

Solutions for Energy Storage Systems (ESS)

26th April, 2022



Energy storage is an integral component of electricity generation, transmission, distribution as well as consumption

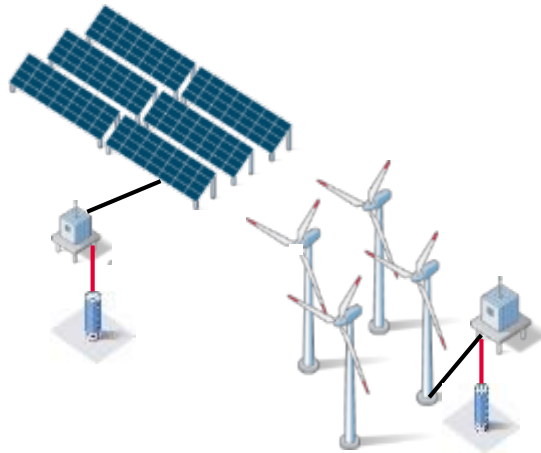
Before-the-Meter

- › Conventional and renewables generation combined with ESS (stationary ESS)
- › Transmission and distribution system with bulk ESS (stationary / mobile ESS)

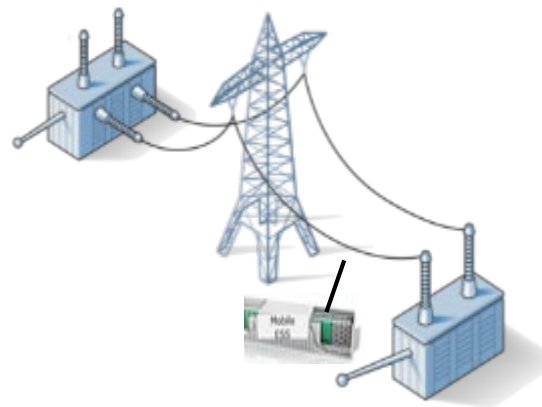
Behind-the-Meter

- › Roof top PV, UPS, V2G (stationary / mobile ESS)

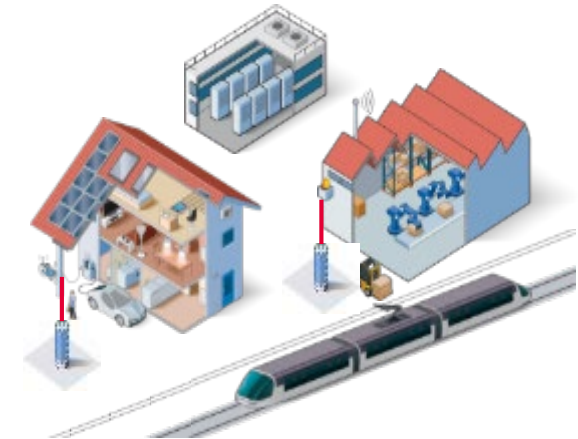
Generation



Transmission



Consumption



Bulk storage, substation, utility wind & utility photovoltaic (PV)

Commercial, residential PV & charging stations

On a high level Energy Storage Systems can be categorized in...

Behind-the-Meter



Commercial & residential

- › Installed in offices, factories and supermarkets mostly for self consumption
- › Excessive non self consumed energy generated by rooftop PV is stored in batteries for later consumption

Before-the-Meter



Intermittent renewables

- › Boom in wind and solar PV leading to massive weather-dependent fluctuations and distributed generation, hence mismatch of supply and demand is growing
- › ESS is needed to smooth-out this fluctuations



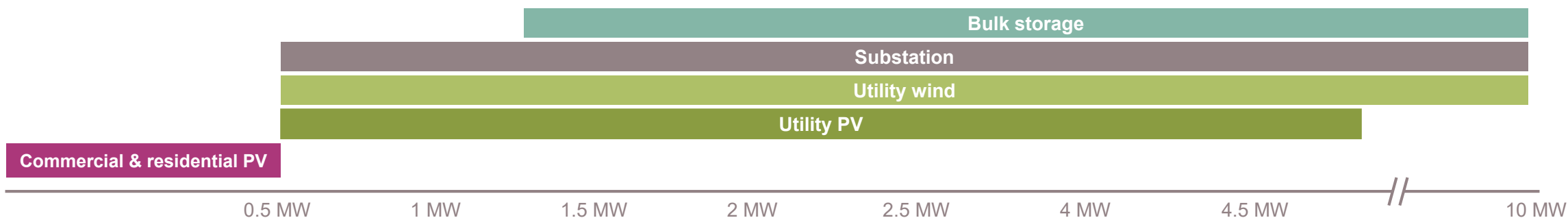
Transmission capacity constraints

- › Growing demand on electricity, especially during peak periods (e.g. aircon use at noon etc.), stretching grids to the limit



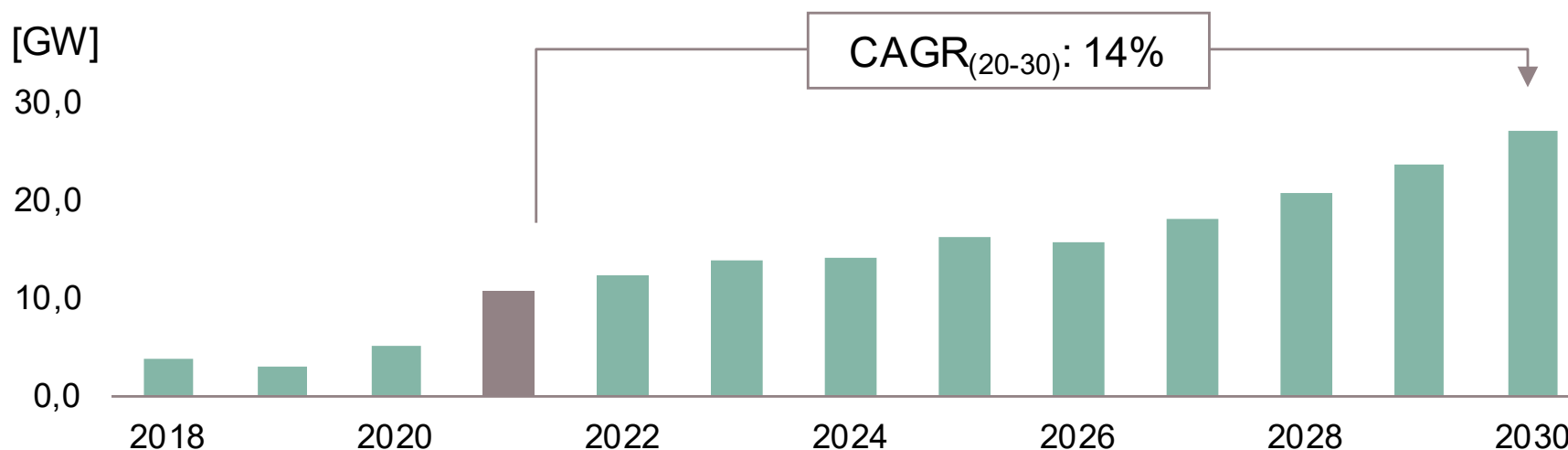
Grid reliability & stability

- › Unstable grids and full-blown blackouts due to natural disasters and technical problems in ageing infrastructures
- › Through ESS grid reliability and stability can be ensured even



Countries around the world look to decarbonize their power sectors

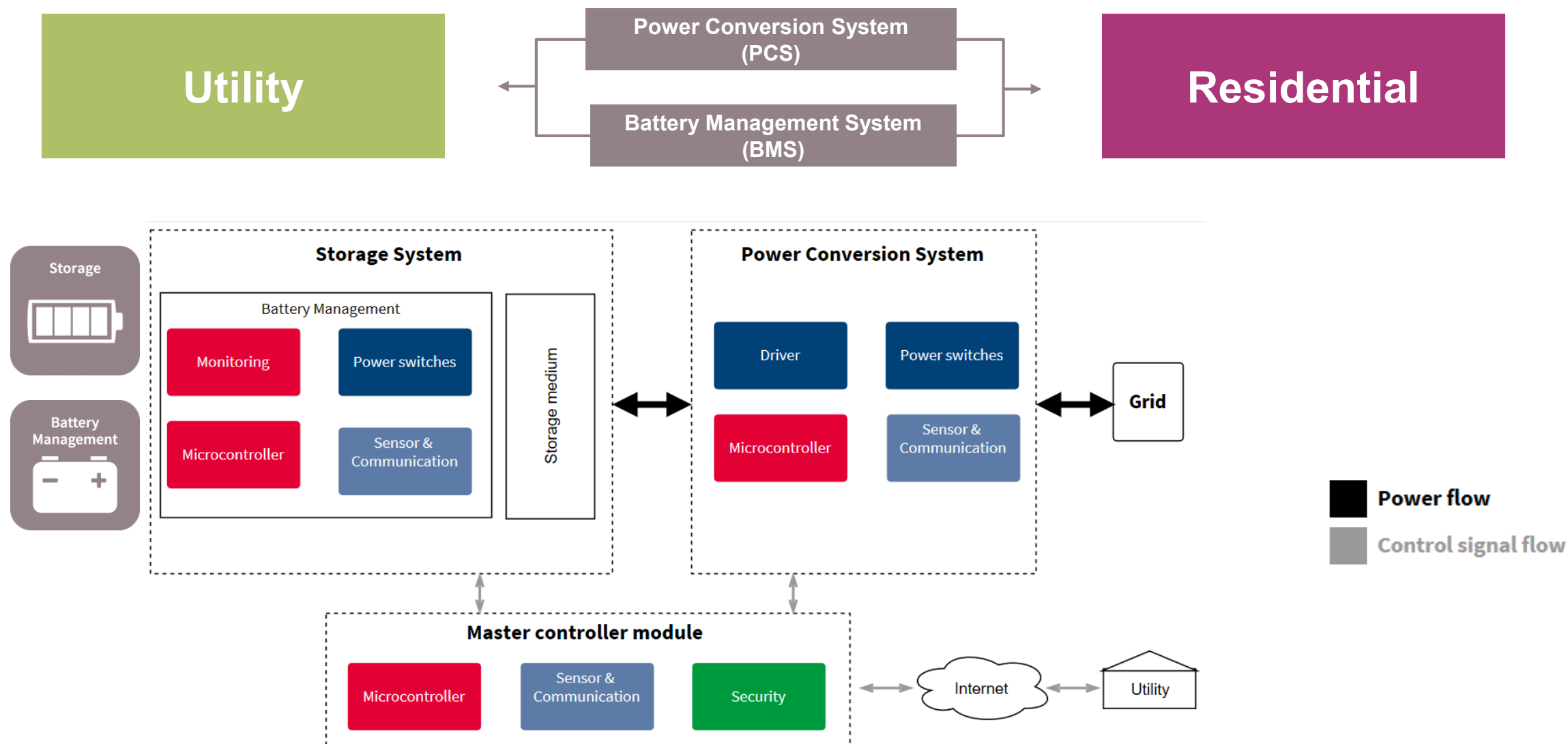
Annual energy storage installations (GW) ¹⁾



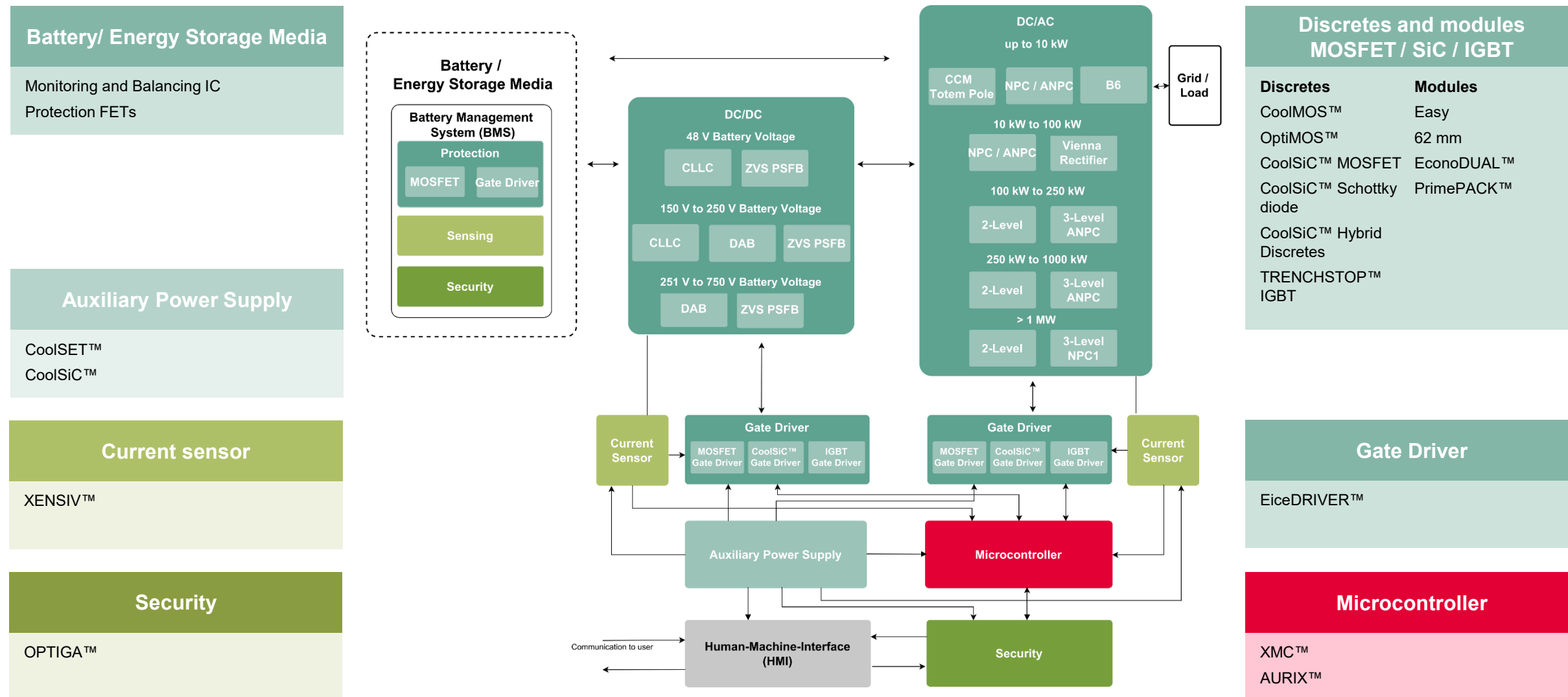
- › Global **power conversion** system shipments are predicted to grow to reach over **11 GW** in 2025
- › The **front-of-the-meter** segment is predicted to account for **62%** of total shipments in 2025 and will reach **>7.0 GW**
- › Significant demand increase in United States due to strong uptake in utility-scale solar plus storage

Source: 1) IHS Markit, "Grid-connected Energy Storage Market Tracker H2 2020", January 2021

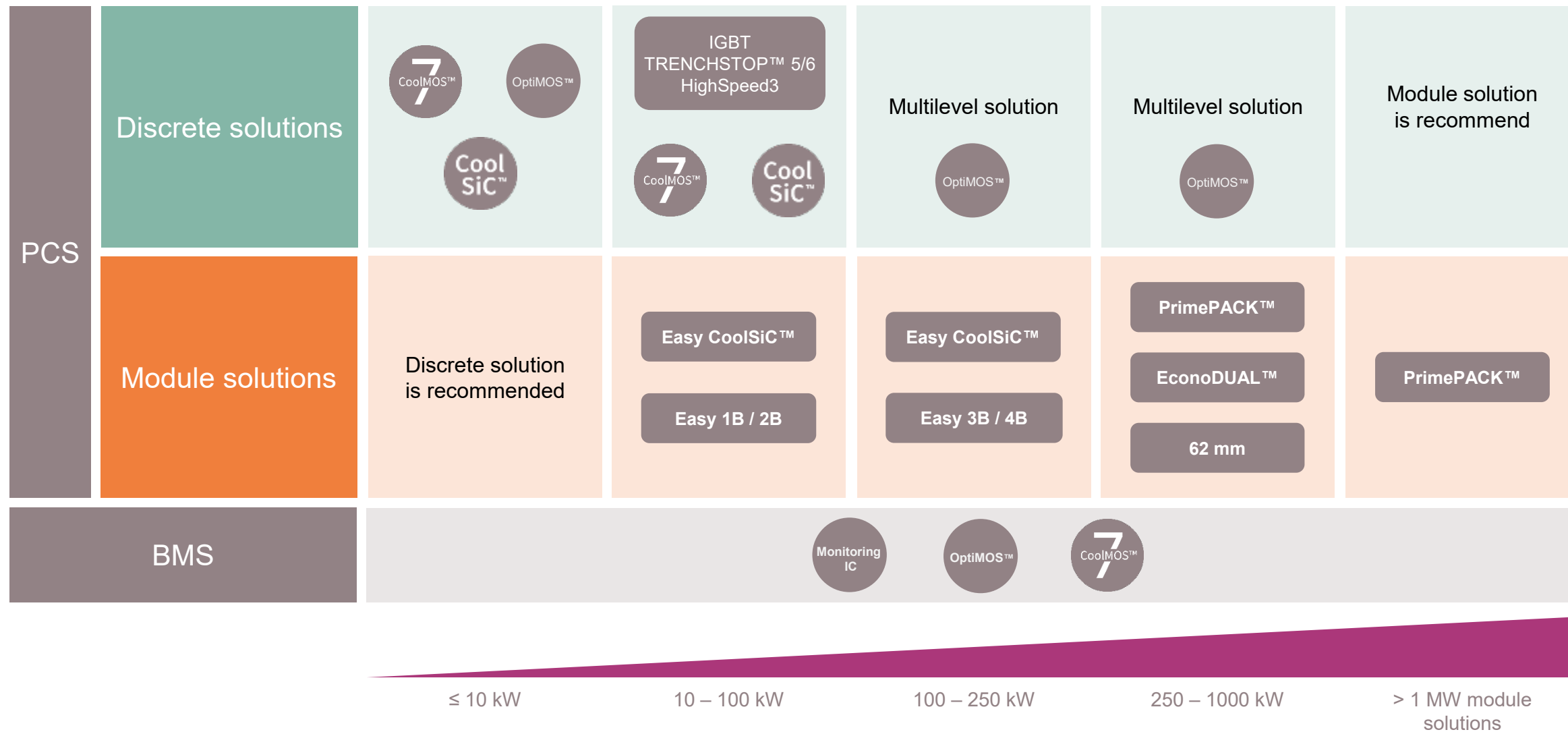
Basic overview of Energy Storage Systems (ESS)



Energy Storage Systems – Infineon’s wide array of offerings



Infineon's power solution offerings for Energy Storage Systems



CoolSiC™ helps to reduce energy losses leading to some extra energy, available when needed



Advantages of SiC

As the battery bank makes up the major portion of the total system costs for Energy Storage Systems (ESS), a change from super-junction MOSFET to 1200 V CoolSiC™ MOSFET can lead to approx. 2% extra energy without increasing battery size



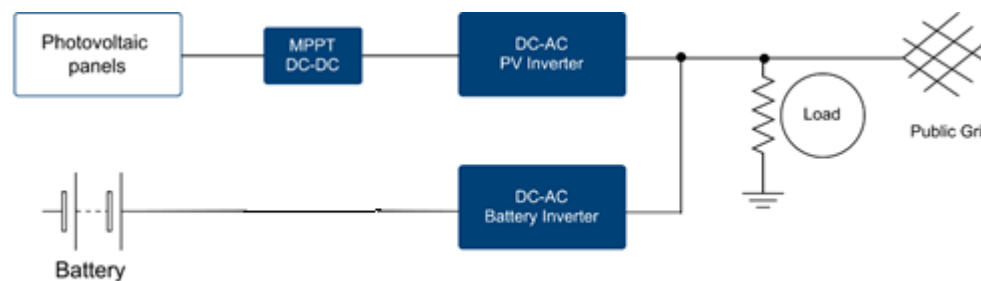
Our CoolSiC™ MOSFET 1200 V cutting losses by 50% for extra energy

Coupling topologies for residential Energy Storage Systems

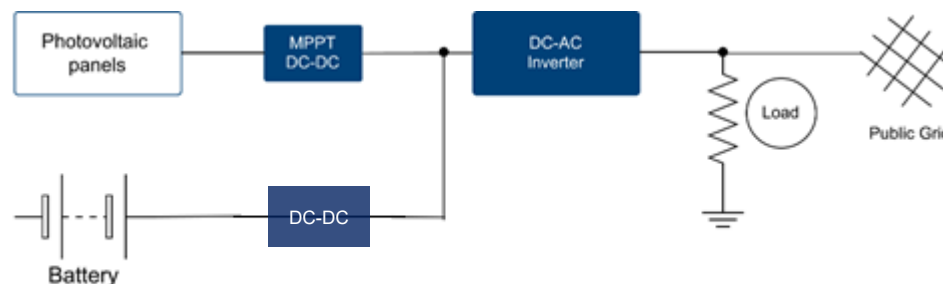


There are two main system coupling topologies for residential ESS, which usually come along with PV installations. Those can be either AC coupled systems or DC coupled

AC coupled



DC coupled



Battery Voltage



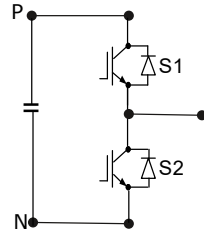
Power rating



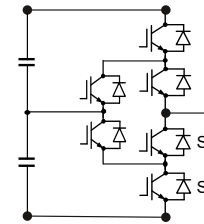
Infineon's suitable solutions for different topologies in the range from > 10 kW and <125 kW

Topology

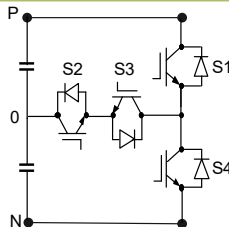
2-level



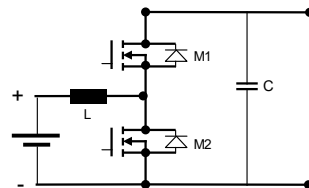
3-level ANPC



3-level NPC2



Bi-directional DC-DC



Features and Infineon's offerings

AC coupled

- Battery voltage <1000 V
 - CoolSiC™ module 1200 V half-bridge (2-level)
 - Easy CoolSiC™ 3-level (3-level NPC2)
- Battery voltage 1200 V, 1300V
 - 1700 V half-bridge module
 - 3-level ANPC module

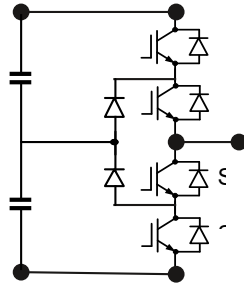
DC coupled

- Battery voltage <1000 V: CoolSiC™ module 1200 V

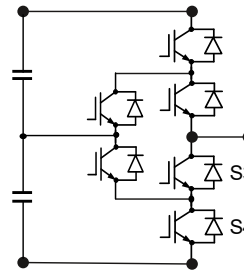
Infineon's suitable solutions for different topologies in the range from >125 kW and up to 2 MW

Topology

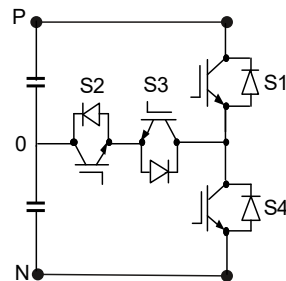
3-level NPC1



3-level ANPC



3-level NPC2



Features and Infineon's offerings

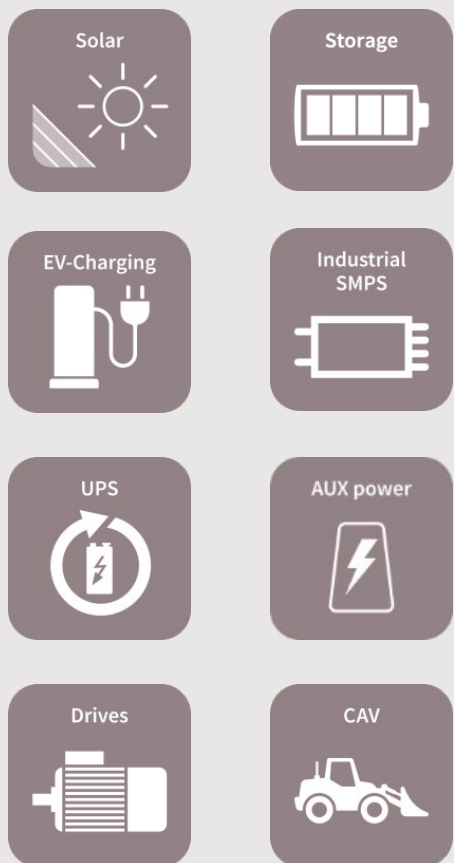
- Battery voltage 1000 V, 3-level NPC1
 - 62mm, EconoDUAL™ 3

- Battery voltage 1500 V, 3-level ANPC
 - Easy 3B
 - 62 mm
 - EconoDUAL™ 3
 - PrimePACK™ 3. PrimePACK™ 3+

- Battery voltage 1500 V, 3-level NPC2
 - PrimePACK™ 3+

Discrete 1200 V CoolSiC™ MOSFET TO-247 3 and 4 pin

Application spaces



Advanced features

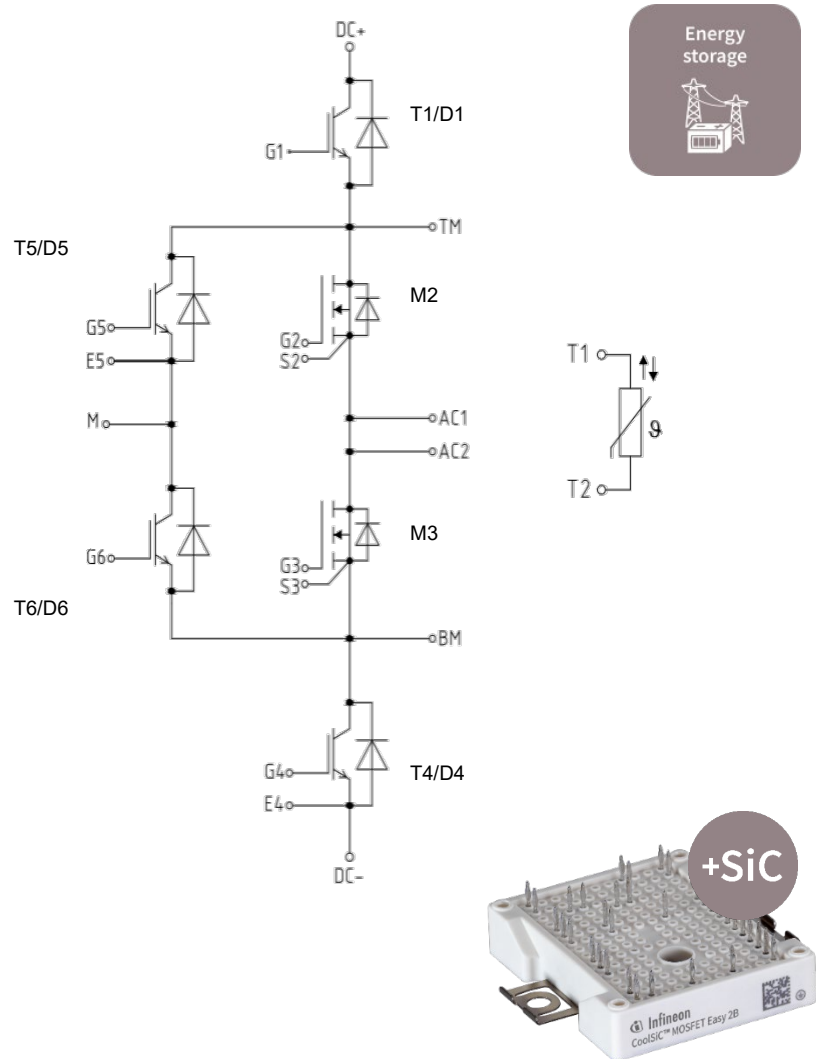
1200 V CoolSiC™ MOSFET:

Higher conversion efficiency and increased switching frequency, enabled by



- › Lowest RDS(on) in TO247 for highest power density
- › Low and temperature independent switching losses
- › Threshold-free on-state → no Vce(sat)
- › Intrinsic diode with low reverse recovery charge
- › Wide gate-source voltage range from 15 V to 18 V
- › Benchmark gate threshold voltage, VGS(th) = 4.5 V
- › -5 to 0 V turn-off gate voltage for easy and simple gate drive
- › Robust body diode rated for hard commutation
- › Robustness levels equivalent to silicon IGBTs, through e.g. superior gate oxide reliability

CoolSiC™ MOSFET for ANPC topology in Easy 2B package with improved Si diodes



BoM

M2/M3	1200 V CoolSiC™ MOSFET: 11 mOhm
T1/T4/T5/T6	1200 V IGBT: 100 A Trenchstop 7
D1/D4/D5/D6	1200 V Diode: 100 A Emitter controlled diode 7

- › ANPC allows optimal integration of CoolSiC™ MOSFET
- › IGBTs are optimized for lowest conduction losses
- › Increased Si diode current rating
- › No external SiC FWD are needed
- › Power losses independent of power factor
- › Full 1500Vdc capability using 1200V switches

Sales name

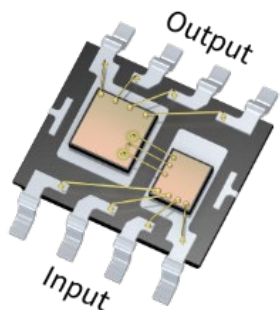
F3L11MR12W2M1H_B74

Description

3-level ANPC Inverter Phase Leg Module

Every Switch Needs A Driver - The right driver makes a difference

ED-E
Enhanced



EiceDRIVER™ Enhanced

Up to 2300 V, 9 A
DESAT, Miller clamp

Rich feature-set for advanced protection:

- **F3 (1ED332x)**: Cost effective solution with DESAT
- **X3 Analog (1ED34xx)**: Best-in-class DESAT accuracy, Analog Configurability
- **X3 Digital (1ED38xx)**: I2C configurable enabling predictive maintenance



www.infineon.com/gdenhanced

ED-C
Compact

EiceDRIVER™ Compact

Up to 2300 V, 18 A
Miller clamp, 2-level slew-rate-control

Reduced feature-set and easy to design-in:

- **X3 Compact (1ED31xx)**: easy to design & cost effective
- **2L-SRC Compact (1ED32xx)**: EMI & switching loss optimization



www.infineon.com/gdcompact

New products with Reinforced isolation (UL 1577 and VDE-11)

TLx4971 Family – Industrial current sensor



Key features industrial current sensor



Key value



Multiple Options

The TLx4971 offers **broad flexibility** as many settings can be optimized by customers in the application. Additionally pre-programmed devices are available



8 different variants each
120A, 75A, 50A and 25A
(UL and non-UL)



Application range

A **bandwidth of 240kHz**, the intrinsic linearity and the very low insertion **resistance of 220 $\mu\Omega$ and less than 1nH inductance** allows a wide range applications, in special **GaN and SiC applications**



Wide range of applications



System compatibility

Stray field robust design with differential measurement of magnetic field allows **accurate measurement** with parallel or multiple current rails



Optimized for **parallel measurement**
e.g. multiple phases



Cost optimization

Reduced BOM cost due to two integrated OCD (Over-Current Detection) pins with less than 1 μ s reaction time and a small **8x8mm power package**



Lower costs due to less external components and small package size



Robust design

Enables galvanic isolated measurement for **high voltage** and **high current applications** without heat sink due to the **superior thermal heat dissipation**



Galvanic isolation plus outstanding thermal performance

Battery Management Systems

Key functionalities



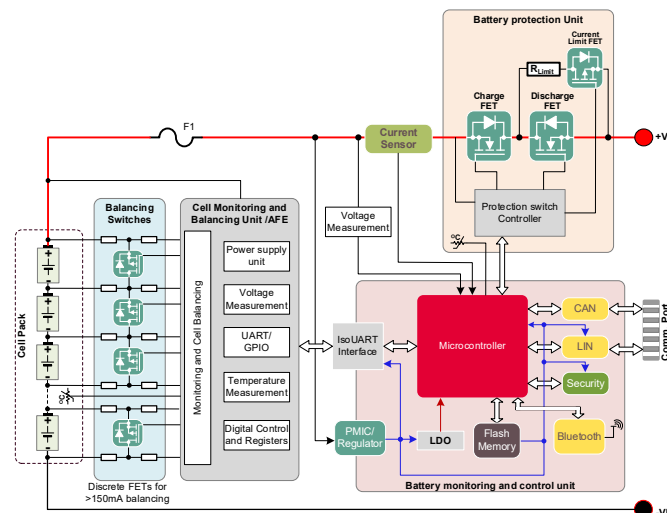
Protection



Performance optimization



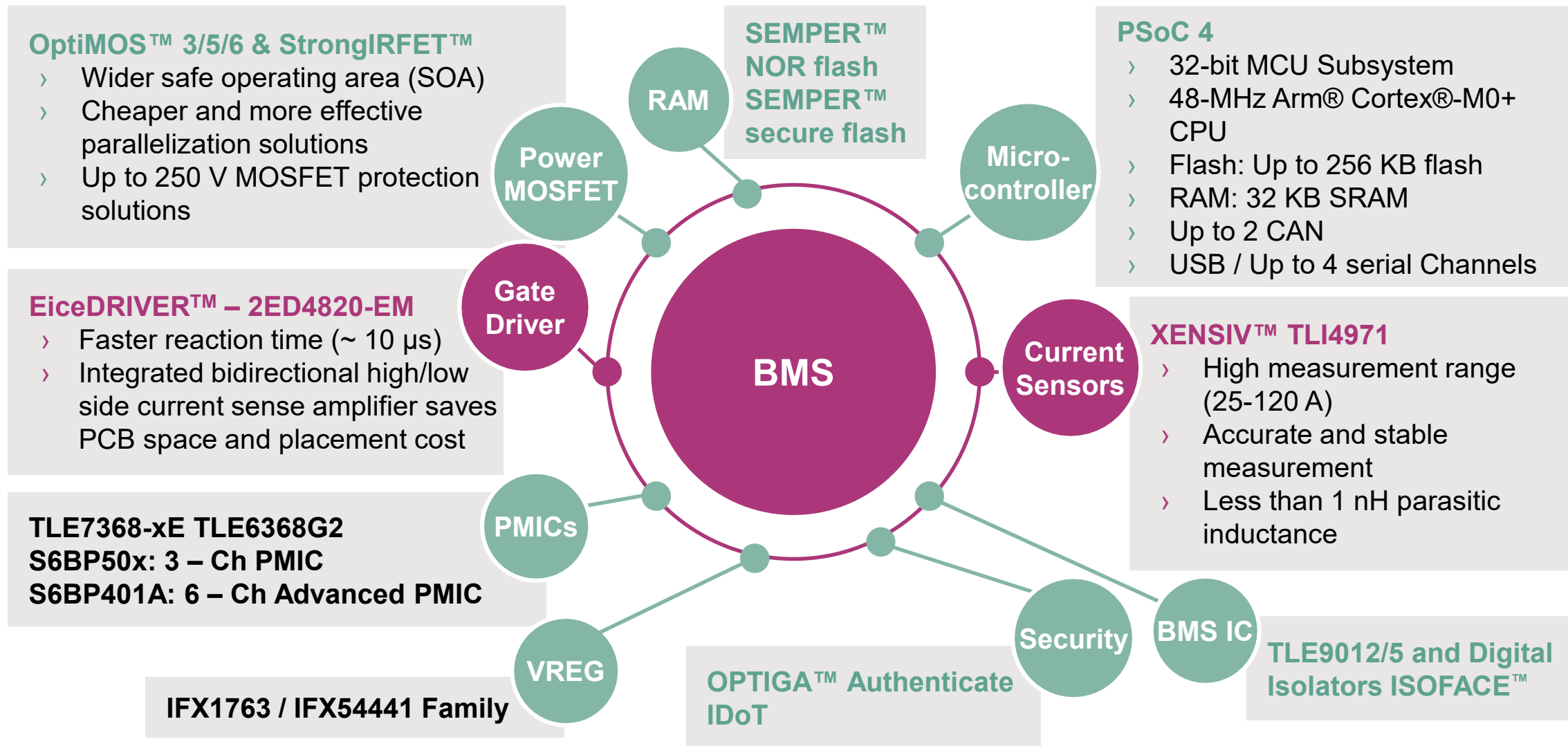
Battery state calculation



BMS functions

Battery protection				Cell monitoring and balancing (CMB)						
Over charge / Deep discharge	Inrush current	Short circuit	Thermal management	Cell voltage monitoring & balancing	Temperature monitoring	Battery pack voltage monitoring	Current monitoring			
Battery monitoring and control (BMC)				Security	Logging	Regulators		Communication		
Fuel gauging	SOH	SOC	Inter-communication	Authentication	Encryption	Data storage	Voltage regulators	PMICs	Wired	Wireless

BMS Offerings



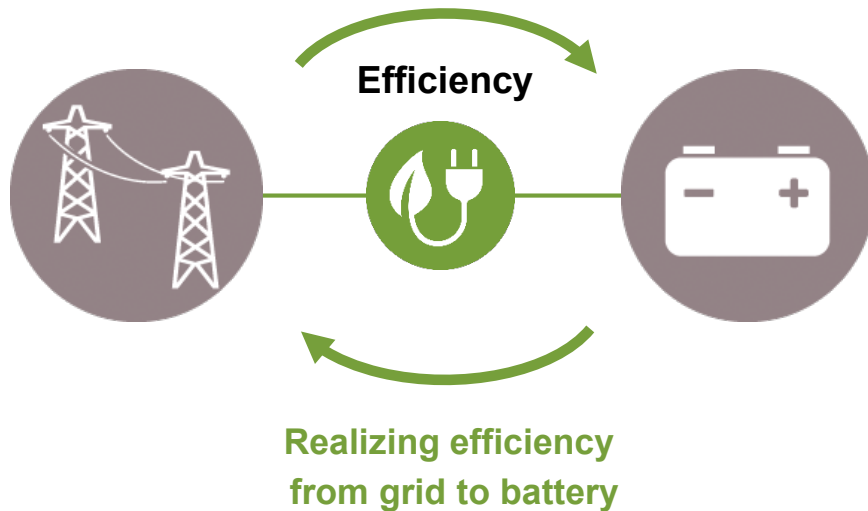
Benefit from Infineon's comprehensive portfolio to solve your Energy Storage Systems design requirements



Reliable
products

Complete
offering

System
expertise





Part of your life. Part of tomorrow.