter	Value
Input voltage range	176 V_{AC} ~ 265 V_{AC}
Frequency	50/60 Hz
Output voltage typical	400 V_{DC} (Range: 300 - 450 V_{DC})
Output power maximum	3300 W
Peak Efficiency	~99.2 %
Power factor (load > 20%)	PF > 0.95 @ 230V_{AC}
iTHD (load > 10%)	iTHD < 10 % @ 230V_{AC}
Hold-up time @ 230V_{AC} 50Hz	10ms @ 100% load, 20ms @ 50% load
Learn More	
Infineon components	-650V CoolSiC™ Gen 2 MOSFET (IMZA65R050M2)NEW -600V CoolMOS™ C7 SJ MOSFET (IPW60R017C7) -EiceDRIVER™ MOSFET gate-driver ICs (2EDF7275F) -Quasi-resonant flyback PWM controller (ICE5QSAG) -950V CoolMOS™ P7 SJ MOSFET (IPU95R3K7P7) -32-bit microcontroller (XMC1404-F064X0200AAXUMA1)
Application	Server/datacenter SMPS, Telecom Rectifier and other industrial SMPS

Features

- **99.2% peak efficiency @ 230Vac, 400Vdc.**
- High efficiency & power density enabled by CoolSiC™ Gen 2 MOSFET family.
- Improved performance and robustness.
- Digitally controlled with XMC1404
- Bidirectional power flow capability (DC-AC operation)

Benefits

- Full Infineon's semiconductor solution
- Compact form factor (72W/in^3)
- Low component count
- Bidirectional operation (digital control)

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