Yokohama in 2030

Envisioning 1.5-Degree Lifestyles

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Partner Organisations (Listed in alphabetical order)

Project Implementation Partners
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Chulalongkorn University, Thailand
ICLEI Africa, South Africa
Swechha, India

Communications and Outreach Partners
Hot or Cool Institute, Germany
ICLEI Japan
Science Communication and Research Institute (SCRI), Japan

Advisory Partners
D-mat, Finland
National Institute for Environmental Studies (NIES), Japan

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EXECUTIVE SUMMARY

Yokohama in 2030 recommends plausible options for 1.5-Degree Lifestyles (1.5°C Lifestyles) and their supporting measures, towards realising the globally unified 1.5°C target of 2.5 t-CO_2e/capita/year, compatible with the Paris Agreement's target of limiting global warming to 1.5°C above pre-industrial levels. Based on the assessment of consumption data across housing, food, mobility, goods, services and leisure, the average lifestyle carbon footprint in Yokohama is 7.1t-CO_2e/capita/year, around Japan's national average, but above the global average at 4.3t-CO_2e/capita/year.

Reduction from 7.1t-CO_2e/capita/year lifestyle carbon footprint to 2.5 t-CO_2e/capita/year is feasible only through a combination of production and consumption side measures.

Our proposed consumption side measures can reduce Yokohama's average lifestyle carbon footprint from 7.1t-CO_2e/capita/year to 3.9t-CO_2e/capita/year (-45%), if we assume no improvements in renewable energy share and environmental efficiency from the current levels. We identified 65-actionable lifestyle change options and estimated their carbon footprint reduction potential based on consumption amount and energy intensity for production across housing, mobility, food, goods, services and leisure domains. Choice of a decarbonised lifestyle is personal, and can vary from one person to another. Through participatory workshops with Yokohama's citizens, feasibility and desirability of the identified options was evaluated. Yokohama citizens conducted a two weeks of household experiment to confirm the viability of the options selected in the workshop. Household experiments enabled identifying the obstacles to implement options and the supporting measures to overcome those.

Current average per capita lifestyle carbon footprint in Yokohama	7.1t-CO_2e/capita/year
2030 average per capita lifestyle carbon footprint in Yokohama after lifestyles change with assuming no improvements in renewable energy share and environmental efficiency from the current level	3.9t-CO_2e/capita/year
2030 average per capita lifestyle carbon footprint in Yokohama after changes in lifestyles with assuming improvements in both renewable energy share and environmental efficiency	2.5 t-CO_2e/capita/year

In Yokohama, the housing domain accounts for the largest carbon footprint, followed by food, mobility, goods, services and leisure. For housing, the high carbon intensity of house construction and energy matrix accounts for the largest carbon footprint. Reducing the dependency on a high intensity energy matrix and when possible, carefully choosing low carbon house construction technology is crucial. For businesses and governments making low carbon energy and housing technology readily available is a key area for intervention. For citizens, subscribing to green energy, installing roof-top solar, choosing to construct or rent energy efficient housing are possible options that have the largest carbon footprint reduction potential. Measures, such as installing LED lighting, using renewable energy powered air conditioning for heating instead of kerosene, gas, oil and other fuel heaters, adjusting clothing to outdoor temperatures to reduce artificial cooling and heating, are the most feasible options in the short term, according to workshop participants.

The identified options to reduce the lifestyle carbon footprint complements Yokohama's city's existing initiatives for reducing carbon emissions, and it can accelerate the transition towards carbon neutrality target by 2050. Through group discussions among research team members and citizens, it was confirmed that decarbonised lifestyles can have multiple co-benefits in addition to limiting global warming. Some of the co-benefits include promotion of ecotourism and revitalisation of local economies, and strengthened inter-relationship among various residents.

In implementing 1.5°C Lifestyles options with high potential to reduce carbon footprints, citizens identified obstacles due to lack of infrastructure, products and services; limited awareness about existing infrastructure, products and services; high costs to implement some options; low accessibility; conflicts with personal need; conflicts with other people's needs; and conflicts with societal norms. Supportive measures by government and business can enable the households to implement decarbonised lifestyle change options effectively, while awareness and willingness of households to take actions can encourage government and business to provide supporting measures.

Furthermore, to realize a decarbonised lifestyle compatible with the 1.5°C climate goal, both production and consumption measures are necessary. For example, if renewable electricity share will reach 45% and annual environmental energy efficiency improvement keeps 3% by 2030, proposed consumption side measures could achieve the goal of 2.5 t-CO_2e/capita/year (-65%). Based on the existing initiatives in Yokohama and Japan, not only renewable energy increase and improvement in environmental efficiency but also other production side changes like the digital transformation, artificial intelligence, acceleration in autonomous and shared mobility, reduction in material consumption, and robotics are expected, all of which can contribute to the carbon footprint reduction.

The lifestyle carbon footprint analysed in this report, as well as the carbon footprint reductions associated with citizen behaviour change, are expressed as the per capita average of Yokohama. Citizens' carbon footprints are highly variable, corresponding to differences in income, occupation, age, family structure and health. The report argues that it is vital to reduce the average lifestyle carbon footprint of citizens below the 2030 target (2.5tCO_2e/yr per person). However, it is neither realistic nor desirable to expect all citizens to take the carbon footprint reduction actions described in the report, regardless of their different standards of living and diversity of needs such as mobility, housing and food.

Yokohama in 2030 accentuates that the 2.5 t-CO_2e/capita/year target is very ambitious but can be achieved if all the stakeholders take adequate actions in a collaborative manner. It aims to provide ideas towards realising a 1.5°C Lifestyle for diverse citizens in many respects and the adoption rates are just indicative figures, not future projections or targets.

CONTENTS

1. INTRODUCTION

Current climate debates largely focus on production-based strategies to reduce carbon emissions. Production-based accounting covers direct emissions from domestic production activities within geographical boundaries and offshore activities under the control of a country, but does not account for embodied emissions from international trade (Boitier, 2012; Moore, 2013). Consumption-based accounting (carbon footprinting) includes both direct emissions and embedded emissions due to the production and distribution of products and services, including imported products, reflecting the global impacts of individuals' final consumption and lifestyles. This approach addresses the carbon leakage in production-based strategies and promotes comprehensive mitigation options while not burdening developing countries with excessive emissions obligations (Peters and Hertwich, 2007).

The analysis of individual lifestyles offers the possibility of a comprehensive assessment of consumption-related carbon emissions in different areas of life such as housing, food, mobility, goods, services and leisure, as well as the links between these areas (Institute for Global Environmental Strategies, Aalto University and D-mat Ltd, 2019). Lifestyle carbon footprint can be assessed through national or city boundaries. Given the availability of consumption data, a city where an individual resides provides appropriate geography to account for carbon emissions across production, distribution, use, and disposal of purchased products and services including those embedded in trades.

This scenario provides an overview of how to substantially reduce consumption-based carbon emissions through the decarbonisation of lifestyles, developed in consultation with citizens of Yokohama, who were selected by IGES based on their existing network and practical considerations for project implementation. This scenario accentuates that the adoption of low-carbon lifestyle options relies on supporting measures by governments and businesses to facilitate efforts by individuals, and emphasises the importance of collaborative efforts by all stakeholders.

1.1 Background

Yokohama is the second-largest city in Japan by population, located south of Tokyo and part of the Tokyo metropolitan area. It is the capital of Kanagawa Prefecture and has a population of about 3.7 million. The largest age group of population is between 40-49 years (Government of Japan, 2021). The city population is still increasing despite an already declining national population, but it is expected to start declining by 2025 (City Planning Division, 2021). The city has over 110,000 businesses employing over 1.4 million people; wholesale and retail sector businesses employ the largest number of people (Statistics Japan, 2020).
In addition, many residents of Yokohama commute to Tokyo and other parts of Kanagawa Prefecture for work and university.

Yokohama is a port city and was among the first ports to be open for foreign trade. As a result, the city is famous for its multiculturalism, and unique cultural trait called Hamakko, which promotes openness to whatever is good (Yokohama Convention and Visitors Bureau, 2021). More than 150 years have now passed since the opening of the port of Yokohama, and the city has set a vision to be ‘attractive, lively, and filled with hopes and dreams that are shared the world over’ (City Planning Division, 2021).

Yokohama sets its long-term vision through the ‘Yokohama General Plan’, which was first introduced in 1973 and

guided city development for the next 30 years. The current plan was introduced in 2006, and it provides a guide on the vision for city development until 2025 for citizens, organisations, companies and city government. The ongoing Yokohama General Plan proposes to build a future based on 1. accumulating vitality and wisdom and 2. making the most of local appeal and creativity, along with acknowledging various development challenges like an ageing population, environmental pollution, and faltering infrastructure and services (City Planning Division, 2021). The Yokohama General Plan encourages the adoption of low-carbon lifestyles by waste reduction, recycling, reuse, local leisure, and the use of public transport.

Yokohama has been at the forefront of environmental leadership since 2010 with the launch of the Yokohama City Global Warming Management Implementation Plan. This was revised in 2016 setting a target to achieve zero carbon by 2050 under its Zero Carbon Yokohama initiative (Sasakawa Peace Foundation, 2021). Under this plan, innovative approaches are already in action, including the Yokohama Blue Carbon Project for carbon sequestration, Yokoyoko Project to supply locally produced renewable energy, Food Bank Yokohama to reduce food waste and hunger, and Zero PC to upcycle and recycle electronic goods like computers and laptops. These initiatives are led by Yokohama City Government, businesses, NGOs, and other organisations (Circular Yokohama, 2021). The Yokohama City office has formulated an urban agriculture promotion plan 2015, under which existing agricultural land is conserved to promote local agricultural supply (Japan for Sustainability, 2015).

The recommendations for lifestyle carbon footprint provided in this scenario give an overview of a complementary strategy for consumption side emission reduction across mobility, housing, food, goods, services, and leisure that can further strengthen ongoing efforts by Yokohama City and its citizens in achieving the net-zero target by 2050.

1.2 The Scenario

Co-created with citizens, this scenario—Yokohama in 2030—recommends options and their supporting measures to reduce lifestyle carbon footprint and towards realising 1.5°C Lifestyles that are defined as sustainable lifestyle, compatible with the 1.5°C Target of the Paris Agreement to limit global warming to 1.5°C above pre-industrial levels. The lifestyle carbon footprints targets are set at 2.5 t-CO_2e/capita by 2030, 1.4 t-CO_2e/capita by 2040, and 0.7 t-CO_2e/capita by 2050 (Institute for Global Environmental Strategies, Aalto University and D-mat Ltd, 2019). This scenario focuses on the 2030 target. We emphasise that 1.5°C Lifestyles aim to achieve decarbonisation without compromising quality of life and that they should be aligned with the city vision. In this regard a co-creation approach involving citizens plays an important role.

Choice of a decarbonised lifestyle is personal, and can vary from one person to another, hence it is crucial to select low-carbon lifestyle options across housing, food, mobility, goods, services and leisure that suit individual preferences and needs. Before considering specific lifestyle options, the first step is to benchmark an individual carbon footprint, and identify hotspots for footprint reduction across housing, food, mobility, goods, services and leisure domains. Analysis of Yokohama citizen's average lifestyle carbon footprint and its related hotspots provide both policymakers and citizens with an indicative carbon footprint benchmarking its hotspot analysis, along with 65-actionable lifestyle change options. These options are also in line with a future city vision, developed based on a participatory workshop. Preferences made by citizens regarding these 65-options are indicated through the adoption rate of these options. Most of the options were implemented by project participants, either before or during the two-weeks household experiment, and they were able to identify the obstacles and the necessary supporting measures by government and businesses to effectively mainstream the decarbonised lifestyles options. Thus this scenario is not only to encourage citizens to make environmentally-friendly choices every day, but also to solicit actions by other stakeholders including the government and the business sector to enable and facilitate citizens to make such choices. In other words, our objective is not only to inspire citizens, governments, and businesses to embrace and promote conscious living, but also to broaden the narrative of taking action from policymakers to every citizen and resident of Yokohama regardless of their age, gender, nationality, and socio-economic status.

The next section details the methodology involved in developing this scenario. Sections 3, 4, and 5 introduce the project findings of average baseline carbon footprint in Yokohama, desired future city vision, and low-carbon lifestyle options across housing, food, mobility, goods, services, and leisure domains. Section 6 identifies the supporting measures for different low-carbon lifestyle options and recommends actions for various stakeholders to facilitate transition towards 1.5°C Lifestyles.

2. METHODOLOGY

For co-creating the scenario a twofold research method was deployed, involving a quantitative analysis and a participatory consultative process. The key steps under each of these steps are elaborated below.

2.1 Quantitative Analysis

The quantitative analysis is used to (i) calculate Yokohama's baseline carbon footprint; (ii) identify lifestyle carbon footprint reduction hot spots; and (iii) estimate the potential of low carbon lifestyle options when adopted in tandem. More details of quantitative methodology and data sources of the analysis of Japanese cities have been set out in previous studies (Koide et al., 2021).

Step 1: Calculation of Yokohama's Average Carbon Footprint

- Carbon footprint calculation takes into account the consumption amount and energy intensity for production of different items across housing, food, mobility, goods, leisure and services domains.
- For Yokohama, the average carbon footprint was calculated by aggregating carbon footprints of about 522 lifestyle items, based on 2015 reference data.
- The greenhouse gas (GHG) intensity data was obtained from the 2015 embodied energy and emission intensity data for Japan using input–output tables (3EID) (Nansai et al., 2012, 2020).

- The monetary-based consumption amount and intensity data were hybridised to incorporate physical units of consumption considering the local price information.

Step 2: Hot Spot Analysis

- Assessment of carbon footprint across housing, food, mobility, goods, services and leisure enabled a comparative analysis to identify which of these domains within Yokohama accounts for the largest carbon footprint.

- Taking a closer look at each domain enabled to identify the carbon footprint hotspots. Here, hot spots mean the individual lifestyle items that have either a high consumption amount, or a high carbon intensity in production, or both of these.

- Hot spot analysis helps to identify lifestyle options that have the largest potential to reduce carbon footprint.

Step 3: Development of Lifestyle Carbon Footprint Reduction Options

- Through analysis of carbon footprint hotspots for each domain and following a systematic literature review, 65 lifestyle carbon footprint reduction options were identified.

- These options were graphically illustrated along with their carbon footprint reduction in an options catalogue. The options catalogue provided simplified communications tools.

- The carbon footprint reduction potential of the 65-lifestyle options was used to design a puzzle game.

Step 4: Estimation of Aggregated Reduction Effects

- The reduction potential of individual lifestyle carbon footprint reduction options was estimated based on an estimation of the reduction in either activity level (e.g. teleworking will reduce commuting distance) or carbon footprint intensity (e.g. shifting private car commuting to that by public transportation will reduce carbon footprint intensity of commuting). In some cases, there may be rebound effects (e.g. shifting private car to EV may result in more private trip due to cheaper running cost), but our methodology does not reflect them. There are many interactions among lifestyle carbon footprint reduction options, for example, teleworking reduces commuting distance and consequently affects reduction potentials of shifting car commuting to other low-carbon mobility means. The aggregated reduction effects of implementing multiple reduction options were estimated taking into account these interactions, which became substantially smaller than simple summation of the reduction potential of each option.

2.2 Participatory Consultative Process

This process aims to reflect citizens' ideas/opinions to co-create the scenario. Both the first and second workshops were held online in collaboration with Science Communications Research Institute Japan (SCRI). Both IGES researchers and the Yokohama City Government jointly recruited the participants. SCRI moderated the workshops. A baseline questionnaire survey was conducted to compare Yokohama's average lifestyle carbon footprint calculated through quantitative analysis and the actual footprint indicated by the participants.

Step 1: Online Workshop 1

The first workshop was held online in December 2020 with 26 participants, 16 women and 10 men. The average age group of workshop participants was about 42 years. The participants were presented with information on climate change and how everyday changes in consumption can affect global warming, then following sessions were conducted.

- The participants were asked to share their vision for Yokohama city in 2050. This enabled them to identify lifestyle carbon footprint options that were most in line with the collective long-term city vision of other participants.

- The participants were then asked to select lifestyle carbon footprint reduction options along with their adoption rate[1].

- Among the 65-lifestyle carbon footprint reduction options, 63 were selected by the workshop participants.

- The participants were explained the details of the housing experiment, including a two weeks trial, followed by a two weeks actual experiments. The participants were provided with recording sheets 'household experiment notebook' and explained the procedure of recording.

1 Adoption rate indicates how widely and fully options will be implemented. For example: If the adoption rate is 100% it means all citizens eligible to implement a low-carbon lifestyle option will fully implement the option.

Step 2: Household Experiment

The aim of the household experiment was to involve participants in trying out low-carbon lifestyle options and to identify implementation barriers. Among 26 participants of the first workshop, 16 participants joined the experiment. Initially it was planned that research team members will visit the households and interview participants during the household experiment. However, this was not possible due to restrictions because of the COVID-19 pandemic. Instead follow-ups were made online and by telephone. The objective of the household experiment was to identify the obstacles in implementing 1.5°C lifestyles and apply this analysis in the recommendations for multi-stakeholder collaboration.

- Before starting the household experiment, the participants were asked to select the current status of all 65 mitigation options and the options that they plan to practice during the experiment.

- The household experiment notebook which was given to the participants during workshop 1, consisted of three parts: 'preparation and planning', 'implementation' and 'summary'.

- Preparations and planning: The participants were asked to write freely about the preparations they made for the experiment (e.g. searching for a shop where they could buy vegan food, discussing it with their family).

- Implementation: The participants were asked to report the degree of daily implementation (100%, 75%, 50%, 25%, 0%, etc.) of the chosen option during the two-week implementation period.

- Summary: The participants were requested to provide a self-assessment of the whole experiment for the options practiced. They were also asked to write freely about any difficulties or obstacles in adopting the option and what kind of support or social changes would help to increase the adoption rate of each mitigation option.

Step 3: Online Workshop 2

- The second online workshop was attended by 14 out of the 26 participants of the first workshop.

- Research team members presented the project findings on city vision, feasibility of lifestyle carbon footprint reduction options and the supporting measures that will enable the citizens to effectively implement the selected options.

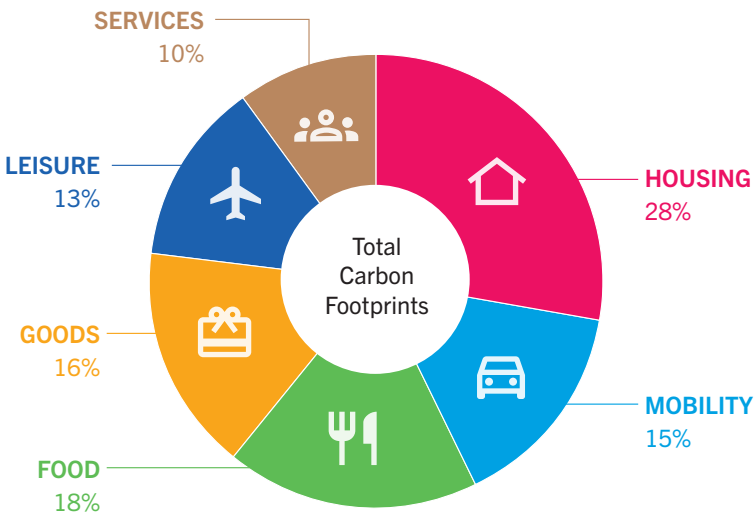
- The findings of data analysis are shared in sections 4, 5, and 6.

3. OVERVIEW of BASELINE DATA

Yokohama's average baseline carbon footprint was calculated as 7.1 t-CO_2e based on input-output analysis together with mixed-unit consumption data. The city's average baseline carbon footprint is equivalent to Japan's national average of 7.1 t-CO_2e (Koide et al., 2021), but much higher than the global average of 4.3 t-CO_2e . In estimating the carbon footprint, six lifestyle domains: housing, food, mobility, goods, services and leisure, accounting for 75% of consumption-based emissions were considered. Among the six domains, it was found that in Yokohama the carbon footprint of the housing domain is the largest, followed by food, goods, and mobility. Each of these domains was analysed in further detail to identify the hot spot for carbon footprint reduction.

Figure 3.1 presents a systematic breakdown of the average baseline footprint.

Figure 3.1 Distribution of carbon footprint in six domains



3.1 Housing

Yokohama experienced a steep increase in housing development in the early 1970s. Housing was built in hilly areas and by clearing farm land and forests (City Planning Division, 2021). Many of the detached houses and apartment buildings constructed up to the 1990s had low energy performance (Iwamura, 2004). The present housing typology comprises multi-storey apartment buildings, detached houses, and a small number of traditional timber houses. The largest share of carbon footprint in the housing domain is due to household electricity consumption. Both high carbon intensity of energy matrix and high consumption amount are the main causes.

Figure 3.2 Hotspot analysis in Housing domain

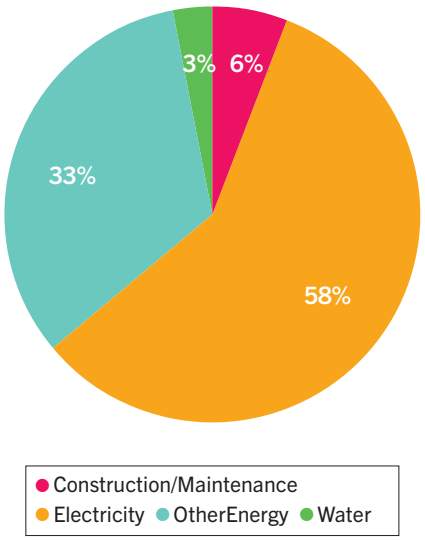
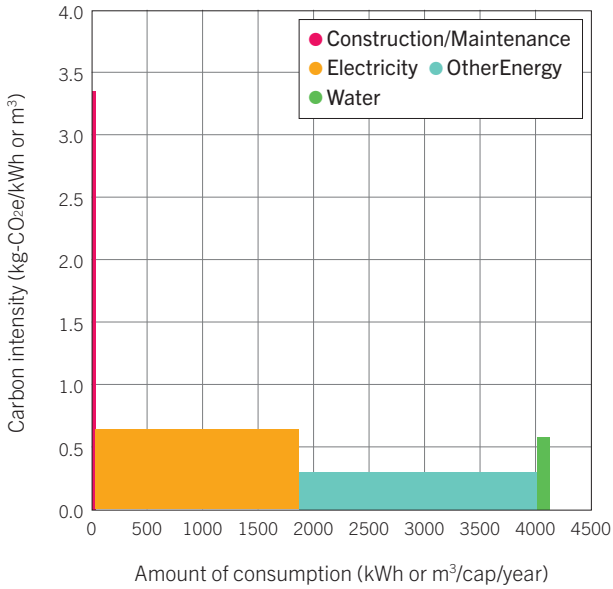


Figure 3.3 Carbon intensity and consumption amount in Housing domain



3.2 Food

Food habits in Yokohama are influenced by its multiculturalism, especially the influence of Chinese cuisine. Currently, the food domain has the second highest carbon footprint. Non-local sourcing of cereals, vegetables; high consumption of beverages and other foods like ready meals and snacks contributes to a high carbon footprint.

Figure 3.4 Hotspot analysis in Food domain

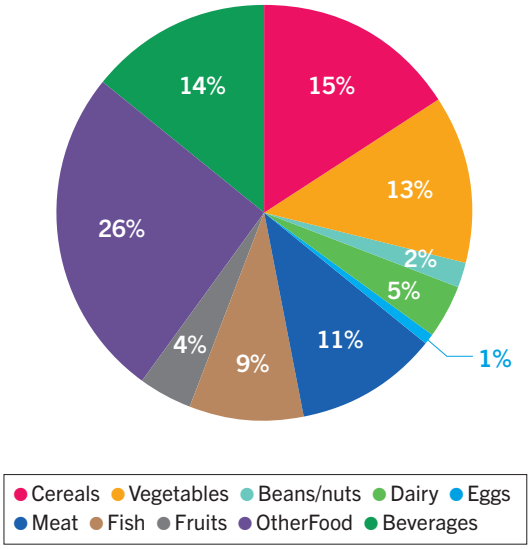
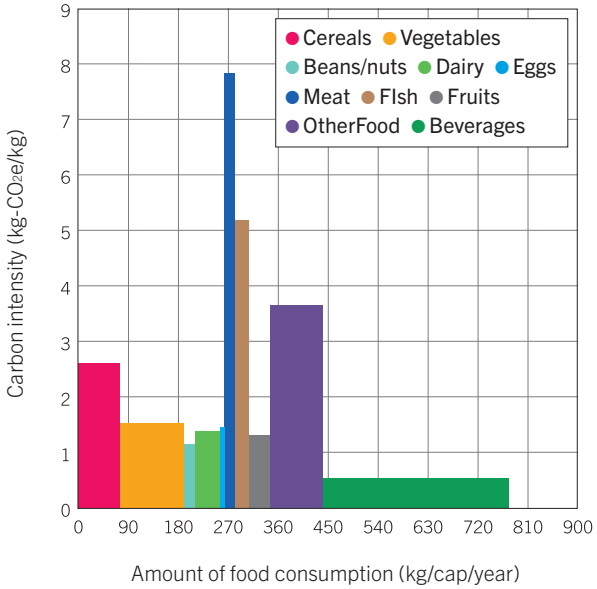


Figure 3.5 Carbon intensity and consumption amount in Food domain



3.3 Mobility

Yokohama is home to many cross-border commuters to Tokyo and other parts of Kanagawa Prefecture. The railway and subway lines serve mainly the north-south spine of the city, towards Tokyo. Conversely, east-west rail and subway lines are relatively scarce. These areas along with the east-west rail and subway lines are served by a bus network. The mobility domain's carbon footprint is mainly due to the usage of conventional internal combustion engine (ICE) powered cars, followed by overseas travel.

Figure 3.6 Hotspot analysis in Mobility domain

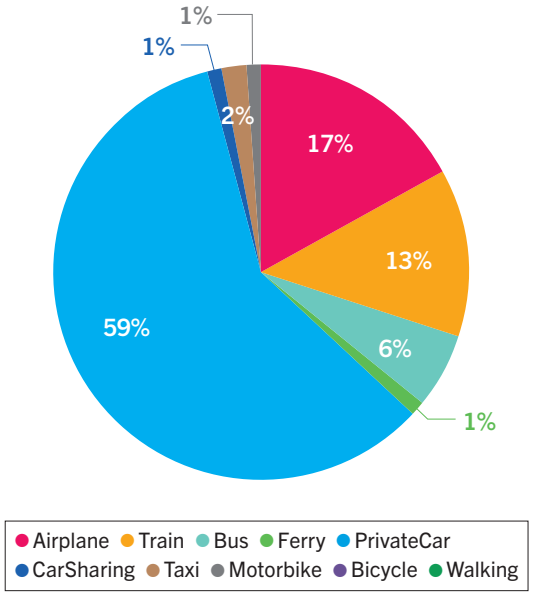
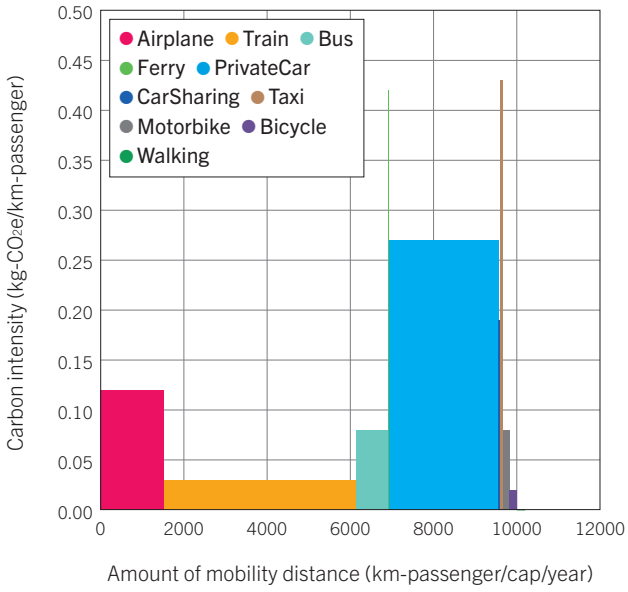


Figure 3.7 Carbon intensity and consumption amount in Mobility domain



3.4 Goods, Services and Leisure

A key challenge in the goods domain is purchase and disposal of clothes. The carbon footprint in the services domain is mainly due to parcel delivery. Leisure 's carbon footprint is primarily due to eating-out and activities related to hobbies like entertainment, sport-related activities and cultural activities.

Figure 3.8 Hotspot analysis in Goods domain

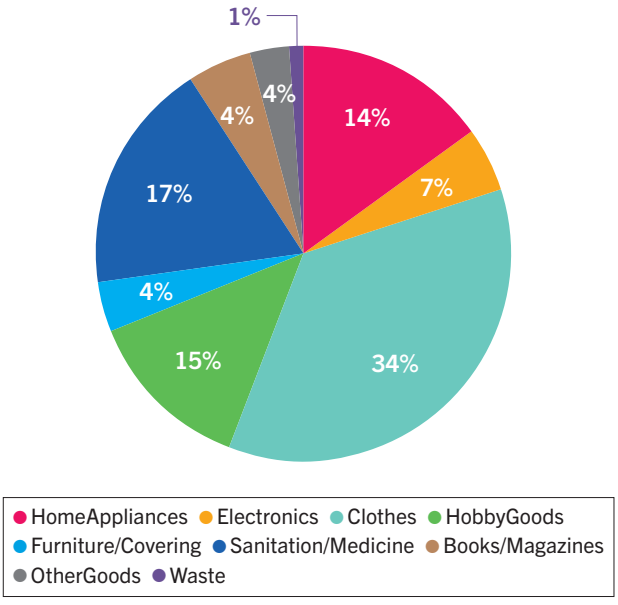


Figure 3.9 Carbon intensity and consumption amount in Goods domain

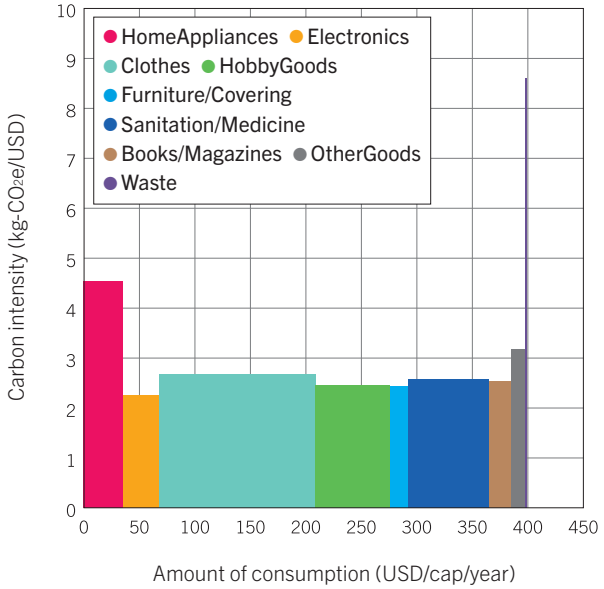


Figure 3.10 Hotspot analysis in Service domain

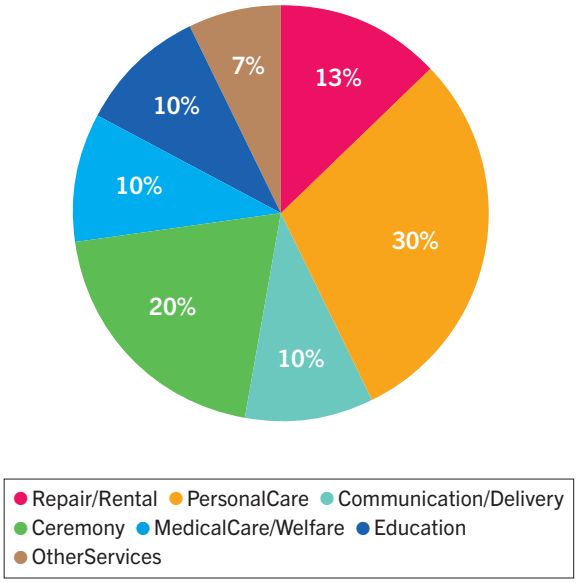


Figure 3.11 Carbon intensity and consumption amount in Service domain

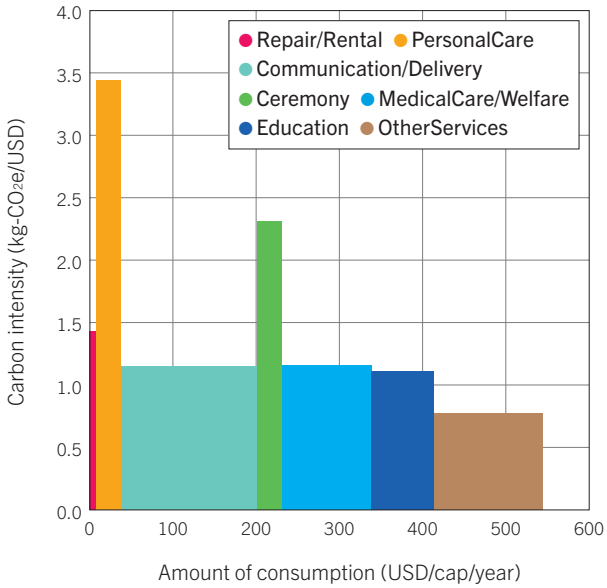


Figure 3.12 Hotspot analysis in Leisure domain

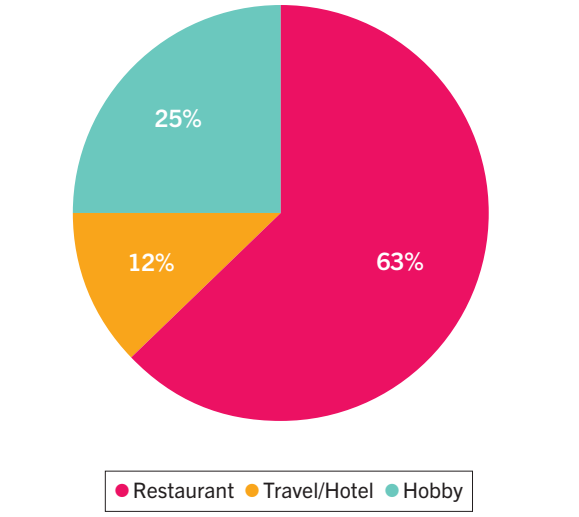
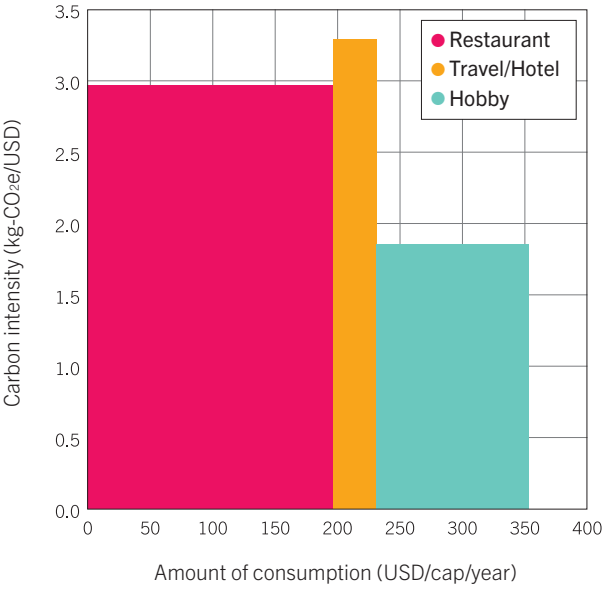


Figure 3.13 Carbon intensity and consumption amount in Leisure domain



4. CITY VISION

- Based on the text analysis of the vision discussion at the first workshop, four themes were identified for the future city vision: ‘Urban Green Space and Urban Design’,‘People-friendly Transport’, ‘Inclusiveness and Diversity’ and ‘Innovation and Education’.
- Yokohama's vision for the future is to be a highly inclusive city that embraces diversity, including the elderly, disabled and other vulnerable groups. This aspect is particularly important to develop a people-friendly transport system.
- As a port city, Yokohama has been a centre of exchange for a diverse range of people and has served as a hub for a variety of innovative industries. These features are advantageous in developing innovative lifestyle change options and in nurturing partnerships between citizens and businesses to promote them.

4.1 Development of City Vision

The city vision towards 2050 was developed from text analysis to gain insights from the participants’ opinions of “What of Yokohama shall be retained towards 2050” and “What of Yokohama-city to be improved towards 2050” shared during two workshops. The year 2050 was selected for an envisioning exercise to enable the workshop participants to envision truly innovative and sustainable futures that were not restricted by existing systemic lock-ins.

The analysis of opinions on “What of Yokohama shall be retained towards 2050” highlighted that many of the participating citizens were very aware of the good living environment in their neighbourhoods and wanted to maintain it in the future. This might be evidence that Yokohama has successfully ensured a good living environment from the early stages of housing development that started during the period of rapid economic growth from the 1960s onwards. In particular, participants pointed out that there are many farms, parks and green spaces in their residential neighbourhoods, as well as a good urban landscape. Participants expressed that they feel comfortable living there.

In addition to this, the city's excellent public transport system was praised, with participants pointing out that it is very convenient to get around. Although expressed less explicitly, participants were also aware of Yokohama's regional character as a port city with a historical history of interaction between diverse human resources, and their expectation was that this regional character would continue to induce innovation in local industries.

As an extension of the discussion during the "What of Yokohama shall be retained towards 2050" session, the negative effects of cars were widely discussed.

In contrast to the much appreciated improvement of public transport, the focus was on problems related to mobility, such as problems with pedestrians and cyclists, which are typical in big cities.

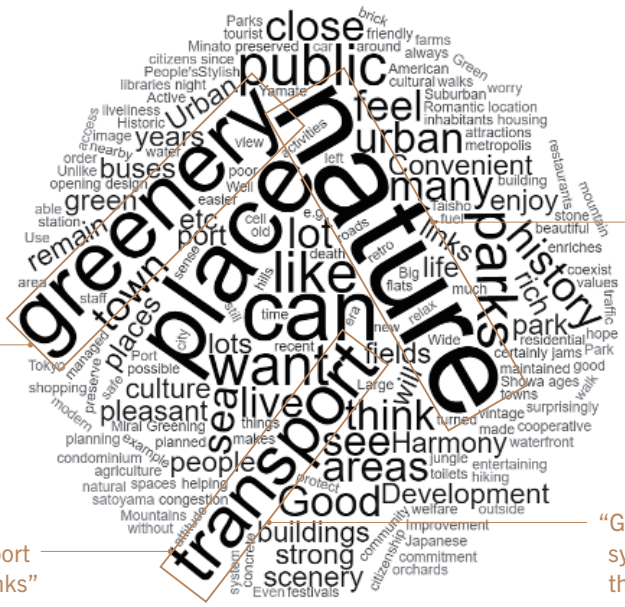
Many participants wanted to see the development of bicycle paths to ensure the safety of pedestrians and cyclists. They also pointed out that the roads are currently too narrow and congested with cars.

This problem of mobility is particularly prevalent among the elderly and physically challenged. The current mobility environment, which is dangerous and inconvenient even for able-bodied participants, is a serious problem for the elderly and disabled.

In addition, the elderly and disabled need access to local welfare and health services, so inclusiveness for these vulnerable groups may be an urgent issue for Yokohama as the city moves towards a super-aged society[2].

Figure 4.1 Analysis of what workshop participants wish to be improved in Yokohama towards 2050

"Yokohama has a strong image of being an urban, but surprisingly there are still many fields. I think it would be good to have many fields left in order to protect Japanese agriculture."



"Convenient transport links"

"I want Yokohama to remain a place of nature, where parks are close to where we live, where we can enjoy the sea and hiking. I want to be able to walk outside with my grandchildren without worry."

"Good public transport system, depending on the location."

4.2 Key Themes of the City Vision towards 2050

The following four key themes were extracted based on the text analysis mentioned above: 'Urban Green Space and Urban Design', 'People-friendly Transport', 'Inclusiveness and Diversity' and 'Innovation and Education'. The key issues for these four themes are summarized below along with some possible solutions.

Theme 1: Urban Green Space and Urban Design (Urban Farming, Parks and Urban Development Controls)

Issues or Requests	Solutions (example)
Decrease in green spaces Lack of parks maintenance	Strengthening of urban development regulations (e.g. a system of contributions for the maintenance of green spaces) More budget for parks

2 WHO defines 'super-aged society' as the society with an ageing rate (the proportion of a society's population over 65-year old) exceeding 21%.

Issues or Requests	Solutions (example)
Expansion of urban farming	Expansion of the budget for the development of urban farms Development regulations (e.g. urbanisation control areas)
Urban landscape design	Improvement of the landscape system Urban planning restoring historic buildings

Theme 2: People-friendly Transport (Walking, Bicycling and Public Transport)

Issues or Requests	Solutions (example)
Ensuring the safety of pedestrians and cyclists	Development of bicycle paths
Ensuring the safety of pedestrians and cyclists	Development of bicycle paths
Improved bicycle accessibility	Promotion of bicycle-sharing
Barrier-free mobility	Making buses barrier-free Improvement of local transport Widespread use of electrically-assisted bicycles (to cope with slopes)

Theme 3: Inclusiveness and Diversity (Elderly, Disabled and Foreign Nationals)

Issues or Requests	Solutions (example)
Super-ageing society	Community welfare and health through collaboration
Life support for disabled people	A community-wide support service system Support for the transition from welfare to work
Longer-term residence of foreign nationals	Employment support for international students Multilingual support for local services

Theme 4: Innovation and Education

Issues or Requests	Solutions (example)
Regional revitalisation and industrial hubs	Business matching Entrepreneurship support
Industry-University Collaboration	Creating business opportunities Support for industry-academia collaboration
Diverse educational needs	Career and lifelong education in partnership with families, communities and businesses

4.3 Overview of the Future City Vision

Through the participatory workshops, many participants in Yokohama appreciated the city's implementation of a growth strategy based on local characteristics, but were also concerned about the negative consequences of rapid urban development which is sometimes undertaken without adequate coordination and landscape management. Advanced urban planning with abundant urban green spaces along with development of urban farming is a key element of the Future City Vision.

Many participants also pointed out the necessity of further efforts to cope with an ageing society. Yokohama's vision for the future is to be a highly inclusive city that embraces diversity, including the elderly, disabled and other vulnerable groups. This aspect is particularly important to develop a people-friendly transport system. Promotion of bicycle use, walking and public transport must be aligned with measures to make them barrier free and accessible to these vulnerable groups as well. The city is expected to become a safe and comfortable city as well as a convenient place to live for all citizens.

As a port city, Yokohama has been a centre of exchange for a diverse range of people from Japan and abroad since the opening of the port, and this has contributed to the city's vitality. As a result, the city has become a hub for a variety of innovative industries, providing opportunities to develop innovative lifestyle change options and nurturing citizen-business partnerships to promote them.

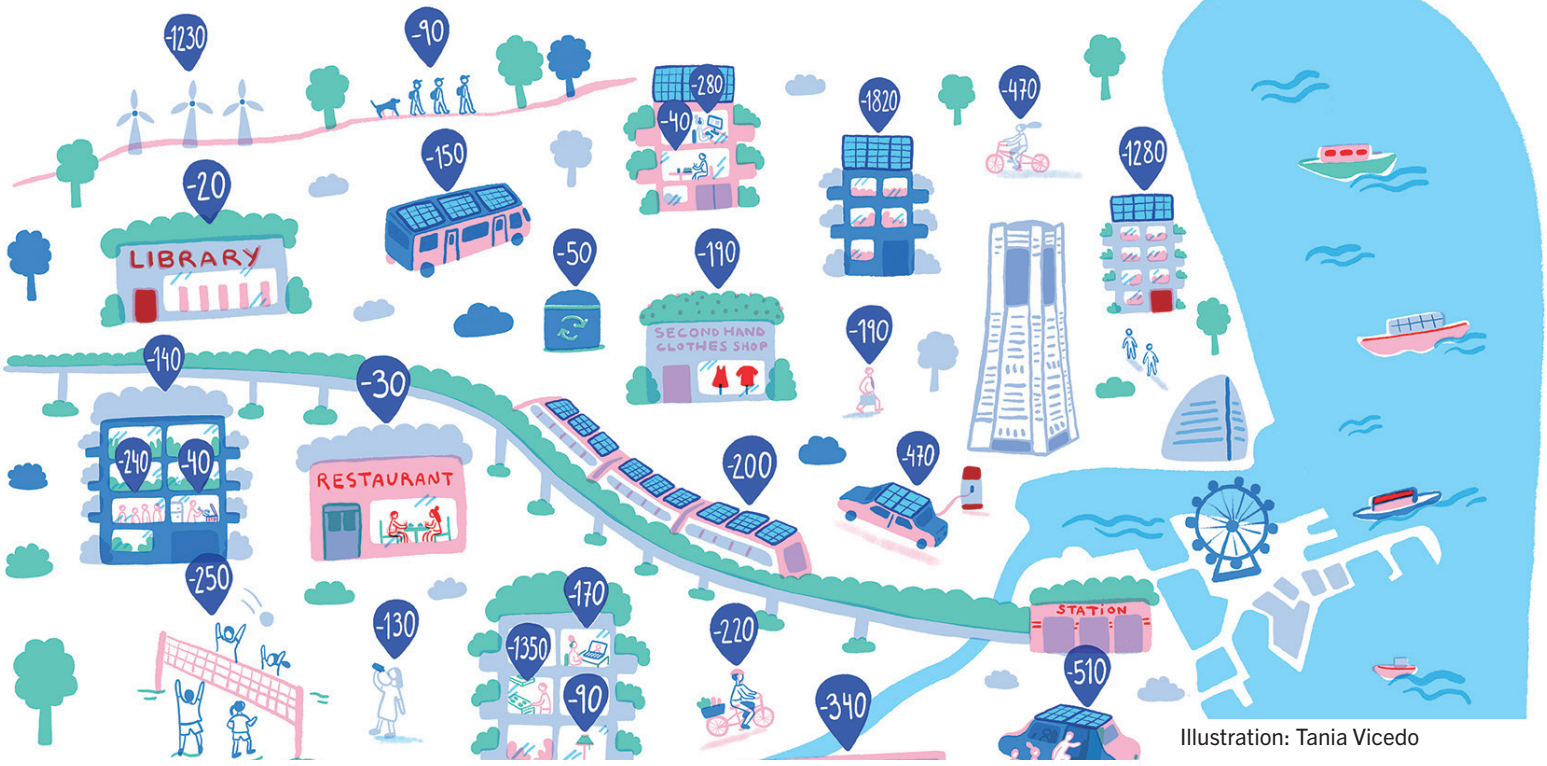


Illustration: Tania Vicedo

5. LIFESTYLE CHANGE TOWARDS 2030

- The identified lifestyle carbon footprint reduction options and their adoption rates can reduce lifestyle carbon footprint by 3.2 t-CO_2e/capita/year (from 7.1 to 3.9 t-CO_2e/capita/year) (-45%), assuming no change to renewable energy share and no change in environmental efficiency improvement by 2030.

- To achieve the 1.5°C Lifestyles' carbon footprint target of 2.5 t-CO_2e/capita by 2030, in line with the Paris Agreement, both consumption and production side measures are needed. For example, if the scenario assumes transformative production side changes such as the share of renewable energy reaching 45% and the 3% annual environmental efficiency improvement will be maintained up to 2030, then the proposed consumption side measures could achieve the goal of 2.5 t-CO_2e/capita/year (-65%).

- Production side measures include an increase in renewable energy supply, improvement of environmental efficiency, as well as other factors like digital transformation, artificial intelligence, acceleration in autonomous and shared mobility, reduction in material consumption and robotics, and these can all contribute to achieving the 2030 reduction target to enable sustainable lifestyles.

- In the major consumption domains, substantial footprint reductions can be expected in housing (-84%), mobility (-81%), and leisure (-61%).

- Food and service domains are areas where it is relatively difficult to reduce carbon footprint.

- Adoption of the proposed lifestyle changes are expected to generate various co-benefits such as economic benefits through reduced operation costs (e.g. less energy expenditure) or reduced consumption expenditure, health benefits (e.g. shifting from car to bicycle, increasing plant-based diet), and more appreciation of local landscape as a result of active mobility and local tourism.

- The proposed lifestyle changes may require changes in our value system such as a shift in priority from material abundance to satisfaction with a sustainable way of living.

- The proposed lifestyle change options are suggestions, and it is assumed that they will be implemented if citizens show willingness and the appropriate situations are enabled.

5.1 Lifestyle change options and adoption rates

There are three main approaches for reducing these amounts: energy efficiency improvement, modal shift, and absolute reduction (Institute for Global Environmental Strategies, Aalto University and D-mat Ltd, 2019). In this scenario, they are defined as follows:

- Efficiency improvement: Decreasing emissions by replacing technologies with lower-carbon ones while not changing the amount consumed or used, such as in energy-efficient agriculture, vehicles, or housing.

- Modal shift: Shifting from one consumption mode to a less carbon intensive one, such as in adopting a plant-based diet, using public transport, or using renewable energy for electricity or heating.

- Absolute reduction: Reducing physical amounts of goods or services consumed, such as food, kilometres driven, energy use, or living space.

Sixty-five (65) lifestyle change options for all three approaches were presented at the citizens' workshop and participants were asked to select options considering their reduction potential and potential contribution to the City Vision. The selected options in the scenario are listed in the following tables (Tables 5.1-5.4), with their respective reduction potential (assuming 100% adoption rate) and assumed adoption rates in 2030. Respective adoption rates were determined based on the results of the first workshops except for those cases where some adjustment was required to address competing options (e.g. three modal shift options from car commuting to bicycle, train, and bus). Reduction potential indicates the maximum carbon footprint reduction if the referent option is adopted 100% without taking account interaction with other options. When multiple options are implemented simultaneously, we need to take into account interactions among options, for example implementing both teleworking and shifting private car commuting to bicycle will decrease the reduction impacts of the latter as the former reduces commuting distance.

Table 5.1 shows the selected mobility options. It is notable that many citizens selected options to reduce travel distance, e.g. local vacation, less frequency of shopping, and so on. Further, private car usage both for commuting and other trips will be substantially reduced and most conventional cars will be replaced by various eco-cars such as electric vehicles and plug-in hybrid vehicles. The volume of road transportation will be further reduced as ride-sharing and car-sharing become common, and much less car traffic will enable better bus services and safer environment for bike users. Along with the City Vision, promotion of public transportation must be done in an inclusive manner with barrier-free consideration. Promotion of bicycle use must be supported by wider use of electrically-assisted bicycles to cope with the hilly terrain of Yokohama.

Table 5.1 Selected mobility related options

Name of Mobility Related Option	Carbon footprint reduction potential ($kgCO_2e$/capita/yr)	Adoption rate in 2030 (%)
Local Vacation	151.8	87.5
Less Frequency of Shopping	144.8	62.5
Local Weekends and After Work	96.9	62.5
Domestic Vacation	57.2	62.5
Eco Driving	148.1	62.5
Shifting from Taxi to Bus and Bicycle	18.3	56.3
Telework	279.4	50
Shifting from Commuting by Car to Train	205.1	50
Ride Sharing	510.2	37.5
Car Sharing	212.7	37.5
Shifting from Car to Bicycle (other than commuting)	466.3	32.7
Online Home Coming Visit	170.4	31.3

Name of Mobility Related Option	Carbon footprint reduction potential ($kgCO_2e$/capita/yr)	Adoption rate in 2030 (%)
Shifting from Domestic Flight to Train	40.7	31.3
Shifting from Car to Train (other than commuting)	435.9	28.6
Shifting from Car to Bus (other than commuting)	328.4	28.6
Electric Vehicle	242.3	25.6
Shifting from Commuting by Car to Bus	154.5	25
Hybrid Vehicle	205.0	21.9
Living Close to Work	191.3	18.8
Shifting from Commuting by Car to Bicycle	221.8	18.8
Shifting from Long Distance Driving to Train	278.1	18.8
Shifting from Long Distance Driving to Bus	208.8	18.8
Electric Vehicle with 100% Renewable Energy	467.4	18.3
Living Close to Services	259.5	12.5
Plug-in Hybrid Vehicle	244.7	11

Table 5.2 shows the selected housing-related options. Relatively easy options such as installing LED lights and regulating the temperature using air conditioners or by adjusting clothing are widely adopted. Electricity generation by solar PV and zero energy houses (including nearly zero energy houses and life cycle carbon-minus houses) are also well promoted.

Table 5.2 Selected housing related options

Name of Housing Related Option	Carbon footprint reduction potential ($kgCO_2e$/capita/yr)	Adoption rate in 2030 (%)
LED Lighting	92.2	93.8
Room Heating by Air Conditioner with Renewable Energy Supply	114.7	87.5
Regulate Temperature by Clothing	112.9	87.5
Nudge for Energy Saving	59.1	75
Improvement of Window for Insulation	46.6	62.5
Hot Water Supply by Heat Pump (Eco Cute)	121.1	52.6
Hot Water Supply by Solar Water Heater	183.8	47.4
Renovation for Insulation Improvement	142.2	43.8
Electricity Generation by Solar PV	1,275.3	27.6
Compact House Living	235.6	43.8
100% Renewable Grid Electricity	1,232.0	27.3
Electricity Generation by Solar PV and IH Cooking Heater	1,352.2	15.8
Nearly Zero Energy House	1,433.4	12.6

Name of Housing Related Option	Carbon footprint reduction potential ($kgCO_2e$/capita/yr)	Adoption rate in 2030 (%)
Life Cycle Carbon Minus House (LCCM)	2,086.7	8.4
Zero Energy House (ZEH)	1,815.1	8.4

Table 5.3 shows the selected food-related options. Many citizens will make efforts to reduce food loss at home. Purchasing seasonal local vegetables will also be widely adopted, which is in harmony with the development of urban farming included in the City Vision. Shifting to a vegan or vegetarian diet is a relatively less popular option but together with other dietary shifts, meat consumption will be substantially reduced.

Table 5.3 Selected food related options

Name of Food Related Option	Carbon footprint reduction potential ($kgCO_2e$/capita/yr)	Adoption rate in 2030 (%)
Food Loss Reduction at Home	37.0	81.3
Eating Seasonal Vegetables (Seasonal Food)	35.9	68.8
Buying Healthy Ready Meal following Food Balance Guide	16.6	68.8
Eating Local Vegetables (Local Food)	7.9	62.5
Food Loss Reduction at Restaurants	17.2	62.5
Drinking and Eating Snack Healthy following Food Balance Guide	126.1	62.5
Healthy Lifestyles by Reducing Tobacco and Alcohol	162.2	56.3
Cooking Healthy following Food Balance Guide	42.6	56.3
Eating Out Healthy following Food Balance Guide	26.6	37.5
Shifting from Red Meat to Chicken (White Vegetarian)	70.4	23.8
Shifting from Meat to Seafood (Pescatarian)	73.6	23.8
Shifting from Traditional Meat to Alternative Meat (Bean-based)	186.4	13.6
Plant-based Diet (Vegan)	341.2	13.6
Plant, Egg, and Dairy-based Diet (Vegetarian)	219.8	10.2

Table 5.4 shows the selected goods and leisure-related options. Longer use and recycling of clothes is particularly popular, and other goods are also carefully selected for a longer use and recycling options. Participating in community recreational activities and community ecotourism is also very common, and this will contribute not only to enhance social capital but also to develop new opportunities for the local economy.

Table 5.4 Selected goods and leisure related options

Name of Goods and Leisure Related Option	Carbon footprint reduction potential ($kgCO_2e$/capita/yr)	Adoption rate in 2030 (%)
Longer Use and Recycling of Clothes	193.7	75
Longer Use and Recycling of Electrical Equipment	44.6	68.8
Sharing of Books and Magazines	18.9	68.8
Longer Use and Recycling of Bags and Jewellery	31.9	50

Name of Goods and Leisure Related Option	Carbon footprint reduction potential (kgCO_2e/capita/yr)	Adoption rate in 2030 (%)
Longer Use and Recycling of Furniture and Carpets	29.0	50
Longer Use and Using Up of Consumables	90.1	50
Longer Use and Recycling of Hobby Goods	113.2	25
Participate in Community Recreation Activities	248.0	75
Participate in Community Eco Tourism	92.2	68.8

It must be noted that the proposed lifestyle change options are assumed to be implemented by citizens who are willing to implement them, and are also in an enabling situation. The scenario aims to provide ideas towards realising 1.5°C Lifestyles for diverse citizens in many respects such as age, physical conditions, occupational situation, socioeconomic status, family composition, as well as access to public transport and shopping areas. It may also depend on a person's value judgement. The proposed adoption rates imply that this scenario should not be interpreted as being prescriptive for all citizens. The adoption rates are just indicative figures embedding the expectations held by workshop participants as well as a feasibility assessment in 2030 and should not be interpreted as future projections or targets.

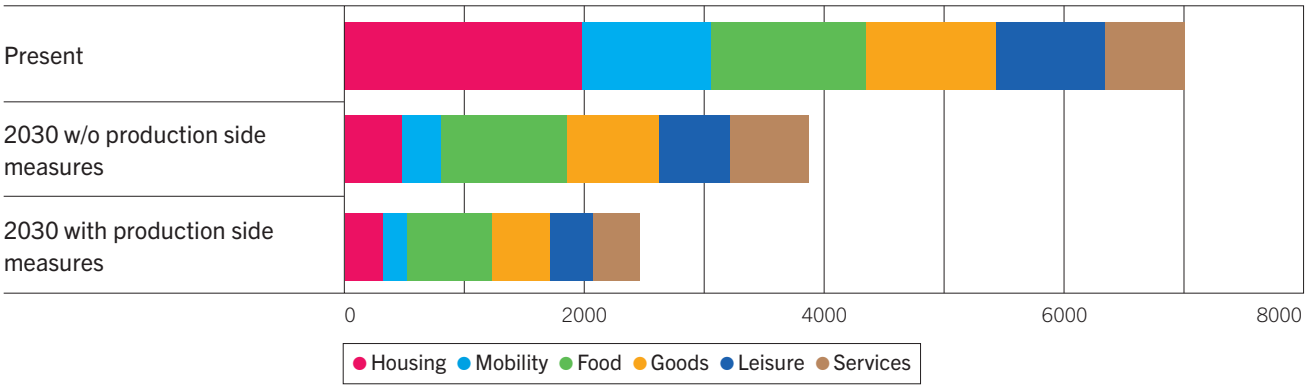
5.2 Change in lifestyle carbon footprints

By the target year of this scenario, 2030, many background conditions of the scenario will have changed; some changes are in line with decarbonisation efforts but some are not. The former changes include systemic changes such as technological advancement and greening of the energy mix. It is very difficult to predict how these changes will evolve by 2030, and we assume two cases — the first case is to assume that there will be no such changes, and the second is to identify the necessary changes in renewable energy share and environmental efficiency in terms of carbon footprint intensity to achieve the 2030 reduction target (2.5 t-CO_2e/capita/year) along with the proposed lifestyle change efforts (selected lifestyle change options with employed adoption rates).

First, if no changes in renewable energy share and environmental efficiency are assumed, the proposed lifestyle change efforts will reduce per capita lifestyle carbon footprint from the current 7.1 t-CO_2e/year to 3.9 t-CO_2e/year. The lifestyle change efforts will show a reduction of 3.2 t-CO_2e/year, but the expected carbon footprint exceeds the 2.5-t target by 1.4 t-CO_2e/year.

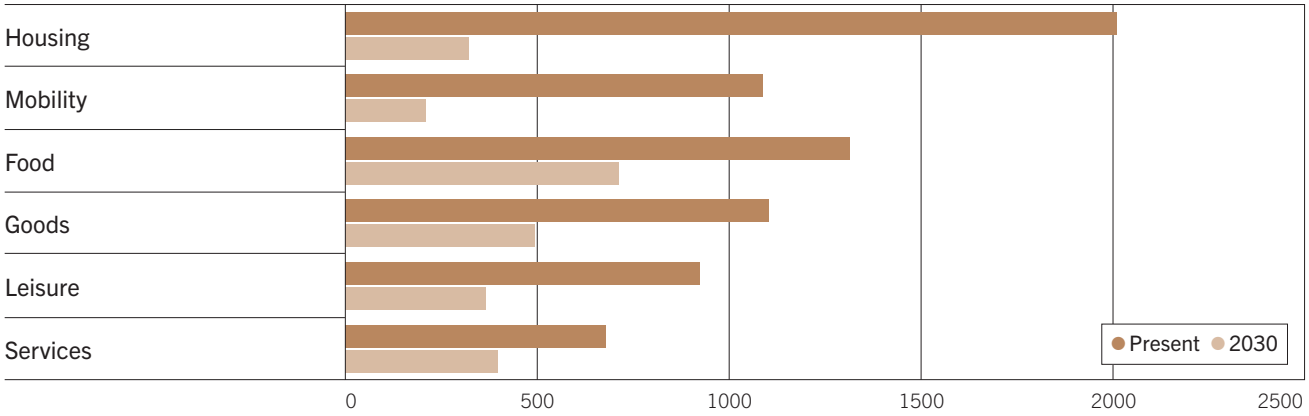
Then, we identify necessary changes in renewable energy share and environmental efficiency to achieve the 2.5-t target as follows. First, we assume a 3% annual improvement in environmental efficiency[3], and set the share of renewable energy such that the 2.5-t target can be achieved. The latter was estimated at 45% (including hydro), which is high compared with the existing national average of 16%. With these assumptions, the per capita lifestyle carbon footprint will be reduced from the current 7.1 t-CO_2e/year to 2.5 t-CO_2e/year (see Figure 5.1).

Figure 5.1 Changes in lifestyle carbon footprint with and without changes in renewable energy share and environmental efficiency



3 In this scenario, environmental efficiency improvement is defined as reduction of carbon footprint intensity.

Figure 5.2 Changes in lifestyle carbon footprint with assuming changes in renewable energy share and environmental efficiency



The lifestyle carbon footprints from the housing and the mobility domains will be reduced substantially, while that from the food domain will be relatively high in 2030.

5.3 Co-benefits of 1.5°C Lifestyles

The proposed lifestyle change efforts will change not only household consumption but also lifestyles in a more broad sense as well as in terms of the roles of communities. Further, they must be contextualised in terms of the changes in our value system. Some lifestyle change efforts may require changes in the value system such as a shift in priority from material abundance to satisfaction with sustainable ways of living, while implementing lifestyle change options may affect the value system of the implementer. The role played by lifestyle change efforts is important to materialise the transformation of our social and economic systems into sustainable, resilient and inclusive ones.

It is also expected that the proposed lifestyle changes will generate various co-benefits. In general, lifestyle changes along with an efficiency improvement approach reduce operation costs (e.g. less energy expenditure), and those following an absolute reduction approach bring economic benefits due to reduced consumption expenditure. Cost implications of lifestyle changes in line with a modal shift approach can be taken on a case-by-case basis, but they are often associated with various co-benefits such as health benefits (e.g. shifting from car to bicycle, or changing to a plant-based diet). Further, promotion of active transportation (bicycle, on foot) may result in more appreciation of the local landscape as a result of reduced speed.

Related to the mobility domain, a drastic reduction of private car use will mitigate traffic jams, and substantial increase of bicycle use backed up by adequate supporting measures including development of bike lanes and bicycle parking places will bring health benefits. A shift from private car use to public transportation will increase the number of passengers, but adoption of teleworking and shopping in bulk will cancel out this increase and hopefully further mitigate congestion on trains and buses. A shift from conventional cars to electric vehicles (EV) and plug-in hybrid vehicles (PHV) will provide electricity storage capacity for the owners and will improve resilience against natural disasters.

Related to the housing/energy domain, improved insulation of housing will improve health problems related to extreme temperature. Improved energy efficiency will reduce energy bills. From a broader view, the shift from thermal electricity to renewable electricity contributes to reducing fossil fuel imports and the financial savings will contribute to an improved fiscal balance.

Related to the food domain, many options contribute to improving the nutritious balance of our diet. Promotion of local vegetable consumption not only contributes to GHG emission reduction from the transportation process but also strengthens the relationship between consumers and local farmers, which may make the city more attractive in many senses, with better food safety, active local agriculture, more balanced land-use patterns, etc.
Related to the consumer goods domain, more selective purchasing behaviour may affect the current business model of mass production and mass disposal of cheap products. Selective purchase of higher quality long-life products may improve quality of life in a very visible manner.
Related to leisure domains, local and community based activities are encouraged and lively active communities may attract the younger generation to live there.

In the leisure domain, local and community-based activities can revitalise communities and neighbourhoods by attracting younger generations to live there.

6. RECOMMENDATIONS TO STAKEHOLDERS

- Lifestyle changes are being recognised by decision-makers as critical elements to address climate change, and the lifestyle carbon footprint is an indicator of the impact of people's lifestyles on climate change. However, how to encourage consumers to play a role in keeping their personal carbon footprint within 1.5°C remains a key challenge.
- A systemic transition is necessary. Consumer practices, markets, services, technology and social rules are interdependent, and must co-evolve. The transition to sustainable lifestyles will also require a diverse range of support measures from key stakeholders covering the whole supply chain.
- Five categories of supporting measures are proposed: social system transformation or transition, improving the infrastructure and implementation environment, improving products and services, providing and disseminating information, and providing economic incentives.
- The workshop participants suggested two important supporting measures common to all lifestyle change options: 1) to disseminate 1.5°C Lifestyles concept and lifestyle change options through education to all generations; and 2) to establish a participatory process to convey messages from citizens to the government.
- Governments should review existing regulations, start indicative planning and transition management to overcome lock-ins, and encourage a focus on sustainability for long-term change, such as ‘teleworking’, ‘ZEH’ and ‘Nearly ZEH’.
- Governments should provide infrastructure for sustainable choice, and motivate citizens and business sectors to take action, as well as provide feedback, for items such as ‘electric vehicles’ and ‘solar PV’.
- The business sector should offer innovative products and services and related new business models, such as ‘vegan diets’ and ‘plug-in hybrid vehicles (renewable energy charging)’.
- Communities, workplaces, and schools should carry out short-term, grass-root initiatives and dissemination actions, such as ‘local recreational activities’ and ‘local ecotourism’.

6.1 Challenges or obstacles in implementing lifestyle changes

People's lifestyles are not easy to change, as some aspects are voluntary, while others are strongly influenced by the availability, accessibility or affordability of products and services, as well as by the surrounding infrastructure and community conditions. Consumers in modern societies are locked in to larger social trends of long working hours and mass consumption lifestyles. In order to realise 1.5°C Lifestyles and to scale up changes at the societal level, this study clarified the obstacles, 'enabling contexts' and expected supporting measures through a participatory approach, and provided policy implications to co-create 1.5°C Lifestyles through stakeholder collaboration. It is also hoped that this will lead to the formation of new values and social norms.

The main obstacles for participants to implement lifestyle change options can be categorised as follows:

1. Lack of infrastructure, products and services.
2. Infrastructure, products and services exist but are not well known.
3. High costs.
4. Low accessibility.
5. Conflicts with personal needs.
6. Conflicts with other people's needs.
7. Conflicts with societal norms.

The participants in the household experiment were also asked to propose some supporting measures to overcome these obstacles. The proposed supporting measures can be divided into five categories: 'social system transformation/ transition', 'improving the infrastructure and implementation environment', 'improving products and services', 'providing and disseminating information', and 'economic incentives'. Table 6.1 shows the supporting measures for the selected lifestyle change options, where supporting measures are particularly effective to facilitate/ promote their adoption.

Table 6.1 Expected supportive measures or social changes

Lifestyle change option	Supporting measures				
	Social system transformation and transition	Improving infrastructure or implementation environment	Improving products and services	Providing and disseminating information	Economic incentives
Teleworking	• Adjust working rules and regulate teleworking achievement rates • Awareness raising for managers and supervisors • Creating a working environment in surrounding areas	• Provision of PC etc. • Securing co-working spaces • Better access system and Security measures • Improvement of nursery schools	• Low price and high quality IT equipment, applications and service • Consultation service	Information provision on how to improve tele-working conditions	• Financial support for the development of the environment • Preparatory funds for companies • Support for housing relocation
• Living close to working place • Compact cities	• Urban planning • Land use planning • Reducing transfers	Correction of excessive concentration to mega cities	Providing basic services to a walking distance		

Lifestyle change option	Supporting measures				
	Social system transformation and transition	Improving infrastructure or implementation environment	Improving products and services	Providing and disseminating information	Economic incentives
Shifting car to bicycle	Proper enforcement of the road traffic law (with provision of adequate bike infrastructure)	• Bicycle parking, • Safe bicycle paths	Provision of low price electrically power assisted bike	Ensure good traffic manners	• Collection of car tolls • Encourage commuting by train
• Ride-sharing • Car-sharing	Deregulation of ride-off services for car sharing		Provision of matching applications		
• Electric vehicles • Plug-in hybrid vehicles		• Increase share of renewable energy • Expand charging infrastructure	Improve cruising range	Provision of information on economic implications	Subsidy to reduce installation costs
• Hot water supply by heat pump • Solar PV • Solar water heaters			• Rental and leasing services • Development of products that can meet landscape regulations and installation location restrictions	Provision of information on economic implications	Subsidy to reduce installation costs
• LCCM • ZEH • Nearly ZEH	• Collaborate with estate agents • Regulation of new residential properties		Development of low-cost, high-performance products	Provision of information on economic implications	Subsidy to reduce installation costs
• Vegan • Vegetarian • Shift from traditional meat to alternative meat	Promotion of health check-ups and health counselling by companies and public institutions	More shops	• Development of low-cost, high-performance products • Development of attractive recipes	• Events and workshops for information dissemination • Provision of nutritious information to address health concerns	
• Eating seasonal vegetables • Eating local vegetables	Utilisation of abandoned farmland	Improvement of distribution of local vegetables	• Improvement of varieties suitable for open-air cultivation • Development of attractive recipes	• Promotion of exchange between producers and consumers • Promotion of food education	

Lifestyle change option	Supporting measures				
	Social system transformation and transition	Improving infrastructure or implementation environment	Improving products and services	Providing and disseminating information	Economic incentives
Longer use and recycling of products (clothes/bags and jewellery / electrical equipment etc.)	• Standard setting for long life high performance products • Deregulation for organising free market at public space		• Provision of long life high performance products with reasonable price • Provision of matching applications	Information for recycling and repair service	
Sharing of books and magazines, use of ebooks and libraries	Transition to e-books	• Popularisation of online libraries • Borrowing from mobile libraries	• Provision of ebook readers at a reasonable price • Provision of use friendly searching applications		
• Local recreational activities • Local ecotourism	Coordination with landscape development and nature conservation	Development of camping and lodging facilities	• More events that are easy to attend • More services for the citizens	Dissemination of information on activities and tours	Subsidy to local farmers

In addition, two important supporting measures common to all lifestyle change options were suggested by workshop participants: one is to disseminate the 1.5°C Lifestyles concept and lifestyle change options through education to all generations, and the other is to establish participatory process to deliver messages from citizens to the government.

6.2 Roles of stakeholders to enable lifestyle changes

Table 6.2 summarises suggested actions for key stakeholders to provide enabling contexts to implement and facilitate lifestyle change options despite the seven obstacles mentioned above.

Table 6.2 Policy recommendations for key stakeholders

Obstacles	Enabling Contexts	Recommendations to Stakeholders		
		National and Local Governments	Business	Citizens and Civil Society Organisations
Infrastructure, Service or Goods do not exist (e.g. Rental Zero-Energy Houses)	Infrastructure, Service or Goods are provided	• Reviewing regulations • Infrastructure development • Investment promotion • Public procurement	• Provision of goods and service • Joint-development of goods and services with governments & citizens • Services improvement	

Obstacles	Enabling Contexts	Recommendations to Stakeholders		
		National and Local Governments	Business	Citizens and Civil Society Organisations
Infrastructure, Service or Goods exist but are not well known (e.g. 100% Renewable Energy Contract)	Information on infrastructure, services or goods are provided	• User-friendly information provision • Labelling • Media campaign	• Provision of user-friendly information • Consulting services (e.g. houses, transportation) • Provision of searching service, mobile apps, etc. • Events	Joint-event with local governments or business
Infrastructure, Service or Goods exist but are too expensive (e.g. ZEH)	Infrastructure, Service or Goods become more affordable	• Tax reform • Subsidy • Price regulation	Provision of more affordable goods and services	
Infrastructure, Service or Goods exist but are too difficult to find and access (e.g. Vegan Foods, Car sharing)	Infrastructure, Service or Goods become more easily accessed found & obtained	Support citizens & business to create more accessible goods or services	Provision of searching service, mobile apps, etc.	• Mapping of goods and services in cooperation with local business, co-ops, etc. • Identifying locally available goods and services
Taking the option might cause conflict with other daily needs (e.g. Commuting to workplace by bus	Options where different needs are met together available	Support citizens & business to create and share options	• Services improvement • Joint-development of goods and services with governments & citizens	• Group buying • Joint-development of goods and services with governments and business (e.g. Living lab) • Sharing citizens' wisdom
Taking the option might cause conflict with others' needs (e.g.1 Online home visits do not make grandparents happy e.g.2 Vegetarian foods are good for parents but questionable for children)	Options where needs of different people are met together are available	Support citizens & business to create and share options	• Services improvement • Joint-development of goods and services with governments & citizens	• Joint-development of goods and services with governments and business (e.g. Living lab) • Sharing citizen's wisdom
Taking the option does not go along with the informal rules or norms of the community or workplaces (e.g.1 Adjusting clothes, e.g.2 unable to install rooftop PV on historical areas)	Informal rules and norms are revisited and modified for encouraging low-carbon actions	• Support community actions • Encourage business to change office rules • Initiate public-citizen collaboration	• Services improvement • Joint-development of goods and services with governments & citizens • Joint-event with citizens groups & communities	• Local events / workshops • Revision of rules in cooperation with governments and business

7. CONCLUSIONS

Key findings of this scenario indicate that after the adoption of identified low-carbon lifestyle options, the average carbon footprint of Yokohama's citizens can be reduced from 7.1 t-CO_2e/capita/year to 3.9 t-CO_2e/year in 2030 (-45%), if we assume no improvements in renewable energy share and environmental efficiency from the current levels. There are existing initiatives in Yokohama and Japan to increase renewable energy share, to improve environmental efficiency, and to promote digital transformation, artificial intelligence, autonomous and shared mobility, reduction in material consumption, all of which are expected to contribute to reducing the carbon footprint and narrowing the gap to be filled by households to achieve the 1.5°C Lifestyles target of 2.5 t-CO_2e/capita/year by 2030. If, for example, the share of renewable energy increases to 45% and environmental efficiency shows an annual improvement of 3%, our proposed lifestyle changes can meet the 1.5°C Lifestyles of 2.5t-CO_2e/capita/year target by 2030 (-65%).

In conclusion, this scenario envisions Yokohama in 2030 with the implementation of 1.5°C Lifestyles, where households will adopt various lifestyle change options through collaborative efforts by all key stakeholders such as national and local governments, the business sector and local communities. A wide range of stakeholders must share the responsibilities and expected roles in achieving the net zero carbon society with the attainment of a good quality of life should be shared by different stakeholders.

This scenario provides a roadmap for the co-creation of a desired decarbonised and sustainable future by diverse stakeholders. In this context, the importance of households becomes clearer: not only do they implement lifestyle change options but they can also send a message to governments and businesses calling on them to provide supporting measures that in turn provide the enabling conditions for stakeholders to take action. This will open the window for discussions on the co-creation of 1.5°C Lifestyles beyond the boundaries of government, business and citizens. Consumer practices, markets, services, technology and social rules need to be interdependent, and must co-evolve. Consumer behaviour change requires three aligned factors: motivation or intention, ability, and opportunity. If consumers are to overcome obstacles and smoothly transition to 1.5°C Lifestyles, then stakeholders must collaborate. Key stakeholders (national & local governments, producers & businesses, citizens & civil society organisations) need to play their part and work together on co-creation. In particular, governments should review existing regulations, start indicative planning and transition management to overcome lock-ins, and stimulate a sustainability focus for long-term change. Governments must also provide infrastructure for sustainable choice, and motivate citizens and business sectors to take action, as well as provide feedback. The business sector should offer innovative products and services, and come up with related new business models. Citizens should exercise sustainable choice, and work with governments and businesses to develop goods and services (e.g. Living Lab). Communities, workplaces, and schools can carry out short-term, grass-root initiatives and dissemination actions.

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