Managing a Tragedy of The Commons

Electricity Supply Shortage in Japan since the Fukushima Nuclear Disaster

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Contents

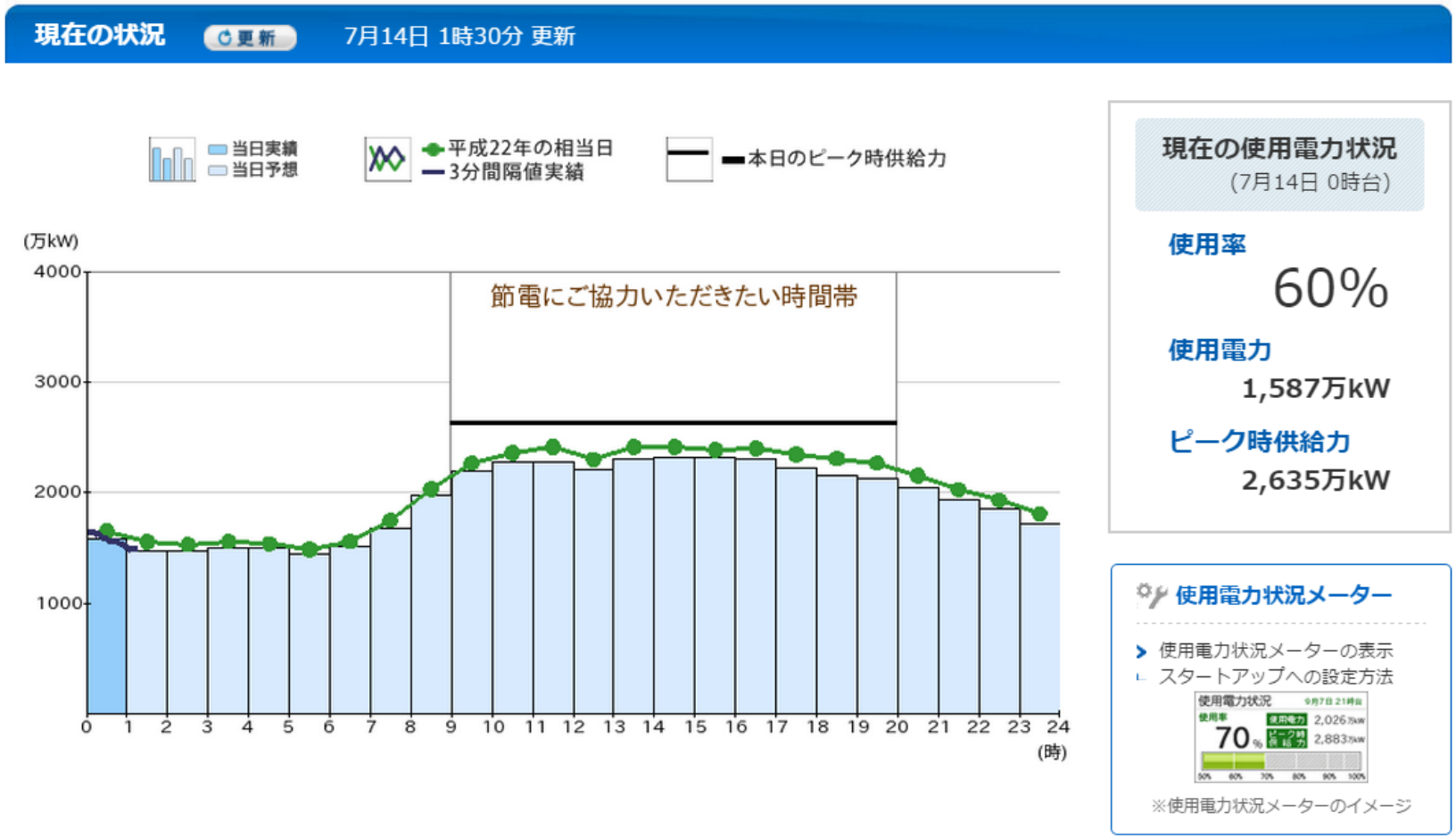
Definition

- A 'Tragedy of the Commons':
  - Coined in the 1968 paper by Gareth Harding.
  - In a situation whereby members of a community share a common resource, and due to the lack of defined sharing rules, the individuals in the community are incentivised to consume more and more of that resource, to the detriment of the whole community.
  - The incentive to destroy the whole results from the ability to individualise benefit and share the damage.
  - examples: separately owned sheep in a common meadow; sending dirty water down a river; emission of polluting gases into the atmosphere; excessive water consumption.

Electrical Energy vs Power

- While energy is plentiful in the world, energy flow is a limiting factor.
- Particularly true for electricity:
  - insufficient power line capacity = insufficient supply;
  - insufficient power generation capacity = insufficient supply.
- Around the world, electricity supply networks (power station and power line capacity) are built on a scale to cope with the maximum peak time demand.
  - any unforeseen in decrease in power generation or transmission can result an unbalanced network.
  - Unbalanced networks are often re-balanced through rolling blackouts.
  - The peak use period may be very short, for example about 4 to 6 hours per day above 66% of peak use, but power plants will be built for that peak, and they will idle for the rest of the 24 hours.
- The main question is: when the imbalance occurs, how do you get all the users to share a limited supply? This was the question after the Fukushima Nuclear Disaster.
- Peak electricity supply is a particularly insidious instance of a Tragedy of the Commons because it has direct (potential supply capacity shortage) and and power plants that idle for most of the day (resource inefficiency).

Electrical Energy vs Power: Supply vs Demand in Kansai, Japan



The making of a 'Tragedy of the Commons'.

- Post-World War II Japan had plenty of shortages: food, energy, other natural resources (e.g. wood).
- As electricity supply grew with post-war industrial growth:
  - industry and businesses took advantage of the new electric supply (widespread powerhungry air conditioning systems, more lighting, bigger machines, etc).
  - Not all business and industrial electricity use was necessary.
  - appliances in households also increased.
  - Similarly, not all households electricity use was necessary.
  - Furthermore, the time-of-use of electricity was not focused on - insufficient incentives to shift load to off peak (*importance of this* - see previous slide).
- An electricity network with excess supply and perverse incentives leads users to take much for granted.

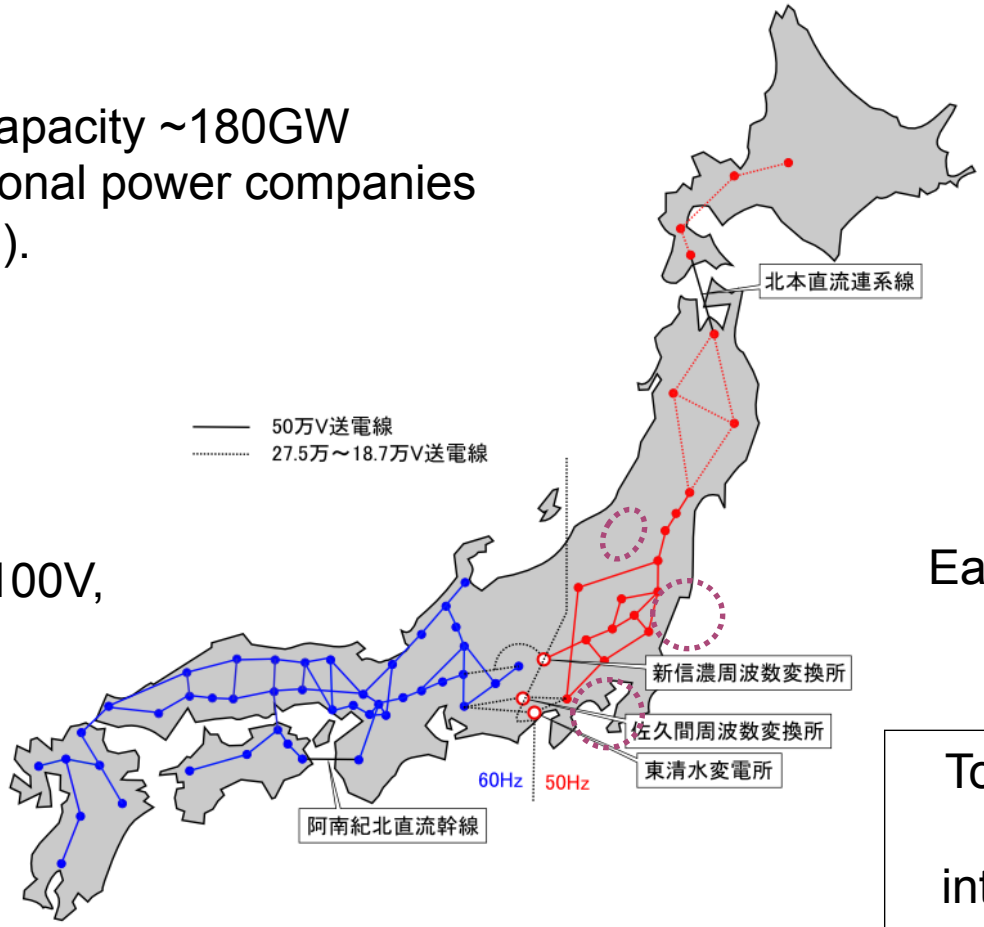
Background (before March 2011)

- Around 1960s Nuclear Power chosen as a key technology to supply energy during Japan's industrial growth period.
  - The first reactor at Fukushima No. 1 came online in March 1971.
- Nuclear power accounted for 25% of electrical energy and 11.1% of primary energy in Japan in 2010.
- Fossil fuels accounted for 81.4% of electrical energy supply.
- There was substantial use of natural gas, imported as LNG (Liquefied Natural Gas).
  - Most homes use electricity for cooking and heating water.
- In 2010, Final Energy Consumption was:
  - Industry and Commercial Buildings = 63% of final energy consumption; Transport 22%; Household use = 15%

Electricity Supply Network in Japan

Total Grid Capacity ~180GW
With 10 regional power companies (monopolies).

Western grid 100V, 60Hz

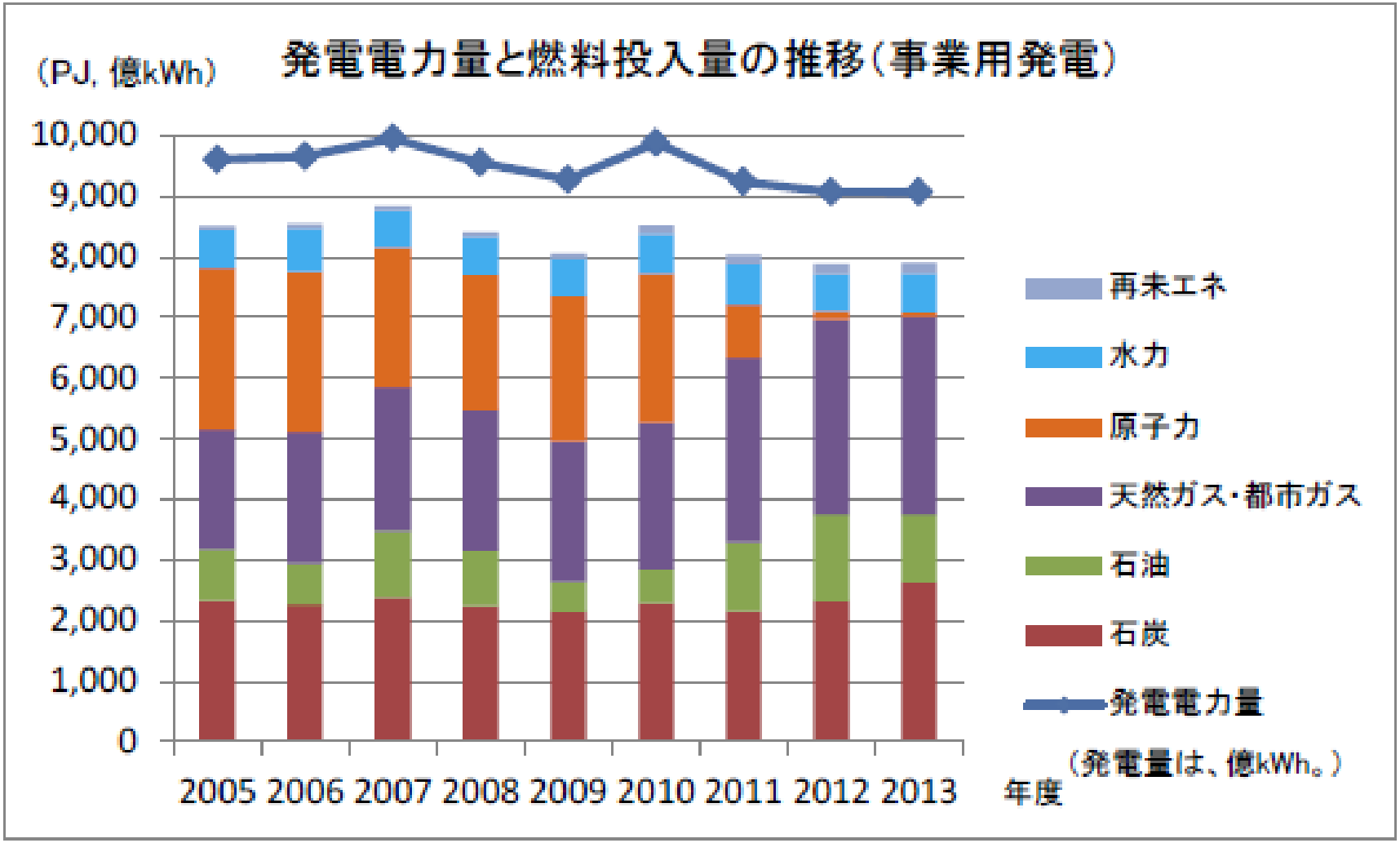


Eastern grid 100V, 50Hz

Total capacity for East-West interconnection = 1 GW

An East-West split electric grid

Effect of the Fukushima Accident on Electricity Supply Source



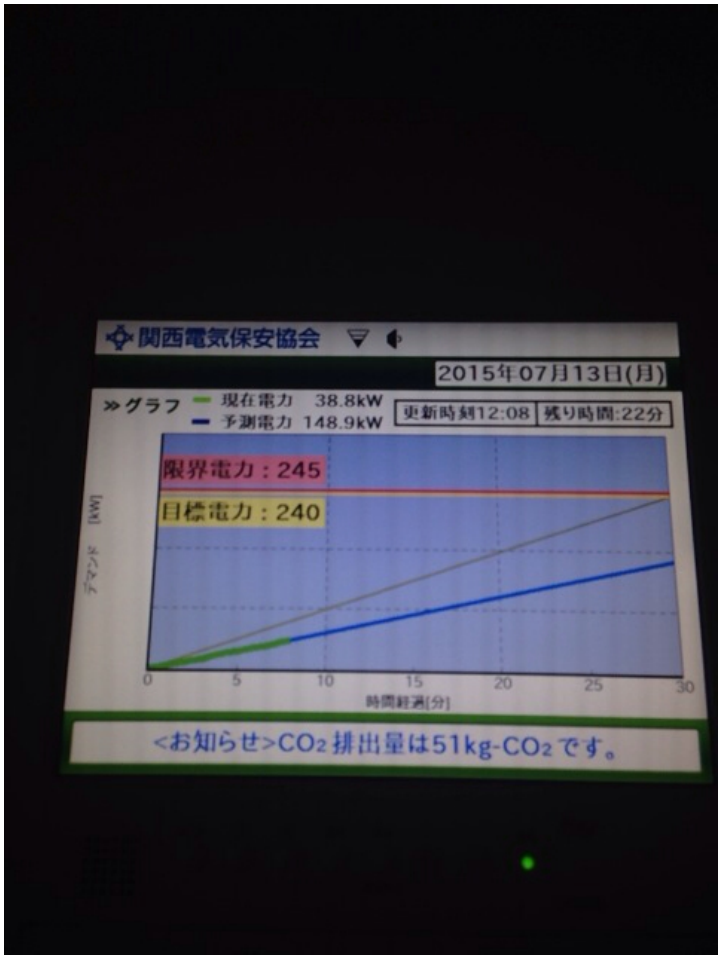
Measures to Reduce Electricity Demand

- Rolling Blackouts (Tokyo Electric Power Company)
- Electricity use Restriction Regulation (Law):
  - Mandatory load limits imposed on businesses
  - Monitoring devices installed at factories (separate slide)
- Peak power reduction initiatives:
  - reduction of train services by up to 30% in Easern Japan for the period 24th June to 22nd September 2011.
  - escalators were turned off.
  - vending machines were reprogrammed to turn off or reduce consumption.
  - Automated ticket gates (for Automated Fare Collection) were reduced in number.
  - turning off lights where possible
  - removal of electric light bulbs/tubes
  - replacement of fluorescent tubes with LED tubes (sometimes a subsidy incentive exists).
  - Increasing air conditioner temperature setpoints in summer and taking off suit jackets at work (usually, uniform codes are strict).
  - Pachinko parlours (gambling halls) implemented 3 holidays a month (big sacrifice!)

Measures to Reduce Electricity Demand (contd)

- Load shifting:
  - In the car manufacturing industry, a number of companies agreed on 19th May 2011, to work Saturday and Sunday, and make Thursday and Friday holidays from July through September 2011.
  - At its research facitilities, NTT (communications/IT company) also made Saturday, Sunday working days, transferring the holidays to Wednesdays and Thursdays.
  - **The Tokyo Prefectural Government Office** implemented the equivalent of Summer Daylight Saving, finishing work early with the objective to reduce the afternoon electricity peak demand by 25%.
  - Panasonic, Nihon Seishi, Daikin Kogyou and many other companies followed suit.
  - The annual National High School Baseball Final major games started early in the morning 09:00.
- Appeals through mass media and by other institutions.
- Incentives: 'cool project' (see separate slide)
- Self-monitoring of power demand (gadgets for sale at electrical/ electronics shops).

Measures: Factory Load Limit Monitor



Measures: 'Cool' Project in Kansai Region

An email is sent to people with smart meters (because they receive their electrical bills online). A coupon is offered which can only be redeemed during electricity use peak times. The idea is that one will have to leave his/her house to redeem the coupon, thus lowering electricity demand.

明日（7月10日）の節電のお願いとクーポンのご案内（みる電 出かけてCOOL プロジェクト） Inbox x

関西電力 <miruden_dekakete@a2.kepco.co.jp> 9 Jul (3 days ago)
to ndumiso.dlamini

Japanese > English Translate message Turn off for: Japanese

「はぴeみる電」会員の皆様へ

日頃より節電にご協力いただき誠にありがとうございます。

「明日（7月10日）ご利用可能なクーポン」を下記URLに掲載いたしました。

クーポン利用可能日時
7月10日（金）13:00～16:00

■クーポン一覧は以下URLよりご確認いただけます。
https://home.kepco.co.jp/miruden/ServiceTop/Lnavi/CoolProject

※明日は安定した需給状況となる見込みですが、本プロジェクトの効果を検証する目的で、配信いたします。
（クーポンはご利用可能です。）

※通信料・インターネット接続料は、お客さまのご負担になります。

※このメールは自動送信です。本メールへの返信によるご質問は承っておりません。ご了承ください。

◆メール配信停止
https://s-onegai-form.kepco.co.jp/1416986162/html/bylaw.html

◆お問い合わせ・ご質問
0120-924008（通話料無料）【受付時間】平日9時～20時

Note: it is possible that actions in response to this initiative increases overall energy consumption (gasoline use, embodied energy of products).

Lessons from the Experience

- Diversification is important: do not rely heavily on one resource or technology (gas for cooking and water heating)
- Operational flexibility is important: grid interconnectivity increases redundancy; gas turbines on standby.
- Technocrats are often wrong: measures taken by businesses showed that assumed customer need can be significantly off target.
- without a mechanism for deciding and monitoring who should reduce electricity consumption, appeals remain as the only option.
- There is a lot of technology waiting in the wings - what is often lacking is the political will to do things more sustainably:
  - people sensors to turn escalators on and off.
  - people sensors to turn lights on and off.
  - LED lighting.
  - Energy demand monitoring and control systems
  - Zone-specific air conditioning

Lessons from Elsewhere

- Peak Pricing in the USA:
  - Some power companies now have a special peak price for electricity to discourage excessive demand during peaktimes. Peak pricing programmes have achieved reductions in peak demand of about 20%.
- The TV meter in South Africa:
  - During the power crisis of the late 2000s, the was use of a power meter on TV screens to warn users when power demand was getting close to power supply.
  - Colour coded indicator placed on one corner of the screen.
  - Reportedly achieved approx 1% decrease in peak demand.
- The village with 'scheduled electricity power on'.

Thank you for your attention!

The End

Nuclear share of total electrical energy

主なエネルギー転換の動向

（単位：PJ。発電電力量は億kWh。）

		年度	1990	2005	2006	2007	2008	2009	2010	2011	2012	2013
石油精製		石油製品生産量	8,023	9,265	8,861	8,978	8,579	8,111	8,100	7,689	7,684	7,786
		（前年度比増減率%）			(▲4.4)	(+1.3)	(▲4.5)	(▲5.5)	(▲0.1)	(▲5.1)	(▲0.1)	(+1.3)
	生産内訳	ナフサ	391	727	725	760	687	717	667	629	633	679
		ガソリン	1,484	2,034	1,995	2,011	1,968	1,983	2,021	1,886	1,839	1,823
		ジェット燃料油	171	417	489	546	582	498	515	470	487	559
		灯油	873	1,029	908	848	747	743	722	705	667	646
		軽油	1,277	1,524	1,513	1,670	1,754	1,621	1,638	1,488	1,476	1,648
		重油	2,910	2,528	2,264	2,210	1,962	1,654	1,608	1,642	1,720	1,483
		他石油製品	919	1,007	968	934	879	895	930	869	862	949
事業用発電		発電電力量（億kWh）	7,495	9,597	9,652	9,947	9,545	9,271	9,873	9,229	9,066	9,063
		（前年度比増減率%）			(+0.6)	(+3.1)	(▲4.0)	(▲2.9)	(+6.5)	(▲6.5)	(▲1.8)	(▲0.0)
	燃料	石炭	877	2,333	2,269	2,384	2,248	2,149	2,286	2,157	2,326	2,629
		石油	1,927	848	672	1,095	901	493	564	1,133	1,422	1,128
		天然ガス・都市ガス	1,532	1,971	2,169	2,376	2,319	2,311	2,409	3,041	3,218	3,258
		原子力	1,883	2,662	2,646	2,306	2,237	2,398	2,465	875	137	80
		水力	755	629	712	602	619	627	659	667	603	628
		再未エネ	14	69	70	75	73	77	133	149	161	170
都市ガス製造		都市ガス生産量	684	1,414	1,557	1,666	1,629	1,613	1,716	1,765	1,774	1,704
		（前年度比増減率%）			(+10.1)	(+7.0)	(▲2.2)	(▲1.0)	(+6.4)	(+2.8)	(+0.5)	(▲4.0)
	原料	コークス炉ガス	19	2	0	0	0	0	0	0	0	0
		灯油	11	0	0	0	0	0	0	0	0	0
		製油所ガス	13	10	7	7	6	1	0	0	0	0
		LPG	137	89	67	66	63	63	68	72	72	74
		天然ガス	504	1,315	1,491	1,594	1,570	1,551	1,668	1,719	1,711	1,662
		再未エネ	1	0	0	0	0	0	0	0	0	0

www.enecho.meti.go.jp/notice/news_release/

Nuclear share of total primary energy

エネルギー源別一次エネルギー国内供給の推移

（単位：10^15J [PJ]、%）

年度	1990	2005	2006	2007	2008	2009	2010	2011	2012	2013
一次エネルギー総供給	20,202	23,755	23,773	23,795	23,150	21,686	23,200	22,047	21,730	21,973
[前年度比]			(+0.1)	(+0.1)	(▲2.7)	(▲6.3)	(+7.0)	(▲5.0)	(▲1.4)	(+1.1)
[2005年度比]			(+0.1)	(+0.2)	(▲2.5)	(▲8.7)	(▲2.3)	(▲7.2)	(▲8.5)	(▲7.5)
一次エネルギー国内供給※	19,695	22,858	22,897	22,987	21,812	20,864	22,157	21,224	20,827	20,999
[前年度比]			(+0.2)	(+0.4)	(▲5.1)	(▲4.3)	(+6.2)	(▲4.2)	(▲1.9)	(+0.8)
[2005年度比]			(+0.2)	(+0.6)	(▲4.6)	(▲8.7)	(▲3.1)	(▲7.1)	(▲8.9)	(▲8.1)
化石エネルギー	16,424	18,854	18,766	19,354	18,287	17,193	18,045	18,674	19,149	19,339
[前年度比]			(▲0.5)	(+3.1)	(▲5.5)	(▲6.0)	(+5.0)	(+3.5)	(+2.5)	(+1.0)
[2005年度比]			(▲0.5)	(+2.7)	(▲3.0)	(▲8.8)	(▲4.3)	(▲1.0)	(+1.6)	(+2.6)
[シェア]	(83.4)	(82.5)	(82.0)	(84.2)	(83.8)	(82.4)	(81.4)	(88.0)	(91.9)	(92.1)
石油	11,008	10,697	10,183	10,219	9,337	8,812	8,820	9,082	9,179	8,977
[前年度比]			(▲4.8)	(+0.4)	(▲8.6)	(▲5.6)	(+0.1)	(+3.0)	(+1.1)	(▲2.2)
[2005年度比]			(▲4.8)	(▲4.5)	(▲12.7)	(▲17.6)	(▲17.5)	(▲15.1)	(▲14.2)	(▲16.1)
[シェア]	(55.9)	(46.8)	(44.5)	(44.5)	(42.8)	(42.2)	(39.8)	(42.8)	(44.1)	(42.7)
石炭	3,314	4,763	4,823	5,037	4,920	4,384	4,982	4,654	4,862	5,277
[前年度比]			(+1.3)	(+4.4)	(▲2.3)	(▲10.9)	(+13.6)	(▲6.6)	(+4.5)	(+8.5)
[2005年度比]			(+1.3)	(+5.7)	(+3.3)	(▲8.0)	(+4.6)	(▲2.3)	(+2.1)	(+10.8)
[シェア]	(16.8)	(20.8)	(21.1)	(21.9)	(22.6)	(21.0)	(22.5)	(21.9)	(23.3)	(25.1)
天然ガス	2,102	3,394	3,760	4,098	4,029	3,998	4,244	4,937	5,108	5,085
[前年度比]			(+10.8)	(+9.0)	(▲1.7)	(▲0.8)	(+6.2)	(+16.3)	(+3.5)	(▲0.4)
[2005年度比]			(+10.8)	(+20.8)	(+18.7)	(+17.8)	(+25.0)	(+45.5)	(+50.5)	(+49.8)
[シェア]	(10.7)	(14.8)	(16.4)	(17.8)	(18.5)	(19.2)	(19.2)	(23.3)	(24.5)	(24.2)
非化石エネルギー	3,271	4,004	4,131	3,632	3,525	3,670	4,112	2,550	1,678	1,660
[前年度比]			(+3.2)	(▲12.1)	(▲2.9)	(+4.1)	(+12.0)	(▲38.0)	(▲34.2)	(▲1.1)
[2005年度比]			(+3.2)	(▲9.3)	(▲12.0)	(▲8.3)	(+2.7)	(▲36.3)	(▲58.1)	(▲58.5)
	(16.6)	(17.5)	(18.0)	(15.8)	(16.2)	(17.6)	(18.6)	(12.0)	(8.1)	(7.9)
原子力	1,884	2,662	2,646	2,306	2,237	2,398	2,465	875	137	80
[前年度比]			(▲0.6)	(▲12.8)	(▲3.0)	(+7.2)	(+2.8)	(▲64.5)	(▲84.4)	(▲41.6)
[2005年度比]			(▲0.6)	(▲13.4)	(▲16.0)	(▲9.9)	(▲7.4)	(▲67.1)	(▲94.9)	(▲97.0)
[シェア]	(9.6)	(11.6)	(11.6)	(10.0)	(10.3)	(11.5)	(11.1)	(4.1)	(0.7)	(0.4)
水力	810	668	763	647	663	659	703	715	648	672
[前年度比]			(+14.3)	(▲15.2)	(+2.4)	(▲0.5)	(+6.7)	(+1.8)	(▲9.4)	(+3.6)
[2005年度比]			(+14.3)	(▲3.1)	(▲0.8)	(▲1.3)	(+5.3)	(+7.1)	(▲2.9)	(+0.6)
[シェア]	(4.1)	(2.9)	(3.3)	(2.8)	(3.0)	(3.2)	(3.2)	(3.4)	(3.1)	(3.2)
再生可能・未活用エネルギー	577	674	723	679	626	613	944	960	893	909
[前年度比]			(+7.1)	(▲6.0)	(▲7.9)	(▲2.0)	(+54.1)	(+1.7)	(▲7.0)	(+1.8)
[2005年度比]			(+7.1)	(+0.7)	(▲7.2)	(▲9.1)	(+40.0)	(+42.4)	(+32.4)	(+34.7)
[シェア]	(2.9)	(3.0)	(3.2)	(3.0)	(2.9)	(2.9)	(4.3)	(4.5)	(4.3)	(4.3)
自然エネルギー	256	273	278	291	279	262	401	401	402	434
[前年度比]			(+1.9)	(+4.6)	(▲4.3)	(▲5.9)	(+52.9)	(+0.1)	(+0.1)	(+8.1)
[2005年度比]			(+1.9)	(+6.7)	(+2.1)	(▲3.9)	(+47.0)	(+47.1)	(+47.2)	(+59.1)
[シェア]	(1.3)	(1.2)	(1.2)	(1.3)	(1.3)	(1.3)	(1.8)	(1.9)	(1.9)	(2.1)
地熱エネルギー	16	28	27	27	24	25	23	23	22	22
[前年度比]			(▲4.7)	(▲1.0)	(▲10.4)	(+3.8)	(▲8.5)	(+1.7)	(▲2.6)	(▲0.4)
[2005年度比]			(▲4.7)	(▲5.6)	(▲15.4)	(▲12.2)	(▲19.7)	(▲18.3)	(▲20.5)	(▲20.8)
[シェア]	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
未活用エネルギー	304	373	418	362	323	326	521	536	469	452
[前年度比]			(+11.8)	(▲13.4)	(▲10.6)	(+0.9)	(+59.7)	(+2.9)	(▲12.5)	(▲3.6)
[2005年度比]			(+11.8)	(▲3.2)	(▲13.4)	(▲12.7)	(+39.5)	(+43.5)	(+25.6)	(+21.1)
[シェア]	(1.5)	(1.6)	(1.8)	(1.6)	(1.5)	(1.6)	(2.4)	(2.5)	(2.3)	(2.2)

（注1）総合エネルギー統計の改訂により、1990年度まで遡って数値が変更されていますので、ご注意ください。
また、エネルギー源別の発熱量に関して2013年度から改訂値を適用していますので、ご注意ください。
（注2）国内供給は、総供給から輸出と在庫調整を控除したもの。
（注3）自然エネルギーには、太陽光発電、太陽熱利用、風力発電、バイオマスエネルギーなどが含まれる。
ただし、太陽光発電及び風力発電は、1発電所の設備容量が1000kW未満の自家用発電は含まれていない。
家庭用のものは1000kW未満なので含まれていない）。
（注4）未活用エネルギーには、廃棄物発電、廃タイヤ直接利用、廃プラスチック直接利用の「廃棄物エネルギー回収」、廃棄物ガス、再生油、RPF等の「廃棄物燃料製品」、廃熱利用熱供給、産業蒸気回収、産業電力回収の「廃棄エネルギー直接活用」が含まれる。
（注5）括弧内の数値は、上段：対前年度比伸び率（%）、中段：2005年度比伸び率（%）、下段：一次エネルギー国内供給に占めるシェア（%）

Final Energy Use

部門別最終エネルギー消費の推移

（単位：10^15J [PJ]、%）

年度	1990	2005	2006	2007	2008	2009	2010	2011	2012	2013
最終エネルギー消費	13,540	15,671	15,693	15,446	14,359	14,089	14,698	14,300	14,126	13,984
[前年度比]		(▲0.4)	(+0.1)	(▲1.6)	(▲7.0)	(▲1.9)	(+4.3)	(▲2.7)	(▲1.2)	(▲1.0)
[2005年度比]	(▲13.6)	(0.0)	(+0.1)	(▲1.4)	(▲8.4)	(▲10.1)	(▲6.2)	(▲8.7)	(▲9.9)	(▲10.8)
企業・事業所他部門	8,809	9,930	10,095	9,840	8,956	8,757	9,239	8,978	8,746	8,737
[前年度比]		(▲0.7)	(+1.7)	(▲2.5)	(▲9.0)	(▲2.2)	(+5.5)	(▲2.8)	(▲2.6)	(▲0.1)
[2005年度比]	(▲11.3)	(0.0)	(+1.7)	(▲0.9)	(▲9.8)	(▲11.8)	(▲7.0)	(▲9.6)	(▲11.9)	(▲12.0)
[シェア]	(65.1)	(63.4)	(64.3)	(63.7)	(62.4)	(62.2)	(62.9)	(62.8)	(61.9)	(62.5)
製造業	6,350	6,617	6,877	6,798	6,052	5,901	6,381	6,241	6,074	5,929
[前年度比]		(▲1.2)	(+3.9)	(▲1.2)	(▲11.0)	(▲2.5)	(+8.1)	(▲2.2)	(▲2.7)	(▲2.4)
[2005年度比]	(▲4.0)	(0.0)	(+3.9)	(+2.7)	(▲8.5)	(▲10.8)	(▲3.6)	(▲5.7)	(▲8.2)	(▲10.4)
[シェア]	(46.9)	(42.2)	(43.8)	(44.0)	(42.1)	(41.9)	(43.4)	(43.6)	(43.0)	(42.4)
農林水産鉱建設業	670	345	340	341	286	287	302	286	306	281
[前年度比]		(▲9.5)	(▲1.4)	(+0.3)	(▲16.0)	(+0.2)	(+5.2)	(▲5.3)	(+6.9)	(▲8.1)
[2005年度比]	(+94.2)	(0.0)	(▲1.4)	(▲1.2)	(▲17.1)	(▲16.9)	(▲12.6)	(▲17.2)	(▲11.4)	(▲18.6)
[シェア]	(4.9)	(2.2)	(2.2)	(2.2)	(2.0)	(2.0)	(2.1)	(2.0)	(2.2)	(2.0)
業務他(第三次産業	1,789	2,967	2,878	2,702	2,618	2,569	2,556	2,451	2,367	2,527
[前年度比]		(+1.6)	(▲3.0)	(▲6.1)	(▲3.1)	(▲1.9)	(▲0.5)	(▲4.1)	(▲3.4)	(+6.8)
[2005年度比]	(▲39.7)	(0.0)	(▲3.0)	(▲8.9)	(▲11.8)	(▲13.4)	(▲13.8)	(▲17.4)	(▲20.2)	(▲14.8)
[シェア]	(13.2)	(18.9)	(18.3)	(17.5)	(18.2)	(18.2)	(17.4)	(17.1)	(16.8)	(18.1)
家庭部門	1,683	2,205	2,128	2,157	2,079	2,057	2,174	2,082	2,065	2,012
[前年度比]		(+4.0)	(▲3.5)	(+1.4)	(▲3.6)	(▲1.0)	(+5.7)	(▲4.2)	(▲0.8)	(▲2.6)
[2005年度比]	(▲23.7)	(0.0)	(▲3.5)	(▲2.2)	(▲5.7)	(▲6.7)	(▲1.4)	(▲5.6)	(▲6.3)	(▲8.7)
[シェア]	(12.4)	(14.1)	(13.6)	(14.0)	(14.5)	(14.6)	(14.8)	(14.6)	(14.6)	(14.4)
運輸部門	3,048	3,536	3,470	3,448	3,324	3,275	3,285	3,240	3,314	3,235
[前年度比]		(▲2.4)	(▲1.9)	(▲0.6)	(▲3.6)	(▲1.5)	(+0.3)	(▲1.4)	(+2.3)	(▲2.4)
[2005年度比]	(▲13.8)	(0.0)	(▲1.9)	(▲2.5)	(▲6.0)	(▲7.4)	(▲7.1)	(▲8.4)	(▲6.3)	(▲8.5)
[シェア]	(22.5)	(22.6)	(22.1)	(22.3)	(23.1)	(23.2)	(22.4)	(22.7)	(23.5)	(23.1)
旅客部門	1,549	2,118	2,066	2,055	1,986	2,007	2,005	1,982	2,043	1,976
[前年度比]		(▲3.1)	(▲2.5)	(▲0.5)	(▲3.4)	(+1.0)	(▲0.1)	(▲1.1)	(+3.0)	(▲3.3)
[2005年度比]	(▲26.9)	(0.0)	(▲2.5)	(▲3.0)	(▲6.2)	(▲5.3)	(▲5.3)	(▲6.4)	(▲3.6)	(▲6.7)
[シェア]	(11.4)	(13.5)	(13.2)	(13.3)	(13.8)	(14.2)	(13.6)	(13.9)	(14.5)	(14.1)
貨物部門	1,499	1,418	1,404	1,393	1,338	1,268	1,280	1,258	1,271	1,259
[前年度比]		(▲1.2)	(▲1.0)	(▲0.8)	(▲4.0)	(▲5.2)	(+0.9)	(▲1.7)	(+1.1)	(▲1.0)
[2005年度比]	(+5.7)	(0.0)	(▲1.0)	(▲1.8)	(▲5.7)	(▲10.6)	(▲9.7)	(▲11.3)	(▲10.3)	(▲11.2)
[シェア]	(11.1)	(9.0)	(8.9)	(9.0)	(9.3)	(9.0)	(8.7)	(8.8)	(9.0)	(9.0)

（注1）総合エネルギー統計の改訂により、部門区分が変更となり、1990年度まで遡って数値が変更されていますので、ご注意ください。
旧区分の「非製造業」は、新区分の「農林水産鉱建設業」に対応しており、旧「産業部門」は、新区分の「製造業」と「農林水産鉱建設
の合計と対応しています。新区分では、旧区分の「産業部門」と「業務他部門」を合わせて「企業・事業所他部門」としました。
また、エネルギー源別の発熱量に関して2013年度から改訂値を適用していますので、ご注意ください。
（注2）「前年度比」及び「2005年度比」は増減率（%）。
（注3）各部門の最終エネルギー消費には非エネルギー用途消費を含む。