



INTERNATIONAL MOLYBDENUM ASSOCIATION  
THE VOICE OF THE MOLYBDENUM INDUSTRY



# 2021 / 2022 ANNUAL REVIEW

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# IMOA ANNUAL REVIEW

Overview from the Secretary-General



Eva Model  
Secretary-General

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Duplex stainless steel superstructure on the four Söderströms rail bridges, Stockholm, provides strength and corrosion resistance to outlast 120-year design life. © Lars Hamrebjörk

## A year of resilience and opportunities

The pandemic has tested us all and continues to do so as the world learns to live with Covid-19. Since taking the helm as IMOA's Secretary-General a year ago, it has been impressive to see how our members have adapted their working practices and the resilience they have shown in keeping the wheels of the molybdenum industry turning. As the world began to open up, there was equal tenacity being demonstrated in the general response to the need to ramp up production to meet demand. However, in terms of molybdenum, production has not kept pace with increasing demand over the past year.

It is encouraging to see that many markets have returned to pre-pandemic levels in terms of demand, however, world events, such as the war in Ukraine, are causing uncertainties with price rises seen in metal commodities, energy and foods affecting the entire industry supply chain through to consumers. Rising inflation and increased energy prices will undoubtedly challenge the industry further.

As discussed at our new, successful *In Focus* webinar series and in IMOA authored articles, there are many exciting opportunities on the horizon which are likely to lead to an increase in demand for molybdenum. For example, molybdenum alloying is particularly valuable to special steels used in wind power generation. Due to the growth of the sector and the increasing size and power output of wind turbines, such special steels are reaching high tonnages. The potential molybdenum use, based on likely wind power capacity scenarios, is estimated to amount to 300,000 metric tons by 2050.

## Responsible sourcing is high on the agenda

Societal expectations are changing. More and more, stakeholders are pushing for companies to implement and verify responsible sourcing practices. Operators in the molybdenum industry are no exception. Responsible sourcing site certification for producers and processors of raw materials is increasingly in focus.

**“The newly published Molybdenum Profile is helping stakeholders to better understand the mine-to-market supply chain.”**

## Molybdenum market demand on the horizon

SMR predicts that over the next 10 years the chemical processing industry and the oil and gas industry will be significant growth areas for molybdenum demand. Transport vehicle production with stainless steel bipolar plates (BPP) containing 2% moly is forecasted to be the main technology in the future for hydrogen fuel cells. While these will be used in electric vehicles and buses, the main demand is expected to be in the truck sector.

IMOIA recognizes the importance of responsible sourcing and is striving to ensure we offer effective options for our members to help them respond to increasing market and regulatory demands in this area.

I am pleased to report that since its launch in September 2020, the IMOIA-led responsible sourcing program has gathered significant momentum. As well as awareness raising webinars, we have worked with TDi Sustainability to publish a Molybdenum Profile. This is helping stakeholders to better understand the mine-to-market supply chain.

By the end of 2021, we were the first metal association to begin collaborating with Copper Mark with the aim of developing a molybdenum specific option for responsible sourcing accreditation. Copper Mark offers our molybdenum-producing members the option to access a credible assurance framework with an already established set of criteria that can be readily adapted to the molybdenum supply chain.

## Exciting market development results

The aim of our market development work, led by technical director Dr Nicole Kinsman, is to expand existing uses of molybdenum and develop new ones. A great example of this is the work we do with Professor Hardy Mohrbacher on the discovery of new metallurgical functionalities of molybdenum which are hugely beneficial for automotive, structural, line pipe and special steel applications.

These discoveries lead to new molybdenum-containing grades of steel being immediately put into production and brought to market. For instance, this year a newly developed heavy gauge 1500 MPa press hardened steel (PHS) for truck components gained traction with a truck equipment manufacturer in Brazil. After qualification testing, the company began using the new Mo-containing components in some of their products for heavy trucks. The development of 'Super-HSLA' steel for thin cold-rolled and galvanized steel sheet in automotive body applications also continues to progress and bear fruit.

Following many years of work and support from IMOA consultants, in conjunction with Team Stainless and a number of steel makers, the first mainstream US structural stainless steel design standards were published by the American Institute of Steel Construction (AISC) in September 2021. The availability of the new design standard removes significant obstacles for structural stainless steel designs and expands global market potential for both austenitic and duplex stainless steels. IMOA-co-sponsored research has also contributed to the design of a pioneering modular, prefabricated stainless steel footbridge for railway stations developed in the UK. The bridge with its duplex stainless steel frame is easily replicated and has potential for adoption both across the UK and around the world.

## Maintaining access to markets

Sandra Carey leads the HSE work on behalf of IMOA. Sandra and the team continue to work tirelessly to secure continued access to markets for members, using rigorous

scientific evidence to support appropriate regulation setting and chemical management.

Increasingly diverse HSE workstreams, range from biological hazard endpoint testing and risk assessment to enable appropriate safeguarding from exposure in the workplace and the environment; through regulatory dialogue about Mo standards-setting; to the recent market-driven interest for embodied carbon (GWP) data about molybdenum products. The latter plugs into the EU Stainless Steel Low-Carbon Production Roadmap and ResponsibleSteel initiatives to attain climate change carbon-reduction goals. Chemicals management legislation data-sharing needs continue to expand, from EU REACH, to Korea-REACH, UK-REACH and most recently Türkiye-REACH. These link into our core MoCon dossier-updating activity to maintain EU regulatory compliance, and therefore market access, for the twelve molybdenum substances in the MoCon portfolio, with all twelve dossiers updated in 2021.

## Expanding communication channels with members

The IMOA team understands the importance members place on being kept informed about IMOA activities and trends shaping the industry. This is why we implemented a new series of *In Focus* webinars. I was heartened to see around 300 members join our six webinar events on topical issues including responsible sourcing, molybdenum end-use market updates and Prop 65 California legislation.

Our media outreach program continues to deliver our messaging globally with over ten IMOA authored articles appearing in trade media publications, reaching an audience of over 125,000. We receive very positive feedback from editors about the quality and content of our articles.

I am personally a great advocate of social media and see great potential for broadening our reach, particularly through LinkedIn. We have increased our social media presence this year by over 30% globally, and by 17% in China. Our regular posts promoting the benefits of molybdenum, as well as IMOA's work, continue to be well received by followers. If you are not following our social media pages, I would encourage you to do so.

## Growing our membership

I am pleased to report on-going interest and an increase in membership this year which we are putting forward for ratification in September 2022 at the AGM.





**“The Mont St Michel sluice gates use molybdenum-containing duplex stainless steel.”**

Over the last year, I have listened carefully to you, our members, to better understand what you perceive as the greater value received from IMOA to ensure we continue to deliver what members need. I have also communicated with numerous mine-to-market non-members, ensuring they understand the benefits of joining IMOA, and hopefully some will make the decision to join over time.

What is clear is that members value market information, support to respond to increased demands around responsible sourcing, and the HSE and Market Development work we do to grow and protect access to markets. As we enter a new strategic planning phase in 2023, we will ensure the views of our members are canvassed before we agree a new operational plan.

Our door is always open, and we always wish to hear your thoughts and feedback. We will continue to work hard to encourage new members to join us.

Joining IMOA felt a little like ‘coming home’ as molybdenum has been such a huge part of my working career and in previous member roles, I was also fortunate enough to support IMOA not only at ExCo level but also as IMOA’s President for a two-year period. Now in the role of IMOA’s Secretary-General, I and the IMOA team are looking forward to further building on the successes achieved and benefits provided to our members.

Over the last year, I have been incredibly grateful for the support of my knowledgeable and experienced IMOA team colleagues: Sandra, Nicole, Jo, Cristina and Karlee. They are key to the success of the Association and have supported me ‘to hit the ground running’. The support of our expert consultants and service providers is likewise invaluable to deliver a seamless service to our members. Finally, I would like to thank the Executive Committee and our members for their support and guidance, which has been crucial as I have navigated my first year at the helm.

# THIS YEAR'S HIGHLIGHTS

HSE/MoCon

## **Regulatory dialogue seeking appropriate regulation setting and chemical management:**

**LCI embodied carbon numbers generated**  
and disseminated for RMC in powder, RMC in briquettes,  
and ferromolybdenum.

**US ACGIH:  
data submission**  
re occupational exposure  
to soluble/insoluble Mo.

**Illinois state USA:**  
**oral testimony given** re proposed  
**Mo limit value in groundwater.**

**German MAK Commission:**  
data submission re **MoS<sub>2</sub>**  
potential Occupational Exposure  
Limit setting.

**US ATSDR:**  
**benchmark dose data generated**  
to demonstrate **unwarranted** ATSDR modifying  
factor used in risk assessment.

## **Regulatory compliance to ensure continued access to markets:**

**MoCon funding call target achieved**  
with **all types of co-registrants** contributing to  
financing the work program.

**Fulfilled ECHA data requirement**  
for 1st species prenatal  
developmental toxicity, resulting in  
**no hazard classification.**

**12** **EU REACH Regulation: Updated all**  
Molybdenum Consortium technical dossiers.

California state USA –  
**IMOA awareness-raising webinar**  
about requirements & consequences of  
**MoO<sub>3</sub> Proposition 65 Listing.**

**MEED project 2021–23**  
participation, updating EU regional  
**Mo exposure monitoring** data.

## Membership

**64** members around the globe including 3 new members being ratified at the 2022 AGM.



## Existing membership

represents **95%** of production outside China, CIS and Mongolia.

## Market Development

**Promoting the advantages of molybdenum-containing alloys in a range of applications:**

**5** Peer-reviewed publications appeared in leading international journals discussing the benefits of molybdenum alloying in **1000 MPa** direct-quenchable heavy plate steel.

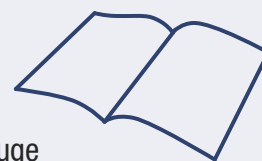
Updated **Austenitic Fabrication brochure** was published in **German**.

Our **webinars** and **conference contributions** reached over

**5,000** attendees.



**2** important heavy gauge **structural stainless steel standards**, developed with IMOA support, published by the American Institute of Steel Construction (AISC).



## Communications

**Raising awareness of molybdenum's unique properties and sustainability credentials:**

Around **300** members attended six exclusive IMOA ***In Focus*** webinars.



Over **3,700** **WeChat** followers.



**10** IMOA authored articles in **trade media publications** reached an audience of over **125,000**.

**33%** increase in **LinkedIn** followers.





# HEALTH, SAFETY AND ENVIRONMENT

Key Activities and Achievements in 2021/2022



Sandra Carey  
IMOA HSE Executive





## IMOA HSE Committee activities

Our HSE Secretariat, with the support of our expert Committee, works tirelessly to secure continued access to markets for members, using rigorous scientific evidence to support appropriate regulation setting and chemical management.

### Embodied carbon in molybdenum products

The UN Climate Change Conference (COP 26) in November 2021, recognized the urgency of addressing global warming to avoid climate catastrophe. Industry is tasked with reducing the carbon footprint of its products,

and implementing carbon-reduction plans. Reducing embodied carbon is an essential goal in the challenge to decarbonize and achieve carbon neutrality by 2050.

Consequently, IMOA received requests early in 2022 through initiatives such as ResponsibleSteel and the Eurofer Stainless Steel Roadmap group for embodied carbon numbers (also known as global warming potential, or carbon footprint) for molybdenum in *metallurgical products*. This means for roasted molybdenite concentrate in powder form and briquette form, and in ferromolybdenum. Fortunately, greenhouse gas data is collected during our five-yearly LCI data-gathering activities, enabling us to share data promptly with the IMOA membership and others.

**“Our priority is pursuing product stewardship excellence in relation to human health and the environment.”**



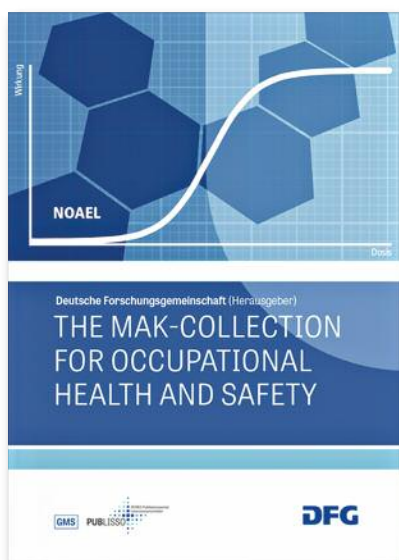


We are planning a refresh of IMOA's Molybdenum Chemicals Life Cycle Inventory in 2023, to generate up-to-date carbon footprint data for molybdenum products used in chemical applications, such as pure molybdenum trioxide, ammonium dimolybdate or heptamolybdate, etc. We also continue to respond to an increasing number of worldwide requests for our LCI datasets, from industry and science-focused academia.

## Safeguarding human health

A constant IMOA priority is pursuing excellence in product stewardship knowledge and practices with regard to human health. On the one hand this means working to ensure the prescribed OECD-protocol compliant test data is generated and available for hazard and risk assessment of key molybdenum products of interest to our membership. On the other hand, it means ensuring the data and assessment methodologies are available for independent assessment by national regulatory bodies. During the year, we proactively interacted with the following:

**German MAK Commission:** We submitted datasets and references about molybdenum disulfide ( $\text{MoS}_2$ ) when the substance appeared on a list of chemicals which the MAK Commission may decide during 2022/23 to hazard and risk assess to propose an Occupational Exposure Limit (OEL) for the substance in the workplace. The MAK Commission is a scientific body whose proposed OELs are often implemented in German legislation, and cited in the GESTIS database which is widely used in Europe and beyond.



**US ACGIH:** The American Conference of Governmental Industrial Hygienists (ACGIH) determines Threshold Limit Values (TLVs) for soluble and insoluble molybdenum compounds to protect those in the industrial workplace.

We contributed data and references in May 2022. Although the ACGIH is not a US government agency, their TLVs are widely adopted and implemented by industry to safeguard worker health.



**Key aspects of hazard and risk assessment**

**OECD capacity building workshops:** Together with several other metal trade associations, and coordinated by the International Council on Mining and Metals, IMOA is co-sponsoring a series of online workshops aiming to share hazard and risk assessment methodologies specific to metals/compounds with regulatory agencies in the Far East. This awareness-raising exercise benefits all parties as more and more Far Eastern countries e.g. Vietnam, Thailand, Indonesia, ramp up to design and implement chemicals management legislation to safeguard human health and the environment.

**US ATSDR:** The American Agency for Toxic Substances & Disease Registry (ATSDR) published an extensive Toxicological Profile for Molybdenum in 2020. While it contains high-caliber content, IMOA cannot endorse the 'so called' modifying factor of three (MF3) which ATSDR included as an additional assessment/safety factor when determining the Oral Intermediate duration Minimal Risk Level (MRL). We initially raised our concerns in writing and have followed up with a further scientific assessment that involved calculating the Benchmark Dose (BMD). The BMD demonstrates that a safety factor of 3 is already included in the ATSDR MRL base calculation, and that therefore applying a further MF3 is unwarranted. We have requested that ATSDR review and revise the Profile accordingly at the earliest opportunity, and are awaiting their response.

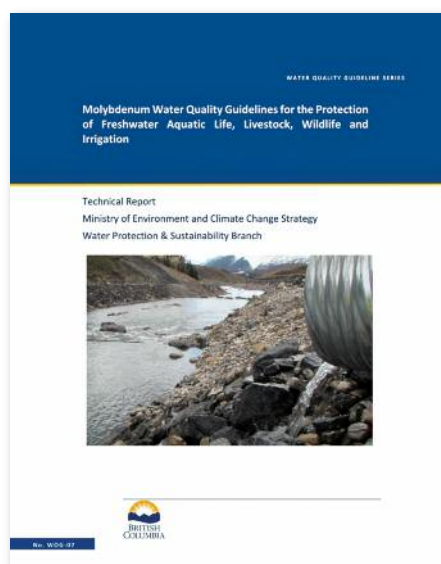


**Endocrine disruption** is a data-hungry toxicological impact endpoint being implemented into chemicals management legislation (e.g. EU REACH, EU CLP, assessments by Canadian and US agencies). IMOA is drafting a manuscript for peer-reviewed publication about molybdenum and this human health endpoint.

Environment-focused activities over the last year include our participation in several ETAP projects. The Environmental Toxicology Advisory Panel, supported by several metal trade associations including Al, Cu, Co, Mo, Ni, Pb and Zn, focuses on cutting-edge scientific issues. One of the projects co-sponsored by IMOA is a peer-reviewed publication about the critically important difference, especially for essential trace elements like molybdenum and zinc, between normal *endocrine modulation* and adverse *endocrine disruption*. It is very important to highlight this difference and raise-awareness about it at a regulatory level so that this endpoint is proportionately included in chemicals management data requirements.

## Mo water quality standards

In *Canada* in September 2021, British Columbia confirmed its finalized chronic long-term Mo water quality guideline for the protection of the freshwater aquatic environment of 5.1 mg Mo/L, which is a 70-fold increase from the 0.073 mg Mo/L value previously in force since 1986. The 2021 value is based almost exclusively on the IMOA molybdate effects dataset.



We continue to interact with *Illinois EPA* and the Illinois Pollution Control Board, whose 2021 water quality standard proposal for molybdenum in groundwater cites an exceedingly low value of 0.019 mg Mo/L because it is based on a highly outdated US IRIS dataset and a calculation methodology that uses the daily water intake of children up to six years old as a starting point instead of an adult

intake. IMOA follow-up includes a 2021 written submission, providing testimony at a hearing, and participation in online conference calls in our quest for an appropriately proportionate rule-making.



## Looking ahead

A project seeking to investigate the cellular impact of molybdate is in the pipeline. Similarly, an independent expert assessment of the available human health toxicological data is planned and intended as a 'shadow IRIS' assessment. This is much needed since the existing US IRIS toxicology database was last updated for molybdenum in 1992, and therefore excludes all the extensive robust toxicology generated over the last 30 years, yet despite this IRIS still remains a primary data source for US Agencies when assessing molybdenum in human health.

We continue to service data-sharing requests for hazard and risk assessments, which now include UK-REACH and Türkiye-REACH as well as Korea-REACH.

November 2021 saw the start of a new service for the IMOA membership: holding single-topic HSE webinars, including one about the hazard classification and labeling impact of the March 2022 Proposition 65 listing of molybdenum trioxide as 'Known to the state of California to cause cancer'. The next planned topic is about the EU SDS Updating Regulation requiring changes to SDSs by December 2022, and the updated SDS templates that IMOA is consequently preparing, to facilitate compliance for the IMOA membership.

## MOLYNEWS

2 November 2021

**Tuesday 9 November**  
**IMOA Webinar 'Save the Date'**

Don't be caught out by the California Proposition 65 legislation!

The HSE and MoCon activities featured in this and the next section are managed and driven forward by the corporate members of the HSE Committee and MoCon Technical Working Group, the HSE Executive and our invaluable technical service providers. We are immensely grateful for their continued dedication and professionalism.

# EU REACH Molybdenum Consortium (MoCon)

2022 marks 12 years of the Consortium continuing to service the core requirement of its members, and MoCon Letter of Access holders, which is to maintain regulatory compliance of its twelve EU REACH technical dossiers. This compliance ensures continued commercial access to EU markets for all manufacturing and importing co-registrants of MoCon REACH-registered chemical substances.

Prior to 2010, MoCon invested four years gathering and generating extensive scientific datasets, enabling it to conduct the substance hazard and risk assessments required by the EU REACH Regulation No. 1907/2006. MoCon continues its regulatory compliance function as the REACH Regulation continues to evolve by adding new scientific data requirements, such as the upcoming Endocrine Disruptor hazard category endpoint, and the Mixture Assessment Factor for health and environment protection against exposure to combinations of chemicals.

## EU REACH Review

The ongoing 2021–22 REACH Review by the European Chemicals Agency (ECHA) and EU Commission will bring about significant changes to the REACH Regulation and its data compliance requirements. The REACH Review includes a series of Open Public Consultations (OPCs) where industry and EU community members are encouraged to submit their views about proposed REACH regulatory enhancements. MoCon has contributed to several OPCs including increasing registration requirements, data generation parameters, and the evaluation process. Multiple OPC submissions have been coordinated and submitted during the first half of 2022 by Eurometaux, the accredited stakeholder representative for the non-ferrous industry sector, in efforts to secure workability and proportionality.

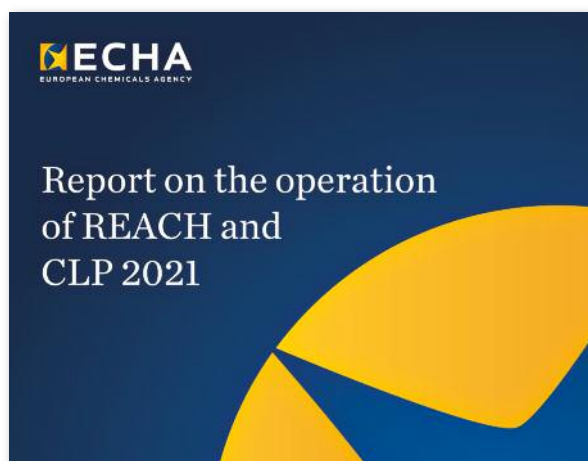
Looking beyond increased data requirements for ED, neuro and immunotox endpoints, other noteworthy REACH Review areas include how to strengthen full compliance of registration dossiers, and likewise increased and more equal treatment across EU Member State national enforcement agencies against companies in breach of the regulation. After a severe in-person-visit downturn during the first Covid-19 years 2020–early 2022, industry can expect more REACH compliance inspections by national enforcement agencies in the coming months and years.



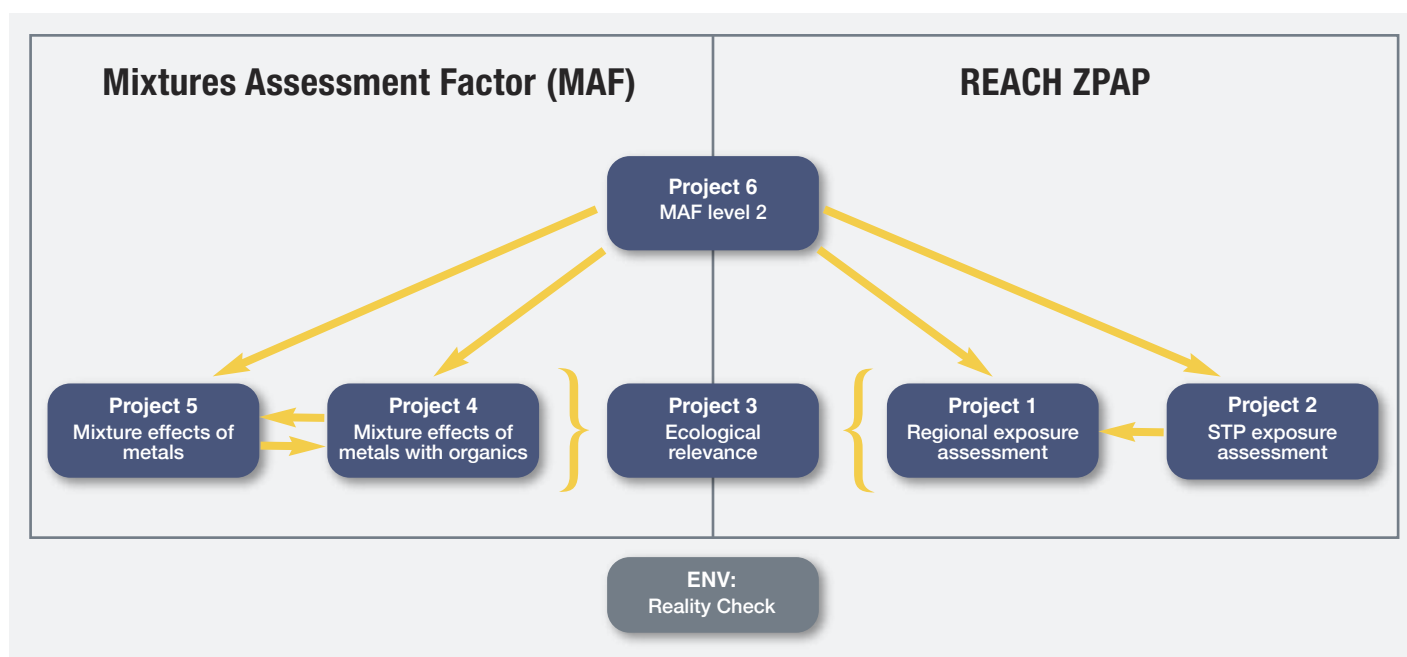
The EU policymaking cycle

## MEED Project

In early 2022, MoCon signed up to the Metals Environmental Data-Gathering (MEED) project, which comprises six data-gathering/analysis sub-projects that are necessary for the continued compliance with REACH environmental exposure assessments about chemical substance emissions quantification, risk control and minimization. Emissions, which come within REACH environmental exposure scope, include: chemicals into water bodies; airborne deposition onto arable and grazing lands; diffuse emissions into the environment from urban or road run-off; chemical influents to municipal sewage treatment plants and land application of resulting effluents as fertilizer. In terms of multi-consortia cooperation, MEED is the successor to the 2018–2021 Metals and Inorganics Sectoral Approach (MISA) collaborative program between industry and ECHA. MoCon also participated in MISA, delivering early in 2019, on the dossier-updating activities it had committed to undertake. Cost and resource efficiencies are always gained when multiple REACH Consortia work together to generate and risk assess datasets, and this has prompted 24 metals Consortia to participate in MEED, which will run for three years, at a per Consortia cost of ca. Euros 15K/year. Eurometaux is the chief coordinator of the six MEED projects.







## MEED project interlinkages and scope of application

Project 1 is of particular interest to MoCon and is due to start in the second half of 2022: molybdate measurement and data-gathering to then update the Regional Environmental Exposure Datasets. This multi-metal project will be led by ARCHE Consulting, MoCon's environmental technical support providers since 2006, and who are therefore already well-versed in all molybdate matters.

The outcomes to-date of Projects 6 and 5, have been very useful to determine that molybdate is unlikely to be an *Inorganic-Priority Contributing Substance* (i-PCS) in either the water or soil compartments. This is important because i-PCSs will receive most ECHA scrutiny in the future. An i-PCS is a chemical substance more prevalent in

environmental emissions that has the greatest potential for unintended co-occurrence and combination with other chemical substances. This could give rise to mixed chemicals exposure which may have a negative impact on human health and the environment.

Safeguarding human health and the environment against exposure to adverse (eco)toxicological effects from *combinations* of chemicals, is one of the areas that the REACH Revision is firmly moving into. It is seeking to minimize (eco)toxicological impacts by introducing a Mixture Assessment Factor, where the likely default number is 10, but there are advocates for that number to be as high as 100. The higher the number the more the operational constraints, e.g. on environmental permitting, unless no-contribution-to-risk in local and regional exposure scenarios can be demonstrated. This reflects the importance of Projects 6 and 5 in determining the likely i-PCS chemical substances, and equally the importance of Project 1 in generating up-to-date molybdate measurements for accurate environmental exposure assessment.

## MEED assessment of likely Inorganic-Priority Contributing Substances:

Freshwater	
Likely	Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, V, W, Zn
Unlikely	Al, B, Ce, Fe, Gd, Ge, In, La, <b>Mo</b> , Sb, Ti
Soils	
Likely	As, B, Cr, Hg, Li, Mn, Ni, Se, V
Maybe	Cd, Co, Cu, Pb, Zn, Zr
Unlikely	Ag, Al, Ce, Fe, Ge, In, <b>Mo</b> , Pb, Sb, Te

Work is also progressing on Project 4, about mixture effects of metals with *organics*, to assess which metals are likely priorities for risk situation co-occurrence with *Organic-Priority Contributing Substances* (o-PCS). Encouragingly, initial data indicates that molybdenum (molybdate) is one of just three metals (B, Mo, Ag) participating in MEED that are *not* occurring in any risk situations in the water or soil compartments with an o-PCS. By way of comparison, 9 metals co-occurred with more than 10 o-PCS in mixture risk situations: Zn, Mn, Cu, Co, Ni, As, Ba, Cd, Hg.



© iStock.com/Henry Arden

**“Molybdenum is a bio-essential trace nutrient for humans, plants and animals.”**

## Soil Health Law

The EU Soil Strategy, adopted in November 2021, includes a Soil Health Law, likely to come into force in 2023. The MEED project outcomes about soils will feed into additional REACH (and other EU legislative) compliance requirements that will be introduced to implement and enforce the soil strategy. EU announcements indicate that the latter ‘sets out a framework and concrete measures for protecting, restoring and sustainably using soils and that mobilizes the necessary societal engagement and financial resources, shared knowledge, sustainable practices and monitoring to reach common objectives. The strategy is closely linked and works in synergy with the other EU policies stemming from the European Green Deal and will underpin our ambition for global action on soil at international level.... achievable through a combination of new voluntary and legally binding measures.’

Metals Consortia including MoCon, via Eurometaux, are currently working to ensure that natural background concentrations and the bioavailability of metals will be taken into account when ‘Clean Soil Outlook Reports’ are generated in the future.

## 1st Species Prenatal Developmental Toxicity (PNDT)

This toxicological endpoint was a key focus of MoCon’s Technical Working Group during 2020-2021 as we strove to provide additional data to ECHA, beyond our original 2013 1st species PNDT study submission. After almost a decade of interaction about this endpoint, we received confirmation from ECHA in September 2021 that MoCon has now ‘met the information requirement’. No hazard classification is required for this endpoint for MoCon substances, which is an excellent outcome.



## 2021 dossier updates

The completion of our work on the 1st species PNDT endpoint meant that MoCon could proceed to update all of its twelve REACH technical dossiers. This task was completed by each Lead Registrant (LR) submitting their MoCon-prepared, updated REACH dossier, by December 2021. All co-registrants of MoCon substances, i.e. MoCon members and Letter of Access holders, were informed about the LR dossier updates. They were also provided with the updated Chemical Safety Reports, and encouraged to review their own co-registrations in case any of the newly added data required an update of their co-registrant dossier in line with the 2020 Implementing Regulation on the Duties placed on Registrants to update their REACH Registrations. MoCon also provided guidance on how to approach such a review.

## MoCon funding

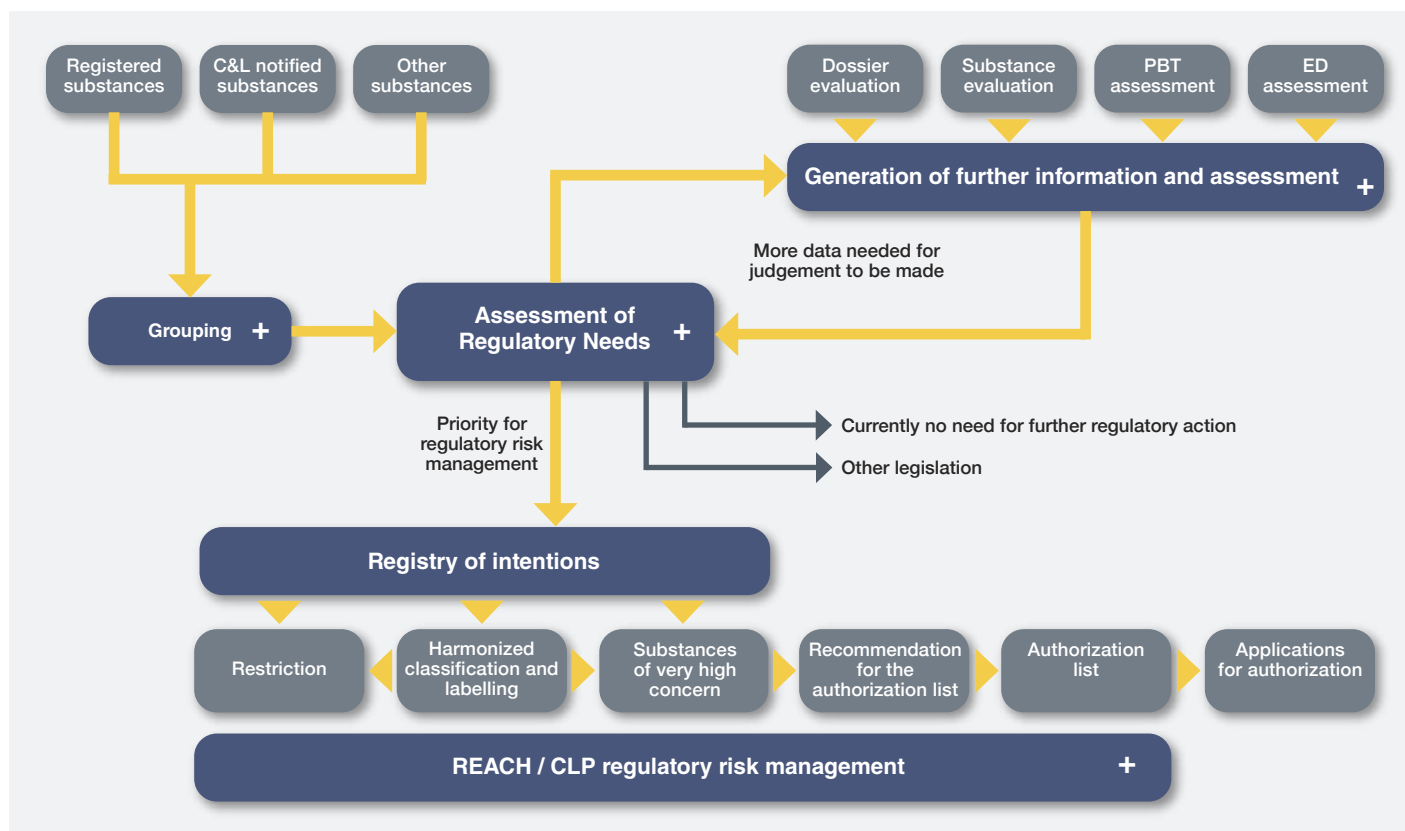
By April 2022, MoCon Secretariat had achieved a payment rate of 98.2% (US\$704K) against the MoCon 2020 funding round, enabling MoCon to continue its work to maintain regulatory compliance of its EU REACH technical dossiers. 100% of MoCon member registrants paid their invoices, while only a handful of LoA holders remain outstanding. The MoCon Steering Committee decides annually whether a further funding round will be triggered.

## Looking ahead

ECHA recently introduced a 'voluntary mechanism' for the Assessment of Regulatory Needs (ARN), a process whereby it groups together chemical substances it considers are sufficiently structurally similar, to assess them for the likelihood of requiring further ECHA regulatory scrutiny/ measures. (Their grouping does not particularly take into account how and why industry has grouped substances, as explained in the industry read-across rationale documents within the technical dossiers). Output from the ARN process is a report of likely future regulatory risk management requirements, published in the PACT section of the ECHA website. ECHA has implemented ARN as it seeks to meet its political commitment to screen all EU REACH registered substances (ca. 23,000 across ca. 102,500 registrations) by 2027.

April 2022 ECHA documentation indicates that all MoCon substances are *already* undergoing the ARN process. The outcome will significantly shape our understanding, both technically and financially, of the future resources needed to maintain regulatory compliance of the EU REACH MoCon technical dossiers. From that perspective the ARN process can be viewed as a positive step forward.

### EU REACH – Assessment of Regulatory Needs process diagram







# MARKET DEVELOPMENT

Key Activities and Achievements in 2021/2022



Dr Nicole Kinsman  
IMOA Technical Director





The ongoing pandemic and ensuing logistical, social, and economic challenges tested us all in 2021/22. A major positive change has been the expansion of IMOA's educational program to more people, in more parts of the world. The need to record sessions virtually offers on-demand capabilities and the support of subtitles for greater accessibility, all while being more cost-effective than traditional live sessions. Overall, we reached more than 5,000 people in some 40 events, including 22 webinars and 17 conferences.

## Carbon Steels

Professor Hardy Mohrbacher conducted webinars and online meetings, disseminating the results of IMOA research projects, including newly discovered metallurgical functionalities of molybdenum beneficial to automotive, structural, line pipe, and special steel applications.

**“We explore and highlight molybdenum’s endless possibilities.”**



© Nant de Drance, Sébastien Moret

## Flat steel development

Hardy has guided an effort to develop a new heavy gauge 1500 MPa press hardening steel (PHS) for truck applications since 2016. After qualification testing, a Brazilian company began production of components in the new grade, confirming the success of this multi-year initiative. The process was demonstrated to a group of local truck original equipment manufacturers (OEMs). Moreover, a paper published in the widely influential journal, *Metals*, describes how laser-welded sheets of this 0.15% molybdenum-containing steel had significantly better fatigue performance than the Mo-free standard 22MnB5 steel.

The development of 'Super-HSLA' (high strength low alloy) steel for thin cold-rolled and galvanized steel sheet in automotive body applications continues to progress swiftly. A leading European steel maker cold rolled the hot strip, containing 0.15% molybdenum, and verified different heat treating scenarios. The molybdenum addition delivers





© Copyright BMW AG,  
München (Deutschland)

**“We focus on steel applications  
in cars and trucks.”**

up to 100 MPa of additional strength without sacrificing ductility. The processing behavior is also very robust. The high achieved yield strength levels of 700–800 MPa, can compete with state-of-the-art dual phase steels. However, super HSLA steels offer a significant cost advantage and excellent weldability and local formability, needed for bending or profiling. Similar developments of advanced HSLA steels are ongoing at several mini mills in North America.

The development of hot rolled steel grades in the 1000–1200 MPa strength range with another leading European steel maker uses molybdenum additions between 0.15 and 0.30%. These steels simultaneously aim at good global and local formability. While the target strength has been achieved, the formability properties still require further improvement. Molybdenum additions towards the higher end of the range are expected to enhance formability.

### Special steel developments

Molybdenum alloying is particularly valuable to special steels used in wind power generation. Due to the growth of

the sector and the increasing size and power output of wind turbines, such special steels are reaching high tonnages. The potential molybdenum use, based on likely wind power capacity scenarios, was estimated to amount to 300,000 metric tons by 2050. A MolyReview article details Hardy Mohrbacher's estimation based on International Energy Agency (IEA) data.

### Webinars and presentations

Over the past year, the webinars and online conference presentations given by Hardy reached an audience of nearly 1,000. He discussed the fatigue performance results of the heavy-gage PHS for trucking components at the Automotive Circle European Joining in Car Body Engineering 2022 conference in Bad Nauheim, Germany. In the Materials in Car Body Conference by the same organizer, also in Germany, he presented on optimizing dual phase steels. He also spoke on alloy design and processing strategies for grain coarsening-resistant carburizing steels during the AIST International Conference on the Advances in Metallurgy of Long and Forged Products.



A video presentation on high strength steels for commercial vehicles was given at the 3rd International Truck Symposium organized by CITIC Metals in Beijing, China. Another paper summarized the results of IMO A projects with CEIT and Oulu University for the 13th CSM Steel Annual Conference. Finally, Hardy contributed to the JDC Molybdenum in Steel Symposium, further detailed in the 'Spotlight on China' section, with a presentation on molybdenum in heavy gage press hardening steel in commercial vehicles.

## Architecture, Building and Construction (ABC)

We continue to build on the success of our long running program promoting the benefits of molybdenum-containing stainless steel in ABC, jointly with the Nickel Institute.

### Delivering stainless steel workshops

IMO A consultant Catherine Houska developed eleven ABC courses, accredited by the American Institute of Architects (AIA), an organization that provides architects and engineers in both the US and partner countries with continuing education credit. During the past year, IMO A and the Nickel Institute also sponsored online workshops presented by Catherine in India, Singapore, and Malaysia.

## Alloy and stainless steel promotion in China

China remains the world's largest steel producer by far: its 2021 crude steel output exceeded one billion metric tons. Its global market share in the first four month of 2022 was 54%, despite a 10% year-on-year decrease in production.

With molybdenum use per ton of crude steel lower in China than other parts of the world, we focus on maintaining our engagement inside the country. This work is led by IMO A consultant Dr Gaetano Ronchi, and despite travel restrictions we maintained a strong presence through our skilled and reliable local team including Chen Chao, Chen Wenlei, Fabio Ries, and John Wu.

The Chinese steel industry continues the process of streamlining its production infrastructure and upgrading its technological capabilities to tackle overcapacity, high energy intensity, and carbon emissions. The focus of our webinars and presentations, which support the development of stronger, lighter, and thinner designs with superior welding properties and corrosion resistance, is well aligned with the technological ambitions of the Chinese steel industry. Despite organizers' focusing on returning the

industry to face-to-face meetings, many events were eventually postponed or canceled due to the pandemic.

## Molybdenum and steel symposiums

Following the successes of the inaugural Molybdenum and Steel Symposium in Shanghai in 2018 and the second event in Xian in December 2019, member company Jinduicheng (JDC) hosted a third conference in October 2021 in Jilin City, with IMO A as co-organizer. Eva Model gave an opening speech, introducing herself and highlighting IMO A's activities in China. Furthermore, IMO A arranged the delivery of four technical presentations discussing molybdenum in gray cast iron, press hardening steel components for commercial vehicles, high strength boron steels, and FGD (flue gas desulphurization). The fourth Molybdenum and Steel Symposium is planned for early November 2022.

## Stainless steel in China

Our ABC activities continued to support Chinese architects, designers, and curtain wall contractors in several building development projects, mainly focused on coastal cities in China's greater bay area (Shenzhen, Hong Kong, Zhuhai, Macau) as well as on Shanghai.

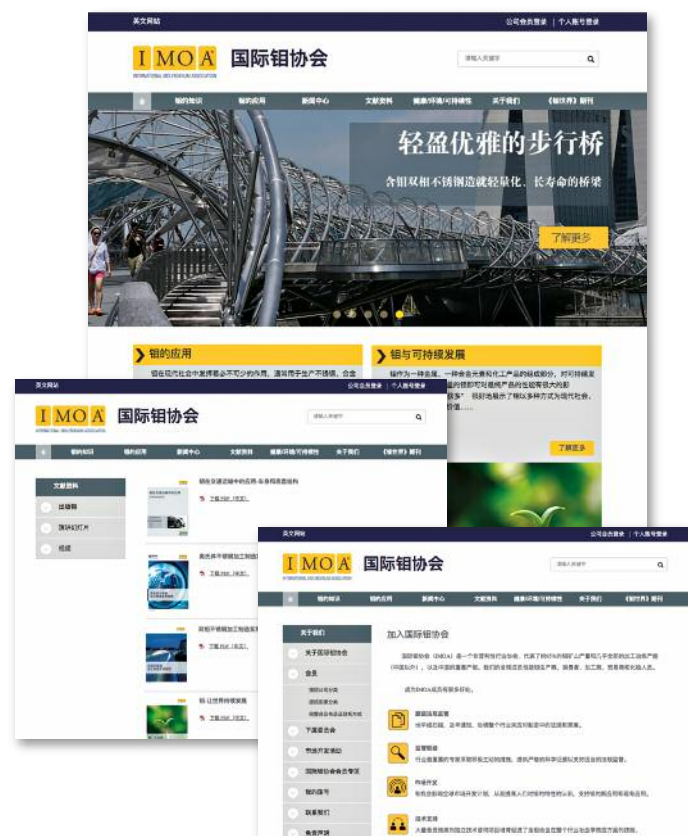


## High-performance stainless steels

At the 2021 Tianjin "Stainless Steel and Nickel Alloy Corrosion and Equipment Manufacturing Technology" Conference, co-organized by the Nickel Institute in July 2021, we delivered a presentation on manufacturing of high-performance stainless steel. An updated version of this presentation was presented at the 2021 Nanjing International Forum on Stainless Steel and Nickel Alloy Petrochemical Equipment Technology and Harsh Applications in November of 2021.

## Stainless steel in water distribution systems

In May of 2021, Donghua University organized the “International Forum on Stainless Steel Application Technology in Water Industry” in Wuxi with over 120 attendees. Fabio Ries delivered a successful presentation focused on the benefits of Type 316 stainless steel adoption. The countrywide overhaul of secondary water systems, which deliver clean drinking water to large multi-family apartment buildings, is expected to require at least five to six million metric tons of stainless steel over the next three to five years, with some 10 to 15% estimated to be Type 316 stainless steel. In September 2021, the 2nd Stainless Steel Pipe Conference, organized in Changzhou by the CSSC had 150 attendees and we delivered an upgraded version of this presentation.



## Chinese website launched

IMOA's Chinese language website, launched in August 2021, has been well received. The site, which features all IMOA Chinese-translated publications, complements IMOA's WeChat channel, which currently has over 3,700 followers. Visit the site for over 30 brochures and MolyReview issues, translated by subject-matter-expert, Chen Wenlei. <http://www.imoa-cn.info/>

## Team Stainless

Team Stainless is a collaboration of global trade associations involved in stainless steel and its alloying elements, such as molybdenum. Together with the Nickel Institute (NI), the International Chromium Development Association (ICDA) and the world stainless association, we pool resources to promote the benefits of stainless steels. IMOA is chairing Team Stainless in 2022 under the leadership of technical director, Nicole Kinsman.

## Stainless steel service lines

Worldwide, water utilities consistently lose 30–40% of treated drinking water, mostly in the last few meters of distribution. Some regions lose over 70% of this precious product. However, Type 316 stainless steel service lines, which transport drinking water from the water main to the meter, were proven to reduce leakage dramatically in Tokyo and Taipei. Team Stainless continues to promote these amazing results to the regions who need it most – those with water scarcity and seismic activity. A trial installation began in Malta in June 2022 – marking a first for Europe. Several Italian utilities have shown interest in conducting trials in the summer of 2022. What's more, an Italian producer is interested in potentially supplying the European region.

## Sustainable stainless steel

Since 2013, Catherine Houska has participated in the ASTM E60 Committee on Sustainability. She also has chaired the general sustainability standards subcommittee since 2015 with the support of Team Stainless. A new standard for evaluating recycled content in life cycle assessment has been finalized after a seven-year effort. Mark Mistry from the Nickel Institute leads this effort with Catherine Houska's support. Publication is expected late this summer.

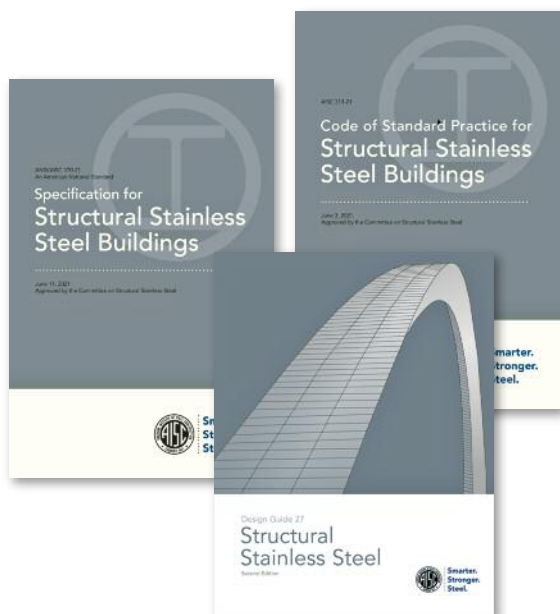
The new standard includes three frameworks for calculating recycled content credit. This publication fills an international standards gap, because the pre-existing ISO life cycle assessment (LCA) standards only provide one approach for calculating recycled content credit, which is not accurate for certain materials and therefore problematic. Due to the wide variety of materials that are recycled and the differences in their life cycles, more than one approach is necessary. Individual appendices provide the appropriate approach for each material. In addition to stainless steel, the correct methods for calculating recycling content for copper, glass, gypsum, plastics, and supplementary cementitious materials will be included.



A vertical stainless steel service line is being installed in a trench. The line is connected to a horizontal pipe at the bottom of the trench. The connection is made using a flange and a nut. The trench walls are made of reddish-brown soil. The stainless steel line has a corrugated section near the top. The horizontal pipe is dark and appears to be made of steel or cast iron. The connection point is secured with a large nut and a washer. The text "We support trial installations of stainless steel service lines at interested utilities." is overlaid on the image.

**“We support trial installations  
of stainless steel service  
lines at interested utilities.”**





## Structural market development

The first mainstream US structural stainless steel design standard, ANSI/AISC 370-21 *Specification for Structural Stainless Steel Buildings*, and its companion standard AISC 313-21 *Code of Standard Practice for Structural Stainless Steel Buildings*, which provides requirements for fabrication, handling, and erection for structural sections, were published by the American Institute of Steel Construction (AISC) in September 2021. The work on these standards, more than 12 years in the making, was sponsored by Team Stainless, AISC and several stainless steel producers.

IMOA consultants Nancy Baddoo and Francisco Meza of the Steel Construction Institute (SCI) in the UK played a leading role in drafting the new design rules. These rules are based on three decades of structural research from universities worldwide. The standard also includes specially-developed design guidelines that highlight the beneficial strain hardening characteristics of stainless steel, leading to substantial increases in member capacity and reduced costs. Catherine Houska was instrumental in the drafting of the Code of Standard Practice.

Published in May 2022, the Second Edition of AISC Design Guide 27 *Structural Stainless Steel* provides complementary design information and design tables for common structural sections. Ten examples are included in the Design Guide that lead designers through each step of the design process.

## Promotion of new structural standards

Two sessions were dedicated to structural stainless steel at the well-attended North American Steel Construction Conference (NASCC) in Denver, March 2022, to introduce designers to the new AISC standard. Nancy and Catherine each led a session. In May 2022, hundreds of designers also attended a three-part webinar series on structural

stainless steel organized by AISC. The conference sessions as well as the webinars have been recorded and are available in the AISC Education Archives.

The availability of the new design standard removes significant obstacles for structural stainless steel designs and expands global market potential for both austenitic and duplex stainless steels. AISC design standards have tremendous influence globally: these standards are used not only in the Americas, but also in the Middle East and for about 30% of all structural projects in China. What's more, the benefits of this standard's work are not limited to buildings and related structures: a forthcoming edition of the AISC *Specification for Safety-Related Steel Structures for Nuclear Facilities* is likely to reference these rules.

Also, work has begun with the American Association of State Highway and Transportation Officials (AASHTO) to develop a series of specifications (material, design, welding, etc.) for duplex stainless steel in highway, pedestrian, and rail bridges in the US. Duplex stainless steel is well suited to bridge structures because its high strength saves weight and its good corrosion resistance reduces maintenance, which can be very costly for bridges over railways and water, and in coastal areas.

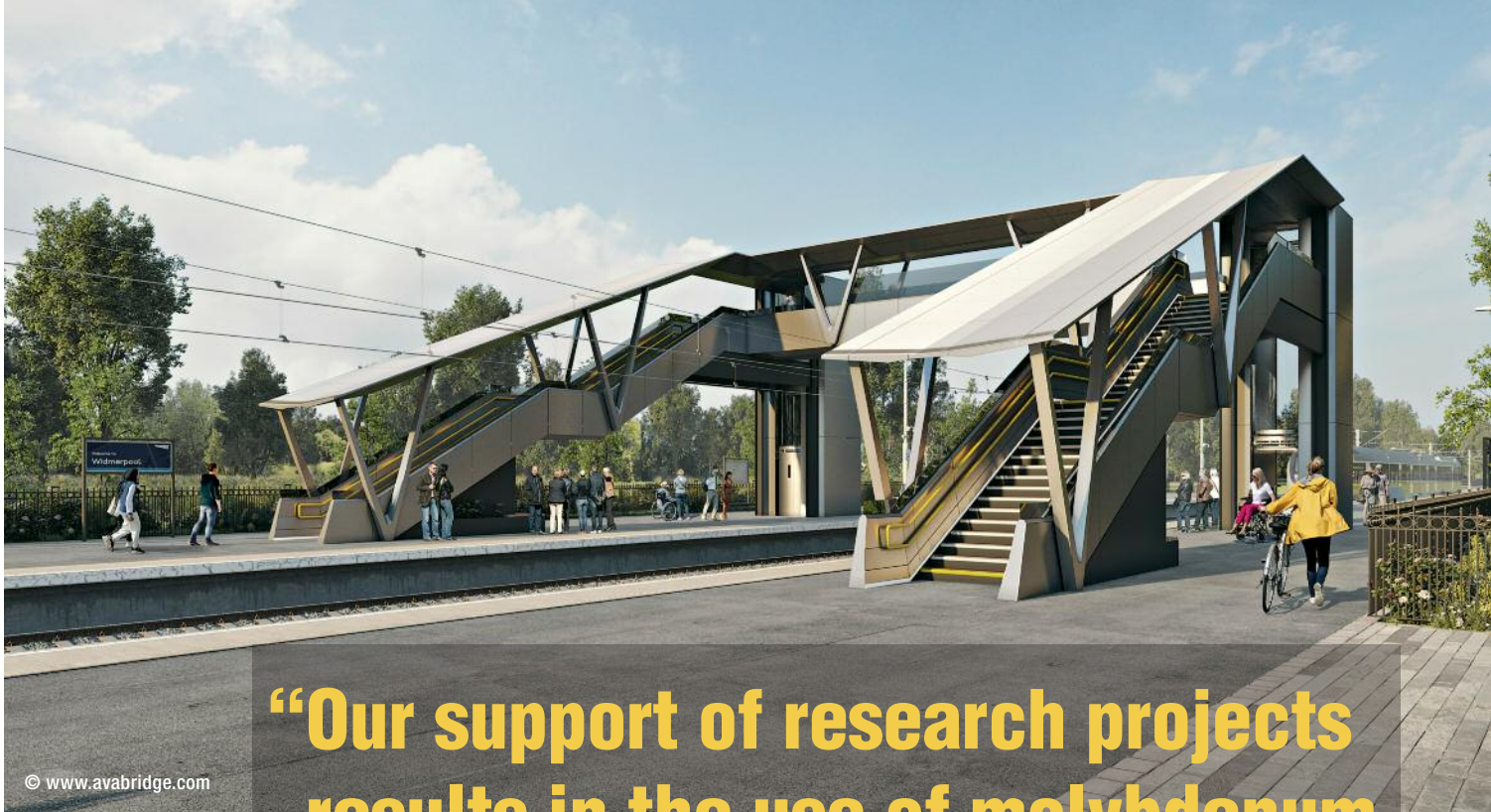


I-74 River Bridge.  
Used with permission. © 2022 Iowa DOT

## Updated standard for cold formed structural steel members

When it was first released twenty years ago, SEI/ASCE 8 *Specification for the Design of Cold-Formed Stainless Steel Structural Members* was the world's first structural stainless steel specification. A revised version has completed final public review and will be published in 2022 by the American Society of Civil Engineers (ASCE). Nancy and Catherine spearheaded this effort and actively serve on the relevant standard committee.





**“Our support of research projects results in the use of molybdenum in innovative constructions.”**

## Revolutionary stainless steel bridge

In the UK, a new concept for railway station footbridges reduces building cost and carbon emissions. Compared with traditional bridge construction, the new approach also increases efficiency and flexibility. The pioneering AVA bridge is a modular, prefabricated stainless steel footbridge for railway stations. The bridge is simple and quick to install, with potential for adoption both across the UK and around the world.

A full-scale demonstrator bridge is being built over the railway tracks near Nottingham in 2022, prior to rolling out the concept throughout the UK network. The footbridge's modular construction uses a light and robust duplex stainless steel frame and faceted cladding, which not only makes AVA beautiful and low maintenance, but also allows the bridge to span different widths of track with ease. The pieces of the frame are connected using stainless steel slip critical bolted assemblies, which were necessary due to the dynamic loads the bridges need to withstand. The performance of these types of connection was validated by an extensive European research program called SIROCO, which IMOA supported from 2014 to 2018.

## Brochures

We released a German translation of our popular austenitics fabrication brochure in collaboration with the German

stainless steel development association ISER. As with the increased translation work into Chinese, this publication provides German readers with greater access to our knowledge base.

## Research projects

The project in cooperation with the Spanish research center, CEIT, and the German heavy plate producer, Dillinger Hüttenwerke, resulted in five peer-reviewed publications that all appeared in leading international journals. The findings discussed the benefits of molybdenum alloying in direct-quenchable heavy plate in the 1000 MPa strength class.

Meanwhile, a new project was launched with CEIT, Dillinger Hüttenwerke, and the Nickel Institute. The project aims to develop a 690 MPa steel grade for thick plates (>80 mm) with excellent toughness in the plate center. These steels are important for super heavy lift cranes, offshore cranes and jack-up platforms, and for heavy construction applications.

Two additional publications were drafted from the findings of IMOA's joint project with Shanghai University's Centre for Advanced Solidification Technology (CAST) on molybdenum's functionality in grey cast iron. The finalization of the papers is forthcoming.



# FINANCIAL REPORT 2021

## Income and expenditure account

For the year ended 31 December 2021

IMOA/Molybdenum Consortium

	2021 \$	2020 \$
Turnover	3,445,287	3,662,154
Operating and administrative expenses	2,749,916	2,822,530
Operating surplus/(deficit)	695,371	839,624
Other interest receivable and similar income	1,336	14,669
Surplus/(deficit) on ordinary activities before taxation	696,707	854,293
Tax on surplus/(deficit) on ordinary activities	8,690	6,589
Surplus/(deficit) on ordinary activities after taxation	688,017	847,704



# Balance sheet

For the year ended 31 December 2021

## IMOA/Molybdenum Consortium

	2021		2020	
	\$	\$	\$	\$
<b>Fixed assets</b>				
Tangible assets		0		525
<b>Current assets</b>				
Debtors	161,212		110,168	
Cash at bank and in hand	4,985,818		4,531,259	
	5,147,030		4,641,427	
<b>Creditors – amounts falling due within one year</b>	(352,486)		(535,425)	
<b>Net current assets</b>		4,794,544		4,106,002
<b>Total assets less current liabilities</b>		4,794,544		4,106,527
<b>Reserves</b>				
Profit and loss account		4,794,544		4,106,527
<b>Accumulated funds</b>		4,794,544		4,106,527

## Financial commentary

The 2021 audited accounts presented here are consolidated figures for IMOA and the Molybdenum Consortium and were approved by members in June 2022. Income from subscriptions and other revenue amounted to US\$3,445,287. After expenses of US\$2,749,916 a surplus (after taxation) of US\$688,017 was carried forward bringing the combined accumulated funds to US\$4,794,544. Of this, US\$4,054,509 was attributed to IMOA and US\$740,035 to the Consortium. In the case of IMOA, below-budget expenditure, largely due to the Covid-19 pandemic, resulted in a significant surplus accruing to the reserves, maintaining the accumulated

funds in line with the Executive Committee's objective of holding one year's expenditure in reserves.

The funding call to Consortium members and Letter of Access holders mandated by the Molybdenum Consortium Steering Committee in 2020, raised further funds in 2021, in addition to License to Use and Letter of Access income which in total raised approximately US\$370,000. The Molybdenum Consortium reserves will contribute to funding the Consortium's essential activities around standard information and maintaining dossier compliance including the updating of Safety Data Sheet templates in 2022.

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\* Member to be ratified at the 2022 AGM



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THE VOICE OF THE MOLYBDENUM INDUSTRY

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