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### **1. Tracking Clean Energy Progress: IEA Report**

*The following was extracted from the IEA website. The report is part of the IEA's support of the first global stocktake of the Paris Agreement, which will be finalized in the run up to COP28, the next UN Climate Change Conference, at the end of 2023.*

The IEA's Tracking Clean Energy Progress (TCEP) assesses recent developments for over 50 components of the energy system that are critical for clean energy transitions. The components assessed include sectors, subsectors, technologies, infrastructure and cross-cutting strategies.

The IEA's Net Zero Emissions by 2050 Scenario (NZE) is a pathway for the global energy sector to achieve net zero CO<sub>2</sub> emissions by 2050, while also achieving universal energy access by 2030 and major improvements in air quality. Progress is assessed at the global level against the Net Zero by 2050 Scenario trajectory for 2030, and recommendations are provided on how they can get "on track" with this pathway. The assessed components include technologies, infrastructure, sectors, subsectors and cross-cutting strategies.

Of the over 50 components tracked, in the 2023 edition 3 are evaluated as fully "On track" with the Net Zero by 2050 Scenario trajectory – solar PV, electric vehicles and lighting. Solar PV was upgraded in this edition, as the annual growth in generation in 2022 of 26% is now aligned with the average compound annual growth rate needed from now to 2030 in the Net Zero Scenario.

Progress on clean energy technology deployment has been very rapid in 2022, even if many components are not yet fully on track at the global level. The momentum towards the clean energy economy is clearly accelerating. Some highlights in 2022 include the following:

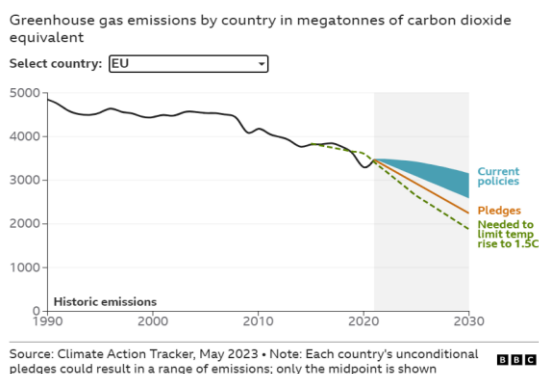
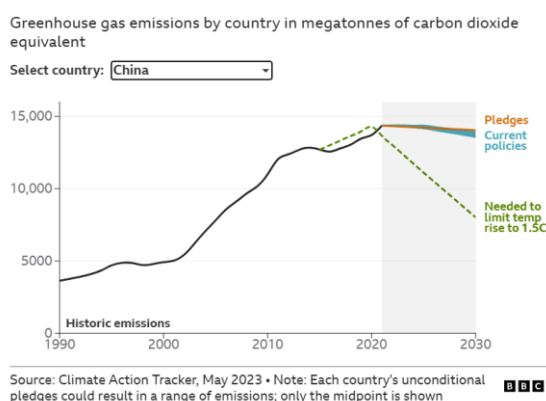
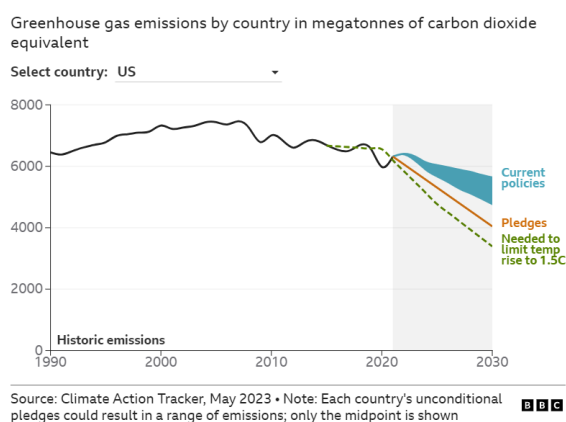
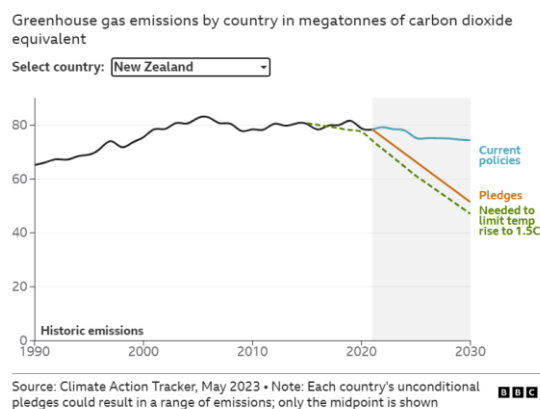
- **Electric vehicle** sales grew by 55%, reaching a record high of more than 10 million. And for the first time ever, announced manufacturing capacity for electric vehicle batteries is sufficient to fulfil expected demand requirements in 2030 in the NZE Scenario.
- **Nuclear** capacity additions grew by 40%, with 8 GW newly installed. While higher deployment is needed in the Net Zero Scenario, the growth in 2022 represents a clear step forward after capacity additions had remained stable from 2019 to 2021.
- **Heat pumps** saw another record year, with 11% growth in sales. This is close to the 15% average compound annual growth needed to fully align with the Net Zero Scenario.
- **Electrolyser** installed capacity grew by more than 20%, while electrolysers manufacturing capacity grew by more than 25%. The bigger story though is likely yet to come - based on the current pipeline of projects under development and their expected operation dates, electrolyser capacity could reach almost 3 GW by the end of 2023, a more than four-fold increase in total capacity compared to 2022. (Electrolysers are “a critical technology for the production of low-emission hydrogen from renewable or nuclear energy.”)
- **Energy efficiency** of the economy overall grew by more than twice the level the previous year. This is a positive step forward following several years of relatively weak improvements.

Progress is occurring faster in those parts of the energy system for which clean technologies are already available and costs are falling quickly, such as for electricity generation and passenger cars. But a full transition to net-zero emissions will require decarbonising all areas of energy production and use. Rapid innovation is needed to bring to market clean technologies in particular for those parts of the energy system where emissions are harder to address, such as heavy industry and long-distance transport. Positive steps forward on innovation have been made in the past few years, but an acceleration is needed in order to soon move to deployment of novel low emission technologies for these areas.

The transition is also occurring at different speeds across regions and sectors. For example, nearly 95% of electric car sales in 2022 occurred in China, the United States and Europe. Meanwhile, nearly 75% of operating and planned carbon capture capacity is in North America and Europe. As such, the global evaluation that a technology is “on track” does not mean that it is on track in all countries, and, conversely, a technology that is “not on track” globally could be progressing more quickly in some specific countries. Stronger international cooperation and robust policy development is needed to spread progress to all regions, particularly emerging market and developing economies.

## 2. Selected charts tracking how countries are meeting their commitments to reduce GHG emissions

Extracted from BBC website, 27 June 2023



## 3. China's Climate Priorities

Source: *Brookings Commentary, August 23, 2023*

Since the early 2000s China's climate change policies have accorded greater priority to adaptation than to mitigation. Its key mitigation targets are to peak GHG emissions by 2030 and achieve carbon neutrality by 2060. China's assessment is that regardless of any mitigation measures China makes, it will still have to cope with temperatures rising well above 1.5 degrees.

China's plans include constructing the largest water transfer in human history; expanding and raising nearly 6,000 miles of sea walls along its coasts; building a strategic grain reserve larger than the rest of the world's combined; carving wetland flood basins in the centres of its largest cities; restoring coastal wetlands to act as buffers against storms; and relocating hundreds of thousands of 'ecological migrants' in low-lying areas.

China has an engineering approach to dealing with climate change's growing impacts. It is able to mobilise vast resources to build infrastructure, change land use patterns, implement focused industrial policies, relocate large populations, and direct funds and human resources to critical research and development priorities.

Water issues pose the gravest national challenges. Major east coast industrial centres are highly exposed to flooding from rising sea levels. Southeastern China has increasingly frequent floods and storms. In recent years heat and drought in Southwest China has at times threatened the viability of the massive hydropower plants. The glaciers along the Hindu Kush and Himalayas which are a key source of water for the rivers in central and southern China are now melting at a very high rate. Northern China is overall extremely water scarce. The South-to-North water transfer project is aimed at moving water as needed across China.

China is investing significantly in developing clean energy technologies, both out of carbon mitigation concerns and with the aim of becoming the indispensable global provider of these technologies.

#### **4. Exxon Mobil 2023 energy outlook**

*Source: Reuters Sustainable Switch, Reuters website, August 29, 2023*

According to Exxon, energy-related CO<sub>2</sub> emissions will peak at more than 34 billion tonnes sometime this decade as economies and energy demand grow, then decline to 25 billion tonnes in 2050. That is more than twice the maximum of 11 billion tonnes the UNIPCC say will be needed on average.

Exxon states that oil and natural gas will meet 54% of the world's energy needs in 2050, with the world failing to keep global temperatures below 2°C.

Exxon is investing US\$17 billion over a 6-year span through 2027 in lower carbon emissions technologies such as carbon captured sequestration and hydrogen.

#### **5. Calls for crackdown on fossil fuel company greenwashing**

*Source: Energy Source & Distribution Latest News, July 12, 2023*

The Climate Council is calling on the Australian Parliament to crack down on greenwashing claims made by fossil fuel giants. In a submission to the Senate inquiry on greenwashing, the Climate Council has named and shamed 10 fossil fuel corporations' dubious climate plans.

Climate Council Head of Advocacy Dr Jennifer Rayner said, "Let's be real—these big polluters are gaslighting Australians. We are living through the climate crisis right now, with megafires, record floods, heatwaves and crippling droughts. The only way forward is to drastically cut emissions this decade.

"Fossil fuel corporations who claim to be pursuing net zero targets are doing the absolute opposite: rapidly expanding new fossil fuel projects like the Scarborough, Browse and Beetaloo carbon bombs that will spew out harmful greenhouse gasses for decades to come. Simply put, it's greenwashing. When these corporations dazzle the public and politicians with buzzwords like 'low emissions', 'net zero' or 'carbon

neutral', it's pure bullsh\*t. Well-funded marketing spin deliberately distorts the facts, prevents real climate action, and funnels precious investment into dead ends— money that should power genuine green innovations.

“Dodgy net zero claims by fossil fuel polluters are the billion tonne elephant in the room of this inquiry. It's time our Parliament tackles the fossil fuel industry's sham environmental claims. Developing new and expanded fossil fuel projects is incompatible with a safe future. The science is clear that this has to stop to avoid escalating climate harm.”

The Climate Council's submission calls on the Australian Parliament to crack down on fossil fuel greenwashing as a priority, starting with the worst offenders.

This includes:

- Banning the use of deceptive 'carbon neutral' claims by any company pursuing fossil fuel expansion, including in public advertising, financial markets, and communications with governments.
- Requiring corporations that make net zero claims to show genuine efforts to reduce emissions, rather than cooking the books by relying on offsets.
- Requiring corporations that make net zero claims to prioritise the absolute reduction of their total life cycle emissions, rather than simply reducing their emission intensity or addressing only a fraction of their total emissions.

## **6. Solar power cell innovations break key energy threshold**

*Excerpts from an article by Damian Carrington Environment editor, Guardian website 6 Jul 2023*

Solar power cells have raced past the key milestone of 30% energy efficiency, after innovations by multiple research groups around the world. The feat makes this a “revolutionary” year, according to one expert, and could accelerate the rollout of solar power.

Today's solar panels use silicon-based cells but are rapidly approaching their maximum conversion of sunlight to electricity of 29%. At the same time, the installation rate of solar power needs to increase tenfold in order to tackle the climate crisis, according to scientists.

The breakthrough is adding a layer of perovskite, another semiconductor, on top of the silicon layer. This captures blue light from the visible spectrum, while the silicon captures red light, boosting the total light captured overall. With more energy absorbed a cell, the cost of solar electricity is even cheaper and deployment can proceed faster to help keep global heating under control.

The perovskite-silicon “tandem” cells have been under research for about a decade, but recent technical improvements have now pushed them past the 30% milestone. Experts said that if the scaling-up of production of the tandem cells proceeds

smoothly, they could be commercially available within five years, about the same time silicon-only cells reach their maximum efficiency.

The current efficiency record for silicon-only solar cells is 24.5% in commercial cells and 27% in the laboratory. The latter may well be as close the cells can practically get to the theoretical maximum of 29%. But one group, led by Prof Steve Albrecht at the Helmholtz Center Berlin for Materials and Energy in Germany, has now published information about how they achieved efficiencies of up to 32.5% for silicon-perovskite cells. The other group, led by Dr Xin Yu Chin at the Federal Institute of Technology in Lausanne, Switzerland, demonstrated an efficiency of 31.25% and said tandem cells had the “potential for both high efficiency and low manufacturing costs”. Chinese company LONGi, the world’s biggest producer of solar cells, announced in June they had reached 33.5% in their research.

All of the high-efficiency tandem cells above 30% efficiency are small so far, measuring 1cm by 1cm. They now need to be scaled up to the size of commercial cells, which are 16-cm squares.

One issue that remains to be resolved is how fast the tandem cells degrade over time in real-world conditions. Today’s solar cells still have 80-90% of their capacity after 25 years and De Wolf said tandems would have to match that, but that there was only limited data on their stability to date.

The key to the higher efficiencies of the tandem cells from the German and Swiss groups was tackling tiny defects on the surface of the perovskite layer. These allow some electrons liberated by solar photons to flow back into the perovskite, rather than contributing to the cell’s electrical current and therefore reducing its efficiency. The solution was to put a layer of organic molecules between the perovskite and the conducting layer through which the current flows, which compensated for the defects.

## **7. Mining giants trial world-first hydrogen pilot for alumina**

*Source: Energy Source & Distribution Latest News, July 12, 2023*

The Australian Renewable Energy Agency (ARENA) has granted \$32.1 million for mining giant Rio Tinto and Sumitomo Corporation to trial hydrogen calcination technology at the Yarwun Alumina Refinery in Gladstone, Queensland. The \$111.1 million Rio Tinto and Sumitomo Corporation Yarwun Hydrogen Calcination Pilot Demonstration Program will be the first-of-its-kind deployment of hydrogen calcination in the world. The project is intended to reduce emissions in alumina refining, which currently contributes roughly three per cent of Australia’s greenhouse gas emissions.

The project will consist of a 2.5MW onsite electrolyser to supply hydrogen and a retrofit of one of the refinery’s calciners to operate with a hydrogen burner. Sumitomo Corporation will own and operate the electrolyser at Rio Tinto’s Yarwun site and supply the hydrogen to Rio Tinto directly. The electrolyser will have a production capacity of more than 250 tonnes of hydrogen annually. Rio Tinto will conduct a series of tests of the hydrogen calciner under differing operating conditions to validate suitability and performance.



Calciners, which use high temperatures to extract chemically bound water from alumina crystals, traditionally use fossil fuels for process heat and contribute roughly 30% of emissions from alumina refining. Hydrogen calcination also produces high purity steam, which unlike contaminated steam from fossil fuel calcination, can be recycled for use in other stages of the refining process.

If successful, the project will demonstrate the viability of hydrogen calcination and pave the way for adoption at scale across other alumina refineries. The demonstration follows a successful feasibility study conducted by Rio Tinto, which ARENA supported with a \$580,000 grant in 2021.

## **8. South Korea's Kepco joins Western Australian hydrogen hub**

*Source: Energy Source & Distribution Latest News, July 12, 2023*

The Western Australian Government has welcomed a Memorandum of Understanding (MoU) signed between Western Green Energy Hub and Korea Electric Power Corporation (Kepco) towards the development of one of Australia's largest proposed green hydrogen hubs.

The project, to be located in WA's Goldfields-Esperance region on Mirning Country, will cover 15,000sq km and require around 3,000 wind turbines and 25 million solar panel modules. These turbines and modules generate energy for the electrolysis which converts water into hydrogen.

Once complete, the project will become one of the largest of such energy hubs in the world and generate 3.5 million tonnes of zero-carbon green hydrogen per year.

## **9. Prospectors hit the gas in the hunt for 'white hydrogen'**

*From an article by Jillian Ambrose, Observer, 12 Aug 2023*

For more than a decade, the village of Bourakébougou in western Mali has been powered by a clean energy phenomenon that may soon sweep the globe. The story begins with a cigarette. In 1987, a failed attempt to drill for water released a stream of odourless gas that one unlucky smoker discovered to be highly flammable. The well was quickly plugged and forgotten. But almost 20 years later, drillers on the hunt for fossil fuels confirmed the accidental discovery: hundreds of feet below the arid earth of west Africa lies an abundance of naturally occurring, or "white", hydrogen.

Today, it is used to generate green electricity for Bourakébougou's homes and shops. But geologists believe that untapped reservoirs of white hydrogen in the US, Australia and parts of Europe have the potential to provide the world with clean energy on a far greater scale. This would have major implications for the climate.

Hydrogen has emerged as a tool in the race to curb carbon emissions. The clean-burning gas can replace fossil fuels in factories, power stations and homes with zero greenhouse emissions. The catch? Typically, hydrogen is made from fossil fuels in a process that creates carbon emissions (so-called "blue" hydrogen), or by using

renewable electricity and water (green hydrogen), which is very expensive. The discovery of natural sources solves both problems.

The size of the prize could be enormous: the US Geological Survey has said that even if only a small fraction of hydrogen under the Earth's surface could be recovered, there would probably be enough to last for hundreds of years.

The burgeoning hydrogen industry's supporters include Bill Gates. The billionaire investor, through his company Breakthrough Energy, was reportedly one of five backers to pour about \$90m into Koloma, a company based in Colorado which is hunting natural hydrogen along the US's Midcontinental Rift System. The 1,200-mile tectonic fault running through North America is also being targeted by Natural Hydrogen Energy, a startup due to begin exploration work alongside Australia's HyTerra in Kansas later this month.

The true potential of white hydrogen will depend on the findings from the early projects, says Philip Ball, a research fellow at Keele University and a geoscientist in the field. "We're on the cusp of a new understanding but whether this translates into a serious new energy source is a very big question," Ball says. "Many geologists don't understand this field. There's a feeling of 'well, if hydrogen was there, wouldn't major oil companies have found it already'? But they weren't looking for it. Most hydrogen discoveries have been by accident."

There remains uncertainty over the way hydrogen forms deep within the Earth, exactly how it migrates to the surface, and how best to extract it. The answers will be crucial in understanding what white hydrogen would cost to produce. Estimates suggest it would be cheaper than hydrogen from fossil fuels or water – but there are many caveats.

Oil companies including Total and Engie in France, and Repsol in Spain, have taken modest steps on white hydrogen. There is limited interest from the industry's largest players, but the results from the pioneer hydrogen hunters could change that. If white hydrogen can live up to the hype, the oil majors could enter the market, as they followed the early shale gas "wildcatters" into fracking. This time, the results could be a bonus for the climate too.

Perhaps the key question is whether the oil companies would be willing to help. Think of a see-saw, says Ball: there might be resistance to helping an industry flourish if its success means driving down the value of multitrillion-dollar fossil gas reserves. But there could be a tipping point where it would become a financial risk to miss out.

## **10. \$4.6 billion plant in South Africa will make 'the fuel of the future'**

*From a story by Jacopo Prisco, CNN, July 25, 2023*

In Nelson Mandela Bay, in the Eastern Cape of South Africa, thousands of hectares of land could one day become the world's largest green ammonia plant. Ammonia, which is made up of nitrogen and hydrogen, is commonly used as a fertilizer. In the early 1910s scientists devised a way to synthesize it, but before



then, the main agricultural fertilizer was guano, bat or bird excrement, which had to be obtained from tropical islands and was in short supply.

Production of ammonia at an industrial scale allowed agriculture to boom, and according to a study from the University of Manitoba, without it, we wouldn't be able to produce roughly half of the world's food today.

Ammonia is also used to manufacture explosives for the mining industry and is a key ingredient in many pharmaceutical and cleaning products. Currently, its production mainly involves fossil fuels and is responsible for 1.8% of global CO<sub>2</sub> emissions. But by using renewable energy, "green" ammonia can be manufactured, slashing the carbon footprint of agricultural production and opening up the compound to further uses.

Prominent among them is the use of ammonia as fuel, which could help decarbonize the shipping sector. It is what the Mandela Bay plant will focus on. "It'll start replacing heavy fuel oils on ships and it'll replace diesel. That will become the fuel of the future, particularly in the maritime industry," says Colin Loubser, managing director of Hive Energy Africa, which is building the plant.

The process to make green ammonia is quite simple, Loubser says, requiring just water, air and energy. Electrolysis is used to separate water into hydrogen and oxygen, and an air separation unit extracts nitrogen from the air. The hydrogen and nitrogen are then combined to produce ammonia.

Projected to start operations in 2026, the plant will cost \$4.6 billion. It will be powered by a nearby solar farm and will get its water — of which vast amounts are needed to make ammonia — from a local table salt factory that desalinates seawater.

The shipping industry made up nearly 3% of global CO<sub>2</sub> emissions in 2018. According to the International Energy Agency, ammonia will need to account for 45% of the global energy demand for shipping in 2050, for net zero scenarios to realize, which means it's an essential component of a greener future. But green ammonia could also be burned in existing coal-fired power plants to quickly reduce their CO<sub>2</sub> emissions, the study notes, or in plants customized to run entirely on ammonia.

One limiting factor is that ammonia is a pungent and toxic gas, so it needs to be handled by trained professionals. Using it as a fuel produces nitrogen oxides, which can act as greenhouse gases and cause air pollution, requiring additional technology to control emissions.

And many of the systems that will make use of green ammonia — including ship engines — are still under development, which is why production levels are low at the moment. However, production is expected to boom: according to a report by Precedence Research, the green ammonia market accounted for just \$36 million in 2021, but will grow to \$5.4 billion by 2030.

## 11. Farmers on frontline as Dutch divided by war on nitrogen pollution

*From an article from the guardian website by Senay Boztas in Barneveld, 25 Jun 2023*

Veal farmer Wim Brouwer sits on his terrace, an “emergency” red flag flying outside and his laptop open on a page revealing he is one of the Netherlands’ peak polluters, due to the nitrogen excreted each year by his 1,360 calves. His business sits in one of the most intensively farmed parts of Europe’s most intensively farmed country, a huge exporter with more than 110 million livestock, including cattle, chickens and pigs.

Nitrogen compound emissions are a big matter in this small, packed country, becoming the dominant political issue over the course of a four-year crisis. Among other impacts, the crisis has hampered crucial housebuilding, because builders need nitrogen permits from a limited supply to cover construction emissions. The crisis has polarised social opinion, spurring the rise of a new rural populist movement and mobilising environmentalists who are desperately concerned about the state of wild habitats.

Brouwer’s emissions are nine times the threshold cited in a Dutch policy, green-lighted by the EU, to offer about 3,000 “peak polluter” livestock farmers voluntary buy-outs from a €975m pot. “This morning I did the calculation for ‘120% of my farm’s value’, what the nature minister called a wildly attractive ruling,” Brouwer said. “There’s nothing wildly attractive for me. You couldn’t even rebuild the farm for this amount. But when a business fills out the form and finds out it is a peak polluter, it’s a death sentence.” Brouwer says his farm is carbon neutral, but he fears being a peak polluter means credit lines drying up.

A series of supreme court rulings in cases brought by environmentalists have brought the Netherlands to a standstill over pollution. Nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>) and ammonia are negatively affecting EU-protected nature reserves, in breach of EU law. Speeds are limited on motorways and desperately needed housebuilding is on pause. A 2020 commission recommended reducing nitrogen-based pollution by 50% by 2030 and a follow-up report proposed asking 500 to 600 peak polluters – mostly livestock farmers – to shut within a year.

“This has been a problem for more than 50 years – that’s the real problem,” said Wim de Vries, professor of environmental systems analysis at Wageningen University. “It’s a disturbance of the whole nutrient balance: too much nitrogen, soil acidification, a lack of calcium, magnesium, potassium. Because of that, you get an impact on soil microorganisms and earthworms. Certain plants outcompete the others so diversity decreases. Insects and butterflies that live on those plants are reduced, and then birds.

After months of protests from farmers, the first closures will be voluntary, Christianne van der Wal, the nature minister, said earlier this month. “The government is fully committed to this voluntary approach and hopes that many of the businesses that qualify will participate ...the government wants to prevent mandatory measures.” Forced buyouts are happening already in Belgium but they are proving to be politically unpalatable in the Netherlands. The Farmer Citizen

Movement (BBB), a new centre-right party surfing a wave of rural anger at environmental policies, recently won key regional elections while parties in the governing coalition have lost support. Public trust in politics is low.

Farmers' union the LTO has said it is withdrawing from negotiations for an agriculture agreement on future environmental obligations and governmental support. It said there was not enough clarity about nitrogen-based emissions or how farmers will compete with foreign products without the same pollution requirements. This *landbouwakkoord* is intended to run in parallel with the buyouts to offer “perspective” to Dutch farmers, but agreement is proving difficult. Environmentalists have welcomed the scheme, which opens on 3 July and will also offer smaller-scale farmers funds from a €500m pot to stop or reduce their impact.

Louise Manning, professor of sustainable agri-food systems at Lincoln University said that as international agreements affect farms, businesses and rural communities globally, governments should not lose sight of “social contracts such as food security, resilient societies and a just transition”.

## 12. World's largest 'wood city' to be built in Stockholm

Source: Article by Jacqui Palumbo, CNN, Wed June 28, 2023



A rendering of Wood City shows what life in a timber-made community might look like. Courtesy Atrium Ljungberg

In recent years, wooden buildings have reached new heights, with soaring timber skyscrapers completed or underway in countries like Norway, Switzerland and Australia. Singapore, meanwhile, can lay claim to the largest timber building in Asia with a sprawling 468,000-square-foot college campus that opened in May.

Now, real estate developer Atrium Ljungberg has announced plans to build the world's largest “wooden city,” which will be constructed in Sweden's capital, Stockholm, from 2025. Stockholm Wood City will feature 7,000 office spaces

and 2,000 homes in the city's southeast, and will offer "a vibrant, urban environment with a mix of workplaces, housing, restaurants and shops," according to a press release. Set across 250,000 m<sup>2</sup>, it has been described by its developer as the "world's largest known construction project in wood."

The first buildings in Stockholm Wood City, which is being designed by architecture firms White Arkitekter and Henning Larsen, are set to complete in 2027.

Wooden buildings have been found to enjoy better indoor air quality and can be constructed with significantly lower carbon emissions than those made with conventional materials. A 2022 study, published in the journal Nature, estimated that constructing enough mid-rise timber buildings to house 90% of new city dwellers between now and 2100 would lower carbon dioxide emissions by 106 gigatons (the planet currently emits about 40 gigatons every year).

A transformation of that magnitude would require sustainable timber plantations, so as not to cause deforestation. But Sweden is a country primed to innovate with wood, with almost 70% of its land covered in forest.

### **13. Attending ESR Committee Meetings – A request for feedback**

The ESR Executive Committee meets monthly by Zoom, on the first Wednesday of the month, starting at 5PM. It deals with such matters as the webinar programme, submissions, and membership. We are looking at making meetings available to the wider membership, and would like some feedback on this. If meetings were open this way, would you be likely to participate? Feedback is very welcome and should be emailed to [lawrencecarter2@gmail.com](mailto:lawrencecarter2@gmail.com). Thank you!

Ross Rutherford

ESR Newsletter Editor

4 August 2023