Energy security with a high external dependence: the strategies of Japan and South Korea

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Summary

Apart from China, there are two other large energy consumers in North-East Asia: Japan and South Korea. These economies, which belong to the OECD, are highly dependent on imports (which account for over 80% of domestic consumption in both cases), especially oil and natural gas. In recent years their energy security has been subject to serious threats. This Working Paper briefly addresses the position and energy forecasts for the two countries. It proceeds to analyse the strategic responses of Tokyo and Seoul to the deterioration (whether perceived or real) of their energy security, highlighting the strengths and weaknesses of each approach. Finally, the paper details some of the lessons that other countries which are highly dependent on energy imports might learn from the experience of Japan and South Korea.

Contents

This working paper was written for the Energy Programme, led by Paul Isbell, of the Elcano Royal Institute. It also forms part of a project by the Research Group on the Growth of the World Economy (GICEM), led by Enrique Palazuelos (Madrid Complutense University), on the energy systems of the three great regions (EU, North America and East Asia) which are very dependent on energy imports. In 2007, the project received funding from the Autonomous Community of Madrid, within the framework of the IV Regional Research Plan. The writer thanks Enrique Palazuelos for his friendly and detailed comments, and Federico Steinberg for his editing of an earlier version of the present paper. Obviously, the author assumes exclusive responsibility for any errors and shortfalls which might remain.

Introduction

Energy security in East Asia is important not only for the economic development of a region which could become the centre of the world in the XXI century, but also for the energy situation in other parts of the world. For example, if the main Asian energy-consuming countries (China, Japan, India and South Korea) find themselves compelled to notably increase their consumption of natural gas, either in the form of liquid natural gas (LNG) or that transported by gas pipeline, the availability and prices of gas in Europe would doubtless be significantly affected.

In recent years, experts have understandably focused above all on the case of China, given the Asian Giant's high increase in energy demand. The interest in China has prevailed somewhat at the expense of analysis of the other great East Asian consumers, Japan and South Korea: economies well-known as being of great importance and which are also OECD members. Japan and South Korea are high in the rankings of the world's main energy consumers and importers: suffice, for the time being, to recall that Japan is the world's third-largest consumer of oil and that Japan and South Korea are the world's two biggest importers of coal and LNG.

Given their importance as energy consumers and importers, energy security –especially insofar as it affects self-sufficiency, reliability and security of external supplies, and the prices of purchases abroad– is forming an increasingly essential aspect of their economic development strategy.

The present paper has two objectives. First, it aims to analyse the scope and implications of Japan and South Korea's high external dependence. Secondly, it attempts to analyse the short and mid-term perspectives for this dependence and for the two countries' strategies for addressing the situation.

1. Energy Security in North-East Asia: An Overview

Energy security is a particularly important matter in North-East Asia, in view of the fact that this region is home to great world consumers, and given the high dependence with respect to imports, especially of oil and natural gas.[1] Although in recent years experts have stressed the case of China, as a consequence of the high increase in its demand,[2] there are two other countries in the region – Japan and South Korea– in which questions of energy security are at least as serious as in China.

In 2006, Japan occupied the fourth place in world energy consumption (behind the US, China and Russia), it was third in oil consumption (after the US and China), fourth for coal (behind China, the US and India) and sixth for natural gas and nuclear power. For its part, South Korea, of less demographic weighting and per capita income, is also a significant consumer of energy (it is tenth for primary energy, seventh for oil and sixth for nuclear power).

Net energy imports account for over 80% of consumption in Japan and South Korea, a proportion which is higher than Spain's and much higher than those of Germany and France. Furthermore, since Japan and South Korea do not have oil, natural gas and coal resources, they import practically everything that they need (as opposed to China, which does have significant coal and oil production, and which, until now, has even met its natural gas needs with its own production). Japan is the second-biggest importer of oil (behind the US), while South Korea is in fifth place, ahead of France and India. Japan and Korea are two of the world's biggest importers of LNG and coal.

[1] See the general studies on energy security in Asia in Isbell (2006), Pardesi *et al.* (2006), CRS (2007), Bubalo and Thirlwell (2007), Harris and Naughton (2007), Niquet (2007), Wesley (2007), Wu *et al.* (2007) and Cole (2008).
[2] In Spain, see working papers including Bustelo (2005) and Palazuelos and García (2007), among others.

According to the APERC (2007) index on energy insecurity for 2004, Japan and South Korea have a relatively high degree of energy diversification and are making a serious effort to advance in non-carbon based fuels. However, they have a very high dependence on net energy imports, weighted in terms of the weighting of each source over total consumption (although this is approximately on a par with that of the US), a very high dependence on oil imports, weighted in terms of the weighting of oil within primary energy consumption (76% in South Korea and 69% in Japan), and an extremely high dependence with respect to oil imports from the Middle East (80% in Japan and 76% in South Korea).

Table 1.1 displays the values of the index of energy insecurity proposed by Wu and Morrisson (2007), which refer exclusively to oil.[3]

Table 1.1. Index of energy insecurity (oil), 1995, 2005 and 2015p

	1995	2005	2015p
Japan	77.8	76.7	75.5
South Korea	82.5	76.3	75.2
Europe	46.6	46.0	46.2
US	38.9	41.6	42.1
China	12.9	35.8	45.2
India	47.9	56.3	59.3

Note: a higher index score equals higher insecurity.
Source: Wu and Morrisson (2007), table 1, p. 208.

The main conclusions in regard to the values for these indices in Japan and South Korea are that these two countries are very dependent on energy imports, oil imports and the supply of oil from the Middle East. The forecasts for 2015 of Wu and Morrisson's synthetic oil insecurity index (2007) would appear to suggest that the insecurity of Japan and South Korea will remain very high (in spite of a slight decrease in both cases), that is to say, much higher than the scores forecast for Europe (which will practically remain unchanged), for the US (which will grow slightly) and for China and India (which will rise considerably).

2. Japan's energy security strategy: the shadow of China

The energy system in Japan has two main features:[4] first, as stated above, the country is a very important consumer of energy;[5] secondly, it is highly dependent on abroad. Net energy imports accounted for 81.2% of its primary energy consumption in 2005, a percentage that is amongst the world's highest and which has hardly fallen since 1990 (in fact, it has increased slightly since 2001).[6]

In recent years, Japan has had to face up to growing challenges to international energy security (an increase in geopolitical risks in the main producing regions, the strong increase in demand from China and India, energy nationalism in certain countries, etc). This context has led the Japanese authorities to implement firm policies to increase government intervention in the internal and

[3] The index is a synthesis of three primary indicators: net oil imports in relation to oil consumption, weighted at 40%; oil consumption in relation to primary energy consumption, weighted at 35%; and imports from the Middle East as a proportion of total oil imports, weighted at 25%. In view of the primary indicators and weightings that it employs, it is obviously an index that may be questioned. See the somewhat more sophisticated international comparison of indicators in APERC (2007), although only for APEC member countries and territories.

[4] See a general overview of Japan's energy industry in EIA (2006).

[5] In short, in 2006 Japan accounted for 4.8% of the world's energy consumption, but this proportion was significantly lower than its weighting in the gross world product, which was 10.3% in 2005 (and 7.04% in purchasing power parity), according to the new World Bank estimates. See World Bank, *The 2005 International Comparison Program – Preliminary Results*, Washington DC, 2007.

[6] According to the *Energy Balances of OECD Countries*, it was 81.9% in 2004, a percentage which is similar to that of South Korea (82.1%), higher than that of Spain (77.1%) and, obviously higher than those of Germany (60.9%), France (50.1%) and the US (29.4%).

external markets, as well as to increase the country's energy security, factors which could lead to an increase in Japan's rivalry with China and South Korea.

But Japan is not only a large consumer and importer of energy. It is likewise a country which in terms of its energy development could serve to inspire others in many ways.[7] For example, in recent years its oil consumption in absolute terms and its per capita energy consumption have both fallen. Japan's energy intensity is currently lower than that of Germany and France, and substantially lower than that of the US. As Prime Minister Fukuda said at the Davos meeting of the World Economic Forum (in January 2008), energy consumption in industry has remained stable for 30 years, despite the fact that GDP has doubled, while CO_2 emissions per unit of GDP are amongst the lowest in the world (Fukuda, 2008). Moreover, the country is proposing to undertake significant investments in alternative energy sources. These could be promising (including, for example, those in the automobile, electronics and hybrid industries), and could turn Japan into a fundamental incubator of innovative techniques for the future of humanity. In addition, given its high level of development and its significant cooperation with other Asian countries, Japan's capacity for disseminating energy advances amongst neighbouring countries is very high.

2.1. Energy Production and Consumption

Production of primary energy reached 99.7 million tonnes of oil equivalent (Mtoe) in 2005 (for a consumption five times higher), of which 79.4 Mtoe were of nuclear origin. In other words, 75% of energy production in 2005 came from nuclear power, since resources of fossil or mineral fuels (coal, oil and natural gas) are practically non-existent, while there is very little hydraulic or other types of renewable energy. Production of primary energy in Japan is therefore very low, especially in comparison with other advanced countries. These include Germany (134.5 Mtoe), France (136.9 Mtoe) and the UK (204.3 Mtoe), according to IEA statistics (2007a and 2007b).

In 2006, according to the BP data (2007) primary energy consumption (PEC) stood at 520.3 Mtoe, making Japan the fourth biggest global consumer (behind the US, China and Russia), with a share of 4.8% of the world total (Table 2.1).

Table 2.1. Main consumers of primary energy in 2006 (Mtoe and % of world total)

Ranking	Country	Mtoe	% total world
1	US	2,326	21.4
2	China	1,698	15.6
3	Russia	705	6.5
4	Japan	520	4.8
5	India	423	3.9
6	Germany	329	3.0
7	Canada	322	3.0
8	France	263	2.4
9	United Kingdom	227	2.1
10	South Korea	226	2.1

Source: BP.

PEC distribution by energy type shows that oil remains the main source of energy (at 47% of PEC in 2005), followed by coal (22%), natural gas (14%) and nuclear power (11%). According to IEEJ data (Kanekiyo, 2007), since 1990 oil has fallen proportionately, coal and natural gas have risen, and the part corresponding to nuclear power has remained constant. Another of Japan's significant characteristics is that hydroelectric energy and renewable energies make up barely 6% of PEC, a proportion that has hardly altered since 1990 (Table 2.2).

[7] See, for example, 'Japan's Energy Conservation Obsession', *International Herald Tribune*, 7/I/2007, and 'Japan's Energy Wisdom', *International Herald Tribune*, 28/III/2007.

Table 2.2. Japan: consumption of primary energy by energy type (as % of the total), 1973, 1990 and 2005

	1973	1990	2005
Oil	77	57	47
Coal	15	17	22
Natural gas	2	10	14
Nuclear	1	10	11
Hydro-geothermic	4	4	4
New energies	1	2	2

Sources: IEA and IEEJ.

Another prevailing feature of the structure by energy types is that Japan (as is the case with South Korea) depends significantly on oil. At 45% in 2006 (47% in Korea), the percentage is higher than in China (21%) and India (28%), which continue to depend greatly on coal, but also greater than in Germany (38%) or the US (40%), where the relative weighting of natural gas is appreciably higher, according to BP data (2007).

The evolution of PEC in recent years shows relatively high growth in the 1980s (with an average annual growth rate of 2.0%) and even in the 19990s (1.4%). But since 2000, this expansion has been much slower (0.5% in 2000-2006). Indeed, as we shall see below, oil consumption has fallen since 1996, when it peaked at 5.81 million barrels a day (Mbd). In 2006, consumption fell to 5.16 Mbd. For the purpose of comparison, oil consumption in the US rose from 18.30 Mbd in 1996 to 20.58 Mbd in 2006.

Table 2.3 shows the distribution of the consumption of final energy by sector. It can be seen that the main sectors are heavy industry, at 40%, and commercial-residential, at 33%. The significant fall in the transport industry (and also heavy industry) since the 1980s stands out, as does the increase in the proportion corresponding to the commercial-residential sector.

Table 2.3. Japan: consumption of final energy by sectors (as a % of the total), 1973, 1980, 2002 and 2005

	1973	1980	2002	2005
Transport	16.4	55.4	27.4	26.5
Commercial/residential	18.1	21.4	31.6	33.1
Heavy industry	65.5	52.9	41.1	40.4

Sources: IEA, APERC and IEEJ.

In comparison with other developed countries, the relative weighting of heavy industry is fairly high (40%, as opposed to an average of 22% for the OECD as a whole), given that Japan still retains a significant industrial base, which, despite improvements in efficiency, continues to consume large quantities of energy.

The IEA forecasts (2007c) suggest that PEC will increase from 530 Mtoe in 2005 to 589 Mtoe in 2015, and to 601 Mtoe in 2030, with average annual growth rates of 1.1% in 2005-2015 (practically the same as for the period 1990-2005), and of barely 0.1% for 2015-2030. Worthy of note is Japan's much lower PEC growth in the past and forecast PEC growth with respect to China and India.

Table 2.4. Forecasts for primary energy consumption and oil, 2015 and 2030, with data for 1990 and 2005 (Mtoe and average annual growth rates in %)

PEC	1990	2005	2015	2030	AAGR (%) 1990-2005	AAGR (%) 2005-2015	AAGR (%) 2015-2030
Japan	444	530	589	601	1.2	1.1	0.1
China	874	1,742	2,851	3,819	4.7	5.0	2.0
India	320	537	770	1,299	3.5	3.7	3.5
OECD	4,518	5,542	6,180	6,800	1.4	1.1	0.6
World	8,755	11,429	14,361	17,721	1.8	2.3	1.4

TPEC	1990	2005	2015	2030	AAGR (%) 1990-2005	AAGR (%) 2005-2015	AAGR (%) 2015-2030

Japan	253	249	238	211	-0.1	-0.5	-0.8
China	116	327	543	808	7.2	5.2	2.7
India	63	129	188	328	4.9	3.8	3.8
OECD	1,893	2,247	2,385	2,478	1.1	0.6	0.3
World	3,261	4,000	4,720	5,585	1.4	1.7	1.1

Source: IEA, 2007.

Table 2.4 also reveals that consumption of oil in Japan has fallen since 1990 and that it will continue to do so in the coming decades.

The IEEJ forecasts for PEC distribution by types of energy (see Kanekiyo, 2007a and 2007b) indicate that the weighting of oil will continue to fall, in favour of natural gas and of nuclear power, while the proportion of coal will remain constant (Table 2.5). It is equally noteworthy that the weighting of hydroelectric energy, geothermic energy and the new energies will barely increase at all: from 6% in 2005 to 7% in 2030, after peaking at 9% in 2010.

Table 2.5. Japan: forecasts for primary energy consumption by energy type (as a % of the total), 2010 and 2030

	2005	2010	2030
Oil	47	44	37
Coal	22	18	18
Natural gas	14	14	18
Nuclear	11	15	20
Hydro-geothermic	4	4	2
New energies	2	5	5

Source: IEEJ.

In terms of consumption of final energy by sectors (Table 2.6), it can be seen that the proportions will remain practically unchanged during the coming decades. Thus, according to APERC (2006), in 2030 the weighting of heavy industry will be 39%, ahead of the commercial-residential sector (34%) and transport (26%).

Table 2.6. Japan: forecasts of consumption of final energy by sectors (Mtoe and % the total), 2010, 2020 and 2030

	2002	%	2010	%	2020	%	2030	%
Industry	141.6	41.1	147.4	39.7	152.4	39.0	156.6	39.4
Transport	94.4	27.4	102.8	27.7	104.9	26.8	104.4	26.3
Res/com	108.8	31.6	121.5	32.7	133.4	34.1	136.5	34.3
Total	344.8	100.0	371.7	100.0	390.7	100.0	397.5	100.0

Source: APERC.

2.2. Energy Imports

Net energy imports rose from 303.2 Mtoe in 1980 to 430.7 Mtoe in 2005. The latter figure represents 81.2% of consumption, a percentage that has increased since 2001 and that only recorded a slight decrease since 1990. These imports do not take into account imports for the nuclear industry. If they are included, dependence with respect to imports would rise to 96% (METI, 2007).

Table 2.7. Japan: Production, consumption and net imports of primary energy, 1980-2005 (thousands of Toe and % of consumption)

	1980	1985	1990	1995	2000	2001	2002	2003	2004	2005
Production	43,281	66,747	76,817	100,414	107,373	106,161	98,670	85,457	96,758	99,792
Consumption	346,526	364,903	445,966	502,449	528,936	520,836	521,652	516,106	533,201	530,463
NetM	303,245	298,156	369,149	402,035	421,563	414,675	422,982	430,649	436,443	430,671
Mn/PEC (%)	87.5	81.7	82.8	80.0	79.7	79.6	81.1	83.4	81.9	81.2

Source: IEA.

In terms of crude imports (4.19 Mbd in 2006), it is important to note two facts: in absolute terms they have fallen since 1997, when they reached a maximum of 4.59 Mbd; and they are largely from the Middle East (87%), a region where the main suppliers are Saudi Arabia, the UAE, Iran and Qatar (Table 2.8).

The percentage of oil imports from the Middle East is very high in Japan, compared with 47% for China, 24% for Europe and 17% for the US. In addition, it is likely that dependence with respect to oil imports from the Middle East will rise in the coming years, in spite of government attempts to develop supplies from other regions (Russia, Central Asia, Africa etc.) and to ensure increased use of natural gas and of nuclear power (Hosoe, 2005).

Table 2.8 also highlights several significant facts: imports from the Middle East are quite diversified by countries; the weighting of Iraq is practically zero; the weighting of Africa is now appreciable (especially for Sudan), and the very recent increase of that of Russia (3.5% in 2007) – which will surely increase greatly in the coming years–.

Table 2.8. Japan: imports of crude by regions and countries of origin, 2000-2007 (in %)

	2000	2004	2006	2007
The Middle East	87.9	88.9	89.2	86.7
Saudi Arabia	*24.2*	*24.5*	*30.0*	*26.9*
UAE	*25.5*	*25.3*	*25.4*	*24.5*
Iran	*12.8*	*15.0*	*11.5*	*12.1*
Qatar	*9.6*	*9.3*	*10.2*	*10.4*
Iraq	*1.4*	*2.2*	*1.0*	*1.0*
Russia	–	0.7	0.7	3.5
Central Asia	–	–	–	0.2
South-East Asia	sd	5.3	4.4	4.7
Indonesia	*4.8*	*3.5*	*2.8*	*3.0*
Africa	0.7	4.2	4.4	3.6
Angola	–	–	*0.8*	*0.2*
Guinea	–	*0.1*	*0.3*	*0.5*
Sudan	–	*1.8*	*2.6*	*2.5*
Australia	1.4	0.6	0.8	1.0
China	2.2	0.2	0.4	0.1
Total	**100.0**	**100.0**	**100.0**	**100.0**

Sources: IEA and METI.

As far as oil derivatives are concerned (table 2.9), according to the IEA data for 2004, the Middle East accounted for 46% of supplies, followed by Asia (31%; including 12% from South Korea and 8% from Indonesia) and the US (8%). These proportions have remained more or less stable in recent years.

Table 2.9. Japan: imports of oil derivatives, by regions and countries of origin, 1996-2004 (in %)

	1996	2000	2004
The Middle East	44.8	44.1	46.0
Saudi Arabia	*18.4*	*16.1*	*17.6*
UAE	*10.3*	*15.0*	*13.6*
Kuwait	*10.7*	*9.4*	*8.4*
Qatar	*2.2*	*2.0*	*4.4*
Asia	31.4	35.9	31.2
South Korea	*11.9*	*21.1*	*12.0*
Indonesia	*7.8*	*4.8*	*8.4*
Singapore	*5.6*	*3.2*	*3.7*
India	*1.0*	*1.9*	*2.8*
US	9.1	7.3	8.3
Former USSR	0.8	0.6	1.7
Rest	13.9	12.1	12.8
Total	100.0	100.0	100.0

Source: IEA.

The following suppliers stand out for natural gas imports: Indonesia (27%), Malaysia (23%), Australia (15%), Qatar (12%), Brunei (11%) and UAE (9%), according to METI data 2004 (Christoffels, 2007, p. 11). There are plans to increase the proportion imported from the Middle East, Russia and Australia. To date, these have been LNG imports (shipped by sea), although there

is currently a debate regarding the possibility of constructing a gas pipeline from Sakhalin, on Russia's Pacific coast (Akasura *et al.*, 2007).

Finally, Australia (33%) and Canada (27%) are the main countries for uranium imports. The proportion from Kazakhstan is still very low (1%), but there are plans to considerably increase it (Masaki, 2007).

Japan is now beginning to import significant quantities of oil and gas from Russia. There are plans for imports of Russian crude from Sakhalin and Siberia to rise considerably, as well as natural gas imports, not only from Sakhalin, but also from the Kovykta field, near Irkutsk, if the problems for the construction of a gas pipeline to the Pacific are overcome (Ahn and Jones, 2008; Masaki, 2008).

The Taishet-Skovorodino-Nakhodka oil pipeline is at design stage. This will link the oil sources to the west of Lake Baikal and the Pacific coast (Lee and Lee, 2006; Itoh, 2007). In 2003, China was initially able to ensure that the oil pipeline would not have this route, but rather that it would link Angarsk with Daqing (China). Nevertheless, Japanese diplomacy won the day and in 2005 Russia announced that it would build the Taishet-Skovorodino section and a first branch from there to Daqing (to supply China), followed by a second branch to Nakhodka (to supply Japan and Korea).

An underwater gas pipeline between Sakhalin and Japan could greatly increase Russia's gas exports, but it has remained at discussion phase until now. As is well known, Russia has two different projects in Sakhalin: Sakhalin 1 –in which ExxonMobil is participating– which exports oil to East Asia[8] and supplies natural gas to the rest of Russia, without having ruled out the possibility of gas exports too; and Sakhalin 2, which, in addition to Gazprom, features the participation of Shell, Mitsubishi and Mitsui, and which exports gas to Japan, Korea and the US.

2.3. Strategies to Guarantee Supply

2.3.1. Ways

Prior to 2006, important steps were taken to diversify energy sources and suppliers, as well as to create a strategic oil reserve and to invest in resources, via exploration and the development of oil and gas fields abroad (Hosoe, 2005; Yokobori, 2006; PAJ, 2007). More recently, the report coordinated by the Japan Forum on International Relations (JFIR), also known as the '27 recommendations', was delivered to Prime Minister Koizumi in May 2006 (see the complete text in JFIR, 2006, and a summary in Toichi, 2006). In June of 2006, the Ministry of Economy, Trade and Industry (METI) published the *New National Energy Strategy* (NNES) –see the complete text in METI, 2006, and a summary in Hughes, 2006; Masaki, 2006a, and ECCJ, 2007–. Lastly, in March 2007, the Diet of Japan definitively approved the Basic Energy Act, based on the NNES.

The analysis underlying Japan's new energy strategy is based on taking into consideration the growing challenges to the country's energy security that have arisen in recent years and which have been highlighted by many experts (see, for example, Evans, 2006; Christoffels, 2007; and Jain, 2007).

These challenges are both general (those affecting all the big consumer countries) and particular (those specific to Japan).

The general challenges are well known: awareness-raising of the finite nature of fossil fuels; an increase in the geopolitical risks in the main producing areas (terrorism, nationalisation, restrictions

[8] Sakhalin-1 will become increasingly important in Japan's crude supply. See 'Nippon Oil Buys Crude from Sakhalin-1 Under Long Term Contract', Bloomberg, 19/II/2008.

on foreign investment etc.);[9] the exhaustion of oil and gas reserves in the US and the EU; the high past and future increase in demand by China and India; global investments that are likely to be insufficient; and price increases, that are likely to prevail in the mid-term.

Japan's particular challenges are diverse. First, the increase in the demand from China[10] has had and will continue to have serious repercussions in Japan, given questions of geographic proximity and historic rivalry between the two countries. Secondly, in recent years there has been a heightening of competition with China and India for the oil and gas resources of the Middle East[11] and Russia, as well as with China and South Korea for resources in Central Asia.[12] In this context, the difficulties involved in solving the territorial disputes in the East China Sea (the Eastern Sea for the Koreans and the Sea of Japan for the Japanese) involving the Diaoyu or Senkaku islands and the small islands of Tokto or Takeshima (Lynch, 2007). Third, the likely increase in dependence with respect to the Middle East (APERC, 2006, p. 4; APERC, 2007, p. 66) is especially worrying given that geopolitical risks have increased significantly in that region, making it potentially very unstable –especially because of the situation in Iraq and Afghanistan and the dispute between the US and certain EU countries and Iran–. Fourth, as is the case in other producing zones, there is growing energy nationalism in Russia.[13] This phenomenon has caused serious concern in Japan: for Taro Aso, the second biggest risk for international energy security is that produced by the fact that 'resource nationalism has resurged throughout the world as a result of the high prices of oil and other minerals' (Aso, 2007, p. 37). Fifth, Japan's foreign policy, aligned with that of the US, has led to setbacks in Iran (Pontius, 2006; Masaki, 2006b) and might accentuate rivalry with China. Sixth, the international regulations on nuclear power (the non-proliferation regime) and climate change (the Kyoto Protocol) are additional challenges for countries having opted for nuclear power and which still depend heavily on fossil fuels. Seventh, the fact that Japan is developing links with non-traditional suppliers, such as those in Central Asia, Africa or Latin America, entails considerable lengthening of the supply chains. Eighth and last, in Japan the high proportion of energy transported through the so-called *chokepoints* (the straits of Hormuz, Malacca and Singapore) is especially worrying, in view of how susceptible they are to being affected by terrorism by a large-scale conflict (for example, between the US and Iran), as Watkins indicates (2006). For Taro Aso, insecurity in the straits is the third biggest challenge to international energy security in general and to that of Japan in particular: he highlights the need for 'further international co-operation for enhancing the security and diversity of energy transportation routes. The straits of Malacca, Singapore and Hormuz are particularly important' (Aso, 2007, p. 37).

Based on the foregoing analysis, the general objectives of the NNES of 2006 are the following three. First, more active governmental intervention in the markets, so as to create strategic links between the energy companies and the governmental institutions –with aim of ensuring greater security in the supply of resources (as a strategy it contrasts with the more liberal one of the 1990s)–. Secondly, a strengthening of resource diplomacy: economic aid, technical support, soft power, both in producing countries and in consumer countries competing with Japan (for example, aid for diversification and energy-saving in China), in order to reduce the competition in

[9] The former Foreign Affairs Minister, Taro Aso, wrote in an article published at the start of 2007 that the main risk to world energy security was the 'geopolitical uncertainty in the Middle East and other energy producing regions' (Aso, 2007, p. 37).

[10] And –although to a lesser extent– also that of other East Asian countries, and even India.

[11] In the next few years it is also likely that there will be an increase in dependency on demand from southern and eastern Asia with respect to the Middle East.

[12] Especially, at least for the time being, of oil and uranium and not so much gas (Masaki, 2007), although the situation may change once the gas pipeline between Turkmenistan and China has been built, in accordance with the two countries' 2007 agreement.

[13] As far as East Asia is concerned, this nationalism was patent in the case of Sakhalin-2, with the initial presence of Mitsui, followed by that of Shell and Mitsubishi, companies which were obliged to sell a majority holding to Gazprom in December 2006. The result is that since then the Russian company has controlled LNG exports to Japan. See Christoffels (2007, p. 44 onwards).

international demand for oil and gas. Third, an increase in emergency response capacity (with an increase in strategic oil and gas reserves).

The specific NNES objectives can be listed as follows:

(a) Diversification of the energy sources towards nuclear power, natural gas and the renewable energies, to which end the government proposes to reduce oil as a proportion of PEC from 47% in 2005 to 40% in 2030 and oil as a proportion of consumption in the transport industry from 100% to 80%, via the introduction of bio-ethanol and of electric automobiles, as well as by increasing the percentage of electricity of nuclear origin in total electricity from 30% to 40% in the same period. Likewise, the government seeks to strengthen Japan's dominant position on the LNG market, which has been somewhat weakened in recent years (Christoffels, 2007, p. 51 and ff.).
(b) Geographical diversification of suppliers: from the Middle East towards Russia, Central Asia, Africa (Libya or Nigeria), Australia, Latin America, Canada, etc, with the Siberia-Pacific coast oil pipeline being of 'strategic importance'.
(c) A substantial reduction in energy intensity, with an increase of 30% in GDP generated per unit of PEC between 2005 and 2030.
(d) An increase in stocks of oil and gas.
(e) Greater direct control on resources abroad. The government aims to increase the level of the so-called *equity oil* (oil controlled by national companies) from 15% of crude imports in 2005 to 40% in 2030.

2.3.2. Requirements and Demands

On an initial viewing, Japan's new energy strategy would appear to be sensible. Nevertheless, the objectives set might also appear to be extremely modest; although it is also true that they will not be easy to achieve.

Diversification towards sources other than oil and coal must be substantially quickened if Japan is to comply with its Kyoto Protocol commitments. According to the Protocol, Japan must reduce its greenhouse gas emissions by 6% in 2008-2012, with respect to 1990. However, it would appear difficult for the country to meet this target, given that in 1990-2005 emission of these gases actually rose by 7%, according to UNFCCC data.[14] Therefore, in order to comply with its commitments in the fight against climate change, Japan must accelerate the pace of restructuring of its energy industry towards nuclear power, hydroelectric energy and the renewable energies.

Moreover, the nuclear power projects –which are significant (there are 55 operating reactors, and a further 13 planned for 2030)– are to a certain extent blocked due to the technical problems they involve and the fact that public opinion is generally opposed to nuclear power. In July 2007, the Kashiwazaki nuclear power station (in Niigata prefecture) –the world's largest– which has seven reactors, was affected by an earthquake which measured 6.8 on the Richter scale, and had to be indefinitely closed. The resistance of local government to the construction of new power stations has put the brakes on the expansion of the nuclear programme, which aims to increase the proportion of electricity of nuclear origin to 40% of total electricity in 2030.

Significant difficulties must be faced in increasing the proportion of hydroelectric energy and, above all, the renewable energies (such as wind power). There is a lack of political will and there are very few initiatives, as shown by a forecast revealing that these forms of energy will hardly increase their weighting in PEC over the coming decades.

[14] UNFCCC, *National Greenhouse Gas Inventory Data for the Period 1990-2005*, FCCC/SBI/2007/30, 24/X/2007.

In regard to the second overarching objective –geographic diversification of energy imports–, at the outset, it must be stated that its progress is proving extremely slow as far as oil is concerned, as mentioned above (see Table 2.8 above).

Indeed, it may be possible that dependence with respect to the Middle East will actually rise. In the words of an APERC report, 'Despite oil's declining share in the primary energy mix, dependence on the Middle East is expected to rise as imports from Asia –such as Indonesia and Malaysia– decline' (APERC, 2006, p. 42).

The high dependence on the Middle East and the likelihood that this will remain (or even increase), over the coming years are especially serious, particularly in view of the fact that the percentage of oil imports controlled by Japanese companies is very low (15% in 2005), in spite of the repeated attempts to increase investments abroad (Mitchell and Lahn, 2007; Lahn, 2007).

Although links with Russia are both growing and promising (Koyama, 2007) and could lead to a reorientation of imports towards the former, financial and technical problems (the high cost and complexity of the planned oil pipeline between eastern Siberia and the Russian Pacific coast) have to be surmounted, as does the dispute over the Kuriles islands (or Northern Territories for the Japanese), as Buscynski (2006) points out. In addition, optimal exploitation of the Russian resources would require the collaboration of companies from Japan, China and South Korea, as well as the eventual involvement of the great US oil companies, given that exporting oil and LNG to the west coast of the US forms part of Russia's strategic interests (Atsumi, 2007, p. 42). However, the Asian companies have displayed precious little interest in partnership projects to date (Choo, 2006) and it remains to be seen if American companies finally decide to invest massively in exporting hydrocarbons from the Russian Far East.

In terms of the planned reduction in energy intensity, although it is very necessary, past experience would not appear to indicate that it will be easy to achieve. The improvement achieved between 1973 and 1990 did not continue into 1990-2005. Smil (2007) highlights two factors accounting for this change in trends: an increase in energy intensity in heavy industry, especially in metal-machinery and ceramics, and an increase of 45% in per capita consumption of residential electricity, due to increased home usage of electrical and electronic devices. Thus, while energy intensity in the US fell by 12%, in Japan it increased by 3%. The elasticity of PEC with respect to GDP, which was 0.12 in 1973-1980 and 0.51 in 1980-90, increased to 1.19 in 1990-2000 (Kanekiyo, 2007a). It is true that in 2000-04 it was 0.16, but this can be partly explained by the higher GDP growth during this period.

Table 2.10 shows that energy productivity (GDP in terms of kilogrammes of oil equivalent) fell by 1.4% between 1990 and 2005, while it increased by 25% in the US and by 32% in Germany. Per capita consumption of electricity rose much more in Japan (21.8%) than in the US (11.9%) or Germany (10.4%). Table 2.10 also shows that South Korea performed substantially worse than Japan.

Table 2.10. Consumption of primary energy and electricity, energy productivity and per capita GDP, for several countries

	PEC Mtoe 2005	PCpec Toe/inhab 2005	PCelc kwh/inhab 2004	Var90-04	GDP/kep US$ PPP 2004	Var90-04	GDPpcPPP US$ 2005
Japan	530.5	4.15	8,459	21.8	6.4	-1.4	31,267
South Korea	213.8	4.43	7,710	178.3	4.2	-6.3	22,029
US	2,340.3	7.89	14,240	11.9	4.6	25.3	41,890
Germany	344.8	4.18	7,442	10.4	6.2	31.6	29,461
Spain	145.2	3.35	6,412	63.3	6.9	-4.9	27,169

Sources: IEA, *Selected Indicators* and UNDP, *Human Development Indicators*.

With regard to strategic oil and gas reserves, it is curious that the Japanese government should insist, more than on increasing said reserves, on the possibility of having recourse to the IEA emergency mechanism and on the importance of the stocks of other consumer countries, such as China and India. In the words of former Minister Aso, 'As uncertain and vulnerable elements in the oil market increase, the role of the IEA in ensuring global energy security takes on new importance. The Agency's emergency response mechanism mobilises the 27 member countries to collectively release supplies from their oil stockpile in the event of unexpected supply disruptions [...]. An important task ahead of us is identifying how to work closely with non-member emerging economies [of the OECD] like China and India in enhancing their oil stockpiling system' (Aso, 2007, p. 37 and 38).

Insofar as control of resources abroad is concerned, it is worthwhile recalling that the proportion of imports executed by Japanese companies is barely 15%. There is an urgent need to increase this proportion, but it may not be easy to do so, in view of the setbacks suffered by Japan in recent years in certain of its investments abroad.[15]

Moreover, the possibility that similar problems could occur in central Asia must not be dismissed. Competition between Asia's national oil companies (ANOCs) is becoming very intense there. For example, it cannot be ruled out that China's rapprochement with Central Asia via Shanghai Cooperation Organisation (OCS) will cause growing difficulties for Japan in terms of its access to these supply sources (Herberg, 2007). However, Prime Minister Koizumi's visits to Central Asia (Kazakhstan and Uzbekistan) in December of 2006, and those of Minister Amari –the head of the METI–, in January of 2007, were apparently successful for Japan, at least insofar as the supply of uranium is concerned. Kazakhstan possesses the world's second largest reserves of this mineral, after Australia.

In conclusion, of the five specific objectives included in Japan's new energy strategy, it would appear that the following three are attainable: increasing efficiency by 30% by 2030 (as long as they change the habits of electricity consumption); reducing the part of oil in PEC to 40%;and increasing the proportion of electricity of nuclear origin to 40% (in the latter two cases, as long as the increase in nuclear power stations is not subject to technical or political setbacks). However, it is not at all obvious that the proportion of equity oil in the imports can be easily increased from 15% to 40%, in view of the heightened competition between Japanese, Chinese, Korean and Indian companies.[16] Lastly, it would appear very difficult to reduce the ratio of oil in the final energy consumption of the transport industry from 100% to 80%, given that such a reduction would require a very decisive commitment to biofuels such as ethanol, electric automobiles, engines based on photovoltaic cells and other systems; and it does not seem likely that this is going to happen without a change in the scope of car manufacturing and demand.

2.4. Conclusions

Japan's energy horizon and the main elements of its new strategy –as detailed in the foregoing sections–, point to several conclusions:

(1) Japan's growing energy insecurity may increase its already considerable frictions with China (Calder, 2007; Khan, 2007; Liao, 2007), unless energy-related questions are treated in

[15] In addition to the aforementioned case of Sakhalin-2, we should recall the Azadegan oil field, in Iran. In September 2004, a consortium of Japanese companies led by Inpex agreed to participate in its development, but the conflict between Washington and Teheran concerning the Iranian nuclear programme led to the Japanese consortium postponing its investment. Lastly, in October 2005, Iran reduced the Japanese holding in Azadegan from 75% to 10%. See Watkins (2006) and Christoffels (2007, p. 25 and onwards).

[16] Nevertheless, Toichi (2006) argues that –given that Japan's crude imports will be reduced from 4 to 3 million barrels a day between 2005 and 2030–, it is sufficient to double from 0.6 to 1.2 mbd the part controlled by Japanese companies in order to achieve the target of 40%.

isolation within the bilateral relationship (Gupta, 2008) and/or lead to higher cooperation on an international scale and between the two countries (for example in questions of maritime security).

(2) Japan's energy requirements may lead to it establishing increasingly closer links with Russia (as a way of reducing dependence on the Middle East), especially in the cases of the Siberian oil (via the future trans-Siberian oil pipeline) and the gas from Sakhalin and of Kovykta (Ahn, 2007). The importance that Central Asia might acquire in the future supply of oil and gas to Japan remains to be seen, although it would appear clear that this region (and especially Kazakhstan) will be of the utmost importance in obtaining mineral uranium.

(3) Avoiding frictions with China and promoting imports of resources from the former USSR require a framework of international cooperation (obviously including these two countries, but perhaps India and the US too, as has been stated by observers including Blank, 2006, and Kangas, 2007). Due to the existence of a historical rivalry this is a question on which little progress has been made until relatively recently (Choo, 2006).

(4) Japan needs to be more ambitious and muster a clear political will for the development of renewable energies, in view of the very low weighting that these forms of energy currently have despite the country's technical sophistication.

3. South Korea's Energy Security Strategy: Caught in a Stronghold

The Republic of Korea (henceforth South Korea throughout the present paper) is the world's 10th largest consumer of energy (at 233.4 Mtoe), ahead of Brazil and Italy, and almost on a par with the UK. It is the world's sixth biggest consumer of nuclear power, the seventh for oil, and ninth for coal.[17]

Like Japan, its external dependence is very high. In 2006, its net energy imports reached 188.8 Mtoe, that is to say 80.9% of its consumption. South Korea is a very important importer of coal and of LNG: the second in the world for both, after Japan. It is also the world's ninth largest oil importer.

From an energy security standpoint, South Korea presents a triple dilemma (Calder, 2005): a lack of energy resources, a high dependence with respect to oil, and a high dependence on the Middle East for oil and gas imports.

South Korea only has small anthracite deposits, and limited hydroelectricity resources, meaning that it has to use imports and wood consumption for energy generation.[18] Net imports, without taking nuclear power into account, totalled 96.5% of internal consumption (80.9%, as stated above, if the production of nuclear power is included). In 2006, oil accounted for 44% of primary energy consumption, a proportion which is higher than that for the world average (38%). Lastly, in 2006, the rate of dependence on imports of crude from the Middle East was 80.7%. In terms of LNG of imports, almost half of the imports in 2006 came from just two Persian Gulf countries: Qatar (25.6%) and Oman (20.7%), something which is important because two Asian countries (Indonesia and Malaysia) accounted for an additional 42%.

This being said, it must be remembered that, thanks to important development of the petrochemical industry, South Korea is a net exporter of oil derivatives. In 2005, exports totalled 35.1 Mmt, while imports were 19.8 Mmt.

[17] A general overview of South Korea's energy situation can be seen in EIA (2007).
[18] South Korea also has some uranium resources, which remain practically unexplored.

3.1. Energy Production and Consumption

Production of primary energy is very low (barely 44.6 Mtoe in 2006). Most of this production corresponds to nuclear power (37.3 Mtoe), to the wood and others category (4.3 Mtoe), to coal (2.1 Mtoe) and to hydroelectricity (1.3 Mtoe). Although production has risen considerably (it stood at 21.9 Mtoe in 1990), thanks to the efforts to develop nuclear power, hydroelectric energy and the renewable energies, it still accounts for only very small quantities.

Primary energy consumption (PEC) stood at 233.4 Mtoe in 2006, and high growth has prevailed in recent years (it was 93.2 Mtoe in 1990). Growth has been constant, except in 1998, when there was a reduction to 165.5 Mtoe from the 179.6 Mtoe of 1997, as a consequence of the financial crisis of that period. However, in 1999, PEC was already over 180 Mtoe, according to the BP data (2007). In 1980-2006, the annual average growth rate for PEC was 6.6%, almost as high as for GDP.

The main reasons for such high growth have been: the rapid rise in GDP (6.8% in 1970-2005, despite significant slowdown over the last decade), significant expansion of heavy industry (cement, steel and petrochemicals) which is very energy-intensive,[19] the marked progress of motorisation (car numbers rose from 557,000 in 1985 to 15.4 million in 2005), and the automation of the plants of the automobile and electronic component industries.

In terms of the structure of primary consumption by energy sources (Table 3.1), it is worth noting that in 1996-2006 the percentage rate for oil fell from 62.3% to 43.6%, in favour of coal (which increased from 18.5% to 24.3%), natural gas (the weighting of which rose from 6.7% to 13.7%) and, to a lesser extent, of nuclear power (11.8% and 15.9%, respectively). In spite of significant diversification in oil, the fossil fuels still account for 82% of consumption.

Table 3.1. South Korea: consumption of primary energy by energy types, 1995-2006 (thousands of toe and %)

	1995	%	2000	%	2005	%	2006	%
Coal	28,092	18.7	42,911	22.2	54,788	24.0	56,687	24.3
Oil	93,955	62.5	100,280	52.0	101,526	44.4	101,831	43.6
Natural gas	9,213	6.1	18,924	9.8	30,355	13.3	32,004	13.7
Nuclear	16,757	11.1	27,241	14.1	36,695	16.1	37,187	15.9
Hydroelectricity	1,369	0.9	1,402	0.7	1,297	0.6	1,305	0.6
Renewable	1,051	0.7	2,130	1.1	3,961	1.7	4,358	1.9
Total	**150,437**	**100.0**	**192,888**	**100.0**	**228,622**	**100.0**	**233,372**	**100.0**

Source: MOCIE.

With regard to distribution by sectors of the consumption of final energy, heavy industry accounts for the lion's share (56% in 2006), and the weighting of this sector has even risen in recent years. The importance of heavy industry in the consumption of final energy is due to the country's productive specialisation (heavy industry, petrochemicals, naval construction and car manufacturing) and to the development of an important refining industry.

Table 3.2. South Korea: Consumption of final energy by sector, 1996 and 2006 (in %)

	1996	2006
Heavy industry	51.4	56.0
Residential and commercial	24.0	20.7
Transport	22.6	21.0
Public and other	2.0	2.2
Total	100.0	100.0

Source: MOCIE.

[19] For example, ethylene production reached 6.5 million tons in 2005, a six-fold increase since 1985 (WP-EPP, 2006, p. 67).

As regards forecasts, APERC (2006) considers that PEC will reach 241.3 Mtoe in 2010, 303.5 Mtoe in 2020, and 351.7 Mtoe in 2030; that is to say, that it will rise by over 50% between 2006 and 2030, although the rate of growth during this period (1.7%) will be much lower than that recorded between 1980 and 2006 (6.6%). In recent years, the rate of growth of PEC (3.2% in 2000-2006) has been considerably lower than this average. The two main reasons for this lower PEC growth since the end of the 1990s are the change in the productive structure towards the services and the information technology industries, and the general efficiency improvements which are expected.[20] Thus, the elasticity of consumption with respect to GDP, which was 1.1 in 1980-2002, will be 0.6 in 2002-2030, according to the forecasts.

Table 3.3. South Korea: forecasts for growth in consumption of primary energy (Mtoe and %)

	PEC		AAGR
1980	41.4	1980-2002	7.4
2002	199.7	2002-2010	2.4
2010	241.3	2010-2020	2.3
2020	303.5	2020-2030	1.5
2030	351.7	2002-2030	2.0

Source: APERC, 2006.

As shown in Table 3.4, the forecasts of the Korea Energy Economics Institute (KEEI) would suggest that, in PEC, the oil ratio will fall from 43.8% in 2006 to 38.1% in 2020, in favour of natural gas, nuclear power, hydroelectric energy and the renewable energies. The proportion corresponding to coal will remain stable at 24%. It is noteworthy that, according to these forecasts, the total for hydroelectric energy and renewables will be barely over 4% of PEC in 2020, and that the fossil fuels will account for three-quarters of PEC in this year.

Table 3.4. South Korea: consumption forecasts for primary energy by types of energy, 2006, 2010 and 2020 (in %)

	2006	2010	2020
Oil	43.6	41.8	38.1
Coal	24.3	25.9	24.0
Natural gas	13.7	15.4	15.7
Nuclear	15.9	14.0	18.0
Hydro and RE	2.5	2.9	4.2
Total	**100.0**	**100.0**	**100.0**

Source: MOCIE and KEEI.

The forecasts for the distribution by sector of final energy consumption do not show significant changes, as shown in Table 3.5.

Table 3.5. South Korea: forecasts for consumption of final energy by sector, 2006 and 2020 (in %)

	2006	2020
Heavy industry	56.0	55.1
Transport	20.7	20.3
Res/com	21.0	22.1
Public and other	2.2	2.4

Source: MOCIE and KEEI.

3.2. Imports

The net energy imports were 188.8 Mtoe in 2006, equivalent to 80.9% of consumption. South Korea's foreign dependence is, therefore, extreme. This dependence, moreover, has risen from 74.1% in 1985 and 76.5% in 1990, although it has fallen slightly since 2000, as shown in Table 3.6.

[20] In addition, naturally, to the effects of the 1997-1998 financial crisis, which meant, for example, that oil consumption reached a maximum of 2.4 mbd in 1997. Consumption fell to 2 mbd in 1998. In 2006, at 2.3 mbd, the figure was even lower than in 1997, according to BP data (2007).

Table 3.6. South Korea: production, consumption and net energy imports, 1985-2006 (thousands of toe and %)

	1985	1990	2000	2006
Production	14,597	21,908	33,367	44,582
Consumption	56,296	93,192	192,887	233,372
NetM	41,699	71,284	159,520	188,790
Mn/Cons (%)	74.1	76.5	82.7	80.9

Source: MOCIE.

In 2006, South Korea imported 101.8 million tonnes of oil, which meant 100% of its consumption. Furthermore, as shown in Table 3.7, over 80% of these imports were from the Middle East, where Saudi Arabia, the UAE, Kuwait, Iran and Qatar are the main suppliers. In recent years, there has even been an increase in the dependence on the Middle East. Although dependence with respect to the Middle East is high, it is relatively diversified between countries from the region (Saudi Arabia, UAE, Kuwait, Iran and Qatar), as is also the case with Japan. There is still no significant increase in imports from Russia and Central Asia, although there is a slight increase in imports from Australia.

Table 3.7. South Korea: oil imports by regions and countries of origin, 1995 and 2005

	1995	2005
The Middle East	75.6	80.7
Saudi Arabia	35.2	29.1
UAE	11.0	17.5
Kuwait	3.9	9.2
Iran	10.6	8.3
Qatar	1.7	6.2
Asia	14.5	9.1
Indonesia	4.9	4.5
China	4.9	1.0
Africa	5.9	4.0
Australia	0.8	3.8
Former USSR	0.4	1.0

Source: IEA.

South Korea is a net exporter of oil derivatives, with a total of 15.3 Mmt in 2005 (16.4 Mmt in 2000). The main consuming countries of these derivatives that year were China (28.1%), Japan (22.7%), the US (12.7%) and Indonesia (9.2%).

The main suppliers of coal imports (54.4 Mmt in 2006) are Australia, China and Russia (Table 3.8). The strong increase in China's weighting is worthy of note. It had been zero in 1995.

Table 3.8. South Korea: coal imports by regions and countries of origin, 1995 and 2006 (thousands of mt and %)

	1995	%	2006	%
Australia	9,159.0	35.7	17,637.1	32.4
Canada	2,157.0	8.4	942.7	1.7
China	–	0.0	14,306.9	26.3
US	1,658.0	6.5	62.6	0.1
Russia	–	0.0	4,058.1	7.5
Other	12,681.0	49.4	17,414.7	32.0
Total	**25,665.0**	**100.0**	**54,422.1**	**100.0**

Source: MOCIE.

Given that South Korea is the second biggest world importer of LNG, the countries of origin of its imports are of great importance. All the gas imported to date has been in LNG form, due to the lack of gas pipelines, although several are planned. As Table 3.9 shows, halfway through the last decade over 90% of these imports were from two South-East Asian countries (Indonesia and Malaysia). The weighting of these two countries has fallen since then, due to factors including an increase in their internal demand. Qatar and Oman have become leading suppliers, and in 2006 these two Middle East countries accounted for almost half of the imports.

Table 3.9. South Korea: LNG imports by countries of origin, 1995 and 2006 (thousands of mt and %)

	1996	%	2006	%
Indonesia	6,262.1	65.6	5,060.0	20.1
Malaysia	2,572.2	27.0	5,545.9	22.0
Brunei	707.0	7.4	849.8	3.4
Qatar	–	0.0	6,458.8	25.6
Oman	–	0.0	5,220.9	20.7
Other (1)	56.7	0.6	2,087.9	8.3
Total	9,539.5	100.0	25,221.9	100.0

(1) Australia, Algeria, Nigeria, Spain and Abu Dhabi.
Source: MOCIE.

The forecasts for growth in imports indicate that there will be persistent growth in all energy imports (oil, coal and LNG), although it will be at a lower rate than that of recent years. According to APERC estimates (2006), from a base of 189 Mtoe in 2006, net imports may raise to 239 Mtoe in 2020, and 271 Mtoe in 2030. According to these data, gas imports could reach 72.9 Mtoe in 2030 (they stood at 31.5 in 2006), while oil imports could rise from 101.8 in 2006 to 135.6 Mtoe in 2030. It is predicted that coal will grow little, from 54.6 Mtoe in 2006 to 62.8 Mtoe in 2030.

3.3. Strategies to Guarantee Supply

South Korea's energy policy has been driven forward considerably in recent years. In February 2006, the national parliament passed the Energy Framework Act and in November of that year the President created a National Energy Committee, with four sub-committees (energy policy, technology, development of resources and conflict management).

South Korea's energy strategy has significant similarities with that of Japan, given that both countries have similar structural features; for example, very low internal production, high oil dependence and a high dependence on the Middle East.[21]

The five main objectives of South Korea's energy security strategy can be summarised as follows: diversification of sources of energy, diversification of suppliers, consolidation of strategic oil reserves, conservation, rationalisation and the quest for efficiency, and development of resources abroad.

First, the aim of resource diversification towards nuclear power and the renewables is the fruit of a desire to reduce external dependence and CO_2 emissions. Opting for LNG, although it might be of interest for reasons of pricing and the proximity of certain suppliers, only partially resolves these problems. Furthermore, the recent growth in LNG consumption has been incredible: having risen from 18.9 Mmt in 2000 to 32 Mmt in 2006.

Nuclear power has to face unfavourable public opinion, such that, as has already been mentioned, a significant increase in its contribution to PEC is not planned. The reverse is true for the renewable energies, which are now a priority objective. In particular, there is an official objective to increase the weighting of renewable energies (not including hydroelectric energy) in PEC from the 2.1% of 2005 to a total of 5% in 2011.

Secondly, South Korea aims to heighten the geographical diversification of its imports, by means of an increase in oil and gas imports from Russia and, to a lesser extent, from Central Asia.[22] For the time being, Africa and Latin America are seen as much lower priorities for the supply strategy. The growth potential for oil imports from Siberia and gas imports from Sakhalin is enormous. In 2005, the countries of the former USSR accounted for barely 1% of the imports of crude. LNG imports

[21] Note, however, that although the rate of self-sufficiency is similar in the two countries (18% with nuclear power and 4% without it), Japan's oil dependency is somewhat higher (47.4% in 2005) than that of South Korea (43.6% in 2006); the importance of the Middle East is also somewhat higher in Japan (88% as opposed to 81%).
[22] See 'South Korea Wins Kurdistan Oil Contract', *The Financial Times*, 15/II/2008.

from Russia are practically zero, in view of the fact that the four leading suppliers (Qatar, Malaysia, Oman and Indonesia), as stated above, account for 90% of said imports. As regards the possibility of ensuring that a gas pipeline reaches South Korea, the question is largely addressed as a measure to meet the energy requirements not only of Seoul but also of Pyongyang. This means that if the North Korean nuclear crisis were definitively resolved it could drive Russia and China to favour this option (Paik, 2005). This desire for diversification is very similar to that of Japan, and both countries are competing with China, especially in relation to Central Asia and Russia.

Third, the creation and extension of a strategic oil reserve is a priority not only due to the importance of the same in the event of supply problems, but also to the IEA recommendations to its member countries. South Korea joined in April 2001. The strategic reserve is equal to 90 days of imports, an increase on the 60 days recorded at the start of 2001 (WG-EPP, 2006, p. 104).

Fourth, Seoul is planning for much higher conservation, rationalisation and efficiency, in view of the fact that its energy intensity is very high for a country with Korea's level of development.[23] In 2005, primary energy consumption for each US$1,000 of GDP was 0.34 in South Korea, as opposed to 0.21 in the US, 0.18 in Germany, 0.16 in Italy, 0.14 in the UK and 0.11 in Japan (MOCIE-KEEI, 2007, p. 63). The official target is to reduce energy intensity to 0.30 by 2012, an aim which does not seem very ambitious. Per capita energy consumption is very high and even higher than that of Japan, despite the fact that there is a substantial difference in the level of development. PEC by inhabitant (in Toe per person) in 2005 was 4.43 in South Korea, 4.16 in Japan, 4.18 in Germany, 3.88 in the UK, and 3.16 in Italy; although, obviously, this is lower than that of the US, which recorded 7.89 Toe per inhabitant (MOCIE-KIEE, 2007, p. 63).

Finally, the government is attempting to foment greater activity in the development of resources abroad. However, Korean companies are entering into conflict with their Japanese and Chinese counterparts, especially where oil is concerned (Herberg, 2007; Mitchell and Lahn, 2007; Lahn, 2007). All being said, there is also an official target to increase the national companies' proportion of production abroad as a percentage of total imports from 3.7% in 2005 to 15% in 2013 for oil; and from 5.8% in 2005 to 30% in 2013 for LNG (Bang, 2007, p. 12).

3.4. Conclusions

South Korea's situation of energy insecurity is very similar to that of Japan, although there are naturally a number of differences. The two countries share a dependence which remains high with respect to oil and a very high dependence with respect to energy imports. The following two differences stand out most: dependence on the Middle East is somewhat lower in South Korea than in Japan (80.7% as opposed to 87.9%, respectively, in 2005); conversely, the South Korean situation is notably worse in terms of energy intensity and per capita energy consumption (for example, it is significant that PEC per inhabitant was 4.43 Toe in Korea in 2005, as opposed to 4.15 Toe in Japan, in spite of the difference in per capita income).

The conclusions given above for Japan also apply to South Korea, although with certain nuances.

First, South Korea's energy insecurity means that it is competing with China and with Japan, but without being able to wield either China's demographic and economic weighting or Japan's level of development, despite the fact that the Koreans have been trying hard for many years to equal and even surpass Japan –something which they have achieved in a number of heavy industries–. The size and per capita income difference vis à vis its neighbours, means that, to a certain degree, South Korea is caught in a stronghold.

[23] This high intensity is accounted for by inefficiency, but also by factors related to industrial specialisation and the importance of the refining industry.

Secondly, as with Japan, the will to diversify its imports from the Middle East –a region on which it has become increasingly dependent for oil and LNG in recent years– is driving South Korea to develop ties with Russia and, to a lesser degree, with Central Asia. If collaboration with Russia to secure oil from Siberia and Sakhalin-1 and gas from Kovykta and Sakhalin-2 is primordial in Japan's case, it is no less so for South Korea, with the particularity that –since it is a continental country– the eventual links by oil pipeline and gas pipeline would appear to be easier. However, it should be recalled that the situation in North Korea is an added factor which could complicate this relationship, or which could rather act to facilitate it, in view of the fact that a definitive solution to the energy problems of North Korea must involve the creation of supply channels throughout the peninsula.

Third, the need for more regional cooperation on matters of energy security is even more pressing for South Korea than for Japan, due to questions of size and those linked to the necessary improvement of inter-Korean relations. Thus, Seoul has a special interest in promoting energy cooperation in North-East Asia. It was not surprising, for example, that in 2004 it took the initiative in founding a mechanism to regulate ministerial level meetings, in order to develop inter-governmental collaboration on issues of energy cooperation. In 2004, said initiative was consolidated by the constitution of Intergovernmental Collaborative Mechanism on Energy Cooperation in Northeast Asia. Its headquarters are in Ulan Bator, and its member countries are South Korea, Russia, Mongolia and North Korea, although still not Japan and China.

Lastly, it is worth noting that the efforts to promote renewable forms of energy have been somewhat greater in South Korea than in Japan. While Seoul has set an official target to attain a 5% contribution of these energies (not including hydroelectric power) by 2011, Japan has no official target of this type, despite having a higher per capita income, and notwithstanding its technical superiority in certain industries.

4. Implications of the Strategies of Japan and South Korea for the EU and Spain

Although the implications are very diverse, the most significant may be listed below.

Firstly, regional cooperation is essential to improving energy security in North-East Asia. It would afford very diverse advantages (Chidester and Kessler, 2007): it would bring down supply prices; it would facilitate improved distribution of costs (since it would include more investors); it would improve the reliability of supplies; it would make it possible –via better inter-connections– to respond to emergencies with better guarantees; and it would ensure that projects involving several countries (for example, oil or gas pipelines from Sakhalin to South Korea, passing through North Korea) became more rational and efficient. However, cooperation is only just getting underway and, to date, it has essentially been limited to the East Asia Summit, which, at its Cebu summit (in January 2007), created a regional cooperation mechanism geared towards pooling efforts in the face of a generalised situation in this part of the world: energy inefficiency, a lack of development of renewable energies, a high dependence on the Middle East and insufficient collaboration between the Asian countries in supply terms (Bustelo, 2007).

The EU has a common energy policy that is of interest to North-East Asia (Gavin and Lee, 2007), given that its long-term strategy features measures including improvement of inter-connections, fomenting saving, reducing the effect of greenhouse gas emissions, and increasing the contribution of renewable energies to primary energy consumption –and that of biofuels in transport sector consumption–.

Within the EU, Spain has been very active in defending favourable positions, including those to promote a European energy market, to diversify supply sources, to stimulate renewable energy

sources, and to include political dialogue with the Mediterranean region (in particular Algeria and Morocco) as part of the EU's priorities.

Secondly, competition between the EU and North-East Asia for Central Asia's natural gas will surely be disadvantageous for both regions. In the future, it may be possible that Turkmenistan and Kazakhstan are connected by gas pipeline both with Europe (a trans-Caspian gas pipeline, that would connect with the southern Caucasus and with Nabucco) and with East Asia (via China, which has already signed an agreement with Turkmenistan,[24] or even via India,[25] although this second route would have to overcome serious political difficulties).

For the EU, the connection with Central Asia is a way of increasing access to resources (supply from Russia might prove to be insufficient, given the country's strong internal demand, scant investment in infrastructures, and the likely increase in European demand), diversifying the supply sources, and avoiding the pressures of Russia, which is increasingly inclined to wield its energy influence as the centrepiece of its foreign policy (Cornell and Nilsson, 2008).

If North-East Asia and the EU are simultaneously interested in Central Asia's gas resources, the results, if cooperation is lacking, could be negative for both sides.[26] It might therefore be advisable to commence some sort of dialogue on energy issues involving Central Asia, to take place during ASEM, or at a specially-created ad hoc forum.

Thirdly, the conjunction of Russia's strategic interest in bringing out the value of its eastern energy resources (Simonia, 2006) and the interest of the countries of North-East Asia in diversifying their supplies from the Middle East might lead to high a Asian dependence on Russia. The efforts which the EU has been making for a number of years now to reduce its dependence with respect to Russia could be a point of reference if, as planned, Japan and South Korea diversify their oil supply from the Middle East and diversify their gas imports from South-East Asia.

Fourth and last, Spain shares certain common features with Japan and South Korea: a high external dependence (81.2% in 2006, very similar to that of the two Asian countries), diversification from oil and coal towards gas and renewable energy sources,[27] diversification of suppliers, a serious problem of energy inefficiency, high greenhouse gas emissions etc.

In recent years, due to its great capacity for LNG imports, Spain has achieved quite significant success in diversification in terms of sources and geography. Between 2000 and 2006 it considerably reduced the relative weighting of coal and oil in favour of natural gas and the renewable energies, while simultaneously diversifying supplies of natural gas from Algeria towards countries like Nigeria, Qatar, Egypt and Trinidad and Tobago. This success was due to the big increase in its regasification capacity: Spain is currently the world's third-largest importer of LNG (behind Japan and South Korea) and its LNG imports account for practically half those of the EU as a whole. In addition, Spain has managed to create a considerable wind power capacity, although the increase in energy intensity between 1996 and 2004 prevented an increase in renewable energies as a proportion of total energy consumption. In other words, Spain is able to offer countries with

[24] The gas pipeline between Turkmenistan and the Chinese region of Xinjiang, via Uzbekistan and Kazakhstan, is planned for 2009. Spanning 2,000 kilometres, it will have the capacity to transport 30,000 million cubic metres a year. See Pao (2007).

[25] India has great interest in developing a pan-Asian network of natural gas inter-connections and, more specifically, in executing the TAPI gas pipeline (Turkmenistan-Afghanistan-Pakistan-India). See Tapi (2006) for an analysis of India's interests in the regional context.

[26] In more general terms, Paltsev and Reilly (2007) forecast that, if a regional gas market is developed in East Asia – connected with the Middle East, Central Asia and Russia– there could be a significant spiralling effect on gas prices in Europe.

[27] Although the weighting of oil is more or less similar in the three countries, Spain is ahead in terms of natural gas (21% of PEC, as opposed to 14% in both Japan and South Korea).

similar structural features –such as Japan and Korea– its experience in diversification of sources, especially with regard to the development of certain types of renewable energies –including wind power, of course– but also in production of electricity from waste and biomass.

And Spain itself could also learn from Japan and South Korea in relation to increasing regasification capacity, given that the totality of the two Asian countries' natural gas imports are in LNG format. Spain can learn from Japan in improvement of energy efficiency (conservation and saving): in 2005, its energy intensity was 0.11 Toe for each US$1,000 of GDP (2000), while this figure stood at 0.21 in Spain and 0.34 in South Korea. We should recall that, in Japan, oil consumption, as well as per capita energy consumption, has fallen in recent years[28], and that energy consumption in heavy industry has remained constant for 30 years. Japan is a very advanced country in terms of energy saving, as a consequence of its successful combination of cutting edge techniques (home appliances and low consumption cars, hybrid cars etc.), high petrol and electricity prices, frugality in daily life, the popular obsession with saving, subsidies for solar power and for the installation of fuel cells in homes, etc.

General Conclusions

As we have seen throughout this paper, Japan and South Korea are important consumers of energy, not only in terms of East Asia, but also on a world level; although their weighting has largely been overshadowed in recent times by the extraordinary rise of China. In addition, the two Asian countries have a dependence on foreign suppliers equal to over 80% of consumption, which they have not been able to significantly reduce in recent years. It is within this context that we have to analyse the effects that the recent changes in the world energy horizon (increasingly higher awareness of the finite nature of the fossil fuels, an increase in the geopolitical risks in the main producing regions, a large increase in demand from China and India, energy nationalism in certain countries, etc.) have had on the energy security strategies of Tokyo and Seoul.

Both countries are aiming to speed up diversification of sources away from oil and coal (which, jointly, still account for two thirds of primary energy consumption) and towards natural gas, nuclear power and renewable energy. This goal not only responds to a desire to reduce external dependence (which is worsened by the long and vulnerable transportation routes for crude and LNG), but also to the demands for a reduction of greenhouse gas emissions. Moreover, given that in both countries over 80% of oil imports are from the Middle East and that gas imports, in LNG form, are very concentrated in just a few South-East Asian and Middle Eastern countries, the governments have set themselves the target of increasing the weighting of Russia and Central Asia, and, to a lesser extent, that of Australia, Africa and Latin America, in their supplies from abroad. Given the important crude and gas fields that Russia is developing in western Siberia and Sakhalin, and the prospects for better access to the resources of Central Asia (particularly in terms of gas and uranium), it is likely that the importance of the former Soviet republics to the energy supply of Japan and South Korea will increase. But geographical diversification does entail a number of difficulties –especially in the case of oil, a resource for which dependence with respect to the Middle East might even increase–. This is not to say that LNG imports might not also increase, in view of the high internal consumption of countries such as Indonesia and Malaysia, whose resources are, moreover, the subject of fierce regional rivalry. Such a development would be worrying, especially in view of the fact that the crude or gas effectively controlled by Japanese and Korean companies has to date constituted only a small part of imports. Lastly, Japan and South Korea are seeking to reduce energy intensity; this is very high in the latter country (which has extremely high per capita energy consumption), and, although relatively low in the case of Japan, it has nevertheless increased over the last 15 years, as opposed to what has happened during this period in Germany or even in the US.

[28] At 4.15 tep, per capita PEC is, lower than in Germany and France, and half that of the US and Canada. See AIE, *Key World Energy Statistics 2007*, Paris, 2007.

The past experience and potential of Japan and South Korea in regard to energy security may be of tremendous interest to the EU and to Spain. On the one hand, the EU's common energy policy could, in certain aspects, serve as an inspiration for the development of regional cooperation in this respect in East Asia. This is still in its initial stages and is essential for management of the joint needs of countries like China, Japan and South Korea. From Southern Asia they will be joined by India very shortly. EU experience may also be useful as a mirror into which the two Asian countries could look in regard to dependence on supplies from Russia. In other words, the willingness of Japan and South Korea to reduce their dependence on the Middle East –a region which is potentially very unstable– could throw them headlong into the arms of Russia, and it is not clear that this would be wholly positive. It is obvious that geographical proximity and the importance of the resources from Sakhalin and western Siberia mean that it will be reasonable to increase the weighting of Russian supplies to East Asia, but such a development could lead to excessive dependence on this country, a situation shown by EU experience to not exactly be very advisable.

Another point to take into account is that the lack of cooperation between the two regions could lead to a significant increase in the price of gas in Europe. This might occur if both the EU and Eastern Asia establish gas pipeline links with Central Asia as is likely to be the case (given that the link between Turkmenistan and China is now under construction) and in view of the fact that demand in the Asian countries is likely to significantly increase. In order to avoid this scenario, which would also be harmful for Asian consumers, it would be advisable to establish a mechanism for dialogue and consultations between the EU and the East Asian countries on energy supplies in Central Asia.

Lastly, Spain could learn a lot from Japan and South Korea in terms of capacity for regasification and LNG imports, given the importance of these activities in the two Asian countries. It should not be forgotten that Japan and South Korea are the two leading importers of LNG and that they are quite far ahead of Spain, which is in third place. As is well known, the county's increased capacity for importing LNG has brought great benefits to Spain in its strategy to diversify energy sources and supplies, such that it will probably remain a priority in the coming years. Lastly, the converse is also true, insofar as the two Asian countries could also benefit from the lessons learnt in Spain's case, in terms of driving forward renewable energies in general and wind power in particular.

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