

Way to the Sustainable Nitrogen Management, an issue in the Planetary Boundary

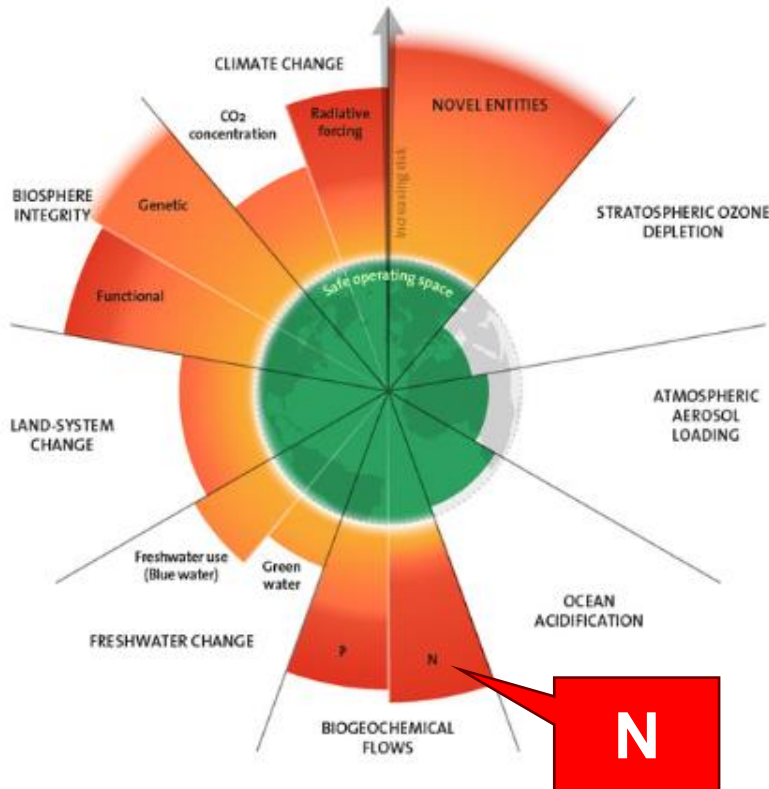
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Nitrogen emissions : one of the most serious issues on Planetary Boundaries
In this talk, political trends and technical solutions are introduced.

Nitrogen Pollution (from UNEP HP)

- 200 million tonnes of reactive nitrogen are lost to the environment every year.
- **100 Billion USD could be saved** by setting an ambitious goal to reduce nitrogen waste.



Climate change

- global warming by N_2O

Air

- smog and ozone by NO_x
- $PM_{2.5}$ by Ammonia

Biodiversity

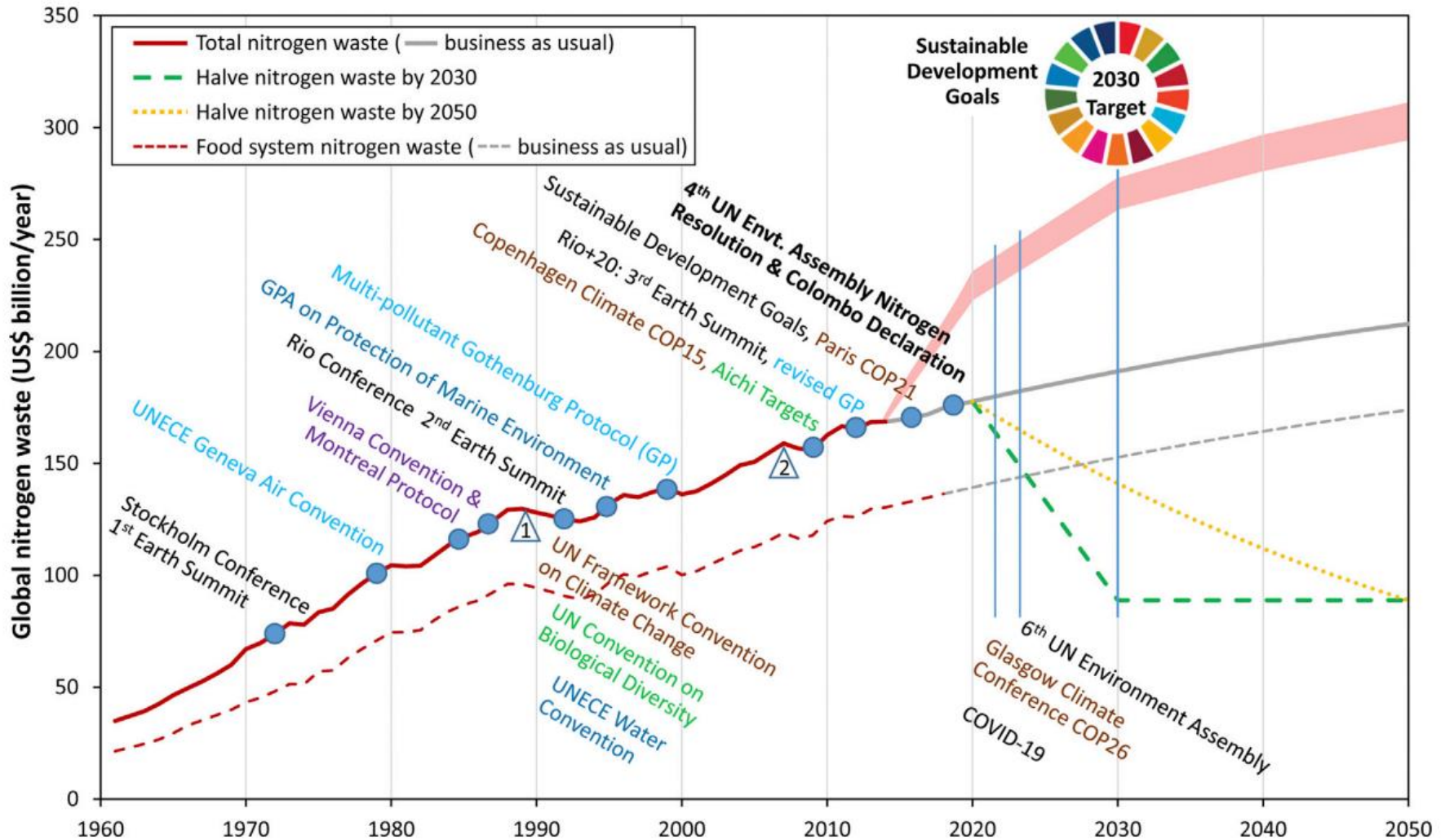
- The biggest driver of biodiversity loss

Stockholm Resilience Centre, <https://www.stockholmresilience.org/research/planetary-boundaries.html>

Why does nitrogen pollution matter?, <https://www.unep.org/facts-about-nitrogen-pollution>

Global nitrogen waste & UN agreements

As nitrogen waste is increasing, UN has also reached various agreements.



Sutton, et al., *One Earth*, 2021, 4, 10

UNEA has made resolutions on sustainable nitrogen management.
The actions are becoming more active.

Resolutions

UNEA-4(2019) 4/14 : First resolution for **Sustainable Nitrogen Management**

UNEA-5 (2022) 5/2 : “reduce nitrogen waste significantly” and a timeline “by 2030 and beyond”

CBD-COP15(2022) : reducing nutrients lost to the environment by at least half.

Actions

INMS(The International Nitrogen Management System, 2016-), developing international process, providing science-based support to policy makers.

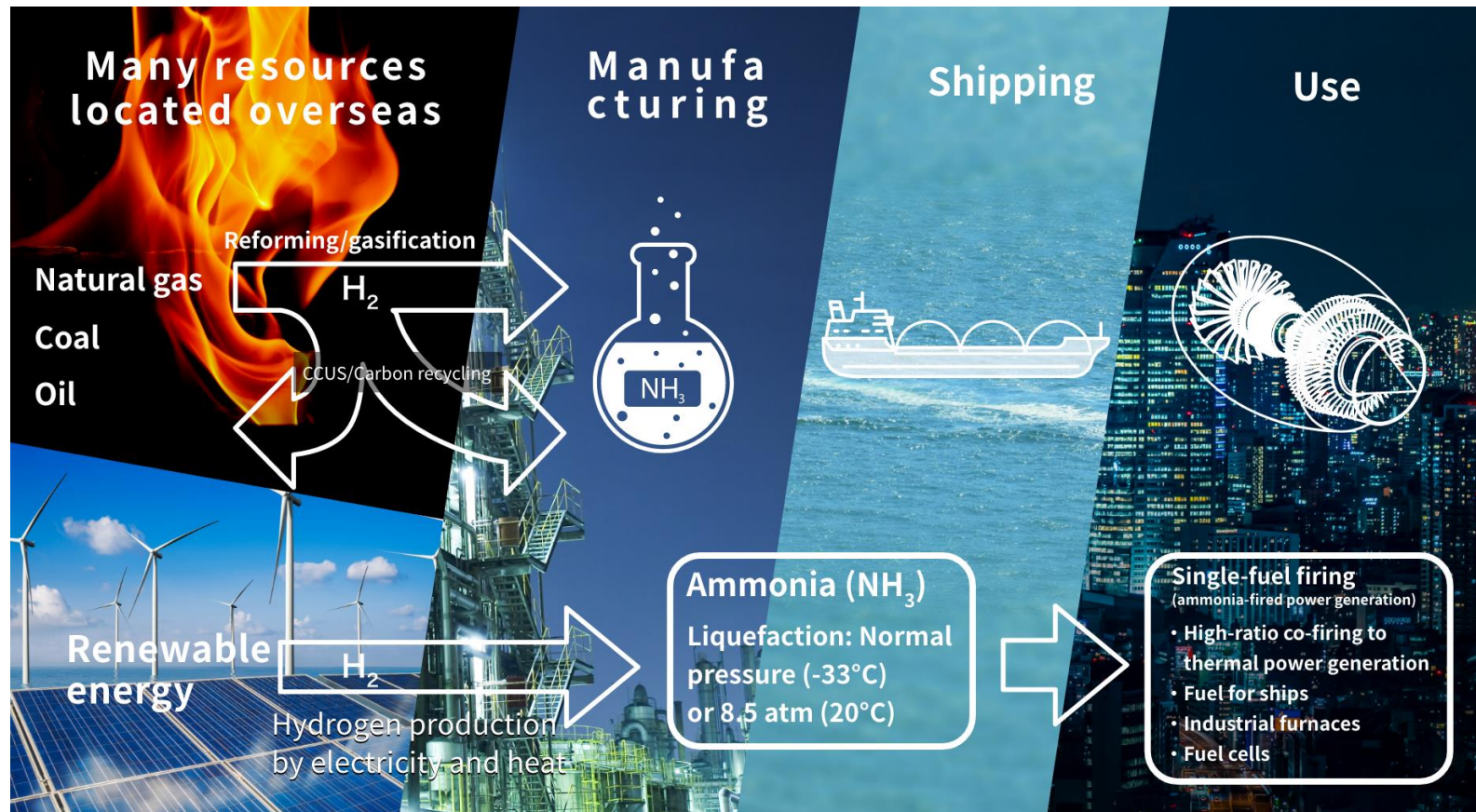
UNEP WG on Nitrogen (2020-) The focal point of 95 countries has been nominated.



UNEA-4: <https://www.unep.org/resources/resolutions-treaties-and-decisions/UN-Environment-Assembly-4>
UNEA-5.2: <https://www.unep.org/resources/resolutions-treaties-and-decisions/UN-Environment-Assembly-5-2>

Another topic on nitrogen: fuel ammonia

Fuel ammonia is attracting attention to achieve carbon neutrality.
The generation of nitrogen waste should also be controlled.



Japan's target of fuel ammonia use: 3 million tonnes in 2030, 30 million tonnes in 2050
(current domestic production: ~1 million tonnes)

<https://green-innovation.nedo.go.jp/en/project/building-fuel-ammonia-supply-chain/>

On September 27th, 2024, the Japanese government formulated an action plan for sustainable nitrogen management.

Action Plan

Action plan for sustainable nitrogen management: the Japanese government formulated on **September 27th, 2024**.

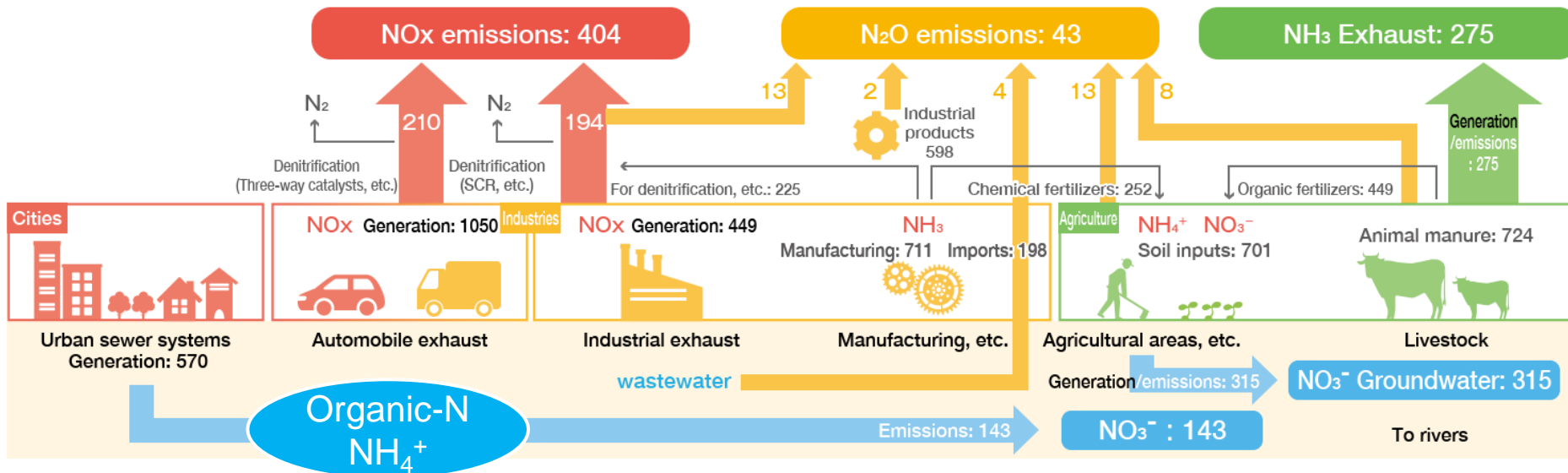
National project as actions

- Moonshot program, R&D for creating disruptive innovations (by NEDO)
 - Nitrogen compound recovery from exhaust gas and wastewater
 - Dilute NO_x removal in exhaust gas
 - Mitigation of N₂O From Agricultural Lands
- Project for Science – Policy – Stakeholder engagement
 - Nitrogen inventory assessment and evaluation of the potential for reducing waste nitrogen
 - Establishment of a system reducing environmental impact with fair nitrogen use

Sources of nitrogen waste in Japan

NO_x, N₂O, NH₃ into air and NO₃⁻ (originally organic-N) is main issues

Major sources for the generation and emission of reactive nitrogen in Japan (unit: thousand tons-N/year)



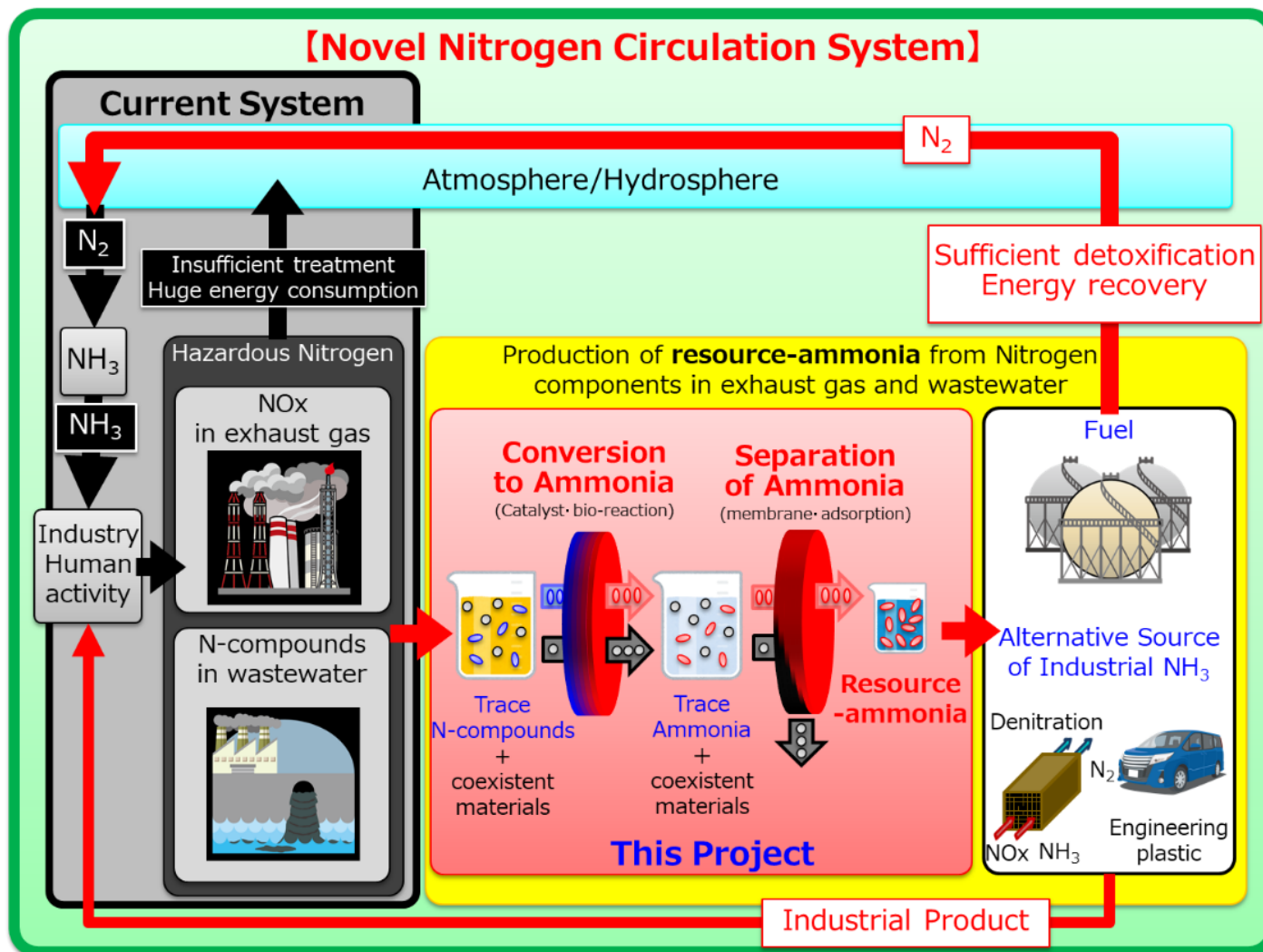
Gas phase: NO_x from industry and NH₃ from agriculture

Water phase: organic-N and NH₄⁺ discharged from cities and agriculture converted to NO₃⁻

<https://webmagazine.nedo.go.jp/pr-magazine/focusnedo84/sp1-4.html>

R&D of Nitrogen Circular Technology in Moonshot program

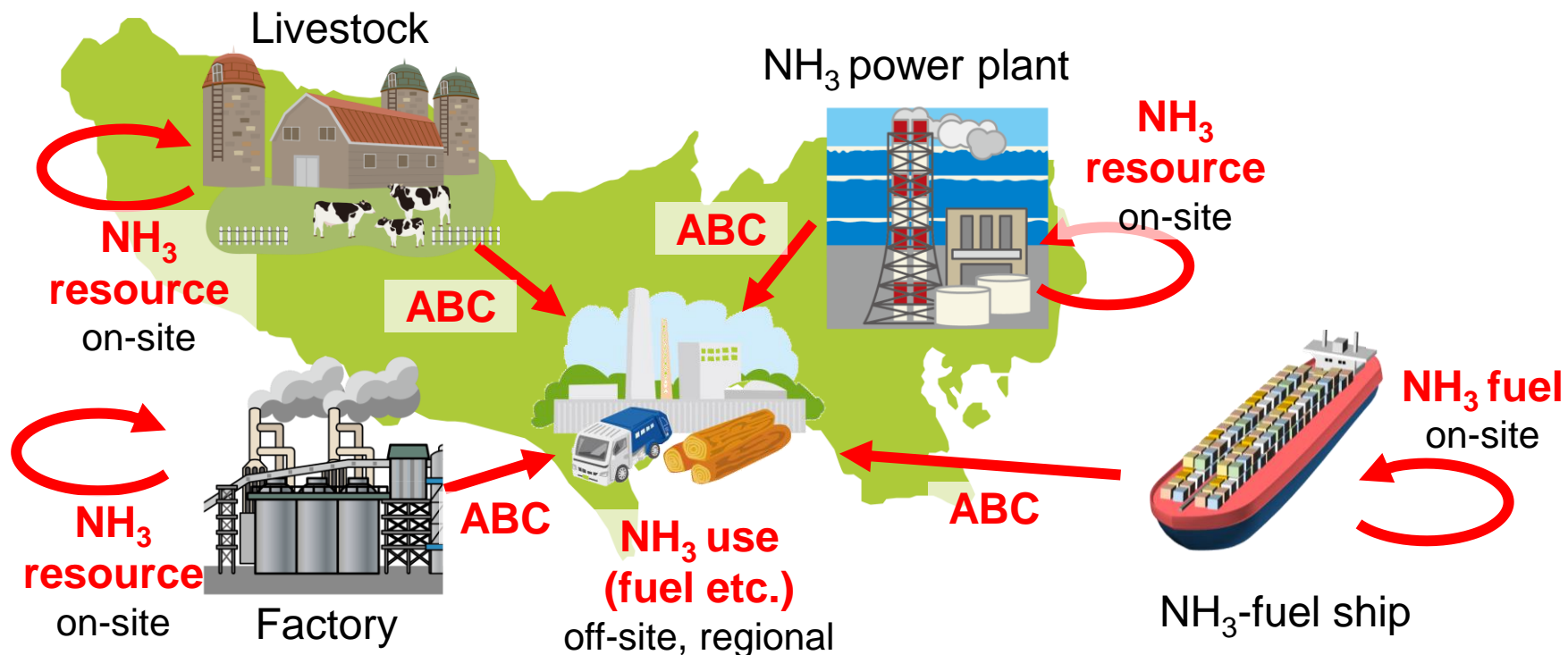
Production of resource ammonia from exhaust gas and wastewater



Our Vision for the future

NH_3 resource is recovered from the waste at power plants, ships, factories, livestock, etc., contributing to Carbon Neutral, and Circular Economy

ABC: Ammonium bicarbonate



Thank you for your attention!