Submission by

to the

Ministry for the Environmnet

on

Te hau mārohi ki anamata

Transitioning to a low-emissions and climate-resilient future

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NZTech Submission

Te hau mārohi ki anamata

Transitioning to a low-emissions and climate-resilient future

1. Summary

NZTech thanks the Ministry for the Environment for the opportunity to submit on discussion document *Te hau mārohi ki anamata* Transitioning to a low-emissions and climate-resilient future.

We are happy to engage further to discuss our submission in detail and provide further assistance.

NZTech recommends that the Government develop a Technology Roadmap as an addendum to the Emissions Reduction Plan (ERP) when it is published in May 2022. International evidence demonstrates that Technology Roadmaps are an important tool to reduce emissions. NZTech also considers that establishing a Technology Roadmap provides the opportunity to drive collaboration across government agencies, as well as supporting broader innovation and deployment of technology - although further Government investment is also required.

NZTech also considers there are a range of key short, medium and longer-term climate technology opportunities that New Zealand's agencies and industries could be progressing. These opportunities are based on international evidence. NZTech considers a range of these opportunities could be incorporated into the proposed Technology Roadmap. Our submission outlines these opportunities in the agriculture, energy, transport, building and construction and waste sectors.

The NZTech Alliance is very experienced collaborating with government agencies to produce work such as a Technology Roadmap. An example is the *Towards Our Intelligent Future* report produce in 2019 for MBIE, together with our partners[1].

Finally, we submit that the draft plan significantly understates the opportunity to enhance and advance the transition to a low-carbon future via the strategic leverage of Aotearoa's knowledge-based and digital economies. The Draft Plan focusses almost entirely on reducing emissions, and not on concurrently empowering and growing New Zealand's already low-emissions industries - such as the creative sector and digital technologies - and consequently enabling greater economic diversity and resilience.

2. Background

NZTech is a member funded, not-for-profit, non-governmental organisation that represents 20 tech associations with over 1600 members, who collectively employ more than 10 percent of the New Zealand workforce.

Our purpose is to help create a more sustainable, equitable and prosperous New Zealand underpinned by technology. We do this by helping our members work together to connect the tech ecosystem, promote the importance of technology for New Zealand and New

[1] https://nztech.org.nz/wp-content/uploads/sites/8/2019/09/AI-Forum-Towards-Our-Intelligent-Future.pdf

Zealand technology for the world, and help advance the growth of the tech ecosystem and the New Zealand economy.

Our members include New Zealand tech exporters, local and multinational IT firms, startups, universities, government agencies, financial service providers and large corporate users of technology. Our members cover a very broad range of industries, including those most impacted by climate change (agriculture, energy and transport).

3. Comment

Proposal to develop a Technology Roadmap as an addendum to the ERP

NZTech recommends that the Government develop a Technology Roadmap as an addendum to the ERP when it is published in May 2022. NZTech has the capability to partner with government to deliver this.

Several countries comparable to New Zealand have reduced their carbon emissions while also growing their economies. Pre-Covid, these countries all reduced carbon emissions by at least 10% and still grew their economies. Technology roadmaps or equivalents were leading contributors in all these countries. The standout comparable countries for New Zealand are Denmark, Finland, Ireland and Switzerland[2].

NZTech has also engaged with MBIE, the Ministry of Transport, the Energy Efficiency and Conservation Authority and Callaghan Innovation who are all broadly supportive of creating a Technology Roadmap. NZTech also considers that establishing a Technology Roadmap would drive collaboration between government agencies, which is consistent with the discussion document's recommendations.

Technology plays an important role in Emissions Reduction

In a recent survey, 95% of our members rated the role technology can play in helping NZ achieve its climate change reduction goals as significant or useful. Further, 96% of our members said a Technology Roadmap should form part of the ERP.

NZTech organisations generally felt technology had a large role to play across all New Zealand's priority sectors, which includes agriculture, energy, building/industry, transport and waste.

International evidence of Technology Roadmaps

New Zealand has an important opportunity to follow-the-lead of countries making greater progress on reducing their carbon emissions by developing a Technology Roadmap as an addendum to the Emissions Reduction Plan (ERP) when it is published in May next year.

International evidence shows that a Technology Roadmap for the ERP can have the important twin role of stimulating and hastening the earlier adoption of emission reductions technology solutions and guide the development and investment of Aotearoa's climate research and development ecosystem. Further information on international evidence is mention in the paragraphs below.

[2] https://www.ecosystemmarketplace.com/articles/21-countries-reducing-carbon-emissions-growing-gdp/

Several European countries follow this practice, including Sweden, which is currently the leading European country on climate change action. Three other European countries, broadly comparable to New Zealand (Denmark, Finland and Ireland) had higher per capita CO2 emissions than New Zealand, but have now fallen below. The adoption, development and implementation of a Technology Roadmap has been a key contributing factor to this.

The United Kingdom (which New Zealand has modelled its Climate Change legislation, formal advice, and governance approach from) launched its first version of a Technology Roadmap in 2010.

In 2013, the Technology Executive Committee of the United Nations Framework Convention on Climate Change published a report recommending countries adopt Technology Roadmaps to advance climate change mitigation and adaption.

Further information on each of these cases is included in **Appendix 1** to this submission.

NZTech's engagement with government agencies on establishing a Technology Roadmap

NZTech supports the proposal in the ERP discussion document to create an advanced technology roadmap. This must be expanded to take advantage of the shorter-term climate technology opportunities some of which are listed further in this submission.

Informal discussions with MBIE, the Ministry of Transport and the Energy Efficiency and Conservation Authority (EECA) indicate support for a Technology Roadmap that would also provide a focus for industry to collaborate more effectively and partner with government agencies.

The Ministry of Transport agrees new innovations in the transport sector must be shaped to deliver positive outcomes for the transport network and climate[3]. EECA's international technology scan highlights a wide range of international available technologies that New Zealand could apply to process heat, one of the country's largest opportunities to reduce energy related greenhouse gas emissions[4].

The government's innovation agency Callaghan Innovation supports a Technology Roadmap approach. When launching the New Zealand Climate Tech For The World report in July 2021, they commented that climate innovation was a key step towards achieving the country's national carbon targets[5]. It also has the value of building a higher-value export sector and new employment opportunities as has been seen overseas.

NZTech considers a Technology Roadmap would increase collaboration amongst government agencies

NZTech considers that creating a Technology Roadmap would increase collaboration amongst government agencies. This is consistent with a key recommendation in the discussion document that collaboration among government agencies be increased.

It was clear from the multi-agency webinars run as part of consultation on the ERP discussion document that the government's response to climate change has increased

[3] https://www.knowledgehub.transport.govt.nz/assets/TKH-Uploads/TKC-2018/Public-Transport-2045.pdf
[4] https://www.eeca.govt.nz/insights/eeca-insights/international-tech-scan/
[5] https://www.callaghaninnovation.govt.nz/sites/all/files/NZ_Climate_Tech_For_The_World_report.pdf

cross-agency collaboration. Constructing a Technology Roadmap would further enhance this, as demonstrated by international evidence.

Callaghan Innovation, New Zealand Growth Capital Partners, the Science for Technological Innovation National Science Challenge, Auckland Unlimited and UniServices have established the NZ CleanTech Mission partnership to convert local CleanTech into thriving and profitable businesses[6]. Initiatives such as this could be prioritised and extended under a Technology Roadmap.

A Technology Roadmap would support broader innovation and deployment of technology, although further Government investment is also required

NZTech considers that establishing a Technology Roadmap would better support existing or near-term technology. Greater progress in and support for deploying existing or near-term technology solutions will aid our emissions reduction targets.

Strengthening New Zealand's innovation, research and development pipeline to explore, test and commercialise future solutions is also important in meeting our emissions targets. The nature of a Technology Roadmap means it can greatly assist both these short-, medium- and longer-term objectives. The overseas experience highlights these opportunities.

New Zealand needs to provide significant investment in the innovation system. New Zealand is 26th on the Global Innovation Index 2021[7] compared with comparable small economies Finland (6th), Singapore (7th), Denmark (9th), Israel (14th), Iceland (16th) and Ireland (18th). New Zealand ranked 15th in this Index in 2015. The country also fell the most in the 2020 Bloomberg Innovation Index down 5 points to 29.

The draft plan significantly understates the opportunity to enhance and advance the transition to a low-carbon future via the strategic leverage of Aotearoa's knowledge-based and digital economies.

The Draft Plan states that '*New business models are required, and public attitudes and consumer preferences need to shift to support them. We need to see new approaches to how we power our economy and lifestyles, how we build our cities and how we move around them'*.

However, the Draft Plan focusses almost entirely on reducing emissions, and not on concurrently empowering and growing New Zealand's already low-emissions industries - such as the creative sector and digital technologies - and consequently enabling greater economic diversity and resilience.

NZTech recommends including a section in the Emissions Reduction Plan on growing low-emission industries.

NZTech also recommends aligning other Government initiatives such as the proposed Digital Strategy for Aotearoa, the Digital Technologies Industry Transformation Plan, the

[6] https://www.callaghaninnovation.govt.nz/technology-and-product-development/new-zealand-cleantech-mission
[7] https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021.pdf

Agritech Industry Transformation plan and re-introducing a Creative Sector Industry Transformation Plan to compliment and support the Emissions Reduction Plan.

4. Key Emissions Reduction Technology Opportunities for New Zealand

NZTech also considers there are a range of key short, medium and longer-term climate technology opportunities that New Zealand's agencies and industries could be progressing. These are based on international evidence. NZTech considers a range of these opportunities should be incorporated into the proposed Technology Roadmap. These opportunities are in the following sectors:

- Agriculture
- Energy
- Transport, and
- Building, construction, waste and other areas

The sub-sections below detail these proposals by sector.

4.1 Agriculture

Agritech New Zealand, an association within the NZTech Group, supports the Technology Roadmap approach. Action 6.2 in the Government's Agritech Industry Transformation Plan outlines that the Government will:

> *Develop a national technology platform view for agritech, outlining where expertise, equipment and support exists and how it can be accessed, along with a roadmap for further development.*[8]

This makes sense as greater, early interventions are more critical in agriculture if the requirement of a 10% reduction in biogenic methane by 2030 likely requires livestock herd sizes to be reduced by up to 14%. The industry considers the resulting economic impact, adjusted for any productivity or compensating gains, could reduce the country's revenues by $10 billion per year.

NZTech recommends the New Zealand Government consider opportunities identified by Ian Proudfoot, KPMG's Global Head of Agribusiness

NZTech agrees with Ian Proudfoot, KPMG's Global Head of Agribusiness that mechanisms to encourage alignment of industry and other investors including research agencies on collaborative innovation investments will see greater New Zealand emissions reduction benefits[9]

[8] https://www.mbie.govt.nz/dmsdocument/11572-growing-innovative-industries-in-new-zealand-agritech-industry-transformation-plan-july-2020-pdf
[9] https://www.linkedin.com/pulse/weve-signed-methane-pledge-what-does-mean-new-ian-proudfoot/?trackingId=5AdrBP31TPmkgM%2B9TLq5GQ%3D%3D

NZTech agrees with Proudfoot's following recommendation, which we recommend should be developed further and included in the proposed Technology Roadmap because they would enhance New Zealand's methane reduction plan. These actions are to:

1. Invest in bringing some of the best scientists in the world working on animal created methane emissions to New Zealand and ensuring that our regulatory framework allows them to do world leading science. This means addressing our legislative framework surrounding gene-editing technologies, and
2. Develop a world class research campus, that co-locates all our climate science capability in a single facility that can host the international teams. Connecting international leaders to New Zealand existing experts offers potential for transformational solutions.

Other opportunities to explore in the agriculture sector

NZTech also considers the Government should explore technologies under development for managing large animal emissions with the potential to reduce the GHG footprint of dairy and beef farming to near zero. 100% reduction won't be achieved but a 50% reduction is likely and yet this potential is not being prioritised. The climate crisis should compel greater acceleration of all four of these recommendations with road blocks to implementation addressed under greater priority. The technologies are:

1. The detection of urine patches
2. The treatment of urine patches including nitrification inhibitors. A number of companies are working in this space, and some published results are showing 90% reductions in nitrous oxide
3. Methane vaccines for ruminants, and
4. Methanogen inhibiting food supplements.

Other opportunities that need greater prioritisation include:

1. Biotech and seaweed nutrient trials scaled up
2. Ponding for urine and faeces on special bomas converter drains, and
3. Use of permeable spots to gather urine and faeces off fields and into bio converters

New Zealand researchers should also collaborate with the EU-Canadian project fast-tracking work led by Ireland researchers to investigate the extent to which methane emissions can be reduced by adding native seaweeds or seaweed extracts to ruminant diets[10]

Other agriculture opportunities underway in the UK Clean Growth Strategy[11], that New Zealand should evaluate for including in a Technology Roadmap:

1. Boost collaborative investment in the Agri-Tech Strategy[12] (UK has committed $NZD303 million)
2. Invest in innovative technology and research for land use, greenhouse gas removal technologies, waste and resource efficiency (the UK has committed $NZD190 million)
3. Co-produce with industry a Bioeconomy Strategy[13] that will bring together biological industries, academia and innovators, linking up farmers and land managers with high

[10] https://www.teagasc.ie/news--events/news/2021/seaweed-supplementation.php
[11]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf
[12] https://www.gov.uk/government/collections/agricultural-technologies-agri-tech-strategy
[13] https://www.gov.uk/government/publications/bioeconomy-strategy-2018-to-2030

tech industries to develop less carbon intensive products such as bio-based chemicals, plastics and other materials

4. Establish an Agricultural Engineering Precision Innovation Centre[14] on precision agriculture to help the agri-food sector develop more productive and sustainable NZ agriculture and export markets
5. Develop a 'big-data' centre of excellence for Agri-metrics[15] to utilise data science and modelling to build a more productive, sustainable and efficient food system
6. Employ Centre for Crop Health and Protection[16] (CHAP) practices to revolutionise how farmers manage crop threats including pests and disease, both in the UK and overseas, and
7. Utilise Centre for Innovation Excellence in Livestock[17] strategies to create new livestock technology and products to boost the profitability and productivity of livestock farming.

4.2 Energy

NZTech notes the International Energy Agency's (IEA)Net Zero by 2050 Roadmap highlights the short-term priorities in the energy sector that countries should be focused on[18]. This includes:

1. Banning new sales of fossil fuel boilers
2. Stopping new unabated coal plant approvals, and
3. Stopping new oil and gas field approvals or mine extensions

The Roadmap charts key milestones in the pathway to net zero across key emissions sectors on page 21. A New Zealand Emissions Reduction Technology Roadmap should use the same tool.

NZTech recommends the New Zealand Government consider the following additional opportunities in the energy space

These additional opportunities are based on proposals by New Zealand's energy industry market participants and from the UK's Clean Growth Strategy.

NZ Tech considers that there are the following "quick win" opportunities

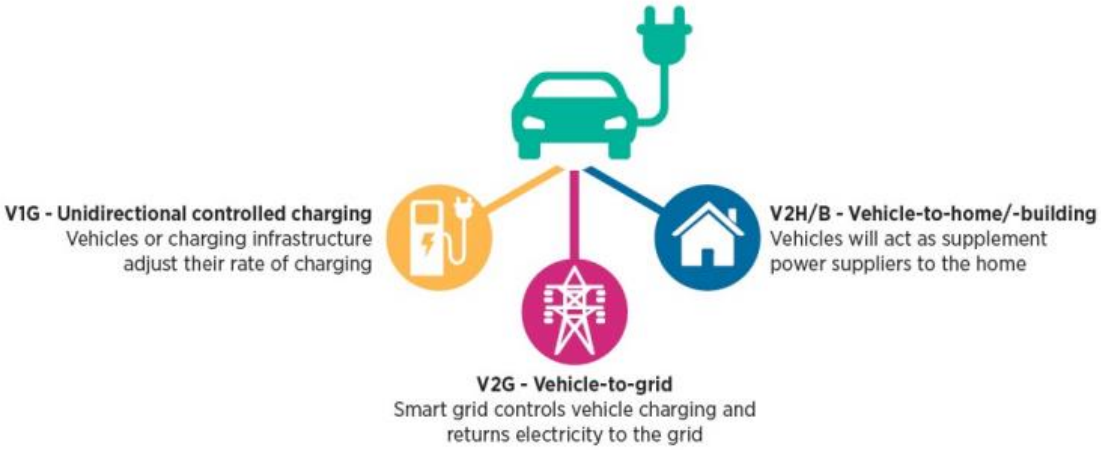
1. Fast-track opportunities in the R&D MOU that the NZ HVAC&R industry has with the Climate Control Companies Assn NZ transitioning synthetic refrigerants.
2. Progress Project Drawdown[19] refrigerant management solutions
3. Trial the management of high Global Warming Potential synthetic refrigerants through the use of Ethereum blockchain smart contracts
4. Ensure that EV chargers are smart to minimise the impact to electricity network peaks and therefore cost to consumer,

[14] https://agri-epicentre.com/
[15] https://agrimetrics.co.uk/
[16] https://chap-solutions.co.uk/
[17] https://www.cielivestock.co.uk/
[18] https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf
[19] https://drawdown.org/programs/drawdown-research

5. Develop and implement smart EV charger regulations to ensure an efficient charging network, and[20]
6. Support greater optimisation of the New Zealand energy system utilising digital platforms to obtain more affordable electrification

[20] https://blob-static.vector.co.nz/blob/vector/media/vector-regulatory disclosures/vector_submission_ccc_draft_advice.pdf

Figure 1: Smart charging



NZTech considers there are additional opportunities in the energy sector in the medium to long-term that could support emissions reduction. These are:

1. Develop an electricity regulation system which better integrates enabling technologies
2. Progress the digitisation of New Zealand's electricity infrastructure by ensuring a digital platform is in place that dynamically tracks and manages demand
3. Redesign the Electricity Authority and Commerce Commission regulatory framework in New Zealand to ensure electricity regulation better supports decarbonisation.
4. Enable greater involvement in new generation market participants to boost renewable generation
5. Further drive energy efficiency future outcomes by targeting passive housing standards and enabling smart home technology in our future housing stock
6. Explore UK Clean Growth Strategy research and innovation in energy, resource and process efficiency, to encourage switching to lower carbon fuels
7. Consider new energy efficiency and heating technologies to enable lower cost low carbon homes (UK Clean Growth Strategy)
8. Invest in low carbon heating to support innovative low carbon heat technologies in homes and businesses between 2016 and 2021 (UK Clean Growth Strategy), and
9. Support innovative energy technologies and processes with investment through an Energy Entrepreneurs Fund (UK Clean Growth Strategy)

The textbox below outlines a New Zealand case study of how technology in the energy sector has supported emissions reduction;

case study

The Kainga Tuatahi project, in partnership between Vector and Ngāti Whātua, supported by Entrust, provides behind the meter solar and battery systems for each of the 30 houses at Kupe street – a residential development for iwi first home-owners delivered by Ngāti Whātua Ōrākei. This project was designed to align with the objectives of Ngāti Whātua – to develop Waro Kore Papakāinga – a carbon zero community – with affordable and healthy housing. This includes bringing together innovative energy systems, waste systems, healthy waterways, kai sovereignty, and ecological enhancement.

The project enables customers to generate and store power for their own consumption and to export any surplus to the grid for a credit. In the year ending 2020, the solar battery systems provided on average, 36 percent of customers' total consumption. Overall, Kupe street households used 20% less grid sourced kWh pa on average than the control group. In the first four months, this resulted in savings of around 12.55 tonnes of carbon dioxide equivalent (CO_2e). The systems have reduced some home-owners' electricity bills – for power from the centralised grid – to as little as $13 per month.

4.3 Transport

NZTech recommends the New Zealand Government consider opportunities identified by the UK Government

NZTech recommends that the New Zealand Government consider opportunities identified in the UK Government's *The Decarbonising UK Transport* report uses the Technology Roadmap approach to progress its strategy[21]. The report outlines seven separate technological roadmaps which will reduce and remove emissions from the UK's domestic transport by 2050. The roadmaps identified the following opportunities:

1. Hydrogen: The report acknowledges that hydrogen-fuelled transport could be integral to achieving full transport decarbonisation. Urgent steps were needed to advance hydrogen's technology readiness and the scaling of its availability, particularly for maritime applications

2. Fleet turnover: As fleet turnover will be a large determinant on the pace for decarbonisation, the UK roadmaps concern reducing and removing direct (tailpipe) emissions of CO_2 from vehicles. Decarbonising the vehicle fleet involves some shorter term retrofit or changes to fuel mix but principally concerns incentivising the replacement, over time, of vehicles that produce emissions with those that do not.

3. The pressing need for infrastructure development: Dominant across the set of UK roadmaps is the need for infrastructure solutions to be further developed and better understood, followed by prioritisation of solutions and scaling up of these solutions across the country. Given the significant dependence in some vehicle use cases upon recharging or refuelling infrastructure being in place, and noting fleet turnover usually takes 15 years, there is an urgency for infrastructure development.

4. Urgent short-term research and innovation interventions: The UK notes that research and innovation are precursors to market readiness and scaling. They are therefore a priority for the earlier part of the 30-year period ahead across all the UK roadmaps.

[21] https://www.gov.uk/government/publications/decarbonising-uk-transport-technology-roadmaps

Most notably, for road-based transport, the research and innovation interventions are all to start, if not have been undertaken, within the next five years. These include highly challenging trials – spanning different forms of solutions - for infrastructure development and use that in turn must inform forward developments in infrastructure roll-out.

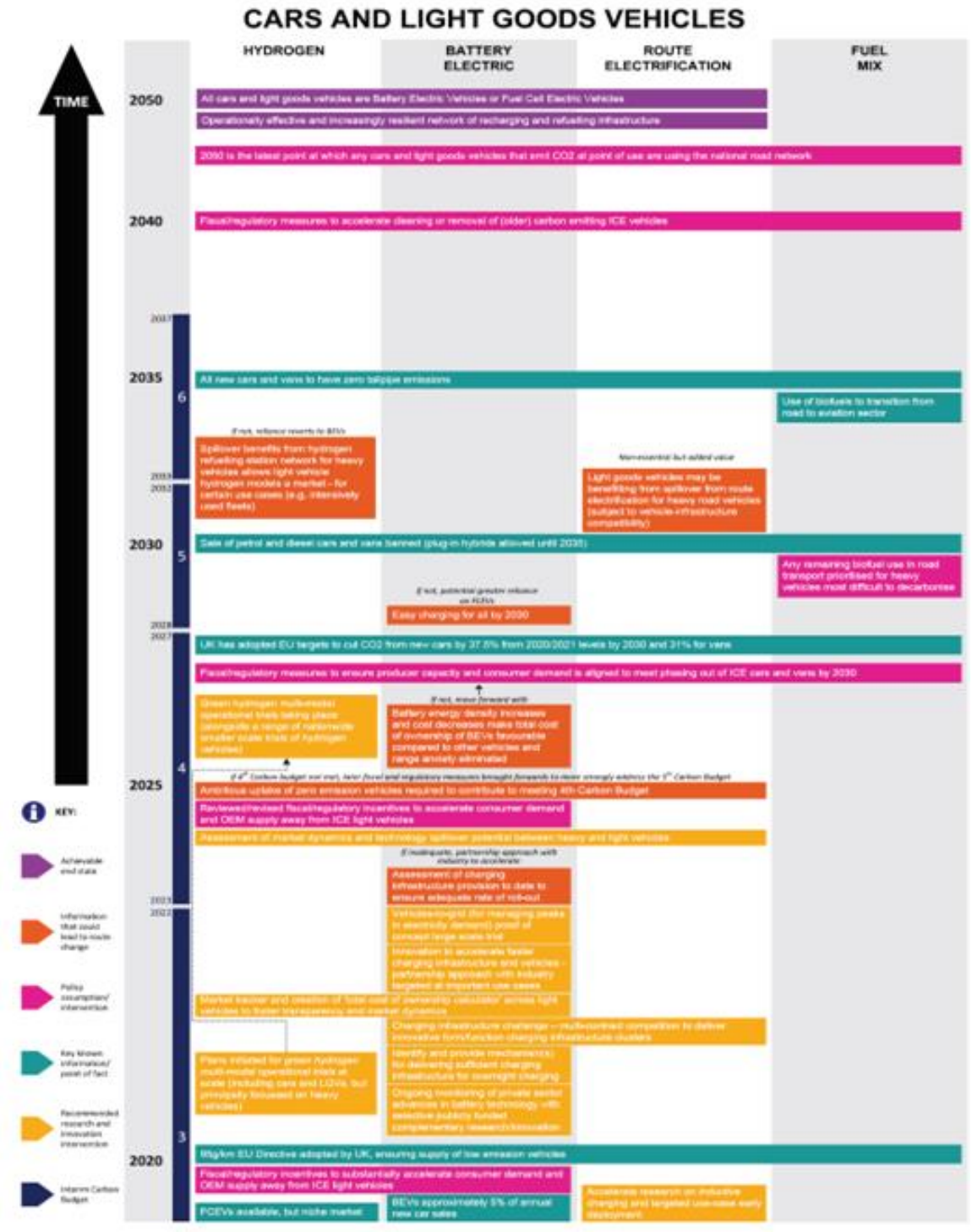
5. Battery technology: While hydrogen features across the roadmaps, there is a fundamental dependence upon batteries to deliver decarbonisation of UK domestic transport. Battery technology has relevance to all modes and there are prospects of spill overs from research and innovation from one use case to another. While significant advances have been made in battery energy density and with developments continuing concerning rapid recharging capability, there is a need for such research and innovation to continue. It is assumed that the private sector in the UK will continue to have an important role here.

The UK roadmap includes a phased implementation approach. Beginning with near term, in the cars and light goods category, the UK starts with the shorter-term research and innovation activities, then it focussed on key categories: infrastructure development and the longer-term project of fleet turnover. For example: short-term research and innovation needs are focussed on battery improvements and provision and improvement of charging infrastructure for EVs.

The short-term scaling up focuses on opportunities for non-rapid charging in areas that help encourage take-up of EVs as well as partnering with industry to provide rapid and innovative charging opportunities targeted at important use cases, such as taxis, vans and LGVs.

Figure 2 below outlines the time/activity horizons in the UK's transport roadmap.

Figure 2: Cars and Light Good Vehicles Roadmap



NZTech also recommends the Government consider other opportunities that have been identified in the United Kingdom, these include:

1. Smart systems to reduce the cost of electricity storage, advance innovative demand response technologies and develop new ways of balancing the grid to prepare for the impact of EVs (the UK is investing $NZD508 million), and
2. The UK has established the Centre for Connected and Autonomous Vehicles to position the UK at the forefront of research, development and demonstration of Connected and Autonomous Vehicle technologies ($NZD480 million, matched by industry)

NZTech recommends the New Zealand Government consider opportunities identified by the Finnish Government

NZTech also recommend that New Zealand Government consider opportunities similar to those identified in Finland's Circular Economy Roadmap[22], where transport and logistics was a key focus area with digitisation identified as an essential enabler.

Digitisation is a key enabler as passenger transport moves towards smart, easy-to-use transport that is based on the sharing and services practice called MaaS (Mobility as a Service). The roadmap outlines development of incentives and policy tools which encourage technology use to deliver a more service-based transport system.

This includes promoting mobility services (MaaS) and smart public transport solutions which spread of new services boosting walking, cycling, ridesharing and car sharing. The goal is a manifold increase in the resource and energy efficiency of the transport system, where user-oriented, interlinked mobility services, including public transport, provide the foundation for smooth travel chains.

Mobility as a Service (MaaS) works by opening up public transport and other service information and payment system interfaces and developing compatibility to promote alternative forms of transport favouring and replacing more carbon-intensive modes. It is a key opportunity for New Zealand's cities.

The text box below outlines a case study in relation to promoting and prioritising mobility as a service in Helsinki. The learnings from this case study could be applied to the New Zealand context.

[22] https://media.sitra.fi/2017/02/28142644/Selvityksia121.pdf

Case Study

Key project in the focus area: Promoting and prioritising Mobility as a Service (MaaS) in the Helsinki Capital Region.

The goal of the Smart & Clean project is to create a low-carbon and smart transport and mobility export concept for Finland. Over a 5-year period, 20-30 significant project entities will be created, with the themes of transport, construction, energy, waste and water sector and consumer cleantech. New type of co-operation (cities, companies, state) to accelerate the climate targets of cities and promote the circular and sharing economy. This will simultaneously produce international references for Finnish companies in the domestic market.

The role of the Smart & Clean project with regard to MaaS is to bring together and link different operators. Its task is to combine operators across administrative and sector boundaries and work actively to ensure that different operators open up their systems (for example, data and payment interfaces).

Transport plays a key role in several Smart & Clean project entities (for example, construction and housing, and consumer cleantech). Smart transport and mobility solutions and their implementers will be seamlessly integrated with the project entities.

The Smart & Clean project will help create a test platform an ecosystem based on open data and infrastructure. This will enable innovations related to smart transport and mobility and the development of new business. Smart & Clean will also bring existing transport pilot projects together under a common communications umbrella.

Owner: Smart & Clean Foundation

Other implementers: Helsinki Region Transport, VR, cities, Ministry of Transport and Communications, companies in the region

The next measures: identification and development of project entities

NZTech recommends the New Zealand Government consider opportunities identified by the Australia New Zealand Smart Cities Council

A report produced by the ANZ Smart Cities Council called Mobility Now[23] highlights the advancing technological capabilities, new service delivery models and unprecedented city growth create great opportunities as well as urgent pressures to deliver new mobility solutions. Although focussed on the Australian market, it has general applicability for the transport element of a New Zealand Technology Roadmap.

The Mobility Now strategy outlines six steps which should begin as soon as possible. All of these have a technology element:

1. Adapt and re-design the urban built environment
2. Develop a new urban mobility operating system
3. Introduce more accessible and equitable mobility
4. Embrace a global 21st century urban mobility data system
5. Create a new mobility incentives regime, and
6. Implement new decision making and strategy development practices.

Other opportunities

NZTech also considers there are other opportunities for companies to provides route optimisation solutions for fleet operators. It comments that fleet operators generally have little ambition to invest in software or expertise to make their operations more efficient as they don't know how to evaluate different technologies because of the inherent complexity involved. An incentive scheme with industry to run Proof of Concepts for route optimisation

[23]https://www.smartcitiescouncil.com/sites/default/files/anz_smartcitiescouncil_com/public_resources/report_mobilitynow_final_1_0.pdf

could help transport business owners reduce emissions and boost New Zealand's productivity.

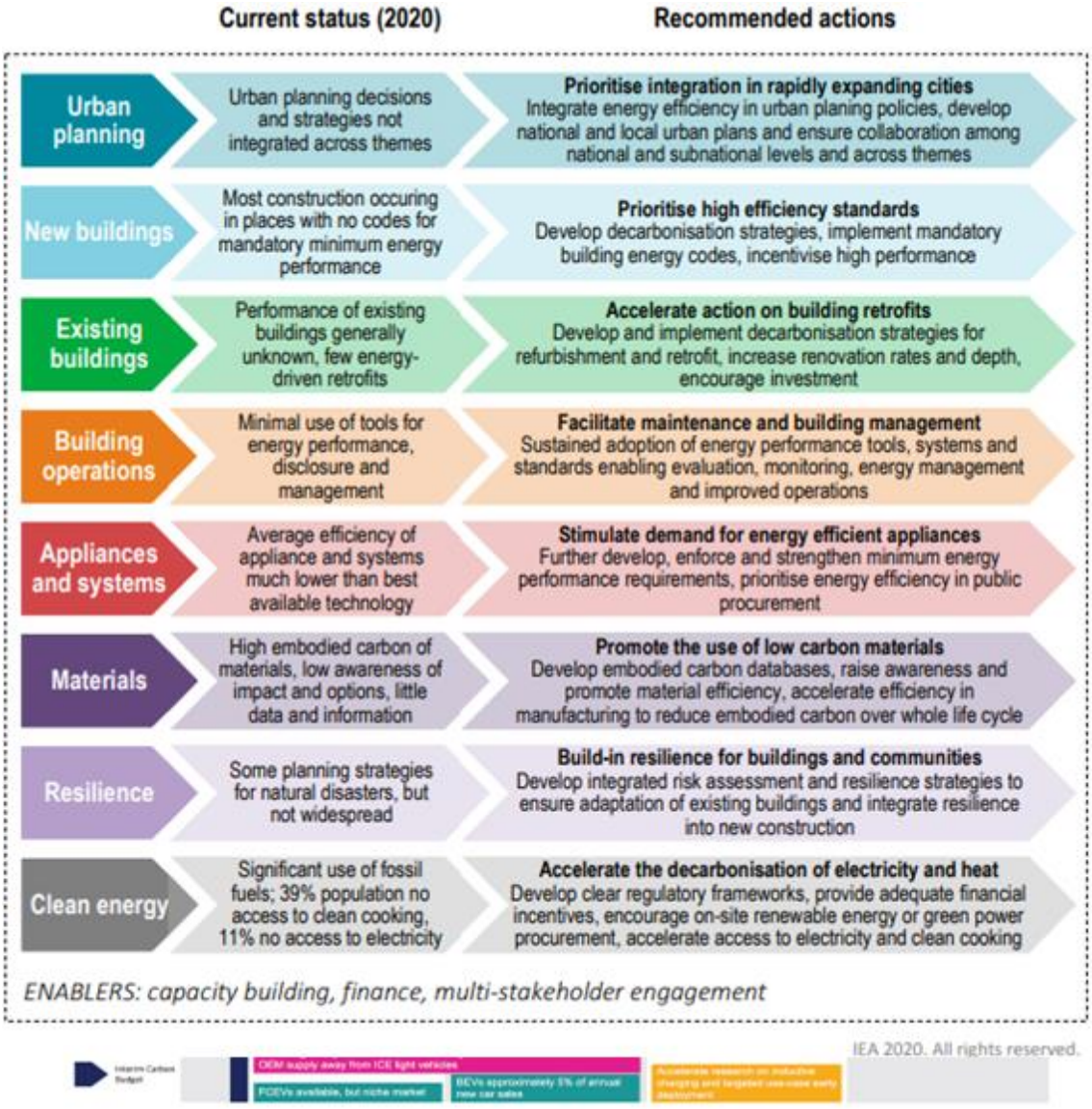
4.4 Building, Construction, Waste and other areas.

NZTech considers that technology can also assist other sectors including building, construction, waste and other areas.

NZTech recommends the New Zealand Government consider building and construction opportunities identified by International Energy Agency

A Roadmap for Buildings and Construction has been produced for the Global Alliance for Buildings by the IEA[24]. The IEA has developed roadmap strategies and actions across the eight dimensions that impact building and construction directly, which are outlined in Figure 3 below.

Figure 3: IEA Roadmap for Buildings and Construction



[24] https://globalabc.org/sites/default/files/inlinefiles/GlobalABC_Roadmap_for_Buildings_and_Construction_2020-2050_3.pdf

Across these areas, a range of policy and technology roadmaps have been developed, including:

1. Technology for sustainable new buildings
2. Technology for sustainable existing buildings
3. Technology for sustainable building operations
4. Technology for resilience
5. Technology for materials
6. Technoloy for sustainable appliances and systems, and
7. Technology for urban planning

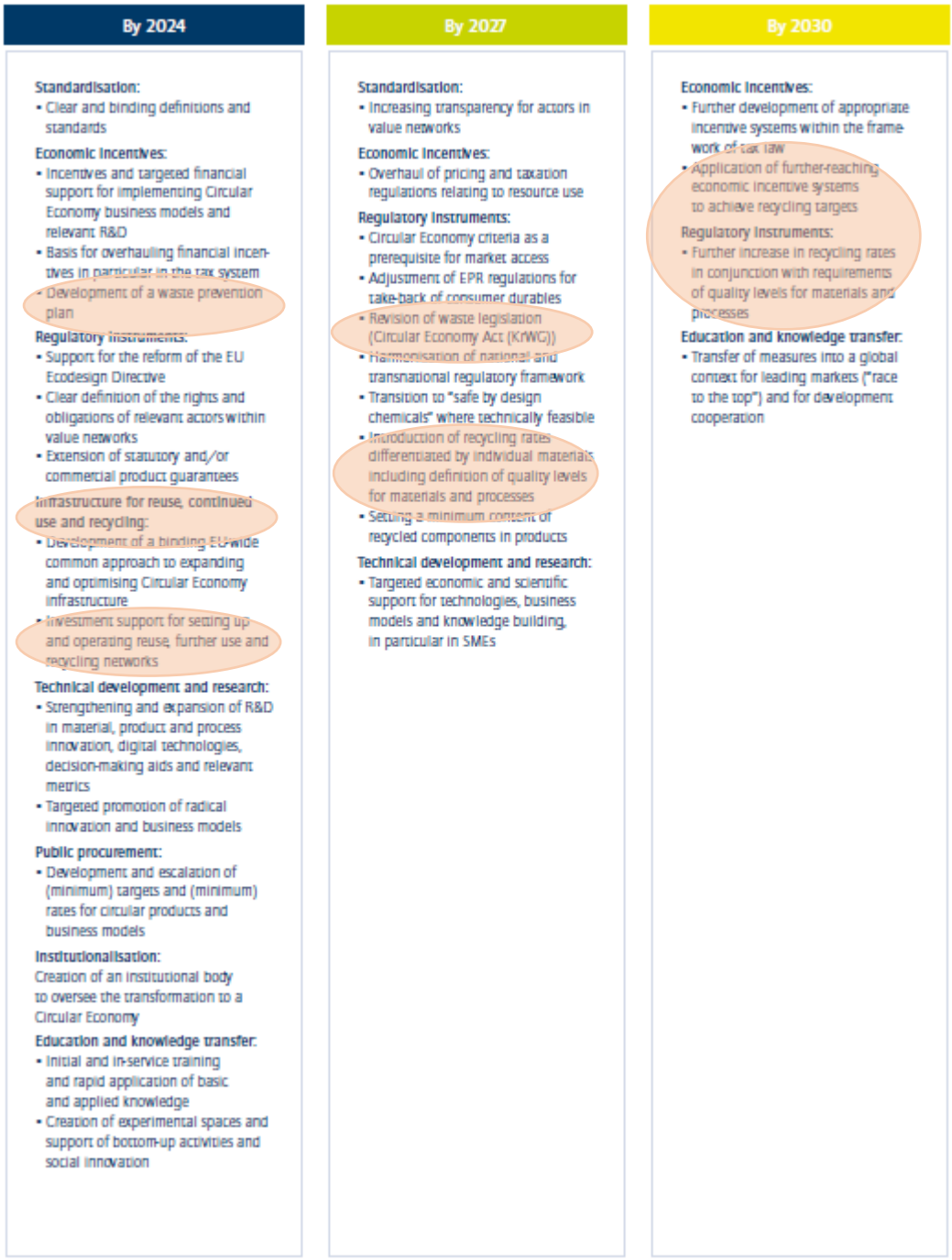
Appendix two outlines, in more detail, the policy and technology roadmaps listed above.

NZTech recommends the New Zealand Government consider waste management opportunities identified by Germany

Germany is one of the world leaders in waste management and their Circular Economy Roadmap[25] has a strong focus on steps New Zealand could consider for the Technology Roadmap. NZTech recommends that the New Zealand Government consider waste management and circular economy opportunities identified in Germany. Figure 4 below outlines the Circular Economy Roadmap for Germany: waste management.

[25] file:///D:/Users/Mark/Downloads/Circular-Economy-Roadmap-for-Germany_EN_Web.pdf

Figure 4: The Circular Economy Roadmap for Germany: waste management



Conclusion

NZTech and our members believe a Technology Roadmap is an essential element to both improve the effectiveness of New Zealand's Emissions Reduction Plan but also to strengthen New Zealand's innovation, research and development system.

The NZ Tech Alliance could add a great deal of value to government by partnering in its development.

Thank you for the opportunity to provide feedback on the discussion document. We are happy to engage further with you to discuss our submission and provide any further assistance.

If you have any queries do not hesitate to contact me.

Yours sincerely,

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Appendix 1: International evidence case studies

Denmark

Denmark halved their greenhouse gas emissions while doubling the size of its economy[26] and since 2010, its emissions have reduced at faster than the European Union average. Manufacturing represents 14% of Danish GDP (12% in New Zealand) and this sector has reduced carbon emissions by 65% since 1990 while improving productivity by 35%[27].

Key to Denmark's success has been the strong backing of innovative technologies in key carbon-intensive industries. This has been allied with a generous public policy mechanisms including incentives to bring these programmes to a market-competitive standard[28].
The Denmark Climate Partnership has been key to prioritising this by using use technologies to reduce carbon emissions. The Partnership has focused on what it calls four technology levers: energy efficiency, electrification, a shift to green mobility and biogas. Roadmaps have been used within industries, particularly focusing on the harder-to-abate sectors[29].

The National Roadmap for Research Infrastructure[30],[31] first published in 2015 and updated in 2020 is an example of the technology roadmap approach Denmark used which has contributed to the industry-led vehicles.

In the 2020 update[32], the roadmap stated that "*modern research infrastructures are an integrated part of the international research and innovation ecosystem. They form the basis for solutions to many central societal challenges, including in the area of a green transition. Research infrastructures also often represent important areas of encounter for new research collaborations; whether this is between Danish and foreign researchers, between researchers from different Danish institutions or between research institutions and businesses*."

This Roadmap has been used to help transfer knowledge, innovation and technology between research agencies and the private sector.

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[26] https://environment.yale.edu/news/article/why-denmark-wants-to-be-a-frontrunner-in-fight-against-climate-change
[27] https://www.weforum.org/agenda/2020/09/how-denmark-s-industry-cut-emissions-and-boosted-productivity/
[28] https://energypost.eu/what-is-making-denmark-a-decarbonisation-success-policy-society-geography/
[29] https://www.weforum.org/agenda/2020/09/how-denmark-s-industry-cut-emissions-and-boosted-productivity/
[30] Research infrastructures encompass a wide array of advanced equipment, databases, laboratory facilities and many more elements that are necessary in the research process and which form the basis for scientific evolution and research breakthroughs
[31] https://ufm.dk/en/publications/2011/danish-roadmap-for-research-infrastructure-2011
[32] https://ufm.dk/en/publications/2020/filer/danish-roadmap-for-research-infrastructure-2020.pdf

These include:

PROPOSALS WITHIN ENERGY, CLIMATE AND ENVIRONMENTAL SCIENCES
(AnaEE Denmark): *Infrastructure for experimental ecosystems research in Denmark*
(HydroObs): *Agro-hydrological and hydro-biogeochemical observatories*
(ICOS/DK)*: Danish infrastructure for measuring atmospheric greenhouse gas emissions and ecosystem exchange processes*
(UAS-ability): *Research infrastructure for the use of unmanned aerial systems (drones) for data collection*
(WindScanner.eu): *The European WindScanner Facility*
(X-Power)*: Power Electronics Reliability Test Facilities*

Finland

Low-carbon roadmaps are a core part of the Finnish response to climate change[33]. Coordinated by their Ministry of Economic Affairs, a Technology Roadmap is one of four priority roadmaps areas for Finland – undertaken in partnership with the Finnish technology sector.

Finland is credited with being the first country in the world, in 2016, to put together a national circular economy roadmap[34]. Four focuses areas were at the heart of this roadmap: the food system, forestry, technology and transport & logistics. Finland's strong technology capabilities helped create a more robust circular framework utilising internet of things technology. The roadmap includes a series of case studies highlighting climate technology opportunity projects.

[33] https://tem.fi/en/low-carbon-roadmaps-2035
[34] https://www.weforum.org/agenda/2021/06/transition-to-a-circular-economy-the-right-roadmap-can-help-sitra/

Case study

Key project: An international demonstration platform for new bioproducts

The key project will be used to build a consortium of companies of various sizes from many sectors, which will apply for international funding for a forest-based circular economy concept for producing new bioproducts (for example, from the EU's Horizon programme, European Fund for Strategic Investments (EFSI) and/or regional development and cohesion funds). The project will be responsible for building the consortium, concept development for the entity and co-ordination of funding applications.

The project will examine forest-based loops and value chains in a comprehensive manner and demonstrate new methods that comply with circular economy principles for manufacturing high added value bioproducts. Bioproducts and services will replace fossil and products and meet demand in completely new areas.

The project will demonstrate circular economy practices and solutions, such as

- the application of new service-based business models;
- optimal use of material flows in industrial symbiosis;
- automation and industrial internet applications in the forest industry;
- development of bio-based chemistry and biotechnology and entrepreneurship and innovation activities;
- forestry that observes circular economy principles.

Owner: Sitra

Other implementers: Finnish Forest Industries Federation, Chemical Industry Federation of Finland, Finnish Energy, Clic Innovation

The roadmap was updated in 2020[35] and a helpful recommended process for developing a roadmap was also produced[36]

Roadmap Implementation
• **Ground work:** Prepare the groundwork and preconditions: not just a task for governments, but also for other stakeholders such as NGOs
• **Stakeholder engagement:** Involve and listen to stakeholders. Commitment in society is vital and it is important to encourage ownership and look outside the box. Whoever takes the lead has to be a neutral player, someone who is respected and can ensure that the roadmap is just and fair from a social point of view.
• **Base line:** It is essential to know where a country stands currently in terms of circularity
• **Vision and goals:** These need to be ambitious and based on metrics. Look for things that are harder to evaluate, rather than more obvious areas such as recycling targets

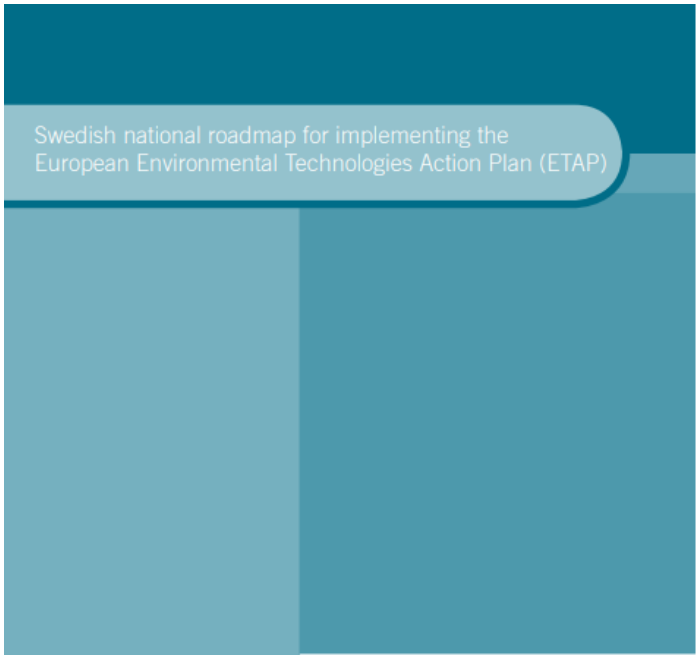
[35] https://www.sitra.fi/en/projects/critical-move-finnish-road-map-circular-economy-2-0/
[36] https://circulareconomy.europa.eu/platform/sites/default/files/ac-report-roadmapping.pdf

• **Focus areas:** Identify the focus areas; limitless possibilities that need to be narrowed down and based on a country's strengths and goals.
• **Action plan:** Planning of actions and all such actions must have owners. Once drawn up, it is essential to communicate the plan in a way that motivates others, with a "circular economy story" that inspires people to connect.
• **Implementation:** the success or failure of the roadmap is often decided at this stage, with not enough emphasis placed on who is taking the lead and how to implement it.
• **Review:** It is not a one-off process. It must be evaluated and updated as necessary.

Sweden

Sweden was the highest ranked country in the European Union's Annual Climate Change Performance Index 2020[37]. The national roadmap it produced implementing the European Environmental Technologies Action Plan has been credited as contributing to this progress.

The Action Plan boosted Sweden's efforts to strengthen further its environmental technology sector. This in turn has created conditions to stimulate both the demand for and development of this technology. In addition to improving its climate change performance, it has had an added benefit of boosting the contribution environmental technology makes to the Swedish economy and increasing the export of environmental technologies.



The action plan focussed on:

- Research and development
- Verification of technologies
- Performance Targets

[37] https://www.euronews.com/2020/12/07/sweden-leads-climate-action-ranking-while-hungary-and-slovenia-lag

- Mobilising financial instruments
- Measures in support of eco-industries
- Market based instruments
- Procurement
- Raising awareness
- Acting globally

United Kingdom

In 2010, two years after its first report, the UK Climate Change Committee published *Building a low carbon economy*[38] which today we would see as technology roadmap.

It stated in 2010 that "*the Government should set out its strategy for developing the technologies required to meet the 2050 emissions reduction target, identifying which technology portfolios will be developed". It went on to say that: "The case for action is strong. With adequate funding, new policies and strengthened delivery arrangements, we would expect UK firms to lead on development of key technologies, driving down emissions to meet carbon budgets and targets, and fulfilling the new Government's clear objective to build a low carbon economy*."

It urged the then Cameron-led government to put appropriate low-carbon technology support arrangements in place so that both environmental and wider economic gains could be unlocked.

It distinguished between technologies the government should develop and then deploy and those it should just deploy and those it should research and develop.

For example, in 2010 it assessed the UK technology landscape and capabilities and recommended the country should:

- *Develop and deploy offshore wind, marine, carbon capture and storage (CCS) for power generation, aviation technologies, smart grids, and electric vehicle technologies.*
- *Deploy nuclear power, advanced insulation materials, heat pumps and CCS for energy intensive industries (there may also be scope for UK participation in demonstration of industry CCS).*
- *Research and develop hydrogen fuel cell vehicles, technologies in agriculture and industry, 3rd generation solar PV technologies, energy storage and advanced biofuels technologies.*

In 2017 the UK government itself published the Clean Growth Strategy[39]. It commented at the time that the Climate Change Committee had highlighted technology as key to making the UK's net zero emissions target feasible and cost-effective. The Strategy also set out to create a more favourable environment to support greater private sector investment in climate technologies. This includes ensuring competitive markets are in place, regulating as

[38] https://www.theccc.org.uk/publication/building-a-low-carbon-economy-the-uks-innovation-challenge/

[39] https://www.gov.uk/government/publications/clean-growth-strategy

appropriate and funding the development of technology both from fundamental research to pre-commercial trials.

In 2019 the Climate Change Committee stressed that strong leadership from government was essential to implement these key technologies.

Royal Society

The Royal Society in the UK, in the lead-up to COP26 earlier this year, set out twelve technology and climate research priorities[40] which it said needed to be translated into roadmaps to deliver net zero carbon emissions by 2050.

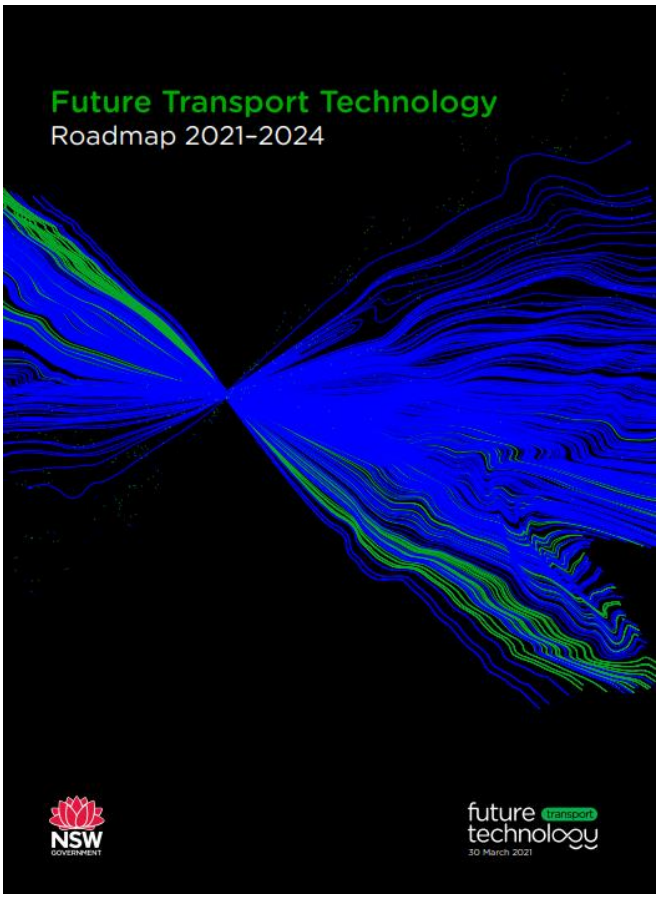
The topics in it include:

- *"Revolutionary ideas for heating and cooling buildings, technologies and industrial processes, such as materials that can capture heat - or 'coldness' - and allow it to be stored, transported or used to improve energy efficiency of industrial or domestic processes.*
- *Priorities for scaling up technologies like "green" hydrogen and ammonia fuels, made using renewable energy, or carbon capture and storage, to reduce costs and improve efficiency.*
- *New approaches to managing land and the food system globally, to enhance terrestrial carbon storage and use scientific innovation to cut waste, improve global sustainability and support human health."*

Other Jurisdictions

The Technology Roadmap approach is also being used in climate priority sectors, including in countries that still struggle with their wider emissions reduction strategies.

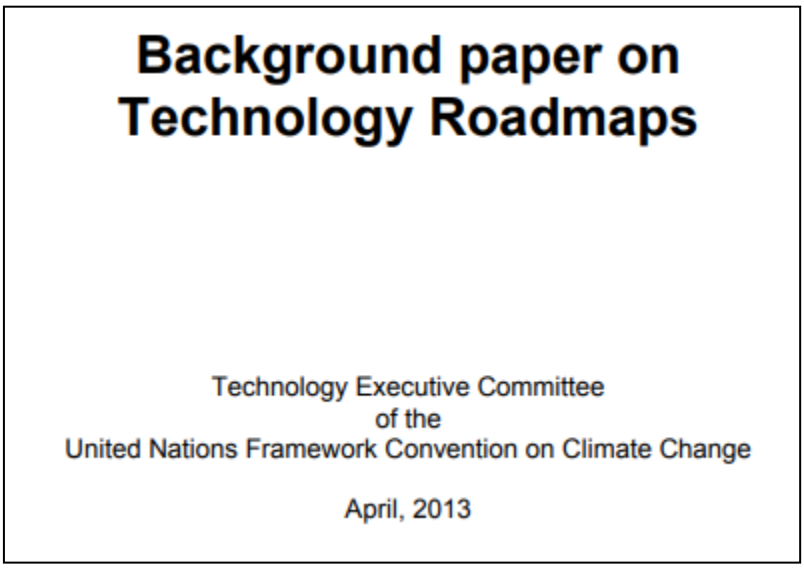
Transport for New South Wales, Australia's largest transport regulator, has published a Technology Road Map since 2016. It's latest version[41] highlights its strong track record of delivery, its technology toolkit and the six technology-lead priority programs it is running to transport the state's transport experience. The roadmap also outlines the commercial and research partnerships it builds to drive better innovation.



[40] https://royalsociety.org/news/2021/05/climate-research-priorities/
[41] https://future.transport.nsw.gov.au/technology/technology-roadmap

United Nations

In 2013, the Technology Executive Committee of the United Nations Framework Convention on Climate Change produced a report recommending countries adopt Technology Roadmaps to advance climate change mitigation and adaption[42].



190 existing Technology Roadmaps were evaluated across 21 countries. New Zealand did not feature except in an Australian-led study on aviation technology fuel roadmap.

The advantages the report outlines by using Technology Roadmaps include:

- Structure approach: They depict trends, objectives and actions in a structured way. These depictions show a highly synthesised picture of strategy which supports the development of subsequent activity.
- Applicability: Roadmapping's origin lies in the firm economic model where technology and product strategy needed to be better aligned. These practical "roots" make it well suited to technology management and the link to policy with technical considerations.
- Creative focus: Roadmapping supports the idea that the future can and should be created rather than being led by what's called technical determinism.
- Builds consensus: The method for building a roadmap is usually characterised by a process involving strong consensus building.
- Retains flexibility: It incorporates a flexible approach, underpinned by a systems-based approach. This allows roadmapping to be employed in varied situations, incorporating other methods such as scenario-planning.

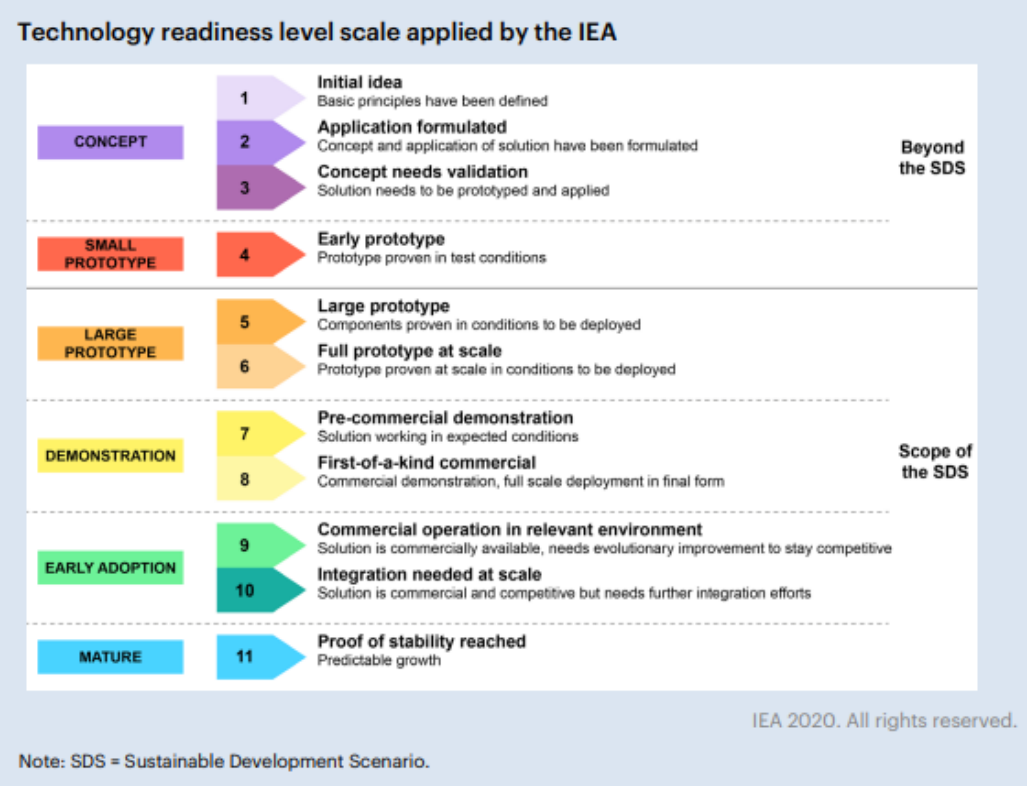
The report did note some limitations to be aware of. These include:

- Tunnel vision: The consensus-building approach factor can create the risk of tunnel vision where the team can focus on one future state, limiting the appreciation for variety and diversity. This can be addressed in the roadmap design and governance establishment phase.
- Alignment: A roadmap will likely only be successful if it is aligned with (updated) government plans, and it must be feasible

[42]https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEC_tab_1/c4305238ff8d4dee90493855bf224fd1/0ee6a8165b634fb0861a4ea6cf2ce411.pdf

International Energy Agency

The International Energy Agency says technology will largely determine our energy future and that achieving our energy and climate goals demands a dramatic scaling up of clean energy technologies. In their latest Energy Perspectives 2020[43] they outline a technology readiness scale which they commend to country technology roadmaps[44].



They also stress that governments have a vital role in stimulating innovation environments. It says an innovation system will struggle to translate research into technological change unless it is performing successfully under four key functions:

- Resource push: There must be a sustained flow of R&D funding, backed by a skilled workforce and research infrastructure. These resources can come from private, public or even charitable sources.
- Knowledge management: It must be possible for knowledge arising to be exchanged easily between researchers, academia, companies, policy makers and international partners.
- Market pull: The expected market value of the new product or service must be large enough to make the R&D risks worthwhile, which is often a function of market rules and incentives established by legislation. If the market incentives are high, then much of the risk of developing a new idea can be borne by the private sector.
- Socio-political support: There needs to be broad socio-political support for the new product or service, despite potential opposition from those whose interests might be threatened.

Developing a strategy around these functions is an important priority project to initiate under the Technology Roadmap.

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[43] https://iea.blob.core.windows.net/assets/7f8aed40-89af-4348-be19-c8a67df0b9ea/Energy_Technology_Perspectives_2020_PDF.pdf
[44] https://iea.blob.core.windows.net/assets/7f8aed40-89af-4348-be19-c8a67df0b9ea/Energy_Technology_Perspectives_2020_PDF.pdf

Appendix 2: International evidence case studies

A Roadmap for Buildings and Construction has been produced for the Global Alliance for Buildings by the IEA. The following figures, extracted from the IEA Roadmap provide examples of the detail that NZTech could help capture in a Technology Roadmap for the New Zealand Emissions Reduction Plan.

Technology for sustainable new buildings

The technologies listed below have been identified as the key technologies or strategies needed to reach the long-term objective of decarbonising the buildings sector.

Specific targets and timelines for sustainable new building technologies are outlined below:

Figure 12 • Technology timelines for new buildings globally

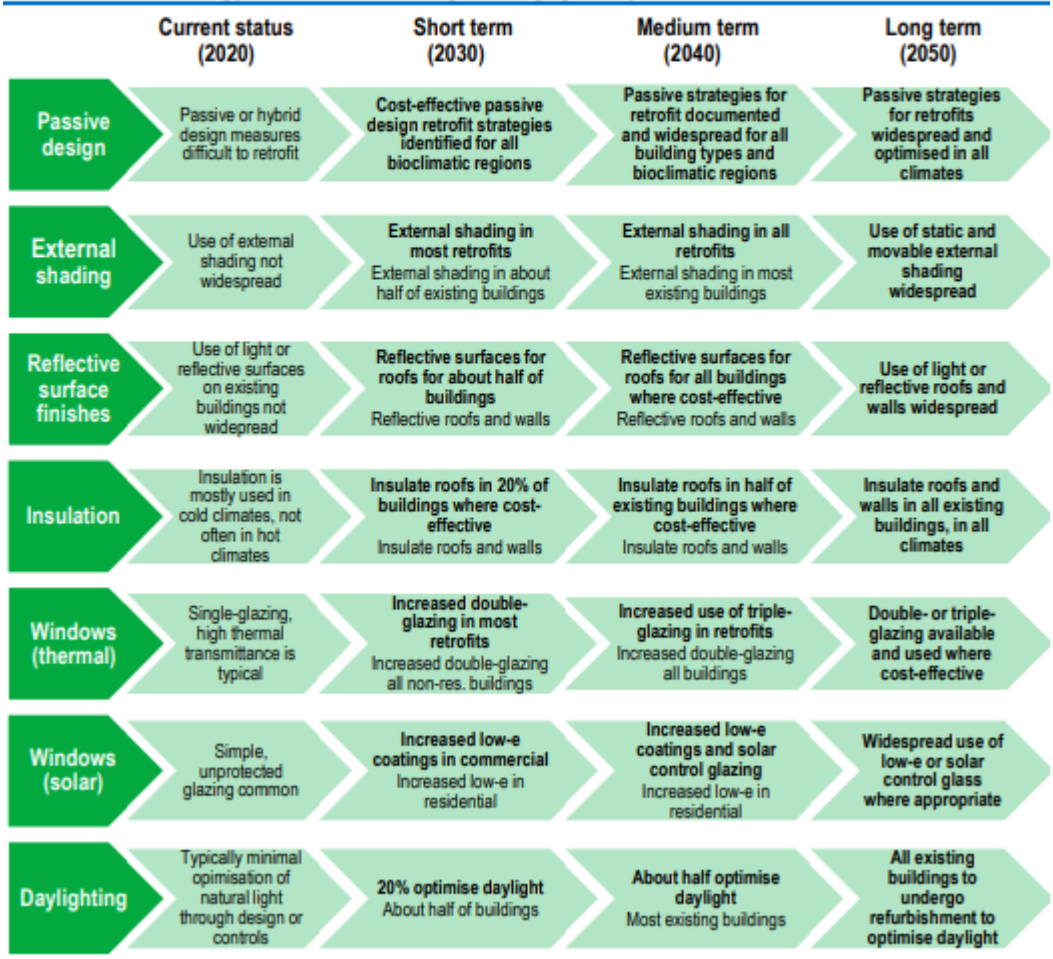
	Current status (2020)	Short term (2030)	Medium term (2040)	Long term (2050)
Building envelope	Typical: 145 watt/m² overall thermal transfer value (OTTV)	**Identify appropriate targets for OTTV depending on building type and bioclimatic zone**	**Widespread knowledge of how to optimise building fabric**	**Building fabric optimised according to building type and climate**
Passive design	Passive design and natural/ hybrid ventilation strategies not always optimised	**Passive and hybrid strategies identified for all bioclimatic regions** Made mandatory in building codes	**Passive/hybrid strategies documented and widespread for all building types/ regions**	**Passive and hybrid strategies widespread and optimised in all climates**
External shading	Use of external shading not widespread	**External shading in most new buildings where appropriate** In all new buildings	**In all new buildings where appropriate** Wide availability of technologies and low cost	**Use of static and movable external shading widespread and low cost**
Reflective surface finishes	Use of light or reflective surfaces not widepread	**Reflective roofs for most new buildings where appropriate** Reflective roofs and walls	**Reflective roofs for all new buildings where appropriate** Reflective roofs and walls	**Use of light or reflective roofs and walls widespread where appropriate**
Insulation	Insulation is used in colder climates, very little in hot climates	**Insulate roofs and walls in most new buildings, and roofs in hot climates**	**Insulate roofs and walls in all new buildings, and most roofs and walls in hot climates**	**Insulate roofs and walls in all new buildings, in all climates**
Windows (thermal)	Typical: mix of single- and double-glazing, high thermal transmittance	**Increased double-glazing in all sectors** Increased use of triple-glazing where appropriate	**Use of double-glazing in most buildings** Increased use of triple-glazing where appropriate	**Double- or triple-glazing available and used where appropriate**
Windows (solar)	Simple, unprotected glazing common	**Low-emissivity (low-e) coatings in most buildings** Increased use of low-e in developing economies	**Increased use of low-e coatings** Use of low-e further increased in developing economies	**Widespread use of low-e or solar control glass where appropriate**
Daylighting	Typically minimal optimisation of natural light through design or controls	**About half of new buildings optimise daylight** Most new buildings	**Most new buildings optimise daylight** All new buildings	**All new buildings optimise daylight**
Design tools	Little use of tools in the design process for new buildings	**Integrated design in most projects** Increased building information modelling (BIM) and simulation	**Integrated design in all projects** Increased use of BIM and simulation	**Integrated design process and simulation tools for all construction projects**

Technology for sustainable existing buildings

The energy use and emissions from existing buildings are influenced by whether the building has undergone a building retrofit, the quality of that retrofit with respect to design, choice of technologies and materials, and what gradual improvements it has undergone over time.

Specific targets and timelines for sustainable existing building technologies are outlined below:

Figure 15 • Technology timelines for existing buildings globally

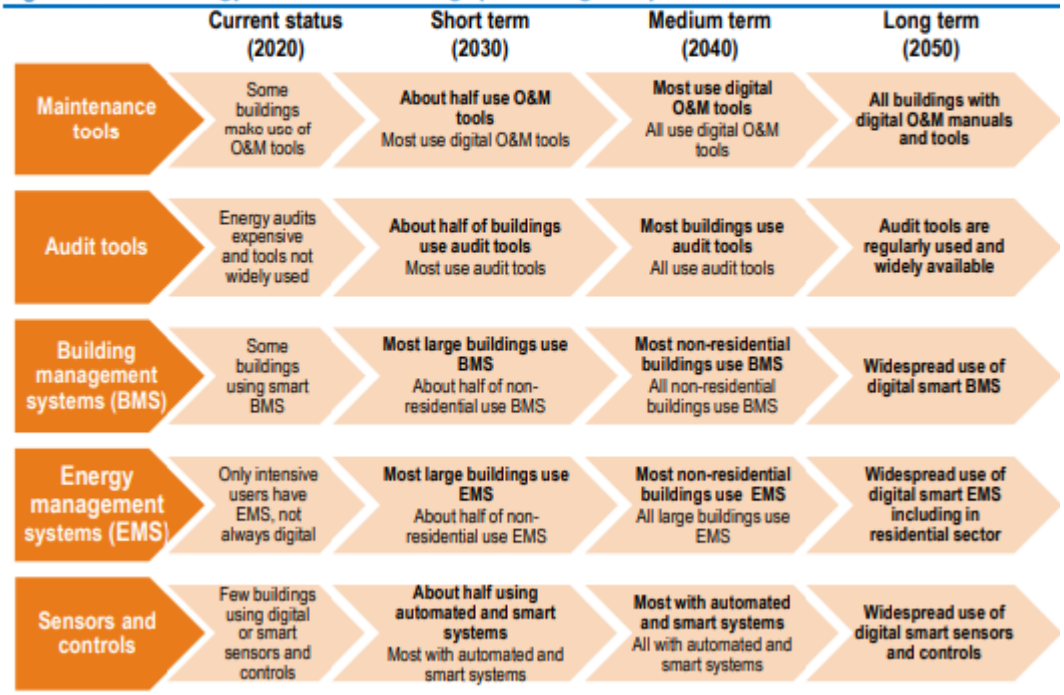


Notes: The **proposed global target** is in **bold**. Below that is the proposed accelerated target.

Technology for sustainable building operations

Specific targets and timelines for the sustainable building operation technologies are outlined below:

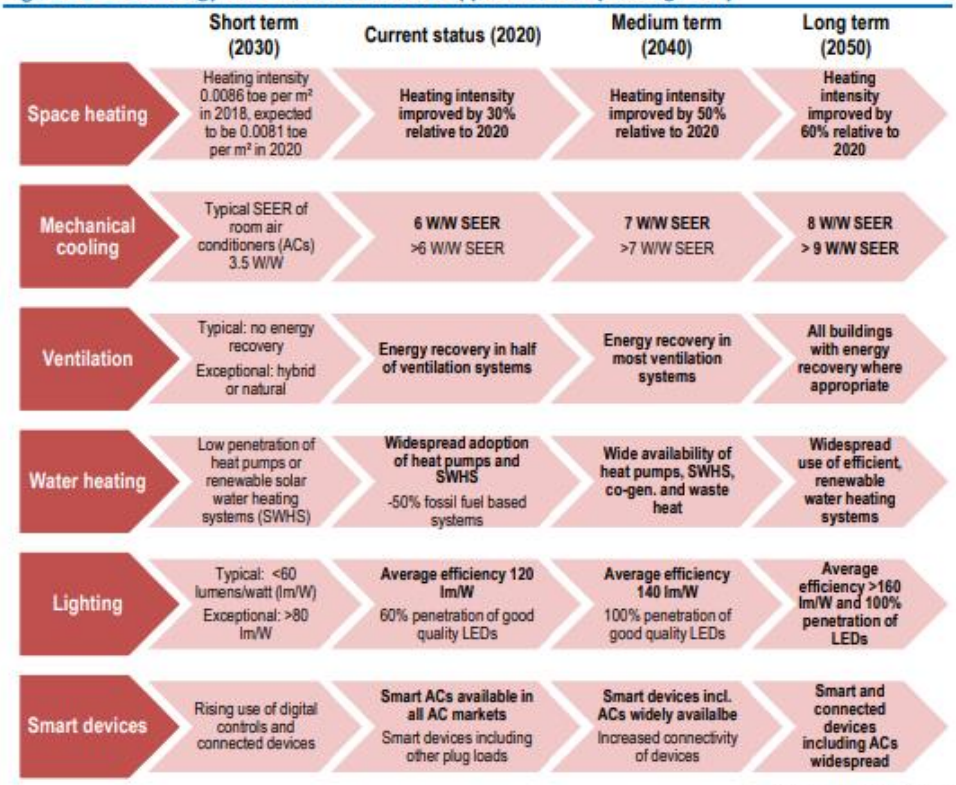
Figure 18 • Technology timelines for building operations globally



Technology for sustainable appliances and systems

Specific targets and timelines for the sustainable system technologies are outlined below:

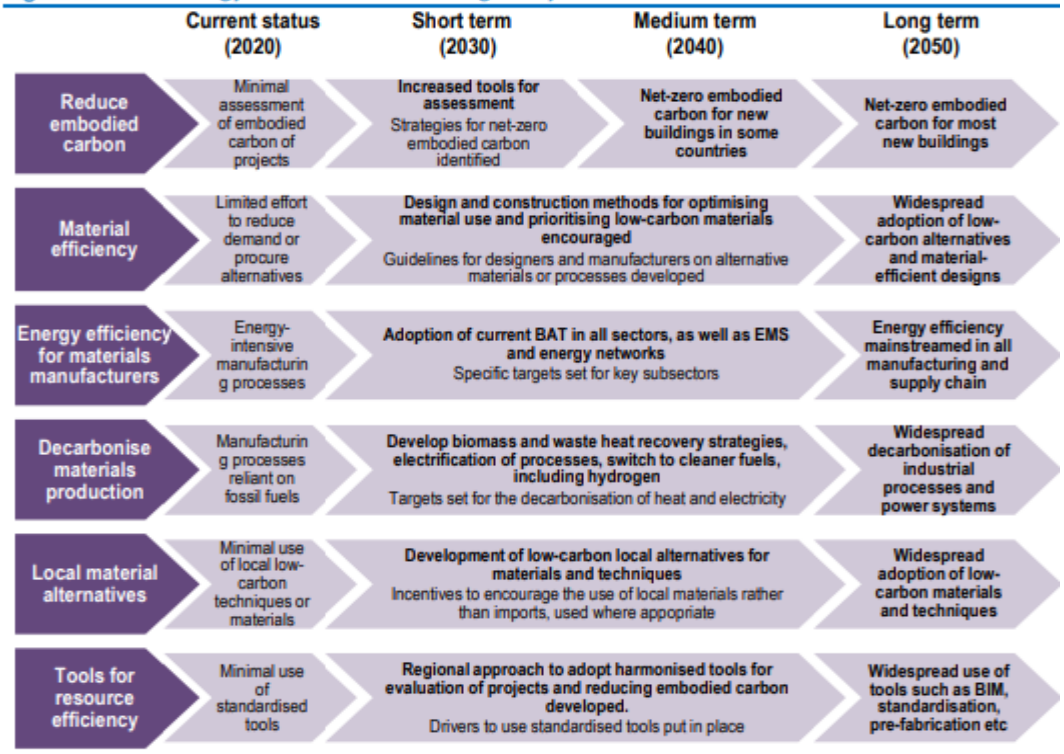
Figure 21 • Technology timelines for sustainable appliances and systems globally



Technology and strategy for low-carbon materials

Specific technology targets and timelines for sustainable materials are outlined below:

Figure 25 • Technology timelines for materials globally



Notes: The **proposed global target** is in **bold**. Below that is the proposed accelerated target.

Technology for urban planning

Technology can enable increased action toward zero-emission, efficient and resilient buildings when coupled with urban planning. Specific targets and timelines for sustainable urban planning technologies are outlined below:

Figure 9 • Technology timelines for urban planning globally