Reduction of energy service demands by introducing ICT services

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- Purpose and research method
- Evaluated target ICT services
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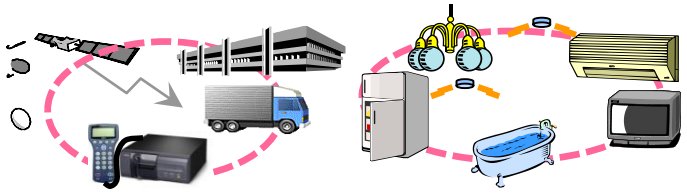
- Summary

Reduction of energy demand by well-used ICT

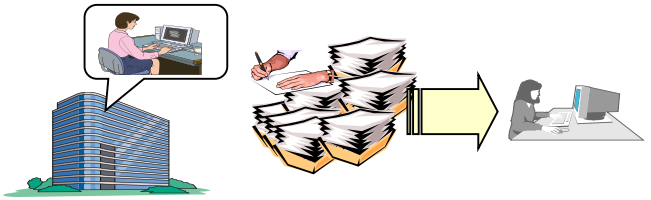
Improved energy efficiency

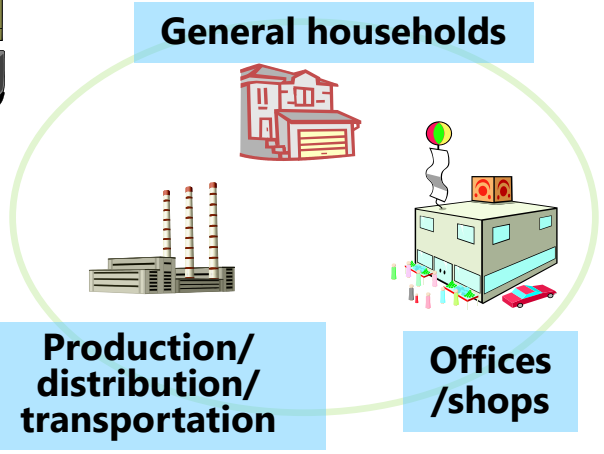
- ITS (Intensive control of ETC, VICS, and traffic lights)
- HEMS (Household energy management system)



Improved efficiency of production and consumption

- Supply chain management
- e-publication and distribution



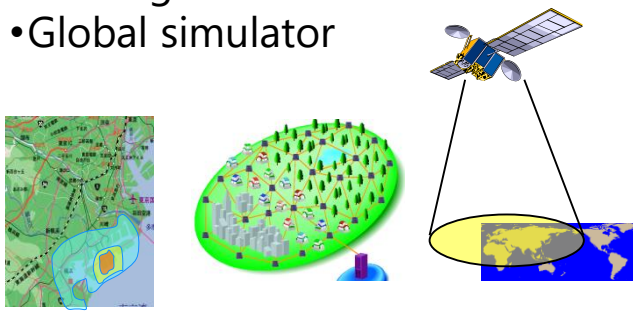


Reduced movement of people and products

- Online shopping, online trading
- Telework, teleconferencing
- Music, video, and software distribution

Environmental measurements and predictions

- Sensing network
- Global simulator

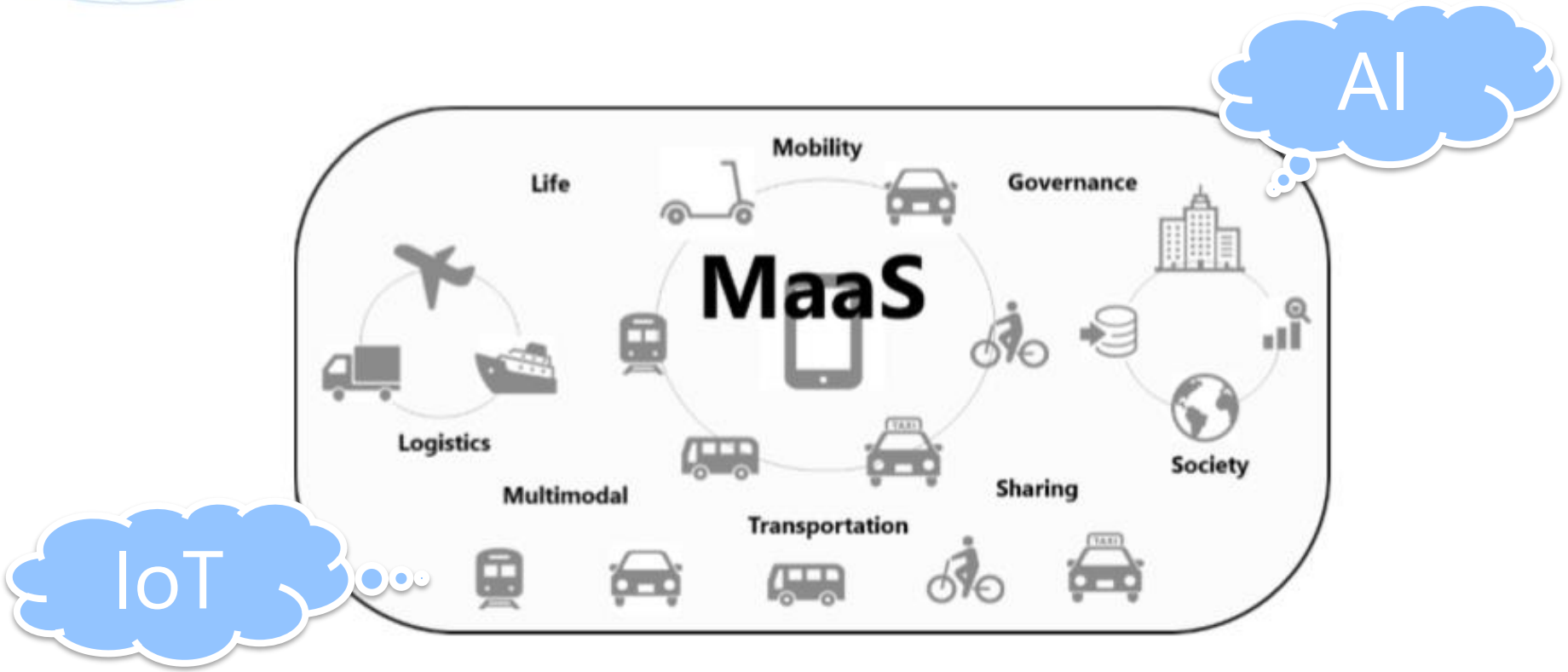


Use of ICT

Contribute to reduce energy demand and tackle climate change

Expectation on reduction of energy demand by new digital technologies

- Various new digital technologies are appearing in these several years.
- Ex., by promoting “Mobility as a service”(MaaS), Kilometers travelled and GHG emissions are expected to be reduced.

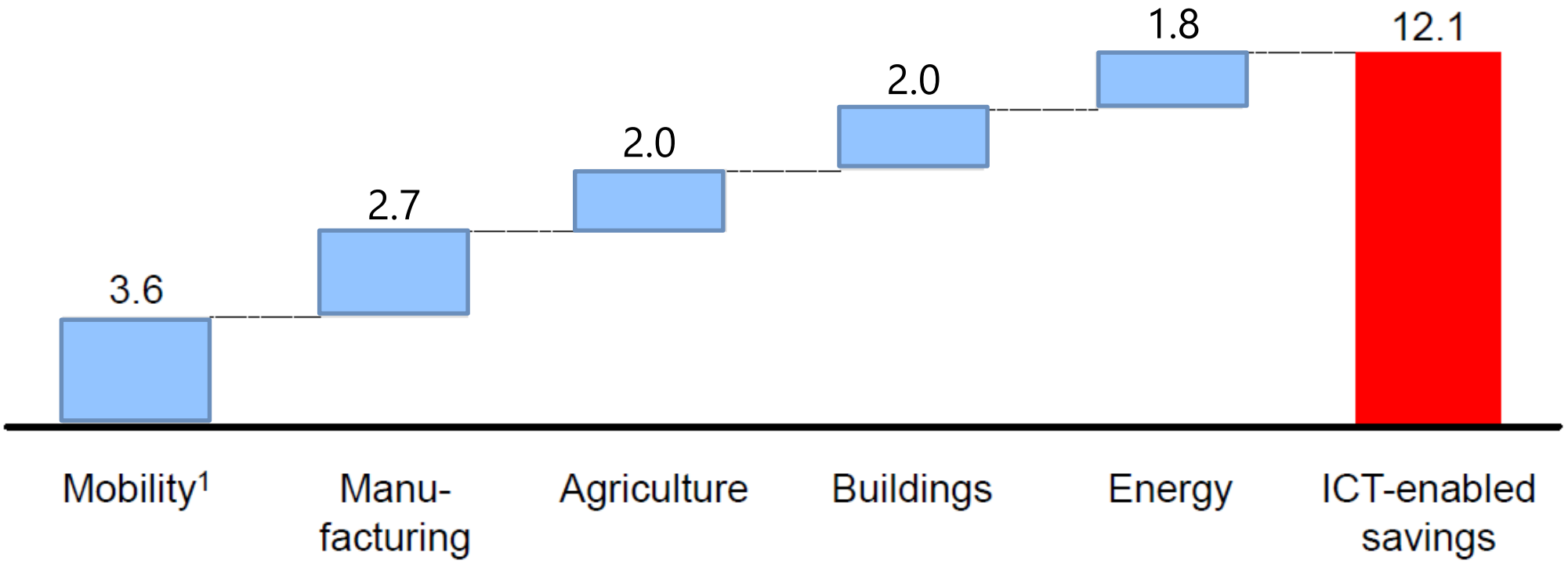


Previous studies: *GeSI SMARTer 2030 (1/2)*

- GeSI (Global e Sustainable Initiative) published "#SMARTer2030: ICT Solutions for 21st Century Challenges" in 2015.
- ICTs can reduce GHG emissions by 12.1 Gt-CO_{2e} by 2030.

CO_{2e} abatement potential by sector (2030)

[Unit: Gt-CO_{2e}]



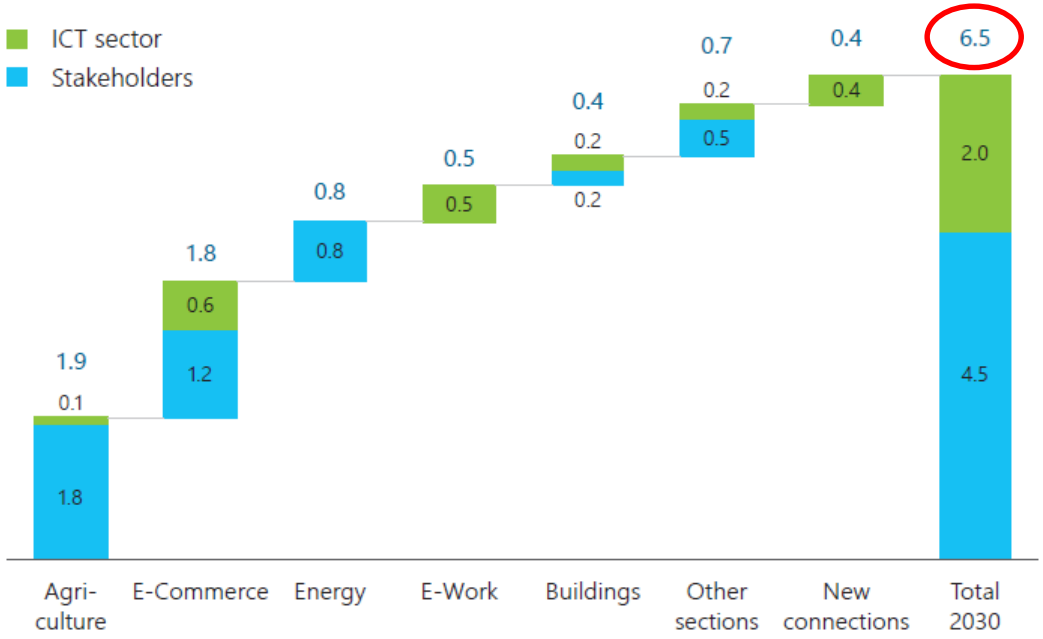
Source: Global e-sustainability Initiative "SMARTer2030"

Previous studies: *GeSI SMARTer 2030 (2/2)*

- GeSI estimated that ICT-enabled services may **add US$ 6.5 trillion of additional revenue** and **cut economic costs across sectors by US$ 4.9 trillion** by 2030.
- In total, ICT may generate over **US$11 trillion in economic benefits** per year **by 2030**, the **equivalent of China's annual gross domestic product (GDP) in 2015**.

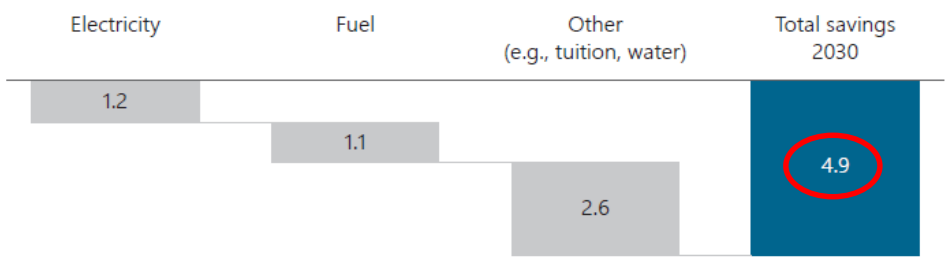
ICT-enabled revenue opportunities (2030)

[Unit: trillion US$]



ICT-enabled cost saving opportunities (2030)

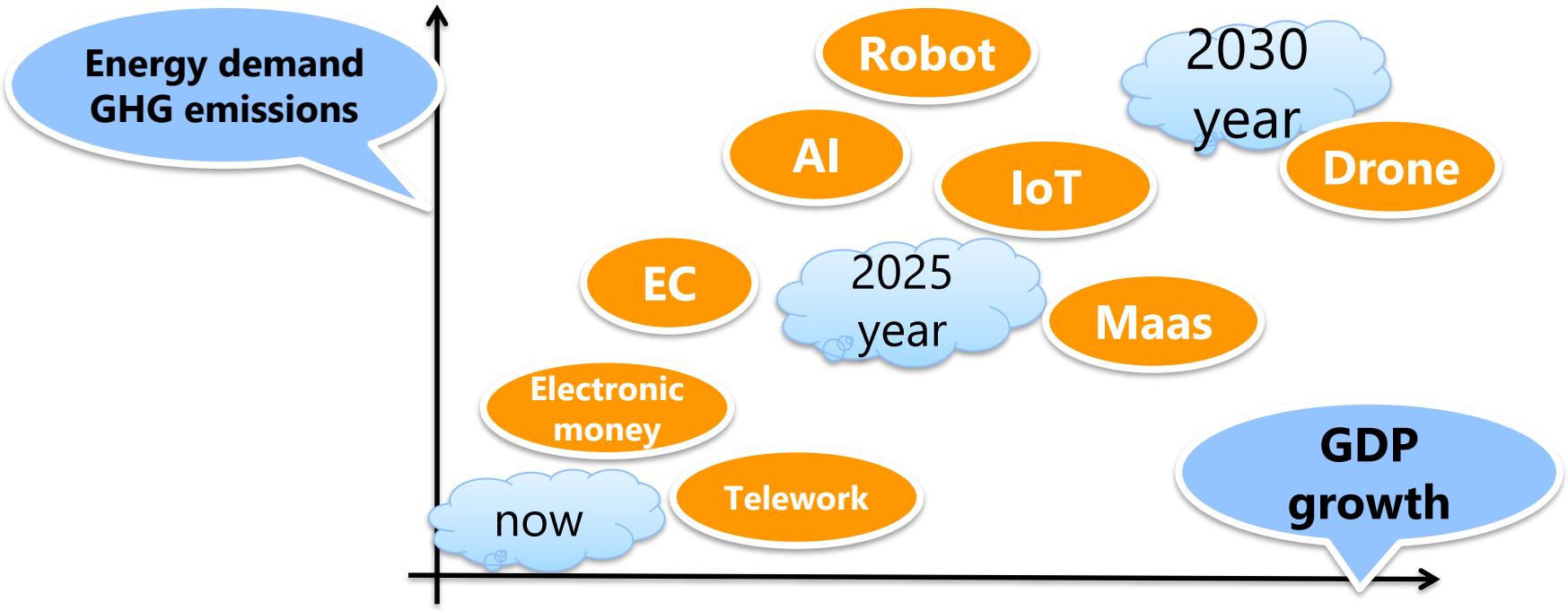
[Unit: trillion US$]



Source: Global e-sustainability Initiative "SMARTer2030" (Ref. [3])

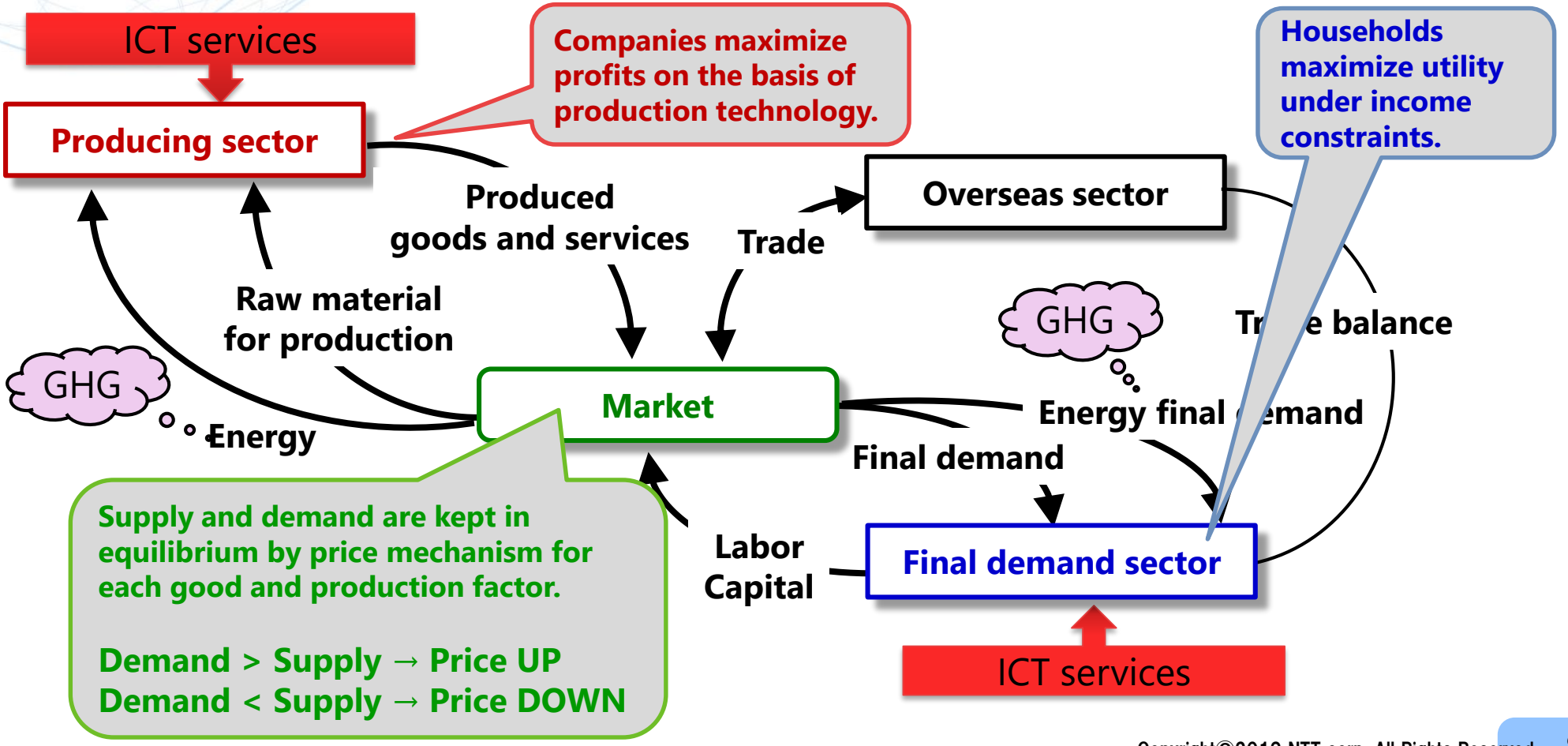
Purpose of our research

- A dynamic CGE model is developed to forecast the environmental impacts on energy service demand and GHG emissions reduction and economic impacts on GDP growth by ICT use for future periods in Japan.



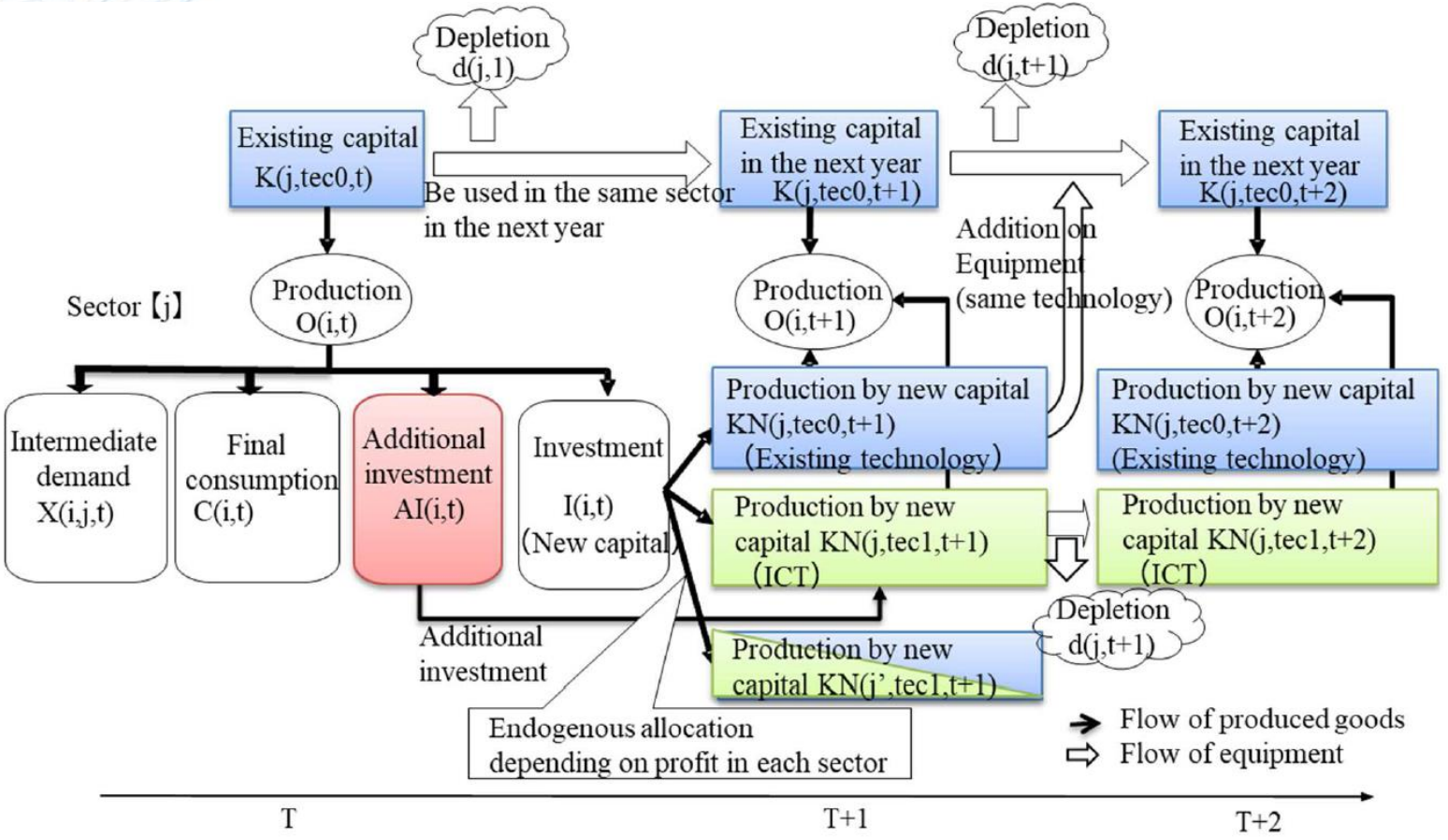
AIM/CGE [Japan] model

- The model is based on the **Asia-Pacific Integrated Model/Computable General Equilibrium (AIM/CGE) [Japan]**. The goods in this model are disaggregated into 40 commodities, and elasticity production is disaggregated into 9 technologies. Under the economic balance, levels of activity in each sector and prices for all goods, services, and production factors are determined by a price mechanism.



Dynamic progress

- The model calibrated coefficients with the IO Table in the base year, 2005. Equilibrium calculation starts from 2005, and then capital stock in the next year 2006 is decided by capital stock, depreciation, and investment in 2005.



Targeted ICT Services (1/3)

Categories	ICT services	Direct Effects
(A) Finance	A_1 Online banking	Reduction on movement; Reduction on bank branches
	A_2 Electronic bond	Reduction of physically transporting bonds; reduction of operation
	A_3 Cashless settlement	Cost reduction in management of store business; cost reduction in operation and management of ATMs
	A_4 Digital technologies in banking	Reduction in office work and customer service in banking
(B) Public service	B_1 Electronic bidding	Reduction of transportation use
(C) Manufacturing	C_1 Supply chain management	Suppression of overproduction; optimization of intermediate distribution and retail sales; reduction of factory and storage space
	C_2 Matching service for re-use of used-car parts	Reduction of resource use; reduction of office use; reduction of waste
	C_3 Matching service for re-use of industrial machinery	
	C_4 Matching service for re-use of construction machinery	
	C_5 Matching service for re-use of computers	
	C_6 IoT technology for manufacture	Productivity improvement by visual control in production line; reduction of lead time
	C_7 AI technology for manufacture	Productivity improvement by using machine to set up or inspect equipment instead of skilled technician; improvement of operation rate; prevention of human error
	C_8 Industrial robot	Productivity improvement
	C_9 Electronic procurement	Cost reduction on operation

Black letters: Well-used ICT red letters: New ICT

Targeted ICT Services (2/3)

Categories	ICT services	Direct Effects
(D) Distribution and services	D_1 B to C e-commerce (EC)	Optimization of intermediate distribution and retail sales; unnecessity of storage space and retail shops; reduction in producing CDs/DVDs/ newspapers and books; reduction in sales distribution and returned goods delivery
	D_2 Online issuing of air tickets	Reduction of transportation use
	D_3 Purchase of tickets at convenience stores	
	D_4 B to B e-commerce (EC)	Reduction of transportation use; optimization of accounting works, intermediate distribution, wholesale, and retail sales
	D_5 Online music service	Optimization of intermediate distribution and retail sales; unnecessity of storage space and retail shops; reduction in producing CDs/DVDs/ newspapers and books; reduction in sales distribution and returned goods delivery
	D_6 Online video service	
	D_7 Online PC software	
	D_8 Digital books	
	D_9 Remote management	Reduction of transportation use
	D_10 AI technology for demand forecast of food products in retail business	Reduction of food loss by advanced demand forecast
	D_11 AI technology for unmanned store	Labor saving by unmanned operation in store
	D_12 AI technology for distribution	Productivity improvement in physical distribution
	D_13 AI technology for self-driving	Cost reduction due to the decrease in motor vehicle accidents

Black letters: Well-used ICT red letters: New ICT

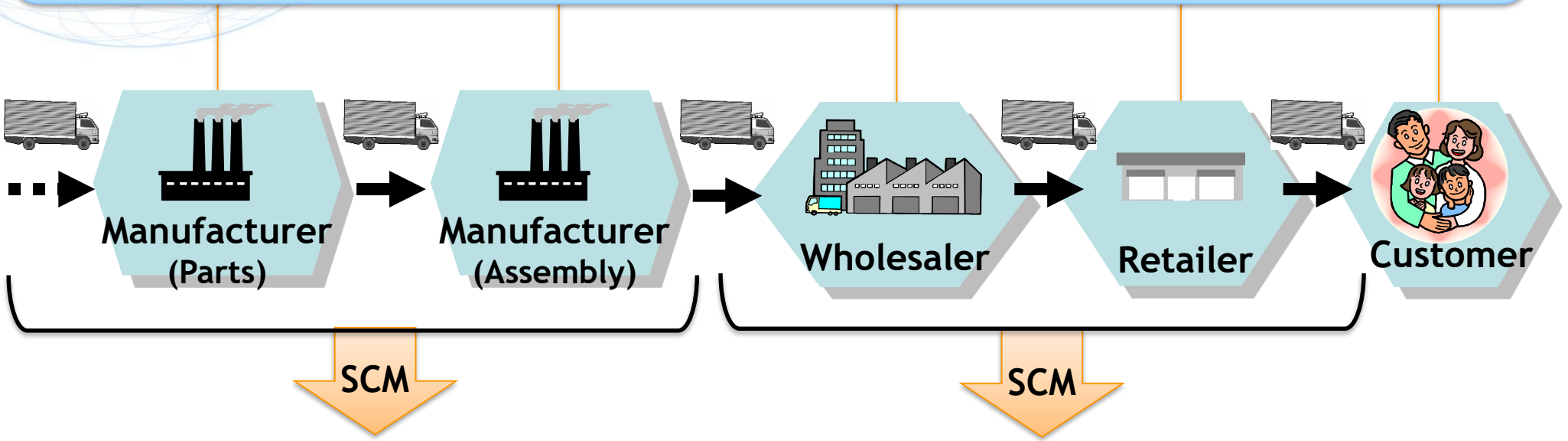
Targeted ICT Services (3/3)

Categories	ICT services	Direct Effects
(E) Medical and agriculture	E_1 Electronic medical records	Reduction of paper
	E_2 Electronic prescription	Reduction of paper
	E_3 Electronic medicine notebook	
	E_4 Smart agriculture	Improvement of efficiency on farm work by visual control based on sensor data; labor saving by introduction of robots
(F) Infrastructure	F_1 AI technology for electricity demand forecast	Improvement of generating efficiency by advanced electric power demand forecast
	F_2 Smart meter for water supply	Labor saving on metering work
	F_3 Smart house	Reduction of electricity consumption
(M) Both category (C) and (D)	M_1 Teleworking	Reduction of transportation use ; reduction of office use
	M_2 TV conferencing	Reduction of transportation use

Black letters: Well-used ICT red letters: New ICT

Example: factors influencing SCM

Supply-chain management (SCM) systems synchronize supply and demand.



- Suppress overproduction
- Reduce storage space
- Reduce factories

- Optimize intermediate distribution
- Optimize retail sales
- Reduce storage space

Future scenarios

- Pre-conditions:

	2005	2030
Population	128 million	117 million
Households	49.0 million	54.7million
GDP growth rate	1.2%	1.7%/year
Power supply configuration (renewable percentage)	11%	22~24%

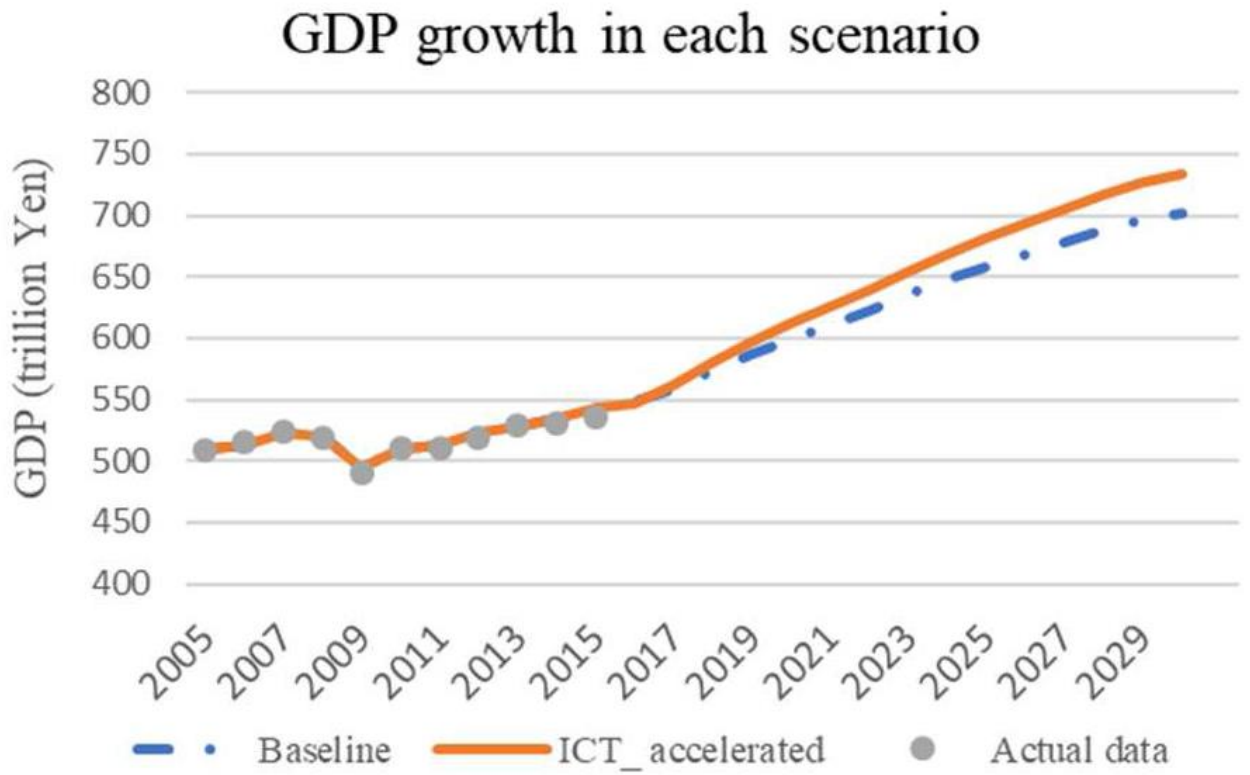
- Baseline scenario and ICT-accelerated scenario (2016-2030)
  - Baseline scenario:
    - all technology levels would be fixed at the level in 2015
  - ICT-accelerated scenario:
    - Well-used ICT: penetration would grow up by linear approximation based on the past data
    - New ICT: penetration are boldly assumed to spread to high levels

Example

Industry category	ICT services	2030 scenarios		
		Index of penetration	Baseline	ICT accelerated
(A) Finance	A_1 Online banking	Internet banking accounts	82.09 million	146.46 million
	A_2 Electronic bonds	Electronic bond records	5.82 million	23.71 million
	A_3 Cashless settlement	Utilization rate	0%	50%
	A_4 Digital technology in banking	Utilization rate	0%	50%

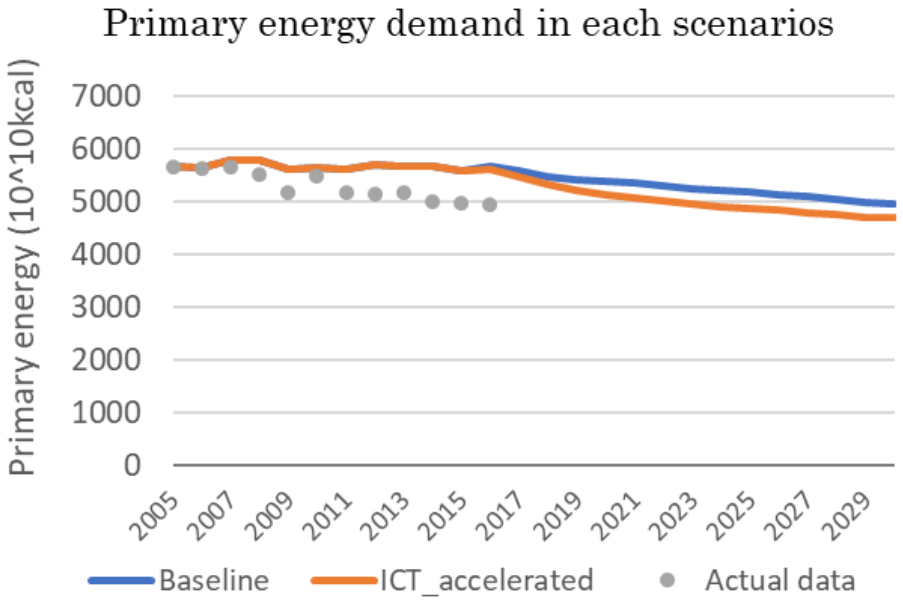
Results and discussions(1/6)

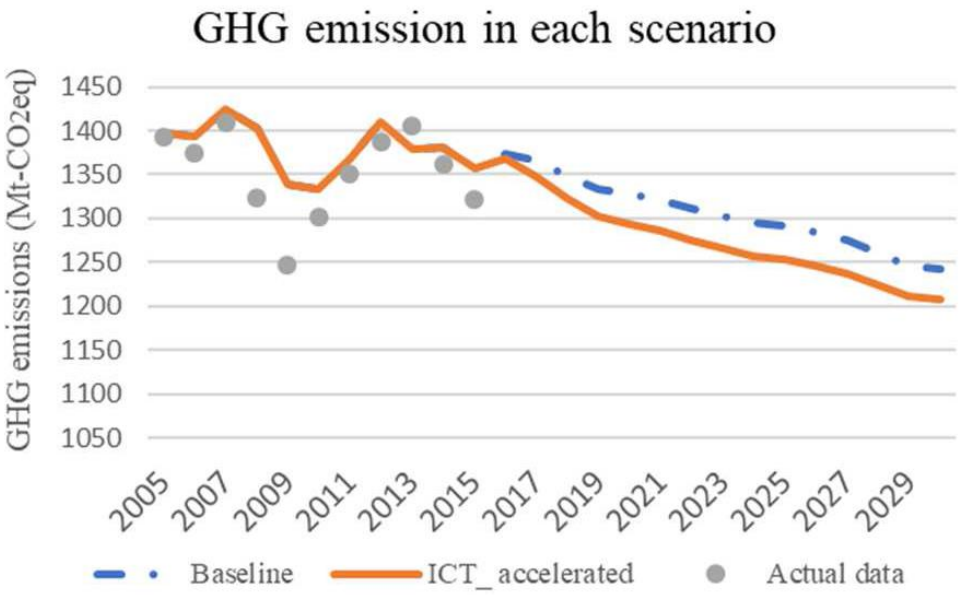
- The results show that Japan's GDP in 2030 will be ¥701 trillion in the baseline scenario but ¥734, ¥33 trillion larger, in the ICT-accelerated scenario since more energy efficient activities will be introduced in producing sectors and households by ICT use.



Results and discussions(2/6)

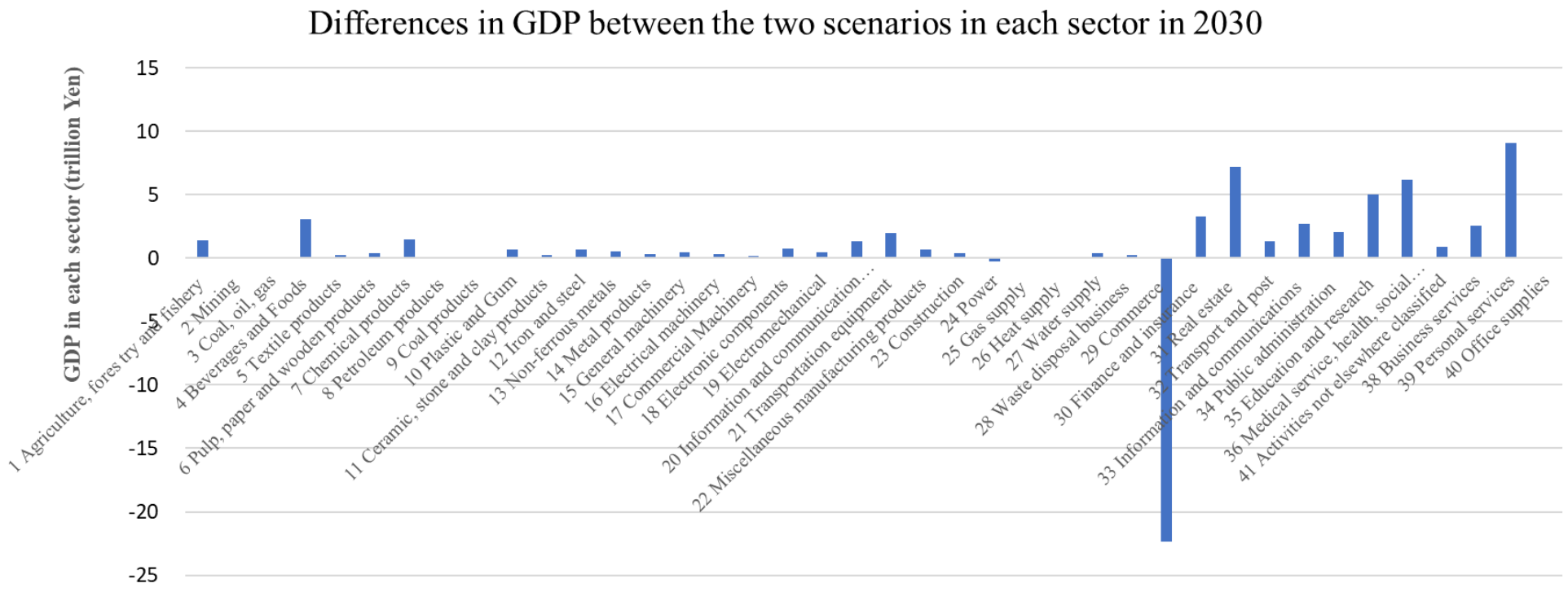
- **Primary energy demand**
  - baseline scenario: **5664 10^12kcal**(2005) =>**4966 10^12kcal** (2030)
  - ICT accelerated scenario: **5664 10^12kcal** (2005) => **4699 10^12kcal** (2030)
- **GHG emissions**
  - baseline scenario: **1397 Mt-CO_2eq** (2005) =>**1242 Mt-CO_2eq** (2030)
  - ICT accelerated scenario: **1397 Mt-CO_2eq** (2005) => **1208 Mt-CO_2eq** (2030)





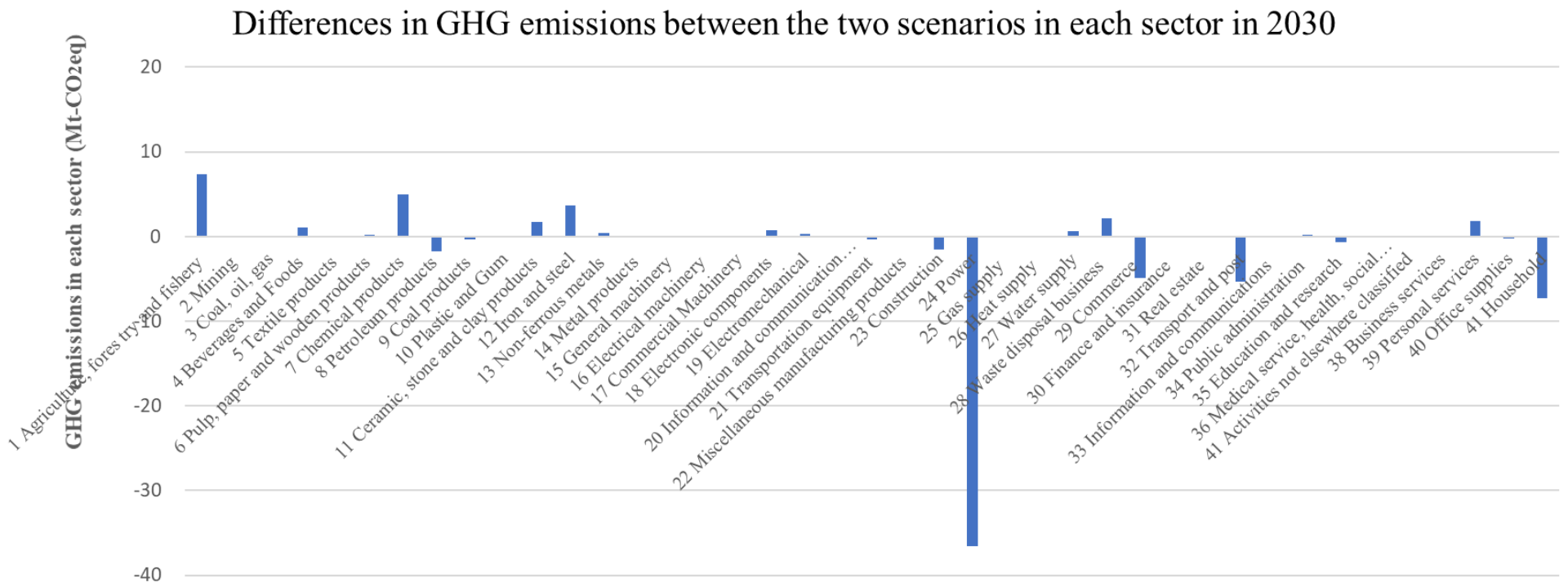
Results and discussions(3/6)

- The results indicate that by using ICT, final consumption will increase as income increases. In particular, utility is mostly enhanced in service sectors, so GDP in these sectors increases more than in the baseline scenario.



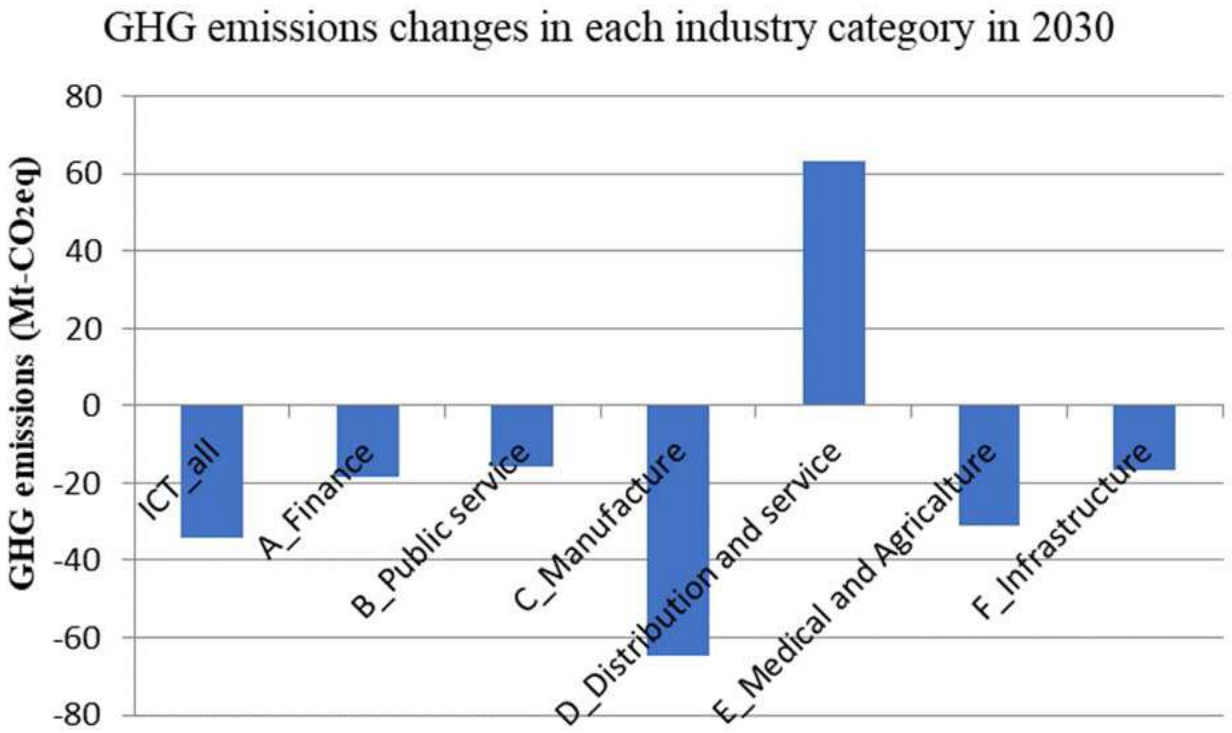
Results and discussions(4/6)

- GHG emissions in many sectors are reduced. Especially, GHG emissions in the transport and post sector decrease largely in accordance with the effect on transport use reduction by using ICT.



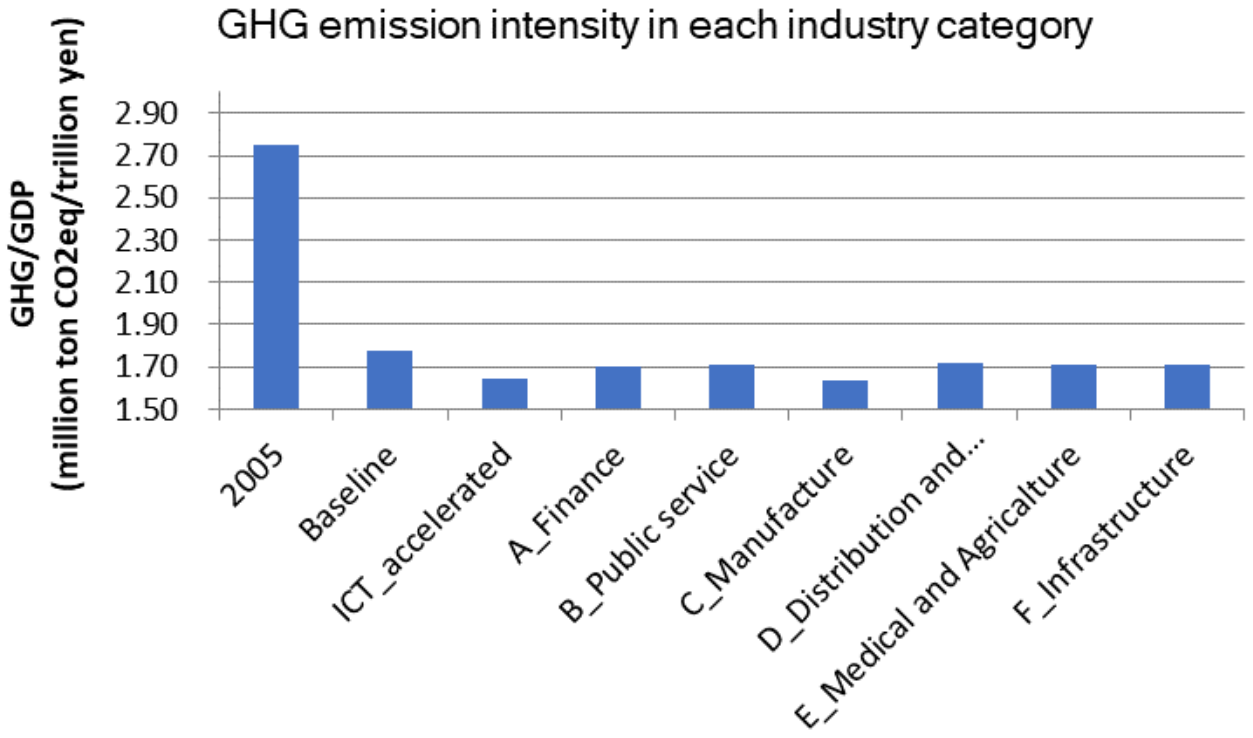
Results and discussions(5/6)

- Use of ICT services in manufacturing can most reduce GHG emissions, depending on the efficiency improvements in production processes.
- Use of ICT services in distribution and services, can drastically reduce labor inputs, but the surplus labor resource also can simultaneously push up additional productive activities and cause strong rebound effects.



Results and discussions(6/6)

- GHG emissions intensity (GHG emissions per Yen of GDP) is 7% lower in the ICT accelerated scenario than in the baseline scenario, and 40% lower than that in 2005.



Summary

- A dynamic CGE model was developed to forecast the environmental and economic impacts, including spillover effects, caused by future ICT use.

- Two scenarios (baseline scenario and ICT accelerated scenario) for future ICT use were presented.

- The results show that by 2030 in Japan, GHG emissions are 34 Mt-CO2eq lower and GDP growth ¥33 trillion higher in the ICT accelerated scenario than in the baseline scenario.

- The results indicate future ICT use can contribute to both GHG emissions reduction and economic growth in the future, although the future issue is remained to continue the discussion on how to avoiding rebound effects.

Thank you!