September 22, 2008

The 11th Follow-up Survey of JPA's Committed Action Plan on Environment

The Japan Paper Association (JPA) conducted the fiscal 2008 follow-up survey on the progress of JPA's Committed Action Plan on the Environment in July 2008.

1. Targets of the Committed Action Plan

- On a five-year average basis from fiscal 2008 to fiscal 2012, to reduce fossil energy consumption per unit and fossil energy-derived CO_2 emission per unit by 20% and 16%, respectively, from the level of fiscal 1990.
- By fiscal 2012, to expand forest plantation areas owned or managed by the industry at home and abroad to 700 thousand hectares.

2. Survey item

Surveyed companies: 41 pulp and paper companies
Survey responses: 35 companies (105 mills and plants*)
*Total paper and paperboard production of these 105 mills and plants in fiscal 2007 accounts for 99.5% of the total production of surveyed companies and represents 89.8% of the total production in Japan.
Surveyed years: from fiscal 1990 to fiscal 2007*
*Each fiscal year covers the period from April 1 to March 31 of the following calendar year.
Surveyed items:

- Consumption of fuel and purchased electricity by mill (including consumption for purposes other than pulp and paper production (Fuel consumption for electric generation of electric power sales is deducted.))
- Pulp and paper production by mill
- Cause of the increase or decrease in fossil energy consumption per unit in fiscal 2007
- Investment for energy saving and fuel conversion in fiscal 2007
- Future measures and plans for energy saving and fuel conversion
- Survey on the consumer and transportation sectors
- Progress of forest plantation

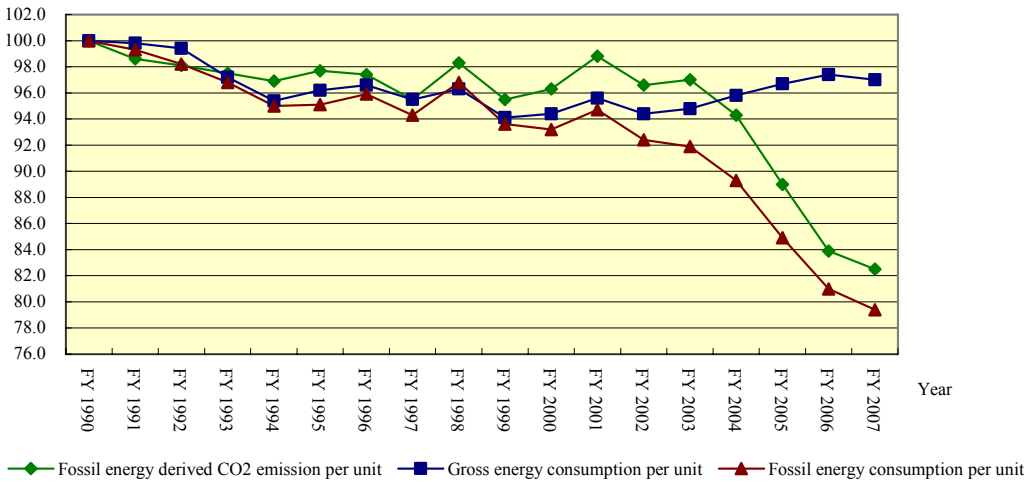
3. Results

3.1 Progress of the Committed Action Plan

In fiscal 2007, the industry advanced energy saving and energy conversion from fossil energy to renewable energy and waste energy. As a result, fossil energy consumption per unit (fiscal 1990 as 100) in fiscal 2007 decreased by 1.6 points from fiscal 2006 to 79.4 (Figure 1), achieving the new target set last year.

Figure 1. Changes in fossil energy consumption per unit and fossil energy-derived CO_2 emission per unit

(FY 1990 as 100)



In addition, fossil energy-derived CO_2 emission (fiscal 1990 as 100) decreased by 1.4 points from the previous year to 82.5, achieving the target of a 10% reduction from the 1990 level.

Figures 2, 3, and 4 show fossil energy consumption per unit by fuel, consumption per unit by energy type and the breakdown of gross energy consumption per unit by energy type, respectively.

Figure 2. Changes in fossil energy consumption per unit by fuel

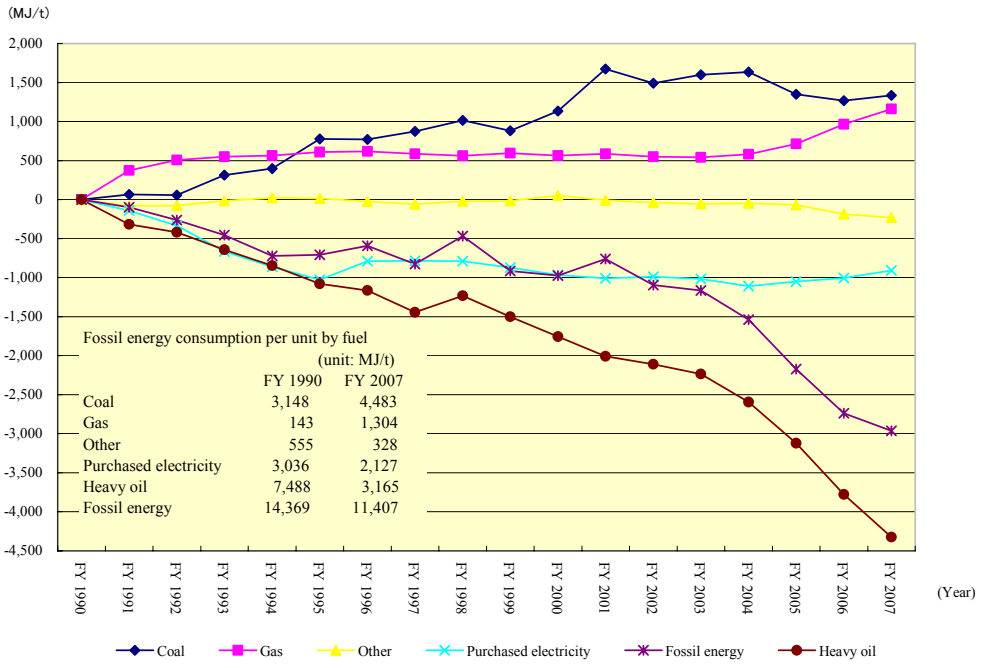


Figure 3. Changes in energy consumption per unit by energy type

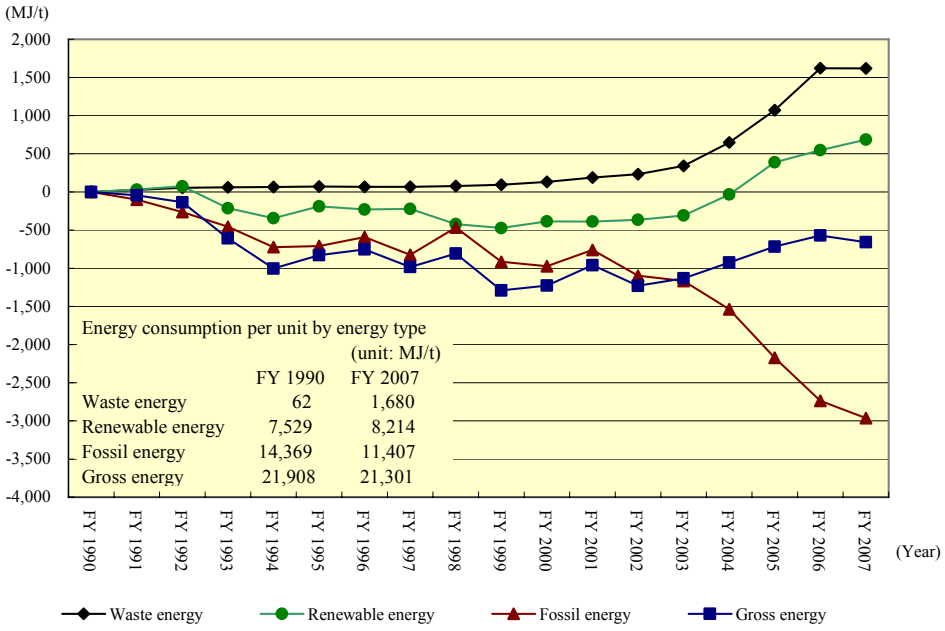


Figure 4. Breakdown of gross energy consumption per unit by energy type

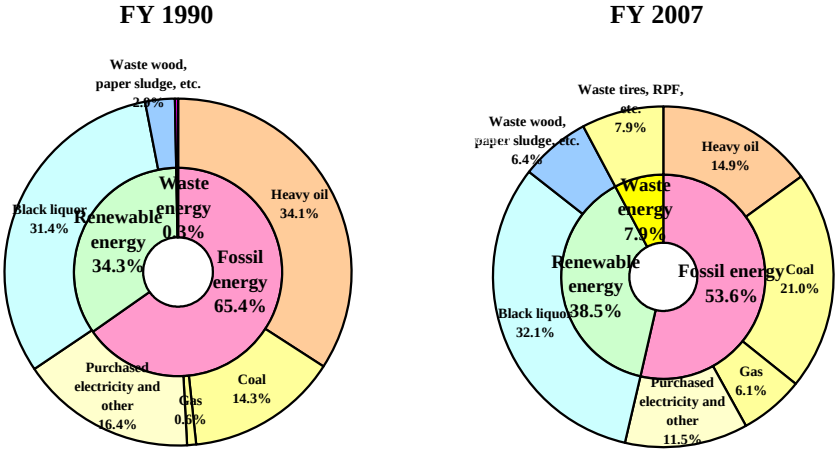


Table 1 shows changes in paper and paperboard production, fossil energy consumption and fossil energy-derived CO_2 emission.

Table 1. Changes in paper and paperboard production, fossil energy consumption, and fossil energy-derived CO_2 emission

	Paper and paperboard production*1 (thousand tons)	Fossil energy consumption		Fossil energy-derived CO_2 emission	
		Consumption (TJ)	Consumption per unit (MJ/t)	Emission (thousand tons)	Emission per unit (t-CO_2/t)
FY 1990	25,564	367,328	14,369	25,505	0.998
Index*2	100.0	100.0	100.0	100.0	100.0
FY 2000	28,409	380,575	13,396	27,292	0.961
Index	111.1	103.6	93.2	107.0	96.3
FY 2001	26,662	362,811	13,608	26,270	0.985
Index	104.3	98.8	94.7	103.0	98.8
FY 2002	27,506	365,063	13,272	26,497	0.963
Index	107.6	99.4	92.4	103.9	96.6
FY 2003	27,287	360,313	13,204	26,398	0.967
Index	106.7	98.1	91.9	103.5	97.0
FY 2004	27,504	352,923	12,832	25,873	0.941
Index	107.6	96.1	89.3	101.4	94.3
FY 2005	27,834	339,447	12,196	24,712	0.888
Index	108.9	92.4	84.9	96.9	89.0
FY 2006	27,802	323,399	11,632	23,260	0.837
Index	108.8	88.0	81.0	91.2	83.9
FY 2007	28,203	321,704	11,407	23,223	0.823
Index	110.3	87.6	79.4	91.1	82.5
Five-year average from FY 2008 to FY2012 (Target)	29,305				
(Index)	114.6		less than 84.0		less than 84.0

Notes:

*1: Total production of JPA's member companies. The total production of the Japanese paper industry is forecasted to be 33,000 thousand tons in FY 2010.

*2: FY 1990 as 100

3.2 Factors causing increase or decrease in fossil energy-derived CO_2 emission

Fossil energy-derived CO_2 emissions in fiscal 2007 decreased by 2,282 thousand tons or 8.4% compared with those in fiscal 1990. It is the third consecutive year that the emissions have finished below the level of fiscal 1990 (Table 2).

Looking at the contributions to the decrease, the industry's efforts resulted in a 5,161-thousand-ton (or 20.2%) reduction from fiscal 1990, while increase in pulp and paper production and a deterioration in the CO_2 emission factor in the power industry caused a 2,633-thousand-ton (or 8.9%) and 247-thousand-ton increase, respectively, from fiscal 1990.

Table 2. Fossil energy-derived CO_2 emissions in fiscal 2007

(Unit: thousand tons, %)

	CO_2 emissions	Percentage change from FY 1990	*1 Removal of power factor's effect		*2 Removal of the influence of stop of operation of nuclear power plants	
			CO_2 emissions	Percentage change from FY 1990	CO_2 emissions	Percentage change from FY 1990
Fossil energy-derived CO_2 emissions in FY 1990	25,505		25,505		25,505	
Fossil energy-derived CO_2 emissions in FY 2007	23,223		22,976		22,487	
Amount of change	▲ 2,282	▲ 8.9	▲ 2,529	▲ 9.9	▲ 3,018	▲ 11.8
(Contribution) Industry's efforts	▲ 5,161	▲ 20.2	▲ 5,161	▲ 16.8	▲ 5,161	▲ 20.2
Power industry	247	1.0	-	-	▲ 489	▲ 1.9
Paper manufacturing	2,633	10.3	2,633	10.3	2,633	10.3

*1: In the case of removing the effects of the CO_2 emission factor of electricity which varies by year, and using the CO_2 emission factor in fiscal 1990 (1.011), fossil energy-derived CO_2 emissions in fiscal 2007 would decrease by 2,529 thousand ton-CO_2 from the level of fiscal 1990.

*2: If nuclear power plants did not stop operation and operate at a comparable level to fiscal 2000 in fiscal 2007, fossil energy-derived CO_2 emissions in fiscal 2007 would decrease by 3,018 thousand tons-CO_2 compared to the level of fiscal 1990 (CO_2 emission factor in fiscal 2000: 0.914).

3.3 Factors in the increase or decrease in fossil energy consumption per unit in fiscal 2007

According to the results of a questionnaire survey on fossil energy consumption per unit (respondents: 32 companies - 100 mills and plants), 55% of respondents improved fossil energy consumption per unit (Table 3).

Table 3. Change in fossil energy consumption per unit over previous year

	FY 2007		FY 2006		FY 2005	
	No. of mills/plants	(%)	No. of mills/plants	(%)	No. of mills/plants	(%)
Improved	55	55	65	62	62	63
Deteriorated	33	33	25	24	25	25
Unchanged*	12	12	14	14	12	12

*: Less than 1% improvement or deterioration in fossil energy consumption per unit over the previous year

Contributions to improvement or deterioration in fossil en consumption per unit

Improvement

Factor	No. of companies	No. of mills/plants
Increase in pulp and paper production	16	31
Start-up high-efficiency equipment	13	22
Increase in the use of renewable energy and waste energy	11	19
Restructuring of the manufacturing process	12	16
Strengthening management	14	18
Other	0	0

Deterioration

Factor	No. of companies	No. of mills/plants
Decrease in pulp and paper production	16	21
Operations of low-efficiency or old equipment	2	2
Increase in fossil energy consumption (e.g., use for night power generation)	9	13
Start-up of quality- or environment-improving equipment	1	2
Increase in small-lot production	2	2
Other	1	1

Although the factors are complicated, meaning some mills have both improvements and deteriorations, the percentage of mills that improved energy consumption per unit from the previous year decreased compared to the last two years.

Factors in improvement in energy consumption per unit range broadly from production increase to enhancement of production management. On the other hand, production curtailment is the most significant factor among those in deterioration in the consumption per unit. This means that,

although companies have made various efforts, increase or decrease in production has a great impact on energy consumption per unit.

3.4 Investment in energy saving and fuel conversion in fiscal 2007

1) Energy saving

For investment in energy-saving, JPA surveyed in two categories—annually made general-purpose investment (less than 200 million yen per project), and large-scale investment made with a long-term perspective (more than 200 million yen per project). Table 4 shows the survey results.

Table 4. Investment in energy saving made in fiscal 2007

Respondents		Investment	No. of companies	No. of mills	No. of projects	Investment amount (million yen)	Energy-saving effect (TJ/year)	CO_2 emissions reduction effect (kt-CO_2/year)
No. of companies	No. of mills							
24	81	GI*1	23	80	736	5,871	3,170	207
		LI*2	6	11	16	25,572	2,660	168
		Total	24	81	752	31,443	5,830	375

*1: General-purpose investment

*2: Large-scale investment

Investment amount, energy-saving effect and CO_2 emissions reduction effect per project

Investment amount per project		Energy-saving effect per project		CO_2 emissions reduction effect per project	
	No.		No.		No.
More than 1 billion yen	3	More than 100 TJ/year	7	More than 100kt/year	0
100 million yen – (1 billion yen)	25	10TJ/year – (100 TJ/year)	89	10kt/year –（100kt/year）	5
10 million yen – (100 million yen)	162	1 TJ/year – (10 TJ/year)	268	1kt/year –（10kt/year）	57
Average (million yen)	41.8	Average (TJ/year)	7.8	Average (kt/year)	0.4

Table 5 shows investment by purpose and sector in fiscal 2007.

Table 5. Investment by purpose and sector in fiscal 2007

Purpose	General-purpose investment				Large-scale investment			
	Investment amount		Energy-saving effect		Investment amount		Energy-saving effect	
	(million yen)	Composition	(TJ/year)	Composition	(million yen)	Composition	(TJ/year)	Composition
Introduction in high-efficiency equipment	2,678	45.6%	927	29.2%	20,753	81.2%	1,591	59.8%
Improvement of the manufacturing process	1,414	24.1%	913	28.8%	553	2.2%	182	6.8%
Waste heat recovery	400	6.8%	299	9.4%	1,764	6.9%	515	19.4%
Improvement in thermal efficiency	566	9.6%	345	10.9%	1,340	5.2%	122	4.6%
Enhancement of production management	209	3.6%	281	8.9%	0	0.0%	0	0.0%
Other	604	10.3%	406	12.8%	1,162	4.5%	251	9.4%
Total	5,871	100.0%	3,171	100.0%	25,572	100.0%	2,661	100.0%

Sector	General-purpose investment				Large-scale investment			
	Investment amount		Energy-saving effect		Investment amount		Energy-saving effect	
	(million yen)	Composition	(TJ/year)	Composition	(million yen)	Composition	(TJ/year)	Composition
Pulp manufacturing	1,426	24.3%	790	24.9%	1,863	7.3%	406	15.3%
Paper manufacturing	2,566	43.7%	1,253	39.5%	6,062	23.7%	293	11.0%
Power (steam & electricity)	1,133	19.3%	645	20.3%	16,789	65.7%	1,672	62.8%
Other	746	12.7%	483	15.2%	858	3.4%	290	10.9%
Total	5,871	100.0%	3,171	100.0%	25,572	100.0%	2,661	100.0%

Investment in fiscal 2007 significantly increased from the previous year, because some large-scale investments were made in the power sector (15 billion yen) and paper-manufacturing sector (5.7 billion yen), except where total invested amount in fiscal 2007 is 10,743 million yen.
Investment amount and energy-saving effect by sector is shown in Table 6.

Table 6. Investment and energy-saving effect by sector

	Year		FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
	(No. of respondent companies)		(39)	(32)	(39)	(29)	(27)	(22)	(22)	(25)	(25)	(25)	(24)
Pulp manufacturing	①Investment	(million yen)	7,051	5,985	11,492	8,011	3,737	2,542	2,198	3,359	2,760	3,009	3,289
	②Energy-saving effect	(TJ/year)	501	705	1,502	1,783	1,207	4,033	1,035	2,158	1,883	1,896	1,196
	①/②	(thousand yen/TJ)	14,074	8,489	7,651	4,493	3,096	630	2,124	1,557	1,466	1,587	2,750
Paper manufacturing	①Investment	(million yen)	5,929	6,290	1,535	7,372	8,593	1,942	2,600	4,301	2,450	2,998	8,628
	②Energy-saving effect	(TJ/year)	408	723	1,613	1,393	1,899	1,779	777	1,237	1,355	1,523	1,546
	①/②	(thousand yen/TJ)	14,532	8,700	952	5,292	4,525	1,092	3,346	3,477	1,808	1,969	5,581
Power (steam, electricity)	①Investment	(million yen)	26,299	20,011	5,325	6,032	2,324	2,537	5,116	16,300	2,726	2,524	17,922
	②Energy-saving effect	(TJ/year)	4,931	3,188	1,472	2,342	1,202	1,017	5,631	2,430	1,410	1,380	2,317
	①/②	(thousand yen/TJ)	5,333	6,277	3,618	2,576	1,933	2,495	909	6,708	1,933	1,828	7,735
Other	①Investment	(million yen)	2,506	3,458	1,142	1,626	2,272	1,172	405	946	452	632	1,604
	②Energy-saving effect	(TJ/year)	2,778	3,386	852	1,157	1,909	526	486	449	597	713	773
	①/②	(thousand yen/TJ)	902	1,021	1,340	1,405	1,190	2,228	833	2,107	757	886	2,075
Total	①Investment	(million yen)	41,785	35,744	19,494	23,041	16,926	8,193	10,319	24,906	8,388	9,163	31,443
	②Energy-saving effect	(TJ/year)	8,618	8,002	5,439	6,675	6,217	7,355	7,929	6,274	5,245	5,513	5,832
	①/②	(thousand yen/TJ)	4,849	4,467	3,584	3,452	2,723	1,114	1,301	3,970	1,599	1,662	5,391
	③Rate of reduction from FY 1990*	(%)	2.36	2.18	1.48	1.82	1.69	2.00	2.16	1.71	1.43	1.50	1.59

*: Rate of reduction of fossil energy consumption from that in fiscal 1990 (367,328 TJ)

2) Investment in fuel conversion

JPA surveyed investment in fuel conversion aimed to reduce fossil energy consumption and CO_2 emissions (Table 7).

Table 7. Investment in energy conversion made in fiscal 2007

Respondents		Investment	No. of companies	No. of mills	No. of projects	Investment amount (million yen)	Energy-saving effect (TJ/year)	CO_2 emissions reduction effect (kt-CO_2/year)
No. of companies	No. of mills							
12	16	GI*1	7	9	9	483	1,008	73
		LI*2	6	8	8	28,144	7,819	481
		Total	12	16	17	28,627	8,827	554

*1: General-purpose investment

*2: Large-scale investment

Investment amount, energy-saving effect and CO_2 emissions reduction effect per project

Investment amount per project		Energy-saving effect per project		CO_2 emissions reduction effect per project	
	No.		No.		No.
More than 1 billion yen	3	More than 100 TJ/year	10	More than 100kt/year	2
100 million yen – (1 billion yen)	7	10TJ/year – (100 TJ/year)	3	10kt/year – (100kt/year)	6
10 million yen – (100 million yen)	6	1 TJ/year – (10 TJ/year)	3	1kt/year – (10kt/year)	5
Average (million yen)	1,684	Average (TJ/year)	519	Average (kt/year)	33

Table 8 shows changes in investment in fuel conversion.

Table 8. Changes in investment in fuel conversion

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
Investment amount (million yen)	24	0	6,650	7,826	18,412	17,714	34,972	28,627
Fossil energy consumption reduction (TJ/year)	151	0	908	3,878	9,046	13,428	12,228	8,827
Fossil energy-derived CO_2 emission reduction (thousand tons/year)	3	0	43	258	494	1,016	661	554

4 Provisional estimation of fossil energy consumption and CO_2 emissions in fiscal 2010

4.1 Future investment plan

JPA surveyed each company's future investment plans for energy-saving and fuel conversion until fiscal 2012. Investment in energy saving is divided into two categories: annually made general-purpose investments (investment amount: less than 200 million yen per project), and large-scale investments (more than 200 million yen per project with a long-term plan that is scheduled to finish by fiscal 2012).

According to the survey results, it is estimated that, for the five years from fiscal 2008 to fiscal 2012, general-purpose investment in energy saving will continue at a level equivalent to the average investment amounts from fiscal 2003 to fiscal 2007 (Table 9), resulting in a reduction of fossil energy consumption of 22,800 TJ.

Table 9. General-purpose investments in energy saving

	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Five-year ave. from FY 2008 to 2012
Investment amount (million yen)	5,217	5,715	5,754	6,248	5,871	5,761
Reduction of energy consumption (TJ)	7,106	4,158	4,910	3,455	3,171	4,560

It is expected that investments of 163 billion yen will be carried out by fiscal 2012 and fossil energy consumption will be reduced by 64,462 TJ/year from the level of fiscal 2007 in fiscal 2012 (Table 10).

Table 10. Investment plan (total amount from fiscal 2008 to fiscal 2012)

	Planned amount of investment (million yen)	Fossil energy reduction (TJ)
Investment for energy saving		
General-purpose investment	28,805	22,800
Large-scale investment	27,177	3,531
Investment for energy conversion	107,085	38,131
Total	163,067	64,462

Table 11 shows the projected consumption of renewable energy and waste energy in fiscal 2012.

Table 11. Consumption of renewable energy and waste energy in fiscal 2012 based on planned investment for fuel conversion

	Consumption in FY 2007 (actual)		Increment for the period FY 2008-FY 2012		Consumption in FY 2012 (projected)	
	(BDt/year)	(TJ/year)	(BDt/year)	(TJ/year)	(BDt/year)	(TJ/year)
Waste wood, bark	1,283,467	20,921	646,688	8,701	1,930,155	29,621
Paper sludge, waste paper	1,547,159	16,575	37,700	424	1,584,859	16,999
RDF, RPF	757,079	19,311	160,778	4,128	917,857	23,439
Waste plastic	74,493	2,122	80,139	2,452	154,632	4,574
Waste tires	395,439	13,035	42,000	1,389	437,439	14,424
Waste oil*[1]	93,325	3,752	0	0	93,325	3,752
Methane*[2]	258	5	1,541	32	1,970	41

Note:

1. The unit for waste oil is the kiloliter.
2. The unit for methane is a thousand Nm^3.

4.2 Provisional estimation of five-year average fossil energy consumption and CO_2 emissions for the period from fiscal 2008 to fiscal 2012

JPA estimated the five-year average fossil energy consumption and CO_2 emissions for the period from fiscal 2008 to fiscal 2012 based on a future investment plan and fuel conversion program, taking into account the increase in energy consumption caused by annually taken environmental measures, quality measures and rationalization efforts, as well as factoring in the procurement rate of fuel and the effects of a total of four new paper machines that have started or will start operation during fiscal 2007 and 2008. The effects of new paper machines include the increase in paper and paperboard production in fiscal 2010 of 800 thousand tons to 29,300 thousand tons from the original estimation, which was 28,500 thousand tons, and some deterioration in energy consumption per unit in the early stage of operation of the machines.

According to the estimation, the five-year average index of fossil energy consumption per unit for 2008-2012 is expected to be 78.5, meeting the 80.0 target. Also, the index of CO_2 emission per unit is 83.1, achieving the 84.0 target. Moreover, fossil energy consumption and CO_2 emissions will decrease by 10.0% and 4.7%, respectively from the level of fiscal 1990, while paper and paperboard production will increase by approximately 14% (Table 12).

However, there are uncertainties such as reduced investment and a decline in the operating rate of paper machines both caused by future economic decline, a decline in the procurement rate of fuel due to a limitation of available fuel, and incineration ash disposal problems related to fuel conversion.

Table 12. Provisional estimation of average fossil energy consumption and CO_2 emissions for the period from FY 2008 to FY 2012

	Paper and Paperboard Production (thousand tons)	Fossil energy consumption		Fossil energy-derived CO_2 emission	
		Consumption (TJ)	Consumption per unit (MJ/t)	Emission (thousand tons)	Emission per unit (t-CO_2/t)
FY 1990	25,564	367,328	14,369	25,505	0.998
Index*1	100.0	100.0	100.0	100.0	100.0
FY 2006	28,203	321,704	11,407	23,223	0.823
Index	110.3	87.6	79.4	91.1	82.5
Five-year average from FY 2008 through FY 2012 (target)			less than 80.0		less than 84.0
Five-year average from FY 2008 through FY 2012 (estimate)*2	29,305	330,559	11,282	24,301	0.829
Index	114.6	90.0	78.5	95.3	83.9

Note:

1: FY 1990 as 100.0

2: For the CO_2 emission factor of electricity, this estimation uses the four-year average from FY 2003 through FY 2006 (1.044 t-CO_2/ten thousand kwh).

5. International Comparison

Table 13 shows an international comparison of final energy consumption per unit in the paper and paperboard-manufacturing process. Japan is the lowest of the countries in which paper and paper production and pulp production are balanced (Japan, U.S., Finland, Norway and France), or pulp production exceeds paper and paperboard production (Brazil and Chile). Germany's low final energy consumption is attributed to the fact that the country depends on imports for pulp, causing less energy consumption in the pulp manufacturing process.

Table 13. Comparison of final energy consumption per unit between major countries.

	Japan	U.S.	Finland	Norway	France	Germany	Brazil	Chile
Final energy consumption per unit (GJ/T)	12.1	27.1	20.3	21.1	15.4	10.3	39.5	36.2
Index (Japan as 100)	100	224	168	174	127	85	326	299

Source: The Institute of Energy Economics, Japan, *Report on Study on Technological Strategies in Manufacturing Industrie.* 2008

6. Energy consumption of the civilian and transportation sector

6.1 Civilian sector (indirect departments)

From the ninth follow-up survey in 2006, JPA has conducted a full-scale survey on energy consumption and CO_2 emissions among head offices, branch offices, research stations, and warehouses.

According to the survey results, both energy consumption and CO_2 emissions in indirect departments are approximately or less than 0.15% of those in the manufacturing process (Table

14). Energy consumption and CO_2 emissions in indirect departments (e.g. offices and warehouses) in mills are included with those of the mills.

Table 14. Energy consumption and CO_2 emissions in indirect departments

	FY 2006					FY 2007				
	Gross floor area (thousand m^2)	Energy consumption		CO_2 emissions		Gross floor area (thousand m^2)	Energy consumption		CO_2 emissions	
		TJ	MJ/m^2	$kt\text{-}CO_2$	$kg\text{-}CO_2/m^2$		TJ	MJ/m^2	$kt\text{-}CO_2$	$kg\text{-}CO_2/m^2$
Head office, branch office	109	161	1,474	7	67	108	161	1,486	8	73
Research station	68	245	3,602	10	152	68	222	3,271	10	141
Warehouse	440	105	238	7	15	417	81	195	4	10
Total	617	510	827	24	39	593	465	784	21	36
(Ref.) Manufacturing process	-	323,399	-	23,260	-	-	321,704	-	23,223	-

6.2 Transportation sector

JPA's transportation committee conducted an actual condition survey on the transportation sector in the pulp and paper industry, in order to gain an understanding of the efforts to reduce the environmental burden in the transportation sector—mainly primary transportation of paper and paperboard (from mill to market)—and collect basic data. A summary of the survey results is as follows.

- Transportation volume, transportation ton-kilometers, energy consumption, and CO_2 emissions

- The subject of the survey was member companies of JPA's transportation committee (13 companies). The number of respondent companies was 13 companies.
- Total transportation of paper and paperboard among respondent companies in fiscal 2007 was 25,371 thousand tons. Shares by means of transportation are: truck - 61.8%, cargo vessel - 25.2%, railway - 12.9%.
- Shares of transportation system in terms of more than 500 km of transportation distance are: cargo vessel - 61.6%, railway - 19.8%, truck - 18.6%. The modal shift rate in the pulp and paper industry is 81.4%, which far exceeds Japan's average rate of 40%.
- Transportation ton-kilometers in fiscal 2007 is 12,307.48 million ton-kilometers, and shares by means of transportation are: cargo vessel - 49.3%, truck - 32.1%, railway - 18.6%. Average transportation distance per ton of product is 485 km (cargo vessel - 947 km, railway - 698 km, truck - 252 km).
- Energy consumption in the transportation of paper and paperboard is 9.4 million GJ (0.24 million kl in crude oil equivalent), which corresponds to approximately 3% of fossil energy consumption in the manufacturing process at mills. CO_2 emission is 625 thousand tons, corresponding to approximately 3% of fossil energy-derived CO_2 emissions in manufacturing process at mills. CO_2 emission per transportation ton-kilometer is 50.8 g.

Table 15 shows fossil energy consumption and CO_2 emissions in transportation sector.

Table 15. Fossil energy consumption and CO_2 emissions in the transportation sector

	FY 2006								FY 2007							
	Transportation volume		Transportation ton-kilometer		Energy consumption		CO_2 emissions		Transportation volume		Transportation ton-kilometer		Energy consumption		CO_2 emissions	
	thousand tons	%	million ton-kilometer	%	TJ	%	thousand tons	%	thousand tons	%	million ton-kilometer	%	TJ	%	thousand tons	%
Cargo vessel	6,018	24.1	5,783	47.5	3,215	34.0	228	36.3	6,403	25.2	6,065	49.3	3,366	35.8	238	38.1
Railway	3,287	13.2	2,413	19.8	1,187	12.6	53	8.5	3,283	12.9	2,291	18.6	1,125	12.0	50	8.0
Truck	15,622	62.7	3,978	32.7	5,046	53.4	346	55.2	15,684	61.8	3,952	32.1	4,909	52.2	337	53.9
Total	24,928	100.0	12,174	100.0	9,488	100.0	627	100.0	25,371	100.0	12,307	100.0	9,400	100.0	625	100.0
(Ref.) Manufacturing process					323,399		23,260						321,704		23,223	

- Green transportation efforts

- The surveyed companies have been making green transportation efforts such as centralization of transportation departments, further promotion of modal shift, larger-sized truck and vessel cargo, and strengthening of cooperation with other paper manufacturers, trading companies and other industries for transportation of products and raw materials.
- For truck transportation, surveyed companies made consigning contracts with 1,123 distribution companies in total, of which 426 companies have environment management certification such as ISO14001.
- For green transportation efforts, it is important to enhance cooperation with not only distribution companies, but also other stakeholders such as customers and the government.

6.3 Other

1) Team minus 6% activity* and Cool Biz & Warm Biz activities

Each company has been promoting such activities mainly at its headquarter office. Activities include the introduction of energy-saving office equipment, promotion of green purchasing and modest cooling and heating temperatures. The number of companies that participated in each activity in fiscal 2007 is as follows.

Team minus 6% activity 8 companies

Cool Biz activity 23 companies

Warm Biz activity 13 companies

* A national project initiated by the Japanese government to achieve a 6% reduction of greenhouse gas emission from the level of 1990, Japan's commitments under the Kyoto Protocol

In addition, each company has been promoting the following activities:

- Members of JPA's energy subcommittee started keeping a household eco-account book through the consumption of electricity and gas at their individual homes for the period from April 2007 to March 2008.
- Education for employees and community, including:
  - Communications through in-house magazine
  - Active participation in tree-planting activities
  - Environmental learning to use its own forests
  - Promoting paper recycling
  - Implementation of a "No Car Day"

2) Environment management system

Of 101 mills and plants answering the survey, 98 mills and plants (97% of the total) have already received ISO14001 certification. In addition, one mill has an environment management system pursuant to ISO14001.

3) Implementation of the Kyoto Mechanism

The action plan has a basic policy of meeting the target by capital investment, and implementation of the Clean Development Mechanism (CDM) is left to the policies of each company.

For CDM, some member companies have been making the following efforts:

- One member company filed a new methodology and project design document for A/R (CDM-AR-PDD) with the CDM Executive Board to obtain the approval of CDM for its forest plantation project in Madagascar, and gained approval in July 2007.
- One member company has been conducting forest plantation in cooperation with other companies in New Zealand.
- One member company has been researching the project with the prospect that it could be applied to CDM.
- One member company has participated in Japan's voluntary emissions trading scheme established by the Ministry of the Environment.
- One member company has been supporting the promotion of tree thinning, in conjunction with one nonprofit organization and the local government, in order to improve carbon sequestration through better forest management

7. Progress of forest plantation

(1) Forest plantation area

For the forest plantation area, JPA set the following target in their action plan: "By fiscal 2012, expand the industry's forest plantation at home and abroad to 700 thousand hectares."

The industry has been expanding its forest plantation smoothly. The industry's forest plantation area at home and abroad is 608 thousand hectares at the end of fiscal 2007, showing a 330-thousand-hectare increase from fiscal 1990 and meeting 87% of the target (Table 16).

Forest plantation areas overseas are 458 thousand hectares at the end of fiscal 2007, a 329-thousand-hectares increase from fiscal 1990. The industry has been practicing forest plantation in eight countries—Brazil, Australia, Chile, New Zealand, Vietnam, South Africa, China and Laos.

Table 16. Changes in forest plantation area （thousand hectares）

	FY 1990	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2012 (target)
Domestic	146	128	125	121	139	151	150	150	150	-
Overseas	129	278	301	342	353	355	387	455	458	-
Total	275	406	426	463	492	506	537	605	608	700
Attainment level of target (%)	39	58	61	66	70	72	77	86	87	-

(2) Cooperation with government and academia

- Two member companies joined the CO_2 fixation technology development program, the five-year program that started in fiscal 2003 led by the Plant Physiology Research Group of the Research Institute of Innovative Technology for the Earth (RITE) which is subsidized by the Ministry of Economy, Trade and Industry (METI). The two companies had been working on the development of a technology that promotes large-scale CO_2 fixation through forest plantation using genetically modified trees, and they started implanting eucalyptus and poplar for plantation with effective genes that have high functions like photosynthetic performance and environment stress tolerance by fiscal 2007, the final year of the program.
- One member company has developed mass propagation technology for useful Pinaceae trees in conjunction with the Research Institute of Innovative Technology for the Earth (RITE). The technology is expected to be applied to the restoration of forest areas suffering pine wilt disease and to the plantation of fast-growing pine trees in degraded land areas such as dry land areas and barren land areas.
- One member company has developed a tree growth-measuring system using satellite images in conjunction with Institute of Industrial Science of the University of Tokyo (IIS) and Kokusai Kogyo Co., Ltd. They have been conducting a practical trial of the system, which is a relatively inexpensive and easy-to-use system using general satellite images and existing management data on forest plantations. The system is planned to be applied to the calculation system of CO_2 sequestration in the future.