



Embodied Energy and Carbon of Rented Simple Apartments (Rusunawa) in Indonesia

Supervisor: Professor Hiroto Takaguchi

Rudi Setiadji Agustiningtyas

Student ID Number 5221AG31

Email: rudi.s@puskim.pu.go.id and agustiningtyas@akane.waseda.jp





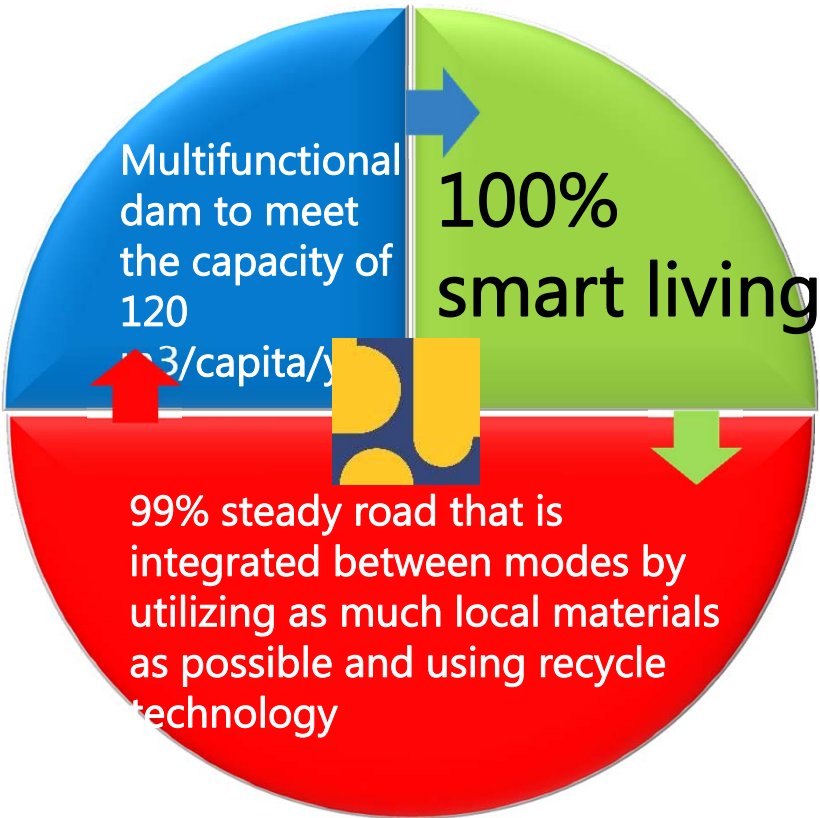
DIRECTORATE OF ENGINEERING AFFAIRS OF SETTLEMENTS AND HOUSING

FUNCTIONS based on the Regulation of the Minister for Public Works and Public Housing No. 13/2020:

- 1. Preparation of norms, standards, procedures, and criteria in the field of technical and non-technical development;**
2. Providing technical advice and supervision;
- 3. Implementation of assessment, engineering, and application of technology;**
4. Development of the reliability of buildings and residential areas;
5. Dissemination and cooperation in technical development;
6. Testing, certification, inspection, calibration, and technical advice;
7. Data management and information systems;
8. Development of functional positions and facilitation of professional development;



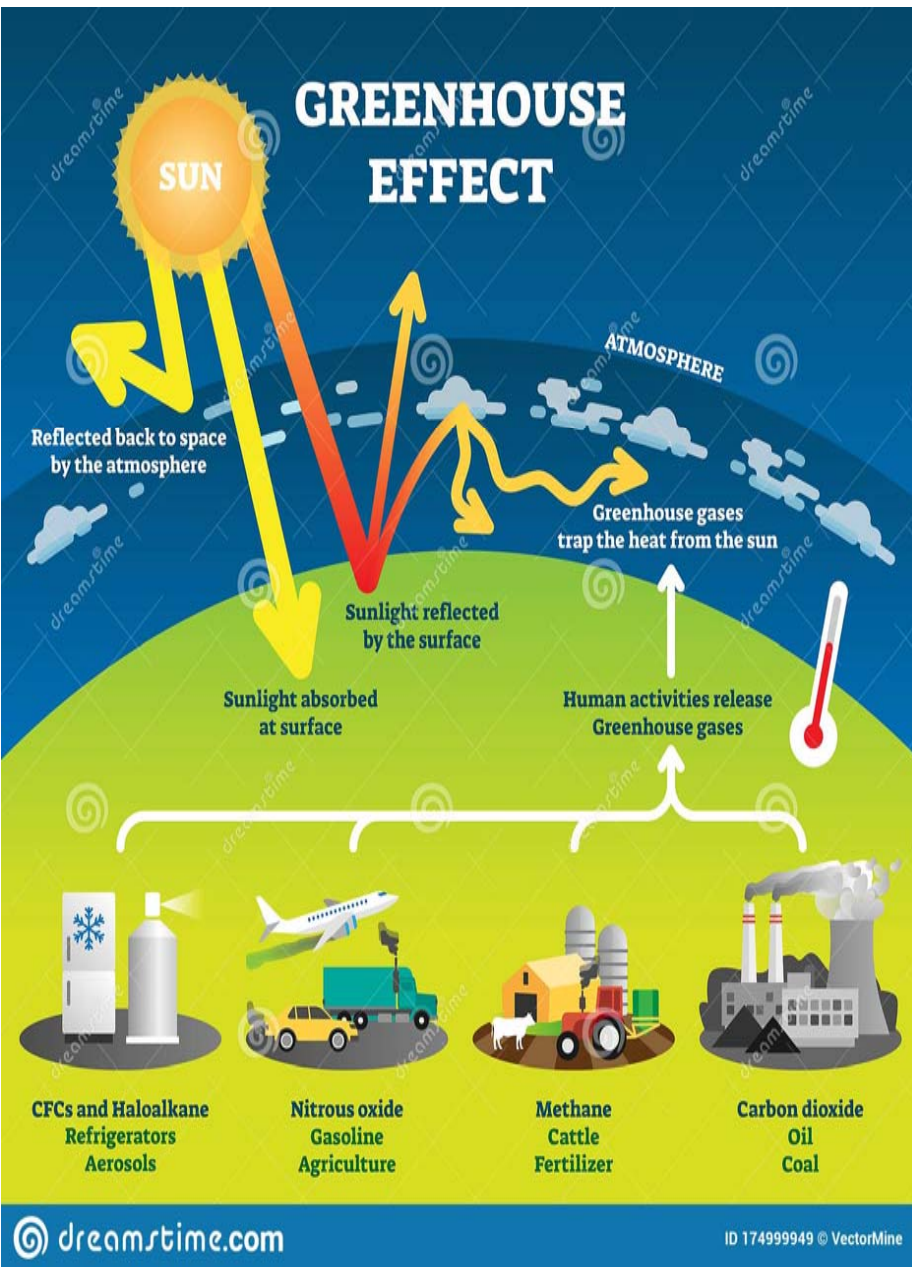
Vision of the Ministry of Public Works and Public Housing 2030



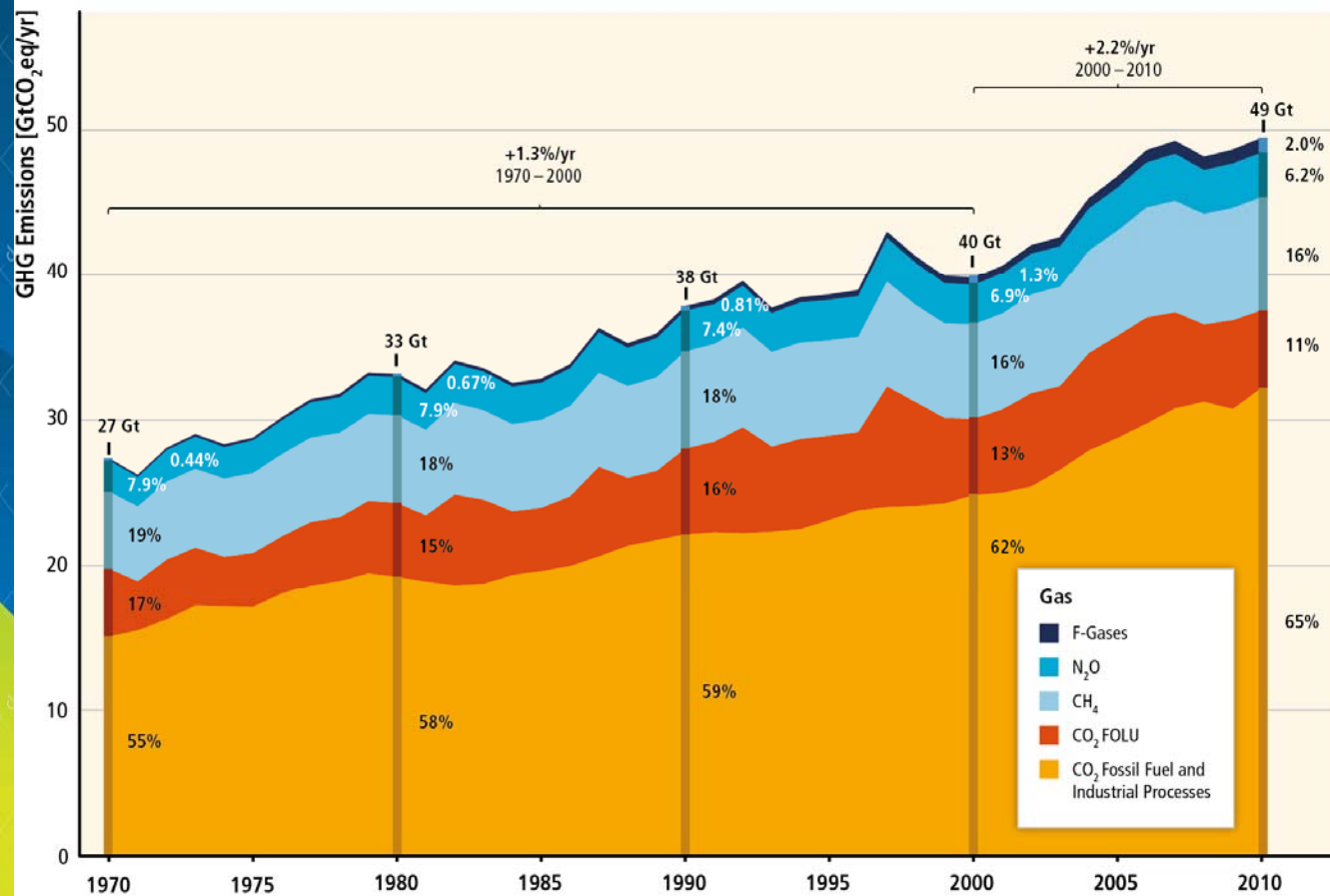
Aspects for the realization of smart living:



Source: Regulation of the Minister for Public Works and Public Housing No. 26/PRT/M/2017

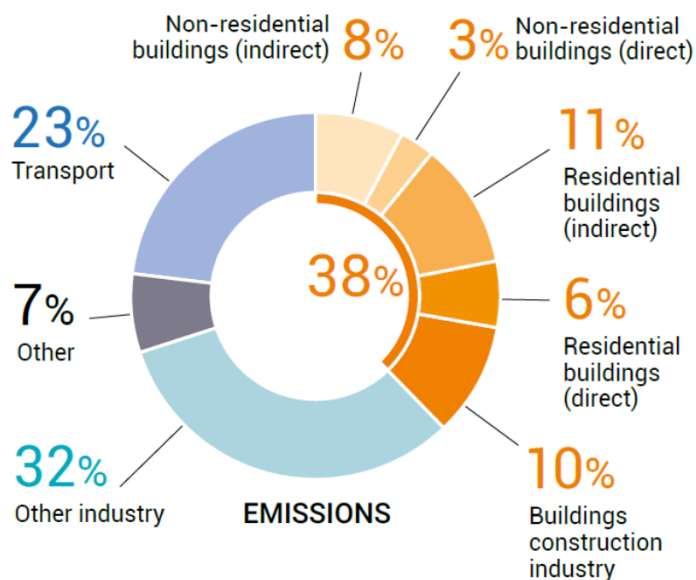
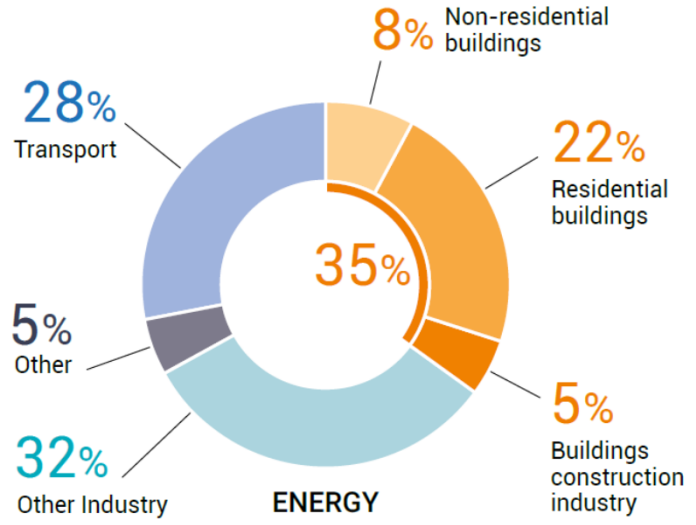


Total Annual Anthropogenic GHG Emissions by Groups of Gases 1970–2010

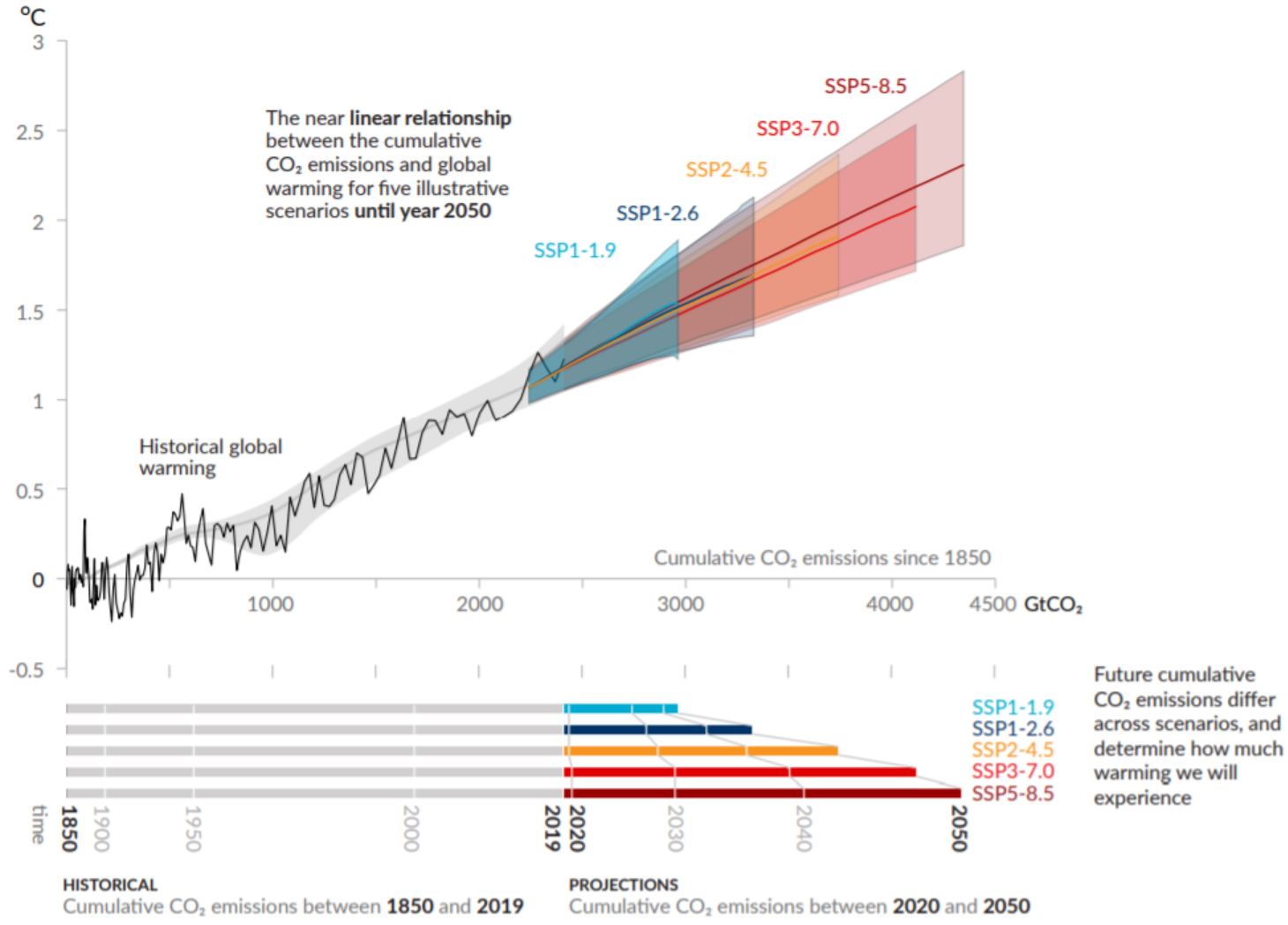


Source: IPCC (2014) *Climate Change 2014: Mitigation of Climate Change*

Global share of buildings and construction final energy and emissions, 2019



Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO₂ emissions (GtCO₂)



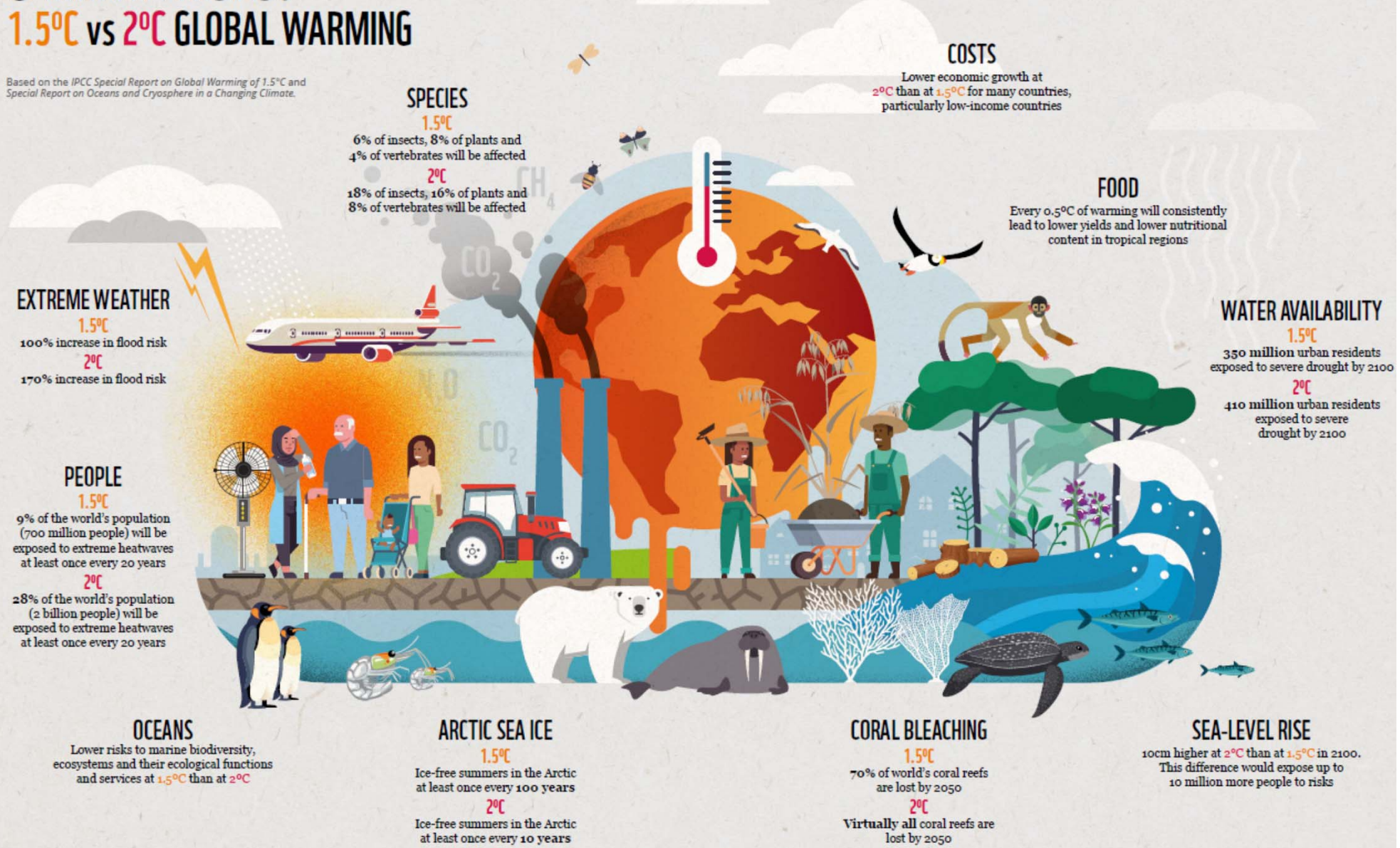
Source: IPCC (2021) Climate Change 2021 The Physical Science Basis

Source: Global Alliance for Buildings and Construction (2020) 2020 Global Status Report For Buildings And Construction

CLIMATE RISKS: 1.5°C vs 2°C GLOBAL WARMING

Source: WWF-UK (2021) FEELING THE HEAT: The fate of nature beyond 1.5°C of global warming.

Based on the IPCC Special Report on Global Warming of 1.5°C and Special Report on Oceans and Cryosphere in a Changing Climate.



COSTS

Lower economic growth at 2°C than at 1.5°C for many countries, particularly low-income countries

SPECIES

1.5°C
6% of insects, 8% of plants and 4% of vertebrates will be affected

2°C
18% of insects, 16% of plants and 8% of vertebrates will be affected

FOOD

Every 0.5°C of warming will consistently lead to lower yields and lower nutritional content in tropical regions

WATER AVAILABILITY

1.5°C
350 million urban residents exposed to severe drought by 2100

2°C
410 million urban residents exposed to severe drought by 2100

EXTREME WEATHER

1.5°C
100% increase in flood risk

2°C
170% increase in flood risk

PEOPLE

1.5°C
9% of the world's population (700 million people) will be exposed to extreme heatwaves at least once every 20 years

2°C
28% of the world's population (2 billion people) will be exposed to extreme heatwaves at least once every 20 years

OCEANS

Lower risks to marine biodiversity, ecosystems and their ecological functions and services at 1.5°C than at 2°C

ARCTIC SEA ICE

1.5°C
Ice-free summers in the Arctic at least once every 100 years

2°C
Ice-free summers in the Arctic at least once every 10 years

CORAL BLEACHING

1.5°C
70% of world's coral reefs are lost by 2050

2°C
Virtually all coral reefs are lost by 2050

SEA-LEVEL RISE

10cm higher at 2°C than at 1.5°C in 2100. This difference would expose up to 10 million more people to risks



” Development of Low-Carbon Affordable Apartments in the Hot-Humid Climate of Indonesia towards Paris Agreement 2030 ”

Achieve comfortable living environment in Indonesia using affordable low-carbon technologies



SATREPS is a **JST** and **JICA** program for research projects targeting global issues and involving partnerships between researchers in Japan and developing countries

Website: delca.hiroshima-u.ac.jp

Principal Investigator
(Affiliation)



Associate prof.
KUBOTA Tetsu
(Graduate School of Advanced Science and Engineering, Hiroshima University)

[researchmap](#)



Dr.
Muhammad Nur Fajri Alfata
(Researcher, Directorate General of Human Settlements, Ministry of Public Works and Housing)



JST + JICA

DeLCA

Development of low-carbon affordable apartment in the hot-humid climate of Indonesia towards Paris agreement 2030

Overall goal and project objectives

Overall goal (2025-2030)

To develop low-carbon affordable apartments, including Rusunawa and Rusunami, and implement them across Indonesia towards the greenhouse gas (GHG) reduction target of Paris agreement for 2030

The proposed low-carbon techniques are implemented in all the newly constructed affordable public apartments with a total floor area of more than 2,000 sqm, including Rusunawa and Rusunami, in the town of Tegal from the target year.

Project objectives (2021-2026)

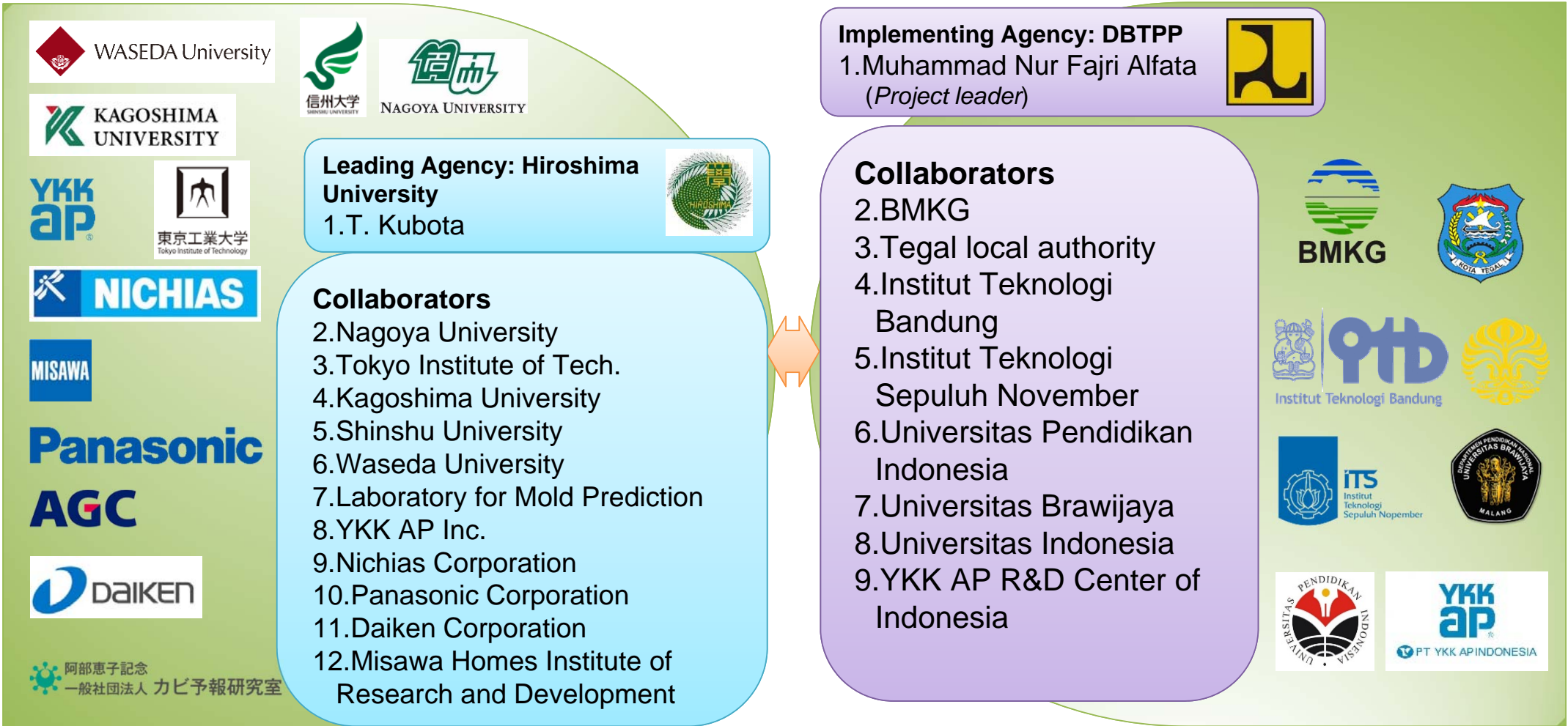
Comprehensive low-carbon cooling techniques for affordable apartments, including Rusunawa and Rusunami, in Indonesia are developed, and the developed techniques are proposed to be incorporated in building codes and guidelines, etc. for construction of affordable public apartments in the town of Tegal.

Rusunawa-type



Rusunami-type

Organization

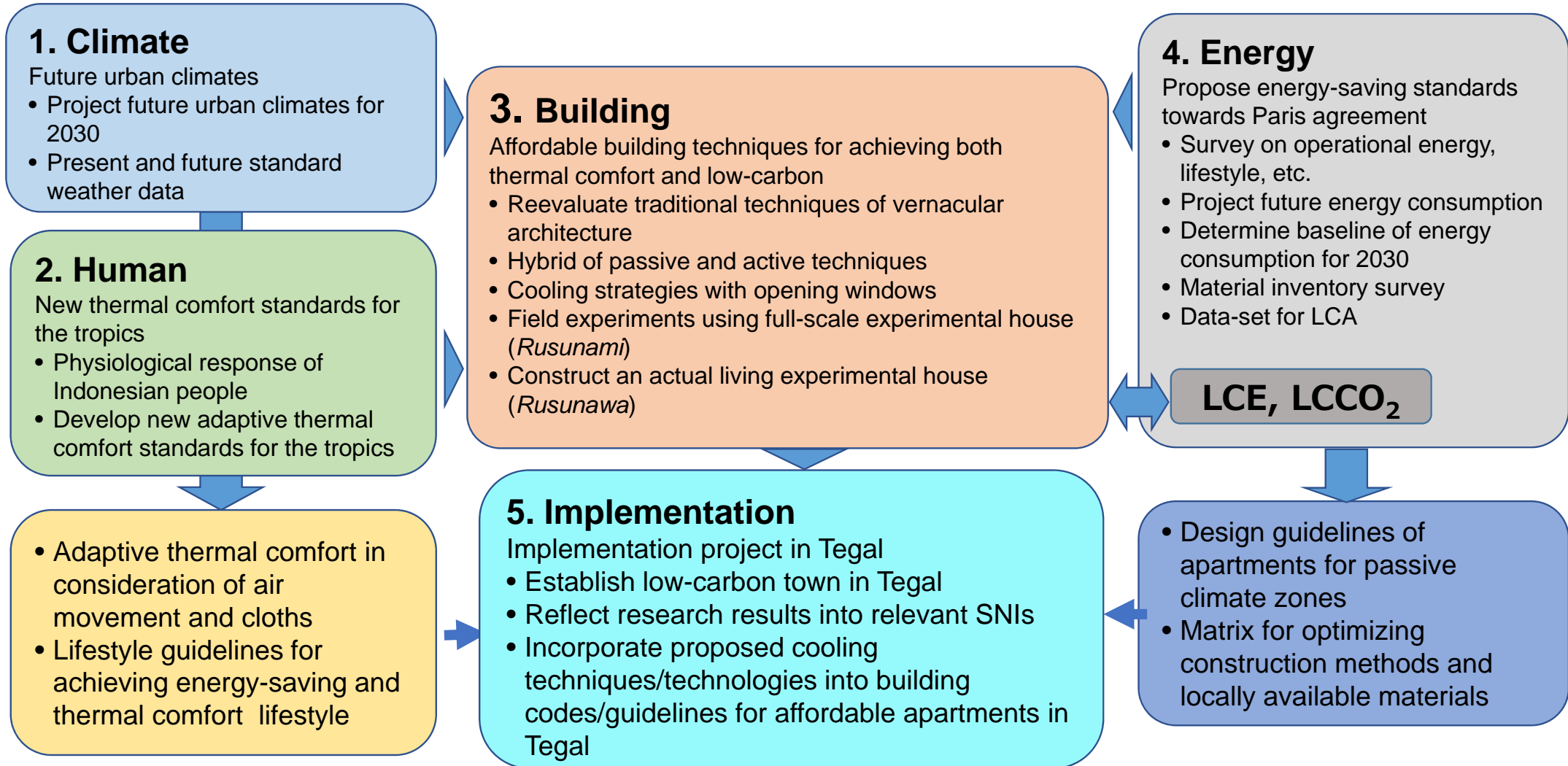


<p>11 SUSTAINABLE CITIES AND COMMUNITIES</p>	<p>7 AFFORDABLE AND CLEAN ENERGY</p>	<p>13 CLIMATE ACTION</p>
---	---	---------------------------------

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
 Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all
 Goal 13. Take urgent action to combat climate change and its impacts



Development of Low-Carbon Affordable Apartments in the hot-humid climate of Indonesia towards Paris agreement 2030



GREEN BUILDING PERFORMANCE ASSESSMENT

based on the Regulation of the Minister for Public Works and Public Housing No. 21/2021:

1. Site management;
2. Energy use efficiency;
3. Water use efficiency;
4. Indoor air quality;
- 5. Environmentally friendly materials;**
6. Waste management;
7. Waste water management.

National Medium-Term Development Plan (RPJMN) for 2020-2024 macro target reducing greenhouse gas emission by 27,3%.



RESEARCH PLAN OUTLINE

How to develop low embodied energy and carbon Rusunawa and contribute to the development of technical guidelines, national standards, and regulations of the green building design?

Analysis of the Embodied Energy and Carbon of Existing Rusunawa

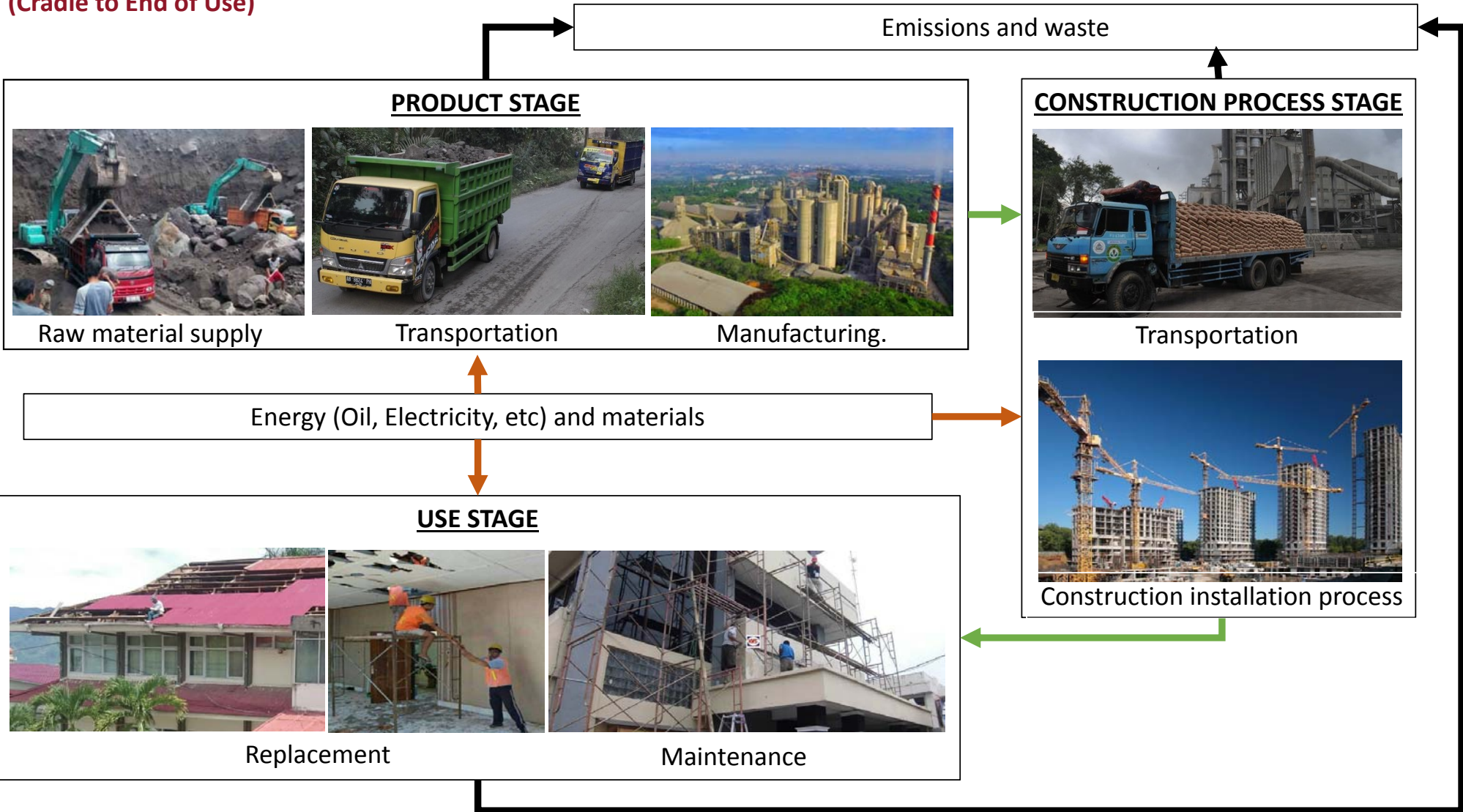
Evaluation of the Life Cycle Energy (LCE) and Life Cycle CO₂ (LCCO₂) of Future Model Rusunawa

Optimization of Future Model Rusunawa

Key Findings and Recommendations

LIFE CYCLE ASSESSMENT BOUNDARY

(Cradle to End of Use)



CLASSIFICATION PARAMETERS OF EXISTING RUSUNAWA IN INDONESIA

YEAR BUILT PERIOD

1980-2007

2008-2021

STOREY NUMBER

Low-rise (≤ 4)

Mid-rise (5-8)

High-rise (> 8)

RESIDENTIAL UNIT TYPE

21 m²

24 m²

36 m²

FLOOR PLAN

*Open
(without bedroom partition)*

*Fixed
(with bedroom partition)*

BALCONY

With

Without

UPPER STRUCTURE

Conventional reinforced concrete

Precast concrete

MASS SHAPE

Slab

Tower

Combination

CORRIDOR TYPE

Single loaded

Double loaded

Core

SAMPLES DISTRIBUTION OF EXISTING



Consist of the nation's capitol, metropolitan city, and medium city.

RESEARCH OUTPUT

Inventory of
building
materials
embodied
energy and
carbon

Guideline of
embodied
energy and
carbon
assessment
method for
Rusunawa

LCE and LCCO₂
characteristics
of existing type
and future
Rusunawa

Optimized Life
Cycle Energy
and Life Cycle
CO₂ of future
Rusunawa
design

Period 2021-
2024

THANK YOU

SATREPS

Science and Technology Research Partnership
for Sustainable Development Program

 **DeLCA** Development of Low-Carbon Affordable Apartments
in the hot-humid climate of Indonesia towards Paris agreement 2030

