#MASTSatCoP26

MASTS lost its CoP virginity in Glasgow, November 2021. There was excitement, anticipation, nerves and uncertainty. A sense that this was an important moment, and a strange feeling afterwards that's hard to fully describe.

Our 14 MASTS Observers collectively spent over 600 hours in the 'Blue Zone'. Other MASTS members accredited through their own institutions or partner organisations also roamed the halls, with some actively involved in delivering conference content. Our 378 message Twitter-storm can still be found at #MASTSatCoP26, with many more pouring from personal accounts, but read on for a more in-depth account…

"This is a code red for humanity" – UN Secretary General

This was MASTS' first time as an accredited observer organisation at a UNFCCC Conference of Parties (CoP). While a couple of us had speaking roles in events, we were glad to have the freedom to roam, with no specified purpose beyond watching, learning, networking and, where allowed, contribute or question speakers and panellists… in CoP parlance: to offer 'interventions'. Now we've got the gist of how CoP works, maybe next time we can be more active in content delivery…

The MASTS Observer Delegation: David Paterson, Hannah Ladd-Jones, Chris Leakey, Andrew Brierley, Anne Magurran, Bee Berx, Hannah Lee, Celeste Kellock, Andrew Johnson, Max Holloway, Alejandra Garcia Cabanillas, Alan Cuthbertson, Guillaume Hermann.

Our team selection sought balance across MASTS member institutions, specialisms and career stages. All had to navigate the mesmerising array of official UN documentation, programmes and general confusion about the registration process, Covid-requirements, session access and supporting online platform. Split into two teams for separate weeks of CoP26, our heavy scepticism about the event administration turned to sympathy as we came to appreciate the magnitude and complexity of proceedings. It is immense. It is not just one conference, but a multitude

of concurrent and connected conferences all smushed together across one gigantic venue. Tens of thousands of in-person delegates roamed the venue and many more connected through a confusing array of online-platforms.

Being on site by 07:30 allowed for swift passage through security, orientation of the 1.5 mile-long venue and checking the latest programme revisions over a rich cultural diversity of free coffee-vendors. Much of our time was dedicated to talks and panel events in the 'Pavilions'. The Science and Nature pavilions were a particular draw, but we also frequented the Water, WWF, Cryosphere, EU, UK and Commonwealth pavilions, and branched out to others such as the Nordic, Korean and Chinese pavilions, the Resilience Lab and too many others to recall. The 'Capacity Building Hub' had some workshops that allowed us to feel much more actively engaged in discussions, while the 'Action Hub' gave more prominence to community, youth and indigenous voices. Getting access to plenary sessions, official meetings and press conferences was well worth the effort for greater insights to the CoP-process, emerging pledges and declaration announcements, but sometimes the queue was just too long, the room too small or security perimeter impenetrable. Mid-way through week-two the release of draft CoP cover decisions brought home the fragility of political negotiations going on behind closed doors.

This report summaries our high-level observations, reflections and some thoughts on whether and how MASTS might engage with the UNFCCC process in the future. It is peppered with some of our favourite quotes from speakers… sometimes we even caught their names. Annex 1 summarises notes organised around key themes of the conference. Annex 2 shows some familiar MASTS faces in action at CoP26.

Of course, many others have written about their experience and views of CoP26. An article from Climate Brief is as good a breakdown as we have seen of the key outcomes and COP presidency announcements, but remember that the event was also used as a stage for many other relevant announcements.

THREE LAYERS OF ACTIVITY… POLITICKING, SCIENCE AND ADVOCACY

We witnessed some **politicking** in plenary sessions where country spokespersons took turns to share their aspirations, and views on draft decisions from CoP26. The political narrative mostly seems to have shifted from dissecting the science to pushing/resisting the moral basis for action. The Small Island Developing States and other vulnerable nations have a powerful story, seeking to hold richer nations to account for emissions and other environmental damage wrought in the name of economic growth. Most wealthy nations are now committing to some enhanced financial aid[1] to support adaptation, recovery from loss and damage, and technology transfer for mitigation. While arguably not going far enough, it is hoped this momentum is not limited to the CoP process and public funds. The main dissenters are developing nations who aspire to economic growth but cannot see their way to doing so without the planetary side-effects. From what we saw, the political negotiations don't go deep enough and are disconnected from all the brilliant discussions in the CoP pavilions, 'action zone' and side events. For instance, they don't appear to be getting to the detail of carbon taxes, unethical subsidies or how to really bring indigenous and vulnerable people into the decision-making process, and the issue of global population rise and related consumption was rarely mentioned. This herd-of-elephants-in-the-room includes any overt admission of guilt and responsibility from the wealthiest, most over-consuming and most wasteful nations and communities. Political progress on climate action is being made, but…

"You can't negotiate with the melting point of ice" – Dr Joeri Rogelj

Science sessions covered a staggering diversity of issues and disciplines. The natural sciences had a very strong presence, with physical oceanography, hydrology, climatology and other technical fields. Ecology, conservation and nature-based solutions (for mitigation and adaptation) has also come to the fore. Technology and innovation are very visible in the solutions-space but are no longer as overwhelmingly dominant. Economic levers are also a lively part of the debate while the behavioural, sociological and cultural dimensions of the social sciences remain poorly represented relative to their capacity to catalyse action.

[1] NB: Much of this financial aid is in the form of loans, not grants! See COP26: Delivering on $100 billion climate finance (parliament.uk)

Advocacy is rightly seeping across all sectors. While we may not think of it as our place, it is very apparent that many academics are stepping beyond their usual boundaries and become great advocates for positive change. We are encouraged to respond similarly to the seriousness and urgency of the climate crisis alongside businesses, public bodies, religious groups and civil society… coming together around the moral argument even if we may not be 100%-aligned on the minutia of scientific detail.

What are we as scientists, as research institutions… as people with a detailed perspective on the impacts of and solutions to climate change… prepared to say and do to help build widespread solidarity and momentum for action?

How well was the ocean and marine and coastal science represented…? Well, we're biased so would of course have loved to have seen even more. At times we had to hunt for marine content, but that's because there is so much other content rather than because marine is under-represented. It was mostly easy to fill our days moving between predominantly marine or coastal-themed sessions. CoP-regulars say that the ocean-agenda is increasingly visible, despite Covid limiting opportunities for smaller organisations or marine-themed start-ups to attend. While there was an excellent 'virtual oceans pavilion' widely available online, it would have been fantastic to have an on-site focus with an ocean or marine-science pavilion. Perhaps an idea for the future that MASTS could be involved with…

"There is a lot of emphasis on the atmosphere, but we're missing the point if we leave out the Ocean. It affects everything. No Blue, No Green. It Is the original Carbon Cycle. Economists follow money, interested in the earth? Follow Carbon." Sylvia Earle

EMOTION, INTELLECT AND PROFESSION

We found it impossible to not be affected by the **highly emotive**, passionate messaging from poorer nations with a high degree of vulnerability to sea-level rise, severe storms, drought, ecosystem regime shifts and wildfires. The lives and livelihoods of people are already being lost or irreversibly damaged in many places, with the likelihood and severity of events on an upward trajectory. Many of us found the experience overwhelming and are still processing our thoughts and feelings. The underlying levels of anger, fear and frustration were even more powerful coming from official representatives and negotiators than in the protests on the streets outside.

"Tuvalu is literally sinking, we must take action now... This is a defining moment... a matter of life and survival for many of us" – Tuvalu spokesperson

Watching on TV, reading papers and all the usual ways we engage with this subject, are no substitute for the experience of this climate-CoP for **a personal but intellectual re-evaluation** of the big-picture of climate change. It was apparent that Scotland is indeed leading the 'race to keep 1.5 alive', although there remain many policy and practical hurdles to overcome. There is a momentous socio-economic shift underway, but to avoid calamitous tipping points in our climate system we must quickly find the tipping points across social, economic, technological and political drivers for climate action. We were struck by the eagerness of business, finance and energy firms to talk to ecologists and other scientists – we may yet find ourselves recognised as important components in delivering solutions, alongside rather than in the shadow of big money and clever technology.

As you would expect and hope, we found **professional benefits**, for ourselves and to share with our research groups, institutions and you. Aside from the reinvigorating effect of being exposed to the global and cross-sectoral drive for meaningful climate action, we all came away with new contacts and institutions to investigate, new ideas to explore, and new policy and practical initiatives link our research with.

POLITICS IS NOT THE ONLY GAME IN TOWN

There has never been a CoP, and will probably never be a CoP, which does everything that needs to be done to solve a problem. So, to declare CoP26 a success or failure seems a naïve binary view. But CoPs, and particularly the political negotiations at their heart, are not the only way that we move forward. What governments sign up to at CoP26 sends signals to business and public sector leaders about the direction, pace and magnitude of change, and there is some public financing that flows from this… and in this we have seen some significant steps forward. But private investment and the transformation of business models arguably have a greater synergistic effect on enabling action from governments. We could see that the private sector is becoming much more advanced in their response to climate change, because (a) they are finding ways to make or save money from more sustainable practices, (b) more of their customers are demanding it, and (c) their shareholders and investors know it. One regularly cited example from the conference came from VELUX, with their Lifetime carbon neutral commitment to sink all the CO_2 produced during the company lifetime (1941-2041), removing 5.6 million tons of CO_2 from the atmosphere by improving their supply chain to supporting forest restoration projects in Uganda. There is of course much 'greenwashing' to contend with, perhaps tackled through improved transparency in supply chain data and/or regulation, but there are many genuine and important business schemes that deserve encouragement.

"Political will is a renewable resource" Al Gore

So, while we would of course have welcomed even more transformative commitments from CoP26's official outcomes, we do recognise the significant progress with a valuable message that should continue to escalate the pace and scale of climate action across public and private sectors and civil society. We might reasonably expect this to keep translating into the role and funding of the most important areas of marine research. Beyond the official CoP26 outcomes there was a broad array of exciting announcements and launches of new schemes, partnerships and commitments from governmental, corporate and charitable actors, all of which also help build important momentum between CoPs.

SHIFTS IN EMPHASIS

There are several areas of apparent shifts in emphasis, both within the official negotiations and across the general hubbub of climate conversations. We consider all to be positive developments, including:

"This is not just a climate conference… it's a climate and biodiversity conference"

- Nature-based solutions to climate mitigation and adaptation are now central to discussions, almost on an equal-footing with technology and innovation
- The ocean has a growing profile, in terms of understanding impacts, mitigation and adaptation
- Innovations for climate action are now paying more attention to the less glamorous but all-important details, like green battery technology
- Adaptation now has an equal footing to mitigation. This is a regrettable but necessary recognition of current climate impacts and immediate threats arising from the failures to date for a global response on mitigation.
- While science still has an essential role in delivering mitigation and adaptation actions, the political argument is now of a much more moral and humanitarian sentiment. Small island developing states are calling out the wealthiest nations for their negligence.
- While easy to paint a very gloomy picture, there is growing recognition of the need for measured positivity around clearly mapped-out courses of action to sustain a broad societal response for the foreseeable future. Psychologically, 'emergency'-framed responses cannot be sustained indefinitely, so we need to leverage and communicate the social, fiscal and health benefits of climate action.
- Finance and business are more present and active in the response to the climate crisis than ever, and indeed more engaged than they are in any other global challenge.

"Responsible consumption and production is a transition accelerator… behavioural change (societal change) is key"

One area in which we feel the right emphasis has not yet been achieved is the role of behavioural, social and cultural change alongside government and business-led actions. Perhaps as a legacy of ill-conceived attempts by some corporations to pass the responsibility to the

consumer, there seems to be nervousness about tackling this elephant in the room. There can be a false dichotomy in weighing up the role of 'system change Vs lifestyle change', which are really "two sides of the same coin". Each can be a catalyst for the other, both in terms of democratic process (the citizen-government relationship) and market-forces (the consumer-business relationship). Governments and big-business *could* force transformative change to food, energy and financial systems, but are very unlikely to do so as effectively or as quickly as they would if society at large is willingly on this journey of change.

"It's not about saving the planet. It's about saving ourselves and the life we share the planet with", Katherine Hayhoe

MASTS @ FUTURE CLIMATE CoPs

Now that we are on the UNFCCC books and will have the opportunity nominate delegates for future climate-CoPs. Here are our reflections on how we could consider engaging in the future:

- There is a certain benefit to being roaming observers without other responsibilities. However, as we would likely have to partner with other major organisations, we would be able to share the burden. We would need to offer something distinctive and must be clear whether we aim to flag up our MASTS 'brand', influence policy or make a difference in other ways. If we had specific announcements to make, a CoP provides a platform.
- Within the Blue Zone, we could make better use of meeting rooms, press conference opportunities and offering of interventions via constituency focal points (in meetings where we aren't otherwise allowed to speak). Now we have some insights to these opportunities we would be better placed in future to take advantage, but we would need dedicated staff time to make the arrangements.
- MASTS can only ever have non-governmental status at CoPs, the lowliest position for access to and active participation in official events, but have links with organisations that can have a higher status (e.g. Scottish Government, NatureScot) so may be able to adopt supporting roles.
- A Climate-CoP in Scotland was a unique opportunity, whereas international travel requires careful consideration in our nomination of delegates. A smaller number of delegates dedicated to the full event makes sense, with just enough to cover the available content. Coordination with delegates accredited through MASTS member institutions would be desirable.
- Technology may allow for more remote engagement at future CoPs. One of our delegates actually ended up attending primarily via the online platforms, some of which were limited to official delegates but many were publicly available. While the vibe, team-building and opportunities for networking and *ad hoc* meetings were missed, there were benefits in terms of choosing sessions, getting a 'good seat' and avoiding the expenses and discomforts of being away from home.
- We are also conscious now of potential opportunities for engaging with intersessional meetings of the UNFCCC, so will be alert to opportunities that we can pass to others in the MASTS community.

CoP26 SESSIONS STILL AVAILABLE ON-DEMAND

Much of the CoP26 content, especially from some Pavilions, the Capacity Building Hub and the Action Hub continue to be available, although unfortunately not all in one place! You might like to explore:

UN Climate Change - YouTube

Action Hub Events at COP 26 | UNFCCC

Paris Committee on Capacity-building - YouTube

Global Climate Action at COP 26 | UNFCCC

UN Global Climate Action Awards at COP26 | UNFCCC

COP26 science pavilion - Met Office

COP26 Cryosphere Pavilion - YouTube

WWF Pavilion at CoP 26 – YouTube

COP26 Nature+Zone

Water Pavilion at COP26 - YouTube

We Mean Business Coalition at CoP26 - YouTube

ANNEX 1. HIGH-LEVEL NOTES UNDER CONFERENCE SESSION THEMES

Skip ahead if there are specific themes that interest you. These notes are organised under the following topics:

- **The World Leaders Summit & other plenaries**
- **Finance**
- **Energy**
- **Youth and Public Empowerment**
- **Nature**
- **Adaptation, Loss & Damage**
- **Gender**
- **Science and Innovation**
- **Transport**
- **Cities, Regions and the Built Environment**

World Leaders Summit and other plenary sessions

There is now considerable **consensus on the fundamentals**, without questioning of the reality of climate change, that some adverse future outcomes are already 'baked in' and that there is already considerable damage to ecosystems and to the human communities that depend on them. The key ambition is to half global emissions by 2030 and achieve net-zero by 2050.

"The difference between +1.5 and +2 degree rise is the difference between 700 million and 2 billion people facing extreme heat, and between losing 70% and all of our coral reefs." - Alok Sharma

The UNFCC Global Stocktake noted that **the ocean is not fully taken into consideration**, despite absorbing 100 times more heat and 50 times more carbon than the atmosphere. There was discussion on building momentum for the inclusion of oceans in this formal stocktake process. The UN Decade for Ocean Science provides the ideal platform for progress, with three stages to a stocktake: (1) information collection component; (2) technical assessment component; (3) high level component, with output expected from global stocktake 2023.

The **link between the climate and biodiversity crises is now being made much more explicit**. Terrestrial initiatives, particularly deforestation, get a lot more attention, though in both cases the promises alone do not ensure delivery. We note Sir David King's comment: *"The importance of the protection, conservation and restoration of nature and ecosystems was recognised… we, the scientific community, have a critical role to play in analysing the actions year-by-year of each country to manage a safe future for humanity, to assist in the process of managing accountability."*

Within the plenary sessions, some developing nations (India, especially) show resistance to limiting warming to 1.5 ˚C above pre-industrial levels. These large voices have far more sway than those in the opposite corner (Small Island States and the most vulnerable). There was concentrated debate about the IPCC report's inclusion of low probability/high impact events, such as AMOC and ice sheet collapse, which India wanted removed.

"Tipping points are the things that keep climate scientists up at night", Katherine Hayhoe

From the IPCC report, 50% Greenhouse gases (GHG) reduction by 2030 (the "50 x 30 commitment") needs to be achieved if we want to 'keep 1.5˚C alive'. For this, emissions of other GHG such as methane and nitrous oxide should be completely terminated by 2070. The IPCC report outlined 6 criteria to check for feasibility, including science, technology, finance and sociocultural factors. Traditional economic growth as an indicator of how good an economy was performing is challenged by some, but even in places like Scotland where government advocates a 'well-being economy' and non-GDP measures through its National Performance Framework, it is not clear what real bearing this has on critical decisions. A Sustainable Development Commission report called Prosperity without Growth is a worthy read. A Climate Analytics study pitting various countries GHG targets against their current policies shows that most countries fall short of the GHG reduction target required to "keep 1.5˚C alive". Pleasingly, Scotland has policies that are in line with delivering targets, pending policy implementation…

"Ocean carbon sinks are not just greater than rainforest sinks, they are greater than all land carbon sinks combined...oceans are currently missing in our climate targets." Dr Anya Waite, Ocean Frontier Institute

Finance

We got a mixed picture of finance and big business. We welcome their growing engagement and can identify many genuine schemes that have the capacity to be truly transformative when done at scale. But for some there is scepticism about the extent to which these sectors

truly 'get it'. Can they look beyond risk to financial assets and the trappings of maximising economic growth? Can carbon offsetting and natural capital approaches be responsibility delivered, in their appropriate place in the mitigation hierarchy? **Is it fair for us to expect this sector to do these things without new legal frameworks and procedures, or at least transparent reporting, to secure their ethical legitimacy?**

For investors there remains a large gap between their perception of climate risks and the severity of actual risks that should be accelerating investments. Scientists should seek industry support and **professional science communication services to articulate risk effectively**. Scientists need to be careful in communicating uncertainty to investors, for whom it carries different meaning and consequence. [See The uncertainty handbook - Climate Outreach]

Environmental investments need de-risking, but quantifying nature for asset managers is complex and needs translation to be useful. The sector view is that investment-grade data on nature does not generally exist - S&P Global provides some data but is very expensive.

Science priorities should now be on solution-enabling research. Translating information into more society-relevant metrics of impacts and scenarios is also key. The answer is not just bigger, more complex models, but a hierarchy of model complexity with machine learning, digital-twin technology and being 'smarter' with the data we have. The most urgent adaptation needs are about extreme events and local change, whereas mitigation is global (an action anywhere contributes) and includes nonlinear changes and feedbacks that are not fully understood.

Several session and speakers considered **climate models**, often in the context of evaluating risk to inform decisions on finance and investments:

- The Coupled Model Intercomparison Project is an international collaboration used by many sectors. Understanding impact drivers and predicting future risks demands higher temporal and spatial detail and more computing power, but with limited computing and human resource it is a compromise between resolution, ensemble size and process complexity. Models are getting more complex and with higher confidence; now it is important to transfer model results into product information and services.
- Climate models require energy intensive computing, so climate models of the future need to be powered by renewable resources.
- Future climate model development (talk from Kirsten Findell, NOAA) seeks to incorporate human structures and interactions, with land management practices [no mention of ocean!?] included rather as separate standalone models (similarly for ice sheet models). Development will have largest impact between typical time scales of weather prediction and seasonal prediction, multi-annual to decadal, and global to regional spatial resolution. The models will expose gaps in observational networks and inform data collection. In the longer term, we also need to develop 'global storm resolving models' - current models don't resolve convection in the atmosphere or ocean eddies and boundary currents, resulting in large uncertainties at regional scales.
- The Met Office (talk by Albert Klein-Tank) Exascale modelling systems are being developed in partnership with Microsoft. There is also focussed development on machine learning and a very high-resolution Digital Twin of the Earth that goes beyond traditional climate modelling.
- However, for big solutions needed in next 10-years there is a need for international collaboration that combines lower resolution Earth System Models with the higher resolution climate models. Global Earth System Models are our only tool to understand feedbacks and tipping points.

Many of the big business representatives noted that this was their first attendance at a COP, which itself indicates progress and ambition in the private sector. A 'Green finance model' was promoted, where banks only invest in project that are net zero. HSBC have released an Investor Guide to Natural Capital.

We heard finance-sector views that unprofitability of fossil fuels was only a matter of time. Oil and gas is "now the worst investment", and unprofitability will eventually drive phasing out. However, subsidies for fossil fuels remain 42x larger than for renewable technologies. Also, plastic production is seemingly still a large part of the oil and gas business model, although we've seen wildly different figures on the proportions.

There are lots of **opportunities for clean growth and investment** returns on sustainable products – the developing world has a choice for a green development, enabling them to catch up with the developed world while skipping the negative side effects, but this argument is still reliant on the funding and technology from the developed world.

We are now seeing **'blue' bonds as well as green bonds**, signalling positive change, but the scale at which capital is being deployed is nowhere near the scale of the problem. Development banks are trying to fill this space for lower-income nations, but it is unclear where blue finance could come from for wealthier nations and areas beyond national jurisdiction. The largest populations live in developing markets, but they receive the smallest investment in renewable energy technologies – the world bank is "an ongoing under-performer" and mission-orientated publicly-owned banks are not yet meeting the scale of the challenge.

"Coral reefs reduce >90% of wave energy, mangroves reduce 60% of wave height" – The Nature Conservancy

A Met Office session on 'climate-informed stress-testing' focussed on using climate projections/scenario analysis tools to inform financial risk. Scenarios had been 'designed' for policy makers by taking the climate information, translating to impacts and then to policy relevant information. A key message at the end was to look for opportunities in the scenarios.

Energy

Commitments to **phase out coal** fell just short of a true triumph in the tense final negotiations. Action on **phasing out oil and gas** is slower; for many countries the timing of this decline may have more to do with market forces than policy direction. The **importance of a "Just transition"** was highlighted by Richard Lochhead (MSP) to avoid socio-economically disasters like the transition from coal mining in the UK in the 1970s. Scotland's Just Transition Commission aims to drive the achievement of net zero without the socio-economic consequences. Communities affected need to be included in discussions, in delivering solutions and adapting workforces. This must apply far beyond energy sector employment, but also to how sectors as diverse as farming, seafood, transport and snow sports transition to a net zero future.

"Net zero is not enough, we need to be net negative"

The Beyond Oil and Gas Alliance were highlighted, core members of which promoted their new commitment to phase out production of oil and gas by 2050 – however, these are not the big players in oil and gas production. During the conference, a Just Transition Declaration was signed by 14 countries plus the EU, to support poorer nations. Scotland has also been welcomed into the 50×30 coalition for their climate plan for net zero. Furthermore, a report from the Energy Transitions Committee can be downloaded at Keeping 1.5°C Alive (energy-transitions.org).

Sessions on renewable energy highlighted **the role of international finance for the just transition**. Key Performances Indicators in the Nordic Investment bank assess the environmental impact of projects. Blue bonds put a value on decarbonising projects and thus attract private investment. NEFOC (the Nordic Green Bank) only provides funds to green energy projects, such as a solar power water desalinisation plant in rural Morocco.

An offshore wind event by Scottish Power unveiled a plan for Climate Smart Marine Spatial Planning. Our sense is that this represents an energy industry accustomed to taking control, not prepared to wait for direction at the pace of government policy, and so taking Marine Spatial Planning into their own hands. High-level statements rightly value biodiversity and supporting co-use of marine areas for energy developments and nature, but with lots of underlying assumptions that windfarms will be good for biodiversity.

Renewable energy sessions were primarily about wind, on land and offshore, while we saw **very little on tidal or wave energy** projects. **Hydrogen fusion** indicated a promising technology described as "the sun in a bottle" but is still at the development stage. A hydrogen fusion power station is hoped to be operational by 2050 (Dr Bernard Bigot – Head of ITER research institute). There are technological challenges but huge potential benefit: vast amount of energy, no waste and safer that traditional fission nuclear energy, as the physical reaction can be stopped instantly.

Nuclear energy is still on the agenda and certainly part of the debate in the pavilions area of CoP26, with Russia standing out as particularly strong advocates.

Although not front-and-centre, attention is also turning to meeting **mineral requirements and green innovations to reduce the impact of growth in green technology**, including for batteries. In a session on green innovation for batteries, industry leaders (Norwegian primarily, particularly https://www.vowgreenmetals.com/) acknowledged their awareness of the growing demand for deep-sea mining to supply minerals but indicated their belief that innovation in metal recovery and battery recovery could negate the need for extensive deep-sea mining.

Youth and Public Empowerment

"When the child of a major corporate CEO asks existential questions about what they are doing to protect their future... that has impact"

The role of individuals as consumers continues to be divisive. Some feel the role of consumers isn't given enough attention, while others feel corporations and governments are too quick to shift the responsibility to citizens. But this is a false dichotomy; not only do we need both systemic and behavioural solutions but the two are synergistic. The need for behaviour change should not be an excuse for a lack of enabling actions by corporations and governments, but neither does due attention to the devises of law, policy and the markets mean there is nothing for ordinary citizens to do. Indeed, unless we want people to feel that system changes are imposed upon them, we would be wise to ensure they are an active part of making that change happen. A session with government representatives from Iceland, Austria, Scotland and Finland indicated that progress toward national targets for emissions cuts is partly hampered by a lack of buy-in by the public. They noted that "Behaviour change is needed to meet climate change targets, but demands for changes in behaviour not always popular with the public" (Michael Mathieson MSP.)

"Sustainability should not be associated with luxury"

However, these matters also need to be balanced according to wealth inequalities. Many and particularly **the most vulnerable do not have the same consumer choices** as middle- and high-income people; these are important dimensions to the justice and equity debate which we did not witness at CoP26.

Technology (e.g. from Google) aims to quantify the different societal impacts and causes of climate change, but can seem very consumer focussed with little attention on the practices and business models of companies, or the billions of vulnerable people who do not have consumer choices. Ruth Porat (Google) stated that by end of 2022 Google will help a billion people to make smarter, greener decisions (by quantifying carbon cost of every consumer decision).

Citizens Assemblies have taken huge strides in recent years, plugging the gap in public process by linking to an informed and representative public voice in decision-making. Richard Wilson (Global Citizens Assembly) pointed out that climate emergency is symptomatic of this governance emergency, that the UN exists for nation-states to come together, that the WEF exists for companies, and that citizens assemblies provide a model for the public voice. Scottish Government will be responding before the end of 2021 to climate action recommendations from its Citizen's Assembly, and also will be announcing the roll-out of a resource library that the assembly requested. Claire Dykta (National Grid) asks that change is "done with people, not to people".

"We [advertising sector] must use our creativity for a future where less does not feel like loss"

The right for indigenous self-determination in research for better climate outcomes was the subject of a panel discussion including Steven Guibault (Canadian Minister of Environment and Climate Change), Inuit Tapiriit Kantami and Dr Daily Sabodoro. The importance to **include local knowledge in all research projects** is paramount. There were many great speeches, including from a young African woman who stated that "indigenous people are not victims, they are the solution". The latter can also apply to coastal communities here in Scotland.

A session with the Centre for Climate Change and Social Transformations asked how **society can live differently and better** to achieve systemic, deep and rapid emissions reductions. They shared results of their surveys across the UK, Brazil, Sweden and China about public perceptions of climate change, including themes of diet, heating, mobility and material consumption.

The youth voices provided a powerful contrast between inspiring us to see 'challenges as opportunities' and the extensive anger and fear/anxiety of many who have no clear idea of what they can do besides yell. It's important we help all people, but especially perhaps anxiety-ridden young people, to move beyond recycling and beach cleans as the only obvious personal actions they can take for the ocean.

There were some good sessions on **the role of culture and art** for public engagement in climate science and advocacy. GLOCHA have created https://digitalart4climate.space/ and we heard from https://www.music4climatejustice.org/ and https://www.artshelp.net/. Advocates for the power of films noted that they help reach people who are not already interested, or are just starting to get interested.

One heart-warming story was from a 12 year-old girl who has been leaving thank you cards on electric vehicles to congratulate drivers for acting to give her a better future.

"It's no longer enough to just do science...we need to tell stories...and the story of (climate) science has not been told well". On how art inspires new, emerging & existing audiences to climate action

From sessions on **communicating climate risk**:

- Communication is essential for local preparedness but it is difficult to communicate some complicated processes, such as the risk of tipping points and 'cascading' climate risk (i.e. > 1-step removed from raw impact, but experiencing knock-on effects)
- Uncertainty is useful information in science but can be easily misunderstood by others. Risk communication requires interdisciplinary work (beware of different domain 'knowns' and methods / language of communication)
- Communicators need to acknowledge policy 'mood music' and need to understand the audience's risk currency (what do they really care about?), framing information in relation to that risk
- On climate there is an unprecedented variety of stakeholders so we need to present a wider variety/diversity of stories. Climate change should be a worry for anyone who makes anything
- A new toolkit for communicating climate science has been developed by the CoP26 Universities Network and others

Nature

Nature is finally starting to get the attention it deserves in the climate debate. Depending on your favourite habitat or specialism you may or not be totally convinced by this statement, but the broader point stands. We heard remarks like "this is not just a climate conference, but a climate and biodiversity conference". The exhibition-stand strapline for NatureScot and Scottish public sector partners was "Climate is Nature; Nature is Climate".

Forests and woodlands were predictably dominant, with some follow-through to the outcomes and commitments of the official negotiations. There was a dedicated 'Peatlands' pavilions and we were aware of sessions on wetlands, mudflats, soil carbon, urban greenspace and more. Building from the formation of an International Blue Carbon Partnership at CoP25, there were quite a lot of Blue Carbon sessions which caught our attention, particularly in relation to mangroves, but it would be interesting to know if these reached the radar of the uninitiated. Fiji announced new legal protection for mangroves with added benefits for food security and coastal protection. Australia announced their new Blue Accelerator Fund, also linked to a broader Nature based solutions programme and carbon finance system, including community participation schemes. A representative from Pakistan described it as "a new frontier in conservation" starting to "work at scale with private sector investment".

The climate adaptation content also had numerous sessions on the role of coastal habitats in protecting coasts from storm surges and sea-level rise alongside multiple supplementary benefits, particularly mangroves but also salt marshes, dunes and reefs.

"Give nature half a chance and it will recover. We need to be nature positive" - Lord Goldsmith

One session pointed out that while positive action means ocean and land carbon sinks are projected to increase in area, many will in time become less effective at storing carbon, with the fraction of CO_2 taken up decreasing as more CO_2 is emitted.

The importance of wetlands to support water supply, food supply and climate change mitigation included a talk from Nathalie Roth (Blue Finance expert) on how issuing "Blue bond investment" could help protect and restore endangered wetlands. Recovery, and not just protection, of such habitats was discussed (Tony Juniper, Natural England), with a new UK Environment Bill expected to pass into law in support of better spatial planning for nature recovery. The ocean and cryosphere received attention from Jane Francis (British Antarctic Survey), noting the Artic ocean holds 30% of the world's ocean water and takes 75% of man-made heat. WWF described krill as a 'Superhero of the Ocean', sinking huge quantities of CO_2, but note krill abundance has seen a 10-fold decline over the past 40 years (Angus Atkinson, PML).

From a session on ***Green-Grey Infrastructure: Building Diverse Partnerships to Scale Innovations for Coastal Adaptation***

The event highlighted the growing commitment to Green-Grey infrastructure through the Green-Grey Community of Practice to invest in and implement adaptation projects that incorporate local knowledge, and the role of Green-Grey infrastructure and adaptation projects in a blue carbon and ocean context. Example of conserved mangroves (green) for ecosystem-based protection and adaption, combined with repaired seawall (grey) for engineered coastal inundation protection. Issues and barriers with Green-Grey issues include: lack of experience or familiarity; technical knowledge; policy and regulatory hurdles; risks. The need to consider sediments in nature-based solutions was also discussed.

UK-focussed sessions flagged schemes such as re-directing the flow of a river in the Lake district (National Trust) to allow the regeneration of wetlands, and trawler exclusion zones to allow recovery of kelp (Sussex Wildlife Trust), such initiatives involving local authorities, government agencies and the community were presented.

Low-income areas in US cities have 40% less tree coverage than wealthy areas, yet urban trees are known to provide benefits for extreme heat mitigation and broader well-being benefits (Mayor of Phoenix, Kip Gayego).

The Amazon Assessment Report was launched, written by the Science Panel for the Amazon (SPA) of more than 200 scientist worldwide. This 1300 page report identifies sustainable development pathways and gives a thorough analysis of the Amazon Basin. The authors discussed the importance of the report for the Amazon basin and the main recommendations, including: Zero deforestation in Amazon by 2030, increased rate of re-forestation, and adequate financing to help local communities.

From a session on **Demonstrating Successes on NbS Design, Implementation and Financing.**

This demonstrated the use of the IUCN Global Standard for Nature-based Solutions (NbS). NbS effectiveness depends on: (1) delivering societal goals; (2) supporting ecosystem health (i.e. effective for nature); (3) effective for everyone – societal equality to ensure locals benefit from NbS. Past and present projects showcased successes in the scaling-up of effective, sustainable and adaptable NbS in the UK. Two UK examples were introduced: (1) Medmerry managed realignment (Nick Gray, EA); and (2) Sussex Kelp Restoration Project (Sally Ashby, Sussex Kelp Restoration Team).

The idea of 'natural capital' and valuing nature remains controversial for some, albeit we suspect this is partly due to some failing to recognise that implementing these concepts does not necessarily involve monetisation or free-market trading. There was much reference to financial systems not properly valuing nature, particularly when accounted for as a static stock –

"Fish is more valuable than diamonds, as fish can be forever when sustainably managed" – Dr Rashid Sumaila

we need to be able to identify 'flows' of benefits from nature, in terms of natural variations and the consequences of our actions. Nevertheless, we heard some original ideas, like paying CEOs based on Natural Capital outcomes of corporations. Whatever your understanding of 'valuing' nature, for nature to flourish and deliver its potential for climate mitigation and adaptation, the natural world needs to continue to be as prominent as other solutions.

Also of interest, we became aware of:

- The launch of the EU-Pacific Green-Blue Alliance
- The Nature-Based Solutions Initiative at the University of Oxford

From the **Great Blue Wall Initiative.**

This launch event of the Great Blue Wall Initiative outlined the Africa-led roadmap to dramatically accelerate and scale up ocean actions by supporting the establishment of a first-of-its-kind Regional Connected Network of Nature-People Positive Seascapes. It is a movement for blue economic development and protection in the Western Indian Ocean that will benefit at least 70 million people. The initiative will also help protect 30% of the ocean by 2030 (30 x 30 target); achieve net gain of critical blue ecosystems by 2030 (e.g. NbS - mangroves, corals, seagrasses); develop a regenerative blue economy and create millions of jobs by supporting local communities through funding, training and technical assistance. Peter Thomson, UNSG's Special Envoy for the Ocean said "The sustainable blue economy is the future of our children…provides fantastic grounds for partnerships".

Adaptation, Loss & Damage

This topic had great prominence at CoP26, partly due to the failure for wealthy countries to meet previous aid commitments. The official outcomes of the conference include new and more ambitious aid pledges. We were shocked to learn that these are actually loans, but we are not familiar with any of the repayment terms.

"There is no such thing as natural disasters, only when we have failed in the short and long term to account for our vulnerabilities" Mami Mizutori (UNDRR)

There were many extraordinary statistics that emphasis the here-and-now of climate impacts. Temperature peaks, storm frequency and intensity, droughts, wildfires, lightning strikes, sea-levels and many more important statistics were shared. Nevertheless, this video from the opening ceremony is also a powerful a reality check: Earth To COP: Action This Day.

In the plenary sessions, official spokespersons from vulnerable and poor nations, consistently lambasted wealthy nations for failing to take responsibility for the planetary consequences of their path to economic development. Trillions of investment is needed to prepare these nations for climate impacts that are already locked in, and more for the transfer of green technologies so that they may develop with the same level of impact. While the sums of money are huge, it is also clear that aid money can be made available if the situation demands it. The challenge therefore is truly recognizing climate change as the emergency it is.

"In the last 18 months the wealthiest have spent trillions on the pandemic... and trillions on fossil fuels... clearly, money is not the issue..." – Maldives spokesperson

Adaptation is often a local or at most regional issue that demands data/knowledge at that scale. e.g. agriculture and food security is a highly local problem (site-specific activity), exposed to climate. The sector requires good quality and readily accessible data to inform decisions with high spatial and temporal resolution, including distributions of variability. People need data now, for the next season and the next few years, as for many climate change impacts are already here.

The number of climate migrants is growing and is likely to greatly exceed forced-migration due to war – although climate scenarios may induce war and civil unrest, so these statistics may become confused. In 2020

"Our grandchildren will live in a clean green world or will be living in a world where they have to fight with others for food and water. This is personal." – EU spokesperson

approximately 10,000 people were reported to have migrated following storms in South America and parts of Africa and other countries are becoming uninhabitable. This is a very complex topic, and we refer to https://climatemigration.org.uk/climate-refugee-statistics/

From the **1st High Level Ministerial Dialogue on Climate Finance – Future Trends in Climate Finance Mobilisation**

This included three panels on enhancing the predictability of climate finance, improving the scale and effectiveness of adaptation finance and the future trends in climate finance mobilisation. This included representations from the World Bank and the government of Barbados, who highlighted ongoing problems with adequate funding for climate adaption, as opposed to short term approach of repairing damage as and when it happens. Their argument was along the lines of "funding is always available for disaster recovery, but rarely adequately available for sustainable economic development and adaption to climate change."

As highlighted above, **nature-based solutions** were widely recognised as very important. Many countries require action more urgently than can be delivered, but they are a key component of the long-term solutions. Increasing resilience in coastal areas was a prominent focus, with plenty emphasis on the need for an inclusive process that makes use of local knowledge. One example was the introduction of insurance policies for coral reef in Mexico (Chip Cunliffe, AXA-XL) to support people affected by the loss of biodiversity. Insurance schemes for farmers and new local weather forecasting schemes were also highlighted. Enhanced infrastructure resilience against coastal inundation in Bangladesh was mentioned, hybrid (green-grey) approaches to coastal and ocean resilience, and "room-for-the-river" schemes in the Netherlands.

An interesting session on atmospheric pollution, focussed on **short-lived climate pollutants** (SLCP) affecting millions of people and children in various cities in South America. Coal powered power station are to be replaced by cleaner sources of energy (Claudio Castro, Chief of the Chilean delegation), but in the meantime air monitors are sharing real-time air quality data to, for example, allowing nurseries to arrange outdoor playtime when air quality is at its best.

"If your car had a 1 or 2% chance of brake failure, would you get in it? The likelihood of climate disaster is much greater than that!" – Nick Bridge, UK Climate Envoy

Besides the ARA (detailed below), other international initiatives with developing nations include Adaptation Action Coalition (AAC), Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), the Risk-Informed Early Action Partnership (REAP) and Weather & Climate Information Services for Africa (WISER). other international initiatives with developing nations include Adaptation Action Coalition (AAC), Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), the Risk-Informed Early Action Partnership (REAP) and Weather & Climate Information Services for Africa (WISER). Other relevant links are:

- Race to Resilience with Climate Group (theclimategroup.org)
- Ocean Risk and Resilience Action Alliance (ORRAA)
- Disaster Risk Reduction | IUCN
- Sendai Framework for Disaster Risk Reduction 2015-2030 | UNDRR
- Global Multi-hazard Alert System (GMAS) | World Meteorological Organization (wmo.int)

From the **Results-Oriented Adaptation Research (ROAR) event.** This was the launch event for the Adaption Research Alliance (ARA), a global initiative to co-create & research adaption solutions for those most at risk from climate change. The ARA is a global, collaborative effort to increase investment and opportunities for action research to develop/inform effective adaptation solutions. The focus is currently on the Pacific region, their first-hand experience of climate change and the existential threat to their indigenous communities. It was surprising that current funding available for climate adaptation is currently only 20% of total funding (remaining 80% is for mitigation).

From a session on **Extreme events and disasters – how do we measure them and why is this important?**

This side event provided information on World Meteorological Organisation (WMO) activities providing authoritative natural hazard information for more accurate and scalable data and how this underpins impact-based forecasting for actionable alerts and warnings. As part of WMO's Global Multi-hazard Alert System initiative, a new data policy aims to free up more data for use around the world on weather, water and climate. This is designed to talk about meteorological impacts rather than just simple numbers associated with meteorology (e.g. wind speeds, temperatures, rainfall depths). An example of the disconnect between meteorological events and potential impacts is Typhoon Haiyan, Yolanda 2003, where a lack of awareness in the coastal population of storm surge risk (compared to good understanding of tsunami risks) led to significant deaths. The goals of Cataloguing Hazardous Events (CHE) was to find the best way to catalogue extreme events by a simplified process: (1) Identify the uniqueness of the event record; (2) generate events list; (3) make process scalable; (4) make process flexible; to assign and attribute the event of a specific type to the impacts from the event.

Gender

The focus of these sessions was on the important role and impact of women in decision-making, innovation, action and influence for climate action, from community or indigenous levels, to scientific and political leadership. Within this there was also attention to the importance of educating women and girls. While progress is being made and there are many great examples, we clearly haven't reached gender equality yet, and government have to make every effort to always include and consider women in policies.

Murielle Elouga (Water Climate Development Program, Cameroon) highlighted how much water crisis in Cameroon is disproportionately affecting women. Rural woman in Cameroon produce 90% of the foodstuff, but are not involved in the decision making process.

"'An estimated 4 million girls won't complete their education due to the climate crisis this year alone... Let's work together where women and girls are at the heart of all of our climate decisions" – Alok Sharma

Gender equality improves science, technology and innovation for climate action. Jo Churchill (MP for Agro-innovation and Climate Adaptation) flagged female roles in the COVID task force, having to take bold decisions. A powerful example of sharing knowledge to improve women conditions was detailed by Pauline Lançon, winner of the Gender Just Climate Solutions 2019. Through sharing ancestral knowledge from French salt producers, fire-based technique to evaporate water for salt production were replaced by passive evaporation system driven by wind and sun energy, thus preventing fires and reducing the workload for women in Guinea Bissau.

Science & Innovation

This is such a huge topic across the pavilions it is hard to do it justice. What is even more difficult, as with other topics summarised, is to what degree the key messages from science reach and influence the political negotiations in plenary and closed sessions to which we did not have access. Our sense is that the CoP-itself is not where this translation is made, but the pavilions content is rich and valuable for those that experience it.

"Tipping points in the climate system are like popcorn…"

Boxes below contain points of detail from a selection of interesting sessions we attended. Other highlights we witnessed include:

- A session involving UK government ministers and supermarket chiefs, indicated we may be moving to a food labelling system that standardises metrics and shows consumers a traffic light indication of sustainability under categories of climate, biodiversity and water. This presents a significant challenge for the flow of data but also the development and agreement of metrics.

- The ocean carbon sink, although it will continue to increase (and drive ocean acidification), will decrease in efficiency, increasing the proportion of emissions that remain in the atmosphere and accelerating warming.

- NOAA (**Rick Spinrad)** announced new global seasonal surface ocean carbon dioxide monitoring to quantify ocean's role in CO_2 uptake and climate change. Co-development is required to ensure that the deliverables are useable for policy makers. Progress is still needed in communicating uncertainty through the use of multi-model ensembles and machine learning to quantify the physical growth of projection uncertainty.

"We can collect all the data, but if nobody acts on it, we're kind of wasting our time" – Steve Widdicombe, PML

- Of the innovative solutions for planetary cooling, **injecting sulphates into the earth stratosphere** (simulating an event that can occur during volcanic eruptions) is a bad idea with potentially damaging consequences. Alasdair Skelton (Stockholm University) showed that the cooling might be effective, but it would not address the quantity of Greenhouse gases being emitted in the atmosphere. It would also need up to 200,000 extra flights a year and cost up to €15bn/year. There is also a huge risk of "terminal shock" when we stop injecting sulphates, i.e. causing a fast increase in temperature that would be more detrimental to biodiversity.

- Sustainable soil management practices include innovation in fertilizers, solar irrigation pumps, waste-water re-use, seawater desalinisation (Aditi Mukherji, IWMI) and innovation in soil health monitoring to support farmers.

- We are entering era of radical transparency – Climate TRACE has global inventory, which aims to zero in on every significant source of CO_2.

- A session introduced the IPP CommonSensing project to help address significant gaps in climate change funding to Pacific Island states by providing quality, unbiased earth observation data. This project supports Fiji, Vanuatu and the Solomon Islands through the innovative use of satellite remote-sensing data to improve climate resilience and disaster risk management. It is funded by the UK Space Agency's International Partnership Programme (IPP) financed through the BEIS Global Challenges Research Fund (GCRF), led by the United Nations Satellite Centre (UNOSAT).

Highlights from a Special event of the SBSTA and the IPCC: Unpacking the new scientific knowledge and key findings in the Working Group I contribution to the Sixth Assessment report: The Physical Science Basis

- On our current trajectory we will reach 1.5˚C warming above pre-industrial levels within 20 years. 2˚C would be exceeded by 2050. On an intermediate emissions scenario 2.7 ˚C by 2100 and >3.3˚C by 2300). Low emission scenarios keep us <2 ˚C above pre-industrial levels. The range (uncertainties) presented in most recent IPCC have narrowed substantially, so confidence in these details is improving.
- The IPCC process makes climate information available and easily accessible to inform decisions.
- The recent responses of many climate systems are unprecedented in thousands of years:
  - Sea Surface Temperature warming unprecedented in 10,000 years
  - Rates of Sea Level Rise are unprecedented in past 3,000 years
  - Last sustained period of global climate +2.5 degrees was >3 Ma
  - Each of last 4 decades has been progressively warmer
- Changes in extreme events, especially in the hydrological cycle, become larger with each additional 0.5 ˚C
- Currently projecting 2-7+ m Sea Level Rise, more if including ice sheet instability processes.
- **Indian delegation states IPCC summary for policy makers is too dire and should be more hopeful, seeking toned down message of high impact but low likelihood events, such as Ice Sheet Collapse (AIS instability / WAIS loss). IPCC response is that low likelihood, high impact threats needed to be included in report.
- The IPCCs next Assessment Report (AR7) will focus on the interactions between cities and climate change

From a session on **Climate Impact Drivers (CIDs):**

- All regions are projected to experience changes in at least 5 Climate Impact Drivers (CID). **Coastal CID** (RSLR, Coastal flood, coastal erosion Marine heatwaves, ocean acidity) projections include:
  - By 2050 Mean projected regional SLR within +/-20% of projected global SLR
  - Extreme sea level events (once per century) will be 20-30 x more frequent by 2100
- Low likelihood, high impact events include AMOC and Icesheet collapse. IPCC section on Climate information for risk and adaptation notes use of probabilistic projections – balancing communication of risk and uncertainty. The biggest uncertainty is still from icesheets response.
- **Indian delegate again made the point that summary for policymakers was too negative and should focus on hope. Response from delegates from some small island states (unsurprisingly) stresses the opposite opinion and want more focus on the threat of extreme events. IPCC response: We cannot rule out lower probability/high impact outcome if, i.e. we cannot ignore the tails of predicted distributions!

From a session on use of 'emulator models'

- An emulator relates to 'simple or reduced complexity climate models', with a carefully considered small number of equations to project a single variable. They are agile and fast, and are tuneable to provide probabilistic projections. They are reliant on process understanding from complex models.
- The approach of latest IPCC report was to use fewer 'expensive' simulations and use emulators to fill the parameter spaces. There is widespread assistance from emulators throughout IPCC report to translate data and provide varying policy relevant detail.
- Key example of emulators use in IPCC report was in projecting sea level rise, in which there is deep uncertainty and variability. The emulators performed (computationally efficient) large ensembles to cover full distributions of variability and examine distribution tails in more detail.
- Working groups within IPCC assessment teams had their own emulators, but there is strong need for interaction between working groups.
- Stakeholders suggest that their interest in impacts goes beyond simply temperature, to climate variables that are more specific to sectors, e.g. precipitation.
- Emulators are so efficient that they can be used to assess how the negotiations are going, updated with NDCs and long-term targets, allowing quick analysis of 'before COP vs during COP'.

From a session on **Ocean acidification**, with a panel including Peter Thomson (United Nations Secretary-General's Special Envoy for the Ocean) and Steve Widdicombe from PML**:**

- Ocean acidification (OA) is happening ten times faster than it has for 50 million years, with imminent perils to ecology and some local economies
- The science of OA has progressed at a startling pace and is now informing policy and action planning. The https://www.oaalliance.org/ has had a key role in driving international collaboration and has developed an OA Action Plan Toolkit. The Commonwealth Secretariat has also been a driving force, with the Commonwealth Blue Charter OA Action Group producing a Policymakers Handbook
- A priority action for the science community is to fund the formation of an observation system.
- Now that OA has progressed from just being a science issue to also being a policy issue, it is easier to push advocacy for action.

Transport

On the surface you could be forgiven for thinking the CoP was not taking the transport issue seriously, with great pomp and ceremony given over to the electric future of Formula 1 racing and single-seater hydrogen-powered airplanes. However, delve a little deep and there was lots of interesting and insightful content, including:

- A digital solution to operational efficiency could bring 30% more capacity to the existing UK rail network.

- In the UK and many other places, a big step is to electrify the railway network, and provide incentive for people to choose the train instead of personal vehicles. There are some real basics to conquer, such as better booking systems for passengers. More involved issues include making freight route design work for companies as an option.

- Electric cars are still more expensive than classic combustion cars but have only 10% of the usual running cost. "Range anxiety" is fading as e-cars can now have a range of up to 250 miles. However, the network of charging and super-fast charging point needs to be extended and become more reliable (Lorna McAteer, National grid).

- A 'Flightpath to Net Zero' session focused on development of aviation technologies to achieve net-zero. This included the potential future use of biofuels, hydrogen, hybrid-electric, electric and even nuclear technologies.

- Shipping represents 3% of global emissions. The UK Transport Minister hinted at carbon rating for ships, cleaner fuels for reduced emissions and a 'Clean Maritime demonstration competition' to stimulate the private sector and Green shipping corridor between countries. The launch of the "Getting To NetZero Coalition" and the Mission Innovation Shipping Mission signal significant ambition. Also, >200 major shipping companies have signed to fully decarbonise by 2050, with policies and measures to be set by 2025. The Clydebank Declaration was be announced, with 19 governments working together to develop 'green shipping corridors' [those that connect ports that have the infrastructure for sector decarbonisation]

"If we decarbonise shipping we help decarbonise so many other sectors that rely on our services"

Cities, Regions and Built Environment

This was not where the ocean-content was, but there were nevertheless some interesting sessions:

- Discussions on "15-minute cities and neighbourhoods" and how cities and towns can be better designed to promote sustainability. However, this concept was rarely well explained. Content on active travel was limited, not providing much balance to "tech-salvation" of the transport sessions.

- What role cities can play in connecting technologies of district heating and cooling, and building energy efficiency for their carbon neutrality targets.

"Landfills will be the mines of the future"

- 'Accelerating Deep Collaboration for Built Environment', bringing together national governments, cities, regions and the private sector to discuss ways to achieve a more sustainable and resilient built environment. It was noted that buildings are responsible for 40% of global emissions (10% from cement alone), and the contribution of housing to global warming is the second largest contribution to global emissions (a fifth of total emissions). Also, an area equivalent to the size of Paris is developed each week in new buildings and for every $1 invested in energy efficient buildings there are $37 invested in inefficient buildings. Examples of best practice were given including the My Planet Initiative in the Maharashtra Region of India for clean energy, water and sustainable transport (won the COP26 award for climate action) and Austin, Texas for its Change Equality Plan including a $7bn new public transport system, designed to benefit all citizens equally.

"We are talking a lot about wasting less but we really need to waste nothing... we need to put it to another use."

- A session on '**net-zero circular water future for cities'** discussed solutions for resilient, net-zero and circular water and wastewater management in cities worldwide, with representatives from cities, national governments and the private sector. An example from Cape Town, where a recent drought meant that water was rationed to 50 litres/day/person, triggers questions on how we can make homes run on that ration but feel like ten-times more (the "50 L Home Coalition"). Discussions included the need for recycling waste water (water re-use) at household, neighbourhood, city and regional scales, with stakeholder testimonies from Vakin (largest wastewater processor in Sweden). Scottish Water, Grundfos and the Water Authority of Jordan identified key challenges and potential solutions in water management.

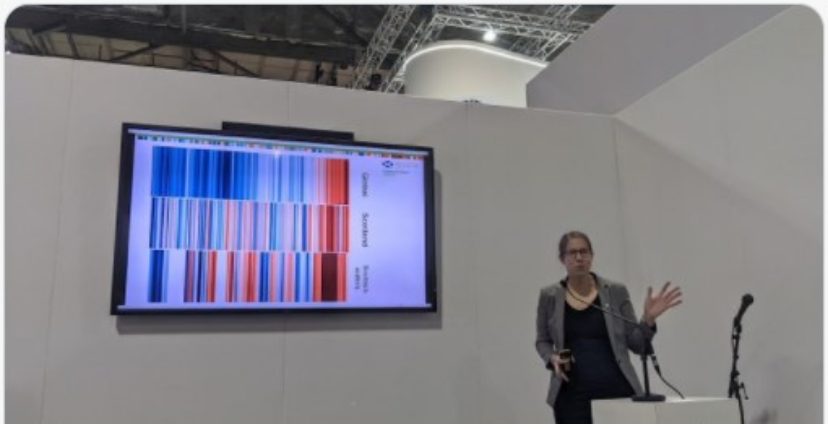
ANNEX 2. MASTS-AFFILIATED PERSONS ON-STAGE AT COP26 BLUE ZONE EVENTS

MASTS @mastscot · Nov 6

From the Australian #CoP26 pavilion, Hannah Lee and Bee Berx watch the international partnership session for #blueCarbon, and Bill Austin (@univofstandrews) is on the panel.
#MASTSatCoP26

MASTS @mastscot · Nov 6

Bee Berx (@marinescotland Sci) highlights #ocean warming in Scottish and local waters, points out and how important regional climate info is important when talking to policymakers as local ecosystems will have to adapt differently.
#MASTSatCoP26



MASTS @mastscot · Nov 6

David McKee (@UniStrathclyde): light is hugely important for photosynthesis in the #ocean as it supports animal life and is affected by #seaice. Ice also harbours Ice #algae, vital for zooplankton nutrition. Changes in ice cover impact the food web.
Slide for info 👇 **#MASTSatCoP26**

MASTS @mastscot · Nov 6

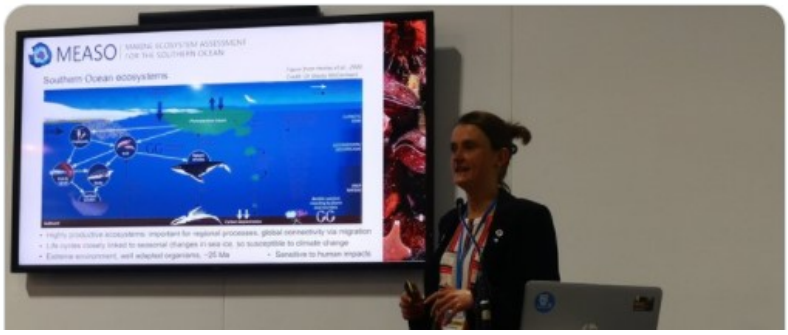
We're getting ready for the 11:30 "Will the #Arctic warm or cool" featuring a lot of MASTS folk at the #Cryosphere Pavilion
Chair: Mark Inall (@SAMSoceannews)
Watch live: youtube.com/channel/UCr_TP... 👈
#MASTSatCoP26

MASTS @mastscot · Nov 6

Sian Henley doing a stella Job at moderating the Cryosphere #COP26 🌏 pavilion 'Antarctic Marine Ecosystems Under Pressure: Protection Locally and Globally'
#MASTSatCOP26

Bee Berx @b_berx · Nov 6

Great explanation of the Southern Ocean marine ecosystem and its global importance by @drsianhenley **#MASTSATCOP26** #COP26



Bee Berx @b_berx · Nov 5

@BillTurrell1 addressing the session on regional ocean acidification. A clear need to monitor carbonate chemistry in Scottish seas, and making sure we observe all parameters required. #COP26 **#MASTSATCOP26** @marinescotland

MASTS
@mastscot

Next up @mastscot member Jack Laverick (@UniStrathclyde) presents "Youth Perspective on climate change and the ocean"
Jack is a founding member of the Youth4Ocean forum with @WON_ROM
His tells how the world has changed since he's grown up and what that story will be for his child

MASTS @mastscot · Nov 4

MASTS members: @b_berx and @drsianhenley chair the #cop26 Nordic Pavilion session: #Ocean Connections from the #Arctic across the globe?
Want to watch? Live stream here: wedonthavetime.org/event/cop26#no...
#MASTSatCoP26

MASTS @mastscot · Nov 4

Happy @mastscot team!
Bee Berx and David Paterson had a quick word and photo with Sylvia Earle at #COP26
Good work #MASTSatCoP26 💙