MERIA

IRAN'S ENERGY VULNERABILITY

By Paul Rivlin*

This paper examines Iran's energy balance and its vulnerability to international energy sanctions. Iran's warnings that it may stop oil exports are idle threats, because it cannot significantly reduce oil exports without inflicting massive damage on its own economy. By subsidizing all energy products, Iran has artificially boosted demand, while U.S. sanctions limit its ability to increase supply. As a result, Iran has become reliant on imports of gasoline and other products and so is exposed to potential international sanctions. Given sharply rising domestic demand, Iran claims to need nuclear power to generate electricity. The economic justifications for this claim will be examined.

THE IRANIAN ECONOMY: AN INTRODUCTION

Iran has a population of 68 million that is growing at about 1.4 percent per annum, resulting in an annual increase of about 950,000 people. Since the 1979 revolution, Iran's population has more than doubled. The labor force, which is about 22.3 million people, is increasing at 3.3 percent a year. As a result, at least 700,000 jobs need to be created per year to prevent a rise in unemployment.[1] In April 2006, unemployment was officially estimated at 2.7 million, or 12.1 percent, of the labor force.[2]

In 2004, gross domestic product (GDP) per capita was $2,320 and purchasing power parity GDP per capita was $7,530. If subsidies had been lower and the prices of basic commodities higher, then the purchasing power parity figure would have been closer to that of GDP per capita. Although oil exports have risen rapidly—from $28 billion in fiscal year (FY) 2000-2001 to an estimated $49 billion during FY 2005-2006—there is little evidence that this has transformed the economy. The balance of payments has strengthened, but the government budget has not.

According to the United Nations Development Program (UNDP), Iran, though rich in human and natural resources, has high levels of income inequality (with a high Gini coefficient of inequality of 0.45) and poverty (16 percent of the population is below the national poverty line). Economic growth per capita was stagnant during most of the 1980s and 1990s. While this has improved with the increase in oil revenues, the majority of the population has not benefited. Social policy has, however, been successful in improving health and education indicators.[3]

OIL AND GAS IN IRAN

Iran is a major producer of oil, with the second largest reserves in the world (see Table 1). In 2005, its share of world production was 5.1 percent, much less than its 11.5 percent share in world reserves. This paradox was common among all the other major Middle East oil producers as well. In 2005, Iran produced 4.05 million barrels per day (mb/d) of oil, compared to 6.06 mb/d in 1974, when oil production peaked. Iran has, after Russia, the second largest gas reserves in the world and is the fourth largest producer of gas in the world.

Table 1: Proven Oil and Gas Reserves, end 2005

Oil (billion barrels)		Share of World (%)	R/P* (years)
Iran	137.5	11.5	93
Saudi Arabia	264.2	22.0	65.6
OPEC	902.4	75.2	73.1
Gas (trillion cubic meters)			
Iran	26.74	14.9	+100
Russia	47.82	26.6	80
Qatar	25.48	14.3	+100

Source: British Petroleum (BP), *Statistical Review of World Energy* (BP, 2006).
* reserves production

In the period between April-September 2005, oil and gas revenues accounted for 75 percent of government revenue. During FY 2004-2005, they accounted for 62 percent. In the first half of FY 2005-2006, oil and gas exports accounted for 86 percent of total exports, and during FY 2004-2005 they accounted for 83 percent. The hydrocarbon sector—which includes crude oil production, gas, refining, and petrochemicals—accounted for 27.8 percent of GDP during the first half of FY 2005-2006 and 24.9 percent in FY 2004-2005.[4]

The role of hydrocarbons in the government budget, the national income, and the balance of payments from the period of FY 2000-2001 to FY 2004-2005 is outlined in Table 2. It shows that although their role in government revenues fell between FY 2000-2001 and FY 2001-2002 and then rose, government spending increased to such an extent during this period that the budget went into deficit. Without hydrocarbon revenues, the 2004-2005 deficit was almost 20 percent of GDP. The share of hydrocarbons in GDP rose by 7.4 percent, while their share in total exports remained over 80 percent throughout.

Table 2: Oil and Gas in Government Revenue, Exports, and GDP

Year	2000-1	2001-2	2002-3	2003-4	2004-5
Total budgetary revenues as share of GDP (%)	33.0	27.2	27.1	27.9	31.0
Oil and gas revenues as share of GDP (%)	22.2	15.5	16.3	16.8	19.1
Budget balance as share of GDP (%)	8.7	1.6	-2.4	-0.1	-0.3
Non-oil fiscal balance as share	-13.5	-13.9	-18.7	-16.9	-19.5

of GDP (%)					
Hydrocarbons as share of GDP (%, current prices)	17.5	14.9	22.7	22.8	24.9
Total exports ($bn)	28,461	23,904	28,237	33,991	44,403
-Oil and gas ($bn)	24,280	19,339	22,962	27,355	36,821
--Crude Oil ($bn)	21,011	16,806	19,380	23,113	31,731
--Refined products ($bn)	2,391	2,141	2,587	2,517	2,650
--Natural gas and other ($bn)	878	392	999	1,725	2,446

Source: International Monetary Fund (IMF), *Statistical Appendix* (IMF, 2006).

In FY 2004-2005, oil and gas export revenues of $36.8 billion equaled 321,463 billion rials (at the average annual exchange rate of $1 = 8,729 rials). This meant that revenues of 56,831 billion riyals ($6.5 billion) did not go directly into the budget. The difference was accounted for by the profits and revenues of the National Iranian Oil Company (NIOC), $5 billion of which were transferred to the government in FY 2005-2006 and FY 2006-2007. The importance of the hydrocarbon sector to the budget was, therefore, even larger than the budget figures for oil and gas revenues suggest.

Hydrocarbons are therefore crucial to the economy. The export of crude oil is by far the most important element. During FY 2004-2005, crude oil exports came to $31.7 billion, refined products equaled nearly $2.7 billion, and natural gas equaled $2.4 billion. Without exports of crude oil, government revenues, total exports, and GDP would collapse.

THE ENERGY MARKET IN IRAN

As the economy and the population have grown, so has the demand for energy. Rapid urbanization has also contributed to the rise in demand, as has the system of massive energy subsidies. The amount of crude oil available for export has been constrained by a growing domestic demand. In 1995, domestic consumption of crude oil was 1.292 mb/d; in 2005, it was 1.657 mb/d, a rise of 35 percent. In 1995, the domestic market consumed 34.5 percent of total production; in 2005, it used 41 percent of total production (See Table 3). Between 1995 and 2005, Iranian oil consumption rose by 28 percent, production rose by 8.1 percent, and exports fell by 2.5 percent. In the rest of the Middle East, production rose by 28 percent, consumption by 35.4 percent, and exports by 26 percent. Domestic consumption accounted for only 18.3 percent of oil production in the rest of the Middle East in 1995 and 19.4 percent in 2005.

Despite the fact that between FY 2000-2001 and FY 2004-2005 the domestic price of high octane gasoline rose by 120 percent and regular octane prices increased by just

over 100 percent, fuel prices in Iran remained a fraction of their world level. In early 2006, the price of gasoline was just $0.09 per liter (or $0.34 per U.S. gallon). While subsidies are common in the Middle East, Iranian domestic fuel prices were among the lowest in the world. The cost of producing a liter of gasoline was estimated to be $0.22, implying a subsidy of 60 percent. The import price was $0.48, implying a subsidy of 80 percent. During the same period, domestic oil consumption rose by nearly 11 percent, but consumption of gasoline for vehicles rose by 72 percent. Implicit subsidies on energy cost some $7 billion, or 15.5 percent, of government spending. These subsidies are a form of welfare payment that reduces the cost of living and helps maintain the popularity of the regime, especially among poorer sections of the population. Under the current five-year plan for the period of 2005-2009, energy subsidies are scheduled to be reduced to 1.7 percent of GDP.

Table 3: Iranian oil production, consumption, and exports, 1995-2005 (mb/d)

Year	Production	Consumption	Consumption as % of production	Exports
1995	3,744	1,292	34.5	2,452
1996	3,759	1,269	33.8	2,490
1997	3,776	1,221	32.3	2,555
1998	3,855	1,243	32.2	2,612
1999	3,603	1,319	36.6	2,284
2000	3,818	1,319	34.5	2,499
2001	3,730	1,331	35.7	2,399
2002	3,414	1,429	41.9	1,985
2003	3,999	1,513	37.8	2,486
2004	4,081	1,573	38.5	2,508
2005	4,049	1,659	41.0	2,390

Source: BP, *Statistical Review of World Energy* (BP, 2005).

GAS

Iran has the world's second largest gas reserves after Russia, with some 16 percent of reserves. Mainly as a result of the re-evaluation of the size of the massive offshore South Pars gas field, estimates of the size of Iran's reserves have increased by 12 percent since 2000. In 2003, Iran produced 124 billion cubic meters (bcm) of gas. The amount sold on local markets was 78 bcm, re-injection into oil fields accounted for 35 bcm, flaring was five bcm, and shrinkage six bcm. Non-associated gas accounts for 75 percent of total production. The Ministry of Petroleum has set a production target of 292 bcm for 2010. Technological progress in the upstream oil sector would reduce the need for re-injection, which is currently the most profitable use of gas.[5] The development of the gas sector, especially the South Pars field, will depend on the availability of foreign technology and capital. Domestic supplies will also depend on the re-injection needs of the oil sector.[6] Although gas production has increased rapidly over the last decade, it has not matched domestic demand, and a small deficit—which has been met by imports—has resulted. This is

in contrast to the rest of the Middle East, where domestic demand has grown more slowly than production, thus permitting exports to grow (See Table 4).

Table 4: Gas Production in Iran, 1995-2005 (billion cubic meters*)

Year	Production	Consumption	Balance
1995	35.3	35.2	0.2
2000	60.2	62.9	-2.7
2005	87.0	88.5	-1.5

Source: BP, *Statistical Review of World Energy* (BP, 2005).
*Excluding re-injected and flared gas

ELECTRICITY

In 2004, Iran had an installed electricity generation capacity of 34.3 gigawatts (GW). In 2005, it was expected to reach 36 GW, an increase of five percent, compared to annual increases of demand from seven to nine percent.[7] Most electricity is produced in steam boilers, using inefficient combined-cycle gas-turbine technology. These are powered by gas in the summer, when consumers need less gas for heating. In the winter, fuel oil is used because gas is need for home-heating, thus reducing the amount of gas available for export.

In 2004, electricity production was estimated to be 165 terawatt hours (TWh). At 2,299 kilowatt hours (KWh) per head, Iran has one of the lowest per capita levels of electricity production in the Middle East (about one third of the Saudi level and similar to the levels in Lebanon). Electricity demand has grown rapidly, partly as a result of the large subsidies that cost the government $2.63 billion in 2004. The low price of electricity means that the power company does not make profits and therefore cannot invest without government help. At the same time, it boosts demand and encourages waste. In 2003, residential users in Iran paid about 22 percent of the cost of electricity, while commercial users paid the full cost. The average rate of subsidy for all sectors was 61 percent of the cost. In 2003, between 75 and 80 percent of electricity was generated by gas power plants, with oil supplying 16 percent. In the mid-1970s, oil accounted for 50 percent of electricity generation.[8] According to the International Energy Agency, during the 2004-2030 period, Iran will need to invest $92 billion (in 2004 prices), equal to 1.3 percent of its cumulative GDP on its electricity network in order to add 54 GW to its generating capacity and to develop its transmission and distributions systems.[9]

The government has also encouraged the domestic use of gas in order to release more oil for export. In 1971, oil accounted for 84 percent of the primary energy demand. In 2003, the share was 50 percent. Between 1989 and 2003, total energy use rose by 5.6 percent per year to reach 136 million tons of oil-equivalent (mtoe). Iran's energy use is inefficient: In 2003, energy intensity in Iran was 0.3 tons of oil-equivalent (toe) per thousand dollars of GDP, some 30 percent higher than the average in the Organization for Economic Cooperation and Development (OECD) group of industrialized countries.[10]

Iran is also a significant importer of gasoline and other refined products. This is because domestic demand exceeds supply. Demand is encouraged by government subsidies, and production is limited by U.S. sanctions (see below).

THE OIL STABILIZATION FUND

In December 2000, Iran created the Oil Stabilization Fund (OSF) in order to cushion the government budget from fluctuations in oil revenues due to international price changes. Revenues from periods of high prices would be used when revenues were low. The third five-year development plan for 2000-2004 set a ceiling on the oil revenues that could be transferred to the budget. Revenues above the ceiling would be transferred to the OSF. If revenues were lower than the budget, funds could be borrowed from the central bank.[11] Since its creation, withdrawals from the OSF have been higher than budgeted. During the last six years during which oil revenues have been high and increasing, the government has been drawing from the OSF rather than making net deposits. Details of the OSF from FY 2000-2001 to FY 2004-2005 are given in Table 4. The table shows that the OSF grew by a net $3.5 billion between April 2001 (four months after it was set up) and April 2005, or by an average of $883 million per year. During this period, Iranian oil and gas exports came to $106.5 billion, or $26.6 billion a year. This was 83 percent higher than in the preceding four years.[12]

Allowance should be made for the repayment of foreign debt that totaled $1.6 billion following April 2001. Taking all these factors into consideration, the increase in OSF reserves was minimal.

Table 5: Transactions of the Oil Stabilization Fund, 2000-2005 ($bn)

Year	2000-1	2001-2	2002-3	2003-4	2004-5
Inflows	5,944	1,678	5,878	5,757	10,388
Net crude oil revenue of government	20,670	16,800	18,809	22,418	30,352
Budget allocation under the five-year plan	-11,731	-12,864	-11,058	-11,579	-12,083
Additional allocation to the budget	-1,654	0	-1,655	-5,331	-8,062
Extra budgetary allocation	-472	-815	-500	0	0
External debt repayment	-869	-1,600	0	0	0
Investment income	0	157	282	249	181
Outflows	0	324	5,094	5,396	9,354
Withdrawals for budget financing	0	0	4,531	4,361	7,512

Net lending to private companies	0	324	563	1,034	1,842
Net change in stocks	5,944	1,354	784	361	1,034
End of period stock of foreign exchange deposits	5,944	7,298	8,082	8,433	9,477

Source: IMF, *Islamic Republic of Iran: Statistical Appendix* (IMF, 2006), p. 26.

GASOLINE IMPORTS

One of the main reasons why spending from the OSF has been so high has been the need to import fuel. Iran's imports of mineral products, fuel, oil products, and their derivatives (including gasoline) have increased rapidly. In FY 2000-2001, the cost of imports came to $330 million and during FY 2004-2005 they totaled just over $3 billion.[13] In May 2005, President Mahmoud Ahmadinejad was quoted as saying that gasoline imports were costing $5 billion per year. Domestic production was 42 million liters per day, and imports were 25-26 million liters per day.[14] This meant that imports accounted for almost 38 percent of domestic demand. The International Energy Agency (IEA) stated that in 2003, Iran's gasoline output met only 40 percent of domestic demand. It also stated that gasoline imports in 2003 were 95 kb/d**,** costing $1.1 billion, and in 2004 they totaled 160 kb/d, costing $4.5 billion.[15]

Iran has to import petroleum products, because its refineries are inadequate both qualitatively and quantitatively. In January 2005, Iran had nine oil refineries, most of which were built before the 1979 revolution. In 2005, they had a combined capacity of 1.684 million barrels per day (b/d).[16] Iran's refineries produce much less gasoline than their European counterparts. Only 13 percent of Iranian refinery output is gasoline, which is half the European level. The refineries were badly damaged during the Iran-Iraq War. In 1980, they had a capacity of 1.3 mb/d. By 1982, their capacity had been halved as a result of the destruction of the Abadan refinery. Reconstruction began in the 1990s, after the end of the war. As a result of U.S. sanctions, Iran has found it very hard to maintain and expand its refinery capacity.

As a result of the weakness of the refining sector, Iran has, since 1982, imported refined products, and these imports have increased rapidly (see Table 6). In 2005, Iran imported an estimated 170,000 b/d of gasoline at a cost of $3-4 billion. Around 60 percent of this comes from a European oil trader, Vitol, with another 15 percent coming from India. It is estimated that in 2006, Iran consumed 462,000 b/d, of which it produced 58 percent and imported 42 percent.[17]

Table 6: Iran's Imports of Refined Petroleum Products, 1998-2003

Year	$ millions	tons
1998	111	936,211
1999	110	446,483
2000	238	1,003,236
2001	504	1,631,289
2002	507	2,154,040
2003	1,350	4,456,276

Source: UN, *International Trade Statistics Yearbook, 2000*, Vol. 1 (New York: UN, 2000); UN, *International Trade Statistics Yearbook 2003*, Vol. 1 (New York: UN, 2004).

The costs of these imports have not been passed on to the consumer. During FY 2004-2005, gasoline import subsidies cost $2.1 billion (1.3 percent of GDP). In FY 2005-2006, they were estimated at $4.4 billion (2.3 percent of GDP).[18] The rapid rise of these costs could not be borne, and in June 2006, the oil minister, Kazem Vaziri Hamaneh, announced that Iran would stop importing petrol starting in September 2006 and would begin fuel rationing. He said the decision to start rationing petrol was preferable to raising prices. In September 2006, the deputy oil minister said that plans were being developed to cut gasoline consumption by 30 percent, which would thus reduce the need for 75 percent of Iran's gasoline imports. The government would present proposals to parliament to raise gasoline and other fuel prices to international levels over the course of a five-year period and would introduce gasoline rationing within four months. Meanwhile, the government requested a further $3.5 billion to fund gasoline imports. Iran has plans to increase its refinery capacity, but this will be extremely difficult to achieve given the country's geopolitical position. One goal of this expansion is to allow Iran's refineries to process a heavier crude slate while decreasing the fuel oil cut. Currently, production from Iran's refineries is around 30 percent heavy fuel oil and only 16 percent gasoline.[19]

U.S. SANCTIONS AND THEIR EFFECTS

U.S. sanctions against Iran have their origins in 1979, when the U.S. embassy in Tehran was taken over. In 1987, President Reagan issued an executive order banning imports from Iran. In 1995, President Clinton imposed much stronger sanctions, citing the threat to U.S. national security as the reason. The executive order forbade U.S. companies and their foreign subsidiaries from conducting business with Iran and banned any "contract for the financing of the development of petroleum resources located in Iran."[20] In addition, Washington's Iran-Libya Sanctions Act (ILSA) of 1996 imposed mandatory and discretionary sanctions on non-U.S. companies investing more than $40 million annually in the Iranian oil and natural gas sectors. In August 1997, this was lowered to $20 million. As a result of the 1995 Executive Order, the U.S corporation Conoco was obliged to withdraw from a $550 million contract to develop the offshore Sirri A and E oil and gas fields. In 1997, President Clinton signed an executive order prohibiting virtually all trade and investment activities by U.S. citizens in Iran.

Since 2000, the U.S. has permitted the import of a limited number of Iranian products. Furthermore, since the 2003 earthquake in Bam, the United States has temporarily suspended the ban on the export of humanitarian items and money transfers to Iran. Under ILSA legislation, the United States can penalize foreign companies for investing in Iran, something that has run into opposition from a number of foreign governments. Between 1996 and 2005, Iran attracted an estimated $30 billion in foreign investment in its petroleum sector. The European Union (EU) opposes the application of ILSA sanctions to companies in member countries, and in 1996 directed EU companies not to comply with ILSA. Although ILSA sanctions against European companies have not been imposed, the threat of such sanctions has deterred some investment in Iran.

In July 2000, the U.S. State Department announced that it would consider sanctions against the Italian company Eni after it signed a $3.8 billion deal for the South Pars fourth and fifth development phases. In July 2001, despite ILSA, Eni signed a nearly $1 billion, five and a half year buy-back deal to develop the Darkhovein onshore oil field. In July 2002, the Australian company BHP Billiton was reported to be considering participation in a project to develop the Foroozan-Esfandiar oil fields. This project was eventually awarded to an Iranian firm. In May 2002, the United States announced that it would review a contract by Canada's Sheer Energy to develop an Iranian oil field to determine whether or not it violates ILSA. To date, no action has been taken on this matter.

Iran awarded contracts to the French company Total and to Malaysia's Petronas to develop the Sirri A and E oil and gas field project at a cost of $600 million, after Conoco was required to withdraw in 1995. The two firms then proceeded to develop the project. Total did not violate U.S. sanctions, because the deal was signed prior to ILSA's enactment.

In September 2000, the U.S. Treasury Department announced that it was investigating whether Conoco had violated U.S. sanctions in helping to analyze information collected by the National Iranian Oil Company (NIOC) on the Azadegan oil field, the largest oil discovery in Iran. Conoco denied that it circumvented sanctions, although it has also stated that it remains interested in helping develop Azadegan when sanctions are lifted. ExxonMobil also expressed interest. In November 2000, Iran granted Japan first negotiating rights over Azadegan, and agreement was reached between Japan and Iran for the Japanese firms Japex and Indonesia Petroleum (both majority-owned at the time by the Japan National Oil Company (JNOC)) to have priority negotiating rights to develop the field. In January 2001, the Iranian parliament approved development of Azadegan by foreign investors using the so-called "buy-back" model. This meant that since Iranian law prevented equity participation by foreigners, they would be paid in oil allocations.

Activity related to the Caspian Sea region has increased Iran's potential ability to engage in oil "swap" transactions. In 2004, PetroKhazakstan and Russia's Lukoil made exploration bids on Iranian oil blocks, but disputes between littoral states on the Caspian Sea have prevented any development in the oil and gas sectors.[21]

RECENT ECONOMIC MEASURES AGAINST IRAN

Investment in Iran's hydrocarbon sector has declined sharply since 2004. Conflicts among political factions and interest groups in Iran have combined with the

deteriorating international environment to bring a number of investment projects to a standstill. There have been disputes over the role of foreign companies, international banks have closed their credit lines to Iran, and international contractors have full order books as a result of business outside Iran.

In March 2006, it was reported that Nippon Oil of Japan would reduce its purchases of Iranian crude oil. Although the cut of 15 percent was from traders rather than from the company's long-term contracts with Iran, it has been interpreted as having political significance. Showa Shell, the largest Japanese importer of Iranian oil, has also reduced its purchases and is increasing those from Saudi Arabia.[22] In May 2006, the OECD downgraded Iran's credit rating for official credits and now assesses Iran at the same level of risk as countries with active insurgencies.[23] In June 2006, the Assistant Secretary at the U.S. Office of Terrorist Financing and Financial Crimes stated that the Union Bank of Switzerland (UBS) had ceased its activities with Iran; Credit Suisse announced that it would no longer establish new business relations with Iran. ABN Amro and HSBC have also curbed their dealings with Iran. Energy firms Baker Hughes, ConocoPhillips, and BP have reportedly suspended dealings with Iran. In September 2006, the U.S. Treasury banned Iran's Bank Saderat from access to the U.S. financial system.[24]

THE NUCLEAR PROGRAM AND IRAN'S ENERGY NEEDS

The fourth five-year plan (2005-2010) includes provisions to generate six gigawatts of electricity from nuclear power plants. This would add nearly 18 percent to Iran's generation capacity.[25] Do these plans make economic sense? There is very little public information available that would permit a proper economic analysis, and so two very partial and opposing studies are referred to below.

The first is by Muhammed Sahimi of the Department of Chemical Engineering at the University of Southern California. He stated that Iran would need 70 GW of electricity generating capacity by 2021, compared to 31 GW now, a 126 percent increase. To generate that quantity would require 112-140 million barrels of oil a year, given that 18 percent of electricity comes from burning oil. This would make Iran an importer of oil over the next decade, something that would destroy its finances. If by 2021 ten percent of Iran's electricity was supplied by nuclear power, 60 percent by natural gas, 20 percent by hydroelectric power, and five to ten percent by other sources, the need for oil would be eliminated. This would also bring environmental benefits. At present, there are 17,000 deaths per year as a result of pollution, much of which is due to Iran's aged and rapidly growing number of vehicles. Since 1980, carbon emissions have increased by 240 percent, from 33 million tons to 85 million.[26] Sahimi accepted Iranian electricity demand forecasts without investigating their sensitivity to subsidy changes and reductions in losses in the transmission and distribution system. In 2003, these transmission and distribution losses equaled 17 percent of supply, double the OECD average. According to the IEA, the elimination of subsidies would reduce electricity demand by six percent, oil demand by six percent, and gas demand by 13 percent.[27]

An opposing view comes from researchers at the U.S. Pacific Northwest National Laboratory and the Los Alamos National Laboratory. They concluded that the investments required to establish the entire nuclear fuel cycle—from mining to

fuel—were not justified by Iran's small uranium reserves. The program could not, in their view, produce nuclear fuel at internationally competitive prices. Iran's known uranium reserves are 1,427 metric tons, enough to supply the nuclear program for four years. If it is assumed that the estimated undiscovered reserves of 13,850 metric tons are used, the program would run out of fuel by 2023, shortly after the completion of the seventh proposed plant. The cost of a nuclear plant is estimated to be between $600 million and $1 billion, and Iran's nuclear power programs envisage the construction of seven to 20 such plants. The minimum cost would therefore be $4.2 billion and the maximum $20 billion.[28] As a result, the production of electricity from nuclear power plants would have to be subsidized.

Neither of the studies quoted provide adequate information to make a judgment. The official report is classified and may contain more economic analysis, while Sahimi's remarks are largely political and contain very little economic analysis. Assuming that Iran is developing nuclear power for civilian use only, it is possible to make the following comments: While it is often wise to not to put all one's eggs in one basket, if the purchase of a new basket is very expensive, then diversification may not be the optimal strategy. Furthermore, the main problem facing Iran's energy planners is that demand has grown rapidly, because energy prices are so low. If prices went up, demand would fall, and the shortages of energy would ease. The other problem is that supply is constrained by the U.S. sanctions that have made development and maintenance of the oil fields problematic. A nuclear program will not solve this problem. In fact, because an increasing number of countries believe that Iran's nuclear intentions may be weapons-oriented, sanctions are likely to be strengthened rather than weakened. This would weaken Iran's hydrocarbon sector even further.

IRAN'S ROLE AS AN INTERNATIONAL SUPPLIER OF OIL

In 2005, Iran exported about 2.3 mbpd of crude oil (see Table 7), equal to 4.6 percent of world exports. The world economy may be able to cope if such a quantity were withdrawn from the market. Surplus capacity in the Organization of Petroleum Exporting Countries (OPEC) is between 1.3 and 1.8 mbpd, equal to between 57 percent and 78 percent of Iran's exports. If Iran ceased exporting and all OPEC surplus capacity were used for production, then the net reduction of oil on world markets would be between 506,000 barrels per day (b/d) and 989,000 b/d. Against this, spare capacity in non-OPEC suppliers should be considered, as should the role of international stocks.[29]

Table 7: OPEC Oil Production (million barrels per day)

	July 1, 2005	August 2006	August 2006	August 2006
	OPEC 10 Quota	Production	Capacity	Surplus Capacity
Algeria	0.894	1.380	1.380	o
Indonesia	1.451	0.890	0.890	0

Iran	4.110	3.750	3.750	0
Kuwait	2.247	2.600	2.600	0
Libya	1.500	1.700	1.700	0
Nigeria	2.306	2.200	2.200	0
Qatar	0.726	0.850	0.850	0
Saudi Arabia	9.099	9.300	10.500-11.000	1.200-1.700
UAE	2.444	2.600	2.600	0
Venezuela	3.223	2.450	2.4500	0
OPEC 10	28.000	27.720	28.920-29.420	1.200-1.700
Iraq		1.900	2,200	0
Crude Oil Total		29,335	31,120-31,160	1,200-1,700
Other liquids		4,168		
Total		34,088		

Source: Energy Information Administration, *Short-Term Energy Outlook* (EIA, September 2006).

As the crisis over its nuclear program has developed, Iran has threatened to stop oil exports and thus cause the international oil price to jump. There have also been anxieties that Iran might close or otherwise interfere with oil exports from other Gulf States by taking or threatening military action. Where do Iran's oil exports go? Who would be affected by a cessation of Iranian exports?

Iran's main oil customers are Japan (570,600 b/d), China (285,000 b/d), South Korea (196,000 b/d), Italy (194,000 b/d), France (142,000 b/d), the Netherlands (139,000 b/d), and Turkey (138,000 b/d).[30] The main importers are countries that have been reluctant to impose sanctions.

Iranian oil exports could decline because of the need to cannibalize some oil wells due to a lack of spare parts. This cannibalization could also cause damage to closed oil wells that would affect output in the future. In March 2005, the Iranian oil minister threatened foreign oil companies with expropriation. Even more drastic than the ending of Iranian oil exports would be an attempt by Iran to block exports from other Gulf States. This could potentially reduce world supply by up to 40 percent, with catastrophic consequences for the world economy.

According to the International Energy Agency, the type of oil (medium gravity, high sulfur) that Iran exports is similar to that exported by other Middle Eastern suppliers.[31] If Iran ceased exporting, then other Middle Eastern countries could replace part of the Iranian supply with

similar kinds of oil. According to the executive director of the IEA, it would be able to compensate for the loss of Iranian exports out of its strategic stocks.

IEA member countries hold emergency oil reserves equivalent to at least 90 days of net oil imports of the previous year. In early 2006, these total stocks totaled four billion barrels, of which about 1.4 billion were government-controlled public stocks (government-owned or held by an agency). The dispute over the Iranian nuclear program has not yet affected world oil supply, although it has contributed to the rise in prices. If Iran were to cut off supplies, the world would lose 2.7 mb/d. IEA member states would be able to offset this shortfall: Their stocks would be able to compensate for Iranian exports for up to a year and a half.[32] If other OPEC and non-OPEC producers increased their output, then stocks would last even longer.

CONCLUSIONS

The world could cope without Iranian oil far longer than Iran could manage with the loss of oil revenues. Iran is far more vulnerable to international energy sanctions than the rest of the world is to Iranian sanctions since the country is massively reliant on crude oil export revenues and relies on imports of gasoline and other refined products to cover a significant share of domestic demand.

Iran's energy use is subsidized to such an extent that its exports of crude oil have been limited. This was not a problem in recent years when oil prices were high, but if such subsidization continues, the volume of oil available for export may fall. If U.S. sanctions against Iran continue, or if they are strengthened or become international as a result of a UN decision, then the development and/or maintenance of the oil fields may be threatened even further. This could lead to a decrease in production with consequences for exports and/or domestic consumption. The imposition of petroleum rationing announced for autumn 2006, if effective, would be a measure of the strength of the regime.

If Iran were to close the Gulf and prevent exports from neighboring Arab countries, then the results would be disastrous, not only for the rest of the world, but also for Iran. It is this scenario that scares so many Western policymakers. This type of action would amount to an attack on its Arab neighbors as well as on its trading partners and others abroad. Such a scenario assumes that the regime in Tehran is willing to contemplate a military conflict as well as economic collapse. For some, this may not seem entirely unrealistic.

According to Iran's leaders, the nuclear program has been developed to provide electricity. Let it be assumed, for argument's sake, that this is the real and only reason for the program. If so, it is worrying that a country so rich in hydrocarbons is in need of nuclear power. It is an indication of the wastefulness of the current policies that the regime has to buy off the public with massive subsidies, resulting in energy wastage, pollution, and consequent damage to the health of the population. At a deeper level, it reflects the weakness of the regime.

**Paul Rivlin is a senior research fellow at the Moshe Dayan Center for Middle East and African Studies at Tel Aviv University.*

NOTES

[1] International Monetary Fund (IMF), *Islamic Republic of Iran*: *2005 A*rticle *IV Consultation-Staff Report*, (Washington, D.C.: IMF, 2006), p. 8.

[2] Central Bank of the Islamic Republic of Iran, *Economic Trends*, No. 43 (Fourth Quarter, 2005-2006), p. 1, http://www.cbi.ir.
[3] United Nations Development Program (UNDP), *Country Program for the Islamic Republic of Iran 2005-2009*, p. 3, http://www.undp.org/ir.
[4] IMF, "Islamic Republic of Iran: Statistical Appendix," *Country Report*, No. 06/129, pp. 5, 7, 10.
[5] Re-injection of natural gas into an underground reservoir containing both natural gas and crude oil increases the pressure within the reservoir and thus induces the flow of crude oil.
[6] International Energy Agency (IEA), *World Energy Outlook 2005* (IEA, 2005) pp. 364-68.
[7] Energy Information Admin. (EIA), *Country Analysis Brief: Iran* (EIA, August 2006), pp. 15-16, http://www.eia.doe.gov.
[8] British Petroleum (BP), *Statistical Review of World Energy 2006* (BP, 2006), http://www.bp.com.
[9] IEA, *World Energy Outlook 2005*, pp. 365-68.
[10] *Ibid*, p. 336.
[11] *Ibid*, p. 339.
[12] Calculated from Organization of the Petroleum Exporting Countries (OPEC), *Annual Statistical Bulletin 2004* (Vienna: OPEC, 2005), http://www.opec.org/library/Annual%20Statistical%20Bulletin/pdf/ASB2004.pdf.
[13] IMF, "Islamic Republic of Iran," pp. 49.
[14] *Middle East Economic Survey*, May 1, 2006.
[15] IEA, *World Energy Outlook 2005*, p. 361.
[16] BP, *Statistical Review of World Energy 2006*.
[17] EIA, *Country Profile: Iran* (EIA, 2006), p. 5, http://www.eia.doe.gov.
[18] IMF, *Islamic Republic of Iran*, p. 13.
[19] British Broadcasting Corporation (BBC), June 23, 2006, http://news.bbc.co.uk/2/hi/business/5109788.stm; *Middle East Economic Digest*, Vol. 49, No. 37 (September 11, 2006), pp. 1-3.
[20] Pat O'Brien, Assistant Secretary of Terrorist Financing and Financial Crimes, U.S. Department of the Treasury, Testimony Before the Senate Committee on Banking, Housing, and Urban Affairs June 22, 2006. http://www.treas.gov/press/releases/js4331.htm
[21] EIA, *Country Profile: Iran*, p. 4.
[22] *Middle East Economic Survey*, March 27, 2006.
[23] U.S. Treasury Press Release, September 8, 2006, http://www.treas.gov/press/realeases/js4331.htm.
[24] *Middle East Economic Digest*, March 10-16, 2006, pp. 4-5, May 12-18, 2006, pp. 6-7; U.S. Treasury Press Release.
[25] *Iran Daily*, November 7, 2005.
[26] Muhammed Sahmi, "Forced to Fuel: Iran's Nuclear Energy Program," *Energy*, Vol. 26, No. 4 (Winter 2005), reprinted in *Harvard International Review*, http://hir.harvard.edu
[27] IEA, *World Energy Outlook 2005*, pp. 346, 352.
[28] U.S. State Department, International Information Programs, http://www.usinfo.state.gov.is
[29] EIA, *Short-Term Energy Outlook*, June 2006.
[30] EIA, *Country Profile: Iran*, p. 9.
[31] IEA, *Monthly Oil Report*, February 10, 2006.
[32] IEA, Top Stories and Comments, Dec. 12, 2006. http://www.iea.org/journalists/topstories2.asp