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DECARBONISING A PROSPEROUS NEW ZEALAND

A Beca think-piece on how our post-COVID-19 recovery and rebuild opportunities could support decarbonizing New Zealand and contribute to a future of sustainable prosperity.

Beca 100 1920 2020

Inspiring one century. **Innovating the next.**

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Decarbonising for a Prosperous New Zealand

Leaders across Beca have prepared this think-piece for Ignite Your Thinking - and to contribute to the ongoing discussions with all New Zealand about how we can get the best outcomes from the significant recovery and economic rebuild being proposed post COVID-19. The scale of investment we are making and the legacy of this for future generations, means it is critical that we take this opportunity to significantly accelerate the decarbonisation of our economy. By taking this approach our recovery will support a prosperous and more equitable and sustainable society.

The effects of global temperature rise (global heating) is arguably the greatest threat facing humanity. If we don't act now to bend the curve and rapidly reduce greenhouse gas (GHG) emissions, we will face challenges far greater than those we've already faced in 2020.

> "By 2030 we need to reduce non-biological GHGs by 50% (≈21MtCO_2e/year), and biological GHGs by 10% (4MtCO_2e/year)."

Our climate is changing rapidly. Even if we successfully halve emissions by 2030 and reach net zero by 2050 the climate will continue to approach 1.5°C of warming. The impacts of this will be felt across the world. With respect to New Zealand, this is expected to result in an increased number of extreme weather events such as sea-level rise, flooding and droughts, heat waves, changes to season durations, more hot days and fewer cold days, as well as climate refugees and increases in vector borne disease.

This means that in parallel with reducing our GHG emissions, we must plan and provide for climate adaptation and built and natural environment resilience in these changes.

Our Beca think-piece proposes transition opportunities that will reduce our emissions and build resilience to climate change, in a way that will also contribute to a more sustainable and prosperous future; by responding to the challenges of unemployment, soil degradation, poor quality and unaffordable housing, biodiversity loss, economic insecurity, poor air quality in urban centres, polluted waterways, inequality, overexploitation of resources, reliance on uncertain supply chains, and poor waste management.

We propose that New Zealand must find solutions to deliver a prosperous economy that simultaneously increases equality and community wellbeing. It must also protect and enhance our natural ecological systems upon which we depend. We believe a strong focus on tackling emissions will provide co-benefits to a range of sustainability challenges.

We have identified eight key transitions that would best enable us to rapidly shift to a low-emission economy, while simultaneously creating jobs and addressing many of New Zealand's critical challenges and moving to a prosperous, circular and equitable economy.

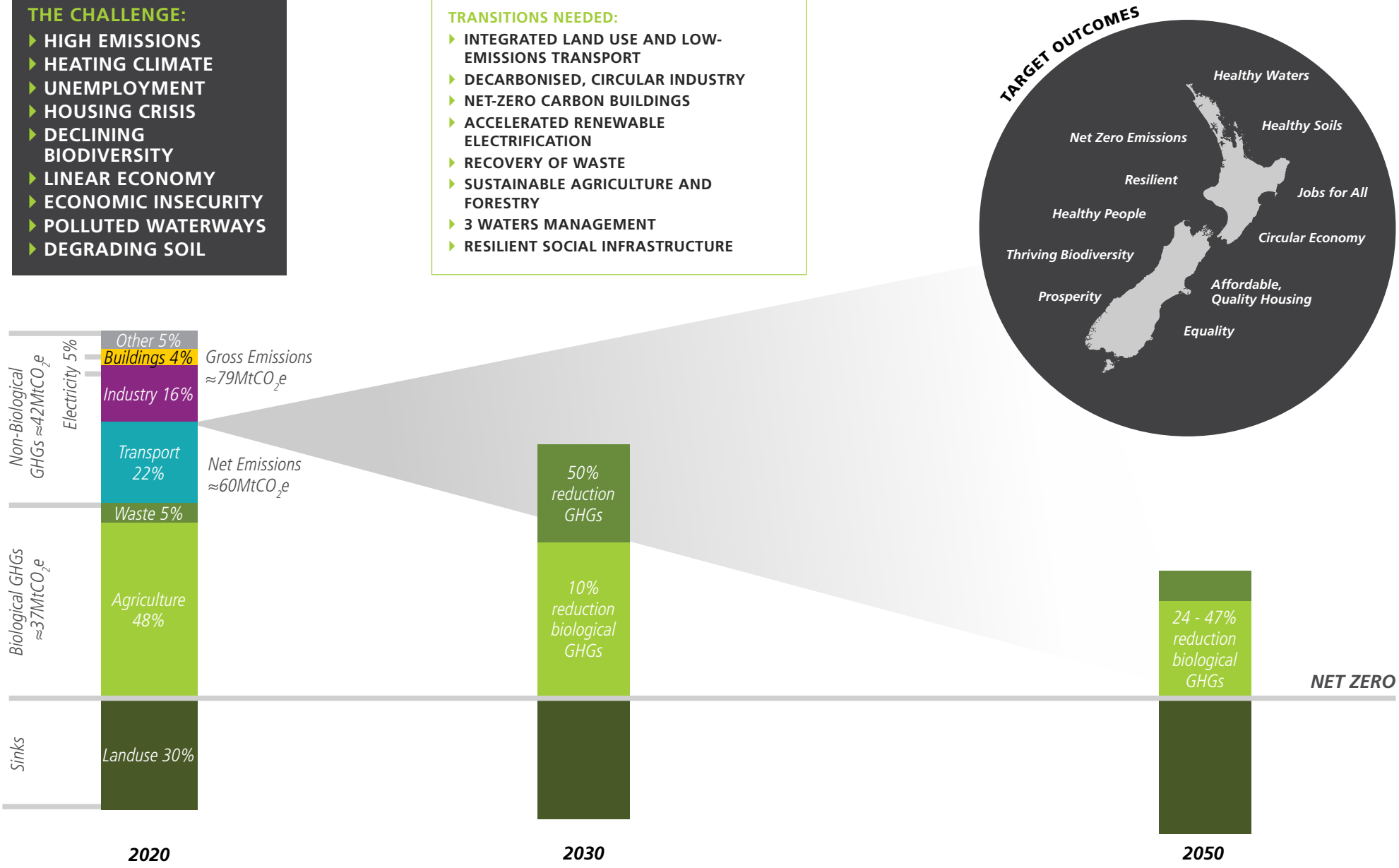
These transitions are summarised on the following page, and expanded on through this report.

THE CHALLENGE:

- HIGH EMISSIONS
- HEATING CLIMATE
- UNEMPLOYMENT
- HOUSING CRISIS
- DECLINING BIODIVERSITY
- LINEAR ECONOMY
- ECONOMIC INSECURITY
- POLLUTED WATERWAYS
- DEGRADING SOIL

TRANSITIONS NEEDED:

- INTEGRATED LAND USE AND LOW-EMISSIONS TRANSPORT
- DECARBONISED, CIRCULAR INDUSTRY
- NET-ZERO CARBON BUILDINGS
- ACCELERATED RENEWABLE ELECTRIFICATION
- RECOVERY OF WASTE
- SUSTAINABLE AGRICULTURE AND FORESTRY
- 3 WATERS MANAGEMENT
- RESILIENT SOCIAL INFRASTRUCTURE



*2020 emissions based on New Zealand's Greenhouse Gas Inventory 1990 - 2018 *$MtCO_2e$ is million tonnes of carbon dioxide equivalent greenhouse gas emissions.

The key transition opportunities we see for New Zealand

1. **Transport:** Strategic, climate resilient transport network planning that reduces private vehicle use; prioritised through land development that encourages public transport, walking and cycling, and flexible transport corridor design. Minimising emissions of remaining vehicle fleet through electrification and green hydrogen.
2. **Industrial product manufacturing:** Minimising inputs of energy and outputs of waste through the development of circular industrial ecosystems. Investments focusing on efficient processes and technologies including digital solutions and transitioning remaining energy needs from fossil fuel-based systems to electric, biomass and green hydrogen alternatives. Leveraging New Zealand's low-carbon grid by growing our high-value, low-carbon export markets.
3. **Electricity:** Expanding renewable electricity capacity, transmission and distribution to enable the decarbonisation of transport and industry. Decarbonising the electricity grid by focusing on large scale wind; enabling distributed photo-voltaic generation, and investing in green hydrogen generation and storage.
4. **Built environment:** Rethinking the way we use spaces and upgrading existing building stock to minimise the demand for new buildings. Improving building codes, design practises and the use of smart building technologies to maximise building energy efficiency and replacing fossil fuel-based systems with electric and alternative fuel-based systems. Prioritising sustainably sourced timber for structures to avoid carbon-intensive materials and to sequester carbon and decarbonise concrete and steel.
5. **Agriculture and forestry:** Prioritising water management to mitigate climate risks. Continuing to increase best practise farm management including support and implementation of on-farm planting. In this transition, promote ongoing research and development to minimise enteric fermentation emissions, and build our capacity to provide international leadership in low-emission agriculture. Expanding forest industries.
6. **Recovery of waste:** Maximising the embedded energy in waste by re-use in a circular economy that supports new business opportunities. Targeting high-value streams for recycling such as PET, organics and key nutrients in wastewater. Supporting these transitions and driving product design change and alternative ownership-and-use models by shifting the responsibility for waste through legislative change and increasing landfill tax on producers.
7. **3 Waters:** Diversifying water supply and treatment, expanding the use of biogas from wastewater for energy generation and reusing biosolids to fertilise land. Mandating water sensitive design and using smart technologies to control wastewater treatment.
8. **Social Infrastructure:** Resilient social infrastructure will be needed to support the above transitions including healthy public housing, green healthcare and education facilities, a focus on public health and low-carbon healthcare products, and skills development particularly in green technology.

TRANSPORT

THE CHALLENGE:

- HIGH EMISSIONS
- HEATING CLIMATE
- UNEMPLOYMENT
- HOUSING CRISIS
- DECLINING BIODIVERSITY
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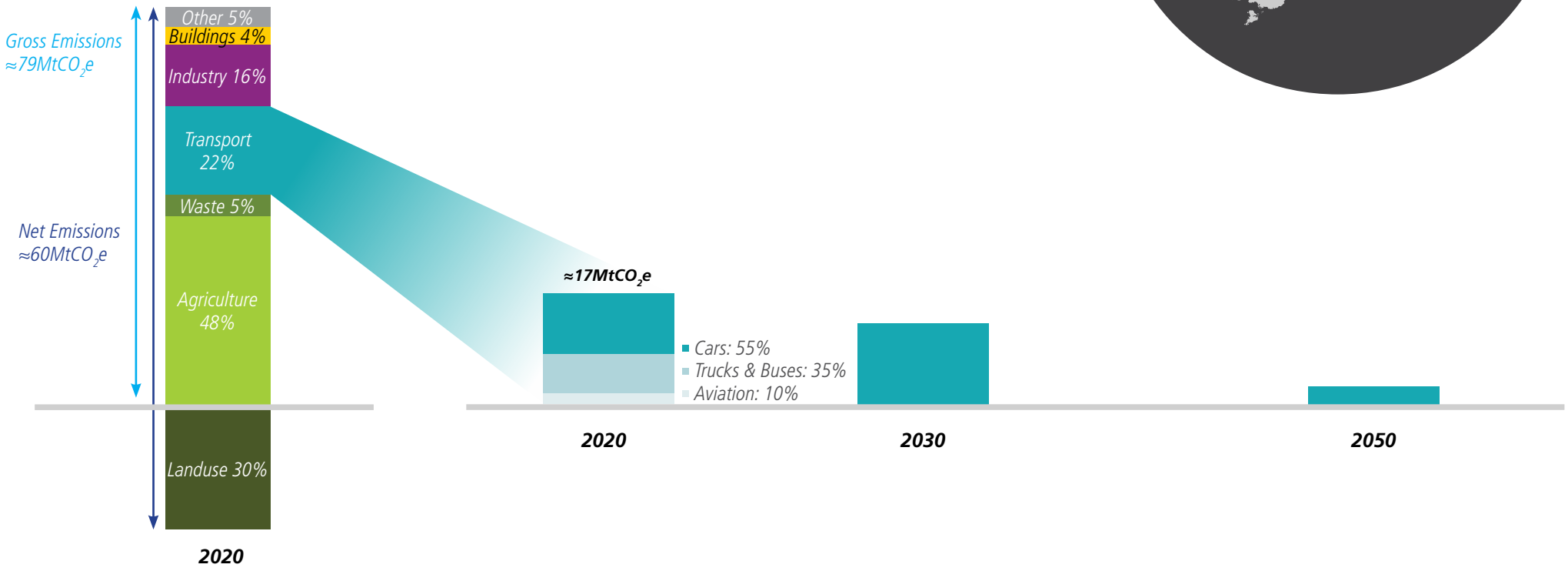
- ECONOMIC INSECURITY
- POLLUTED WATERWAYS
- DEGRADING SOIL

TRANSITION: TRANSPORT:

- STRATEGIC TRANSPORT NETWORK PLANNING
- TRANSIT AND ACTIVE-MODE ORIENTED LAND DEVELOPMENT
- MINIMISING TRAVEL DEMAND
- ADAPTIVE TRANSPORT CORRIDORS
- LOW-EMISSIONS VEHICLE FLEET
- RESILIENT TRANSPORT SYSTEMS



Transition: Land Transport Systems

CHALLENGE STATEMENT

Movement of people and freight will continue to be essential to maintaining our society, but we must reduce the environmental impacts and plan for resilient systems. Energy use associated with transport systems contributes roughly 17MtCO_2e/year,[1] approximately 20% of national greenhouse gas (GHG) emissions and is a significant source of air and water pollution. Of this, 90% is land transport. Some environmental impacts of building and maintaining transport systems are often typically mitigated, however there is significant opportunity to do more. A future focused view of the long-term risks from climate change will support greater investment in the development of a more resilient and adaptive transport network.

KEY OPPORTUNITIES

Beca's transport and community shaping specialists have identified the key opportunities for transformation of land transport systems below.

Strategic transport network planning: 90% of transport emissions are from road transport. Cars contribute approximately 9.5MtCO_2e/year, and trucks and buses a further 5.6MtCO_2e. There is an urgent need to **reduce low occupancy, high-emission vehicle use by:**

Projects supporting transit and active mode-orientated land development: A focus on strategic active mode projects that support unhindered city centre access, and those on key spine routes linking new developments to embed new behaviours. Continued focus on projects to increase public transport capacity and importantly access to it, is necessary to support recovering patronage and confidence and remains part of our post-COVID-19 future.

Projects managing and reducing travel demand: Initiatives that leverage off working-from home and flexible work times will help to 'flatten the peak' and address reduced public transport capacity. COVID-19 has fast-tracked the ability of many organisations to encourage remote working for employee and students. Continued investment in remote working technologies and development of "work-hubs" for those without good work-from-home conditions would further promote remote working. Intelligent transport systems (including safe rideshare apps) should enable better trip management. Prioritise higher-productivity movement through key corridors that help increase vehicle occupancy and system productivity. Careful consideration of reducing parking provisions and timing of applying congestion charges is needed, but both should be progressed. The current rapid uptake of micro-mobility/e-modes should be supported through infrastructure and policies.

Projects with adaptive transport corridor design: Provide transport corridors that demonstrate flexibility and an adaptive approach, to allow changes in their function and physical interfaces, that respond to changes in land use and the way we move around in the future.

Benefits include improved air quality, more equitable access to jobs and services, reduced travel costs, and improved housing affordability (enabling people to live further away from urban centres).

Reduce emissions of vehicle fleet: Prioritise transition to low-emission and electric vehicles through the provision of charging infrastructure, financial incentives, designating EV/low-emission-vehicle lanes and traffic zones, improving vehicle emission standards, and accelerating the update of the existing fleet. For freight, priority should be to upgrade and electrify regional rail networks, and use efficient coastal shipping. Green hydrogen fuel infrastructure could be tested to support low emissions road freight. Fleet electrification will require expansion of electricity capacity and enhanced management of peak demand. Batteries also have limited life expectancy and integration of projects for recycling and reducing costs should be progressed.

Climate resilient infrastructure: Approximately 2,100km of roads are exposed to a 1.5m sea level rise with a replacement value of $1 billion.[2] Priority should be for projects that support Council climate adaptation planning and avoids at-risk floodplains and coastal areas.

THE CHALLENGE:

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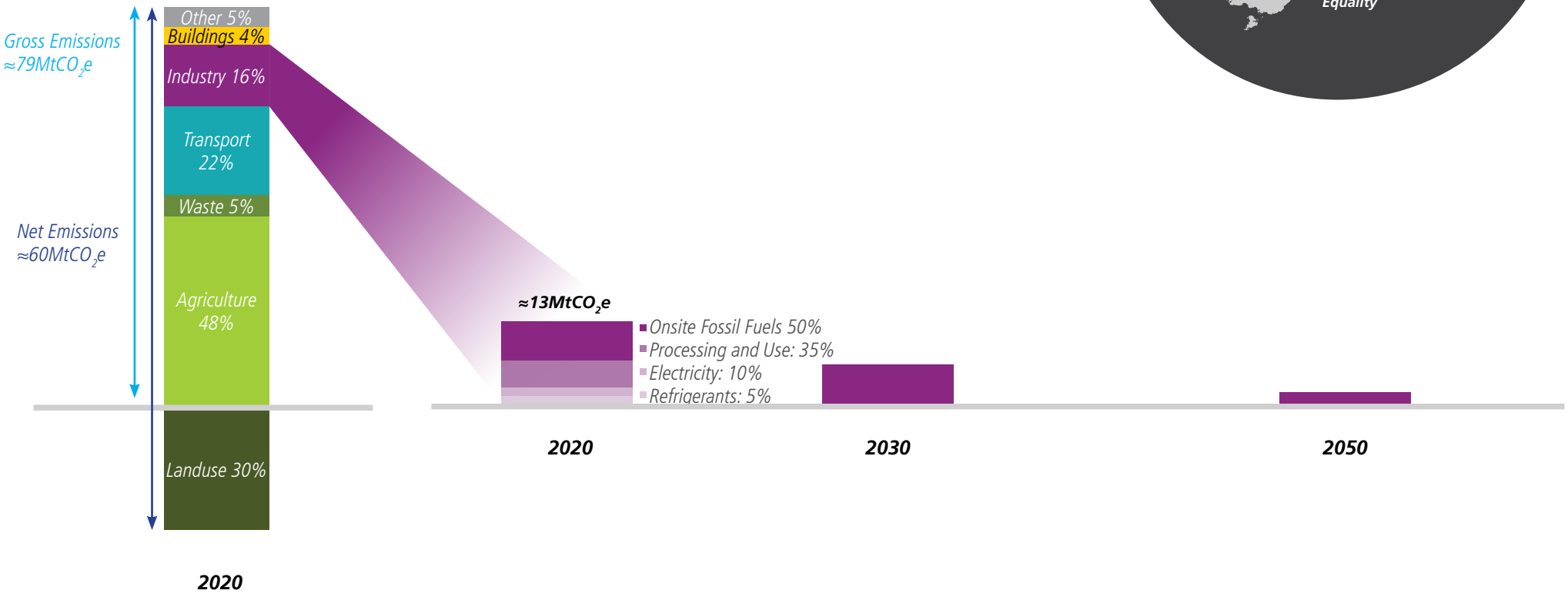
TRANSITION: INDUSTRY:

- HIGH-VALUE LOW-CARBON PRODUCTS
- RENEWABLE PROCESS HEAT
- REFRIGERANT UPGRADES
- CROSS-SECTOR INITIATIVES



Transition: Industrial Product Manufacturing Systems

CHALLENGE STATEMENT

Industrial manufacturing produces the goods we require for both domestic consumption and export revenue. It is also an excellent vehicle to create a range of jobs within New Zealand, plus the COVID-19 pandemic has highlighted the importance of production, certainly in respect of essential items. However, from a sustainability perspective, there are several challenges for industry. Some 13 $MtCO_2$[1] has been attributed to this sector (approximately 16% of New Zealand's gross emissions), predominantly the result of process heating. High levels of water use and wastewater creation can also pose a challenge for local environmental systems and can constrain industrial intensification without ongoing innovation and investment. Beca's industrial specialists have identified the following opportunities to move New Zealand to a lower carbon manufacturing sector.

KEY OPPORTUNITIES

High-value low-carbon products: A low carbon manufacturing sector supplying high value products to discerning consumers globally would have less of an environmental impact and the potential to create more economic value. Investment in the development of industrial ecosystems, and renewable technologies could provide highly skilled jobs in many regions. For example, hosting data centres, production of ammonia, aluminium and other energy intensive processing. As an example, aluminium produced in New Zealand has one of the lowest carbon footprints per tonne of aluminium so will become increasingly cost competitive on a global scale when accounting for the cost of carbon. The below initiatives will further de-carbonise New Zealand's products.

Investments in renewable process heat:

- Focused investment in advanced optimisation of existing processes.
- Projects converting from fossil fuel to electric boilers/ heat-pumps for low to medium heating. This can be constrained by the electricity transmission network and return on capital. Targeted projects to upgrade the transmission network capacity in unison with government support to decrease cost of non fossil-fuel process heat would create conditions for adoption and change. Additional renewable electricity generation is also required (see Electricity Transition). Electrification of 4TWh of energy would give savings of 1.9$MtCO_2e$ (assuming 92% renewable electricity from the grid).[2]
- Projects supporting replacement of coal with biomass would create jobs to manufacture and install the new equipment. However, large sites are constrained by available quantities of local fuel. This would require a long-term plan for regional afforestation and a larger forestry industry to provide the required biomass for future conversions.
- There is also potential to utilise green hydrogen formed from renewable electricity for process heat, with current technology enabling the potential blending with natural gas in existing distribution systems. This would also create new job opportunities with a new hydrogen industry.

Refrigerants Upgrade Projects: Replacement of high global warming potential refrigerants (such as hydrofluorocarbons) with natural refrigerants (e.g. ammonia and CO_2) would reduce New Zealand's greenhouse gas (GHG) emissions by up to 0.8$MtCO_2e$.[3] The challenge is to support companies to reduce the economic burden of process safety management (particularly SMEs) associated with natural refrigerants and the capital cost for these upgrades. Rational integration of heat pumps with refrigeration is an opportunity that users will also require assistance with.

Support for Cross-sector Initiatives: Organisations can partner to move towards a circular economy. For example, creating recycle loops for PET packaging, or treating high chemical oxygen demand (COD) dairy waste in shared municipal wastewater biodigesters creating biogas for heat and electricity cogeneration. Supporting economies of scale will allow more effective recycling/regeneration and create additional value streams. There are several areas where cross-sector focus is occurring and more are required.

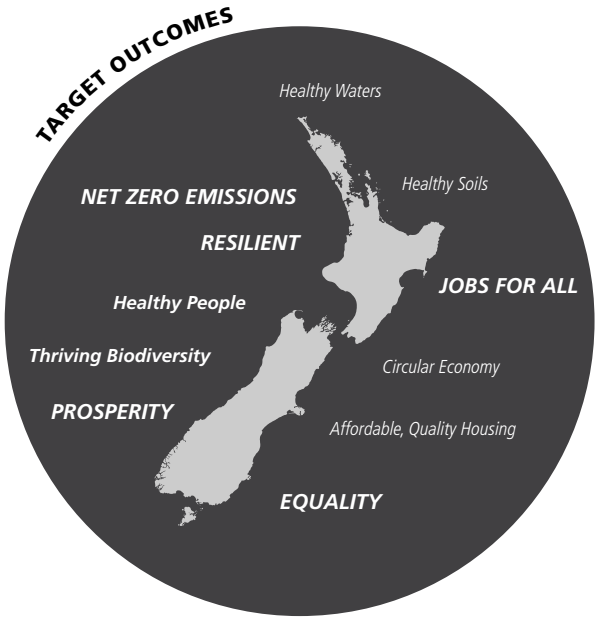
ELECTRICITY

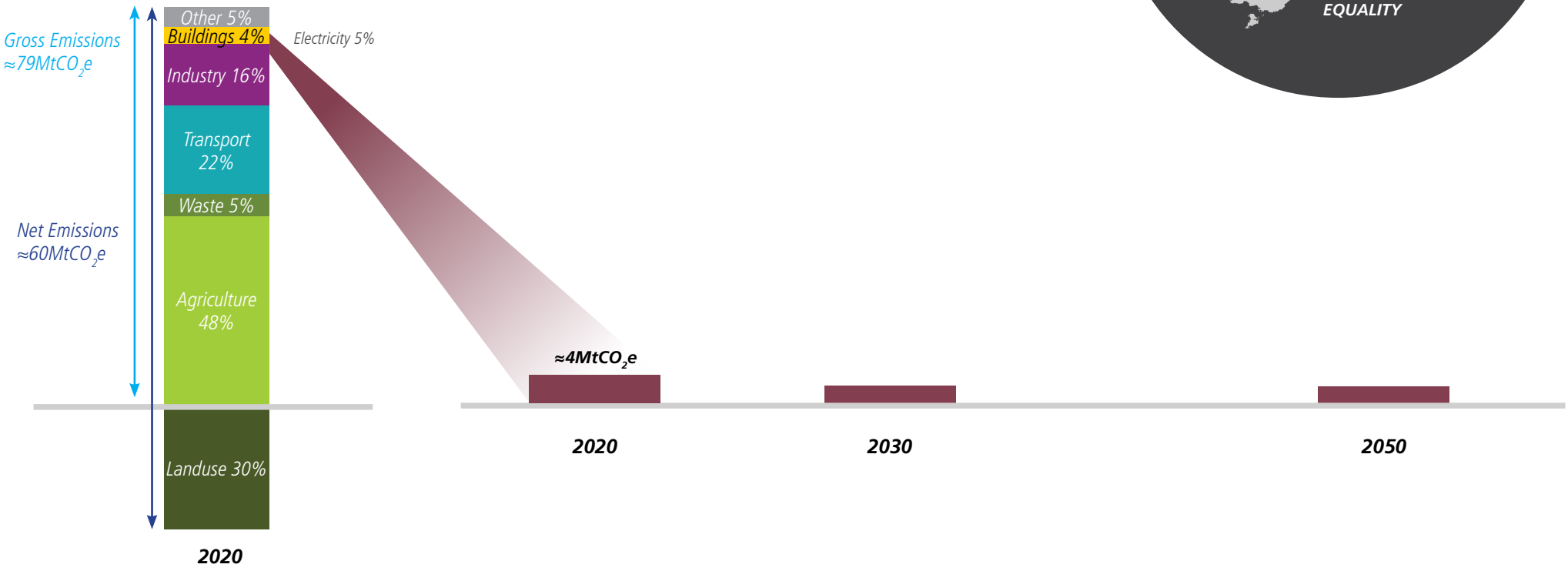
THE CHALLENGE:

- HIGH EMISSIONS
- HEATING CLIMATE
- UNEMPLOYMENT
- HOUSING CRISIS
- DECLINING BIODIVERSITY
- LINEAR ECONOMY
- ECONOMIC INSECURITY
- POLLUTED WATERWAYS
- DEGRADING SOIL

TRANSITION: ELECTRICITY:

- SUPPORTING ACCELERATED ELECTRIFICATION
- UTILITY SCALE WIND & RENEWABLE ELECTRICITY
- TOWARDS 100% RENEWABLE
- REGULATORY SYSTEMS & RENEWABLES FINANCING





Transition: Electricity Systems

CHALLENGE STATEMENT

New Zealand's electricity grid has a high proportion of renewable energy (approximately 82%) and as a result, only contributes ≈4MtCO_2e/year, approximately 5% of national GHG emissions. Electricity is an essential service providing household heat, light and communications, however its cost has led to "energy poverty" in some low-income households.[1] Further, in order to substitute fossil fuel energy with electricity, we will need to expand electricity infrastructure, particularly as we transition to greater use of electric vehicles. All electricity infrastructure has some environmental impacts and some, like visual impacts are often opposed by local communities.

KEY OPPORTUNITIES

Beca specialists have identified the following key opportunities for grid electricity transitions which could be progressed as part of our Wave-3 recovery:

Supporting Accelerated Electrification: The greatest opportunities for rapid decarbonisation in New Zealand include a rapid shift from fossil fuel-based energy to electricity in transport and industry. Grid capacity will need to expand to help support this and additional transmission and distribution networks and/or upgrades may be required to support high process heat users. Fast tracking this will create employment opportunities throughout the country.

Utility Scale Wind & Renewable Investment: Utility scale wind will be an essential component of both accelerating electrification and transitioning towards 100% renewable electricity. Unit costs of photovoltaic, wind and green hydrogen generation, plus energy storage including batteries are declining.[2] These can all be used to further support a renewable grid and growth in renewables aligns with the government's target of a 100% renewable grid by 2035. Many renewable energy systems have previously been consented but not built, making these highly suitable for a preliminary focus in Wave-3. Green hydrogen generation and storage can be used to support a renewable grid and has the potential to become a future export. Accelerated development of hydrogen capability in New Zealand would create high-value jobs, and help to position New Zealand as world leaders in hydrogen.

Enhanced Management of Hydropower: Existing hydropower will continue to play a major role in New Zealand's electricity systems. It is the largest source of electricity currently and plays a key role in balancing fluctuating supply of other renewable sources. However, some of the water bodies servicing hydro generation are in poor condition.[3] Projects that prioritise the management of water bodies, considering both ecosystem health and cultural values will support management of hydropower.

Towards 100% Renewable Electricity: Fossil fuel-based electricity must be rapidly phased out to reduce emissions, and dependence on fossil fuels. Growing New Zealand's renewable capacity should be a key focus during the post-COVID-19 recovery. However, while long term goals need to include the complete phase out of fossil fuels, it would be more cost effective to focus in the first instance on increasing renewable energy generation during this post-COVID-19 transition before targeting 100% renewable energy.

Regulatory Systems & Renewables Financing: We believe that regulatory and financing changes will be needed to enable accelerated electrification and growth in renewable energy. The streamlining of consent processes for renewable energy solutions and transmission network installations and upgrades should be undertaken to enable an accelerated growth in renewable energy and access to electricity and associated job creation. It is our view that new financing models may be needed for renewable systems. Wave-3 initiatives should include modelling of future financing mechanisms and the development of clear road-maps that address challenges such as price structures, enabling and incentivising distributed energy and storage (e.g. from rooftop solar, electric vehicles and household batteries), and different roles for key stakeholders including government, electricity suppliers, transmission and distribution companies, and end users.

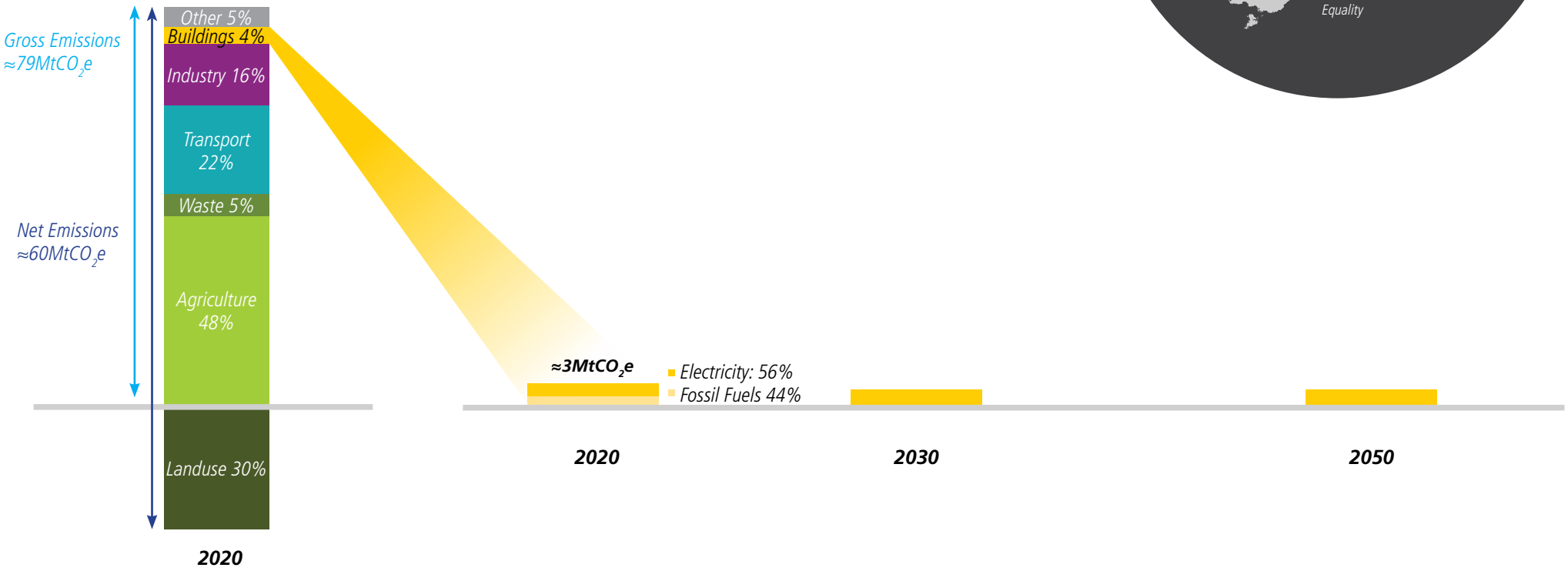
BUILDINGS

THE CHALLENGE:

- HIGH EMISSIONS
- HEATING CLIMATE
- UNEMPLOYMENT
- HOUSING CRISIS
- DECLINING BIODIVERSITY
- LINEAR ECONOMY
- ECONOMIC INSECURITY
- POLLUTED WATERWAYS
- DEGRADING SOIL

TRANSITION: BUILDINGS

- UPGRADE & REPURPOSE BUILDING STOCK
- MORE EFFECTIVE BUILDING USE
- MINIMISE ENERGY DEMAND
- DECARBONISE CONSTRUCTION MATERIALS
- EXIT FOSSIL FUELS



Transition: Built Environment

CHALLENGE STATEMENT

While good building design can have a positive influence on our health and wellbeing, the built environment also has impacts on our natural environment and climate. Only 4% (≈3.2MtCO_2-e/yr) of emissions can be directly attributed to building energy consumption during operation. However, a significant proportion of the emissions associated with the manufacture of key building materials and transport can also be attributed to building construction. The built environment will also be impacted by the effects of global heating; including sea level rise, flooding, overheating, and severe weather events. The house price-to-income ratio of New Zealand homes is classified as "severely unaffordable" (although COVID-19 may effect a fall in house prices) and many New Zealander's live in poor quality, damp homes that they cannot afford to heat. In addition to challenges faced, there are also potential opportunities to add value streams both within buildings and as an industry e.g. through leadership in sustainable design and intellectual property, increased productivity in construction and building use/ operations, and export opportunities.

KEY OPPORTUNITIES

Beca buildings specialists have identified the following key opportunities for built environment transitions as priorities for economic recovery:

Upgrade and repurpose existing building stock: Upgrading and repurposing existing building stock is substantially less carbon intensive than building new, due to the carbon intensity of many building materials and associated construction process. Existing buildings can often be brought up to similar energy efficiency, health and wellbeing standards as top performing new builds for a fraction of the cost.

Increased remote working could lead to opportunities such as repurposing central offices to residential spaces, which would simultaneously increase housing availability and reduce GHG emissions from commuting. Investment in upgrading and repurposing existing buildings through Wave-3 would create quality jobs around New Zealand, improve the efficiency of existing assets and avoid impacts from new developments.

Enabling more effective building use: Many buildings are underutilised, with low or intermittent occupancy (e.g. infrequently used meeting rooms or school buildings that are empty during holidays), with low or no occupancy for many hours of the year. COVID-19 has highlighted the social and environmental benefits of remote working including greater flexibility for workers, reduced reliance on proximity to workplaces and reduced work travel and associated greenhouse gas emissions. Continued remote working could exacerbate underutilisation of spaces. A key opportunity for Wave-3 is investment in projects and programmes that increase the adaptability, effectiveness and efficiency of buildings, such as investment in smart building systems that can be used to extend hours of building use, focusing energy use only on occupied areas to optimise energy efficiency during extended periods of use.

Minimise energy demand: Building code standards, a capital cost focus and the lack of incentives to ensure high energy efficiency has helped lead to poor performance building stock in New Zealand. In commercial buildings, building tuning alone typically achieves 10 to 30% energy and emissions savings with very short financial payback periods.

Warm, efficient buildings reduce emissions and improve health and wellbeing. Energy efficiency measures that help to moderate electricity peaks (that occur during times of peak demand) will also lead to less reliance on fossil fuels for electricity generation.

Decarbonise construction materials: Sustainably sourced timber structures significantly reduce upfront emissions and compared to emissions from cement and steel and, act as a carbon sink / sequestering carbon into our built environment. Projects to accelerate this industry shift could result in significant emissions savings every yea. Expanding timber production for local use and exports would create more jobs and revenue, whilst increasing our total carbon sinks. Some concrete and steel cannot feasibly be replaced by timber. Investing in solutions to decarbonise these materials would also create high quality jobs and revenue streams.

Exit fossil fuels: The combustion of on-site fossil fuels for space heating, hot water and cooking contributes approximately one third of building emissions. Projects should focus on the replacement of such systems with low carbon systems such as heat-pumps and/or alternative energy sources (such as biomass) to significantly reduce emissions.

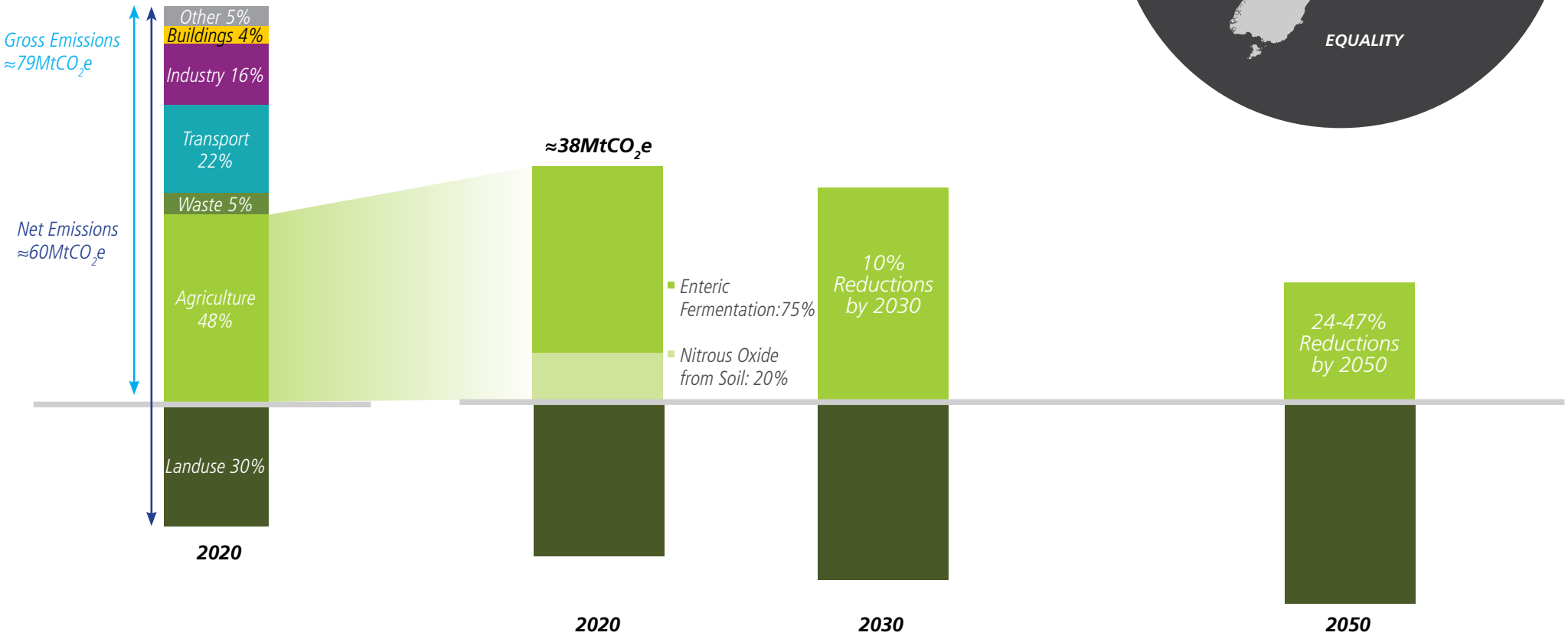
AGRICULTURE & FORESTRY

THE CHALLENGE:

- HIGH EMISSIONS
- HEATING CLIMATE
- UNEMPLOYMENT
- HOUSING CRISIS
- DECLINING BIODIVERSITY
- LINEAR ECONOMY
- ECONOMIC INSECURITY
- POLLUTED WATERWAYS
- DEGRADING SOIL

TRANSITION: AGRICULTURE & FORESTRY:

- WATER MITIGATION FOR CLIMATE RESILIENCE
- R&D FOR EMISSIONS MANAGEMENT
- ON-FARM BEST PRACTICE
- GROWTH OF FOREST INDUSTRIES



Transition: Agriculture and Forest Industries

CHALLENGE STATEMENT

Agriculture, Forest Industries and associated primary production are critical to New Zealand's economic future, with $46 billion in receipts projected for FY20. Our nation's primary businesses produce some of the highest quality natural goods in the world, and we can also lead the world in sector sustainability. However, at present, almost half of New Zealand's greenhouse gas (GHG) emissions can be attributed to agriculture. Leadership in this area is essential to retaining a consumer premium perception of New Zealand agricultural produce. This sector is also particularly at risk from business interruption due to climate change effects. It has a central role to play in ensuring sustainable water use; in protecting our fragile soils and enhancing biodiversity, a stewardship role in protecting waterways from nutrient contamination plus an important community role through providing employment in rural areas.

KEY OPPORTUNITIES

Beca's environmental, water, soil, agriculture, and forest industries specialists propose the following key opportunities to support New Zealand's Wave-3 recovery:

Water management, storage and irrigation: Mitigation of the impacts of climate change, including more intense rainfall, longer and more pronounced droughts. Ongoing investment in large-scale water interception and storage for reduction in flood flows and for agricultural irrigation, represents an opportunity to improve resilience to climate change effects and to provide increased management flexibility for our grass-based agricultural systems.

Greenhouse gas emission reduction mechanisms: Under the Zero Carbon Act, emission reductions of 10% are needed by 2030 and 24 to 47% by 2050.[1] The agricultural sector can go part way to achieving this required reduction through on farm practices, however a focus on new technologies and emission reduction mechanisms will be key to meet these targets and support economic growth. Ongoing programmes to support on-farm planting have been estimated to save 7% of total agricultural GHGs (about 2.5MtCO_2e in total).[2] A top priority should be continued sector-wide research and development (R&D) funding to develop mitigations for on-farm emissions, including reducing enteric methane and nitrous oxide release as well as opportunities for carbon sequestration. Biochar should also be a key consideration. Leadership in low-emission agriculture would create an opportunity for new technology revenue streams and will bolster New Zealand's reputation for environmental stewardship.

R&D to promote on-farm best practice: Progressive farmers have been adapting their farming systems to improve the health of land, water and biodiversity for years, and there have been recent regulatory changes to ensure widespread uptake. New Zealand's primary sector is gradually moving from a maximum production focus to one that is more aligned with environmentally and economically sustainable outcomes. Projects for R&D to validate these positive effects and ongoing information sharing, will be critical to accelerate adoption of identified best practice. These projects can be used to create high value jobs through the COVID-19 recovery and will provide our rural economy an enhanced toolbox from which the primary industry can operate and grow in prosperity.

Focus should be on projects that prioritise greater soil health and associated carbon sequestration; improved water infiltration and retention on land, leading to improved sector resilience to the negative effects of climate change; and to projects and programmes for the reduction in nutrient, sediment and bacterial transfer to our waterways.

Expanding forest industries: Wood is a sustainable resource and an important carbon sink and New Zealand has been focused on forest replanting. Net uptake of carbon from combined impacts of land-use, land-use change, and forestry is approximately a third of New Zealand's GHG emissions (net sequestration of ≈23 MtCO_2e/year). Tree plantations are being used to enhance ecosystems and sequester carbon (e.g. through the One Billion Trees initiative).[3] There is a growing resurgence in the use of timber as a commercial product including use as a building material to replace steel and aluminium; the pulp and paper market for global packaging and tissue; wood pellets to replace coal for industrial boilers; and extractives from plants and wood. As the demand for sustainable products continues to grow, the need for wood as a raw material will increase. Expansion of forest industries that support the use of timber as a commercial product should be prioritised during Wave-3 to create jobs through increased local manufacture and processing and increase revenue streams, increasing our carbon sinks and enhance our environment.

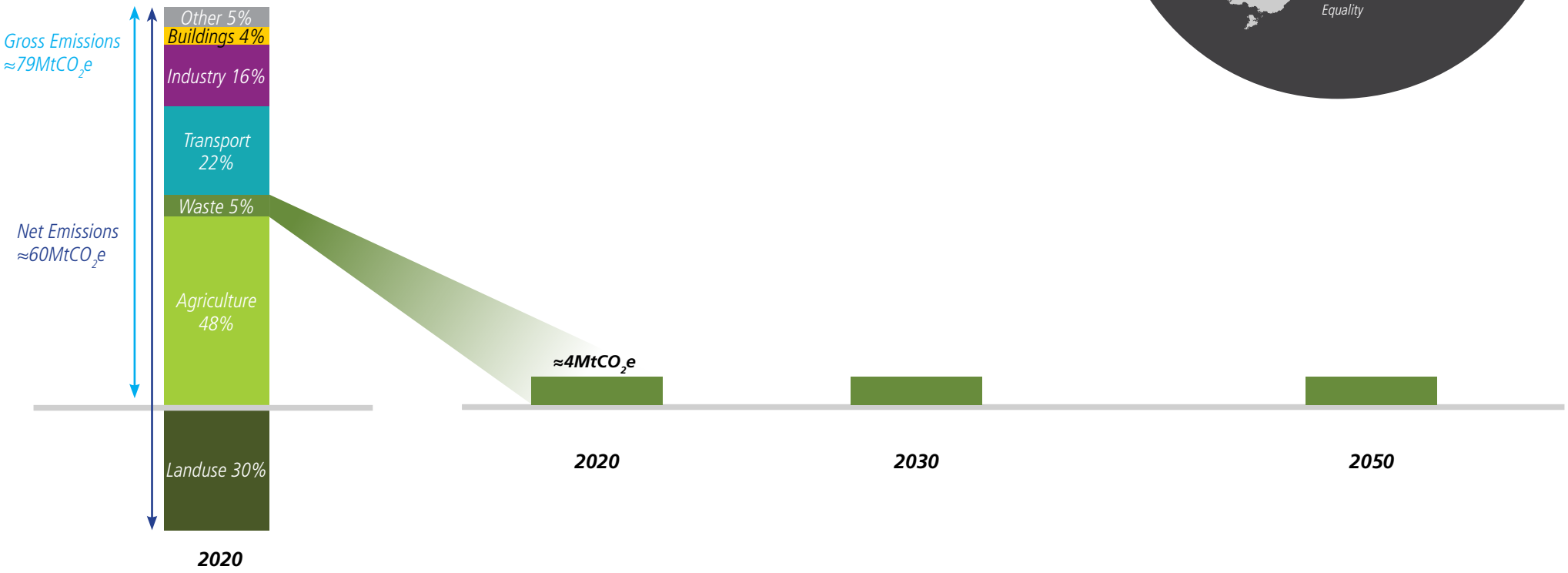
WASTE RECOVERY

THE CHALLENGE:

- HIGH EMISSIONS
- HEATING CLIMATE
- UNEMPLOYMENT
- HOUSING CRISIS
- DECLINING BIODIVERSITY
- LINEAR ECONOMY
- ECONOMIC INSECURITY
- POLLUTED WATERWAYS
- DEGRADING SOIL

TRANSITION: WASTE RECOVERY:

- RECYCLE HIGH-VALUE WASTE
- ANAEROBIC DIGESTION
- INNOVATION FUNDING
- ROAD MAP FOR WASTE



Transition: Recovery of Waste/Circular Economy

CHALLENGE STATEMENT

The circular economy advantage has been stated to be in the billions in GDP growth for Auckland alone and is therefore an exciting mechanism to enable economic growth.[1] It targets waste recovery - a significant challenge for New Zealand with an estimated 3.2 million tonnes of waste being sent to Class 1 landfills each year.[2] The negative impacts of waste to landfill are both the potential degradation of our land and water, and the lost value of reusable or recyclable materials prematurely being designated as "waste". Most waste, before it became waste, had significant energy put into it either through it being grown or via a manufacturing process. At present, our waste system is designed to encourage a linear economy (extract, refine, use and dispose). Contamination and the mixed nature of waste in current waste streams makes it much more challenging to leverage its value, since without a certain degree of purity, materials have little use in available recycling processes.[3]

Our leaders believe that to make the most of our resources, New Zealand needs to prioritise a transition to a circular economy, where pathways exist for valuable materials to be re-used and recycled many times over. This will help address key environmental challenges in New Zealand while creating jobs and supporting our economic recovery.

KEY OPPORTUNITIES

Beca's industrial specialists have identified the following key opportunities for a waste transition that can help support our economic recovery:

Recycling high value waste streams: Investments in projects that enable high-value waste stream recycling such as PET plastic will create new industry locally – supporting the Wave-3 transition, reducing our reliance on imports and decreasing transport emissions. To do this we need enhanced recycling methods to increase purity and keep value attached to the product such as return-to-manufacturer schemes, container deposit schemes and increasing the number of domestic bins for source-segregating domestic waste.

Anaerobic Digestion Plants: Organic waste makes up 40% of household waste in New Zealand. Projects creating valuable fertilizer and fuel products from food waste/organic waste via anaerobic digestion also serve to limit organic materials taking up landfill space, while generating renewable energy in new facilities and creating jobs across New Zealand. If all the domestic food waste nationally could be captured, it could power thousands of homes. There is even more opportunity with commercial food waste.

Funding for Breakthrough Innovation: Targeted investment is needed in projects that accelerate growth for high-tech SMEs and start-ups in low waste/reuse-friendly product design and packaging technology, waste segregation and sorting etc. This will create immediate jobs and increase the speed with which we can leverage the economic benefits of a circular economy.

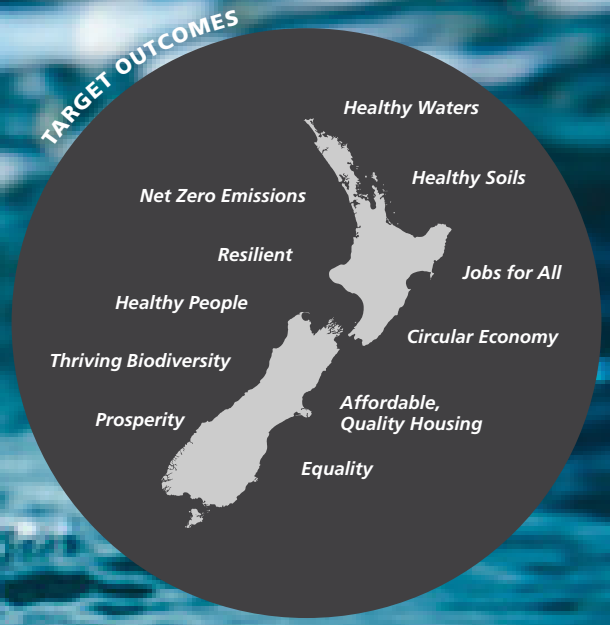
Altering the road map for waste: The creator of waste is often not responsible for its disposal with the cost sitting with the consumer or the local government body. The development of an alternative road map for waste should be prioritised. This should include a review of how we can work with producers to encourage alternative pathways for waste. It should also encourage initiatives like high quality modular design for easier replacement and upgrade of components, plus alternative economic models like lease pricing (e.g. Philips pay per lux lightbulbs). The EU is considering legislation to prevent throw-away products, in parallel with considering a reduced tax on recycled goods, levies on single-use packaging and has much higher landfill levies.[4] New Zealand should consider a similar approach so we can actively manage our waste streams. While this will initially be a cost to business and inevitably consumers, it will also foster investment in new industries and alternative technologies, leading to new revenue streams and creating jobs.

THE CHALLENGE:

- HIGH EMISSIONS
- HEATING CLIMATE
- UNEMPLOYMENT
- HOUSING CRISIS
- DECLINING BIODIVERSITY
- LINEAR ECONOMY
- ECONOMIC INSECURITY
- POLLUTED WATERWAYS
- DEGRADING SOIL

TRANSITION: 3 WATERS:

- BIOSOLIDS REUSE
- DIGITAL & ANALYTICS
- WASTE TO ENERGY & RESOURCE RECOVERY
- WATER DIVERSIFICATION
- WATER SENSITIVE DESIGN



Transition: Three Waters Systems

CHALLENGE STATEMENT

Clean and healthy waters are essential to wellbeing, provide vital habitats and are areas of cultural significance and cherished recreation. Water use, treatment and disposal contribute to greenhouse gas (GHG) emissions and can have a significant environmental impact on land and water bodies through source pressure, contaminant loading and waste production. Many smaller communities do not have the rate base to afford enhanced water quality and wastewater treatment. Key sources of emissions include biogas and biosolids from wastewater as well as the emissions from the construction and operation of water assets. Key climate risks relating to our water systems include drought (reducing supply), floods (damaging local ecosystems and contaminating waterways), and major storm effects (damaging water assets).

KEY OPPORTUNITIES

Beca water specialists have identified key opportunities for transitions in the water system during the Wave 3 recovery as:

Biosolids reuse: In New Zealand, 90% of biosolids are sent to landfill. Projects that focus on biosolds reuse will reduce GHG emissions and cost associated with sludge disposal, which can contribute to 90% of total treatment plant Scope 3 emissions, by offsetting fertiliser application to land, thereby reducing nitrous oxide (N_2O) emissions from nitrogen-based fertilisers. Investments in R&D projects on post-processing will create high value jobs and help to maximise fertiliser value. Investments in biochar projects will improve land productivity and absorb contaminants by use of biochar (land revegetation and rehabilitation). Benefits include displacement of non-renewable nutrient use and carbon sequestration.

Asset data digital sensing and analytics: Investment in digital sensors and data capture systems and R&D funding into implementation strategy will create high-value employment and proved a range of environmental benefits. Active control of biological wastewater treatment processes can minimise both process and effluent N_2O emissions. Enhanced control of water and wastewater treatment increases efficiency and improves water recovery. Efficient process control reduces N_2O emissions, presenting significant GHG reduction benefits since N_2O is 300 times more potent than carbon dioxide (CO_2) for atmospheric warming.

Waste to energy and resource recovery: Biogas capture in municipal wastewater treatment reduces process emissions and offsets power requirements for the plant (can generate >100% of a plant's electricity demand). This involves lower infrastructure costs as most of the facilities are already operating. Projects that facilitate capture of residential food waste within the wastewater system support additional useful biogas generation at treatment plants. Projects promoting nutrient capture such as struvite recovery from wastewater provide a phosphorus source, offsetting non-renewable phosphorus mining. Industrial wastewater to energy should be considered in the longer term but is not a priority in the Wave-3 recovery.

Water storage, supply and treatment diversification: Investment in water storage projects; with appropriate storage of harvested water collected during wet weather and high flows, can support productive land (irrigation for agriculture to protect the rural economy), provide potable water for our urban and rural systems and significantly improve drought resilience.

Projects that provide indirect potable reuse of wastewater or non-potable reuse through "purple pipe" systems, help to close the water and wastewater loop. Benefits to communities include reliable water to supply green spaces and recreational areas. Indirect potable reuse is difficult to retrofit to existing urban areas; public perception and health-based stakeholder support will require rigorous risk management and a multibarrier approach to pathogen reduction. Projects that improve internal water recycling within wet industry (pulp and paper, dairy) through onsite wastewater recovery have benefits including reducing water scarcity pressure and reduction in wastewater discharges to the environment. Economic viability for industrial water recycling requires a high level of capital investment and may require a legislative driver to create this shift.

Roadmaps for water sensitive design: Investment in R&D and development of roadmaps for water sensitive design should be prioritised. These should focus on improved stormwater recycling or treatment prior to discharge to reduce contaminants going rivers and the ocean and the use of green infrastructure to provide climate change adaptation and flood relief.

SOCIAL INFRASTRUCTURE

THE CHALLENGE:

- HIGH EMISSIONS
- HEATING CLIMATE
- UNEMPLOYMENT
- HOUSING CRISIS
- DECLINING BIODIVERSITY
- LINEAR ECONOMY
- ECONOMIC INSECURITY
- POLLUTED WATERWAYS
- DEGRADING SOIL

TRANSITIONS: SOCIAL INFRASTRUCTURE:

- HEALTHY PUBLIC HOUSING
- GREEN HEALTHCARE FACILITIES
- PUBLIC HEALTH INVESTMENTS
- LOW-CARBON HEALTHCARE PRODUCTS
- TARGETED SKILLS DEVELOPMENT
- GREEN EDUCATION FACILITIES

Transition: Social Infrastructure

CHALLENGE STATEMENT

Robust social infrastructure will be critical in enabling all of the transitions identified in this document. Transitions in social infrastructure will help create jobs, support health outcomes, reduce health and social inequalities and support New Zealand's low carbon transition. Key components of social infrastructure (including housing, education and health) are intimately connected. Closer integration of spending and desired outcomes can improve the total value realisation across the social infrastructure system. For example, securing long term employment through better education outcomes plus sustained levels of spending in a particular sector by region, and supporting health through better housing stock can lead to better social outcomes and reduce the cost of treating illness.

KEY OPPORTUNITIES

Beca buildings, healthcare, and community shaping specialists have identified key social infrastructure transitions that will support New Zealand's recovery and the transitions presented in this thought-piece.

Investment in healthy public housing: Accelerating programmes such as insulating homes,[1] and other energy efficiency measures will have co-benefits including supporting the healthcare focus, improving equality and creating jobs. Accelerated investment in public housing developments that are integrated with land-use and transit planning will create jobs in the short-term, plus support increased patronage of public transport and better access to housing and jobs in the long-term.

Investment in green healthcare facilities: Healthcare is the largest public sector electricity consumer in New Zealand.[2] The majority of hospitals also use fossil fuels as a heat source and for back-up electricity generation. The indoor environment in hospitals are key to provide the best outcomes for patients and to support staff productivity and wellbeing.[3] The design of new healthcare facilities should be aligned to the potential outcomes of the Ministry of Health's working group for 'Greening Healthcare Infrastructure Guidance', while balancing capital cost so that money saved is available to deliver healthcare outcomes. Investments in existing healthcare asset upgrades including mechanical system upgrades, building and envelope upgrades, enhanced maintenance and fossil fuel transitions through Wave-3 will support the creation of jobs, improvements in healthcare environments, reductions in greenhouse gas emissions and reductions in operating costs. Furthermore, the development of health care facilities needs to consider broader community aspects such as healthcare precincts, associated accommodation and access via public transport.

Projects to improve public health: Projects should focus on primary prevention of health risks through public health initiatives, with investment targeted to reduce health inequalities. In the long term, a public health focus will lead to better health outcomes for more people, supporting New Zealand's growth and productivity as well as a more effective healthcare system.

Low-carbon healthcare products: Analysis of primary care prescription process for inhalers with a specific focus on high-carbon meter dose inhalers. Projects to collect data on medical gas use from public and private sector healthcare to support prioritisation of low-carbon anaesthetic gases.

Projects supporting targeted skills development: Research and development should be undertaken to address the skills gap for the transition to a low-carbon economy across key sectors, including identifying where workforce skills can be pivoted to create high-quality jobs. Investment in expansion of remote leaning capacity through digital networks should be prioritised, including funding electronic hardware purchasing for education facilities and supporting equal access.

Investment in green education facilities: Projects that decarbonise heating and ventilation systems and support creating a healthy and comfortable learning environment will enhance the productivity and wellbeing of students and staff, create jobs and reduce emissions. Spaces should be designed to be flexible so that they can adapt to changes in future learning.

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