tec news

HARTING's Technology Magazine

RENEW-ABLE POWER

Our technology gives wings to worldwide expansion

"WE ARE RIGHT IN THE MIDST…"

Arvid Gillert, ZVEI, on the expansion of the German power grid

KEY ASPECT INTEROPE-RABILITY

Jörg Scheer, HARTING

MORE POWER FOR THE SAME SIZE

Norbert Gemmeke, HARTING

editorial

Dear readers,

the future vision of an "All Electric Society" (AES) is approaching in leaps and bounds.

Renewable energies are transforming the global energy sector – thanks to cost efficiency and innovative storage technologies. At the same time, performance gains in electrification are advancing at an incredible speed.

But what does this development mean for the components that literally hold our electrified systems together? In particular, the question arises: What role do connectors play in terms of "Connecting the All Electric Society with Power"?

"For a long time – and perhaps far too long – size was a symbol of performance. The All Electric Society is dispensing with this dogma. In the past, the power of an electric motor scaled linearly with the size, but now, the All Electric Society is governed by new rules. Actuators have a clear purpose to fulfil, which follows a specific, usually escalating power requirement. There are many examples of this – in the tool and machine sector, for example, drives have been converted to DC or servo technology delivering maximum performance. Thanks to the use of innovative technology, electric vehicles can achieve a level of performance that was unimaginable just a few years ago – and this applies likewise to many areas. To date, size was an unalterable boundary condition due to the respective application.

Now, performance gains are not achieved through upscaling, but through innovation. Consequently, this also has an impact on connectivity, as this must make the performance connectable and pluggable in parallel, for example by way of higher currents and voltages. If the classic and conventional means of scaling is not available, then only innovation will help.

Our latest edition of tec.news showcases how connectivity innovation is paving the way to the All Electric Society. I'm sure you will enjoy reading the new issue!

Philip Harting
Chairman of the Board,
HARTING Technology Group

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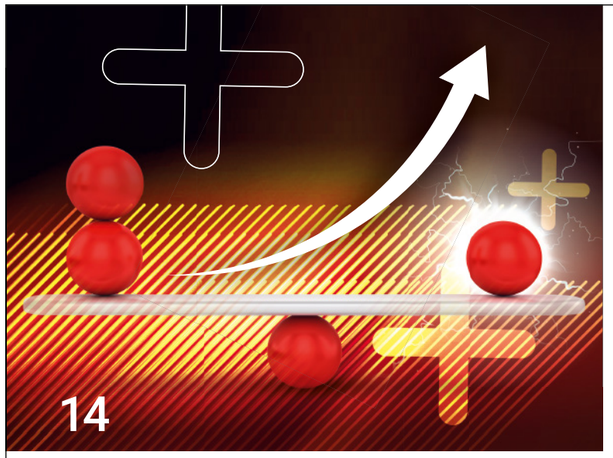
HARTING
Pushing Performance
Since 1945



More power for the same size

Technological developments in connectors: central importance for the success of the AES

M12: Power^{X}

Up to 7.5 kW supply power in the smallest of spaces: Connectors with enough capacity for the increasing power requirements of applications in all sectors of the AES

Charting the course to a green future

Ship propulsion with hydrogen: A project made for the eCap Marine GmbH from Hamburg

Intelligent innovation for sustainable mobility

Developing and promoting innovative transport solutions: together on the road to a low-carbon future

Issue 48 | Cover story:

EMPOWERING THE ALL ELECTRIC SOCIETY

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WE STEP OUT OF THE SHADOWS

The goal was and remains clear: the use of biogas strengthens the self-sufficiency of the HARTING Technology Group and actively realises the vision of sustainable production in Germany.

There is no alternative to the vision of a carbon-neutral future in which renewable energy sources cover all energy requirements. But there is still a lot to be done. The wildly fluctuating energy volumes from renewable sources, such as the much cited "Dunkelflaute" [a period of time in which little or no energy can be generated with wind and solar power, because there is neither wind nor sunlight], pose a particular challenge. But it can be solved – and in several ways.

To this end, the German National Academy of Science and Engineering (acatech) is currently researching the future role of base load power stations, for example. The "Energy Systems of the Future" (ESYS) initiative is investigating whether base load technologies such as nuclear fission, natural gas, geothermal energy or nuclear fusion might be of benefit to the German energy system.

Intelligent networks and storage technologies represent a further concept for stabilising electricity supplies. So-called smart grids improve grid stability by providing balancing energy, thereby matching supply and demand. Groundbreaking solutions such as virtual power stations and long-term storage solutions are helping to master the challenges of fluctuating energy volumes and boost the integration of renewable energies.

By way of a further alternative, HARTING is banking on a concept of its own that builds on demand-oriented, decentralised power generation. This third way is the decentralised way. If we go down this path, a familiar technology presents itself. The flexibilisation of biogas plants by retrofitting them with biogas storage tanks, in conjunction with combined heat and power plants, leads to flexible power stations. The technology has proven its potential. The commitment of companies demonstrates its feasibility time and again. HARTING is one such company that has been exploiting the possibilities of biogas plants for over a decade.

The foundations for sustainable business were therefore laid early on and underlined by the inception of ZEA Green Energy in 2011. HARTING spotted the opportunity offered by the Renewable Energy Sources Act that had just been passed at the time. This was followed by the construction of a 0.5-megawatt biogas plant, from which electricity was generated. A little later, the idea was born to produce biomethane. A 3-megawatt biogas plant with a treatment plant was built in Uchte for this purpose.

Sustainability has never been just a label for us. Rather, HARTING sets great store by the fact that the ZEA Green Energy only uses renewable raw materials, primarily maize, as its input material. Around 90 per cent of the biomass comes from the company's own farmland, in which a blend of crops and flowering areas are cultivated to promote biodiversity. The goal was and remains clear: By using biogas, we are strengthening the self-sufficiency of the HARTING Technology Group and acting as a role model in embracing the vision of sustainable production in Germany. HARTING is thus stepping out of the shadows figuratively speaking.

Philip Harting
Chairman of the Board, HARTING Technology Group

I GOT THE POWER

How does energy determine the future of the All Electric Society? How is the trinity of generation, control and consumption changing and shifting? These issues are increasingly becoming the focus of the industrial arena and of society at large. The role of electrical energy as a driving force is not only transforming production processes, but also the perception of energy itself.

Andreas Huhmann
Strategy Consultant, HARTING Stiftung & Co. KG

Dr. Stephan Middelkamp
General Manager Quality & Technologies, HARTING Stiftung & Co. KG

Our perception of electricity has changed fundamentally in recent years. In the past, electricity was seen as a kind of abstract commodity – often being viewed merely as a source of energy that did its work silently in the background. Put simply, electricity simply came out of the socket and that was it. This image is now changing.

The integration of new technologies, in particular battery storage systems and decentralised generation plants, is transforming electricity into a tangible commodity. **More and more consumers are recognising electricity as a manageable and tradable commodity that can not only be used, but can also be stored and sold.** This development is creating new opportunities in the energy market and promoting a good deal of rethinking in the way we use electrical energy – and this also applies to its generation.

RENEWABLE ENERGIES ON THE UP AND UP

The expansion of renewable energies is being driven forward apace – across the globe. Countries are investing massively in technologies for the generation of electrical energy from solar and wind power. The reasons are obvious: Renewable energy sources not only make ecological sense, they also deliver economic benefits →1.

The price of electricity generated by renewable sources is now competitive and is giving rise to new business models emerging. Companies and consumers are benefiting from this development, as the costs of renewable energies are continually trending downwards. This transformation is resulting in new dynamics in the energy market, which are also incurring lasting impacts on the various branches of industry in the truest sense of the word.

THE SIGNIFICANCE OF ENERGY MANAGEMENT AND STORAGE TECHNOLOGY

Sector coupling is a decisive factor for the future energy supply of all consumers, from industry through to the private sector. The seamless integration of electricity generation, storage and consumption gives rise to more efficient utilisation of electrical energy. The challenge is to network the various consumers and producers so as to optimise the energy flow. This sector coupling is essential to ensure a stable and needs-based energy supply. New storage technologies and intelligent control networks are playing a decisive role here.

Consequently, energy storage systems are essential for the transformation of energy distribution →2. In view of the fluctuating generation from renewable sources, the storage of electrical energy is advancing as a key technology. Companies are investing in innovative storage systems to bridge the time gaps between generation and consumption as well as compensating for so-called dark periods. Leading edge technology, such as modularisation using plug-in battery storage systems, makes it possible to store electricity when it is produced at lower costs. When demand increases, it can then be sold or utilised – a development enabling more flexible pricing and contributing to the economic stability of the energy market.

THE DECENTRALISATION OF ENERGY GENERATION

The decentralisation of energy generation is another key aspect of modern energy supply scenarios. An increasing number of companies and households are turning to their own generation options, such as photovoltaic systems. These systems ease the burdens on existing energy grids and enable producers to operate independently of centralised power plants. The trend is for electricity consumers to become electricity producers at the same time – a development that is changing the market dynamics and could revolutionise access to electrical energy.

As energy generation changes and shifts, new business models are also emerging. Companies are increasingly having to adapt and find more innovative ways to offer their services. Trading in electrical energy becomes more attractive as price and supply fluctuations enable maximising financial efficiency. Consequently, the generation, storage and distribution of electrical energy is becoming a complex, dynamic business area offering scope for diversification and new approaches.

Efficient utilisation means not only to reduce costs but also to minimise the ecological footprint.

ENERGY EFFICIENCY IN THE AGE OF DIGITALISATION

The issue of energy efficiency is also becoming increasingly significant – not least within the context of digitalisation. More and more companies are facing the challenge of making their energy consumption sustainable. This holds particularly true in the electromobility and data areas, the second important lifeline of the All Electric Society. Intelligent control systems enable companies to optimise their consumption so that energy is used when it is available and favourably priced. After all, efficient use not only means reducing costs, but also minimising the ecological footprint. This in turn requires a deeper integration of technologies that enable seamless communication between the different sectors.

To recapitulate, the course to the All Electric Society is characterised by various factors. The perception and appreciation of electrical energy is changing. Renewable energy forms are gaining in importance and requiring new approaches to sector coupling. Energy storage is advancing as a central issue for the economic and sustainable use of energy. Decentralising the energy generation is revolutionising the energy market, while new business models are opening up new avenues. And lastly, energy efficiency is also an essential component that will characterise future energy consumption. With these changes and shifts, the course has already been irreversibly set for a sustainable and efficient energy future that meets the needs of consumers and the relevant ecological requirements at the same time.

1 *Study "LCOE Renewable Energies" of the Fraunhofer Institute for Solar Energy Systems ISE*

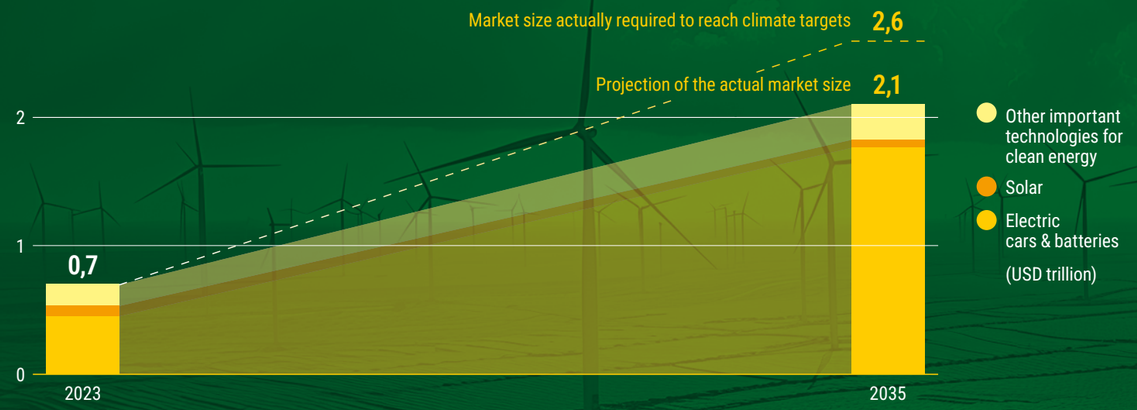
2 *Report "Expansion of Renewable Energies" of the Federal Network Agency*

POWER-UP

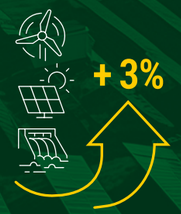
Renewable energies reach new all-time high

Market size of the most important technologies and components for clean energy"

Source/data basis: IEA

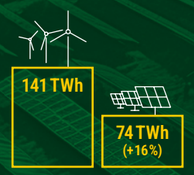


Energy Technology Perspectives 2024" (ETP-2024) focuses on the **prospects for solar photovoltaics, wind turbines, electric cars, batteries, electrolysers and heat pumps.** Based on the current political conditions, the global market for these technologies will surge from USD 700 billion in 2023 to over USD 2 trillion by 2035. Trade with clean technologies is also likely to rise rapidly and reach USD 575 billion which is more than 50% larger than today's global trade with natural gas.



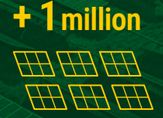
Last year, Germany generated **59% of its electricity from renewable sources such as wind, solar, water and biomass.** In the previous year, the share still stood at 56%.

Consequently, the **share of renewable energies in gross electricity consumption** expanded to around 54% (2022 46.3 %; 2023: 52.5 %)

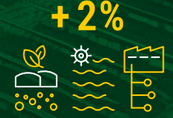


Electricity generation from wind energy in 2024 was **roughly on a par with the previous year,** while electricity from photovoltaic systems **trended upwards significantly.**

Rise in PV systems: The total installed power **climbed by almost 16 gigawatts** to its current level of a sound 98 gigawatts.



Over a million new PV systems are currently being connected to the grid every year – including large-scale ground-mounted systems and small solar systems for balconies.

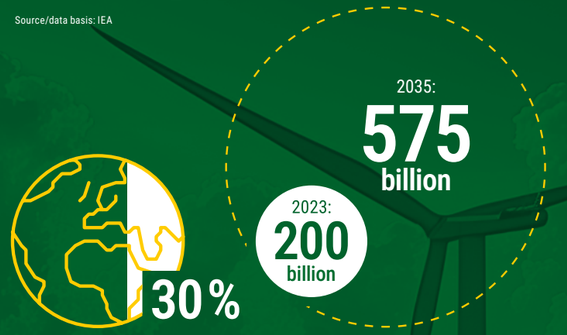


Electricity generation from **biomass, hydroelectric power and geothermal systems** in 2024 also rose by around 2% year on year.

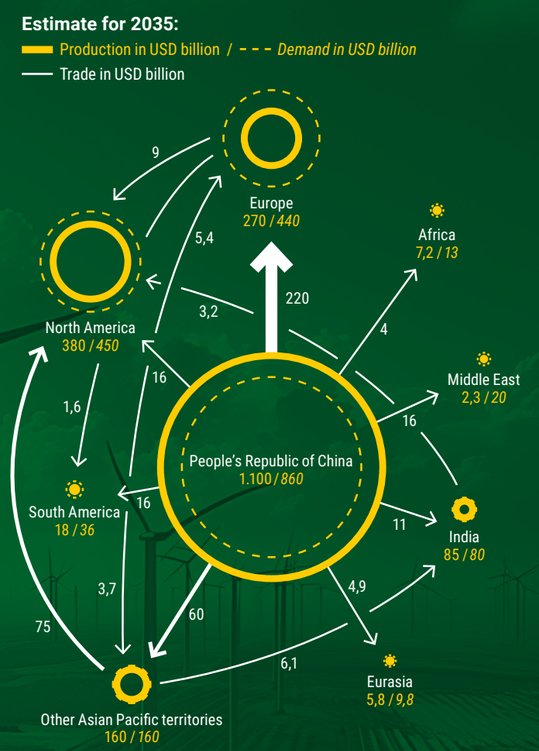
Source/data basis: German Federal Environment Agency, zeit.de

Worldwide trade with clean energy technologies

Source/data basis: IEA



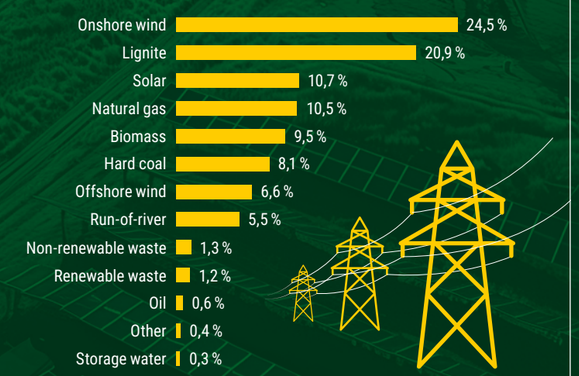
Worldwide trade with clean technologies = USD 200 billion = 30% of the global market value.
Electric cars make up the largest share and have doubled since 2020 followed by photovoltaic solar systems.
This figure is expected to climb to USD 575 billion by 2035.



Supply chains for clean technologies are largely dependent on trade and will remain so in the future.

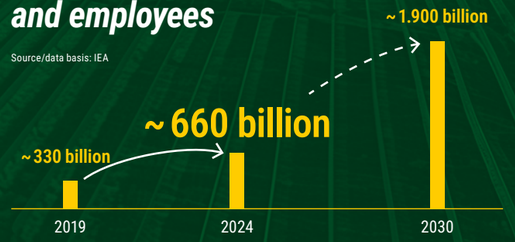
Energy sources for Germany's public sector net electricity generation, November 2024

Sources/data basis: Statista, ENTSO-E, Federal Statistical Office:, AGEB



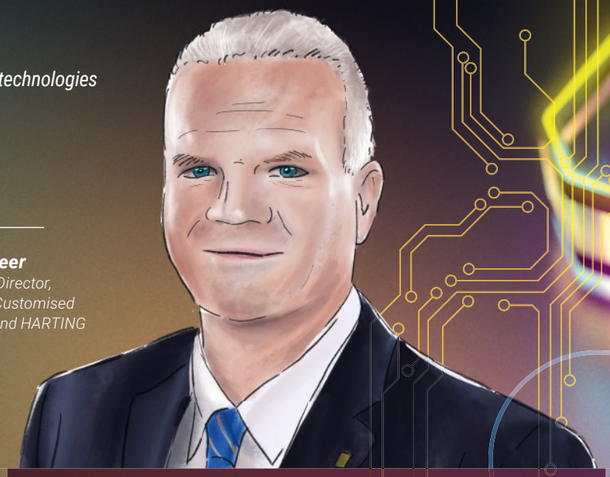
More investments and employees

Source/data basis: IEA



Capital expenditure on efficiency in end-use sectors, including electrification, is likely to have risen by 4% to around USD 660 billion in 2024, thereby matching the alltime high of 2022.

This is also reflected in the corresponding occupations: In 2024, the number of employees in jobs linked to energy efficiency reached nearly 10 million.



Jörg Scheer
Managing Director, HARTING Customised Solutions and HARTING Electronics

"INTEROPERABILITY IS A VITAL ASPECT OF THE ALL ELECTRIC SOCIETY"

HARTING is playing a vital role in the vision of the All Electric Society, creating nothing less than the link to a more sustainable future. Our innovative connectivity solutions enable the interaction between electrification, digitalisation and decarbonisation. We are promoting the integration of renewable energies and boosting the efficiency of energy supplies. In this context, HARTING is engaging closely with partners from various sectors to overcome challenges in networks and ensure genuine interoperability. In our interview, Jörg Scheer explains why we at HARTING are tackling these tasks with a good measure of confidence.

Sebastian Human
tec.news editorial team

tec.news: What does the All Electric Society mean for HARTING in specific terms, and what role is your company playing in this transformation process?
Jörg Scheer (JS): The All Electric Society is of decisive importance to HARTING, as it serves as the technological key to a sustainable future. The electrification of society not only opens up new business opportunities, but also makes active contributions to environmental protection. Providing our connectivity solutions, are we supporting innovative strengths in the sector and meeting the demands of an increasingly electrified world. HARTING is concentrating on three central elements: Electrification, digitalisation and automation – and always with the aim of ensuring that these elements contribute to decarbonisation. This combination is reflected in our product portfolio and is part and parcel of our DNA and our vision.

How does HARTING's product portfolio support the integration of renewable energies?
JS: Our product portfolio comprises connectors and cable systems that are essential for renewable energies, particularly in wind power and hydrogen technology scenarios. With our solutions, we promote efficient energy conversion and transmission so that the green energy generated can be utilised smoothly and seamlessly. Innovative designs reduce installation and maintenance costs.

The use of renewable energies unfolds its full potential while maximising efficiency. What does HARTING contribute to achieving greater efficiency in our energy supplies?
JS: Efficiency, as well as grid stability, is of central importance in the supply of energy, and HARTING is making decisive contributions here. Our connectors minimise contact resistance. That's how we reduce power loss at the respective connection points and maximise efficiency throughout the entire energy chain. At the same time, HARTING is fielding a convincing portfolio in terms of robustness and quality, which is elementary for stable networks. We are constantly striving to improve our products and integrate technologies that meet the latest efficiency standards.

In which specific sectors do you see the greatest challenges in the implementation of electrical solutions and how is HARTING meeting these challenges?
JS: The mobility and agricultural engineering sectors present particular challenges as they rely on traditional technologies. In the mobility sector, there are economic hurdles that are slowing down the use of electric solutions – and many companies are reluctant to invest in the necessary infrastructure. The situation is similar in agricultural technology, where farmers often adhere to tried and tested solutions. HARTING is meeting these challenges with customised, economically and technically viable solutions. We engage and work closely with our partners to understand the specific requirements of the respective industries and sectors.

How do the connectors HARTING develops promote interoperability between different technologies and sectors?
JS: Interoperability is a key aspect of the All Electric Society. Our connectors are designed so as to be seamlessly integrated into various applications. By standardising our products, we enable convenient integration into existing systems, which is particularly important for Industry 4.0. We are continuously investing in research and development to ensure that our solutions meet the latest technical requirements.

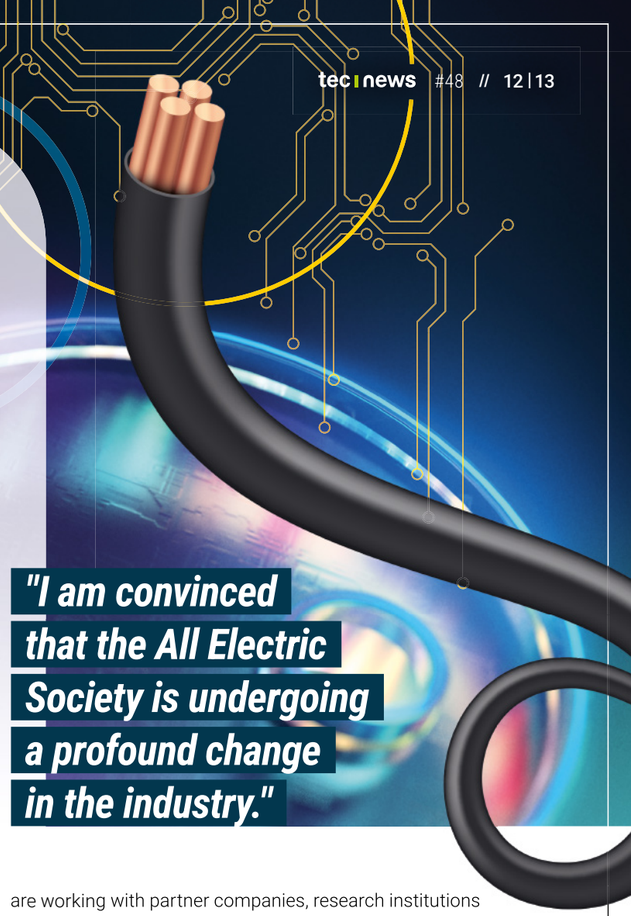
What are the most important innovations that HARTING has developed in recent years in terms of connectivity solutions for the AES?
JS: In recent years, we have made significant progress in charging infrastructure and data and energy transmission. For example, we have developed an extensive portfolio of charging plugs for electric vehicles that are suitable for AC and DC fast charging. We have also developed special connectors for railway technology and power supply solutions for data centres.

Could you give examples of how HARTING solutions have been successfully implemented to promote sustainable development?
JS: One example is our collaboration with a leading wind farm operator, where the use of our connectors and cable systems has significantly raised the efficiency of energy transmission. Another example is the implementation of our solutions in the charging infrastructure for electric vehicles in urban areas, which has helped to reduce CO_2 emissions and enhance mobility.

What role does cooperation with other companies, public institutions or research facilities play for you in bringing the vision of the AES to life?
JS: Collaboration is decisive in realising the vision of the All Electric Society. HARTING cannot achieve everything on its own, so the exchange of knowledge and resources is an essential factor. We are working with partner companies, research institutions and political players to develop standardised solutions and drive innovative projects forward. These collaboration activities enable us to pursue approaches that extend beyond our own capabilities.

How do you perceive the future development of electrical systems and the corresponding technologies and what trends should specialists keep an eye on?
JS: We expect electrification to continue to advance in many areas. The shift towards more networking technologies that enable the efficient use of energy is a key trend here. Consequently, experts should monitor Industry 4.0 developments and their influence on new applications and production processes. Innovative connectivity solutions will facilitate and support this transition and open up new business opportunities.

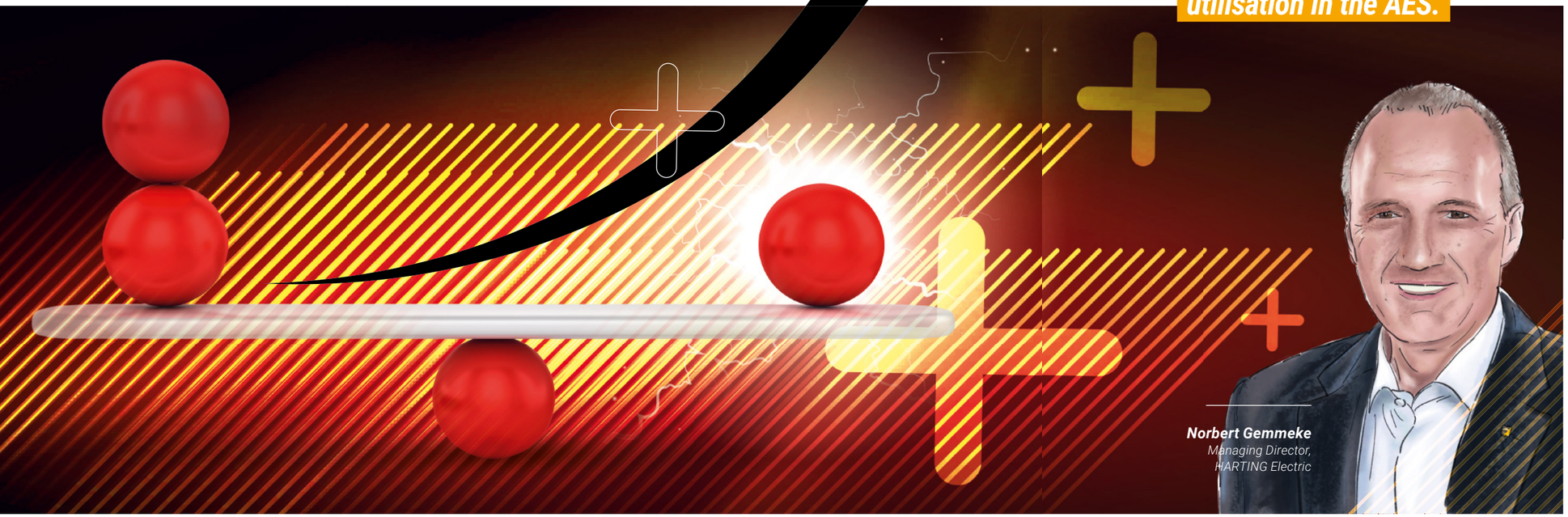
What are your personal views on the long-term impact of the All Electric Society on industry?
JS: I am convinced that the All Electric Society will usher in far-reaching changes that will not only promote technological progress, but also drive more environmentally friendly practices forward. This shift will create new business opportunities. **Early adapting companies that develop innovative solutions can benefit from the competition. HARTING perceives itself as shaping and designing this future, in which the connection of energy and data is an essential factor.** We want to make decisive contributions to the realisation of the All Electric Society through innovative products and strategic cooperation activities. The challenges are complex, but I am decidedly optimistic about the prospects.



"I am convinced that the All Electric Society is undergoing a profound change in the industry."

MORE POWER
FOR THE SAME SIZE

Raising the current carrying capacity is crucial in order to meet the increasing requirements for energy flow and simultaneous utilisation in the AES.



Norbert Gemmeke
Managing Director, HARTING Electric

Technological refinements to connectors are of key importance for the success of the All Electric Society – and HARTING has assumed a leading role in this field. But progress doesn't always mean just growing in size.

Sebastian Human
tec.news Editorial Team

While we used to buy performance in kilograms in the past, the end of geometric linear scaling marks a further step towards the future. One striking example of this thesis is the refinement of our connector contacts from TC-70 to TC-100.

This new generation of connectors offer higher current carrying capacity but without any proportional change in size. Thanks to innovative materials and design approaches, we are succeeding at HARTING in boosting the efficiency of energy transmission while at the same time minimising space requirements.

From 70 to 100: Han® series overhaul

Good contacts are everything, as they say. To enable us to conduct more power through the same contact, we set about revising the TC 70 to TC 100. The aim is to optimise the size of the unit without compromising on power. In order to achieve this, our colleagues have to take technical aspects into consideration such as contact resistance and insertion forces. To this end, we come up with innovative solutions to enhance geometric parameters and material properties. These adaptations are crucial for boosting the efficiency of the contacts and optimising heat dissipation – critical factors in an increasingly electric environment.

Raising the current carrying capacity from 70 to 100 amps represents an important step taken straight from the requirements of the All Electric Society (AES). Increasing current carrying capacity is crucial if we are to meet the rising demands on power flows and simultaneous use in the AES. **This is because the vision of an AES not only necessitates a higher volume of energy but also the capability to make this energy available simultaneously for different applications and subscribers in a network.** Higher current carrying capacities facilitate this simultaneous use by several devices without putting too much strain on the required infrastructure. This is especially relevant, for example, against the background of the integration of smart grids in which various digital applications are connected with each other in real time.

Groundbreaking applications require viable solutions fit for the future

This rising demand has a direct impact on technological developments. This is exemplified by battery storage modules that are becoming more compact and powerful. These modules also require connectors which meet the greater demands made on electricity and performance. The hydrogen sector is also a pivotal growth area and higher current carrying capacities are required here in order to guarantee efficient energy transmission. Higher electricity requirements can also be observed in data centres in which ever smaller, more powerful devices are needed. Consequently, high process efficiency calls for constant adaptation of the infrastructure to rising energy volumes.

One for all: universal usability of the TC 100

With the TC series, HARTING is pursuing the goal of universal usability in different sectors. For example, the new contact is to find applications in both railway technology and data centres. By developing a universal connector, we are not only boosting efficiency but also giving flexibility of use a literal power-up.

At HARTING, we have long known that the ability to create powerful connections is key – also to meeting the demands made on the AES and its associated infrastructure. This facilitates the simultaneous operation of several power-hungry applications in the same network, contributing to the stability and reliability of the power supply.

Therefore, the All Electric Society requires nothing less than a fundamental realignment of connectivity. While electronic devices are becoming more and more powerful, their dimensions must be reduced. This means our products must deliver higher performance without becoming appreciably larger. In order to meet these challenges, we need innovative solutions that align with the changed requirements of the AES.

Genuine efficiency through the use of Artificial Intelligence (AI) in product development

One important point of technological differentiation for us also lies in the use of Artificial Intelligence. HARTING integrates AI in the development process in order, for example, to optimise materials and designs and ensure that the new contacts meet the rising demands of the AES. The use of generative design and powerful simulation software enables us to deliver efficient product development that not only improves material selection but also makes decisive contributions towards the optimisation of geometries and contact principles.

Full of energy: the pathway is clear

We have set ourselves clear targets for development of the TC series. The roadmap focuses on the systematic refinement of contact technology and the implementation of new applications. With the trinity of HARTING's innovative energy, targeted use of Artificial Intelligence and clear focus on universal usability, we are creating a forward-looking solution for industrial connectivity. Developments within the All Electric Society call for rapid adaptations and powerful, reliable products. The future requires us to develop the right technologies and strategies – and HARTING stands ready to accept and master these challenges in order to pave the way to a sustainable, electric future.

M12: POWER X

Jonas Diekmann
Technical Editor,
HARTING Electronics

L-coded and K-coded M12 connectors meet the increasing energy requirements of compact devices and transmit more than 10 times the power of previous solutions, while retaining the same size. They provide up to 7.5 kW supply power in the most compact of spaces.

More than enough for compact, decentralised applications in all sectors of the AES. M12 circular connectors are a common standard in many industrial applications when it comes to the robust connection of data and power. Given their international IEC standardisation, PNO conformity and widespread use, they represent an ideal foundation for industrial applications.

Devices and drives in industrial applications are becoming increasingly powerful, while retaining the same dimensions as before. These performance gains are also reflected in the consumption of electrical power, which must be connected by way of a suitable interface. HARTING is meeting this challenge of enabling existing, familiar connection sizes to elevate performance with robust, internationally standardised M12 circular connectors.

X-times the power

M12 connectors are a well established interface for the transmission of signals, data and power in industrial applications. The power supply for devices was limited to around 100 W with the existing A, B and D codes. With the K-coded and L-coded connector faces, the M12 size meets the requirements of the AES – thereby offering several kW of **transmission power (up to 7.5 kW) in the most compact of spaces. This boosts the possible transmission power in a compact size by orders of magnitude.**

K-coded

The 5-pole K-coded connectors transmit up to 630 V and 12 A – covering the typical connection parameters of three-phase motors in the kW range (up to 7.5 kW) – which account for the lion's share of the systems.

Cable assembly or field connection

On the cable side, HARTING is offering field-assembly HARAX® insulation displacement connectors (IDC) and crimp connectors for straight pin and socket versions, featuring a 360-degree hood concept. Consequently, HARTING's M12 connectors are meeting market requirements that extend well beyond the specifications of the relevant IEC 61076-2-111 standard.

In detail:

The 5-pole L-coded connectors can handle an output of 0.75 kW at 16 A in the extra-low voltage range – making the L-coded version highly suitable for field distributor boxes, fieldbus-controlled I/O boxes, power supply units and valve applications. Sub-distribution networks with 24V or 48V working voltage also feature as typical utilisation scenarios. The PNO (ProfiBus user organisation) regards the L-coded M12 Power as the new standard device connection for the power supply of field devices.

The PNO (ProfiBus-user organisation) regards the L-coded M12 Power as the new standard device connection for the power supply of field devices.

OPTIMISED CURRENT CARRYING CAPACITY TRANSFORMS CONNECTORS

INTO BRIDGES TO THE ELECTRICAL FUTURE

The manufacturing industry is faced with the challenge of adapting its systems to increasing performance requirements – without claiming more space. Find out here how we at HARTING are improving the efficiency and performance of electrical connections through targeted design optimisations and advanced, leading-edge technologies.

Dr. Stephan Middelkamp
General Manager Quality & Technologies, HARTING Stiftung & Co. KG

The All Electric Society requires electrical energy, which is supplied by way of the power core both between and within the sectors. In many cases, the transition to electrified systems will entail higher performance levels or new systems with more power will have to be created.

The gains in on-board power in automobiles is an illustrative example from everyday life. This measure simplifies the implementation of so-called "break by wire" and "steer by wire" applications. The former refers to an electric braking system in which the braking forces are transmitted electronically and not mechanically, in other words by way of brake lines. The second refers to an electronic steering system in which the connection between the steering wheel and the wheels is also not mechanical, as with steering rods, but is executed via electrical signals.

These performance gains also optimise the charging process for electric cars. Here, large amounts of energy have to be transferred to the vehicle by way of a connector in a short time so that the electric car is as powerful as a combustion engine when "refuelling". Similar examples can also be found in other sectors.

Despite the higher energy requirements, the available space remains unchanged. At the same time, the efficient installation, maintenance or operation calls for the use of connector, which must therefore be able to offer higher current-carrying capacity while retaining the same size.

There are three key starting points for improving current carrying capacity: the connection of the cable, the contact material and the contact point itself.

THE KEY TO BOOSTING EFFICIENCY

This is where current carrying capacity enters the picture. It indicates the maximum current that a connector can transmit for a specific cable diameter. This capacity results from the balance between the heat generated due to the electrical resistance and the heat dissipated. The latter is dissipated both by radiation and by way of the cable. While higher current-carrying capacities can be realised more easily with larger connectors and cables, this is not an option in many applications. In some cases, **active cooling of the connectors** or the **use of alternative plastic materials** that allow higher temperatures will provide a solution.

Reducing electrical resistance is another alternative, which prevents heat from developing. This also improves energy efficiency. Ultimately, there are three key starting points for improving current carrying capacity: the connection of the cable, the contact material and the contact point itself.

There are various solutions for the cable connection. So-called "crimping", i.e. making a mechanical connection that provides both electrical contact and mechanical strength is a common technique in the energy sector.

A well-executed crimp considerably reduces the contact resistance due to the plastic deformation of the cable and the contact area. The right crimping tool and the correct parameters are crucial factors here. In terms of the contact material, the alloy selected is also of particular interest, as it can significantly increase conductivity. Copper alloy is generally used as the base material.

The resistance in the mating area is influenced by various factors. **The number and size of the contact points can be optimised by the specific design:** The larger the contact surface, the lower the resistance. The normal force – in other words, the force with which the mating parts are pressed together – also plays a major role in this context. **A higher normal force increases the effective contact surface,** meaning that more current can flow per contact point, whereby the choice of surface supports this effect. A higher normal force also entails greater insertion force, however, which in turn can increase wear.

Ultimately, **it is evident that the optimised design of many parameters improves the overall current carrying capacity.** State of the art simulation tools enable us to optimise the current carrying capacity as early as the design phase, meaning that different designs and materials can be selected and adapted accordingly.

customer benefits

SIMPLE & SECURE SCALABILITY OF ENERGY FROM THE GRID

Consistent implementation of the All Electric Society requires the provision of energy at highest current and voltage levels in the smallest of spaces. A corresponding grid infrastructure must be designed in such a way that energy can be optimally regulated, measured and controlled. HARTING solutions can help to simplify and secure scalability from the grid.

The advantages of plug & play solutions over hardwiring become evident when a consumption point is connected to the transmission network.

The advantages of plug & play solutions over hardwiring become evident when a consumption point is connected to the transmission network: the installation time is reduced, for example, if at least parts of the transition from the 110 kV high-voltage network to the lower voltage levels inside a consumption point (400 V/230 V) are designed using cable assemblies with connectors.

The Han® HPR High Performance Transformer Connector (HPTC) series is the ideal solution for the transformer connection on the output side. The connector enables a transmission up to 3.6 kV/1400A (AC/DC), with a housing remaining free of partial discharges, and ensure an effective protection against dust and moisture (up to IP68/69 degree of protection) in outdoor areas. The components of the interface are designed to be so robust that power transmission between generators, converters and transformers remains stable in the long term.

The connection between the transformer and downstream devices like inverters also requires plug & play solutions based on pre-assembled cables. The new Han® HPR Single Pole is a unique, robust metal interface to establish pluggable single wires based on the well-known Han® HPR standard for very harsh environments. The Han® HPR Single Poles can cover currents from 250A to 800A (max. 4kV). They can be combined with bulkhead mounting housings or panel feed through solutions for power distribution, e.g. in wind turbines or battery applications.

PRE-ASSEMBLED CABLES TO REDUCE INSTALLATION TIMES AND LABOUR COSTS

Pre-assembled cables to reduce installation times and labour costs Indoors, Automatic Transformer Switches (ATS) ensure a safe power supply to downstream consumers, e.g. by shifting loads to emergency power sources (UPS) if necessary. For connection of these switches, you will hardly find a better solution than Han® HPR Single Poles or, alternatively, the new HARTING ICC 20 Single Pole (up to 400 A / 600 V). This is due to the following advantages:

- With single-pole arrangements, cables can be pre-assembled before installation which enables the power supply infrastructure to be set up quickly.
- **Compared to hardwiring, plug & play solutions enable accelerated maintenance processes for the whole energy infrastructure.**
- Single-pole housings are equipped with locking screws that prevent unintentional mating or unmating.
- On the live side, the single poles have a comprehensive contact protection to eliminate the risk of electric shock in the event of a decoupling.

High-quality materials ensure a longer lifetime for outdoor connections

Norbert Weiß
Teamleader Marketing Service, HARTING Electric

„WE ARE RIGHT IN THE MIDST...“

The German electricity grid must be shaped and designed for security and sustainability. Arvid Gillert, Senior Manager Energy Technology at the Association of the German Electro and Digital Industry (ZVEI), explains how this can be achieved and what German companies have to offer.

tec.news: ZVEI is speaking of the "evolution of the network ... through the development of network technologies" and call for technology openness. What exactly do you mean by open technology?
Arvid Gillert (AG): The grids are facing tremendous challenges: on the one hand, more and more volatile generators need to be integrated, while on the other, developments such as electromobility are upping the demands made on grid capacities. In this context, technology openness means that the technologies deployed must be tailored to the specific requirements – without being unnecessarily restricted by historically evolved specifications. The technical connection conditions of the grid operators, for example, are often too strongly focussed on individual solutions. Instead, we should focus on available and near-series technologies in order to be able to scale faster and boost network efficiency.

The current regulatory framework is still strongly orientated towards the structures of the past.

Does that mean you are intentionally not talking about a revolution, but an evolution with existing means?
AG: As part of a study, we have compiled profiles of technologies that are already available today, but are not yet sufficiently utilised from our viewpoint. Intelligent local substations are a good example. There is still considerable potential in the use of such technologies – especially with regard to the digitalisation of network components. We can already make significant progress here with existing resources without having to wait for revolutionary new developments.

ZVEI is also calling for incentives and appropriate regulation. What do incentives look like? And where are the specific regulatory levers?
AG: The current regulatory framework is still strongly orientated towards the structures of the past. To date, network operators have had little incentive to invest in matters such as the digitalisation of their networks – they have mainly implemented what has been promoted by regulation. The Federal Network Agency is now sending out important signals by focussing on so-called energy transition expertise: Grid operators should position themselves for the future and take the necessary steps, such as a forward-looking grid expansion, at an early stage. So far, there has been a lack of incentives here and the grid operators have only pushed ahead with grid expansion to the extent that is directly necessary. Given the increasing requirements of electromobility and heat pumps, for example, grid expansion cannot wait until the demand is there – things must be handled proactively.

Keyword 'climate neutrality network': With this in mind, the trade association is driving forward standardisation and development and focusing on three topics. Where do you see Germany and the industry in terms of infrastructure expansion, the introduction of climate-friendly technologies and the digitalisation of grid components?
AG: Germany is not in an unfavourable position – the progress made in recent years should also be emphasised. Looking at the figures for 2024, 52 per cent of electricity consumption will be covered by renewable energies. In 2005, the figure still stood at 10 per cent. The infrastructure is also solid overall and provides a good foundation. The task now is to expand on this and make things fit for the future. Digital solutions play a key role here. The manufacturers organised in ZVEI already have numerous innovative technologies in their portfolios. Now it's all about scaling, where Germany needs to do even better. Consequently, we still need physical expansion in Germany. But it will not succeed without harnessing digital solutions.

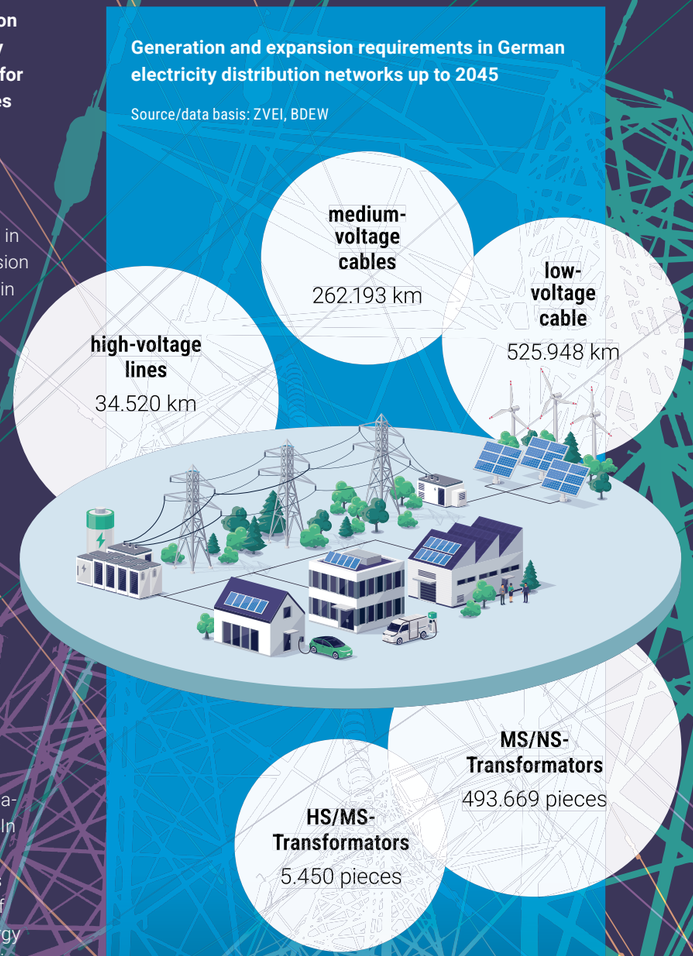
„Germany is not in an unfavourable position – the progress made in recent years should also be emphasised.“

Arvid Gillert
Senior Manager Energy Technology, ZVEI e.V.

More than 500,000 kilometres of cable in addition to some 500,000 transformers will be needed by 2045. That would be an attractive order volume for local companies. Aren't ZVEI member companies formally offering themselves as suppliers here?
AG: That is de facto the case. The ZVEI Energy Technology Association, which represents the relevant manufacturers, is particularly aware of these tremendous demands. This is also reflected in investments – both in personnel and in the expansion of production capacities. However, there is a certain drop of bitterness here: these investments do not always take place in Germany and Europe. Here, too, we are facing global competition. Where better location conditions prevail, investments will ultimately be made. Politicians could take countermeasures here – by reducing bureaucracy and streamlining authorisation procedures.

Where do you currently see sector coupling unfolding? Where is the problem and what are successful examples?
AG: We are right in the midst of this, but there is still a lot to do. We are seeing successes on the feed-in side and progress is also being made in terms of grid expansion. We have the impression that network operators have also recognised the needs and are taking action. However, consumers also appear to be disconcerted to some extent by politics when it comes to switching to electricity-based technologies and the price of electricity itself. In order to counter this uncertainty, it is important to consistently relieve the electricity price of all levies and to incentivise grid-friendly behaviour by way of pricing signals. This is how we are driving the energy transition forward – and thereby also sector coupling at the same time.

The interview was conducted by
Christian Otto
tec.news editorial team



collaboration & co-creation

INDIA'S TANGIBLE ENERGY PLANS

WIND ENERGY, A VISION AND TECHNICAL EXPERTISE

Thirumurthy Ventachalam
Regional Product Manager, HARTING India

India ranks as one of the top 3 greenhouse gas emitters in the world. The government, however, has defined clear reduction targets and renewable energy is the key. Local technologies are being continuously expanded to generate and store this energy.

India finds itself in a challenging starting position when it comes to decarbonisation: After all, after China and the United States the country is the third largest emitter of greenhouse gases. Every year, the world's most populous country accounts for a total of 4 billion tonnes of CO_2 equivalents in net emissions. Around 70 per cent of India's emissions are caused by the six sectors of energy production, steel, automotive, aviation, cement and agriculture.

The McKinsey report "Decarbonising India: On the road to sustainable growth" estimates that annual emissions will escalate to 11.8 billion tonnes of CO_2 equivalent by 2070.

Although India has reduced its emissions intensity by 1.3 per cent per year over the last ten years, the pace of reduction is decidedly too slow.

The vision and plan for the clean energy mission

This is why the government has become active in terms of environmental policies. With the "Viksit Bharat@2047" vision, the Indian government wants to transform the country into a developed nation by 2047 – just in time for its centenary year of independence. The plan includes goals such as economic growth, social progress, good governance and, above all, environmental sustainability.

In this context, the term "All Electric Society" (AES) has also arrived in India, where it is linked to the reduction of carbon emissions, the improvement of energy efficiency and the promotion of sustainability. In order to achieve this, the country is aiming to establish a fully electrified infrastructure for transport, heating and industrial processes and is investing comprehensibly in renewable energies, grid infrastructure, energy storage and electric mobility.

In the course of the UN Climate Change Conference in Glasgow 2021, the country also presented what is known as the Panchamrit Plan. Accordingly, among other things, the plan stipulates that 50 per cent of energy requirements should stem from renewable energy sources by 2030 and that net zero emissions should be achieved by 2070. Meanwhile, some of the plans are already being put into practice: The capacity of wind and solar has risen from around 26 gigawatts in 2014/15 to some 138 gigawatts in September 2024. As wind and solar power generation technologies are already available on a large scale, power generation would be the sector that could most quickly achieve potential net zero emissions. The mid-2050s is the time horizon envisaged here, whereby the transition to renewable sources of electricity would also reduce the cost of energy production.

In India, wind turbines are playing an increasingly vital role in energy generation.

Energy shortages and energy efficiency: Two sides of the same coin

Consequently, the Indian government is pursuing a two-pronged approach to meet energy demands, while minimising the growth in CO_2 emissions. On the generation side, the government is promoting the increased use of renewable energies in the energy mix, specifically through the already successfully growing shares of solar and wind energy.

On the demand side, leading Indian policymakers are endeavouring to use energy efficiently through measures under the Energy Conservation (EC) Act of 2001. The aim of the EC Act is to reduce the energy intensity of the Indian economy. Among other things, the act provides the regulatory framework for the standards and labelling of appliances and systems, the Energy Saving Ordinance for commercial buildings and energy consumption standards for energy-intensive industries. In this context, the National Mission for the Promotion of Energy Efficiency (NMEEE) also comes into play. The mission aims to strengthen the market for energy efficiency by creating a favourable regulatory and political framework, while also providing for the promotion of innovative and sustainable business models in the energy sector.

Challenging energy storage

However, a higher share of renewable energy in the energy mix presents challenges. This is because grid stability must be maintained, and the power supply must be guaranteed without interruptions. The availability of renewable energy sources, however, varies depending on the climate, time of day, season and geographical location. As a solution, energy storage systems (ESS) can be deployed to store excess capacity from renewable energies at certain points and then utilise this precisely during peak times of the day.

India is well aware of the relevance of energy storage: The National Electricity Plan (NEP) had already assumed in 2023 that 82.37 gigawatt hours of storage capacity would be required in 2026/27. This requirement is expected to rise to 411.4 gigawatt hours by 2031/32. Moreover, the demand for energy storage is forecast to rise to 2,380 gigawatt hours by 2047.

The wind energy success story

In India, wind turbines are playing an increasingly vital role in energy generation – and the country has modern technologies for manufacturing wind turbines: The current annual production capacity stands at around 15,000 megawatts. All the major global players in this sector are maintaining branches in the country. In total, there are more than twelve different companies active, including joint ventures under licence production, subsidiaries of foreign companies and Indian companies drawing on their own technology. The machine size has increased to 5.2 megawatts.

In this context, HARTING is also represented in India, maintaining a production location that is already supplying several connecting elements that can be deployed in the wind energy sector. In addition, HARTING India, with its Innovation and New Product Development Team, is already capable of developing products for regional requirements and can support the manufacturing team in terms of improving productivity and efficiency through process optimisation and waste reduction, among other relevant factors.

SENVION IS EMPOWERING THE FUTURE OF WIND ENERGY

AND REDUCING THE TOTAL COSTS OF OWNERSHIP (TCO)

Through robust design, superior components, and a strong focus on reducing CO_2 emmissions, Senvion continues to lead the way in creating efficient, reliable, and sustainable wind energy solutions. One of the most important foundations for bringing the All Electric Society (AES) to life.

The global transition to renewable energy has never been more critical, and wind power plays an important role in shaping a sustainable future. As one of the fastest-growing wind energy companies in India, Senvion is at the forefront of this transformation. With over 25 years of engineering expertise and a strong commitment to innovation, Senvion delivers tailored solutions that empower cleaner and more efficient energy production worldwide. Strategic collaborations, like the long-standing partnership with HARTING, ensure the use of cutting-edge components that meet the highest standards of performance and sustainability.

Originally established as RE Power in 2001, Senvion nowdays is the fastest growing wind company in India. With R&D centers in Bangalore and Hamburg, plus different manufacturing facilities and manufacturer's setups at different locations, Senvion operates worldwide. The journey in Bengaluru (India) started in 2015 and with a total legacy of over 25 years of technical excellence, Senvion today engage over 1000 direct and indirect resources across the value chain in India. The continuous striving for technical innovation and customer satisfaction enables Senvion to push the boundaries of what is possible in the renewable energy sector.

Senvion's mission is to empower the future of wind energy with clean, reliable, and efficient solutions. Through expertise in developing, manufacturing, assembling, installing, and marketing technologically advanced Wind Turbine Generators (WTG), Senvion aims to offer project-specific solutions that fulfil a wide range of customer requirements.

Senvion utilizes around 80 different types of connectors from HARTING's overall portfolio.

Engineering excellence for the wind industry to boost the AES

With a total legacy of over 25 years of technical excellence, Senvion today engage over 1000 direct and indirect resources across the value chain in India.

Prafullakumar Dhole
Head of Procurement, Senvion

Powering renewable energy with robust, sustainable technology

In order to continuously drive technical innovation and maintain a competitive edge in the renewable energy sector, Senvion relies on robust design principles, high-quality products and a strong focus on sustainability when utilizing various components. By prioritizing these factors, Senvion ensures that its solutions not only meet but often exceed the demands of modern energy markets, fostering long-term reliability and environmental responsibility. Industrial connectors from the market leader HARTING are well-suited to meet all these requirements. These connectors are not only characterized by their exceptional quality and reliability, but they are also remarkably easy to maintain, ensuring reduced downtime and simplified operations. Additionally, the plug-and-play functionality of HARTING's products makes them highly user-friendly.

HARTING is also pioneering new benchmarks in sustainability through the introduction of the innovative Greenline series connectors. These connectors are designed with a significant focus on reducing CO_2 emissions during production, aligning perfectly with the global push for greener technologies.

Shriniwas Chitnis
Regional Sales Director West, HARTING India

Strengthening wind energy with trusted partnerships

Senvion trusts its suppliers 100% and is fully committed to long-term partnerships. That is why the company has been working with HARTING since 2021, forming a reliable partnership that continues to evolve and grow. Senvion utilizes around 80 different types of connectors from HARTING's overall portfolio. These high-quality components are specifically used in the nacelles and hubs of Senvion's wind power plants, where they ensure optimal performance and long-term reliability even under challenging environmental conditions.

HARTING has also set up a new production facility in India. This has significantly improved Senvion's response times, enhanced supply chain efficiency, and contributed to reducing the carbon footprint of the wind and power industry in India. This development not only benefits current operations but also lays a robust foundation for even more intensive co-operation and joint innovations in the future.

Tailored solutions with a comprehensive range of industrial connectors and customized cable assemblies from a single source.

Exceptional reliability and extended service life ensured by high-quality connectors, reducing maintenance costs and downtime over time.

Increased energy generation for the AES due to higher wind turbine availability.

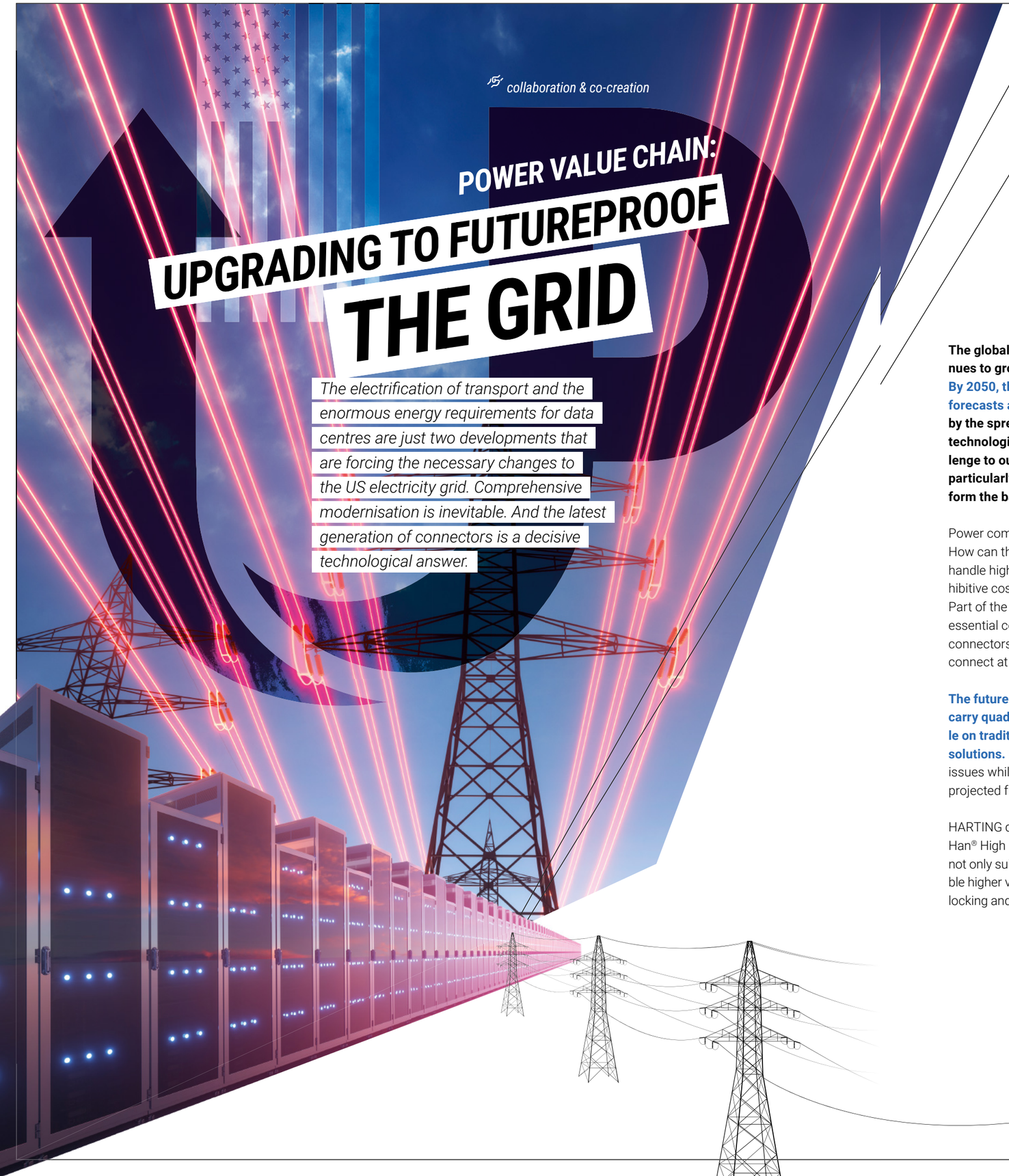
High flexibility and modularity, enabling seamless adaptation to evolving project needs and future expansions.

Sustainability and eco-friendly performance with CO_2-reduced components.

collaboration & co-creation

POWER VALUE CHAIN: UPGRADING TO FUTUREPROOF THE GRID

The electrification of transport and the enormous energy requirements for data centres are just two developments that are forcing the necessary changes to the US electricity grid. Comprehensive modernisation is inevitable. And the latest generation of connectors is a decisive technological answer.



The global appetite for electricity continues to grow at an unprecedented rate. By 2050, the International Energy Agency forecasts a doubling in demand, driven by the spread of electrification and digital technologies. This surge presents a challenge to our current power infrastructure, particularly the connector systems that form the backbone of our electrical grid.

Power companies face a critical question: How can they upgrade the existing grid to handle higher power loads without the prohibitive costs of replacing entire systems? Part of the solution lies in redesigning an essential component of power systems: connectors, which allow a quick power disconnect at the equipment level.

The future requires connectors that can carry quadruple the current loads possible on traditional connectors or hardwired solutions. Upgrading must solve today's issues while also evolving the grid to meet projected future demands.

HARTING develops connectors such as the Han® High Power or Han® S 400A. They are not only suitable for high loads, but also enable higher voltages, higher currents, simple locking and various configuration options.

Four Trends Driving Change

01

First, **the integration of renewable energy sources** like wind and solar, which fluctuate in availability, requires advanced transmission systems to maintain balance. As renewables become central to global energy strategies, the grid must evolve to transmit large amounts of power across varying distances more efficiently.

02

Second, **the rapid electrification of transportation**, like electric vehicles has created a need for high-capacity charging infrastructure. Without upgrades to connectors and transmission lines, the EV revolution could outpace the grid's ability to deliver necessary power.

03

Next, as **manufacturing increasingly returns** to the United States, more power will be required to support a resilient supply chain. Particularly in segments like the semiconductor industry, with government grants and earmarked funds, a focus will remain on upgrading the existing power grid to meet growing demand.

04

Lastly, **the increasing reliance on data** has led to the expansion of large-scale data centers. These facilities consume vast amounts of electricity, necessitating connectors to handle substantial loads efficiently and reliably.

despite higher initial costs. Efficient connectors reduce power consumption through better contact resistance and minimize energy wasted as heat, contributing to substantial cost savings over time. **Additionally, high-capacity connectors offer enhanced reliability. By lowering the likelihood of system failures, these connectors reduce the need for more frequent maintenance, ultimately cutting down on operational downtime and cost.**

This ensures continuous power supply and helps utilities avoid costly disruptions that impact consumers and businesses. Especially in rapidly growing disruptive markets like data centers, where data haul refreshes happen regularly, connector systems help to future-proof designs, preparing them for increasing system demand.According to recent reports, these initiatives could contribute to savings of up to $3.5 billion in grid resilience alone. Infrastructure projects are expected to support the delivery of 30 gigawatts of renewable energy, benefiting millions of households and businesses, while also creating economic opportunities through improved infrastructure.

The innovation of connectors is about more than just increasing the current.

Modern connectors need to evolve in multiple ways to meet changing grid demands.
Advanced materials like high-conductivity alloys improve heat dissipation and reduce energy loss.

Converting to high-performance connectors offers clear economic advantages despite higher start-up costs.

Optimized design plays a key role in this arena; **new connectors are engineered to reduce resistance and increase efficiency, minimizing energy waste.** This includes innovations in contact geometries designed for better overall performance.

Upgrading to high-capacity connectors presents clear long-term economic benefits

Savings of up to

3,5 billion $

Jon DeSouza
Member of the Board for Sales and Marketing, HARTING Technology Group

WHAT ROLE CAN BASE-LOAD POWER PLANTS PLAY IN THE FUTURE?

Nuclear fission, natural gas, geothermal energy, nuclear fusion: Would these base-load technologies be expedient for the German energy system in the future? These issues were analysed by the academy initiative "Energy Systems of the Future" (ESYS).

future trends

WHAT ARE BASE-LOAD TECHNOLOGIES?

Base-load technologies are continuously available for power generation.

Due to their high investment costs, base-load power plants must be in operation almost uninterruptedly in order to be profitable. At present, nuclear power plants and lignite-fired power plants feature as typical technologies.

In the case of residual load power plants the situation is different: Although these power plants are also continuously available, they only run intermittently, for example when solar and wind energy are not supplying enough electricity. Residual load power plants entail comparatively low investment costs but high fuel costs. Hydrogen-fuelled gas turbine power plants are salient examples of low CO_2 residual load power plants.

Natural gas power plants with CO_2 capture could probably be realised on a large scale within the next 20 years, while building up the infrastructure for CO_2 will represent a challenge.

Nuclear power plants are associated with unanswered questions revolving around costs, safety, final disposal issues and proliferation. Current new construction projects are usually significantly overrunning schedules and budgets.

POSSIBLE LOW CO_2 BASE-LOAD TECHNOLOGIES

Geothermal energy has little potential for generating electricity in Germany – here is better suited to providing thermal energy.

Nuclear fusion is not expected to be able to make a significant contribution to the electricity supply until after the year 2045 at the earliest.

Further information is available at

Karen Pittel
ifo Institute, ESYS Board of Directors
Philipp Stöcker
ESYS Office

BASE-LOAD POWER PLANTS CAN, BUT DO NOT NECESSARILY HAVE TO BE PART OF THE FUTURE ENERGY SYSTEM

The expansion of renewables and the European electricity and hydrogen grids are expected to cover the electricity demand and most of the hydrogen demand within Europe. Nevertheless, base-load power plants could still contribute to the energy supply. The key here is a flexible hydrogen system that enables the power plants to achieve high capacity utilisation. Their electricity could be used for electrolysis in times of low demand and thereby reduce hydrogen imports. However, they hardly impact on the expansion and development requirements of the grids for electricity and hydrogen, and the switch to e-mobility and heat pumps would also have to remain unchanged. Their benefits arise primarily when they are more cost efficient than their alternatives. However, due to their long construction and utilisation periods, new base-load power plants are more of a long-term option.

BASE-LOAD POWER PLANTS DO NOT SUBSTANTIALLY CHANGE THE OVERALL COSTS

The overall system costs of the transition to climate neutrality by 2045 in connection with the expansion of base-load power plants – also under optimistic assumptions – are similar to those in the reference scenario, which primarily relies on the expansion of solar and wind energy. Additional risks notable here: Increased costs and delays in the construction of base-load power plants, both due to the lower level of technological maturity of the respective technologies and the typical complexity of large-scale projects.

TEAMWORK MAKES FOR EFFICIENT CONVERTERS

GKN Hydrogen GmbH demonstrator system for the on-site generation of electricity for electric mobility.

The components for energy generation and storage in self-sufficient energy supplies operate internally with direct current (DC). However, they are coupled by way of alternating current (AC). The necessary rectification and alternating direction incurs losses and is unnecessary. DC/DC converters equalise the level of the components far more efficiently and are now being developed by the Fraunhofer IEE project MarrakEsH.

A clear division between the sectors used to be in place: Some were consumers, while others generated energy. The dissolution of this rigid categorisation is one exciting change brought about by the All Electric Society. In future, energy will be stored, generated and consumed in all sectors – meaning that decentralised solutions are a keyword here. And work is currently underway in the building sector, for example.

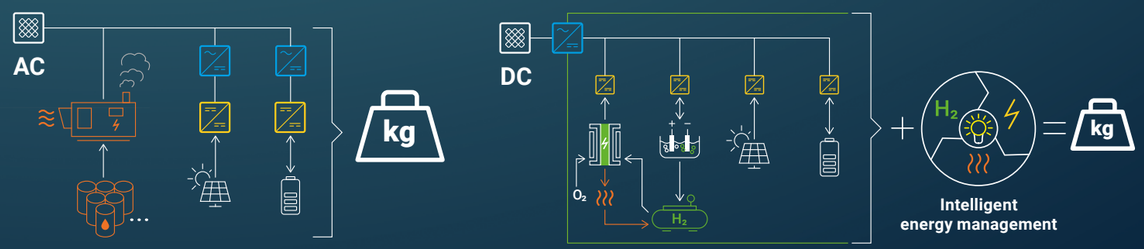
Energy supply systems based on renewable energies usually consist of a photovoltaic system, a battery and a connection to the conventional grid. The latter supplies energy when the PV system is not delivering power, and the battery capacity is exhausted. In the case of self-sufficient systems based on renewable energies, it is expedient to replace the grid connection with a combination of an electrolyser for hydrogen production and a fuel cell for generating electricity from hydrogen.

The crux of all systems in this area is that the components operate internally with direct current. Until now, however, the systems have always been interlinked by way of alternating current connections.

This means that the electricity within the system must always be managed by way of inverters. In addition, each of these inverters is preceded by a DC/DC converter that brings the DC voltage to a suitable level.

As rectifiers and inverters each have a specific scope of efficiency, energy is lost. These components also contribute to the high price of such solutions. **It would be much more efficient to link the components directly via DC/DC converters and only install a single inverter in the line to consumers.** This means that the electrical energy can be exchanged between the components much more efficiently without conversion, while also saving on expensive components.

Self-sufficient energy supply: conventional/fossil (left) and MarrakEsH project approach (right) / Source: Fraunhofer IEE



The "Modular, regenerative and self-sufficient energy supply with H_2 technology project" (MarrakEsH), which is funded by the Federal Ministry of Economics and Climate Protection (BMWK) and involves six partners, is dedicated to this approach: GKN HYDROGEN GmbH, Proton Motor Fuel Cell GmbH, Würth Elektronik eiSos GmbH & Co. KG, Infineon Technologies AG, Bonn-Rhein-Sieg University of Applied Sciences (H-BRS) and the Fraunhofer Institute for Energy Economics and Energy System Technology (Fraunhofer IEE) have all teamed up.

The development of a DC/DC converter based on modern gallium nitride power semiconductors with a switching frequency of up to two MHz is one key focus of the collaboration.

The entire system is being developed at GKN HYDROGEN, which is additionally developing a new type of metal hydride-based hydrogen storage unit, which is designed to provide higher storage capacity at lower costs. Moreover, the metal hydride-based hydrogen storage system can be discharged more effectively at higher operating temperatures. The latest generation of fuel cells, which Proton Motor Fuel Cell is contributing to the project, is optimally adapted to this storage unit. The thermal losses of the fuel cell are used to dissolve the hydrogen from the metal hydride of the H_2 storage tank.

"In the meantime, the definition phase of the project has been completed at system level and the sub-systems have all been described. Here at the IEE we are now working together with the Rhein-Sieg University of Applied Sciences on the topology of our MMPU (modular multiport converter)."

Daniel Haake
Fraunhofer Institute IEE, Department of Power Converters and Electric Drive Systems

H-BRS is involved in the project with two contributions: On the one hand, a flexible, intelligent energy management system is being developed that optimally controls the energy flows between electrical energy generators, storage systems and consumers and also ensures the efficient utilisation of system waste heat. Secondly, H-BRS is developing a scaled laboratory model of the DC/DC converter, connecting the energy generators and storage units. As Prof Dr Marco Jung, Professor of Electromobility and Electrical Infrastructure at Fraunhofer IEE, comments: "Thanks to the development and investigation of an initial scaled laboratory sample at an early juncture, we are able to analyse and evaluate the challenges and impacts that arise from switching frequencies in the MHz range. The results of these tests are incorporated directly into the corresponding demonstrator."

This demonstrator, in turn, is being developed by Fraunhofer IEE. Featuring a switching frequency of up to two MHz, it forms the interface for connecting the fuel cell and electrolyser to the self-sufficient energy supply system. The very high switching frequency aimed for makes it possible to realise very compact DC/DC converters.

Würth Elektronik eiSos is providing the necessary magnetic components. Infineon Technologies is coordinating the project and supplying the high-performance controller hardware required for the power electronic converters, as well as power transistors made of silicon and gallium nitride. Within the context of the project, the controller firmware is being developed and adapted so as to enable the converters to operate at switching frequencies of up to two MHz.

More information on this topic

Ralf Steck
tec.news editorial team

customer benefits

CHARTING THE COURSE TO A GREEN FUTURE

Guido Steenbock
Sales Engineer, HARTING Customised Solutions

According to the Federal Waterways and Shipping Administration (WSV), around 172 million tonnes of freight are transported by ships every year, thereby relieving traffic congestion on road and rail. Due to their high tonnages, ships could therefore act as a comparatively environmentally friendly means of transport, as one single vessel can replace 150 lorries. Hydrogen offers promising potential application scenarios for ship propulsion. An electric motor installed in the drivetrain, which is supplied with energy from a fuel cell system, would only require a continuous supply of oxygen and hydrogen. Stored in pressurised or refrigerated tanks, this can be implemented on board a ship, for example. In other words, a project tailor-made for eCap Marine GmbH from Hamburg.

Wherever monitoring and control functionalities are required in the production (electrolysis), storage, distribution and filling of hydrogen, modular and individually configurable components as well as customised system solutions from HARTING will be on the job.

The Coastal Liberty supply ship provides the Mittelplate oil and production platform with materials and brings back waste. A fuel cell system converts the hydrogen into electricity and thereby enables operation with electric motors through the use of hybrid transmissions.

Josefin Klindt
eCap Marine

HARTING IS RENOWNED FOR THEIR HIGH LEVEL OF EXPERTISE, QUALITY AND PRODUCT RELIABILITY IN THE FIELD OF HYDROGEN."

Guido Steenbock
Sales Engineer, HARTING Customised Solutions

Well aware of how important safety is when dealing with hydrogen, we supply intrinsically safe Ex-i solutions that are suitable for all types of signals.

Bringing the potential to the waters

Committed to the clearly defined aim of minimising the environmental impact of shipping, the Dutch shipping company Acta Marine has opted for green hydrogen as its main energy source. With the Mittelplate supply vessel Coastal Liberty, which is deployed in the Wadden Sea, the company is now endeavouring to set a pioneering example in the direction of sustainability and emission-free, on-board energy supply. ECap Marine was assigned to the task of converting the emission-free electric propulsion system to a hydrogen-based system. Over a period of two years, the company developed a containerised hydrogen-electric energy system that enables emission-free ship operation. The so-called tanktainer system featuring two Ballard FCwave fuel cells (2 x 200 kW), a maritime battery system, a fire extinguishing system, tank units, a customised energy management system and all the necessary cooling and safety equipment can be exchanged "plug-and-play" by way of a harbour crane and refilled in ports using an electrolysis system. As Lars Ravens, Managing Director at eCap Marine, explains: **"To date, this is a unique installation on board a seagoing vessel. Thanks to modular and individually configurable components, these are also scalable for larger merchant ships and smaller inland vessels."** At the beginning of 2024, the retrofitted supply vessel for the tanker system was also awarded class certification from DNV (German Maritime Industry Classification Organisation).

Josefin Klindt, Sales Manager at eCap Marine, proudly explains that changing, disconnecting and reconnecting the hydrogen tanks is very convenient and safe thanks to a tool-free connectivity concept and the standard connections for cranes and lorries. This is ensured, among other things, by connectivity solutions that meet the highest DNV requirements in terms of safety, durability and reliability. Together with eCap Marine, HARTING developed the innovative solution that ensures efficient networking of components and systems.

A special interface was required for communication between the PowerPac and the H_2 tank. "We thought of a box that for one would pick up the signals from the transmitters and the valve position indicators from the tank. It should then be possible to connect this on the other side of the housing using a plug-in coupling connection," says Josefin Klindt, explaining the problem. The selection valves of the tank should be monitored by way of the interfaces of the box. System temperature and pressure should also be transmitted. On the one hand, this is safety relevant, while on the other hand it can also be used to determine the fill level in the tank. The high IP class required for the housing for the electrical and electronic components presented another challenge. This is essential for the long service life of a ship navigating the North Sea. In addition, all electrical components of the tank container system had to be ATEX-compliant. This protection class is required for a potentially explosive atmosphere, as is given due to the low ignition energy of hydrogen.

Expertise in technology and methods

In order to enable the developers of e Cap Marine to concentrate on the electrolysis and storage technology and series production, HARTING assumes the responsibility for the specification, selection and development of the appropriate electrical connection technology. The accredited HARTING Quality and Technology Centre (HQT) accompanies the qualification, validation and, if required, the approval of the developed solution. Guido Steenbock sums things up as follows: "Our commitment to customisation and space optimisation is illustrated by the terminal boxes in this project. These boxes are designed to offer robust and space-saving connection options that can be seamlessly integrated into existing infrastructures. Our customers benefit from plug & play-capable solutions that are pioneering for the hydrogen industry."

collaboration & co-creation

SMART INNOVATION
FOR SUSTAINABLE MOBILITY

Common contribution to a low carbon future by developing and promoting innovative and sustainable transportation solutions.

***Secure installation** of high-current connections due to finger-protected contacts*

***Efficient installation** through user-friendly plug-and-play connectors, speeding up project timelines*

***Optimized performance** in harsh environments with robust, high-quality connectors designed to withstand extreme conditions in rail applications for the whole lifetime*

***Enhanced energy efficiency** by providing reliable battery connection solutions and solutions to reduce weight support sustainable and eco-friendly rail systems.*

***Scalable and adaptable solutions** that easily integrate with evolving rail technologies and infrastructure needs.*

***Reduced maintenance costs** with durable connectors offering long-term reliability and minimized need for replacements or repairs.*

ALSTOM, a global leader in railway technology, and HARTING, a trusted partner in connectivity solutions, are shaping the future of sustainable rail mobility together. A concept for designing the future in the All Electric Society (AES). With a shared commitment to innovation, both companies address the challenges of a rapidly evolving transportation sector by delivering cutting-edge solutions. From battery-powered trains to advanced connectivity systems, their collaboration highlights the importance of reliable partnerships in driving eco-friendly advancements. By combining ALSTOM's expertise in mobility with HARTING's modular product portfolio, they are setting new standards for sustainability and performance worldwide.

Global leader in the transportation sector with a green heart

Founded in 1929, ALSTOM is now one of the largest railway technology companies in the world. ALSTOM's vision is to contribute to a low carbon future by developing innovative and sustainable transportation solutions that people enjoy riding.

Battery connectors for an electrified mobility

One of the biggest challenges that a leading global company like ALSTOM faces in its daily work is finding the best connectivity solutions for its products to fulfil customers' design requirements and speed up time-to-market. In the competitive and rapidly evolving rail industry, meeting these demands requires not only innovation but also strong partnerships with reliable suppliers who share the same commitment to quality and efficiency. For ALSTOM's engineers, using HARTING's connectors means that time to market can be significantly reduced, allowing new products to be introduced faster while maintaining high standards of quality and reliability.

Furthermore, installation times can be improved through convenient plug & play functionality. This helps ALSTOM meet tight deadlines and maintain its reputation for delivering cutting-edge rail solutions.

On the other hand, in the past it has often been possible to jointly develop solutions using the existing product range, leveraging the expertise of both ALSTOM and HARTING to overcome specific technical challenges. One of the most important current projects is the connection of batteries on the roof of a regional train, which plays a critical role in the development of modern, energy-efficient rail systems. The collaboration with HARTING has made it possible to develop innovative solutions here, demonstrating the value of a close, cooperative approach between the two companies.

"We have a very good relationship with HARTING and can often jointly develop solutions based on their existing product range. For example, for connecting the batteries on the roof of the new regional train."

Damien Chauveau
Senior Expert Traction Electrical Architecture at ALSTOM

Shaping the future of railway mobility together

The requirements for new products in the railroad sector are very high, with rapidly changing conditions constantly challenging manufacturers. HARTING's extensive and modular product portfolio enables ALSTOM to develop innovative solutions and bring them to market successfully. By offering flexible and reliable components, HARTING supports ALSTOM in meeting diverse customer needs and adapting to evolving industry demands.

The global shift toward sustainable technologies, such as electromobility and battery-powered trains, plays an increasingly important role, shaping the future of the rail sector. These advancements are key drivers for innovation and sustainability – both key factors of the AES. ALSTOM and HARTING have been strong partners for over 20 years, with HARTING developing customised connection solutions to meet ALSTOM's requirements. Moving forward, their cooperation will focus on advancing green energy-based mobility solutions, driving progress in eco-friendly transportation and setting new standards for sustainability in the industry. Together, they are committed to shaping the future of rail technology.

Fabien Segura
Global Account Manager, HARTING France

customer benefits

END TO END SOLUTIONS

FOR INDUSTRIAL AUTOMATION FROM A SINGLE SOURCE

The typical challenge in the automation industry is to fulfil all the specific needs. Each project has different requirements and often requires special solutions to achieve optimum efficiency. With its wide range of industrial connectors, HARTING helps the automation solution provider Wipro PARI as a strategic partner to find solutions in numerous automation technology areas. **Thanks to the worldwide availability in the same high quality, the extensive modularity and strong reliability of the connectivity products, even the most specific automation requirements can be fulfilled. The collaboration, which has lasted for over 25 years, is a true success story.**

Connectivity solutions from HARTING are available worldwide. The modularity of these products gives our engineers benefits when incorporating them in our design. And the last point is reliability. These products are very reliable, which our customers really appreciate.

Rahul Keskar *Functional Head Control Design, Wipro PARI*

Video:
Atul Patil, Global Controls Engineering Director, Wipro PARI

Wipro PARI, a fusion of Precision Automation & Robotics India Private Limited (PARI), founded in 1990 and Wipro Enterprises is the leading industrial automation company in India and among the Top 20 in the world.

Wipro PARI has the vision to utilise its expertise and resources to bring the best-in-class automation and robotics solutions to its customers. Through their global reach and technical expertise, Wipro PARI offers a comprehensive range of industrial automation solutions, including turnkey physical automation projects and digital factory initiatives to serve their customers.

Wipro PARI provides industrial automation solutions globally, primarily to the automotive industry, e.g. to optimise production processes of the e-car industry. This helps to meet the high demand for electric vehicles worldwide and paves the way for the All Electric Society (AES).

The solution portfolio is highly diversified. The services range from the automation of machining lines for crankshafts, block and head using either gantries or robots running on rails. Storage retrieval systems, high-speed electronic manufacturing machines to assemble tiny parts and automated parking systems for large car parks are also typical application fields.

Thirumurthy Venkatachalam
Regional Product Manager, HARTING India

Benefits:

- *Perfect fit solutions for all automation requirements, enabled by the largest industrial connector range on the market and cable assemblies from a single source*
- *High reliability and longer lifetime due to globally standardised high quality*
- *High flexibility and modularity enabled by HARTING connectivity solutions*
- *Future proof and scalable due to easy extension and upgrade options*

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OUR AI.
Supported by intelligent AI, you can configure your customised connector in record time with our product configurator. Precise, simple and perfectly tuned to your requirements.
Innovation meets efficiency – try it out it now!
HARTING
Pushing Performance
Since 1945