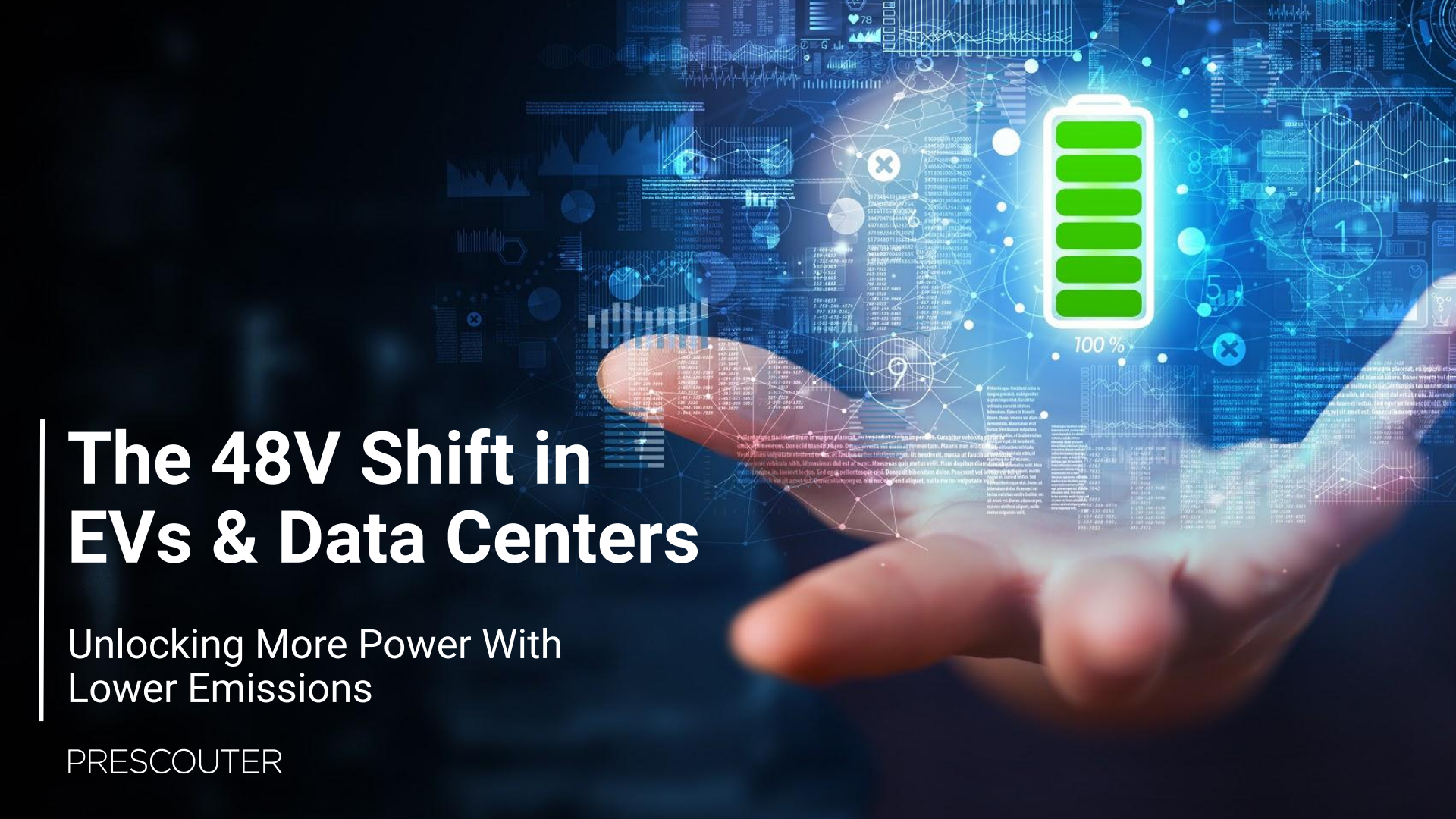


The 48V Shift in EVs & Data Centers

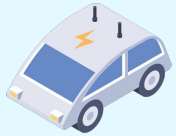
Unlocking More Power With Lower Emissions

PRESCOUTER

48V electrical systems enable higher power efficiencies and reduced fuel consumption, which can help companies meet their carbon goals.

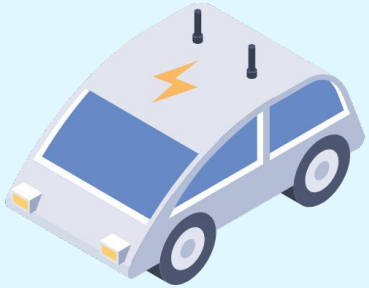
48-volt infrastructure defines a system used by the automotive and data center industries to deliver more safe power that aims to increase performance and therefore efficiency without the tradeoffs of increased cost, size, and weight. A major benefit of the 48V architecture relates to reduced greenhouse gas emissions in the short and long terms.

In this report, we provide a clear overview of the benefits of 48V for both the automotive sector and data centers and a landscape of the key segments needed to build a 48V infrastructure. We also present the key players and global developments in each field, by region.



EVs

Data Centers



48V and Electric Vehicles

The 48V architecture is emerging as a cost-effective system much needed by vehicle OEMs to meet increasingly stringent CO2 emission standards (≤ 97 gCO2/km by 2021).

Reduced fuel consumption

48V hybrid architectures are claimed to reduce fuel consumption by

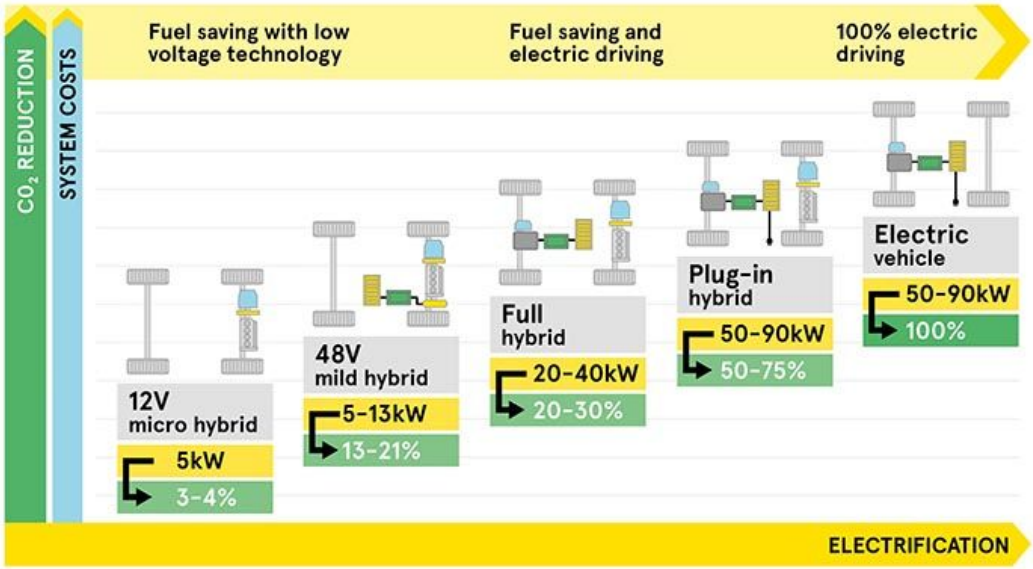
10%-15%

Improved performance

48V increases power capability by

4X

and allows the engine to be run with electrically driven systems, resulting in improved performance and efficiency.



Scalable powertrain electrification technology based on 48V systems and reduction of CO2 emissions, from micro hybrids to EVs. Source: Avnet.

The 48V infrastructure offers 4 main benefits for the automotive sector.

1. **Satisfies higher voltage needs** by modern vehicles and allows different configurations (simple integration, lower weight, and reduced space requirements) for optimizing fuel economy and emissions.

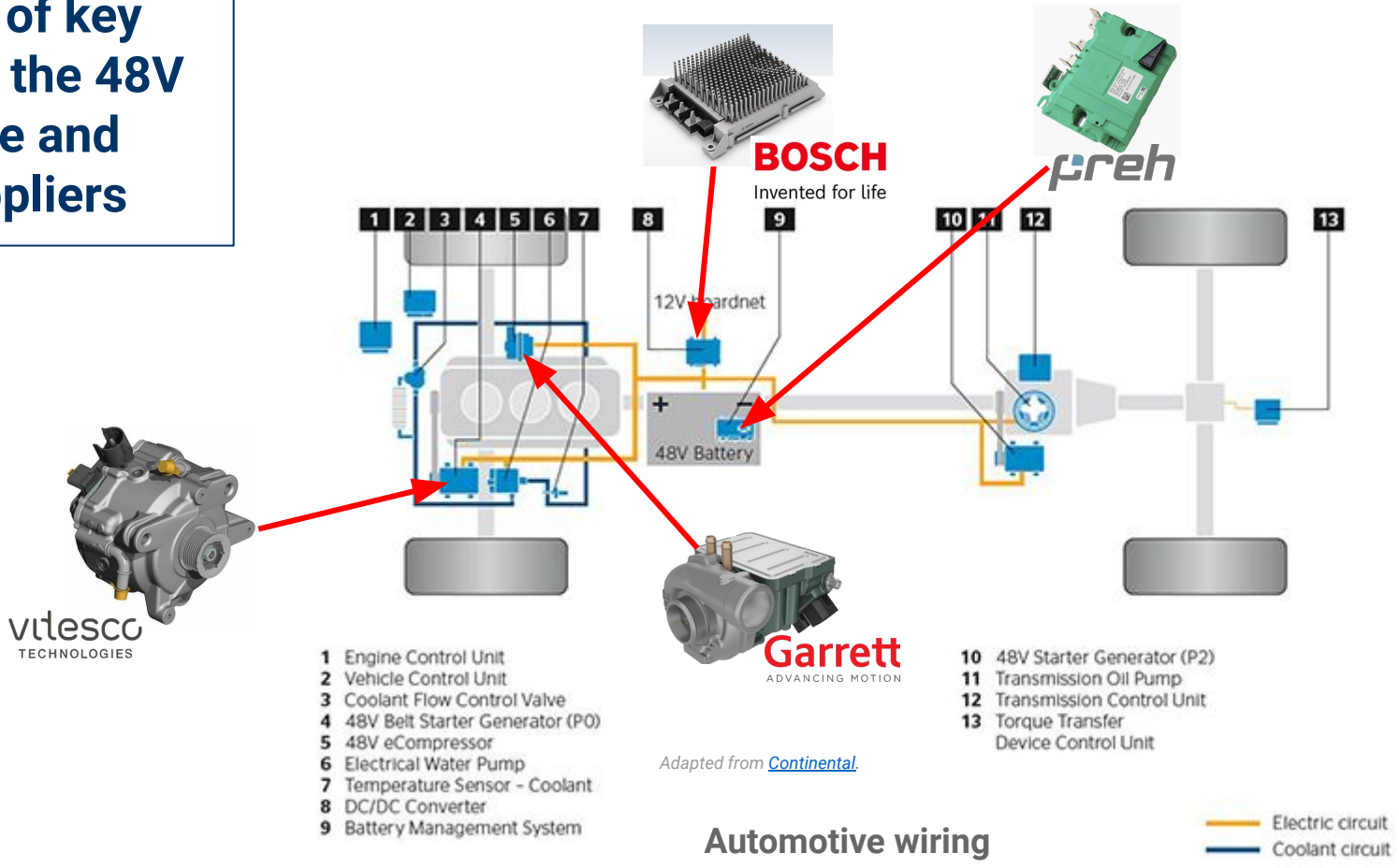
2. Automotive developers claim that 48V hybridization technology can **reduce fuel consumption by up to 21%.**

3. **Supports heavier load components** (e.g., air conditioner, engine fan, enables faster cabin heating and catalytic converter at startup).

4. **Provides additional torque,** improving the dynamic driving performance, including a flawless start-stop function.

The 48V component makers supplying the automotive sector

A landscape of key segments of the 48V infrastructure and example suppliers



EVgo - A public fast charging network for EVs powered by 100% renewable energy

TECHNICAL DESCRIPTION

EVgo chargers average an up time of 98%. Most stations contain DC Fast 50kW chargers, which can charge a low battery to nearly 80% full within 30 minutes. In other markets, EVgo has Level 2 chargers, which charge up to 25 miles per hour. EVgo has the power to charge any EV on the market.

At a glance

Type	Charging station for EVs
Year	2010
Key Feature	Fast charging

SOLUTION HIGHLIGHTS

- Stations power all current EV models with 50kW Level 3 DC fast charge capabilities
- Cost is $0.21-$0.31 per minute, pay as you go or monthly membership
- Serves more than 220,000 customers

EVgo has 800 charging locations in 67 metropolitan areas across 34 states. Source: EVgo.

Vitesco - Develops powertrain technology for EVs

TECHNICAL DESCRIPTION

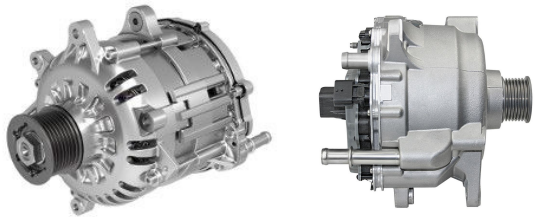
The 48-volt Belt-Driven Starter Generator (BSG), an electric motor with 48V operating voltage, acts as a powerful replacement for the generator. When starting up, it immediately boosts the drive torque via the boost function, providing up to a 10% reduction in CO2. Its continuous power can reach up to 5 kW, with a maximum efficiency of 85%.

At a glance

Type	48V belt-driven starter generator for EVs
Year	2019
Key Feature	Easily integratable into existing EVs

SOLUTION HIGHLIGHTS

- Increased power and enhanced comfort
- Lower fuel consumption and associated CO2 emissions
- Easy to integrate into existing and future vehicles
- Compatible with all transmissions and engine types
- No service required



Three different types of 48V BSG with integrated inverter: air, liquid, or hybrid cooled. Source: Vitesco.

Garrett Motion - Delivers power density through aerodynamics and electrical design

TECHNICAL DESCRIPTION

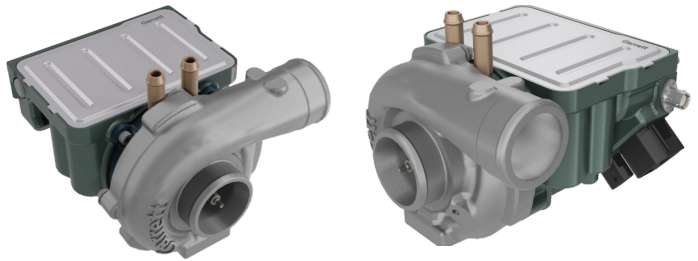
The eCompressor offers motor power, speed capability, and aerodynamic performance, increasing engine power density and transient response. Its electronic design and thermal management allow the eCompressor to operate continuously, improving engine low-end torque.

SOLUTION HIGHLIGHTS

- Improved acceleration and downspeeding
- Enabled advanced combustion strategies
- Reduced engine emissions and lower fuel consumption
- Compact design and installation flexibility

At a glance

Type	48V eCompressor
Year	2003
Key Feature	Continuous operation



Images of Garrett Motion's 48V eCompressor. Source: Garrett Motion.

Preh - Solutions for e-mobility, car human-machine interface (HMI), and commercial vehicle HMI worldwide

TECHNICAL DESCRIPTION

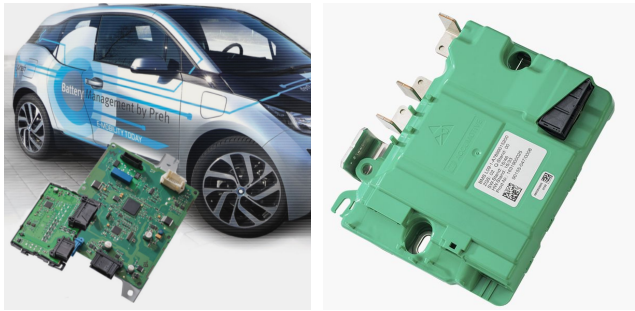
Preh's Battery Management System (BMS) is a multiconverter that transforms 800V into three voltages: 400V (for the air conditioning compressor), a bidirectional 48V voltage (for chassis roll stabilization), and 12V for the onboard power supply.

SOLUTION HIGHLIGHTS

- Monitors the voltage and temperature of each individual battery cell
- Calculates state of charge, remaining car range, and battery lifetime
- Ensures optimal battery performance

At a glance

Type	Battery management system
Year	2003
Key Feature	Optimizing battery performance



48V battery management control unit. Source: Preh.

Bosch Mobility - Powertrain systems and electrified mobility for diverse requirements

TECHNICAL DESCRIPTION

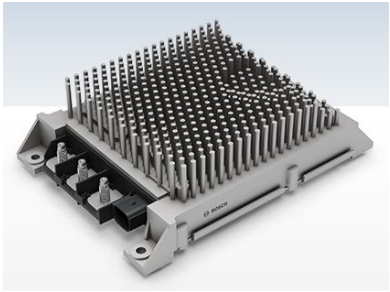
This bidirectional 48/12 V DC/DC converter is used in boost recuperation systems and provides stable energy to the 12V electrical system independent of the engine speed. Thus, it supports innovative fuel-saving driving applications such as advanced start-stop and regenerative braking or coasting.

At a glance

Type	48V DC-DC converter
Year	1886
Key Feature	Passive cooling

SOLUTION HIGHLIGHTS

- Compact design, thanks to passive cooling
- Reduction of fuel consumption and CO2 emissions
- Safety functions such as temperature overload detection



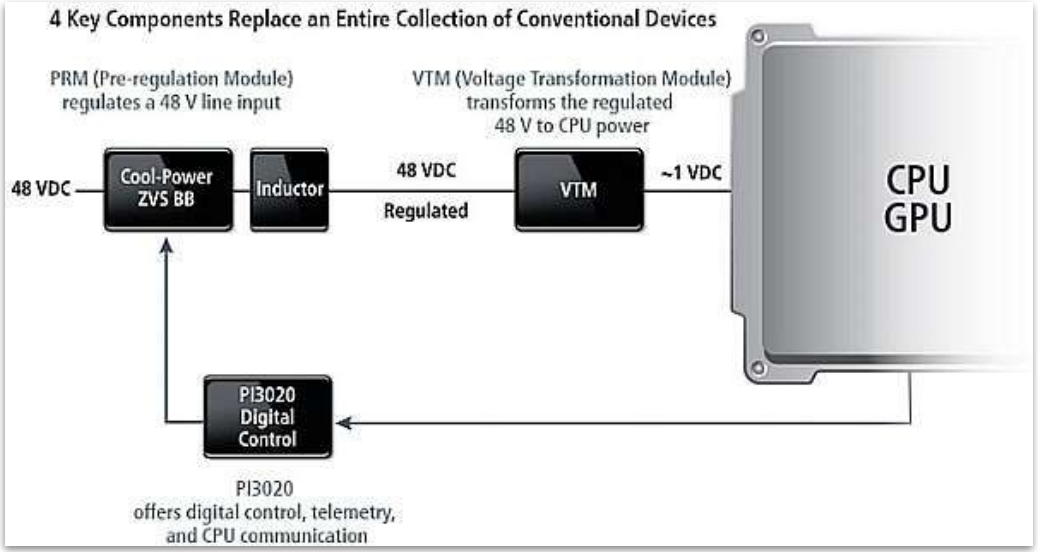
48V DC/DC converter. Source: Bosch Mobility.

48V and Data Centers

The rapid development of cloud computing is demanding higher energy power from data centers and supercomputers (205 terawatt-hours as of 2018).

By 2025, there will be more than 175 zettabytes of data, and preventing disruptions to operative systems is critical. Like the automotive 48V system, data centers are able to support a shift to 48V.

48V architecture provides increased flexibility, solving the challenge of reducing power flow to the load effectively, given cable, connector, and/or PCB limitations.



Vicor's alternative architecture to conventional multiphase is the 48V directly to the CPU. Source: Vicor.

In data centers, shifting to 48V offers a better power conversion efficiency (98%) and lowers distribution currents, with the same safety level as 12V.

BENEFITS OF SHIFTING TO 48V IN DATA CENTERS

Lower distribution losses:
16X reduction in I^2R losses

4X reduction in capacitor volume

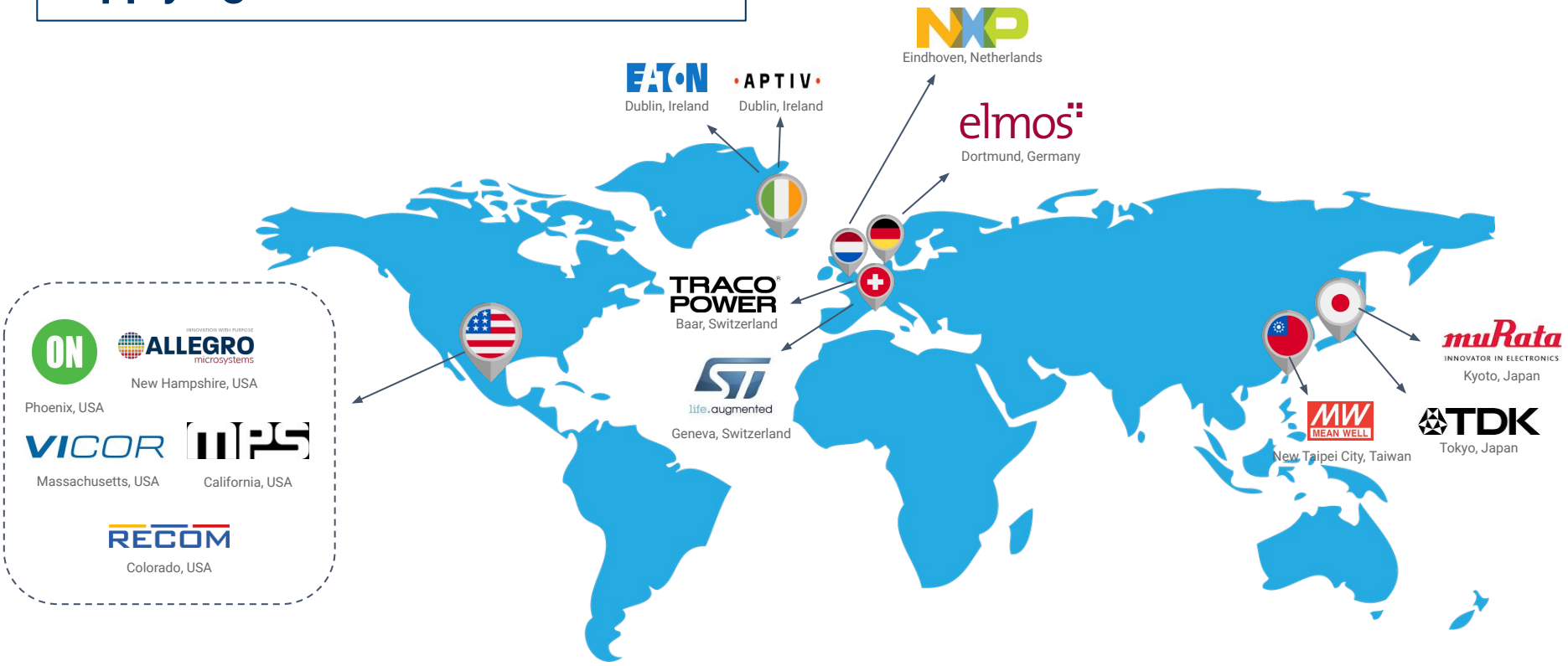
Low weight

Higher power density
and efficiency

Deployment flexibility

Cost-effective in-rack UPSs

The 48V component makers supplying the data center sector



Vicor - Develops modular solutions for power systems enabling advanced computer architectures

TECHNICAL DESCRIPTION

Vicor's DCM DC-DC converter is a 48V regulated DC converter recommended for data center applications and high-performance computer systems. It has a 97.0% peak efficiency, which represents the power delivered to the load divided by the total power drawn by the converter.

SOLUTION HIGHLIGHTS

- Compact size allows easy placement on 12V boards
- Parallel operation is also possible to attain higher power levels above the 750W capability of one module
- Requires minimal external components, adding to its high-density, low-impact design capability

At a glance

Type	48V DC-DC converter for data centers
Year	1981
Key Feature	High density, low-impact design

Non-isolated derivative to a standard DCM dedicated to 48V-to-12V conversion in data center, automotive, and industrial markets. Source: Vicor.

48V technology is already being adopted by key players in both the automotive and data center sectors and will be a game-changer moving forward.

Nearly 60 million vehicles are predicted to have start-stop technology, and more than 7 million vehicles will have 48V technology as mild hybrids. Likewise, **1 out of 10 cars sold across the world will be a 48V mild hybrid by 2025**.

With the adoption of 48V main bus architectures (which reduces distribution losses by a factor of 16 compared to 12V power delivery), the goal is to **balance cost and efficiency** as deployments scale to the level of 13 million new servers installed in data centers every year.

The 48V system will not only translate into reduced fuel consumption and emissions, but it will also result in more vehicle power, active safety systems, advanced electrical systems, and reduced cost of electrical components.

About the Authors

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Sofiane leads the high-tech, aerospace and defense, automotive & logistics practices at PreScouter. For nearly a decade, he has worked with hundreds of F500 and G1000 clients across multiple industries, through which he has developed an expertise in key emerging technologies (such as 5G, IoT, AI/ML, blockchain, energy storage and generation, quantum sensing, and others) and a strong understanding of the associated business ecosystem and drivers pushing these sectors forward (for e.g. key players and trends, roadblocks to commercialization, etc). Sofiane's strategic insights have ranged from technical due diligence for acquisition targets to identifying relevant markets for newly developed products based on emerging technologies and assessing market penetration strategies. Sofiane holds a Ph.D. in Materials Science and Engineering from the Georgia Institute of Technology, where his research focused on nanotechnology and energy storage.

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Researcher & Team Leader, PreScouter

Jorge supports PreScouter as an Advanced Degree Researcher helping provide clients high-quality information and analysis about the latest insights into disruptive technologies, helping companies find new markets and remain competitive in their market niche. Jorge performs research in developmental and environmental sustainability in both developed and developing countries, using expertise acquired at the Universities of Florida and Syracuse (US), Ryerson, and Environmental and Climate Change Canada. Jorge holds a Ph.D. in Biology and a M.A. in Conservation Biology.

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