2025/05/23

Our Initiatives Towards Circular Design Built -Through Make, Use, and Connect Circularity-

- Investment seminar for the Düsseldorf

海野

Biography

Genki Unno

Sustainable Designer
MEP Designer
Urban Researcher

Professional Practice: 10 years
Architecture & Sustainable Design

2024- **TAKENAKA Corporation- Sustainable Design Group Sustainable Design Specialist**
- Participate, supervise and coordinate the development of the Circular Built Environment philosophy and strategies.
- Conducting sustainable design and analysis.

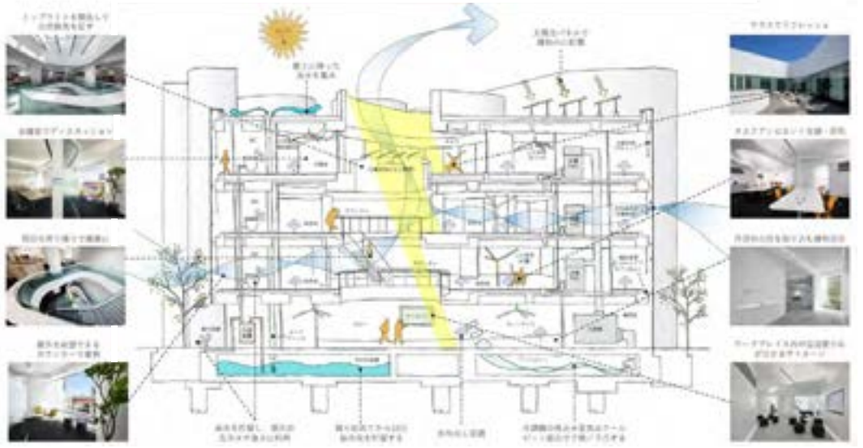
2021-2023 **Singapore-ETH Centre- Future Cities Laboratory**
Urban Rsearcher
- Evaluating the Context- adaptiveness of Mobility Visions for Future Smart Cities.
- Is the Smart Circular City emerging?- Mapping Policies and Initiatives in 12 Cities.

2016-2021 **TAKENAKA Corporation**
MEP Designer
- Designed architecture integrated both design and environmental performance.
- Created buildings which consume energy half of standard.
- Acquire energy certifications which were the highest rank in Japan.
- Used BIM throughout design and construction stages.

2014-2016 **TAKENAKA Corporation**
Site Supervisor
- Supervised an office building which qualified LEED Platinum under the job rotation system in Takenaka

2012-2014 **Waseda University- Master of architecture: Sustainable Design**

2008-2012 **Waseda University- Bachelor of architecture: Architectural Design**



My research outcomes during 2021-2023 at Singapore-ETH Centre

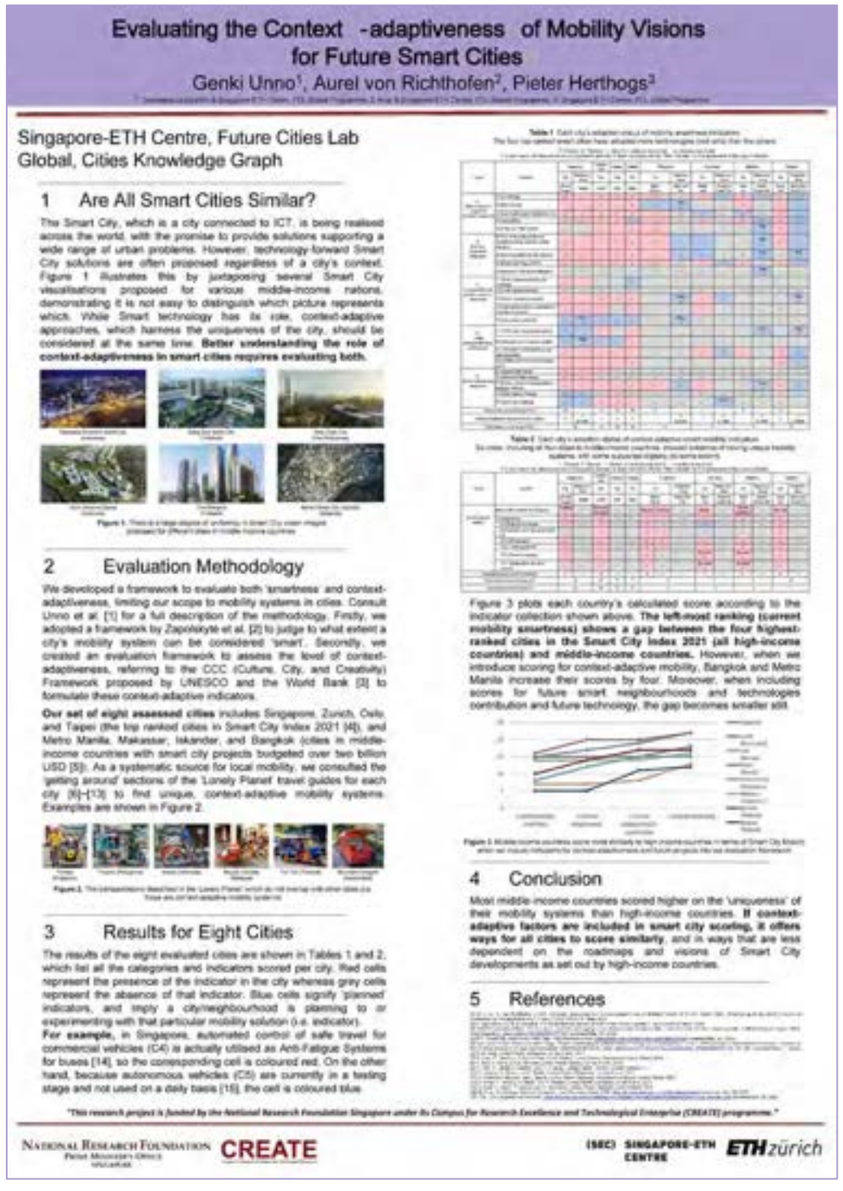
■ **I submitted 2 papers to academic conferences and presented there. Journal paper will be published within a couple of months.**

<u>Evaluating the Context-adaptiveness of Mobility Visions for Future Smart Cities</u>

- Evaluating 8 cities in Europe and Asia, we suggested a better way to understand city development.

<u>Smart Circular Cities</u>

- Evaluating 12 cities in Europe and Asia, we identified which city is close to Smart Circular Cities-cities using Smart technology to enhance circularity of building materials.



Evaluating the Context -adaptiveness of Mobility Visions for Future Smart Cities

Genki Unno[1], Aurel von Richthofen[2], Pieter Herthogs[3]

Singapore-ETH Centre, Future Cities Lab Global, Cities Knowledge Graph

1 Are All Smart Cities Similar?

The Smart City, which is a city connected to ICT, is being realised across the world, with the promise to provide solutions supporting a wide range of urban problems. However, technology-forward Smart City solutions are often proposed regardless of a city's context. Figure 1 illustrates this by juxtaposing several Smart City visualisations proposed for various middle-income nations, demonstrating it is not easy to distinguish which picture represents which. While Smart technology has its role, context-adaptive approaches, which harness the uniqueness of the city, should be considered at the same time. **Better understanding the role of context-adaptiveness in smart cities requires evaluating both.**

2 Evaluation Methodology

We developed a framework to evaluate both 'smartness' and context-adaptiveness, limiting our scope to mobility systems in cities. Consult Unno et al. [1] for a full description of the methodology. Firstly, we adopted a framework by Zapolskyte et al. [2] to judge to what extent a city's mobility system can be considered 'smart'. Secondly, we created an evaluation framework to assess the level of context-adaptiveness, referring to the CCC (Culture, City, and Creativity) Framework proposed by UNESCO and the World Bank [3] to formulate these context-adaptive indicators.

Our set of eight assessed cities includes Singapore, Zurich, Oslo, and Taipei (the top ranked cities in Smart City Index 2021 [4]), and Metro Manila, Makassar, Iskander, and Bangkok (cities in middle-income countries with smart city projects budgeted over two billion USD [5]). As a systematic source for local mobility, we consulted the 'getting around' sections of the 'Lonely Planet' travel guides for each city [6]–[13] to find unique, context-adaptive mobility systems. Examples are shown in Figure 2.

3 Results for Eight Cities

The results of the eight evaluated cities are shown in Tables 1 and 2, which list all the categories and indicators scored per city. Red cells represent the presence of the indicator in the city whereas gray cells represent the absence of that indicator. Blue cells signify 'planned' indicators, and imply a city/neighbourhood is planning to or experimenting with that particular mobility solution (i.e. indicator).
For example, in Singapore, automated control of safe travel for commercial vehicles (C4) is actually utilised as Anti-Fatigue Systems for buses [14], so the corresponding cell is coloured red. On the other hand, because autonomous vehicles (C5) are currently in a testing stage and not used on a daily basis [15], the cell is coloured blue.

Figure 3 plots each country's calculated score according to the indicator collection shown above. **The left-most ranking (current mobility smartness) shows a gap between the four highest-ranked cities in the Smart City Index 2021 (all high-income countries) and middle-income countries.** However, when we introduce scoring for context-adaptive mobility, Bangkok and Metro Manila increase their scores by four. Moreover, when including scores for future smart neighbourhoods and technologies contribution and future technology, the gap becomes smaller still.

4 Conclusion

Most middle-income countries scored higher on the 'uniqueness' of their mobility systems than high-income countries. **If context-adaptive factors are included in smart city scoring, it offers ways for all cities to score similarly**, and in ways that are less dependent on the roadmaps and visions of Smart City developments as set out by high-income countries.

5 References

"This research project is funded by the National Research Foundation Singapore under its Campus for Research Excellence and Technological Enterprise (CREATE) programme."

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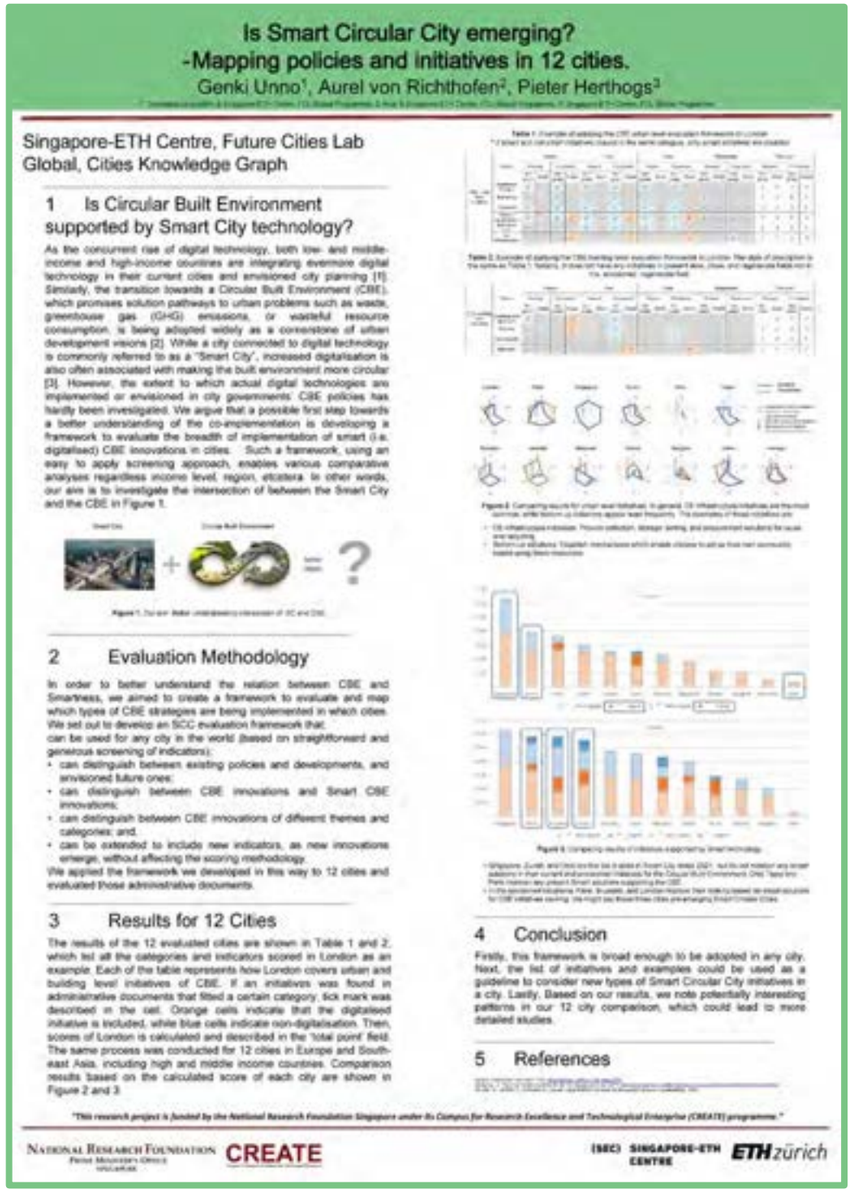

Is Smart Circular City emerging?
-Mapping policies and initiatives in 12 cities.

Genki Unno[1], Aurel von Richthofen[2], Pieter Herthogs[3]

Singapore-ETH Centre, Future Cities Lab Global, Cities Knowledge Graph

1 Is Circular Built Environment supported by Smart City technology?

As the concurrent rise of digital technology, both low- and middle-income and high-income countries are integrating evermore digital technology in their current cities and envisioned city planning [1]. Similarly, the transition towards a Circular Built Environment (CBE), which promises solution pathways to urban problems such as waste, greenhouse gas (GHG) emissions, or wasteful resource consumption, is being adopted widely as a cornerstone of urban development visions [2]. While a city connected to digital technology is commonly referred to as a "Smart City", increased digitalisation is also often associated with making the built environment more circular [3]. However, the extent to which actual digital technologies are implemented or envisioned in city governments' CBE policies has hardly been investigated. We argue that a possible first step towards a better understanding of the co-implementation is developing a framework to evaluate the breadth of implementation of smart (i.e. digitalised) CBE innovations in cities. Such a framework, using an easy to apply screening approach, enables various comparative analyses regardless income level, region, etcetera. In other words, our aim is to investigate the intersection of between the Smart City and the CBE in Figure 1.

2 Evaluation Methodology

In order to better understand the relation between CBE and Smartness, we aimed to create a framework to evaluate and map which types of CBE strategies are being implemented in which cities. We set out to develop an SCC evaluation framework that:
can be used for any city in the world (based on straightforward and generous screening of indicators);
- can distinguish between existing policies and developments, and envisioned future ones;
- can distinguish between CBE innovations and Smart CBE innovations;
- can distinguish between CBE innovations of different themes and categories; and,
- can be extended to include new indicators, as new innovations emerge, without affecting the scoring methodology.

We applied the framework we developed in this way to 12 cities and evaluated those administrative documents.

3 Results for 12 Cities

The results of the 12 evaluated cities are shown in Table 1 and 2, which list all the categories and indicators scored in London as an example. Each of the table represents how London covers urban and building level initiatives of CBE. If an initiatives was found in administrative documents that fitted a certain category, tick mark was described in the cell. Orange cells indicate that the digitalised initiative is included, while blue cells indicate non-digitalisation. Then, scores of London is calculated and described in the 'total point' field. The same process was conducted for 12 cities in Europe and South-east Asia, including high and middle income countries. Comparison results based on the calculated score of each city are shown in Figure 2 and 3.

4 Conclusion

Firstly, this framework is broad enough to be adopted in any city. Next, the list of initiatives and examples could be used as a guideline to consider new types of Smart Circular City initiatives in a city. Lastly, Based on our results, we note potentially interesting patterns in our 12 city comparison, which could lead to more detailed studies.

5 References

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Beyond Scrap & Build

Circular Built Environment is not a new idea in Japan- Ise Jingu

- Every 20-year cycle the shrine is duplicated.
- It lasts 1300 years.
- Sustainable forestry provides timber.
- Dismantled materials are donated to other shrines for repairs.
- Building technology is also passed on to the future.

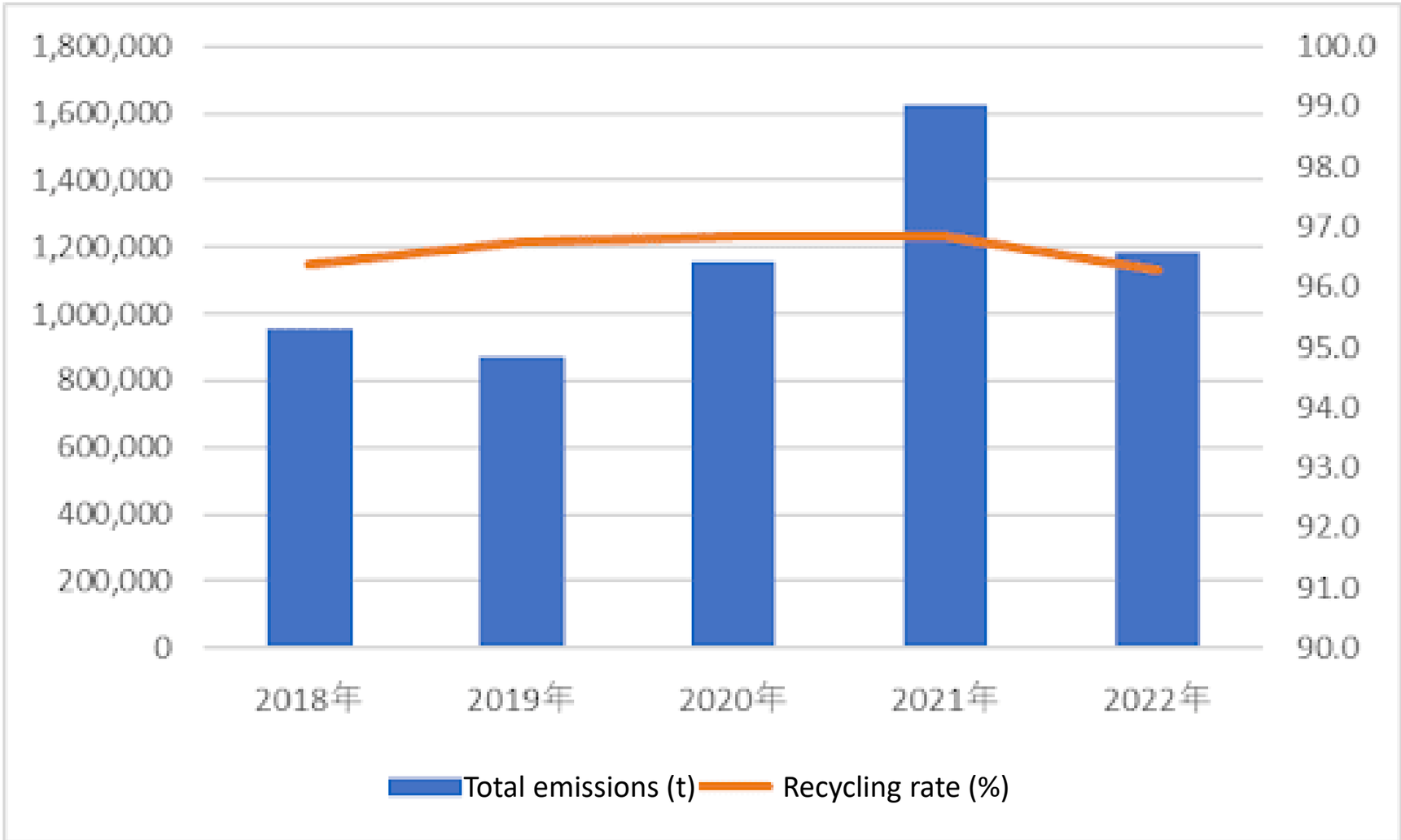
・　Chief engineer, Sustainable design team
→設計部環境G　主任

My presentation title:
→サーキュラーデザインビルドに向けた私たちの取組みーつくる循環、つかう循環、つなぐ循環を通してー

Content:
・　Our concept of Circular Design Built (Make, Use, and Connect Circularity)
→サーキュラーデザインのコンセプトについて（つくる循環、つかう循環、つなぐ循環）
・　Our concrete initiatives based on the concept to realise Circular Design Built
→サーキュラーデザインビルドを体現する具体的な取組み
・　How to connect circularity and carbon neutrality in construction sector
→建設領域において、資源循環と脱炭素を両立するには

Total emissions and recycling rate from Takenaka Corporation's business activities.

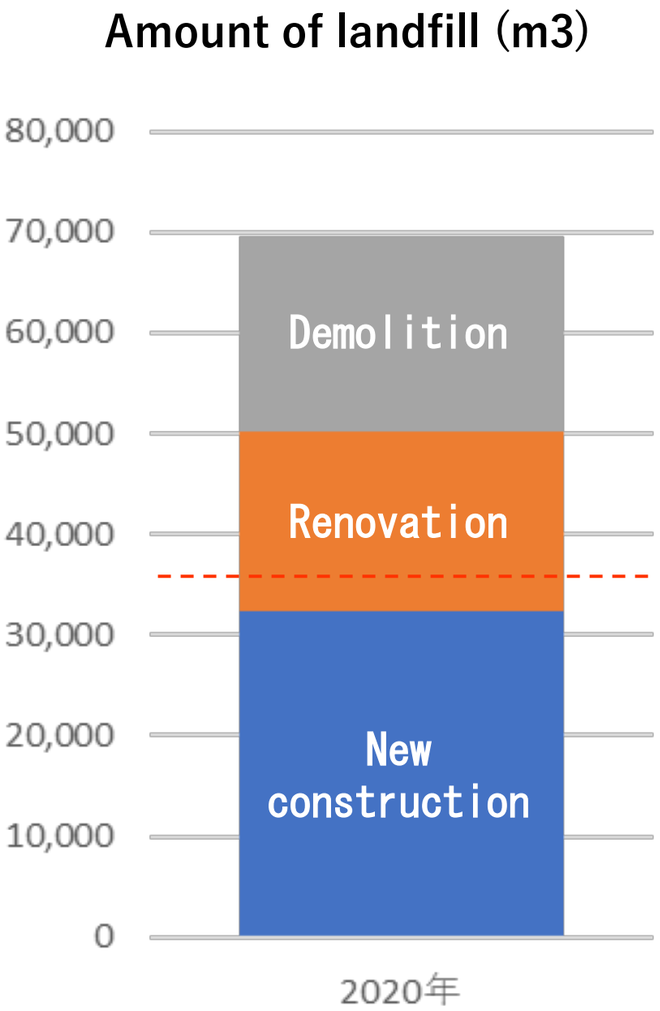
■ We work with intermediate treatment companies in various regions to ensure detailed sorting.
As a result, the recycling rate is consistently above 90%, even when an increase in construction work generates a lot of waste material.



On the other hand, the recycling rate drops to the 50s if the conversion of crushed concrete into roadbed material and the use of heat from combustion (thermal recycling) are excluded.

Total emissions and recycling rate from Takenaka Corporation's business activities.

■ Breakdown of the few per cent left out of recycling



The above quantities exclude construction sludge and hazardous substances (waste oil, waste acid, waste alkali, waste asbestos, etc.).

- Main final disposal building materials generated by **new construction**.
  mill ends of construction materials, **temporary materials** (curing or packaging materials) are discarded.
- Mill ends
  Boards other than PB, ALC, extruded cement board, glass wool, tiles, vinyl cloth, stone
- Excess material in sprayed fireproof cladding (spillage)
- Garbage swept up

- Main final disposal building materials generated **during demolition**
  All the building materials **used themselves** are discarded.
- Non-combustible building materials
  Boards other than PB, ALC, extruded cement board, glass wool, tiles, vinyl cloth, stone, sanitary ware, fireproof cladding, glass, composite materials (exterior metal panels, partitions, OA floors)
- Garbage swept up
  Hazardous substances (waste oil, waste acid, waste alkali, waste asbestos, etc.)

Buildings constructed decades ago are not designed for demolition

Many building materials that can only be finally disposed of are still used in new construction

→ Reuse existing buildings as much as possible and actively use reusable and recyclable building materials in new construction.

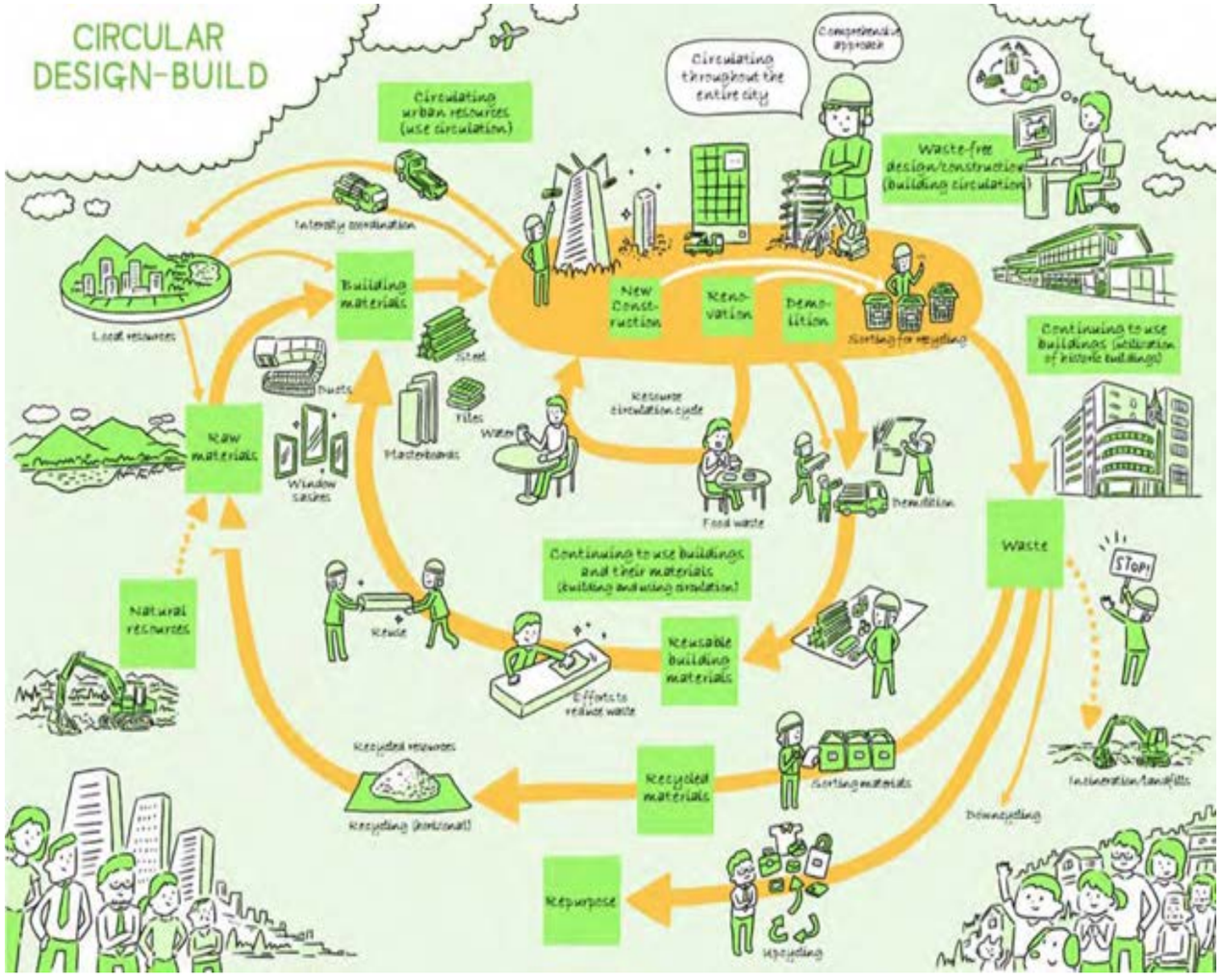
Takenaka's Circular Economy Goal

96.3% of industrial waste generated from work sites are recycled (2022).

↓

50% of waste will be reduced by 2030.

100% of waste will be reduced by 2050.



But How?

1. Make-Circularity

Produce so as to not generate waste

2. Use-Circularity

Continue to use buildings and their materials

3. Connect-Circularity

Circulating town resources

Make, Use, and Connect Circularity

1. Make-Circularity

Produce so as to not generate waste

2. Use-Circularity

Continue to use buildings and their materials

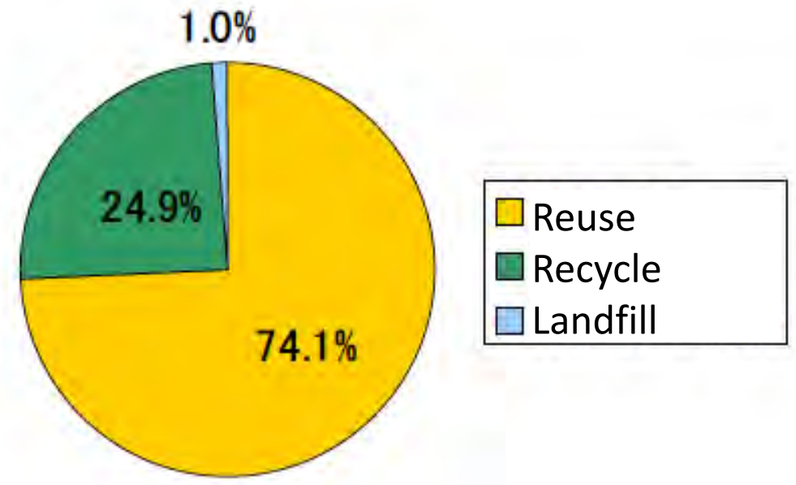
3. Connect-Circularity

Circulating town resources

A project considered the first CBE architecture by Takenaka – G8 Hokkaido Toyako Summit International Media Center

- This building was temporary, in 2008.
- Fit-out was carefully studied for future reuse.

As a result, only 1% of material is landfilled when demolition.



Reuse and Recycle rate when dismantled
(weight-base)

Make, Use, and Connect Circularity

1. Make-Circularity

Produce so as to not generate waste

2. Use-Circularity

Continue to use buildings and their materials

3. Connect-Circularity

Circulating town resources

Singapore Landmark Tower

- Solution to the long-term deterioration of tenants' habitability due to refurbishment while in residence.
- Solution to the increased risk of leaks when the exterior is refurbished from the outside.

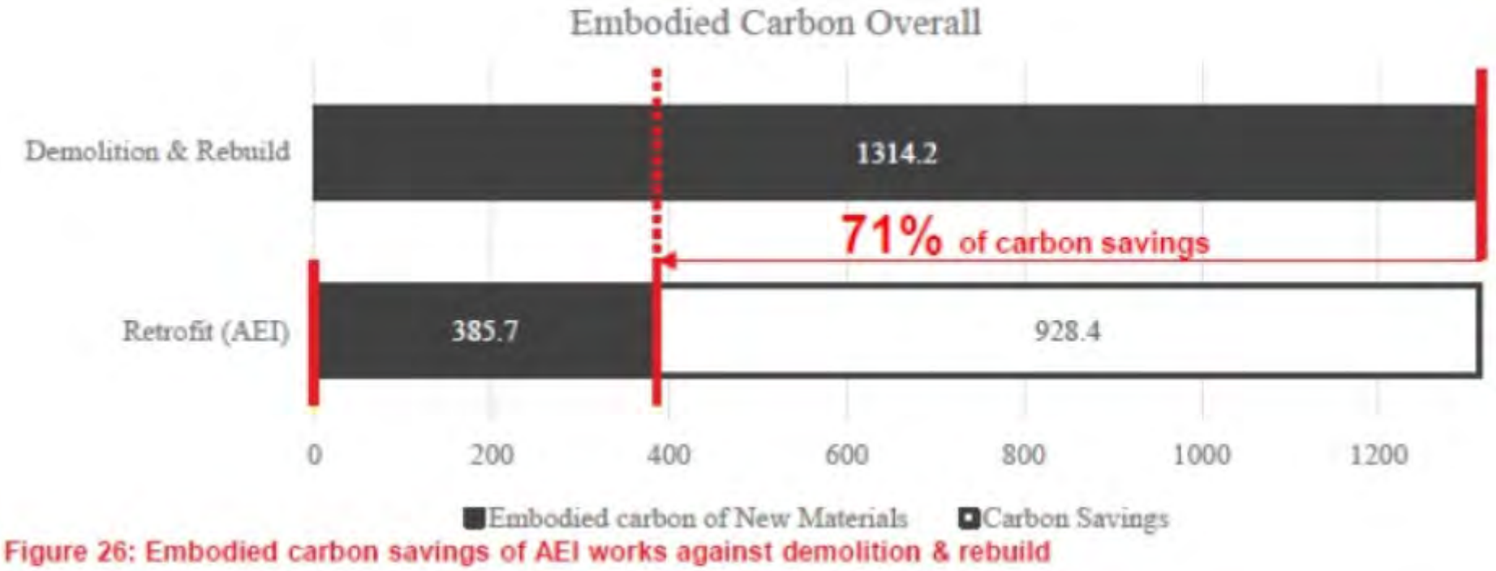
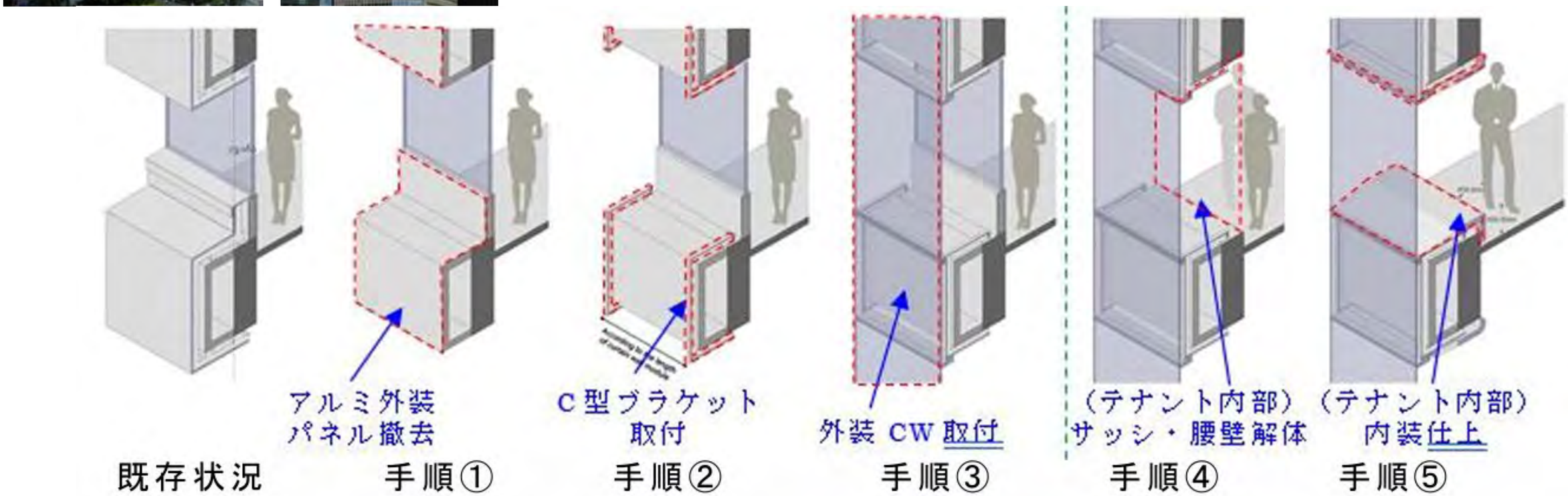


Figure 26: Embodied carbon savings of AEI works against demolition & rebuild



Make, Use, and Connect Circularity

1. Make-Circularity

Produce so as to not generate waste

2. Use-Circularity

Continue to use buildings and their materials

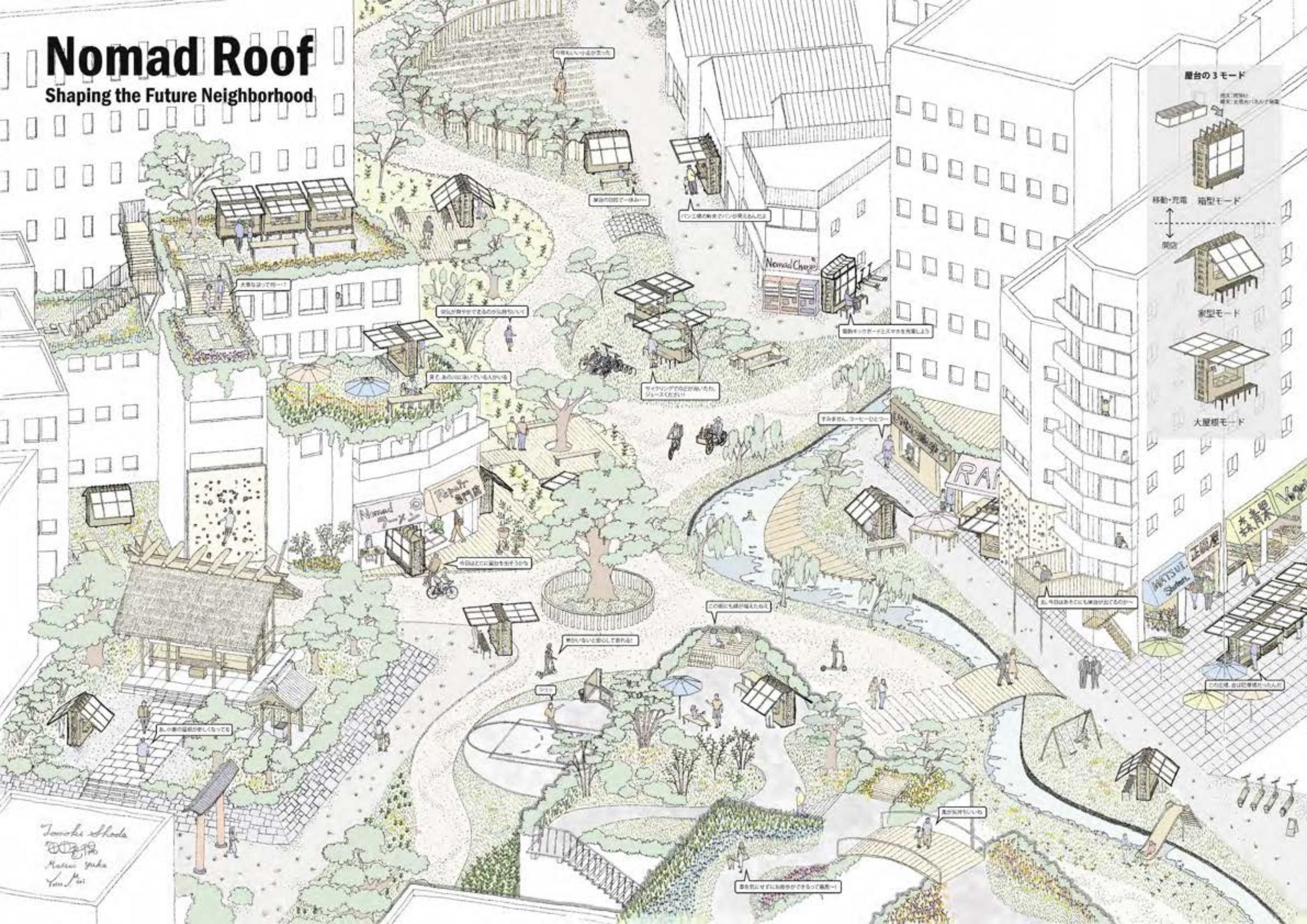
3. Connect-Circularity

Circulating town resources

Rahmen stall

Nomad Roof

Shaping the Future Neighborhood



Circular design initiatives:

Although there is a target of zero waste by 2050, there are different routes to get there.

→ The initiative itself is fun, which is the driving force.

Takenaka’s Environment Strategy

Circular Design Build

96.3% of industrial waste generated from work sites are recycled (2022).

50% of waste will be reduced by 2030.

100% of waste will be reduced by 2050.

Carbon neutrality

27.5% of CO2 emission will be reduced by 2030. *Scope 3

100% of CO2 emission will be reduced by 2050. *Scope 3

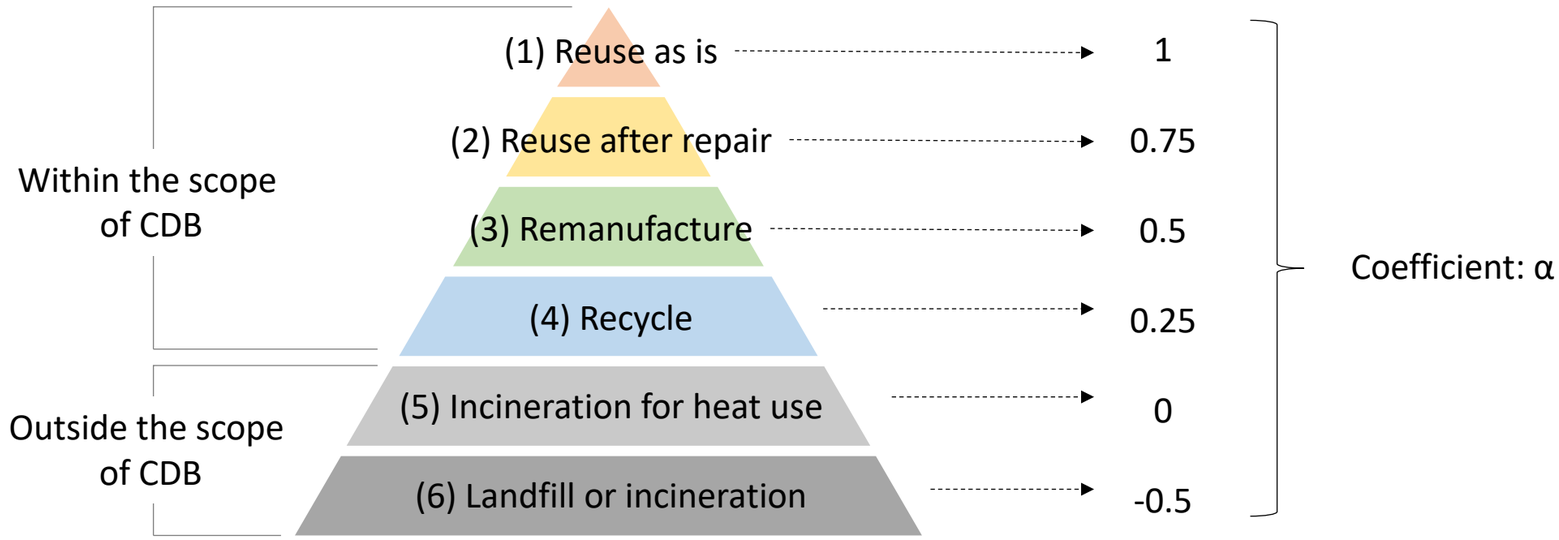
New evaluation scheme to achieve simultaneously both circular design build and carbon neutrality

We created an evaluation tool which can calculate **CDB score**- considering both material circularity and carbon neutrality.

When there are k types of materials that compose a given building,
The CDB score can be expressed below:

$$\sum_{i=1}^{k} \alpha \times \frac{the\ amount\ of\ embodied\ carbon\ of\ material\ i}{the\ total\ embodied\ carbon\ of\ the\ whole\ building} \times 100$$

Where,



Evaluation scheme implementation

■ As an example, I evaluated Takenaka corporation Tokyo Headquarters

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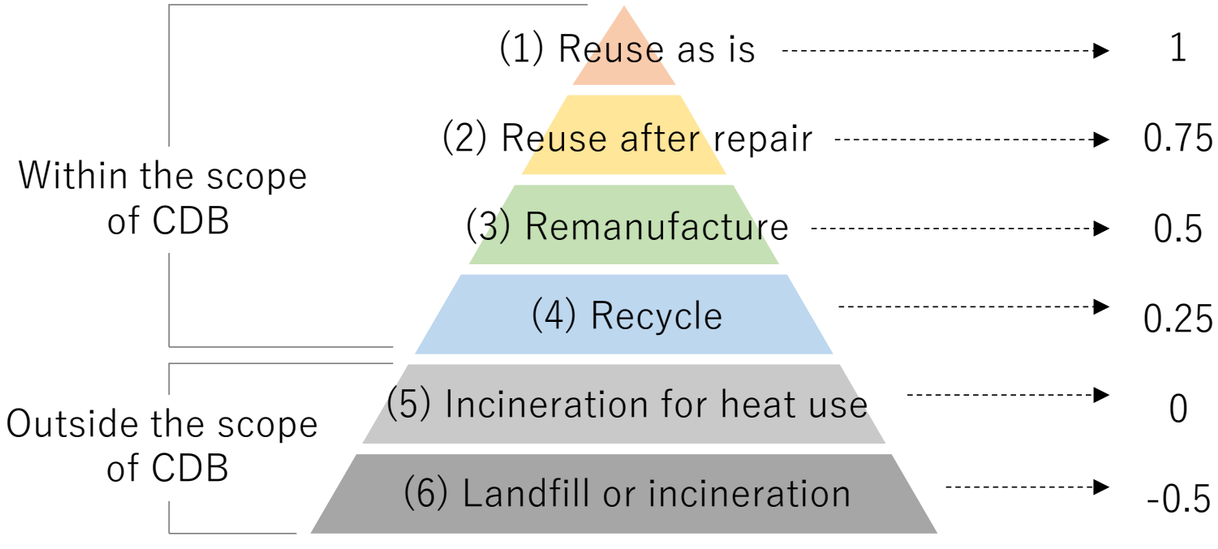
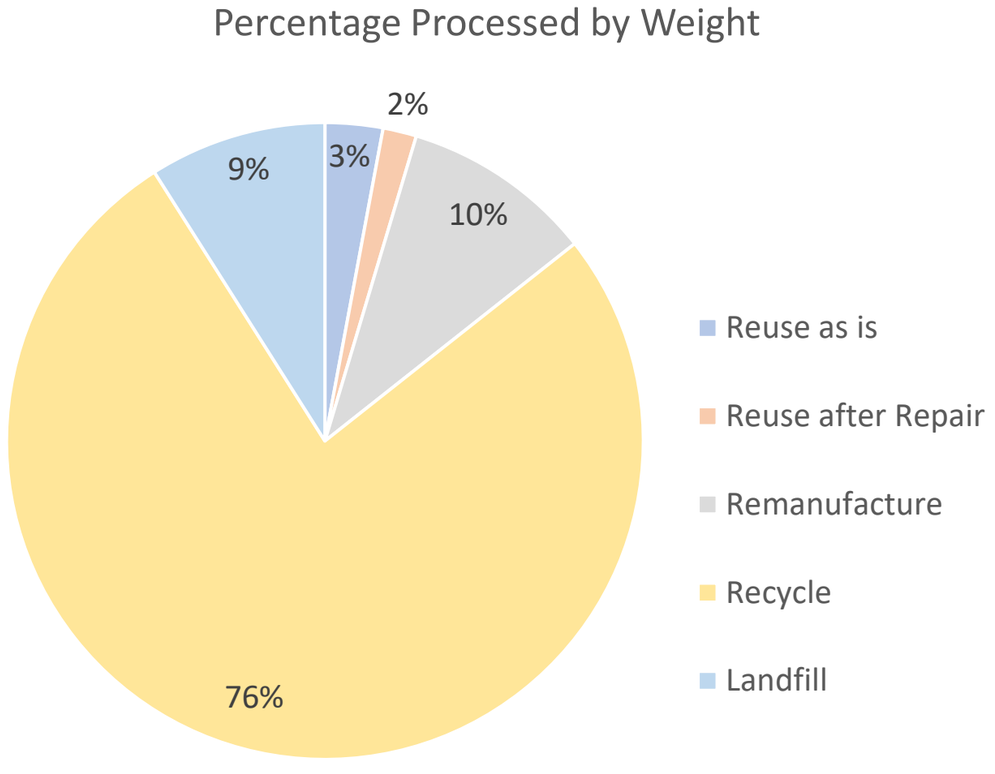


Evaluation scheme implementation

■ As an example, I evaluated Takenaka corporation Tokyo Headquarters

Reuse as much as possible

Total score: 36.8
(out of 100 points)



Evaluation scheme implementation

■ **As an example, I evaluated Takenaka corporation Tokyo Headquarters**

① Wet-method construction

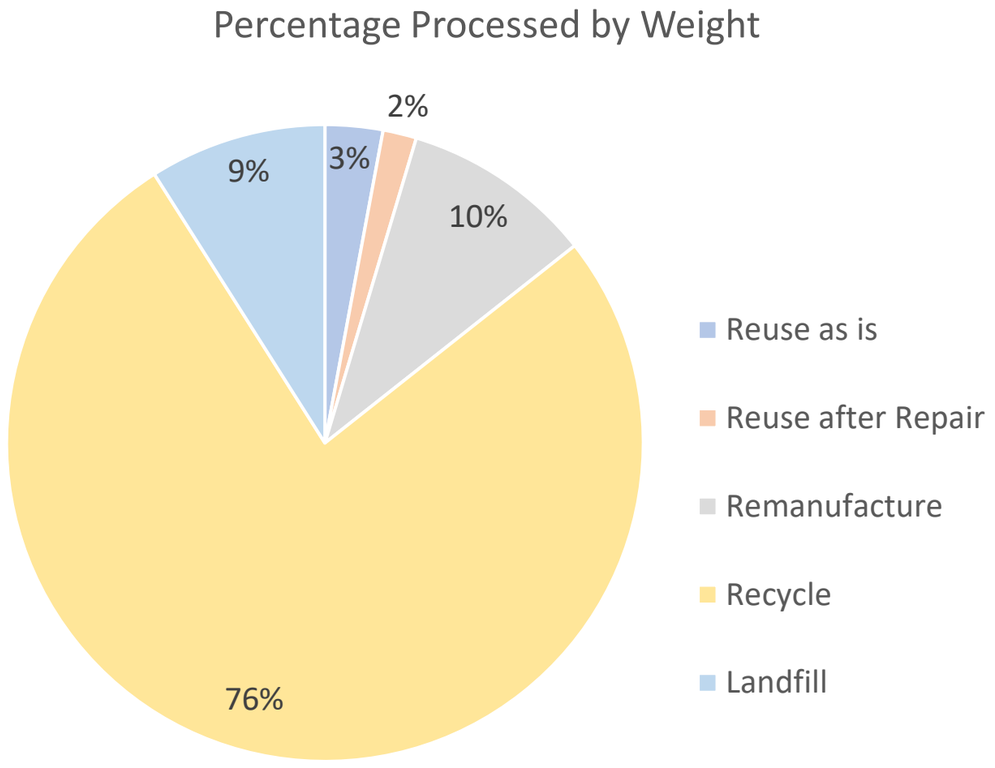
- Tiles, stone slabs, deck slabs, steel beams, etc., installed as an integral part of concrete cannot be removed by themselves.
- Tiles and stone slabs also inhibit the recycling of concrete.
- Mortared stone floors cannot be dismantled without crushing.
- Gypsum board is also a recyclable material, but it is difficult to reuse it after demolition if it is bonded to other boards with adhesives.

② The dimensions of the building materials used are not modular.

- Modular products such as carpet tiles can be easily removed, and most of them are distributed at 500 square meters, so they can be easily converted to the next building.
- On the other hand, float glass and exterior PC boards can be removed in the same condition as when they were installed, but it is difficult to reuse them as they are because they were made according to the dimensions of this building.

Reuse as much as possible

Total score: 36.8
(out of 100 points)



Our project aiming for both CO2 reduction and Circular built environment

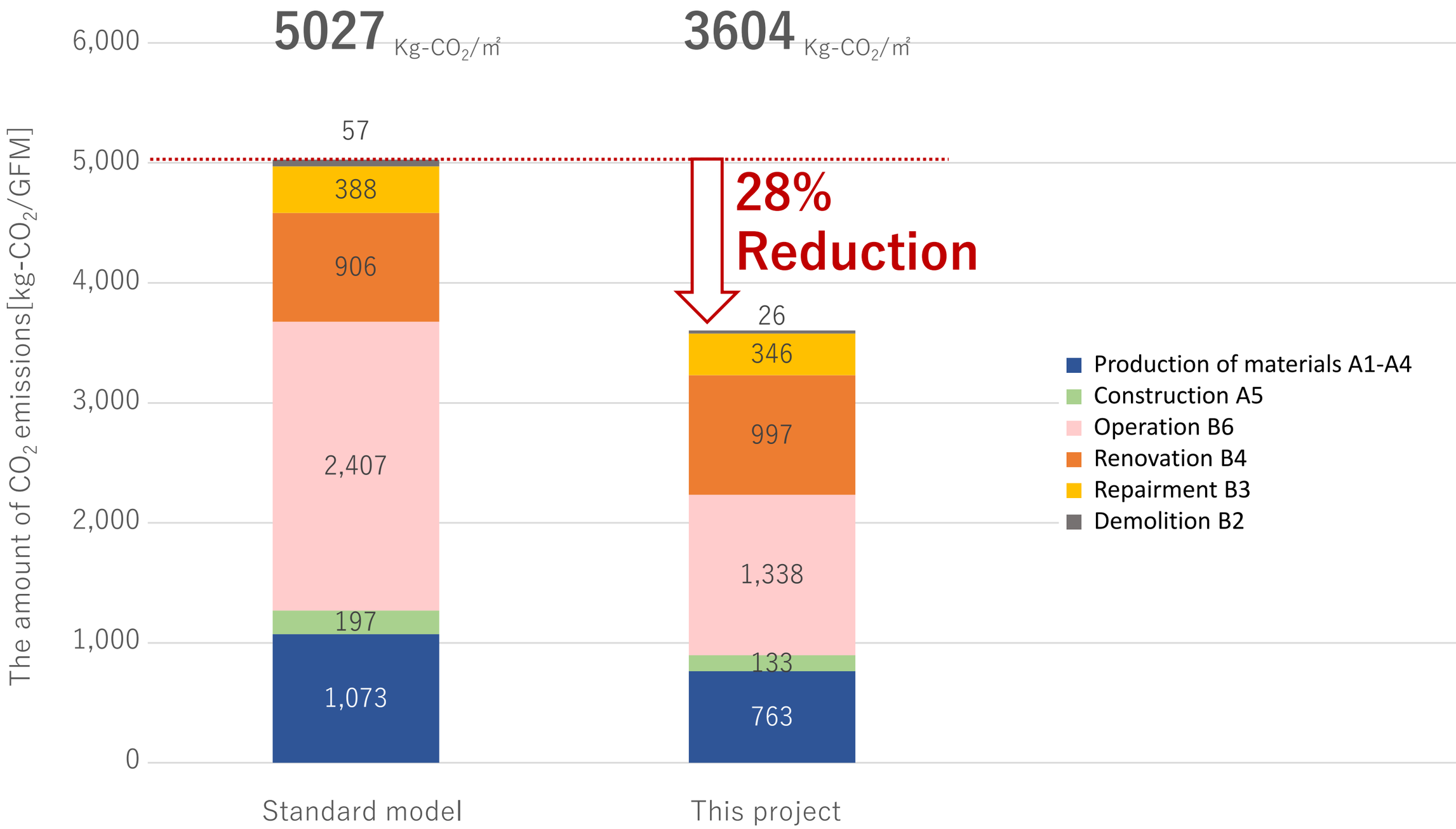
■ **Built in Hokkaido**

Our project aiming for both CO2 reduction and Circular built environment

■ Circular built environment

Our project aiming for both CO2 reduction and Circular built environment

■ **Towards carbon neutrality**



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