Creating ICT development scenarios to analyze ICT's role in decarbonization and social issue solutions

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Ⅰ: Introduction

Decarbonization by 2050
Japan aims to achieve carbon-neutrality by 2050[1].

Existing social issues
Japan faces an aging population and depopulation in rural areas. Information and communications technology (ICT) can potentially solve these issues as described in Society 5.0, Japanese Science and Technology Basic Plan.

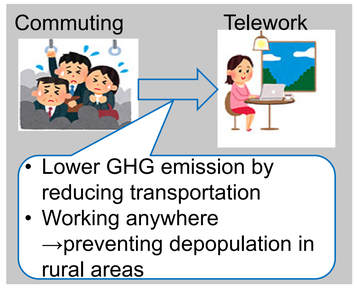

Fig.1 Example of ICT's impact

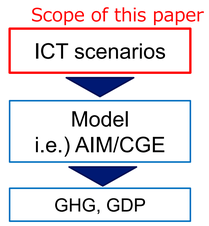

Fig.2 Overview of this project

ICT contributes to mitigate climate change through reduction in transportation and material use. Several studies have investigated ICT's environmental impact, but few studies have mentioned ICT's long-term impact.

Goal: Describe ICT society in 2050 to analyze impact of ICT development on economy and environment.
This paper describes scenarios based on megatrends and a case study.

Ⅱ: Methods

Describing ICT scenarios
Scenarios of ICT-based society in 2050 were created on the basis of survey reports about trends of ICT services in several industries focusing on the four points below.
Quantitative impacts of ICT services on industry and lifestyles were calculated on the basis of statistical data and our estimation.

(1) Improvement of productivity due to automation technology
・Automated robots in industry will reduce manual operation.

(2) Optimization of the entire society with AI/Bigdata
・Bigdata collected from several devices will enable large-scale optimization calculation.
→Effectively use capital in traffic control and equipment.

(3) Comfortable and green mobility due to development of mobility technology
・ Automated driving and car sharing will reduce in traffic jams and material use.

(4) Increase in convenience and lifestyle change through online services
・ Online services will reduce transportation and free up leisure time.

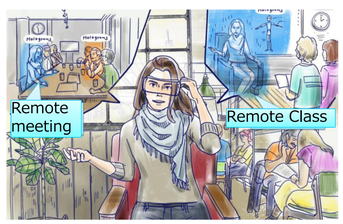

Fig.3 Image of lifestyle change (cited from Ref. 2)

Case study
To clarify challenges in analyzing ICT's environmental impact, impacts on CO_2 emissions by existing lifestyle changes related to point (4) were estimated with lifecycle assessment as a case study.

Ⅲ: Results & Discussion

Quantitative impacts of ICT

Table 1 Example of quantitative impacts of ICT in various fields

Field	ICT	Main impacts of each ICT	
Agriculture	Plant factory	Constant production	Increase production input in vegetable sector by 66%
Manufacturing	AI/IoT and Robotics for industry	Improved productivity	Decrease labor input in manufacturing sector by 50%
Infrastructure	Monitoring of infrastructure	Longer service life of equipment	Decrease intermediate input and construction costs by 57%
		Reduction in maintenance	Decrease labor input in infrastructure sector by 25%
Mobility	Automated driving	Comfortable transportation	Increase car speed by 15% due to fewer traffic jams
		Effective use of time	Double household demand for service sectors
Daily life	Telework	Reduced transportation	Decrease household demand for mobility by 19% Increase leisure time by about 2 hours/day/person
		Reduced office space	Reduce office space by 70%
	Robotics for households	Reduced house work	Increase leisure time by about 1 hour/day/person

Operation cost for water facilities[3]

$$\frac{\text{4.67 billion − yen for longer life}}{\text{8.12 billion − yen for conventional}}$$

Improving productivity and reducing transportation would especially contribute to reduce GHG emissions.

Case study
Several online behaviors were compared with conventional real-world behaviors in terms of estimated changes in CO_2 emissions.
Changes in individual time use were focused on, i.e., how long is spent doing each behavior in a day.
Reduction in transportation will be the main factor in decreasing total CO_2 emissions. Increases in telework and online shopping will cause increases in electric consumption at home or home delivery.
→Lifestyle changes that contribute to efficient electricity use should be considered.

Table 2 Targeted behaviors and ICT services

Behaviors going online	ICT services
Work	Telework
School, Study	Online classes
House work	Cooking robot
Shopping	Online shopping
Watching media such as TV, books, radio	E-books
Social relations	Video call
Medical care	Telemedicine

Cases description
Case 1: Almost all behaviors above going online
Case 2: About the half ICT penetration of Case 1

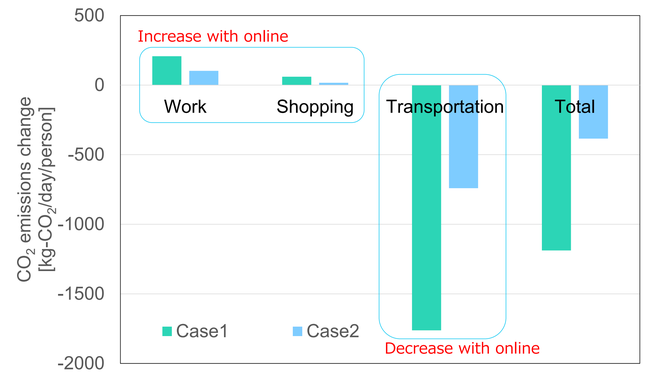

Fig.4 CO_2 emission changes compared with conventional behavior

Ⅳ: Summary

- Created ICT scenarios on the basis of megatrends to analyze impact of future ICT development on environment and economy
- ICT penetration in industry and daily life will contribute to reduce GHG emissions through improved productivity and reduced transportation.
- From case study results, reduction in transportation will decrease total CO_2 emissions, while lifestyle changes that contribute to efficient electricity use should be considered.

References
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3 https://www.city.hiroshima.lg.jp/uploaded/attachment/24544.pdf