Impact Assessment of Advancing ICT Orientation on Energy Use
– Consideration of A Macro Assessment Method –
Executive Summary

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Abstract

Advancing ICT[1] orientation causes drastic changes in social structure and our daily behaviors, thus consequently influencing an energy consumption mix too. Under this research, we developed a macro impact assessment model, with which we simulated what impacts an intensified ICT orientation could produce on energy consumption 10~20 years later from now. In specific terms, we prepared two cases. One is the base case, which provides the basis for our impact assessment. The other is the ICT case, which assumes a more ICT-oriented socioeconomic structure than in the base case but the economic growth unchanged from the base case[2]. From the differences between the two cases we calculated impacts of intensified ICT orientation.

We found total primary energy supply in FY2010, 575.7 million tons oil equivalent (MTOE) in the base case, would shrink by 1.4% to 567.8 MTOE in the ICT case. Also, total final energy consumption in FY2010 would be down 1.9% from 382.9 MTOE in the base case to 375.5 MTOE in the ICT case.

We also got a conclusion that Japan's energy consumption won't increase overall if an ICT-induced extra economic growth were capped at around 0.3%/year.

1. Introduction

It appears the rapid advance in ICT revolution these years has come to a pose due to the collapse of ICT bubbles. However, a sweeping penetration and use of ICT-related equipment among offices and households, as well as resultant changes in business and industrial structure sector-wide, all just depend on the trends to unroll from now. Given a time span of a few decades ahead, steady progress is likely in construction of infrastructure, typically optical communication infrastructure and expanding wireless communication tools. It will then induce considerable changes in social structure and our daily behaviors, through which an energy consumption mix will be affected as well. That's why qualitative and quantitative impact assessments of ICT orientation on energy use are indispensable for considering how we could better

This paper provides a summary of a report on "Impact Assessment of Advancing ICT Orientation on Forms of Energy Use – Consideration of A Macro Assessment Method," a research project awarded in FY 2002 to IEEJ by the Committee for Energy Policy Promotion.

[1] ICT: Information and Communication Technology
[2] Many point out an intensified ICT orientation accelerates an economic growth, but no consensus has been reached yet on the magnitude of so-induced extra growth. In this research, we assumed the ICT case to have an identical economic growth to the base case so as to highlight the impact of an intensified ICT orientation on energy supply & demand.

respond to various energy-related problems in the future.

2. Overall model structure

Under this research we developed a "Long-term Macro Economy – Energy Supply & Demand Model" designed to assess the impact of intensified ICT orientation on energy supply and demand in macro terms. Roughly divided, the model consists of three sub-models, "Macro Economic Model," "Input-Output Model" and "Energy Supply & Demand Model."

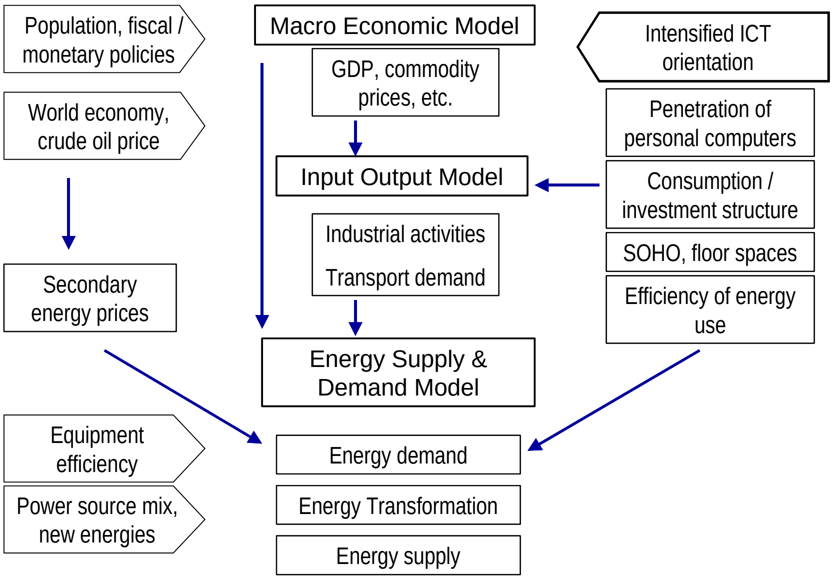

Fig. 1 Overall Construction of the Newly Developed Model

Fig. 1 shows overall construction of the "Long-term Macro Economy – Energy Supply & Demand Model." First, the "Macro Economic Model" is designed to obtain macro economic indicators, such as GDP components, typically private final consumption and private equipment investment, and consumer price index. In specific terms, given overseas factors (e.g. world economy, crude oil price), fiscal/monetary policies (e.g. public investment, interest rate) and demographic factors (e.g. population growth, aging society), among others, as exogenous variables, this model simulates such macro variables as an economic growth rate, commodity price and IS (investment-savings) balance. Then, GDP components (e.g. private final consumption, private equipment investment) and consumption structure (e.g. household-budget expenditures) estimated by the "Macro Economic Model," the "Input Output Model" simulates industry-specific production values, major industries' output (e.g. crude steel production) as well as industrial activity-linked indicators like transport demand. This model also estimates secondary energy prices (i.e. petroleum products, electricity, town gas) from such exogenous variables as crude oil, coal and LNG import prices, exchange rate and general commodity prices gained by the "Macro Economic Model." The macro economic indicators, industrial-activity indicators and secondary energy prices estimated in this way are given to the "Energy Supply & Demand Model" as its preconditions.

The "Energy Supply & Demand Model" is the core of the newly developed model and designed to estimate an energy supply and demand balance from a variety of macro economic and social indicators as well as weather conditions. They include the aforesaid various indicators, GDP, industry-specific production activities, transport demand, energy prices, population, number of household, commercial floor areas, technology-based energy conservation, nuclear & hydro installed capacities (supply potentials) and new energy introduction amounts. As the main flow, the model is run first to estimate final energy demand by use in each sector (by industry in case of the industrial sector, by end-use in the residential & commercial sectors and by mode in the transport sector). Next, energy sources best matching so-estimated demand by use in each sector are determined from inter-energy competitions, from which estimated are final energy demand by source, including new energies. From the outcome, plus such energy transformation as power generation and petroleum refining taken into account, estimated is primary energy supply. Thus, this model is able to obtain an entire energy flow ranging from final demand to primary energy supply in the form of an energy balance table. What is more, the newly developed model is capable of calculating CO_2 emissions from primary energy consumption by source.

3. Case setting and assumptions

In this research, we prepared following cases in an attempt to assess impacts of an intensified ICT orientation on energy supply & demand.

[Base Case]

The base case, which provides the basis for our impact assessment, describes a future course of energy supply & demand under rather realistic assumptions given the status quo of the economy, social situations, policies and so on. ICT orientation is assumed to keep advancing on the line of present trends. Also employed in the base case is the latest long-term energy supply & demand outlook (2002) released by IEEJ.

[ICT Case]

The future course of energy supply & demand envisaged in the ICT case depends on a scenario that the socioeconomic structure will become more ICT-oriented, though the economic growth remains unchanged from the base case. In specific terms, an intensified ICT orientation is found in various forms. They include a greater ownership of ICT-related equipment among households and offices, an increasing number of navigation-mounted cars, the rise of e-business and resultant changes in lifestyle, more ICT-oriented public investments, value-added industrial structure (shifts from material to processing/assembly industries) and efficiency control of energy use society-wide.

Meanwhile, despite a popular indication that an intensified ICT orientation can spur an economic growth, we assume the ICT case to have an identical economic growth to the base case, so that impacts of an intensified ICT orientation on energy supply & demand can be highlighted.

Table 1 Scenario Images

	Base case	ICT case
Japanese economy	Whole period (2000~2020) 1.3% 2000~2010: 1.5%/year 2010~2020: 1.1%/year	The same as in the base case.
Industrial structure	Service / ICT orientation of the economy under way with shifts from basic to processing / assembly industries. Crude steel output, 2020: 90 mil. tons Machinery output, 2020: 161 (1995 = 100) ICT-related manufacturing, 2020: ¥84 trillion (in 1995 price)	Accelerated industrial structural changes centering on ICT-related manufacturing & services. Crude steel output, 2020: 73 mil. tons Machinery output, 2020: 172 (1995 = 100) ICT-related manufacturing, 2020: ¥135 trillion (in 1995 price)

	Base case	ICT case
	ICT-related services, 2020: ¥85 trillion (in 1995 price)	ICT-related services, 2020: ¥149 trillion (in 1995 price)
ICT penetration	In progress [Ownership in 2020] Home servers: 0.7 unit/household BEMS: 20% of commercial floor areas Navigation-mounted VICS: 70% of road vehicles	Accelerated [Ownership in 2020] Home servers: 1.0 unit/household BEMS: 60% of commercial floor areas Navigation-mounted VICS: 100% of road vehicles
Changing lifestyle	Limited Telecommuting, TV conference, net marketing	Moderately in progress Telecommuting, TV conference, net marketing
Energy conservation	Energy conservation under way at current pace Industrial: Keidanren-led voluntary action program Residential & commercial: Top-runner standards Transport: Top-runner standards	Accelerated efficiency control by ICT Residential & commercial: Growing popularity of HEMS, BEMS. Transport: Expanding use of ITS, VICS, etc.

3.1 Input Output Model

The Input Output Model is given final demand estimated (e.g. private final consumption expenditure, private equipment investment, etc.) as an exogenous variable from outside. In this research, because given final demand comes from the Macro Economic Model, only the three of Leontief inverse matrix coefficient, final demand converter and import coefficient need to be determined as the preconditions of estimating domestic production values. Also, to obtain output of major industrial materials and transport amounts involves a basic unit that allows conversion from money amount to material amount, etc.

After calculated with the RAS method in use, the Leontief inverse matrix coefficient was adjusted to gain definite values. The private consumption expenditure converter was calculated first by grouping household-budget expenditures into 13 items, then weighing a specific converter to each item by each-item expenditure to produce weighted average. Meanwhile, the makeup of household-budget expenditures and converters were estimated in reference to "Impact Assessment of Advancing ICT Orientation on Forms of Energy Use" (2002)[3] prepared under the auspices of the Committee for Energy Policy Promotion (hereinafter referred to as "2002 Study"). The remaining final demand converters were calculated on the assumption that the past trends would moderately continue.

[3] summaries are available on IEEJ website: http://eneken.ieej.or.jp/data/pdf/174.pdf (English), http://eneken.ieej.or.jp/data/pdf/476.pdf (Japanese)

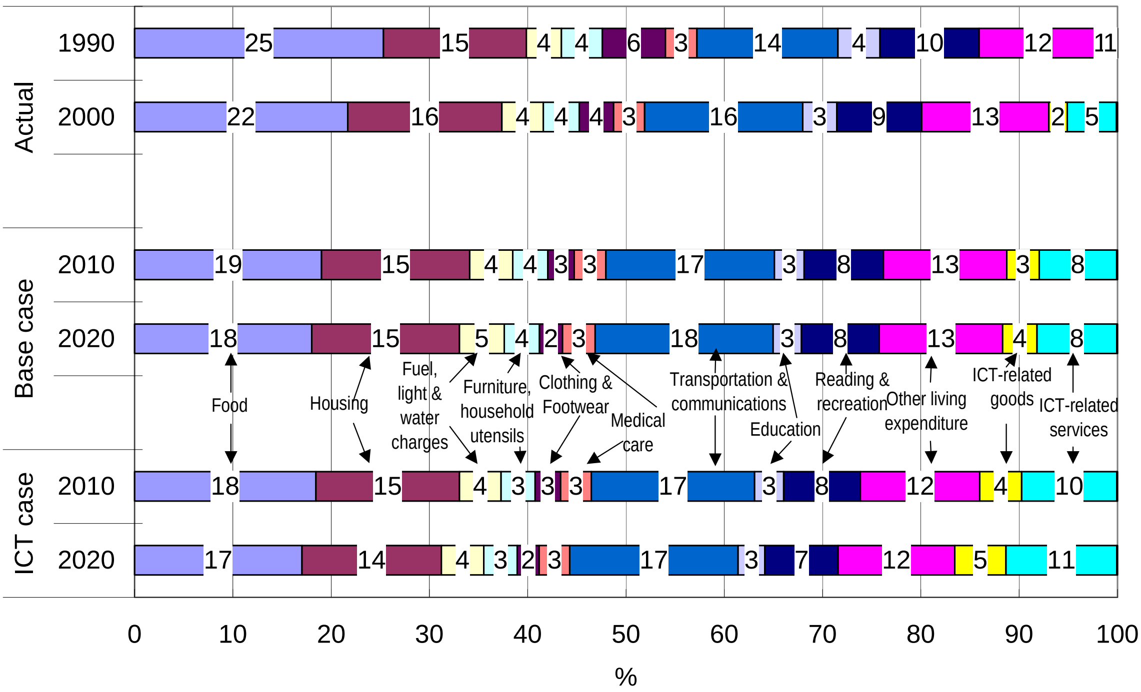

Fig. 2 Assumed Shares of Household-Budget Expenditures

3.2 Energy Supply & Demand Model

3.2.1 Industrial sector

Table 2 ICT-based Changes in Production Activities by Industry

		FY2000	FY2010			FY2020		
			Base case	ICT case	Base=100	Base case	ICT case	Base=100
Crude steel	1,000t	106,901	95,917	91,889	95.8	90,431	73,382	81.1
Ethylene	1,000t	7,566	6,679	6,510	97.5	6,678	5,940	88.9
Cement	1,000t	80,068	70,284	66,953	95.3	68,020	55,272	81.3
Paper / paperboard	1,000t	31,742	35,955	35,222	98.0	39,863	36,836	92.4
Pulp	1,000t	11,266	11,789	11,549	98.0	12,443	11,487	92.3
Food	1995=100	99	103	100	97.4	107	101	94.0
Textile	1995=100	71	55	53	97.0	49	46	94.5
Nonferrous metals	1995=100	106	103	100	96.9	107	86	81.1
Metallic machinery & others	1995=100	113	138	141	102.0	161	172	106.6

Industry-specific production activities gained from the input-output analysis showed that the metallic machinery industry, which includes the electric & electronic industry producing ICT-related goods, would have larger production than in the base case, but the remaining industries all register lower production values than in the base case. Above all crude steel and cement production would plunge markedly, for which chiefly responsible are more ICT-oriented private-equipment and public investments.

3.2.2 Residential sector

In the residential sector, the greater ownership and expanding use of ICT equipment is expected to increase energy intensity per household, particularly electricity among energy sources and power/lighting among uses. In addition, a growing popularity of telecommuting is expected to boost energy demand for airconditioning and power/lighting uses above all. Concurrently, encouraged now is the introduction of ICT-based energy conservation systems to automate residential energy demand control (home energy management system, HEMS).

In reference to the 2002 Study and an Energy Conservation Subcommittee Report of the Advisory Committee for Resources and Energy, among others, we estimated changing energy intensity due to such factors as the greater ownership and use of ICT equipment, penetration of HEMS and a growing popularity of telecommuting. The results are shown in Table 3 below.

Table 3 ICT-based Changes in Energy Intensity for Residential Sector

1,000kcal/household

	FY2000	FY2010			FY2020		
		Base case	ICT case	Base=100	Base case	ICT case	Base=100
Power / lighting & others	3,952	4,293	4,401	102.5	4,561	4,626	101.4
Space heating	3,111	3,246	3,148	97.0	3,210	3,049	95.0
Space cooling	249	279	270	97.0	308	293	95.0

3.2.3 Commercial sector

In the commercial sector, the greater ownership of ICT equipment is expected to send energy intensity rising. On the other hand, penetration of ICT-based energy conservation systems to automate commercial energy demand control (commercial building energy management system, BEMS) is under consideration. Besides, commercial energy demand would be affected by shrinking office floor spaces due to a growing number of telecommuters and retail-shop floor spaces undermined by rising e-commerce.

We estimated changing commercial energy intensity, as well as shrinking floor spaces among some businesses, both attributable to the greater ownership and use of ICT equipment, penetration of BEMS, a growing popularity of telecommuting and so on. Relevant data were referred to the 2002 Study, an Energy Conservation Subcommittee Report of the Advisory Committee for Resources and Energy, “White Paper on Information and Communications in Japan” released by the Ministry of Public Management, Home Affairs, Post and Telecommunications, etc. The results are shown in Tables 4 and 5 below.

Table 4 ICT-based Changes in Energy Intensity for Commercial Sector

1,000kcal/m^2

	FY2000	FY2010			FY2020		
		Base case	ICT case	Base=100	Base case	ICT case	Base=100
Power/ lighting & others	111.9	125.9	125.5	99.7	131.6	130.6	99.3
Space heating	60.0	50.2	50.0	99.5	46.8	46.3	99.0
Space cooling	24.7	27.2	27.1	99.5	28.0	27.7	99.0
Water heating	61.0	58.7	58.3	99.5	54.4	53.9	99.0

Table 5 ICT-based Changes in Floor Spaces for Commercial Sector

	FY2000	FY2010	FY2020
Rate of shrinking offices	0.3%	0.8%	1.4%
Rate of shrinking wholesale/retailing	0.3%	2.6%	3.0%

3.2.4 Transportation sector

In regard to the transportation sector, pointed out is the strong likelihood that stronger ICT presence in such forms as the penetration of ITS[4] and VICS[5] greatly contributes to lowering energy consumption because they can help smoothen traffics & distribution and curb traffic volumes. Also, ICT-based value-added industrial structure is likely to make transport demand more value-added than otherwise. Namely, through transportation shifts from heavy to light commodities, ICT orientation can trim transport demand. Greater ICT-related spending, which holds a certain share in household-budget expenditures, can lead to falling passenger transport demand by trimming non-ICT spending, typically travel expenses, and through penetration of net-shopping and TV conferences.

In reference to the Energy Conservation Center's data, among others, we estimated lowered energy intensity by ICT-based efficiency increases in traffic systems, lighter (shrinking) freight transport as a result of industrial structural shifts, as well as falling passenger transport due to an intensified ICT orientation. The results are shown in Tables 6 and 7 below.

Table 6 ICT-based Changes in Energy Intensity and Volume for Passenger Transport Sector

		FY2000	FY2010	FY2020
Passenger-car fuel efficiency (km/L)	Base case	8.2	9.2	10.2
	ICT case	8.2	9.3	10.4
	Base=100	100.0	101.2	102.2
Passenger demand total (Billion passenger km)	Base case	1,420	1,492	1,516
	ICT case	1,420	1,458	1,455
	Base=100	100.0	97.7	96.0

Table 7 ICT-based Changes in Energy Intensity and Volume for Freight Transport Sector

		FY2000	FY2010	FY2020
Truck fuel efficiency (km/L)	Base case	8.9	9.4	10.0
	ICT case	8.9	9.5	10.2
	Base=100	100.0	101.1	102.0
Freight transport demand by truck (Billion tons km)	Base case	313	319	314
	ICT case	313	302	278
	Base=100	100.0	94.6	88.5
Freight transport demand by boat (Billion tons km)	Base case	242	218	205
	ICT case	242	211	192
	Base=100	100.0	96.8	93.7
Freight transport demand by rail (Billion tons km)	Base case	22	24	25
	ICT case	22	25	26
	Base=100	100.0	101.4	102.6

4. Analysis of simulation results

4.1 Total primary energy supply

As a result of intensified ICT orientation, total primary energy supply in FY2010 would be down 1.4% from 575.7 million tons oil equivalent (MTOE) in the base case to 567.8 MTOE in the ICT case. It is

4 ITS: Intelligent Transportation Systems
5 VICS: Vehicle Information and Communication System

because almost all consuming-sectors would consume less energy in reflection to more value-added industrial structure and higher efficiency of energy use, both realized by ICT. The simulated energy consumption mix by source shows oil, coal and natural gas would decline chiefly because the industrial and transportation sectors become less energy-intensive. As a consequence, CO_2 emissions would drop 1.8% from 325.2 million tons carbon equivalent (Mt-C) to 319.3 Mt-C. This trend would be strengthened further in FY2020.

Table 8 Total Primary Energy Supply Outlook

(Unit: 10^{10}kcal = 1,000 TOE)

	Actual	Base case		ICT case			
	FY2000	FY2010	FY2020	FY2010		FY2020	
					Gap		Gap
Coal	100,223 (17.9)	107,786 (18.7)	110,871 (18.9)	105,838 (18.6)	-1,949 (-0.1)	105,706 (18.6)	-5,165 (-0.3)
Oil	289,205 (51.8)	278,652 (48.4)	265,943 (45.4)	273,306 (48.1)	-5,346 (-0.3)	255,401 (44.9)	-10,542 (-0.4)
Natural gas	73,398 (13.1)	85,618 (14.9)	92,747 (15.8)	84,930 (15.0)	-687 (0.1)	90,403 (15.9)	-2,344 (0.1)
Hydro	19,253 (3.4)	19,314 (3.4)	19,360 (3.3)	19,314 (3.4)	0 (0.0)	19,360 (3.4)	0 (0.1)
Nuclear	69,241 (12.4)	75,444 (13.1)	86,818 (14.8)	75,444 (13.3)	0 (0.2)	86,818 (15.3)	0 (0.5)
Geothermal	964 (0.2)	1,023 (0.2)	1,059 (0.2)	1,023 (0.2)	0 (0.0)	1,059 (0.2)	0 (0.0)
New energies	6,491 (1.2)	7,909 (1.4)	9,498 (1.6)	7,909 (1.4)	0 (0.0)	9,498 (1.7)	0 (0.1)
Total	558,651 (100.0)	575,747 (100.0)	586,296 (100.0)	567,765 (100.0)	-7,982	568,245 (100.0)	-18,051
Real GDP (¥ Billion in 1995 price)	535,690	624,248	696,995	624,248	0	696,995	0
CO_2 emissions (Mt-C)	316	325	323	319	-6	310	-13

(Source) General Energy Statistics, etc. Forecast by IEEJ.

(Notes) 1. In parentheses are shares (%).

2. "New energies" include photovoltaic, wind power and black liquids.

4.2 Final energy consumption

The stronger ICT presence would help reduce final energy consumption in FY2010 by 1.9% from 382.9 MTOE in the base case to 375.5 MTOE. By sector, as a result of value-added industrial structure, industrial energy consumption would decline, particularly in the material industries that produce industrial materials. Transport energy consumption would decrease as well in reflection to shrinking freight transport paired with higher energy efficiency. Residential energy consumption would rise a bit partly due to the greater ownership and use of ICT equipment, while commercial energy use would be down. By energy source, oil and coal would decline dramatically in reflection to the increasingly less energy-intensive industrial and transport sectors. In FY2020, these trends are likely to continue except that, without influenced by ICT penetration so much as in the past, residential energy consumption would fall as in the rest.

Table 9 Final Energy Consumption Outlook

(Unit: 10^{10}kcal = 1,000 TOE)

	Actual	Base case		ICT case			
	FY2000	FY2010	FY2020	FY2010	Gap	FY2020	Gap
By sector							
Industrial	185,255 (49.3)	179,719 (46.9)	183,087 (47.2)	176,252 (46.9)	-3,467 (0.0)	175,182 (47.1)	-7,905 (-0.2)
Residential & commercial	99,745 (26.5)	113,238 (29.6)	119,164 (30.7)	112,559 (30.0)	-679 (0.4)	117,464 (31.6)	-1,701 (0.8)
Residential	53,392 (14.2)	58,638 (15.3)	59,666 (15.4)	58,645 (15.6)	7 (0.3)	59,108 (15.9)	-558 (0.5)
Commercial	46,352 (12.3)	54,600 (14.3)	59,499 (15.4)	53,914 (14.4)	-686 (0.1)	58,356 (15.7)	-1,143 (0.3)
Transport	90,740 (24.1)	89,988 (23.5)	85,292 (22.0)	86,697 (23.1)	-3,291 (-0.4)	79,372 (21.3)	-5,920 (-0.7)
Passenger	58,079 (15.5)	58,609 (15.3)	55,945 (14.4)	56,732 (15.1)	-1,877 (-0.2)	52,747 (14.2)	-3,197 (-0.3)
Freight	32,661 (8.7)	31,379 (8.2)	29,347 (7.6)	29,965 (8.0)	-1,414 (-0.2)	26,625 (7.2)	-2,722 (-0.4)
By energy source							
Coal & others	41,360 (11.0)	37,651 (9.8)	35,669 (9.2)	36,262 (9.7)	-1,389 (-0.2)	32,638 (8.8)	-3,031 (-0.4)
Oil	221,914 (59.1)	215,832 (56.4)	209,260 (54.0)	210,450 (56.0)	-5,382 (-0.3)	199,037 (53.5)	-10,223 (-0.5)
Town gas	24,658 (6.6)	28,965 (7.6)	32,349 (8.3)	28,680 (7.6)	-285 (0.1)	31,760 (8.5)	-589 (0.2)
Electricity	83,227 (22.2)	95,375 (24.9)	104,445 (27.0)	95,041 (25.3)	-335 (0.4)	102,871 (27.7)	-1,575 (0.7)
New energies & others	4,582 (1.2)	4,562 (1.2)	4,887 (1.3)	4,514 (1.2)	-48 (0.0)	4,779 (1.3)	-108 (0.0)
Total	375,740	382,945	387,543	375,508	-7,438	372,018	-15,525

(Source) General Energy Statistics, etc. Forecast by IEEJ.

(Notes) 1. In parentheses are shares (%).

2. “Industrial” sector includes non-energy consumption.

3. “Coal & others” include coke, coke oven gas, blast furnace gas and briquettes.

4. “Town gas” includes natural gas-powered vehicle fuel needs.

5. “New energies” include photovoltaic, wind power and black liquids.

4.3 Conclusion, et al.

4.3.1 Impacts of industrial structural shift

Industrial structural shift resulting from an intensified ICT orientation was not covered by the 2002 Study, which identified what should be subject to the impact assessment and added up small pieces of sector-by-sector impacts. To fill the hole, we assessed impacts of industrial structural shift on energy consumption by estimating to what extent changing industrial structure would affect production activities of manufacturing and transport amounts in the transportation sector with an input-output table in use. Given differences in what were subject to assessment, the results won’t stand for a simple comparison. Yet, our assessment found a five-time larger amount of impacts, which uncovered a more ICT-oriented structure of industry could have a massive impact on energy consumption.

Of the amount of impacts identified this time we picked out the portion stemming from industrial structural shift. In FY2010 it would be a fall of 5.8 MTOE (down about 1.5%) and in FY2020 a fall of 12.3 MTOE (down about 3.2%), or an estimated about 80% of the whole. By sector, impacts were observed markedly in the industrial sector where production of industrial materials would be curtailed considerably due to the structural shift, as well as in the transportation sector due to diminishing demand for moving industrial materials.

Table 10 Breakdown of Contributors to Changing in Final Energy Consumption

(1,000 tons oil equivalent)

	FY2010			FY2020		
	Structural changes	Increasing efficiency	Total	Structural changes	Increasing efficiency	Total
Final demand total	-5,810	-1,628	-7,438	-12,261	-3,264	-15,525
Industrial	-3,774	0	-3,467	-8,580	0	-7,905
Residential	0	7	7	0	-558	-558
Commercial	0	-686	-686	0	-1,143	-1,143
Transport	-2,343	-949	-3,291	-4,356	-1,564	-5,920
Final demand total	-1.5%	-0.4%	-1.9%	-3.2%	-0.9%	-4.0%
Industrial	-0.9%	0.0%	-0.9%	-2.0%	0.0%	-2.0%
Residential	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%
Commercial	0.0%	-0.2%	-0.2%	0.0%	-0.3%	-0.3%
Transport	-0.6%	-0.3%	-0.9%	-1.1%	-0.4%	-1.5%

Note: The figures in percent in the total columns are the rates of reduction and those in the sector columns the degrees of contribution to reduction.

4.3.2 Impacts of increasing efficiency of energy use

On top of incremental energy demand that might result from the greater ownership and use of ICT-related equipment, we also assessed energy-saving effects produced by ICT-based energy-efficient energy-consuming systems. They include HEMS, BEMS, increasing efficiency of upgraded traffic systems (e.g. VICS) and distribution, and modal shifts. When combined, increasing efficiencies of these energy uses would send energy consumption plunging by 1.6 MTOE (down about 0.4%) in FY2010, and sliding by 3.2 MTOE (down some 0.9%) in FY2020. Thus, increasing efficiency has not a little impact[6], though not so much as industrial structural shift does.

4.3.3 Impacts of an economic growth

In order to highlight the impact of stronger ICT presence, our impact assessment was made on the assumption that the economic growth induced by advancing ICT orientation would remain unchanged from the base case. Namely, we assessed impacts of intensified ICT orientation with a pie of the economy limited in size. In reality, however, an intensified ICT orientation induces an extra economic growth,

[6] The estimated amount of impacts here includes incremental energy consumption attributable to the greater ownership of ICT equipment and longer running hours, among others. The original amount of impacts should have been a little greater than shown here if the incremental portion were subtracted.

accompanied with an increasing ownership of equipment, longer running hours and stimulated industrial activities, which all contribute to increasing energy consumption. These impacts may offset some of the energy-saving effect estimated this time. Several estimates have been made of induced economic effects by ICT orientation, which, however, remain uncertain in many points.

Here, we intend to interpret the impacts of advancing ICT orientation on energy from the standpoint of energy and the economy. Then, as a yardstick, we try to assess to what extent ICT-based energy-saving gains can offset incremental energy consumption resulting from an ICT-spurred extra economic growth.

When the economy keeps growing 1% per annum for ten years, its impact on final energy consumption amounts to about 20 MTOE[7] as of FY2010. Out of the amount of impacts estimated for FY2010 this time, or 7.4 MTOE, 1.6 MTOE results from increasing efficiency of energy use, and the energy-saving portion attributable chiefly to economic structural changes amounts to 5.8 MTOE. This amount of 5.8 MTOE is equivalent to incremental energy due when the economy grows by about 0.3% yearly. In other words, as long as an ICT-based extra economic growth should be capped at about 0.3% a year, Japan’s overall energy consumption won’t increase. On the other hand, if an intensified ICT orientation spurs a faster economic growth than 0.3%, impacts of economic expansion, typically income effect, could outrun ICT-based energy-saving gains and thus send energy consumption above the base case. However, if energy efficiency were improved more than assumed this time, an extra economic growth, if any, should not increase energy consumption beyond the base case.

Thus, the impact produced by advancing ICT orientation on energy supply and demand represents a combination of composite factors, which won’t stand for a simple assessment. Yet, we should not underestimate the impacts of industrial structural changes especially highlighted this time, as well as those of efficiency gains, the original objective of ICT orientation. These are the implications drawn from our research.

4.3.4 Future subjects

In order to highlight the ICT-based impacts, we assumed the economic growth unchanged between the two cases. But, as aforesaid, an ICT-based extra economic growth has not a little impact on energy supply and demand. A more intricately designed assessment, if made by taking such an ICT-based extra economic growth into account, would allow us to grasp a more comprehensive impact of advancing ICT orientation.

Also, on industrial structural changes, apart from expanding production of the industries producing ICT-related goods and services, ICT introduction can help individual industries increase productivity and, through strengthening of competitiveness and changing prices, industrial structure as well as import/export compositions can undergo further changes. Meanwhile, given distribution, among others, structural changes in traffic system can spread from a single corporate level to industry-wide and such a broader penetration than assumed this time can trigger staggering expansion of impacts.

[7] The difference between the base and low growth cases released by IEEJ in its “Japan’s Long-term Energy Supply and Demand Outlook,” November 2002.

Upgrading of industrial structure and establishment of efficient energy utilization system can play not a little role in curbing Japan’s energy consumption. That’s why further accumulation of research results of this field is imperative.

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