



International Copper
Association
Copper Alliance

Tomorrow,
built with copper.

2021 ANNUAL REPORT

VISION

The International Copper Association (ICA) is the leading advocate of the copper industry.

MISSION STATEMENT

ICA is a nonprofit organization that brings together the copper industry and its partners to make a positive contribution to the UN Sustainable Development Goals and to support markets for copper.

VALUE PROPOSITION

ICA is dedicated to championing the industry on issues critical to copper, now and in the future.

ICA provides a common platform for what is a nonintegrated industry. In this capacity, ICA, with its partners, connects the upstream (mining and smelting/refining) and downstream (fabricating) parts of the copper value chain.

Being commercially neutral, ICA is a credible advocate of the copper industry to defend its interest with policymakers, regulators and other key stakeholders (e.g., United Nations, NGOs, etc.).

By pooling resources through ICA, the copper industry can accomplish much more than any single company could on its own.

MEMBERS

As of 31 December 2021

Anglo American . Antofagasta Minerals S.A. . Aurubis . BHP Billiton Plc . Boliden AB . Buenavista de Cobre, S.A. de C.V. . Compañía Minera Dona Inés de Collahuasi . Compañía Minera Zaldívar . CODELCO-Chile . Freeport-McMoRan . Glencore . Golden Dragon Precise Copper Tube . KGHM Polska Miedź S.A. . LS-Nikko Copper Inc. . Metalurgica de Cobre S.A. de C.V. . Metso Outotec Oyj . Minera Antamina S.A. . Minera Antucoya . Minera Centinela . Minera Escondida Limitada . Minera Los Pelambres . Mitsubishi Materials Corporation . Operadoras de Minas de Nacozari, S.A. de C.V. . Pan Pacific Copper . Rio Tinto Kennecott . Sociedad Contractual Minera el Abra . Sociedad Minera Cerro Verde S.A.A. . Southern Perú Copper Corporation . Sumitomo Metal Mining Co., Ltd. . Teck

COPPER ALLIANCE® DIRECTORY

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Message to Membership

We write this message as the world enters the third year of the global pandemic. In the Fall of 2021, there were signs of at least a partial return to normality as conditions improved in a number of jurisdictions. For many of the members and management of the International Copper Association, an in-person component to ICA's annual meetings in October, in London, represented the first face-to-face contact in nearly two years. This was followed in close proximity by COP26, the annual, global climate change conference, in Glasgow, UK, where ICA had a strong presence. Then, the Omicron variant made its global entrance in December 2021 forcing a step back in terms on in-person events. The world is still dealing with Omicron at the time of writing.

Challenges aside, there are numerous successes to share as we look back on the last year.

2021 marked the second year in the delivery of the ICA 2020 - 2022 Strategic Plan. We are pleased to report that the main objectives of the plan are all on-track and ahead of expectations in some instances. In addition to KPIs on industry reputation, regulatory affairs, and market impact, ICA successfully executed additional off-plan items such as a relaunch of antimicrobial copper activities in the U.S. and in parts of Asia, and an all-new effort to develop a Global Copper Decarbonization Roadmap (GCDR). Work on the GCDR is progressing well, and we anticipate launching this critical piece of work in the second quarter of 2022. Here we wish to acknowledge the International Council on Mining and Metals' (ICMM's) "Climate Change: Position Statement" that was published in October, which sets a broad direction for all the mining industry in its efforts to decarbonize its operations.

As ever, partnerships played an important role in 2021. Collaborations with the International Wrought Copper Council (IWCC) and the Copper Development Association U.S. (CDA) continue to strengthen ICA's connection with the downstream copper industry and the end-use markets they represent. A whole-value-chain approach to ICA's programs is critical to ensuring copper maintains fair market share in its key end-use sectors.

Another important industry partnership is with the Copper Mark, a credible assurance framework to promote responsible production practices and demonstrate the copper industry's commitment to the green transition. The Copper Mark is a stand-alone entity organized under the laws of the United Kingdom, and as of January 2022, 33 copper-producing sites are participating. We encourage both ICA members and nonmembers to apply for The Copper Mark. Learn more at coppermark.org.

In addition to industry partnerships, ICA launched a new external partnership that puts ICA and its members at the heart of the global movement to ensure universal access to energy. The Cornerstone of Rural Electrification, or CORE, operates at the nexus of energy efficiency and access in support of UN SDG7, to "ensure access to affordable, reliable, sustainable and modern energy for all." ICA's lead partner in CORE is the Alliance for Rural Electrification (ARE), and the founding partners represent a "who's who" in the energy access space. We invite you to visit core-initiative.org to learn more.

ICA has developed a high level of credibility in a number of areas directly linked to the global sustainable development agenda, and this is entirely due to our most important and valuable resource: our people. We offer thanks to both ICA members and management for their continued hard work and dedication. Strong collaboration between active member company representatives and an empowered employee base are the key to ICA's success as demonstrated by the many achievements outlined in this report.

Looking ahead, in 2022 we will see the development of ICA's next three-year Strategic Plan, covering 2023 through 2025. With the significant changes made through an organization-wide restructuring in the ICA 2020 plan, we see this next phase in ICA's strategy as more of an evolution than a revolution. Having said that, the new plan is likely to see an even greater call on ICA to "be a public voice for copper" for both the metal and the industry. We look forward to sharing details on the ICA 2023-25 Strategic Plan in next year's report.



STEVE HIGGINS
Chairman



TONY LEA
President

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NEW ICA MEMBER

At the annual meetings in October of 2021, the ICA Board of Directors elected Vale as a new ICA member. Vale, headquartered in Brazil, is among the world's largest miners, with operations covering approximately 30 countries. Vale is committed to becoming one of the safest and most reliable global mining companies. Vale joins the ICA at a critical juncture for the copper industry as it strives to support global goals rooted in the Paris Climate Agreement and the UN Sustainable Development Goals.

ICA's members and management offer thanks to Vale for this commitment. We invite those companies who are not yet members of ICA to follow Vale's lead and partner with us, to further strengthen our position as the leading advocate for the copper industry worldwide.

Industry Reputation-Building

Over the course of ICA's current strategic plan, the Industry Reputation-Building (IRB) Team's objective has been to increase the reputation of the copper industry in a measurable fashion. To reach this goal, the IRB Team focused its outreach and communications on a limited number of themes via collaboration-oriented, online campaigns and events in 2021.

While the burden of the pandemic continued to constrain IRB's ability to engage partners and stakeholders in person, the IRB program sustained communications throughout 2021 by concentrating on timely and informative initiatives.

- **THE CIRCULARITY OF COPPER:** the Circular Copper Campaign showcased ICA members' contributions to the circular economy and copper's role in creating a culture of sustainability—without waste. The campaign tripled the average amount of time visitors spent on the ICA website. In addition, an interactive LinkedIn Live event featured nearly 200 attendees.
- **THE ROLE OF COPPER IN SUSTAINABLE INFRASTRUCTURE:** the Infrastructure Reimagined Campaign asked stakeholders from prominent organizations (e.g., the International Energy Agency) and governments around the world (e.g., U.S. Congress) to imagine the infrastructure of the future. Their responses were recorded on video, shared online and viewed more than half a million times across platforms. The campaign also featured an interactive infographic highlighting the role of copper "behind the scenes" in transportation, home and office, and industry and the power grid. The complete infographic can be found [here](#).
- **THE RESPONSIBLE PRODUCTION OF COPPER:** grounded in member case studies, the Responsible Copper Campaign shared infographics, social content and editorials centering on five topical issues, each illustrating the industry's efforts to improve performance toward reaching the UN Sustainable Development Goals (SDGs): mining, climate, environment, social responsibility and innovation. As part of the campaign, an op-ed discussing mining misconceptions was published on ICA's VP of Public Affairs LinkedIn page. The article has proven to be ICA's most popular op-ed on LinkedIn, with an above average engagement rate.



These communications campaigns were developed in collaboration with ICA members and other ICA programs, specifically, the Material Stewardship (MS), Clean Energy Transition (CET) and Green & Healthy Buildings (GHB) teams. In addition, to guarantee relevance, content development was closely coordinated across regions to ensure all required nuances were captured in subsequent communications.



A critical vehicle for maintaining a strong reputation is a well-designed and functional website.

Another key component of IRB efforts in 2021 included participation in external events. ICA continued sponsoring events such as Climate Week NYC and GreenBiz to reach target stakeholder audiences. Additionally, these events gave ICA the opportunity to highlight staff expertise in specific areas and reach a greater number of stakeholders because organizations such as The Climate Group enjoy a larger social media and online presence.

Based on IRB's success working with outside organizations in planning and hosting online events in 2020, ICA decided to serve as solo host of two LinkedIn Live events in 2021, both rooted in the circular economy—Circular Copper, and Industrial Symbiosis. These events not only expanded our relationships with members companies, but they enabled ICA to connect with critical stakeholders such as the World Resources Institute and the European Commission.

The importance of expanding ICA's network can be seen in another critical piece of ICA's advocacy strategy: the development and nurturing of partnerships and collaborations. 2021 saw IRB joining with IWCC to create messaging on the circular economy, highlighting the importance of the complete value chain, as well as assisting Global Partnerships on efforts such as United for Efficiency and the Cornerstone of Rural Electrification (CORE). Relationships such as these enable IRB to reach the objective of improving the copper industry's reputation.

A critical vehicle for maintaining a strong reputation is a well-designed and functional website. Over the last year, IRB undertook the task of combining three websites into one. The best features and content from sustainablecopper.org and copperalliance.eu were merged into an optimized copperalliance.org. This new and improved website allows ICA to share content in a more engaging manner through better use of video, infographics and images. For example, viewers can not only learn where ICA members stand on the EU Green Deal, but they can also learn how copper drives infrastructure and smart-building design around the globe.

With the experiences of 2021 in the rearview mirror, the IRB team is poised to build on the success and strengthen the industry's reputation in 2022.





Material Stewardship

REGULATORY OUTLOOK

The shift by governments from short-term economic stimulus packages in late 2020 to broad sustainability policies, initiatives and regulations addressing, for example, climate impacts, biodiversity loss and circularity, intensified in 2021 across all regions.

The European Union via the Green Deal has continued to scale-up their sustainability agenda. This has presented challenges for the copper industry but also opportunities for ICA to demonstrate the contribution of copper to circularity, to advocate for third-party voluntary initiatives like the Copper Mark to be recognized within proposed regulations on batteries and End-of-Life Vehicles, and to present ICA-funded, independent scientific research demonstrating the safe use of copper in the workplace and the environment.

Ambitious sustainability initiatives are also reflected in China's 14th Five-Year Plan, which has a strong focus on green development, decarbonization, and supply chain security, i.e., copper availability and recycling. In addition, the China Nonferrous Metals Industry Association publicly announced that establishing a responsible sourcing scheme is in their work plan.

The U.S. passed the Bipartisan Infrastructure Deal, which includes requirements for green transportation, and a number of carbon concepts were introduced at local, state, and federal levels. One of the most notable being Executive Order 14057, which outlines a path to achieve net-zero emissions from federal procurement by 2050 while increasing the sustainability of federal supply chains.

From a Material Stewardship (MS) perspective, this has translated into an increase in the urgency and scope of challenges and opportunities relating to chemicals management and sustainability. MS Council members and staff continue to focus on continued access to markets and to position copper as a sustainable, responsibly produced metal, while navigating the increased awareness and scrutiny around the broad sustainability of materials.

MS PROGRAM

2021 was another productive year for the MS program, despite continued restrictions on in-person meetings and travel due to the ongoing pandemic. This productivity has ensured that the MS Team is on track to achieve its original program goals by the end of 2022, as well as additional goals emerging during the course of the current strategic plan. Major accomplishments in 2021 by the MS program include:



Completing a project to better understand the copper industry's carbon footprint and contribution to global greenhouse gas (GHG) emissions as part of the Global Copper Decarbonization Roadmap (GCDR), led by the Clean Energy Transition (CET) Team.



The receipt by CDA U.S. of an award at the Health Product Declaration Collaborative Symposium for its leading-edge case study advocating for the consideration of physical form in hazard assessments of metals.



Publication of the entire library of Unified Numbering System (UNS) copper alloys in Toxnot as individual shared materials.



Publishing six scientific articles in peer-reviewed journals on life cycle impact assessment, copper in the aquatic environment, recycling, and occupational exposure to copper.



Completing a pilot study on social impacts in the copper sector for the United Nations Environment Program (UNEP) Life Cycle Initiative using the newly published Social Life Cycle Assessment Method.



In collaboration with the Green & Healthy Buildings (GHB) Team, demonstrating copper's environmental performance compared to a competitor product in drinking water tubing systems.

Most of these accomplishments were delivered through collaboration with other ICA programs, reflecting the MS Team's continued efforts to add additional value to ICA members within the current structure and to ensure a more-efficient delivery on the team's value proposition to members.

STAKEHOLDER ENGAGEMENT AND PARTNERSHIPS

MS staff met virtually with several Members of the European Parliament, EC officials, and regulators in the U.S. and Asia to discuss dossiers that are of critical or high priority to members. ICA also secured continuation of ICMM's Material Stewardship Facility through a revised Memorandum of Understanding and continued to support The Copper Mark through, for example, knowledge-sharing and joint positions on regulatory proposals in Europe.

2021 was another productive year for the Material Stewardship program, despite continued restrictions due to the ongoing pandemic.

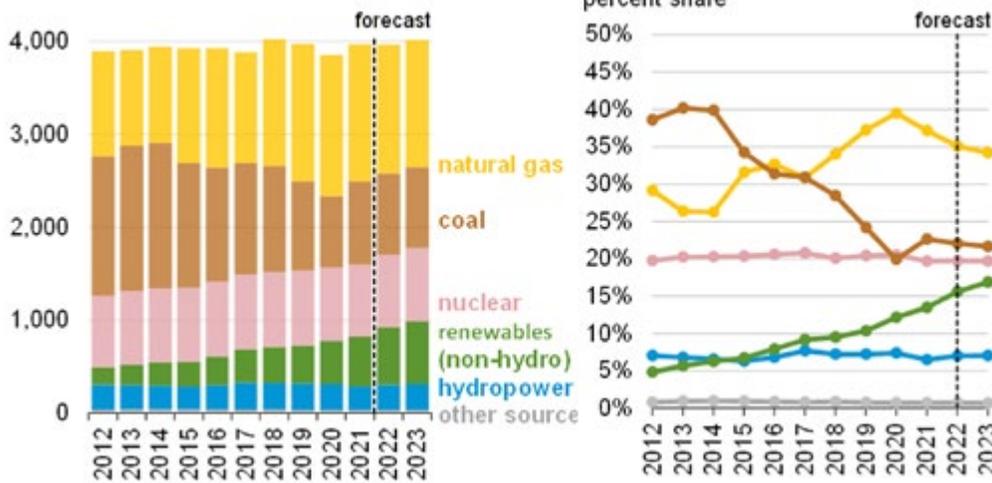
CET Contribution

The Clean Energy Transition (CET) team, covering the three regions where ICA operates, generated significant impact in 2021 along the three pillars of the CET program: opportunities in renewables, contribution to energy efficiency and support to members in addressing the challenges of the energy transition.

RENEWABLES

In the U.S., the Copper Development Association (the North American arm of ICA) influences federal- and state-level policies towards accelerating the transition to renewable energy. These efforts are working, as the rapidly increasing share of renewables in the U.S. energy mix shows.

U.S. ELECTRICITY GENERATION BY SOURCE, ALL SECTORS
billion kilowatt hours



Source: U.S. Energy Information Administration, Short-Term Energy Outlook, January 2022





Fossil-free energy, generation technologies, coupled with battery storage, generate a potential of over 75,000 tonnes of additional annual copper demand in the U.S.

Also in the renewables sector, ICA in China partnered with local authorities to issue a standard for the replacement of wind farms older than 10 years—which represent about one-third of the installed capacity—with modern, higher-efficiency windmills that also deliver higher power quality. Work is now in progress to finalize this standard.

As well as renewables, efforts were undertaken on sustainable mobility, with a focus on electric vehicles (EVs). ICA's team in Europe, represented by the European Copper Institute, secured the inclusion of a key recommendation in the legislative proposal by EU authorities on charging infrastructure: public 150kW charging points will be installed every 60km along the core Trans-European Transport Network by 2025. This element is crucial to accelerate the uptake of battery electric vehicles in Europe.

Under the leadership of CDA Inc., the Electric School Bus Coalition secured 2.5 billion of federal support, through the Infrastructure Investment and Jobs Act passed in November 2021, to start replacing 450,000 school buses in the U.S. with their electric equivalents.

A copper-intensive EV battery pack developed by a Chinese manufacturer with the support of ICA received recognition from the UN Industrial Development Organization (UNIDO) for worldwide promotion. This new pack, in which the nickel bus bar is replaced by copper, comes at a lower price while providing higher efficiency and safety.

Fossil-free energy generation technologies, coupled with battery storage generate a potential of over 75,000 tonnes of additional annual copper demand in the U.S.

ENERGY EFFICIENCY

Promoting copper's ability to improve the efficiency of electric motors in an economic and sustainable way has been the cornerstone of CET team activity in 2021 on this pillar of the program.

The ICA team in India collaborated with other industry associations and the Indian government to develop a training curriculum based on best practices in industrial motor rewinding, with the training endorsed with an official certificate. Using the correct size of magnet wire in electric motors could lead to 33TWh annual energy savings in India. Also, as a knowledge partner in the National Motor Replacement Program, ICA India contributed to an initiative that makes higher-efficiency motors (IE3 category) more affordable, i.e., through the extension of credit for early motor replacement up to the payback period duration. This program helped increase the share of IE3 motors from 15 to 21 percent during 2021.

In China, the joint efforts of the CET team with industrial partners to develop a copper rotor motor led to its certification as the only motor in the highest energy efficiency category (IE5). This significant result was achieved without increasing the frame size of the motor, thanks to the superior conductivity of copper.

Our team in China also succeeded in influencing the Ministry of Industry and Information Technology and the State Administration for Market Regulation not to limit the use of copper in their Motor Energy Efficiency Improvement Plan launched in November 2021. The Chinese electric motor market will benefit from manufacturing motors with higher copper density as this contributes to significant increases in energy efficiency.

Leveraging the experience in India, our European team launched a joint initiative with EU energy agencies, policymakers and manufacturers to increase the rate of motor renovation, by proposing to draft policies that address the upgrading or replacement of old, inefficient motors. This could lead to 18TWh of energy savings. An application for EU public funding was submitted along with five other organizations, dealing with electrical motors to progress this initiative.

On a broader level, we successfully introduced amendments to the European Commission revision of the Energy Efficiency Directive: amplifying the uptake of copper-intensive energy-efficient equipment and appliances like heat pumps and motor-driven automation systems in small and medium enterprises (SMEs) and buildings.

Although motors were the focal point of the CET Energy Efficiency pillar, activities were also developed in other important copper applications.



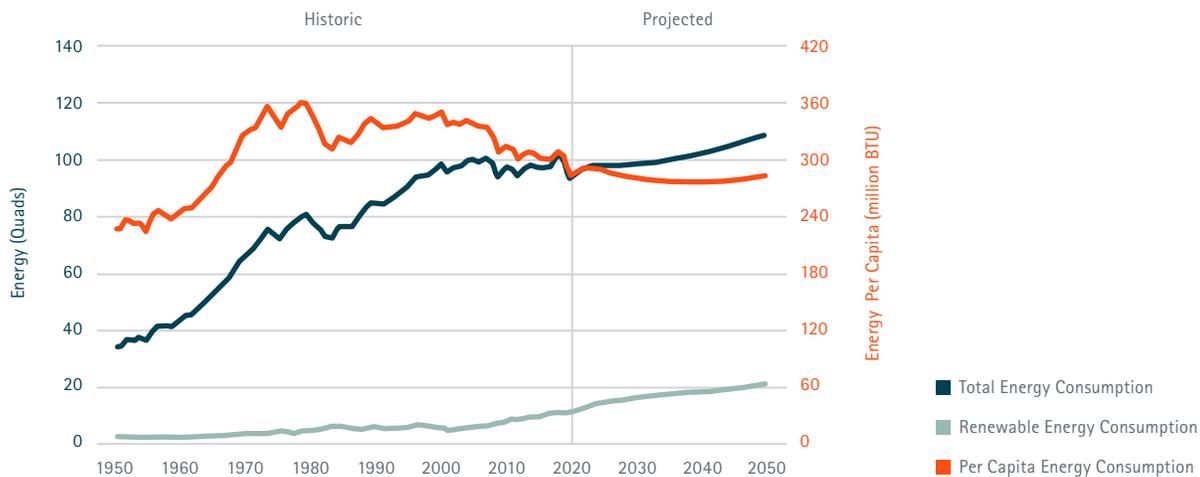
Using the correct size of magnet wire in electric motors could lead to **33TWh annual energy savings** in India.

Following recommendations by the local CET team, the China National Code for energy-efficiency grades of multi-connected aircons has been reviewed with a view to achieving a 25 percent increase of efficiency levels in part through higher intensity of copper use. The CET team also published a white paper emphasizing the significant contribution of heat pumps for reaching carbon neutrality, which resulted in this technology being earmarked by the Chinese authorities in their guidelines on decarbonization.

ICA, through the Copper Development Association and its partners, has continued to influence U.S. policy to adopt more stringent energy-efficiency standards. Results of these efforts are now coming to light in recent reports.

The effect of new energy-efficiency regulations that started in 2016 can be seen in data that clearly indicates a downward trend in per capita consumption.

U.S. ENERGY CONSUMPTION: HISTORIC AND PROJECTED VALUES



Source: University of Michigan

Many state governments in the U.S. followed up in 2021 on decarbonization goals with new legislation focused on accelerating clean energy development while also making new investments in energy efficiency to help meet climate goals. New energy and water saving appliance standards were adopted by five states plus the District of Columbia (D.C.). Appliances included in some of these laws are air purifiers, computers and restaurant equipment.

In Europe we joined forces with Europacable, the association of cable manufacturers, to make electrical designers and installers aware of the need to oversize fire-resistant cables to ensure the electrical integrity of safety systems in the event of a fire. A joint survey by the two organizations showed installers and designers are not aware of this technical requirement.

CHALLENGES OF THE ENERGY TRANSITION

The transition to a climate-neutral economy requires a reduction of the carbon footprint of all industrial activities, including the copper value chain.

Europe has been leading the way in shaping and implementing such regulations, such as the Emissions Trading System (ETS), which constitutes an important component for the energy-intensive copper industry. ICA is closely following the evolution of this regulation and is engaging directly with the European Commission on its proposal for a revision of the ETS, to ensure a fair treatment of the copper sector, especially in the light of the significant initiatives taken by the industry to decarbonize its processes.

In early 2021, ICA and its members embarked on designing a Global Copper Decarbonization Roadmap that aims at assessing the options available for the industry to reduce its carbon footprint, together with the conditions to be met to implement such options. The outcome of this major undertaking should be made publicly available by midyear 2022.



Green and Healthy Buildings

ICA JOINS THE GLOBAL ALLIANCE FOR BUILDINGS AND CONSTRUCTION

The buildings and construction sector accounts for nearly 40 percent of world final energy consumption and CO₂ emissions. If there is any chance of meeting the Paris Agreement goal of limiting global warming to 1.5°C, this sector must urgently be decarbonized through a triple strategy: reducing energy demand, decarbonizing the power supply, and addressing embodied carbon stored in building materials. Looking ahead, the challenges to reaching a net zero, energy-efficient and resilient buildings and construction sector are considerable but achievable.

In 2021 ICA joined the [Global Alliance for Buildings and Construction \(GABC\)](#), led by the United Nations Environment Programme (UNEP). The Alliance was launched in 2015 at COP21 in Paris, and with [204 members, including 34 countries](#), and it brings together governments, the private sector, civil society, and intergovernmental and international organizations to increase action towards a zero-emission, efficient and resilient buildings and construction sector through:

- **Raising ambitions to meet the Paris climate goals.** While the sector is a major emitter, it also holds huge potential for improvement. The Alliance works to raise the level of ambition in retrofitting existing buildings and future proofing the investments going into new buildings over the next 15 years.
- **Mobilizing all actors along the value chain.** Faced with a fragmented value chain, all stakeholders—from design to construction, operations and demolition in the private and public sectors—need to play their part. The Alliance encourages policy frameworks that promote both uptake of existing, cost-effective solutions and private sector innovation—using sustainable public procurement as a lever to create markets and investor security.

ICA started exploring how it can leverage the expertise and current advocacy efforts lead by its Green and Healthy Buildings Team to influence three out of the five work areas of the GABC:

- Public Policies
- Market Transformation
- Building Measurement, Data and Information

Ultimately, by partnering with the Alliance, ICA aims to ensure that copper-based systems and solutions will continue to contribute to zero-emissions, efficient and resilient buildings and constructions.

GABC work areas:



Awareness and Education



Finance



Public Policies



Market Transformation



Building Measurement, Data and Information

The challenges to reaching a net zero, energy-efficient and resilient buildings and construction sector are considerable but achievable.



ICA INCREASES BUILDING WIRE DENSITY IN CHINESE NATIONAL DESIGN CODE

As a result of ICA's market advocacy work in China, building-wire density increased by two percent in the newly revised China National Design Code for Residential Buildings.

The upgrade leads to higher electrical safety standards for Chinese dwellings, especially for small apartments usually bought by lower-income homebuyers in developing areas. The revision also provides a solid base to further reduce operational carbon emissions.

Enhanced requirement on the minimum power load for each flat—an increase from 2.5kW to 4kW—leads to upsizing power cables. ICA also prevented an attempt to downsize the minimum size of the feeder conductor (from 10mm² to 6mm²).

Overall, ICA played a leading role by facilitating and sponsoring the code revision, and continues to advocate copper's benefits in the 1.2 million tonnes urban building wire market.

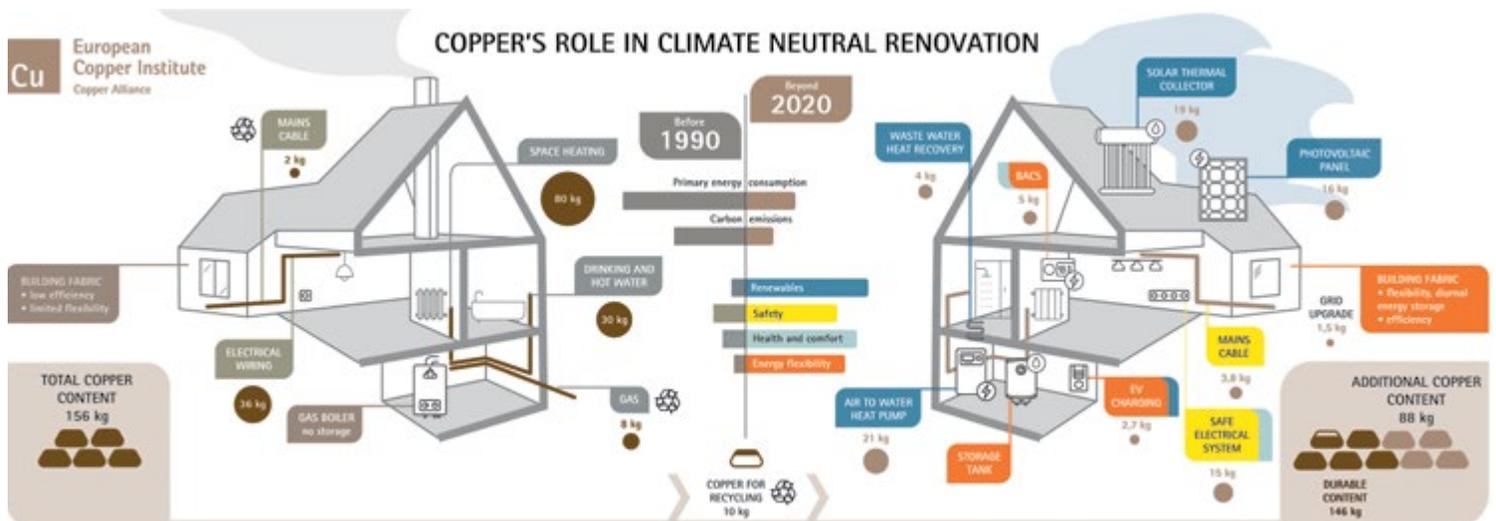
THE EUROPEAN COMMISSION ZERO-EMISSION AMBITION FOR BUILDINGS

The European Commission proposed a recast of the Energy Performance of Buildings Directive (EPBD), its main instrument to achieve energy efficiency and climate-neutrality in buildings. The proposal is broadly in line with our recommendations and aims to at least double the renovation rate by 2030 and achieve a zero-emission building stock by 2050.

Copper-based solutions such as heat pumps, solar thermal, solar photovoltaic and building automation and control systems (BACS) have a significant role to play. The proposal also strengthens the requirements for electric vehicle charging points in buildings.

The team in Europe will continue to work with the European Parliament and the Council in 2022 to ensure appropriate final text and an appropriate consideration of copper-based solutions, in particular electrical installations and waste-water heat recovery systems.

■ For further reading please click here.



All these figures are sensible midpoint estimates of parameters that vary widely for a 120m² family house.

CDA THOUGHT LEADERSHIP IN PRODUCT TRANSPARENCY GARNERS MARKET RECOGNITION

Over the past several years, CDA has been participating in the leading North American product transparency organizations to help shape their tools and strategies in the field of copper and copper materials and building products. In doing so, CDA has become a recognized thought leader in the green and healthy building and product transparency space, including being distinguished late in 2021 with the new Health Product Declaration Collaborative (HPDC) **Material Health Innovation Award** for the case study "*Looking Beyond the CAS Number: Considering Form Specificity in Hazard Assessment of Metals.*"

CDA's efforts have begun to shape building decision-maker opinions on the use and sustainability of copper versus other building products. This includes: all (750+) Unified Number System (UNS)-registered copper alloys in the **toxnot** shared materials database to ease material selection and specification by end-users. The publication of health product declarations through the **HPDC** for 10 copper building products; and the dissemination of these to building decision-makers through a partnership with *mindful Materials* and *Sustainable Minds*, this thought leadership is driving market action as evidenced by the following recognition:



“

Copper Development Association has recently made a strong statement in displaying leadership towards their commitment in improving manufacturers' abilities to achieve full material disclosure for safer product design. —toxnot

Unfortunately, outside of limited studies on copper, no building products with added antimicrobials have been shown to reduce infections in a human population. —mindful Materials

As with most product decisions, tradeoffs exist and must be considered. In the final analysis we favor copper joined without solders, fluxes, or other filler metals in most situations over the plastic alternatives. Despite environmental health impacts associated with copper mining and smelting, the evidence suggests fewer concerns than plastic products during the use phase and at the end of life. —Healthy Building Network

THE EUROPEAN PARLIAMENT CALLS ON MEMBER STATES TO DEPLOY ELECTRICAL INSPECTION REGIMES

The European Parliament recently called on Member States to deploy electrical inspection regimes as part of their building renovation efforts. This is the direct result of advocacy efforts of the Forum for European Electrical Domestic Safety (FEEDS), established and managed by the GHB team in Europe since 2017.

FEEDS reports show that 50 percent of accidental domestic fires, have an electrical source and that this should be addressed by encouraging inspection and renovation of electrical installations. ECI will build on this to integrate stronger requirements during the revision of the Energy Performance of Buildings Directive in 2022.

ICA INTRODUCES STANDARD FOR COPPER CONDUCTOR USE IN MEDICAL FACILITIES IN INDIA

During the pandemic crisis, Indian electrical systems were under tremendous stress, leading to multiple fires in healthcare facilities and hospitals.

To address this issue, ICA in India partnered with the Bureau of Indian Standards and the Ministry of Home Affairs to introduce a new electrical installation standard specifying the use of copper conductors for medical facilities. The standard was finalized and released in April 2021.

This new standard will be used for electrical installations in all future medical facilities and when carrying out electrical inspections of existing medical facilities, helping to reduce the number of electrical fires in medical facilities and hospitals and in turn saving lives and preventing property loss.



- Watch, Seán Kelly, MEP, recognize electrical safety as one of the key enablers for EU #EnergyTransition. As a Member of the European Parliament, he calls on Member States to deploy electrical inspection regimes.

Substitution Defense

REGULATORY OUTLOOK

Significant movements in commodity markets throughout 2021 posed increased challenges to copper from competing materials in areas of electrical conductivity, heat exchange, alloy fabrication and others. ICA focused its strategies and directed its resources based on the impact and urgency of challenges to defend copper's end-use markets in key jurisdictions and products. Major progress was made in establishing copper's strategic role in codes and standards, enhancing technical research and analyses on market intelligence, and engaging the supply chain to promote copper's superiority on environmental and techno-economic performance.

COPPER SETS THE STANDARD

- **ICA Successfully Defends Copper's Share of Chinese EV Infrastructure**
Copper power cable constitutes over 90 percent of copper usage in an EV charging station, making it an important application in the copper portfolio. ICA has strengthened its ties to the China Electricity Council (CEC) Standardization Center through revision committee work ensuring copper is the material of choice in EV charging and battery swapping stations, rather than aluminum alloy cable.



ICA has strengthened its ties to the CEC Standardization Center, ensuring **copper is the material of choice** in EV charging and battery swapping stations.

Photo: Members of the China Electricity Council (CEC) Standardization Center

- **Copper Distribution Transformers Incorporated into Technical Standards for Rural India**
ICA in India launched the Business to Government (B2G) campaign working with provincial governments to improve reliability for rural power distribution transformers, through techno- and socio-economic messages for advocacy. As a result, ICA successfully upgraded the technical standards for rural electrification, incorporating copper distribution transformers in the Tamil Nadu and Bihar provinces. This upgrade will significantly reduce distribution losses.
- **ICA Participation in IEC Technical Committee Solar PV**
ICA participated in International Electrotechnical Commission (IEC) standardization committees and joint working groups to secure the use of copper in mobile parts and cables for connect/disconnect operations in PV plants. The estimated use of copper in solar photovoltaic utility-scale plants ranges from 1500kg/MW to 2500kg/MW. Copper is used in PV panels (e.g., conductive busbars) and other parts of PV plants (e.g., cabling, inverters, transformers).
- **CDA Testing Helps Block Copper Clad Aluminum Cable from U.S. Electrical Code**
A proposed change to the 2023 U.S. National Electrical Code would allow 14 AWG copper-clad aluminum nonmetallic sheathed cable in 10-amp branch circuits. Testing managed by the Copper Development Association (CDA) showed dangerous overheating concerns, which helped block copper-clad aluminum cable from U.S. electrical code. The vote to reject this code change means that the 2020 code, currently in effect and prohibiting copper-clad aluminum cable in branch circuits under 15-amps, will remain unchanged in the proposed 2023 code. The 2023 U.S. National Electrical Code will be finalized later in 2022.



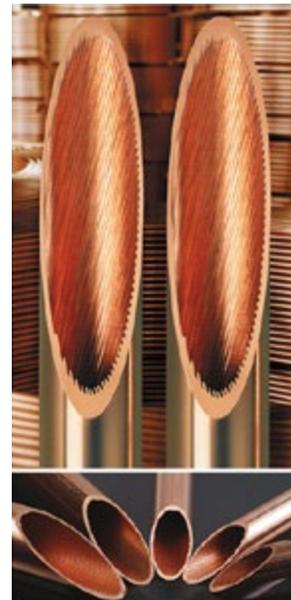
ENGAGING THE SUPPLY CHAIN

- **Over 50 Engineers Registered the HXSim Simulation Software from the Middle East HVAC Market**

Over 50 engineers asked for the HXSim simulation software's license after an article was published in the magazine *Climate Control Middle East*, VOL.16, June 2021. The magazine has been reporting on the HVACR industry in the Middle East for 13 years. The article "Why the HX should go with copper?" was edited by the MicroGroove™ team. It introduced the advantages and environmental contribution of the small-diameter copper tube heat exchanger through the experience in the Indian market. It also mentioned how the HXSim simulation software helped aircon manufacturers apply the technology.

- **Reducing GHG Emissions in the HVACR Sectors with Small-Diameter Copper Tube Heat Exchanger Technology**

After 10 years of development, the small-diameter copper tube heat exchanger (HE) technology, created by ICA, and the Heat Exchanger Technology Alliance (HETA), has become the core approach for reducing GHG emissions in the heating, ventilation, aircon and refrigeration (HVACR) sectors in China. At the 2021 Q1 HETA working group meeting, the group decided the small-diameter copper tube HE technology would be used in the outdoor unit of new refrigerant systems. HETA, which was established by ICA, is comprised of the Shanghai Institute of Refrigeration and major aircon manufacturers, including Gree, Midea, Haier, Hisense, TCL, Chigo, Toshiba Carrier, Hisense Hitachi and Changhong.



The

**100%
COPPER**

label is now displayed on 524 models out of 570 sold in India.

Some of these brands include:

Whirlpool

LG

Midea

- **Indian Room Aircon OEMs and Consumers Trust Copper**
Every Indian room aircon OEM has adopted ICA's "Copper Benefit messages" in "100% Copper" labels displayed on their products. The "100% Copper" label is now displayed on 524 models out of 570 sold in the country. ICA's social media campaign promoting copper's benefits in room aircons has reached a 10 million plus target audience, impacting more than 90 percent of purchase decisions in favor of copper room aircons. Further, ICA helped OEMs to improve cost, energy and environmental performance through technical marketing of the small diameter copper tube MicroGroove™ campaign. In 2021, the market share of 5mm Inner Groove copper tubes reached 37 percent. In summary, through sustained Copper branding and technical marketing of small diameter aircon tubes, copper heat exchanger share increased to 90 percent in 2021 from 55 percent in 2014.
- **Brass Rod Alloys Poised for Inclusion in North American List of "Acceptable Materials" for Drinking Water**
Faucet and plumbing component manufacturers are redesigning product lines to comply with a newly adopted and more stringent lead-leaching performance standard that becomes mandatory in 2024. The standard even presents a challenge for "lead-free" brasses, which may contain lead impurities. Copper Development Association (CDA) executed an extensive testing program that demonstrated multiple lead-free brass rod alloys easily meet or exceed the new standard. A ballot action was also secured to add several alloys to a list of "acceptable materials" in the North American drinking water health effects standard. The results and standard change will provide manufacturers with confidence to continue using brass, protecting market share in the largest end-use market for brass rod (46kt Cu) and the fourth largest market for copper-alloy castings (37kt Cu).
- **New Platform to Engage Korean Utilities and Cable Makers**
ICA in Korea developed a new working group as part of its power cable defense program. Under the management of International Conference on Electricity Distribution (CIRED) Korea; group members include Korea Electric Association (KEA), Korea Electric Power Corporation (KEPCO) and major Korean cable makers, including LS Cable, DaeHan Cable and Ijin Cable. The working group will be a neutral platform to discuss and share knowledge for optimizing cable installation and will provide an opportunity for ICA messaging to reach key power cable decision makers, as well as the power grid and industrial market. The first meeting was held at the Korea Electric Equipment Manufacturer's Association (KOEMA) in April.





The NEV team has developed a workplan to advocate for the **safety of copper cables** and to monitor the development of aluminum high-voltage cable technologies.

UNDERSTANDING THE SUBSTITUTION THREAT

- **ICA China Creates NEV Work Group to Combat Aluminum High-Voltage Cable Substitution**

ICA China established a new energy vehicle (NEV) work team to combat aluminum substitution in EV high-voltage cables. The NEV team has developed a workplan to advocate for the safety of copper cables and to monitor the development of aluminum high-voltage cable technologies. The team consists of NEV project partners, colleagues in the power-cable defense program and experts from related OEMs and research institutes.

- **Ongoing Study Examines Copper Busbar and Conductor Substitution in North America**

A markets-of-opportunity study focusing on data centers, EV-charging infrastructure, energy storage and high-tech manufacturing is providing critical insights for copper busbar substitution in North America. For each sector, the study has identified decision makers, specification pathways and maps to product usage, as well as drivers affecting material selection. Critical findings will guide the development of current and future substitution defense initiatives for copper busbar and conductors.

- **ICA Organizes Webinar on "The Future of Electrical Conductors"**

A webinar on "The Future of Electrical Conductors," held by the Copper Academy, ICA's initiative targeting end users on conductivity applications for copper, discussed ICA-initiated research from the Ultrawire project and a review paper developed with support of ICA. The topic included two main approaches to enhance conductivity: 1) a combination of metals and carbon, and 2) pure carbon-based material for mechanical strength. ICA studies of these technologies show laboratory feasibility but indicate commercial deployment is likely decades away. ICA is continuing to monitor this field and assess its implications for the copper industry.

Global Partnerships

Global Partnerships operates under the premise that like-minded organizations can accomplish more by combining resources rather than working alone. In this spirit, ICA partners with more than 500 organizations globally to create and implement projects that make a positive impact on the UN Sustainable Development Goals (SDGs). In particular, the Global Partnerships focuses on SDG7, "Affordable and Clean Energy for All" by 2030.

ICA's flagship program in this space continues to be United for Efficiency (U4E). While the COVID-19 pandemic delayed some implementation activities (especially in-person training of energy-efficiency practitioners and policymakers), U4E made strong progress—in particular, in Africa.

In 2021, implementation began on U4E projects in Africa through its first-ever funding from the Green Climate Fund (GCF) for "Readiness and Preparatory Support" projects in eight countries. ICA authored the proposals that are focused on converting these markets towards energy-efficient distribution transformers and residential refrigerators. The lead partner is BASE, a Swiss not-for-profit foundation and a Specialized Partner of the United Nations Environment Program (UNEP). ICA is leading implementation in four countries: Malawi, Namibia, Zambia and Zimbabwe.

With U4E firmly entrenched, Global Partnerships in 2021 sought to develop a new initiative based on the U4E model. An audit of the energy access space showed a lack of initiatives focused on the integration of energy efficiency into the effort to electrify the world.

For some perspective, about 760 million people, or roughly 10 percent of the world's population still do not have access to modern energy services. The Global Partnerships team saw an opportunity to integrate ICA's 30 years of experience in energy efficiency into energy access project. The Cornerstone of Rural Electrification (CORE) was formally launched at COP26 (Glasgow, UK, November 2021) to operate at the nexus of energy access and energy efficiency. A video introducing CORE can be found on the homepage of the new website.

ICA does not intend to start new electrification projects, as many organizations are already working to accelerate universal access to energy. CORE will leverage ICA's wealth of expertise and experience in energy efficiency and will bring technical expertise and capacity-building to existing projects. CORE will ensure that rural and peri-urban electrification is efficient and sustainable.

ICA's lead partner in CORE is the Alliance for Rural Electrification (ARE). The other founding partners include the UN Environment Program (UNEP), the UN Industrial Development Organization (UNIDO), the International Renewable Energy Agency (IRENA) and Sustainable Energy for All (SEforALL). These partners form the Board of CORE, and ICA has the position of the first Chair of the Board.

Even though it was only launched near the end of 2021, CORE is already working with eight energy access projects in Africa and Southeast Asia, and that number continues to grow. Importantly, CORE is a local jobs creator; with locally empowered communities able to install and service decentralized renewable energy systems.



An audit of the energy access space showed a lack of initiatives focused on the integration of energy efficiency into the effort to **electrify the world.**

LOOKING AHEAD TO 2022

ICA plans to convene a global event to scale-up energy-efficiency financing as a critical component of climate change mitigation efforts. ICA's Global Partnerships will also launch another new partnership in Africa to focus on increasing the efficiency of Africa's electrical grids. Where CORE operates on decentralized energy distribution systems, this new initiative will focus on electrical grids and presents a new opportunity for ICA to make a positive impact in Africa.

It is past success with programs like U4E, and the rapid uptake of new partnerships like CORE, that gives ICA's Global Partnerships program the confidence to branch out into new areas on behalf of its members. The investments by its members in ICA enables the formation and successful running of these partnerships, and we strongly encourage ICA's members to carry the news on U4E, CORE and more in their own outreach efforts.

ICA AT COP26

The annual United Nations climate change conference, **COP26** (Glasgow, UK, November 2021) provided ICA with a rare and welcome opportunity to meet in-person during the pandemic. ICA has participated in the COP since 2005 and our presence and activities there have grown in recent years. ICA had multiple speaking engagements at the all-important COP21, and moderated "Energy Day" at COP23. In all, ICA had five speaking engagements at COP26.

ICA had a strong presence at the **SDG7 Pavilion**, which was hosted by our long-time partner Sustainable Energy for All. SDG7 Pavilion was the site for the launch of CORE as well as an ICA moderated a session there on energy efficiency financing.

U4E was featured at the launch of the "**Product Efficiency Call to Action (PECA)**," a new initiative led by the UK Government and the International Energy Agency (IEA). Four of the five products covered by PECA are a part of U4E's portfolio and there is already good collaboration between PECA and U4E, in particular on motors.

For the fourth time, ICA participated in the **Sustainable Innovation Forum** and spoke at two sessions, one on sustainable financing, and the other on aligning climate action with the Sustainable Development Goals.



Market Intelligence and Outreach

In 2021, ICA Market Intelligence and Outreach participated in a wide range of important financial institution meetings. Meetings in this sector expanded ICA's output to a broader audience and increased ICA's public image. Market Intelligence output in 2021 focused on future material demand and material sustainability and developments in the circular economy creating newsworthy and bespoke material for industry and market influencers. Public-facing outreach activities to the media and the copper commentator community strengthened relationships with leading financial institutions and the press, building trust in ICA's original research and data.

INDUSTRIAL SYMBIOSIS

Industrial symbiosis, the concept of recovering and reusing discarded resources from one industrial operation by another, has the potential to significantly increase use of copper byproducts, ICA research has found. Successful industrial symbiosis examples in industry include the reuse of iron silicate, a byproduct of the smelting process, for aggregate in road construction, cement production, concrete, and abrasives. Industrial symbiosis can also be applied to the repurposing of electric vehicle batteries at end of life as a means of retaining approximately 70 to 75 percent of their economic value. Industrial symbiosis is an essential strategy to support the green energy transition, the circular economy and responsible production.

Potential Reuse of Iron silicate

1. The majority of copper slag is **stored in landfills**
2. Concrete production uses **rocks extracted from quarries** as aggregate material
3. Storing copper slag and extracting aggregates has **adverse impacts**
 - Extraction from quarries linked to harmful **social impacts**
 - Storing copper slag **burdens** smelters
4. Copper slag's, e.g., iron silicate, mechanical properties makes it **suitable for several uses** including as a **replacement to natural aggregate in concrete production**

Based on previous experience (e.g., iron silicate), industrial symbiosis with Copper slag is possible and likely to bring about **benefits for the actors involved.**

UN SUSTAINABLE DEVELOPMENT GOALS: THEIR CONTRIBUTION TO INDUSTRIAL SYMBIOSIS

- UN SDGs push for worldwide action on specific topics
- Some SDGs (indirectly) push for industrial symbiosis to take place



SDG 8 - Decent work and economic growth
Industrial symbiosis can boost economic growth



SDG 12 - Sustainable consumption and production
Production would be sustainable with industrial symbiosis



SDG 9 - Industry, innovation, and infrastructure
Industrial symbiosis modernizes industry, brings about innovation, and requires new solid infrastructure



SDG 13 - Climate action
Industrial Symbiosis can reduce carbon emissions

POTENTIAL USES OF RE-PURPOSED EV BATTERIES



Grid

- Balancing the market
- Voltage regulation
- Re-dispatching
- Flexibility



Off-Grid

- Backup
- Grid deferral
- Micro grid
- Self-consumption (storage)



Residential Storage

- Self-consumption (storage)
- Flexibility
- Backup
- Energy arbitrage



Commercial & Industrial

- Self-consumption (storage)
- Ancillary services
- Backup
- Peak shaving



Renewables

- Arbitrage
- Asset optimization
- Black start



Thermal Generation

- Ancillary services
- Asset optimization
- Black start
- Energy arbitrage



Electric Vehicles

- V2G and V2H applications
- Peak Shaving

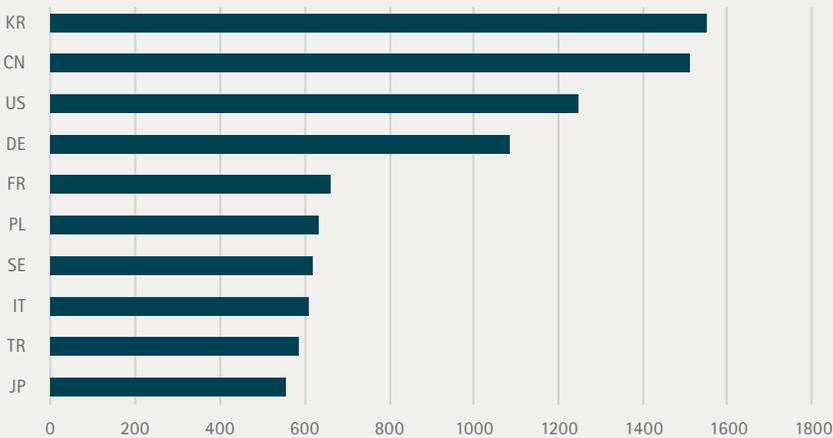
Source: Reid and Julve, 2016 | Arcadis

POWER CABLE TRADE FLOWS

The majority of power cables are produced and used within single regions, but there remain examples of strong intercontinental trade. ICA research revealed that China and Korea led the global export of power cables, when measured in cumulative net tonnage, between 2000 – 2019. The top 10 exporters accounted for approximately 55 percent of exports over the same period. Western nations, including the U.S., Germany and the U.K. receive the highest levels of imports.

TOP-10 EXPORTERS OF THE PERIOD 2000 – 2019: KOREA, CHINA, U.S., EUROPEAN COUNTRIES, TURKEY AND JAPAN

The top-10 exporters account for approximately 55 percent of the world's power-cable exports of the period 2000-2019.



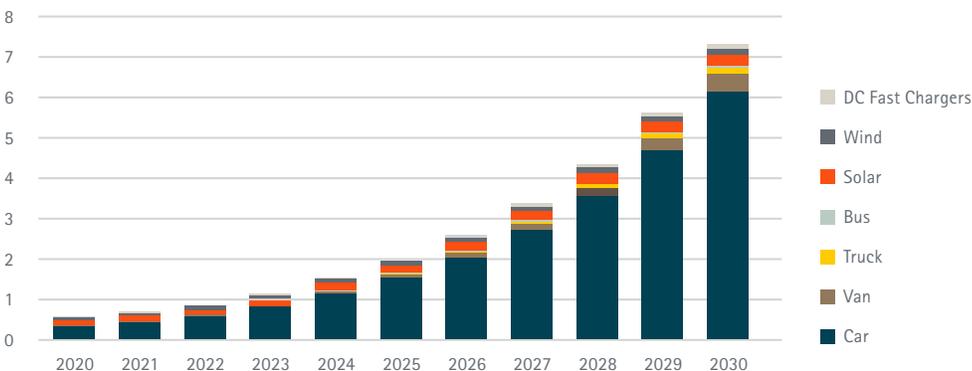
Power-cable exports of the period 2000 – 2019 (net weight) / kt. Raw data from UN Comtrade (2021)

Source: Fraunhofer ISI

POWER ELECTRONICS

Over the next two decades, the widespread adoption of power electronics devices in electric vehicles and renewable energy sources will increase copper demand. ICA research found that, by 2030, applications within these sectors—including inverters, onboard chargers and DC converters—will require around 20kt of copper per year. Furthermore, shifts from internal combustion engines to electric vehicles as part of new climate goals will result in 45kt of copper required per year in 2040 for electric car inverters alone.

CAPACITY-ADDITIONS BY APPLICATION (TW)



Source: IDTechEx

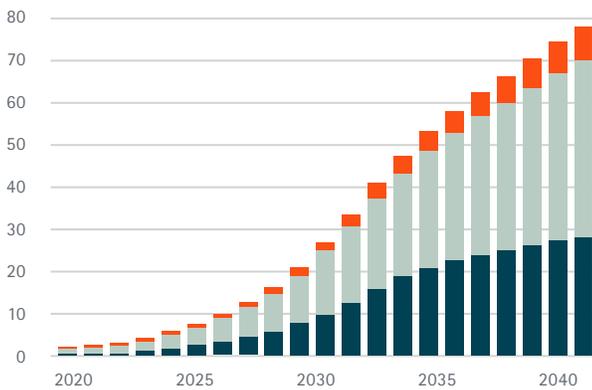


COPPER DEMAND: LONG-TERM SNAPSHOT OF ELECTRIC CARS

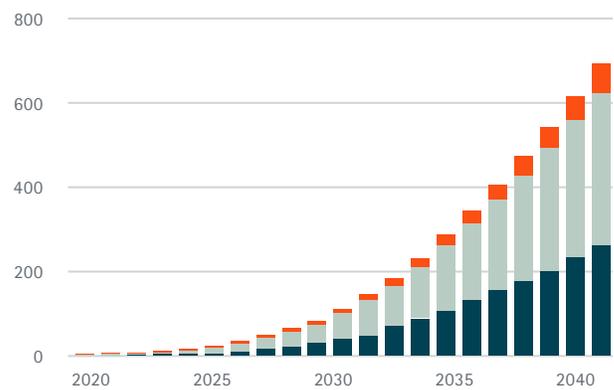
In 2040, ~78kT of new copper demand per year will be required for electric car power electronics.

■ DC-DC Converters (EV) ■ Onboard Chargers (EV) ■ Inverters (EV)

Copper Demand from Electric Car Power Electronics (kT)



Accumulated Copper Demand from Electric Car Power Electronics Between 2020-2040 (kT)



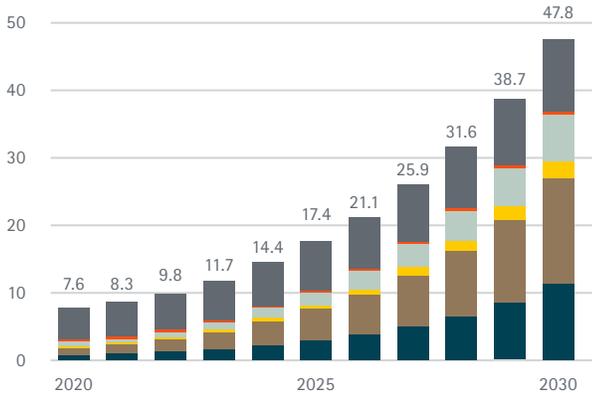
'Electric car' includes plug-in hybrid and pure battery electric cars. Source: IDTechEx

COPPER DEMAND FROM POWER ELECTRONICS

By 2030, ~48kT of yearly copper demand will arise from power electronics in renewable energy and on-road electric vehicle sectors. This decade, this will yield an accumulated 234kT of new copper demand.

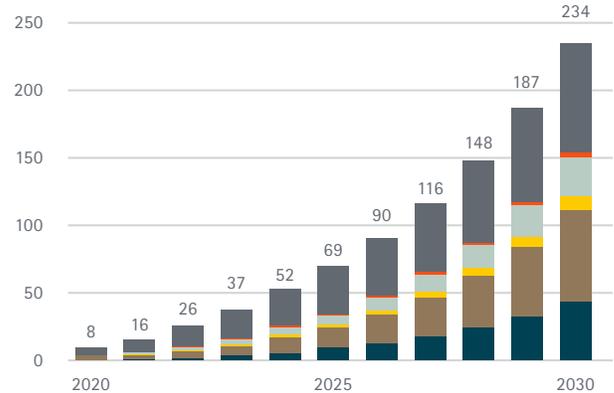
■ Solar Inverters ■ Wind Inverters ■ DC Fast-chargers ■ DC-DC Converters (EV) ■ Onboard Chargers (EV) ■ Inverters (EV)

Annual Copper Demand (kt)



Source: IDTechEx

Accumulated Copper Demand Between 2020-2030 (kt)



Source: IDTechEx

SUBSTITUTION AND MINIATURIZATION

Copper continues to offer the best cost-performance combination for many of its applications—especially where high and efficient electrical conductivity is required, or where corrosion resistance, friction resistance or available space is limited. In 2020, net substitution stood at 0.95 percent of total global copper use, a slight increase from 0.83 percent in 2019. China, the largest demand market for copper, continues to benefit from the lowest net substitution across the world at 0.6 percent of total copper use. Low levels of material substitution present a promising view for the industry's future. As China, Europe, and the U.S. work to introduce more environmental regulations, research anticipates increased gains for copper in a wide variety of applications including electromobility, heat exchangers and transformers.

IMPACT OF COVID19

Neutral Impact

Utility Power Cables/Winding Wire in Transformers/Busbars

The upgrade of the electricity network continues to be an important objective and COVID19 has not significantly influences utility investments. Some even restocked at low copper price.

Equipment Wire/Winding Wire in Motors/Industrial Tubes/Electronic PSSF

The production of home, household and consumer appliances was remarkably stable during the pandemic. For example, the residential aircon market was growing in 2020 as people installed aircons not only in the bedroom but also in other rooms where they worked. However, as consumers' available income might decline, price-driven substitution might increase in near future.

External and Internal Telecommunication and Data Cables

COVID19 has only limited impact on the telecommunication network, substitution by optical fiber and 5G continues. Installations of optical fiber in the homes might be slowed down by 2020.

Slightly Negative

Industry Power Cables/Winding Wire in Transformers/Other Winding Wires/Busbars/Industrial Motors/Casting

COVID19 has impacted industrial demand based on limited demand/supply/labor but it quickly rebounded. If negative economic climate and budget pressure continue, these can lead to delayed projects and increased substitution.

Negative

Building Wire/Architectural PSSF/Bare Wire/Plumbing Tube

Commercial construction was seriously impacted by COVID19 leading to budget pressure and increased value engineering. This has and continues to have an impact on demand and substitution of copper products.

Automotive Wires/Casting

Automotive sales plummeted during 2020, and OEMs do not expect any sharp recovery in 2021. Also the restricted supply of semiconductors from China impacts automotive production. We expect further substitution to reduce costs, especially in India, China and the U.S.

Source: DMM Advisory

COPPER SUBSTITUTION & MINIATURIZATION

In kt and % of Copper Use in 2020 - 2025

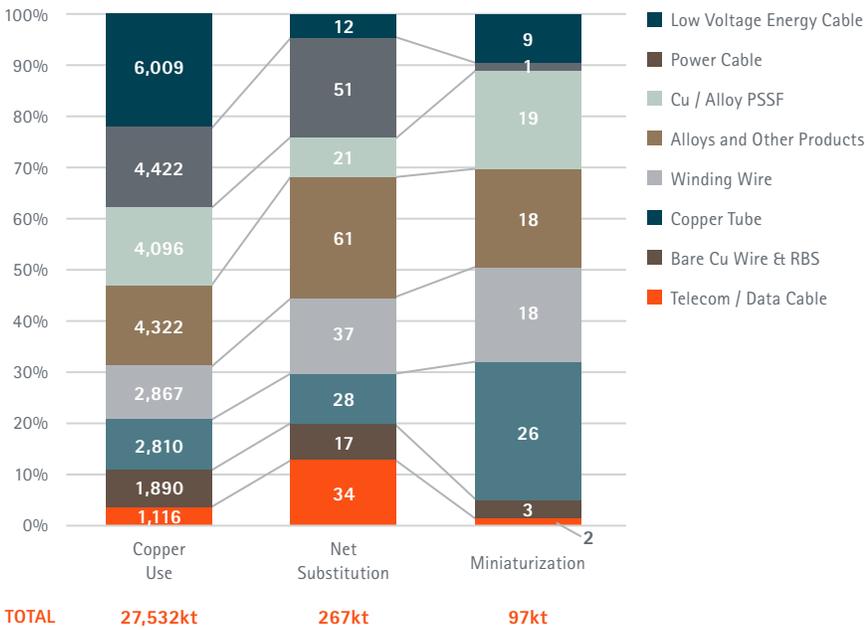


Source: DMM Advisory

*Forecast

COPPER USE, NET SUBSTITUTION AND THE MINIATURIZATION

By Copper Products in % of Total in 2020

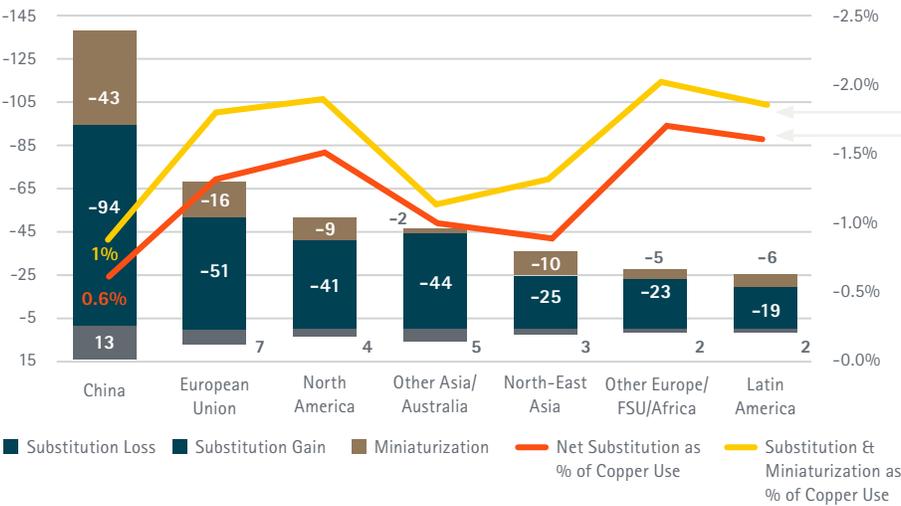


Source: DMM Advisory



SUBSTITUTION AND MINIATURIZATION BY GEOGRAPHIC REGIONS

In kt and % of Copper Use in 2020



North America has a relatively high Net Substitution as % of Copper Use driven by strong local cost focus.

China's Net Substitution as % of Copper Use is at 0.6%, the lowest across all regions.

Source: DMM Advisory



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