



SET FOR WTC 2022 - AND SUSTAINABILITY

The ITA's World Tunnelling Congress takes place in Copenhagen, hosted by the Danish Society for Tunnels and Underground Works (DFTU). A key theme for the gathering is getting practical on sustainability



Above: WTC 2022 conference venue - Bella Centre, Copenhagen PHOTO CREDIT: ITA

When the global tunnelling community gathers shortly in Copenhagen, a key focus for the presentations, training and discussions at the World Tunnelling Congress will be on exploring practical ways to pursue sustainability. The WTC conference and exhibition will take place in the Bella Congress Centre, in the south of the capital.

The host is the Danish Society for Tunnels and Underground Works (Dansk Forening for Tunnel- og undergrundsarbejde - DFTU), together with the international Tunnelling and Underground Space Association (ITA), will deliver the pre-congress training course, a substantial portion of which is focused on practical sustainability.

Sustainability is rising in importance as a challenge for the global tunnelling industry. Malaysia, which hosted WTC 2020 online, due to covid pandemic lockdowns, took forward this area of growing information need. This WTC's year's drive on sustainability aims to take the effort forward significantly while discussing many wider, detailed aspects and experiences of tunnelling projects, technology, geology, health & safety, and operations and maintenance.

In this preview of WTC 2022, T&T brings together a number of contributions to look at sustainability and the tunnelling industry. **Prof Arnold Dix**, an ITA vice-president and a nominee this cycle to be president of ITA, discusses possible paths ahead for the international tunnelling industry to pursue delivering practical sustainability - including ways to rapidly develop a dedicated measuring tool on carbon measurement for the industry, plus, vitally, an option to establish a 'non-dispute' based contract that is fit for the times.

Dr Alun Thomas, of All2plan Consulting and vice-animator of ITA's Working Group 12 (Sprayed Concrete), urges action, in his review of what can be acted upon immediately, especially with the difference that can be made in design and by supportive clients. He will play a key role in the pre-congress training course session focused on sustainability.

Antonia Cornaro and Han Admiraal, co-chairs of the ITA Committee on Underground Space (ITACUS), discuss the need to take a long view in decision-making around practical sustainability as well as the merits - of economic and more - of planning for project with multi-use strategies. They will also be presenting at the pre-congress training course session.

Recently, the Norwegian Tunnelling Society (Norsk Forening for Fjellsprengningsteknikk, NFF) published a report focused on sustainability and which is introduced in this WTC preview.

WTC awaits. ■

VISION FOR A PATH AHEAD

ITA Presidential nominee **Prof Arnold Dix** discusses his vision for how the international tunnelling industry can accelerate ways to practically pursue sustainability - including creating a tailored-made measurement tool and, crucially, introduction of a 'non-dispute' option in contract law



Above: Sustainability in the industry is a key vision for Arnold Dix

Since ancient times the use and development of underground space has been associated with technologically advanced civilisations investing in intergenerational underground development. Today, such long term investments demand complex sustainability and social development goal assessments.

Earlier in 2022, the current ITA Executive Committee resolved to include Sustainability and the United Nations Sustainability Goals in its strategic plan, and to include sustainability considerations in everything ITA does or publishes. President Jenny Yan (2019-2022) committed ITA to the sustainability agenda and, shortly, after the September elections, the new Executive Committee will be considering new initiatives.

ITA has proudly held consultative status with UN ECOSOC since 1987. ITACUS plays a central ITA role on the world sustainability stage. During the last decade, ITA has signed MoUs with UNISDR and UN Habitat in 2013 and participated in the last three World Urban Forums. ITA has also signed with the UN Environmental Programme and is involved in the UN Sustainable Transport Conference.

ITA has noted, though, that currently there is no tool specifically designed to capture the sustainability performance of underground structures. Despite advances in low carbon concretes, zero fossil fuel construction methods and even recycled heavy equipment, such as TBMs, there is no agreed framework for quantifying underground projects and their use in terms of sustainability metrics. Existing tools such as Envision, Ceequal (BREEAM, from BRE), Infrastructure Sustainability (IS), Green Roads, and Green Star, are excellent, but not good enough for ITA as they do not well articulate the benefits of going underground.

ITA recognises that a special Sustainability Underground Development Rating tool is needed to better highlight the true Social Development benefits of going underground.

Proposals for ITA's forthcoming new Executive Committee to tackle this issue head on in the next cycle include:

- An ITA/BRE collaboration on a new sustainability Indexing tool for underground projects.
- An ITA/NEC/BRE tri-partite package of Sustainability & Contracting for collaborative whole of life project decision making.

To that end, early discussions on possibilities of how BRE and New Engineering Contract (NEC) can potentially work with and support the aims of ITA have begun.

In addition to the measurement tool, suitably adjusted contract law will be key to help the industry move with momentum in delivering, systematically, improved performance in sustainability. To that end, recognising the world is changing, an approach that seeks to highlight 'relationship-contracting' is vital.

The approach to contracting needs to be 'non-dispute based'. This approach would help to accommodate delivery of lower carbon assets, faster. It would also be a legal framework to enable variations to be absorbed, without disruption to the contract relationships, in response to changes in demands and knowledge as further data, insights and knowledge come on environmental conditions and changes, and consequent recommendations, over the coming decades.

The aim would be to create an objective sustainability measurement and indexing tool tailored for underground infrastructure and to have the option of coupling it to the latest generation of non-dispute based conditions of contract, such as potentially through NEC.

This new contract approach would be an option for consideration on projects by clients, perhaps initially where NEC contracts are primarily used. The outcomes of the approach, however, along with the benefit of the new dedicated measurement tool for underground space, would demonstrate what can be done and give data for more clients, and countries, to possibly consider.

While the ITA would seek to introduce these beneficial changes to support the industry's performance in sustainability, as a federated body it would provide them, globally, for national members to consider for adoption.

It can be emphasised, though, that in a world of uncertainty and where the metrics of sustainability are changing, non-dispute based contracting is likely to be central to achieving the best outcomes for multi-generational infrastructure.

The new Executive Committee will also soon consider whether ITA should become a signatory to the UN Compact and thereby embrace the suite of UN Social Development Goals and actions, including labour, slavery and anticorruption measures.

Preliminary feedback from ITA's Working Groups and Committees is entirely positive. ITA is poised - with all its sections - to commit itself to a leadership role on the Social Development and Sustainability benefits of the underground.

Underground infrastructure and places are a proven method for robustly addressing adaptive and transitional climate change.

From the provision of clean water and sewerage to highly efficient underground transportation systems, to the efficient and effective delivery of energy and other resources, the association between underground places and social and environmental benefits is clear. ITA is accelerating its programmes to keep pace with the metrics used to measure and communicate the collective benefits of the use and development of underground space. ■

SUSTAINABILITY – THE FUTURE IS NOW

Time is of the essence for the tunnelling community to get real with sustainability on projects, stresses **Dr Alun Thomas** of All2plan Consulting. He believes opportunities abound but a mindshift is needed



Above: Installation of innovation drainage mesh as an alternative to an internal driphed - alternative to standard Norwegian approach
PHOTO CREDIT: ALUN THOMAS

Arnold Dix – who is set an ITA presidential nominee – has just issued a rallying call for action on sustainability. This is a watershed moment for our sector. When I first started working on sustainability, naturally I turned to publications like this one as well as industry organisations to learn more about the subject... and I found virtually nothing. That reflected where the industry was at, not least due to a lack of incentives from clients.

Now, there is plenty of hot air – arguably more greenwashing than in a fake Irish pub on St Patrick's – but still very little hard information. Sometimes cost cutting or normal value engineering is rebranded as a green initiative. There needs to be a stronger understanding and deeper knowledge of sustainability among engineers.

We need to change and this is how:

Recognise that this is our problem

Sustainability is our responsibility just as much as safety, quality or cost. This needs to be integrated into our daily work, rather than being seen as an add-on feature handled by the environmental team. We need their expertise for guidance but it is us, the engineers, who will shape the solutions.

Use the tools we have

Let's keep life simple and look at just the carbon footprint. All we need is a list of the quantities. We have this in the Bill of Materials. We assign an emission factor to each material. These are often available from free carbon cost databases. Then, we add up the total embodied carbon and, looking at the big numbers first, see what we can improve. This is just like the way we optimise the financial cost.

In Scandinavia, carbon footprint calculations are a standard requirement for projects in Sweden. There are often fixed targets for carbon reductions on roads in Norway. Few other countries are at this level, sometimes due to conservatism and cost.

All we have to do is to look for the information – or for a quicker answer, ask someone who knows. Here, I'd like to plug the best ITA course, to be held at the World Tunnel Congress, in Copenhagen, on 2-3 September. Day 1 of the course focuses exclusively on sustainability.

Focus on what we can do now

We can influence four areas: Operations (indirectly); Equipment used in construction; Materials; Design (which influences all of the above)

Being naturally curious, I get excited by innovations like 'cement-free concrete'. However, let's not get distracted by glitzy future technologies. These will take years to become commercially viable – if they ever do. We need to act now... and use what we have available.

In a recent paper, I demonstrated how the ambitious target of a 30% reduction in carbon footprint set by the Norwegian Public Road Administration (NPRA, or Statens Vegvesen) can be achieved today. The saving comes from a combination of measures such as swapping to electric vehicles, using low carbon materials like glass fibre reinforced polymer (GFRP) and through better design.

Focus on the design for quick wins

One of the largest savings comes from a better design. The traditional 'inner lining' of concrete panels acting as a driphed can be replaced by a spray applied waterproofing membrane (SAWM) and/or an innovative drainage mesh. The unit carbon cost and financial cost for both options are about the same but the driphed only has a lifespan of 50 years. Hence, the SAWM option has a carbon saving of 50% when the whole life of the tunnel is considered.

Consider the whole life

The example also highlights that the whole life of a structure must be considered. Cheap and dirty solutions often offer false economies in comparison to cleaner ones which are more durable.

Recognise the cost of the green transition

One view is that 'the green solution is always cheaper'. In our case, this is a reckless fallacy which breeds complacency. In operations, sometimes one can have a win-win situation where the green solution saves money over the whole life but this is rarely true in construction. Electric vehicles or sophisticated low cement concrete mixes cost more than their traditional counterparts. Clients must recognise this and reward the choice of green options in the tender evaluation.

In summary, there is a lot that we, as tunnel engineers, can do today. From the example of a road tunnel in rock, one can see that major reductions can be made with the tools and technology available now.

We need to act now with the technologies available. If we open up the specifications and accept that in some areas there will be higher capital costs, then we can make significant progress. This will bridge the gap until, within the next 5-10 years, the new technologies appear. Inaction will harm us as the pace of climate change accelerates faster than we originally feared. ■

WTC – TRAINING ON SUSTAINABILITY

Antonia Cornaro and **Han Admiraal**, co-chairs of ITACUS, highlight the key features of a landmark dedicated training course on the practical implementation of sustainability in underground design, being held immediately before WTC in Copenhagen, in September



Above: Multiple uses of underground space are being researched, including data centres requiring cooler environments and so less energy
PHOTO CREDIT: SCALIT

Achieving sustainability in underground design is more than just looking at new construction methods; it entails creating a strategy for achieving harmony between humanity and nature, say Antonia Cornaro and Han Admiraal, authors of the book 'Underground Spaces Unleashed. Planning and creating the cities of the future' (ICE 2018), and co-chairs of the ITA Committee on Underground Space (ITACUS).

The key is understanding analysing how underground spaces can contribute to sustainability without impacting the environment within which they are created. It requires engineers to work with planners, designers, and geologists in creating multi-purpose spaces that combine uses over time.

The need to consider the long view, and the potential for multi-use strategies, when planning for use of underground space investment are increasingly important.

Sense of Space and Time

Temporality is a topic which needs to be addressed, specifically when designing underground spaces. It is also at the core of sustainability, as sustainability requires us to consider the long-term implications of our actions and how they can positively impact future generations.

The term temporality is often used in philosophy to express the way time is understood. Traditionally, temporality is seen as a straightforward procession of past, present, and future.

A unique four-factor approach which helps appraise underground space projects in terms of their contribution to sustainability will be shown during the practical training session. Furthermore, specific examples of how underground spaces contribute to sustainability and the UN Sustainable Development Goals will be presented.

Examples will include the prototypes in the Hagerbach Test Gallery, in Switzerland, with underground green farming and underground data centres coupling their energy flows and working on the principles of a circular economy. This means one system's waste is another system's energy source. Important insights on energy aspects, such as the constant temperatures in the subsurface and its effects on reduced heating and cooling requirements, will be shared.

The importance of multi-functional infrastructure will be highlighted and demonstrated based on examples of transport infrastructure coupled with energy or telecom systems (Cargo Sous Terrain) or alleviating flooding while serving mobility and transport (SMART Tunnel).

The significance of underground infrastructure in dealing with and adapting to climate change will also be an important part of the session, which is hosted by Dr Alun Thomas, of All2plan Consulting and the Danish Tunneling Society (DFTU).

Another interesting part of the training will be the hands-on workshop on underground space planning, moderated by ITACUS Steering Board Member Marilu Melo Zurita and ITACUS contributor Loretta von der Tann.

The session follows earlier discussions and exploration of carbon costing and the views of a contractor and client, respectively, on practical matters of delivering on sustainability. ■

DAY 1 – Sustainability focus:

Detailed Programme Spotlight

Session 1: Sustainability (moderator: Matas Bazevicius – DFTU)

09:30 - 09:45 Opening (DFTU-ITA)

09:45 - 10:30 Introduction to sustainability (Alun Thomas, WG12)

10:30 - 11:15 Carbon costing - a worked example

(Tabita Grondal - Sveco)

11:45 - 12:30 Reduce the footprint - contractor's viewpoint

(Jorunn Halbak, NCC)

12:30 - 13:15 A client's perspective (Mrs Andersson-Ovaka,

Träffverket)

13:15 - 13:30 Q & A

Session 2: Innovative use of underground space

(moderator: Alun Thomas, DFTU)

14:30 - 15:15 Advantages of underground space regarding sustainability issues (Han Admiraal & Antonia Cornaro, Co-chairs of ITACUS)

15:15 - 15:45 Helsinki - a case study in underground urban planning

16:15 - 17:45 Workshop for underground space planning (facilitated

by Marilu Zurita, ITACUS and Loretta van der Tann, NGL

Norway)

17:45 - 18:00 Q & A

To join the training, on 2 September 2022, in Copenhagen, immediately preceding WTC, go to: <https://wtc2022.dk/training-session>

SUSTAINABILITY IN NORWEGIAN TUNNELLING

In its most recent publication, the Norwegian Tunnelling Society (NFF) gives the global industry an update on how sustainability is being approached in the country's tunnelling sector

Sustainability is the sole focus of the latest of the Norwegian Tunnelling Society's (Norsk Forening for Fjellspresingsteknikk - NFF) annually published reports, traditionally published in English to share experience with a wider audience.

NFF hopes that the report - Publication No. 30: Sustainability in Norwegian Tunnelling - will bring tunnellers and a wider readership involved in owning, creating and maintaining underground space, inspiration "to participate in the work" across the world. And, it adds, through involvement and discussion to "hopefully help us to find even better solutions" for practical sustainability in tunnels.

Sharing the Publication widely, and encouraging discussion, also meets with United Nations objectives, it adds. NFF says, "We truly believe that UN Sustainability Goal No17 - 'Partnership for the goals' - is essential to reach a more sustainable way to work and live."

A call to conversation.

A guide to possibilities in discussion - coming as the International Tunnelling and Underground Space Association (ITA) and this year's World Tunnel Congress, to be held in neighbouring Denmark, encourage more active and practical focus on what is needed and how it can be achieved.

The report comes through NFF's International Committee, which is responsible for bringing international knowledge into the organisation as well as disseminating Norwegian experience abroad with the themed publications, issued each year, a prime vehicle for doing so. Latest, and No. 30 in the long list of publications, is Sustainability in Norwegian Tunnelling.

But this year's report is not the first time that NFF has put its focus on sustainability. Mid way through the long list of annual reports out so far is Publication No.15, Sustainable Underground Concepts.

Issued in 2006, Publication No. 15, then, discussed and gave project examples of more broad questions, such as why hydropower went underground in the mountainous country, the storage of hydrocarbon products in unlined rock caverns, the creation of underground spaces for telecommunication and other utilities like water and wastewater treatment facilities, and also tunnels for defence. Not least, the report covers transport links using tunnels in the rugged environment, including subsea tunnels blasted out below the many fjords of its long west coast facing the weather and cold of the Atlantic Ocean.

The importance of many potential uses of large-scale creation of underground space is becoming even more of a focal point of discussion for strategy on determining how to invest significant capital for the long term, with an inter-generational perspective. The previous report, in spotlighting sustainable underground concepts, is an excellent reference point to support the evolving discussion.

In its latest and timely shared Publication, released in June 2022, NFF takes a deeper look into the Norwegian industry's approach to sustainability, at present, and does so with papers and strategies shared by its members. Organised in two parts, the publication first focuses on how the country's tunnelling sector works towards increased sustainability, and, second, then it presents possibilities on how different parts of the value chain can do so.

Reference is made to its Publication No.15, and also the activities and output of ITA's Working Group 15 (Underground and Environment).

While Publication No.30 discusses the idea of life-cycle assessments, NFF notes that specifics related to rehabilitation of tunnels are not included - but observes two points: many of the topics covered are relevant to rehabilitation; and, extending the useful life of such existing assets is an approach to sustainability itself, seen from a wider perspective.

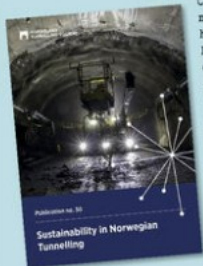
The latest Publication also discusses challenges around approaches to delivering sharp-enough measurement of performance for practical use. There are plenty of high-level 'indicators' but how they can be reported varies somewhat, from methodology and also data availability - including to establish baselines to measure against as well as going forward to run metrics over project activities in planning and being executed.

It notes that, as with almost all other topics, the principle of 'what you measure is what you get' definitely "influences the work with sustainability."

NFF's Publication No.30 adds: "It is so much easier to both discuss and follow up the areas that can be measured, such as the carbon footprint. This has to some extent made it natural to think about sustainability solely as the emission of CO₂."

The Publication is also, it further adds, proof that the industry is not awaiting perfect indicators, measurement tools or baselines built from exhaustive data before pursuing improvement in sustainable performance. It discusses what tools and data are available, and the methods and materials in tunnelling, the importance of zero emission electrification underground, the activities of key client bodies for rail and road transport, and also spotlights many of its members throughout the supply chain.

NFF's annual publications in English began with focus on a variety of themes, such as Tunnelling Technology, Hydropower Tunnelling, Road Tunnelling, Geology of Norway and many more including Operations, Grouting, Health & Safety, Water Control and Contracts, up to the most recent years which have looked at Caverns, Digitalisation and the first dedicated to a single large - and landmark - tunnel project in the nation, Follo Line. The NFF rich and growing library reports of shared knowledge can be found, free to download, on its website, www.nff.no ■



Left: NFF has published its report on 'Sustainability in Norwegian Tunnelling'

ITA-AITES WTC 2023

Expanding Underground
Knowledge & Passion to Make
a Positive Impact on the World

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