ESR NEWSLETTER
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1.Calculating emission reduction requirements to achieve net zero – A discussion

1.1 Ministry for the Environment Emissions Tracker

The MfE's Emissions Tracker dated June 2021 includes the latest greenhouse gas emissions data for New Zealand, which is for the year 2019. The following analysis uses the MfE data.

Table 1: NZ Greenhouse Gas Emissions 2019

Greenhouse Gas (GHG)	Gross Emissions		Net Emissions	
	kt $CO_{2\text{-}e}$	%	kt $CO_{2\text{-}e}$	%
Carbon Dioxide (CO_2)	37,494.50	45.55	9,881.97	18.00
Methane (CH_4)	34,621.29	42.06	34,697.85	63.21
Nitrous Oxide (N_2O)	8,363.18	10.16	8,474.06	15.44
Synthetic GHGs (HFCs etc)	1,838.90	2.23	1,838.90	3.35
Total	82,317.87	100.00	54,892.78	100.00

The Energy sector accounted for 42% of gross emissions, Waste for 4%, Agriculture for 48% and Industrial Processes etc. for 6%. The methane and nitrous oxide emissions are primarily generated by the Agriculture sector.

Transport accounted for almost 20% of gross emissions and 47% of carbon dioxide emissions. Road transport emissions were 96% higher in 2019 than 1990.

In 1990 New Zealand's gross emissions were 65,129.23 kt $CO_{2\text{-}e}$ and net emissions were 41,114.77 kt $CO_{2\text{-}e}$. Total GHG emissions increased rapidly between 1990 and the early 2000's but have remained relatively stable since. Compared to the 1990 base year, gross emissions have increased by 26.4% and net emissions by 33.5%.

The net emissions figures are obtained by subtracting the CO_2 absorbed by "Land Use/Forestry". This sector removed 24,014.46 kt $Co_{2\text{-}e}$ from our gross emissions in 1990 and 27,425.09 kt $Co_{2\text{-}e}$ in 2019. The 14.2% increase in GHG emissions removals is due to the rapid expansion of afforestation in the 1990's and the subsequent increased harvesting of the wood products. This effect will reduce in the near future.

The Energy sector, which includes Transport, is predominantly responsible for New Zealand's carbon dioxide emissions. Using the MfE data, while carbon dioxide emissions are 45.6% of gross GHG emissions they are only 18.0% of net emissions (as land/use forestry almost exclusively absorbs CO_2). Put another way, reducing carbon dioxide emissions in Table 1 by 9,881.97 kt or 26.4% would result in net zero carbon dioxide emissions for NZ. (Also, all greenhouse gases except methane would need to reduce by 42.3%)

1.2 Climate Change Commission Report 2021

The Climate Change Commission splits greenhouse gas emissions into long-life gases and biogenic methane. Long life gases include nitrous oxide and synthetic greenhouse gases/F-gases.

The Climate Change Commission's final report refers to the need to reduce long-life gas emissions to net zero by 2050. Biogenic methane (50% dairy, 48% sheep and beef, 2% other) is to reduce by 10% by 2030 and by 24-47% by 2050.

The Climate Change Commission's report also distinguishes between gross and net greenhouse gas emissions. The country's gross emissions for 2019 are given as 82.3 $MtCO_{2e}$ which agrees with the MfE figure. The net emissions are, however, stated to be 74.9 $MtCO_{2e}$ after "forestry carbon removals". The difference between the net and gross figures is 7.4 $MtCO_{2e}$. The Commission uses a different method for calculating the emissions reduction figure. The effect is summarised in Table 2 which was produced using a similar process to Table 1.

Table 2: Climate Change Commission Data

Greenhouse Gas (GHG)	Gross Emissions		Net Emissions	
	Mt $CO_{2\text{-}e}$	%	Mt $CO_{2\text{-}e}$	%
Carbon Dioxide	37.5	45.6	30.1	40.2
Biogenic Methane	33.7	40.9	33.7	45.0
Nitrous Oxide	8.4	10.2	8.4	11.2
F-gases + non-biogenic methane*	2.7	3.3	2.7	3.6
Total	82.3	100.00	74.9	100.00

1.8 + 0.9*

Using Table 2 data carbon dioxide emissions need to reduce by 30.1 Mt CO_2 or 80.3% to achieve net zero. The long-life gases would need to reduce by 40.3 Mt CO_{2e} or 84.5%.

This analysis demonstrates the major effect of the means of calculating the emissions reductions used by the Climate Change Commission on the resulting greenhouse gas reduction requirements to achieve net zero. It indicates that an informed and open discussion around the appropriateness of the approach taken is needed due to the potential significance of the Commission's recommendations on government policy.

2. The water is coming': Florida Keys faces stark reality as seas rise

Extracts from an article by Oliver Milman @olliemilman Guardian Website,24 Jun 2021

Long famed for its spectacular fishing, sprawling coral reefs and literary residents such as Ernest Hemingway, the Florida Keys is now acknowledging a previously unthinkable reality: it faces being overwhelmed by the rising seas and not every home can be saved.

Following a grueling seven-hour public meeting on Monday, held in the appropriately named city of Marathon, officials agreed to push ahead with a plan to elevate streets throughout the Keys to keep them from perpetual flooding, while admitting they do not have the money to do so.

The string of coral cay islands that unspool from the southern tip of Florida finds itself on the frontline of the climate crisis, forcing unenviable choices upon a place that styles itself as sunshine-drenched idyll. The lives of Keys residents – a mixture of wealthy, older white people, the one in four who are Hispanic or Latino, and those struggling in poverty – face being upended.

If the funding isn't found, the Keys will become one of the first places in the US – and certainly not the last – to inform residents that certain areas will have to be surrendered to the oncoming tides. "The water is coming and we can't stop it," said Michelle Coldiron, mayor of Monroe county, which encompasses the Keys. "Some homes will have to be elevated, some will have to be bought out. It's very difficult to have these conversations with homeowners, because this is where they live. It can get very emotional."

Once people are unable to secure mortgages and insurance for soaked homes, the Keys will cease to be a livable place long before it's fully underwater, according to Harold Wanless, a geographer at the University of Miami. "People don't have a concept of what sea level rise will do to them. They just can't conceive it," he said.

On Monday, the county gave details of its plan to spend $1.8bn over the next 25 years to raise 150 miles of roads in the Keys, deploying a mixture of new drains, pump stations and vegetation to prevent the streets becoming inundated with seawater. The heightened roadways are eagerly anticipated by residents who told the meeting of cars being ruined by the salt water and of donning boots to wade to front doors.

"The roads are shot, they're full of cracks, the water is permeating up," said Kimberly Sikora, who lives in a vulnerable neighbourhood of Key Largo called Stillwright Point that is still awaiting a full road elevation proposal. "I'm just looking for some kind of relief."

Another resident, Robert Schaller of Twin Lakes, an area further along in the planning process, muttered that he "should've done my due diligence" when buying his house last year. "I literally stand on my balcony and watch the water come up through my street," he said. "It's coming up right through the pavement."

But Monroe county's budget will not cover the raising of all the roads, nor any mass buyout of homes, and an appeal to Florida state lawmakers to levy a new tax to cover these mounting costs has been rebuffed. Further costs will pile up as the county grapples with how – and who pays - to keep critical infrastructure such as sewers and power substations, as well as people's homes, from being flooded along with the roads.

"If we can't raise additional money then we will have to look at prioritizing," said Rhonda Haag, Monroe county's chief resilience officer. "For example, should we spend money on raising roads if people aren't paying to raise their yards? We are blazing trails here. We are ahead of everyone in having to think about this."

The pancake-flat Keys are in jeopardy from rising seas that are, as a National Oceanic and Atmospheric Administration (Noaa) scientist told the county commissioners in the Monday meeting, accelerating upwards as the vast ice sheets of Greenland and Antarctica melt away. Compounding this problem, the islands' porous limestone allows the rising seawater to bubble up from below, meaning it just takes high tides on sunny days to turn roads into ponds, while global heating is also spurring fiercer hurricanes. that can occasionally crunch into the archipelago.

"The Florida Keys are one of the most vulnerable places to flooding in North America," said Kristina Hill, an environmental planner at the University of California, Berkeley, who warned that the islands would face growing road and pipe maintenance costs, more pollution leaks and harmful algal blooms. "Without a change in strategy, parts of the Keys will become accessible only by boat," said Hill, adding that the islands could have to resort to floating structures and navigable canals to remain viable. "The islands will gradually disappear into a higher ocean, potentially leaving a ruined landscape of leaky underground storage tanks, old pipes, and flooded road segments behind to pollute the water."

The threats faced by the Keys are shrugged off by some of its wealthy retirees who view the situation with a certain fatalism, while others in this Republican-voting bastion openly question the science. Eddie Martinez, one of the county's five elected commissioners, challenged the Noaa scientist, William Sweet, on his sea level rise projections on Monday. The sea level rise to date is "really a nothing number", said Martinez. Another commissioner said that "predicting the future is probably best done with a crystal ball" and speculated that global temperatures could change following several volcanic eruptions.

"There are people who don't want to sell because they love it here, others who want to get out while they can and those in complete denial who call you a troublemaker who is driving down property values by talking about it," said George Smyth, a retiree who moved to Key Largo a decade ago for the quiet, slow-paced lifestyle. In 2019, his neighbourhood spent 90 days partially submerged in water.

Other new realities are more laborious – Smyth has to wash his car continually to rid it of salt water and has to pay for trucks to unload piles of crushed-up rocks around his property as a buffer against the encroaching tides. While Smyth doesn't class himself as particularly wealthy, these protections are beyond the means of low-income Keys residents, many of whom live in exposed mobile homes dotted along the islands.

3. IPCC steps up warning on climate tipping points in leaked draft report

*Extracts from an article by **Fiona Harvey** and agencies, Guardian website, .23 Jun 2021*

Climate scientists are increasingly concerned that global heating will trigger tipping points in Earth's natural systems, which will lead to widespread and possibly irrevocable disaster, unless action is taken urgently. The impacts are likely to be much closer than most people realise, a draft report from the world's leading climate scientists suggests, and will fundamentally reshape life in the coming decades even if greenhouse gas emissions are brought under some control.

The Intergovernmental Panel on Climate Change is preparing a landmark report to be published in stages this summer and next year. Most of the report will not be published in time for consideration by policymakers at Cop26, the UN climate talks taking place in November in Glasgow.

A draft of the IPCC report apparently from early this year was leaked to Agence France-Presse, which reported on its findings on Thursday. The draft warns of a series of thresholds beyond which recovery from climate breakdown may become impossible. It warns: “Life on Earth can recover from a drastic climate shift by evolving into new species and creating new ecosystems … humans cannot.”

Tipping points are triggered when temperatures reach a certain level, whereby one impact rapidly leads to a series of cascading events with vast repercussions. For instance, as rising temperatures lead to the melting of Arctic permafrost, the unfreezing soil releases methane, a powerful greenhouse gas that in turn causes more heating. Other tipping points include the melting of polar ice sheets, which once under way may be almost impossible to reverse even if carbon emissions are rapidly reduced, and which would raise sea levels catastrophically over many decades, and the possibility of the Amazon rainforest switching suddenly to savannah, which scientists have said could come quickly and with relatively small temperature rises.

Bob Ward, the policy and communications director at the Grantham Research Institute on Climate Change and the Environment at the London School of Economics, said: “Scientists have identified several potential regional and global thresholds or tipping points in the climate beyond which impacts become unstoppable or irreversible, or accelerate. They could create huge social and economic responses, such as population displacements and conflict, and so represent the largest potential risks of climate change. Tipping points should be the climate change impacts about which policymakers worry the most, but they are often left out of assessments by scientists and economists because they are difficult to quantify.”

Previous work by the IPCC has been criticised for failing to take account of tipping points. The new report is set to contain the body’s strongest warnings yet on the subject.

Simon Lewis, a professor of global change science at University College London, said: “Nothing in the IPCC report should be a surprise, as all the information comes from the scientific literature. But put together, the stark message from the IPCC is that increasingly severe heatwaves, fires, floods and droughts are coming our way with dire impacts for many countries. On top of this are some irreversible changes, often called tipping points, such as where high temperatures and droughts mean parts of the Amazon rainforest can’t persist. These tipping points may then link, like toppling dominoes.”

He added: “The exact timing of tipping points and the links between them is not well understood by scientists, so they have been under-reported in past IPCC assessments. The blunter language from the IPCC this time is welcome, as people need to know what is at stake if society does not take action to immediately slash carbon emissions.”

According to AFP, the IPCC draft details at least 12 potential tipping points. “The worst is yet to come, affecting our children’s and grandchildren’s lives much more than our own,” the report says. The report may be subject to minor changes in the coming months as the IPCC shifts its focus to a key executive summary for policymakers.

It says that with 1.1C of warming above pre-industrial levels clocked so far, the climate is already changing. A decade ago, scientists believed that limiting global warming to 2C above mid-19th-century levels would be enough to safeguard the future. That goal is enshrined in the 2015 Paris

agreement, adopted by nearly 200 nations who vowed to collectively cap warming at "well below" 2C – and 1.5C if possible. On current trends the world is heading for 3C at best.

Earlier models predicted that Earth-altering climate change was not likely before 2100. But the UN draft report says prolonged warming even beyond 1.5C could produce "progressively serious, centuries-long and, in some cases, irreversible consequences."

4. Cloud spraying and hurricane slaying: how ocean geoengineering became the frontier of the climate crisis

Extracts from an article by Amy Fleming, Guardian website, 23 Jun 2021

Tom Green has a plan to tackle climate change. The British biologist and director of the charity Project Vesta wants to turn a trillion tonnes of CO_2 into rock, and sink it to the bottom of the sea. Green admits the idea is "audacious". It would involve locking away atmospheric carbon by dropping pea-coloured sand into the ocean. The sand is made of ground olivine – an abundant volcanic rock, known to jewellers as peridot – and, if Green's calculations are correct, depositing it offshore on 2% of the world's coastlines would capture 100% of total global annual carbon emissions.

The plan relies on a natural process called weathering. "Weathering has been working on the planet for billions of years," says Green, a graduate of Harvard Business School who runs Project Vesta from San Francisco. "When rain falls on volcanic rocks, they dissolve a little in the water, causing a chemical reaction that uses carbon dioxide from the atmosphere. The carbon ends up in the ocean, where it's used by marine-calcifying organisms like corals and shell-making animals, whose skeletons and shells sink to the bottom of the ocean as sediment and eventually become limestone."

Olivine weathers easily, and allowing ocean currents to churn it up, says Green, "will make it dissolve much more quickly, to happen on a human-relevant timescale". It is not a rare mineral: there are beaches in the Galapagos islands and in Hawaii that are green with olivine-rich sand.

The idea of using the sea to absorb excess carbon is not far-fetched, says Green. Ocean water can hold 150 times more CO_2 than air, per unit of volume. "The ocean has already taken up about 30% of the excess carbon dioxide that we've emitted as a society," he says. He and his colleagues are gearing up to test their process in two similar Caribbean coves, one acting as an untouched "control" in the experiment.

There remain many unknowns. Would such an intervention work? Who gets to decide if it should go ahead? Could there be side-effects? It is complex chemistry, and the natural process of weathering would be accelerated to an unnatural pace. Our understanding of the workings of the ocean is a mere drop in the proverbial. But with our race to mend the planet having taken on Sisyphean overtones, there is still hope that the vast, churning seas can be our lifeline.

There are many ingenious ideas being discussed. Coastlines could be rewilded with underwater forests of kelp or seagrass, surface water cooled by generating air bubbles to whoosh cold water up from the deep, and marine clouds sprayed with seawater to reflect more heat from the sun.

As the UK prepares to host the UN Climate Change Conference (Cop26) in November, dozens of these projects are being trialled. Most rely on the ocean's many natural balance-restoring processes: enhancing them to help slow cooling, to lock away carbon, to protect Arctic ice or even to reduce the threat of hurricanes.

Nobody knows if these concepts will work, or what consequences there could be. They all qualify as geoengineering – a dirty word for some environmentalists. Human intervention in the natural world has often gone awry: cane toads unleashed in Australia in the 1930s to protect sugar crops continue to decimate native fauna. And there is always the prospect of high carbon-emitting industries viewing such solutions as an excuse to dodge their emission-cutting commitments and maintain business as usual.

Gaurav Sant, director of the UCLA Institute for Carbon Management, says there is no longer time to waste debating. "What else could happen? The short answer is we don't know, and I don't think anybody else does either. We're simply going to have to do this and find out. Sant is referring to another concept, which he is helping to develop just a few hundred miles down the coast from Green, where UCLA engineers have developed a machine that mimics how seashells form. Called a flow reactor, the machine sucks seawater in, and an electrical charge makes it alkaline, which triggers the CO_2 to react with the seawater's magnesium and calcium, producing limestone and magnesite (like forming shells). The water then flows out and, depleted of its captured CO_2, is ready to take up more. A byproduct of this process – hydrogen – can be extracted for fuel.

It's a similar concept to weathering olivine in the ocean, and Sant's plan is for initial small studies before a gradual scaling up. The team aims to remove between 10 and 20 gigatonnes of CO_2 from the atmosphere, starting in 2050. Sant says it will be a huge challenge to build a system large enough – and then to build thousands more. "Anyone saying 'we're going to do this in five years', is greatly underestimating the challenge," he says. "We're talking about an enormous enterprise, the size and scale of which humanity has not seen before."

The sheer scale of geoengineering needed to tackle the climate crisis means that even well-known ideas are floundering. The notion of boosting phytoplankton blooms, tiny floating plants that absorb CO_2 when they photosynthesise, and can be helped along by nutrients, such as iron, was much mooted. But Jean-Pierre Gattuso, research director at the Laboratoire d'Océanographie de Villefranche in Paris, says the latest research suggests the idea is not viable. "Ocean fertilisation experiments were performed at sea demonstrating that iron addition can trigger a phytoplankton bloom," he says. "However, the amount of CO_2 permanently sequestered appears to be small, because most of the organic matter produced is respired back to CO_2 before it has a chance to be stored in the deep ocean. An unintended consequence may also be the creation of low-oxygen areas of water."

Another setback has arisen in the attempt to neutralise methane as it escapes from beneath melting Arctic ice. Methane bubble plumes are increasingly being seen in the Arctic, and Wadhams is frustrated that the Intergovernmental Panel on Climate Change (IPCC) has not yet accepted his theory that, as the ice melts, we could face a catastrophic escape of methane that has been stored for 20,000 years. Estimates, he says, range from 50 to 700 gigatonnes, which could "cause maybe a degree [centigrade] of warming, more or less instantly", bringing forward by 15–35 years the average date at which the global mean temperature rise exceeds 2°C above pre-industrial levels.

The best geoengineering prevention for that relies, again, on the ocean. "If you blow a fine powder, or aerosol, of an iron salt called ferric chloride over the sea surface in the place where methane is bubbling out, it reacts with the methane, producing ferric hydroxide, which dissolves in the water," he says. Frustratingly for the theory's backers, a test voyage this year by the University of Copenhagen found no evidence that it could work efficiently enough to remove the required amounts of the gas.

Like many geoengineering ideas, a potential preventive measure that could cool Arctic waters, and thereby help to keep the methane sealed in the ice comes mired in fear and politics. “Marine cloud-brightening” is spraying a fine mist of seawater into clouds so that the salt makes them brighter, and more reflective of the sun’s heat.

It is already being trialled as part of an Australian government-funded research programme to limit damage to the Great Barrier Reef, and Wadhams believes it could be used on a mass scale. However, he thinks the most urgent need is to deploy it “on a more restricted scale, around the edges of the Arctic” where the methane escape risks are highest. Vessels with tall masts would spray the seawater, in a system being developed by Stephen Salter, emeritus professor of engineering design at Edinburgh University. Wadhams says it’s “the one major method of reducing global warming and saving us from methane attack … But there’s a lack of understanding of it, lack of vision and of course, lack of money. It will cost a few tens of millions to get this thing going.”

But even as Wadhams believes the process will be harmless, Ray Pierrehumbert, professor of physics at Oxford University, sees red flags. “A lot of weather patterns like monsoons depend on the difference in heating between the continents and the oceans,” he says. “If you do something to cool down the North Atlantic, let’s say to preserve the sea ice or Greenland glaciers, that shifts precipitation in the tropics. Every part of the atmosphere is connected, so if you don’t balance your warming and cooling very carefully, then you get all sorts of changes in the climate system, some of which are difficult to predict.”

A graver risk, he says, is viewing technology such as this as a way to avoid reducing emissions. “Once you emit CO_2, its warming effect will continue for thousands of years. Whereas marine cloud-brightening relies on particles that fall out of the atmosphere after, maybe, seven days. So you have to renew them every week. And if you come to rely on it for something like keeping the Great Barrier Reef from dying, you have to continue doing it for ever. But all sorts of things could happen to force you to stop – wars, whatever – and if you do stop, then you get this extremely rapid, catastrophic warming.”

Attempts to hack the weather are controversial. A method of solar radiation management, supported by Bill Gates, which would involve sending particles into the stratosphere to reflect sunlight**,** was described as a billionaire trying to blot out the sun. And cloud-seeding rarely appears without the accompanying phrase “playing god”. But that isn’t deterring the people behind another new ocean geoengineering project to tackle hurricanes by cooling the surface water where they form.

In 2017, with his brother Bjorn, Olav Hollingsaeter, a former Norwegian navy submariner, started OceanTherm to repurpose established technology to reduce storm intensity. During Norwegian winters, OceanTherm uses “bubble curtains” to release compressed air into deep water. These push warmer water to the surface, which stops harbours freezing over. Deploying bubble curtains in warmer waters shoots colder deep water upwards, cooling the surface. Hollingsaeter is in talks with decision-makers in areas affected by hurricanes around the Gulf of Mexico, but his quest is complicated by legal and ethical concerns. A similar “hurricane slayer” project by Alan Blumberg, the oceanographer behind an attempt to cool surface water by pumping colder water up, told the Washington Post in 2019 that his research stalled over fears it might change the landfall of a storm, or increase its flooding impact.

Hollingsaeter claims his design improves on Blumberg’s . “When you’re pumping colder water to the surface, the cold water is much heavier and will sink. But the bubble curtain mixes the water temperatures all the way up, so there’s a thick layer of cooler water.” He admits that nobody knows

if cooling surface water could change a storm's trajectory or power but argues that the potential benefits make it worth further research.

Rewilding coastlines is perhaps an easier climate crisis mitigation plan to get behind. There are three types of "blue carbon" coastal ecosystems that store carbon in sediment or soil: mangroves, salt marshes and seagrasses. Together, they absorb more carbon than land forests, and the carbon escapes only if the ecosystems are destroyed. Unfortunately, this is what has happened to half of the world's mangroves and many salt marshes, as coastlines are cleared of natural landscapes. In the UK alone, more than 90% of seagrass meadows have been lost to coastal development, anchor damage and algae-feeding pollution.

There are efforts to restore these habitats, as well as to encourage the growth of kelp, which absorbs an estimated 600m tonnes of CO_2 a year globally. Restoration is a local issue: in the UK, Project Seagrass is laying rope and seed to create new sea meadows and the Wallasea Island Wild Coast initiative in Essex is building up salt marshes using clay, chalk and gravel dug out by the Crossrail tunnelling in London. In Kenya, where mangrove wood is used for charcoal, shipbuilding and carpentry, conservation organisations are working together on long-term mangrove restoration projects.

Yet Gattuso believes that, while blue-carbon ecosystems need to be conserved and restored anyway, their potential effects on climate is limited. Meanwhile, the other ocean-based measures that do not involve rewilding "are either at concept stage or risky", he says. "I wish that countries would put less emphasis on these approaches and return to the well-known, safe and most effective approach, which is to decrease sources of greenhouse gases," he adds. "This is where the urgency is."

5.Can old traditions and tech help Singapore reach zero waste?

Extracts from an article by Peter Hoskins, BBC Business reporter, Singapore, 19 June 2021

You can hear Madam Ng trundling down the road long before you see her. In the quiet of the early morning, the low rumble of her heavily laden trolley reverberates through the streets of the historic Tiong Bahru area of Singapore. Madam Ng is a karang guni trader, one of the rag and bone collectors who have traditionally picked up the things people throw away. This includes everything from old newspapers, drinks cans, second-hand clothes to unwanted electronic devices. They usually sell them on to other karang guni traders or recycling firms.
Karang guni itself comes from the Malay term for the large hessian sacks that they traditionally used to carry their goods. Nowadays, these have been replaced by trolleys like Madam Ng's, often four-wheeled flat-bed carts, or two-wheeled sack trolleys as well as trucks and vans.

Madam Ng became a karang guni more than three decades ago, as she wanted to make extra money to help pay for one of her daughters to study abroad. Now, aged 78, her daily work routine would be daunting for many half her age. "Every day I wake up at 4am and am out of the house by 4.30am. I push my cart around the neighbourhood, collecting discarded newspapers and cans. I am out for about four to five hours, then I go home and I'm done for the day."

While rag and bone collectors may seem like an echo from the past in many countries, they are still part of Singapore's present and most likely its future. Singapore is known as one of the cleanest cities in the world, and its army of collectors are the city-state's original recyclers. Even in this US$380bn economy, the government sees them playing a crucial part in its sustainability programme.

The Singapore Green Plan 2030 covers a whole range of sustainable goals, including cutting the amount of waste sent to landfill by 30% within the next decade. The recycling business was hit hard by the pandemic as the volume of material Singapore recycled dropped, as the global economy was shut down to slow the spread of Covid. The sudden halt saw the country's overall recycling rate, for homes and businesses combined, fall to 52% in 2020 compared to 59% the previous year.

The National Environment Agency (NEA), which is charge of Singapore's recycling efforts, thinks that this was just a blip and is now focussed on plans to become a zero-waste economy. Christopher Tan, director of NEA's sustainability division says he sees karang guni men and women playing a role in the city-state's recycling network as it aims to hit that ambitious zero-waste target. "They can complement the current collection methods. There's still the challenge of getting the recycling from the door of your home. They have networks. They have knowledge of what can and what cannot be recycled," he says.

Singapore relies on the private sector to manage the island's rubbish collection, waste disposal and recycling services - and it is these firms that are working with the karang guni industry. One such firm is SembWaste. It has created an app - ezi - that helps to connect the karang guni collectors with the company during their working day, as well as members of the public who want recycling collected from outside their homes. "We have forged partnerships with a network of karang gunis... with more than 100 of them as part of the ezi network," says Goh Siok Ling, SembWaste's commercial director.

At 32, Aiden Ang is part of the new generation of karang guni traders. After graduating with a diploma in telecommunications engineering he chose to follow in his father's footsteps to join the clothing recycling business rather than pursue a more mainstream career. Despite the downturn in recycling due to Covid, Mr Ang is confident the industry has a promising future. Mr Ang sees the use of apps as a big step forward, "with young blood in the company we can run the business in a better way, especially with technology". He says this is what helped convince him to enter the trade - and to improve it.

"It is super convenient for the residents interested in participating in the recycling drive. For us as the operator, it helps us to organise the operational flow and handle the transactions very efficiently." Mr Ang also points to opportunities he sees for young people, as the trade is currently dominated by older karang guni collectors, like Madam Ng, many of whom are nearing retirement.

Ross Rutherford

ESR Newsletter Editor

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