



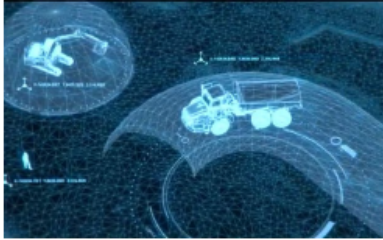
Komatsu IR-Day 2023

**Development path towards
carbon neutrality**

Taisuke Kusaba
Senior Executive Officer
CTO & President of Development Division

Mid-term management plan

1. Accelerate growth by means of innovation



Create new customer values by optimizing workplaces

- Promote DX Smart Construction and its overseas expansion
- Business promotion using mining open technology platforms
- Advanced product development and market introduction with high compatibility with platforms

Tackling the challenge of crafting values (products and solutions) for carbon neutrality

- Development and market introduction of electrified machinery
- Promotion and expansion of Smart Forestry
- Plants with zero environmental impacts

2. Maximize earnings power



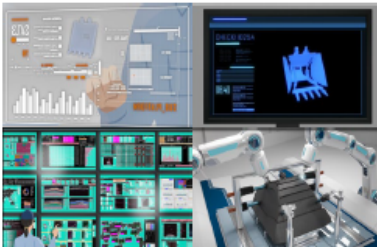
Expand presence in key emerging markets

- Strengthening of marketing strategies in Asia and Africa markets
- Expansion of forestry machinery and hard rock equipment businesses
- Expansion of aftermarket business

Further growth from evolution of value chain business

- Development of data-driven business model
- Promotion of differentiation through life cycle support business
- Expansion of reman/rebuild businesses

3. Enhance corporate resilience



Drive efficient business operations and reinforce risk management

- Strengthening of production and procurement systems resistant to environmental changes (increase of multi-source ratio of parts)
- Enhancing assessment of economic security risk and preparedness
- Strengthening the corporate brand by developing a global brand strategy

Enrich human resources base with diversity

- Enhancement of diversity & inclusion
- Offering of a variety of talent development opportunities and improvement of employee engagement
- Human resources development for digital applications and open-innovation

Global movement towards carbon neutrality

- **EU** : Allowing sales of new vehicles using synthetic fuel
- **North America** : It is likely to become a major driver in the future due to huge investment. (Up until now, we have mainly focused on electrification in Japan and Europe, but we would like to keep an eye on the US as well in the future.)

EU

- On March 8, 2023, EU decided to ban sale of new cars other than non-emission cars that do not emit CO₂ from 2035 onwards but will allow sale of new cars that use **synthetic fuel** as an exception.

North America

- On August 16, 2022, **US Inflation Reduction Act (IRA) was enacted**, providing subsidies of up to \$7,500 to EV buyers. Automakers and battery manufacturers are increasingly **announcing plans to establish production facilities in United States** to meet requirements for tax credits.

Main battery factory construction plans: GM + Samsung SDI / Hyundai Motor + LG Energy Solution / Panasonic Energy / VW / Honda + LG Energy Solution / Ford / Toyota

- **Environmental Protection Agency (EPA)** announces **policy to replace 500,000 school buses in United States with latest electric buses**, and work is underway to replace them. (Period: 2022-2026, Budget: \$5B)

Japan

- On June 6, 2023, government decided to revise the basic hydrogen strategy at meeting of relevant ministers and **announced investment plan of 15 trillion yen in public and private sectors over the next 15 years**. Hydrogen supply expansion policy: current 2 million tons, 30 million tons in 2030, 12 million tons in 2040, 20 million tons in 2050

- On June 16, 2023, Ministry of Economy, Trade and Industry decided to **provide approximately 120 billion yen in subsidies for development of batteries** for Toyota EVs.

Government has designated storage batteries as particularly important material for economic security and has set budget of over 300 billion yen to encourage domestic development and production.

Others

- **COP28** (from November 30, 2023, UAE):

Countries such as United States / EU / UAE are expected to formulate pledge to **triple their use of renewable energy in 2030**. There is strong possibility that "**liquid hydrogen**" and "**ammonia**", which are effective carriers, will attract more attention as activities toward spread of hydrogen society.

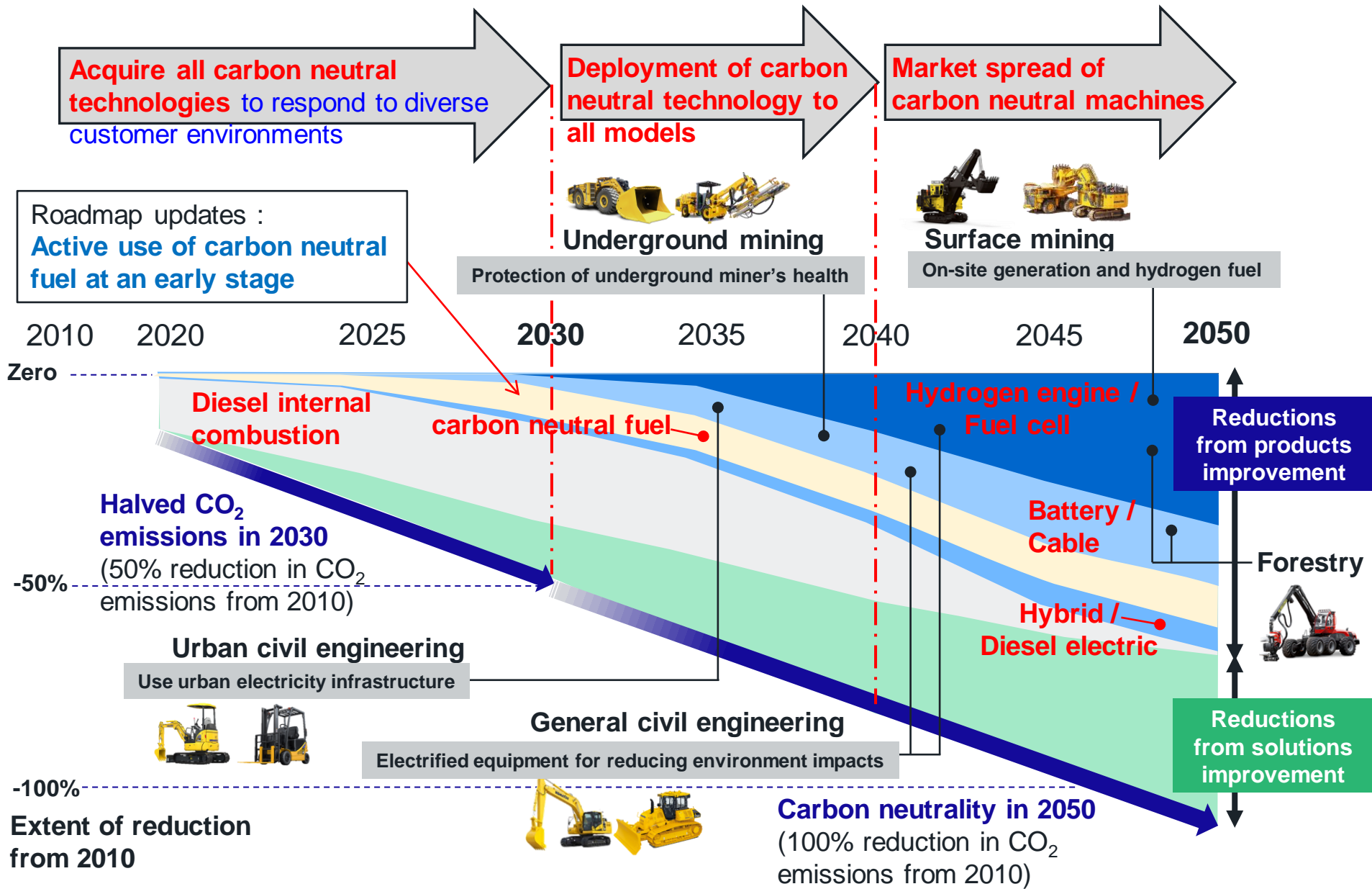
- **F1: Adoption of carbon neutral liquid fuel until 2026**

Aim for carbon neutrality in all activities until 2030

CO₂ actually emitted in F1

- (1) Areas away from site, such as moving machines and parts : **45%**
- (2) Staff movement : **22.7%**
- (3) CO₂ emissions from F1 cars : **0.7%** of total F1 CO₂ emissions

Roadmap for achieving carbon neutrality



Two-pronged approach of improvements in products and solutions to reduce CO₂ emissions

Solutions that optimize customers' operation processes through digitalization, together with safe, eco-friendly, and highly efficient products that are compatible with our solutions.

(For Smart Construction)

Maximizing customer value

- Level 5**
Create work tasks and work orders
- Level 4**
Optimization of construction planning
- Level 3**
Data monitoring
- Level 2**
Visualization of topography/workplace
- Level 1**
Workplace digitization

Solutions (Optimization level of customers' entire operation processes)

- ◆ Safe, highly productive, smart and clean workplace of the future
- ◆ Digital transformation
- ◆ Carbon neutrality

Conventional

Products (Level of automation and autonomous operation)

- Level 1**
Limited operation support
- Level 2**
Advanced operation support
- Level 3**
Advanced solo automation
- Level 4**
Advanced collaborative autonomous operation
- Level 5**
Advanced decision-making autonomous operation

Products (Improvement of equipment efficiency / Reduction of CO₂ emissions)

Innovate manufacturing technology and develop new value chain



Challenges and countermeasures to new power sources

Construction and mining equipment operate under harsh vibration, dust, and harsh temperature conditions, etc.

Performance

- Countermeasures to decrease energy density
- Extension of energy input and output (output power and endurance)

Durability

- Durability under harsh vibration



Vibration level of construction and mining equipment (especially crawler type):
More than 10 times that of an automobile

Bigger room for new power source!!

4 challenges to overcome for new power sources

Environment

- Quick supply energy
- Reliability and durability under harsh condition

Cost

- Price optimization
- Development of energy supply infrastructure including battery circulation, etc.



Snow condition



Dust condition



Electric construction machineries introduced to the market this fiscal year

3-ton class electric mini excavators "PC30E/PC33E-6" equipped with lithium-ion batteries are released in the **Japanese and European markets**.



【PC30E-6】

13-ton class electric excavators "PC138E-11" equipped with lithium-ion batteries, are scheduled to be introduced in the **Japanese market as a rental machine** from January 2024 onwards.



【PC138E-11】

We plan to begin introducing **20-ton class** electric excavators "PC200LCE/210LCE-11" equipped with lithium-ion batteries **as a rental machine** in the **Japanese and European markets** from October onwards. (Sequentially introduced in Asia, North America, and Australia)



【PC200LCE-11】

Electric micro excavators "PC05E-1" jointly developed with Honda Motor Co., Ltd. are released in the **Japanese market** from October this year.



【PC05E-1】

Research and development related hydrogen

Concept machine of medium-sized hydraulic excavator equipped hydrogen fuel cell

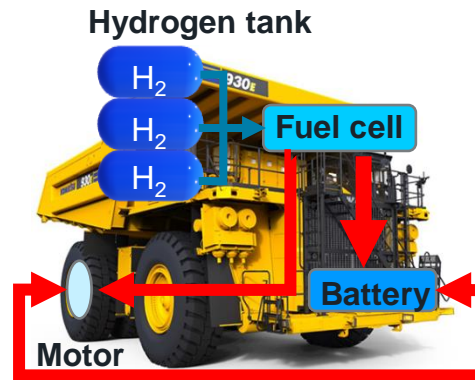


Komatsu started proof-of-concept (PoC) in May 2023 on concept machine for medium-sized hydraulic excavator equipped key components developed in-house and fuel cell, with aim of mass producing medium- to large-sized construction machineries equipped with fuel cell in the near future.

Research and development of electric dump truck equipped fuel cell

We have clarified technical issues and are currently building fuel cell control and simulation technology on the bench.

In addition, we will install megawatt class fuel cell bench in Oyama Plant into operation by the end of 2025 with aim of establishing multi-parallel control and energy management control in vehicle circuits.



Fuel cell bench test facility



Fuel cell bench test (Megawatt class): verification with real component

Test on prototype machine

Hydrogen mixed fuel engine

Commercialized 250kW hydrogen mixed generator with Denyo Co., Ltd. Introduced at our Oyama Plant.



Means of products towards carbon neutrality "Tank to Wheel"

- Promote usage of proprietary technology as a "bridge technology" to carbon neutrality.
- Efforts will also be made to utilize "carbon neutral fuel" such as biodiesel and HVO.

Bridge technology



Trolley / Cable



Hybrid



Diesel electric

Direction of development : Energy

Non-internal combustion

Battery vehicle

Fuel cells vehicle

2020

2030

2040

2050

Hybrid, Diesel electric, Trolley / Cable

Diesel engine vehicle (Improved fuel efficiency)

Carbon neutral fuel

HVO
(Hydrogenated vegetable oil)

Bio diesel (FAME)

GTL fuel

Gradually switching filling fuel to HVO fuel at European factories

Biofuel

e-fuel

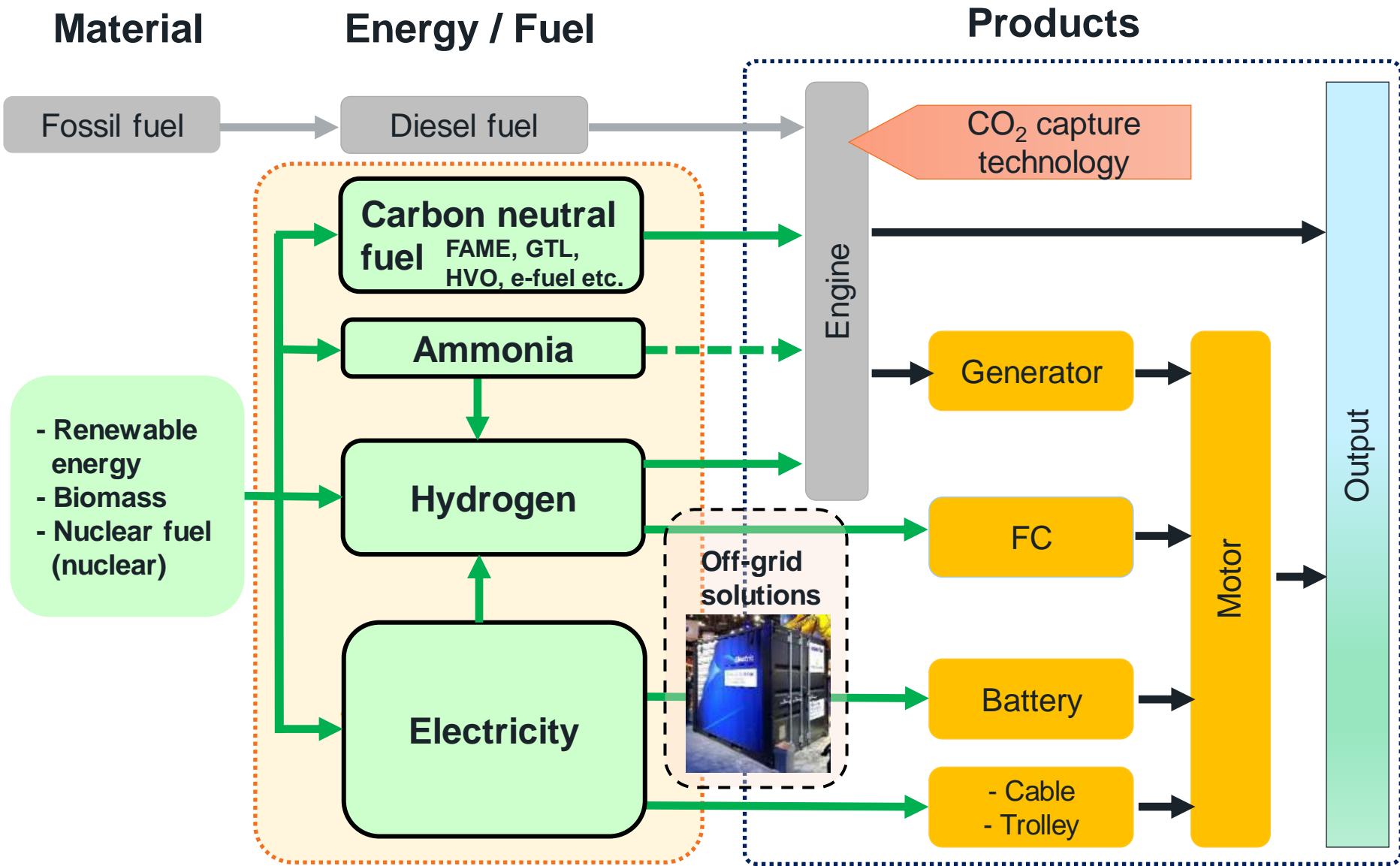
CO₂ capture technology

Internal combustion

Hydrogen mixed fuel engine (Generator)

Hydrogen fuel (100%) engine vehicle

Energy and fuel towards carbon neutrality “Well to Wheel”



Generated by green energy

Charging for electric construction machinery

Automobile

Easy to charge by yourself !

Use charging station in the city
(Gas station, shopping center, etc.)



Not easy to charge by yourself !

Vehicle for charging

Utilization of electricity infrastructure



Charger with power storage function



Charge from generator or battery



Charger

Charging infrastructure (sample)

Electric micro excavator of 1 ton or less



Electric mini excavator



Small- to medium- sized electric excavator



Image of a broad-ranging battery-sharing system established through utilization of "Mobile Power Pack"



Reduction of CO₂ emissions by solutions (1)

DX Smart Construction

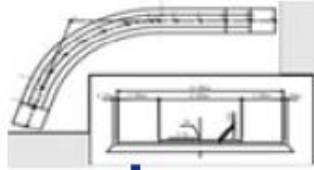
Surveying

Planning

Construction

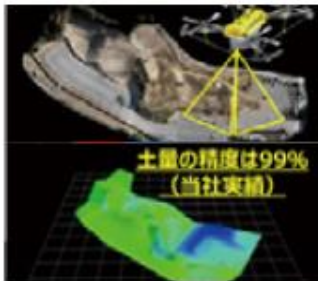
Inspection

Traditional analog process

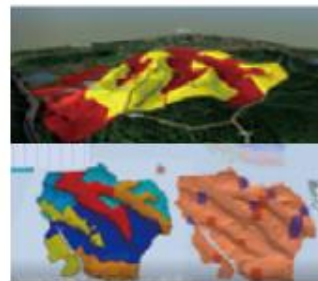


“Vertical digitization”: Digitization of individual construction processes (previous Smart Construction)

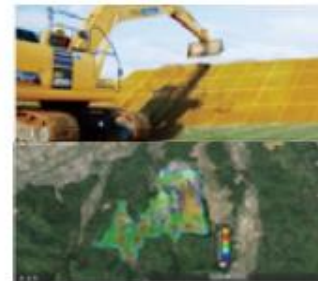
Drone 3D measurement/
Visualization



Construction simulation/
Digital task preparation



3D construction/ Management
with ICT-intensive equipment
and apps



Drone 3D finished
landform inspection

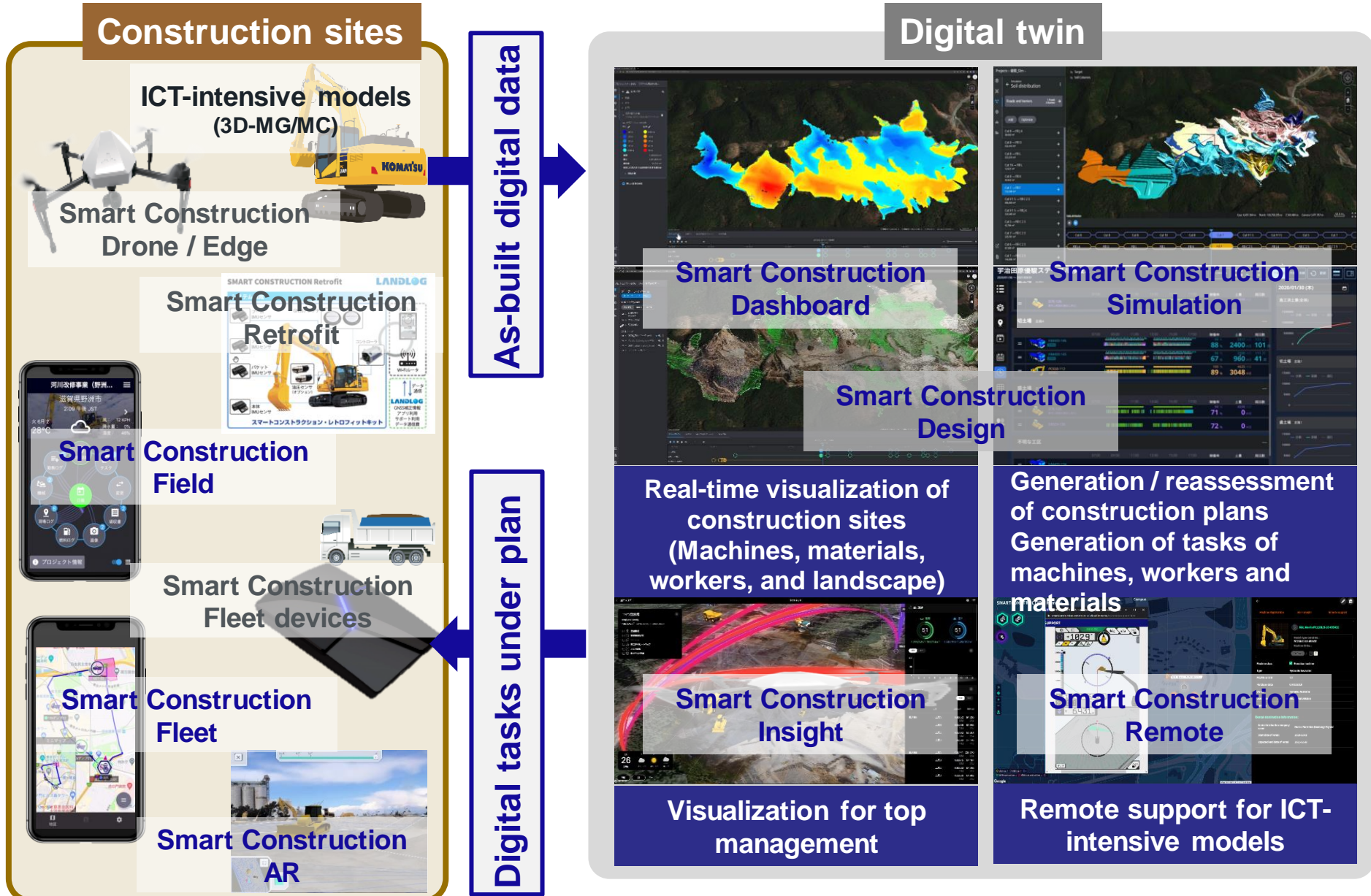


Digital transformation (“DX”) process

Solution

“Horizontal digitization”: Digitization and connection of all processes to optimize entire construction process – the “digital transformation of construction” (“DX Smart Construction”)

Reduction of CO₂ emissions by solutions (2)



Contribution of carbon neutrality by “products” and “solutions”

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Thank you for your attention



【Picture】 medium-sized hydraulic excavator equipped with hydrogen fuel cell (concept machine)