11 (1) Carbon recycling (carbon recycling/material industry)

<Main future efforts>

- Developing production technologies for low-cost, high-performance CO_2 absorption type concrete and CO_2 recovery type cement.
  - Aiming to achieve the same price (= 30 yen/kg) as existing concrete in 2030 as a cost target by expanding sales channels through public procurement. Developing and demonstrating new products with rust prevention performance, and expanding the applications to buildings and concrete blocks.
  - Establishing technologies to recover CO_2 from the combustion of cement raw material (limestone) and to produce cement from recovered CO_2 and waste.
- Making carbon-free synthetic fuels commercially viable by 2040 and their price below the price of gasoline by 2050. Promoting large-scale demonstrations to reduce the cost and expand the supply of SAF with the goal of commercialization around 2030.
  - Conducting intensive development of innovative technologies for synthetic fuels, which are produced from a reaction between CO_2 and hydrogen, over the next 10 years. In addition, establishing SAF production technology.
- Aiming to bring the price of plastic raw materials made by artificial photosynthesis to the same level as existing products by 2050.
  - Reducing manufacturing cost by 20% by 2030 by developing a photocatalyst with high conversion efficiency. Also, considering security and safety regulations ahead of time by 2030.
  - Establishing manufacturing technology for chemicals derived from biomass and waste plastics by 2030. Also, promoting the advancement of naphtha cracking furnaces.
- Promoting the development and demonstration of technologies to separate and recover CO_2 from exhaust gas with lower concentration and lower pressure.
  - Further reducing the cost of separation and recovery technology and expanding applications other than EOR (Enhanced Oil Recovery) by 2030.
  - Aiming to secure 30% of the world's separation and recovery market, which is expected to reach 10 trillion yen annually by 2050.

Benefits to people's lives in 2050

- Enabling the provision of concrete products and buildings that meet consumers' needs for environmental friendliness and longevity.
  - CO_2 absorption will improve the water resistance and durability of concrete.
  - Rust prevention performance will be obtained through technology development. When purchasing houses, etc., people will be able to select products and buildings that meet their needs for longevity.
- Automobiles, electronic devices, etc. with higher functionality will be available at the same prices as existing products.
  - Functionality will be further improved, such as higher heat resistance and impact resistance and lighter weight, while the cost of functional chemicals will be reduced.
  - This will realize products (automobiles, electronic devices, etc.) with higher added value than current products.

11 (2) Material (carbon recycling/material industry)

<Main future efforts>

- Developing and demonstrating technologies to realize “zero-carbon steel”.
  - For hydrogen reduction steelmaking, establishing the following technologies:
    (1) Furnace heat compensation technology necessary for iron ore reduction
    (2) Technology for securing airflow due to the reduced use of coal
    (3) Technology for advancing electric furnaces and removing impurities, which is essential for melting reduced iron.
  - Aiming to capture a maximum of approx. 500 million tons per year (approx. 40 trillion yen per year) in 2050, considering a global market prospect for green steel.
- Developing and supplying innovative materials that contribute to the decarbonization of industrial fields.
  - Developing innovative steel plates (ultra-high - tensile steel plates) that exceed high - tensile steel plates, as well as bonding and joining technologies essential for combining multiple materials.
- Promoting the decarbonization of heat sources in industries that require high temperatures in the manufacturing process.
  - In the paper manufacturing and glass and ceramics industries, developing technologies for manufacturing facilities that utilize heat sources derived from non-fossil fuels such as hydrogen and ammonia.

Benefits to people’s lives in 2050

- Costs such as transportation and travel time will be greatly reduced.
  - The weight reduction by innovative metal materials will enable faster transportation equipment.
  - Research and development will be conducted with attention to social implementation, for example, by setting a target value for a material to be used in future high-speed transportation equipment considering social implementation.
- Structures with high resilience and longer service life will be realized.
  - High-strength steel with even higher strength and toughness will not only be resistant to earthquakes, but will also extend the service life of structures.
  - When buildings with excellent design are realized, their value as tourism resources will be enhanced, increasing the number of inbound tourists and revitalizing the local communities.