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Position Statement (View, Suggestion, Explanation, Others)

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Externalities of Energy and Nuclear Power

The “externalities” of energy refer to the social effects arising from the process of producing the energy, but that are not reflected in the market price of the energy. A typical example is pollution. In Japan, when combustion gases from fossil-fuel power stations were released into the atmosphere in the days before any equipment was installed to remove sulfur oxides (SOx) and nitrogen oxides (NOx), the released SOx and NOx caused pollution. This in turn affected the natural environment, the health of local residents and the private property of third parties not directly related with the energy production activities. This is an example of the externalities of energy. Cases such as this with negative effects are also referred to as an external diseconomy or “external cost.” (Some externalities have positive effects, and they are referred to as “external economy.” This paper describes the negative externality, that is, external diseconomy or external cost, which are mainly discussed in relation with energy.) Later, efforts were made to prevent pollution by installing equipment to remove SOx and NOx. Costs incurred for installing such removal equipment or other measures were incorporated into the production price of energy. This means that the negative effects of combustion gases were reflected in the market price. This is referred to as the internalization of externality.

In a free market economy in general, the costs of mitigating various negative environmental effects (e.g., release of waste and hazardous materials) derived from the individual phases of economic activities such as production, distribution and use, had not been incorporated into the market mechanism.

The concept of externality itself was developed as far back as the 1920s. It started to attract industry attention in the 1970s when environmental effects (pollution) became apparent. In 1974, the Organization for Economic Co-operation and Development (OECD) announced the “Polluter Pays Principle,” and studies on applying the externality to the field of power generation started in the US in the 1980s. When liberalization of the electricity market in the US was being considered, electric utilities proceeded to review the externality assessment under the direction of the states that are in charge of deciding the electricity rates.

Meanwhile in Europe, in the course of development and expansion of the European Union (EU), to what degree the externality would attract attention was one of the concerns if a competitive electricity market was to be established. In the early 1990s, the ExternE (Externalities of Energy), a joint research project of the European Commission (EC) and the US Department of Energy (USDOE) was launched. This was a significant project in that the externalities of power generation systems were evaluated internationally and systematically. The results of research projects published before 1997 identified some technological challenges, and were subsequently updated as appropriate, the latest methodology being reported in 2005.

In Japan, as the retailing of electricity was partly liberalized in March 2000, the externalities of various power generation systems in the development of power sources have attracted attention throughout the economy, just as in

the US and Europe. In addition, in selecting an appropriate energy system to cope with global warming, it is well recognized that an assessment of externalities is very important. From the viewpoint of seeking effective and specific actions addressing the global warming, the externalities of power generation systems have become a major factor in reviewing energy problems, regardless of whether they are local or global.

The global assessment of externalities in recent years assumes the physical effects of individual pollutants and accumulates the damages by a bottom-up system. This method usually consists of the following four steps:

① Identify the effect to be assessed and select the elements of the external cost of the effect to be assessed.
② Assume changes of the environmental quality (e.g., factors indicating the status of contamination of air, water, soil, etc.) (to identify the amount of released pollutants, migration in the environment and the amount of exposure).
③ Assume physical effects on the environment, health, etc.
④ Convert the assumed physical effects into monetary values.

The result of an assessment of ExternE is shown below as an example of the externality assessment.

In the following table, the externalities of global warming effects, health effects on the public and personnel, physical damage, etc. were assessed in terms of economic aspects, and converted into the cost per kWh (EUR-cent, or 1/100 Euro) (1 kW × cost per hour).

As shown in the table, the externalities of nuclear energy range from 0.2 (Germany) to 0.7 (the Netherlands) (EUR-cent/kWh) depending on the country; compared with other power sources, they are the second lowest after wind power. This is mainly because nuclear power generation emits fewer greenhouse gases. Furthermore, the differences of the assessed values are relatively small for nuclear energy among the nations while for biomass, hydro and wind power, the assessment of the importance of the landscape and forests differs from country to country, causing relatively great differences.

The energy sources are determined by assessing various factors including the supply of resources, stability and price. The externalities have become increasingly important as one of the assessment factors.

Table: Example of Externality Assessment for Generation System (Result of Assessment of ExternE)

(EUR-cent/kWh)

Country	Coal	Oil	Natural Gas	Nuclear	Biomass	Hydro	Photovoltaic	Wind
Australia			1 - 3		2 - 3	0.1		
Belgium	4 - 15		1 - 2	0.5				
Germany	3 - 6	5 - 8	1 - 2	0.2	3		0.6	0.05
Denmark	4 - 7		2 - 3		1			0.1
Spain	5 - 8		1 - 2		3 - 5 *			0.2
Finland	2 - 4				1			
France	7 - 10	8 - 11	2 - 4	0.3	1	1		
Greece	5 - 8	3 - 5	1		0 - 0.8	1		0.25
Ireland	6 - 8							
Italy		3 - 6	2 - 3			0.3		
Netherlands	3 - 4		1 - 2	0.7	0.5			
Norway			1 - 2		0.2	0.2		0 - 0.25
Portugal	4 - 7		1 - 2		1 - 2	0.03		
Sweden	2 - 4				0.3	0 - 0.7		
U.K.	4 - 7	3 - 5	1 - 2	0.25	1			0.15
Annual average	4 - 7	4 - 7	1 - 2	0.4	1.2 - 1.6	0.4 - 0.47	0.6	0.13 - 0.17
* : Mixed combustion with lignite								

http://www.externe.info/

OECD: Organization for Economic Co-Operation and Development

EU: European Union

EC: European Commission

USDOE: United States Department of Energy

Reference

1. “Externalities of Energy and Nuclear Power,” Keishiro Ito, Satoshi Konishi, et al., Atomic Energy Society of Japan, 2006