

## Special Focus for The 30<sup>th</sup> Issue:

## Nuclear Energy

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### Letter from the Editor

Dear Readers,

Turkey's ratification of the nuclear law is an important indicator for moving forward to build a nuclear power plant. Therefore we prepared a special issue for you. The main focus is Nuclear Energy.

Nuclear energy is not built by law, although it is a necessity, nuclear energy is built through public discussion. It is certain that political will is the most important parameter, but without public support, the aims may turn into problems.

To contribute to the public discussion, we present to our readers, easy to read and thought provoking commentaries on nuclear energy, Turkey and EU.

We hope you enjoy this issue

Until next week, all the best,

Editor



**Rovshan Ibrahimov**

Editor in Chief of  
USAK  
Energy Review

## **Nuclear Energy, the EU and Russia: What are Perspectives? Possible Scenario**

Growing EU dependence on imported oil and gas, forcing this organization to seek ways to change the situation, which could turn into a serious problem and assume the risk to the safety of the entire community. The weakness of coordinating of common energy policy of community, prevalence of national interests of the members over the EU led to a situation where more than 40% used in the EU states, natural gas has imported from Russia, and this number continues to grow. No better situation with the oil, where Russian oil has significant portion in the European market.

In this situation, EU countries are trying to find alternative ways to address the problem of growing dependence on imported energy. One of the exits in this situation is to increase the use of nuclear energy. The fact that after the accident at the Chernobyl Nuclear Plant in 1986, in connection with the dire consequences of the spread of radiation to the construction and operation of power data for the last 20 years has slightly declined. In particular place dismantling stations in Germany, as well as in Eastern Europe, where the station had been built on Soviet technology, and therefore considered the most dangerous to the environment. Despite this, in 12 countries, the EU still uses energy, elaborated on Nuclear Station.

In addition to that increased energy consumption in the EU has forcing to reconsider its position in relation to use, less risky at first glance, source of energy. The transition to the use of atomic energy driven by the fact that unlike the unsuccessful attempt to create a common energy policy related to the oil and gas, production, use and distribution of atomic energy is the prerogative of EURATOM, and therefore there is coordinated policies in this area . Due to revive the use of atomic energy, it is expected that by 2025, in the EU countries, nuclear power stations cover 60% of electricity demand.

The desire of Russia to dominate on the European energy market in this case is limited by EURATOM; the EU states used just 20% Russian original nuclear fuel. In this case, the use of nuclear energy as possible way to decrease of dependence on Russian energy is very attractive to the EU.

However, despite the obvious benefits possible increase production and use of atomic energy in the EU, there are also some weakness sides of this initiative.

In particular EU countries do not have sufficient reserves of uranium, and in this case the EU states have to export it.

Russia, which wants to dominate in the energy market of the EU, now has extensive relations with Kazakhstan and Uzbekistan, two countries which have sufficient deposits of uranium, the raw material which is needed for energy production on Atomic Station. Both countries need to Russian technology and expertise in the production of uranium and even European countries will offer its assistance to them, these countries are unlikely to agree to move to Europe in this matter. Given that Kazakhstan is looking for alternative for Russia ways to the world markets for exports of its oil and gas reserves, this country will not risk its relationship with its great neighbor in this matter. It should be mentioning that Kazakhstan is the second uranium producer in the world. The share of the country accounted for 10.5% of world uranium output. An additional 5.5% of the world's production is in Uzbekistan. Russia itself produces up to 8%, which together with Kazakhstan and Uzbekistan is 24% of total world production.

Of course, the EU will be able to acquire the necessary raw materials from other producers in the world, in particular from the leader in this area Australia, producing up to 22.8% uranium in the world and owns 40% of the world's deposits. This year, however, Russia and Australia entered into a contract on the supply of uranium to Russia. This treaty Russia has been able adjustment of uranium produced in Australia. And if today the country, traditional consumers of uranium, did not face a shortage of raw materials, as more uses of atomic energy, such a problem could arise.

With regard to other producers in the world, the United States, China and Ukraine are themselves consumers of uranium produced. In this case, only two remain major exporter: Namibia share in the production of which is 7.5%, and Niger with 7.4%. As can be seen, in the long term production capacity of nuclear power in the EU, could again lead to a situation where Russia an opportunity to enhance its influence and power in this area.

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## A Personal Evaluation of Nuclear Energy in Turkey- 2007

Those of 1968 generation will recall that there was a "Nuclear" division in the METU Mechanical Engineering Department along with "Heat" and "Mechanics". There were many graduates with BSc and MSc, even PhD degrees from "Nuclear" division, all confident that they could design, build and operate nuclear power plants.

There were also students from other Middle East Countries, even several from Iran, studying together with their Turkish colleagues. The Iranians had a thick Azeri Turkish accent at the beginning, which was lost in time, replacing it with smooth daily Turkish, making them no different than our own local nationals. Then in time they completed their university studies, got their diplomas and returned to their countries, and worked on their careers

In Turkey, Turkish METU graduates started working at Turkish Electricity Authority, Nuclear Energy Department, but then years passed, Turkey could not enter into the nuclear age during all these years. Time passed by with no serious development in Turkish Nuclear energy plans except serious corruption news in Turkish Nuclear tenders. Then, IMF asked the government to stop work on Nuclear Energy tenders since that activity put high financial risk on the Turkish Treasury. Work ceased in early 2000s.

Nuclear Energy Division of Turkish Electricity Authority which was created in early 1960s, was also closed and its mostly METU graduate engineers were either transferred to other departments or left the establishment. Almost 40 years passed since 1968 years, which were exciting for METU graduates. What do you think those METU ME Nuclear graduates have been doing since 1968 years??

Some of the Turkish graduates formed their own private companies in the energy sector. Most were very successful in their own private businesses. They constructed high capacity coal mine transfer systems in thermal power plants, some completed mechanical installation works in thermal power plants, others completed site installations abroad, especially in the Middle East Countries as well as in the Central Asian countries.

Some formed their own plants in order to make fabrication of steel structures for industrial installations, some worked in public enterprises, in the Ministries. They were promoted to high prestigious public posts and private positions, many of them went to abroad to earn their life and pursue their own careers. Some of them worked in Nuclear power plants in those foreign lands and occupied high level positions in USA, Canada, Switzerland nuclear

power industries.

Some of the Iranian national METU graduates worked on their own Nuclear Industry in Iran. Today we all know that Iranian METU graduates cover the decision-making posts of top management level in Iranian nuclear business. They construct, design, build and hopefully will soon operate nuclear power plants in Iran.

Whatever is said on Iranian business environment, you may criticize their products, their outputs, their political environment or else, but you should evaluate carefully the latest stage that they have reached in their own nuclear technology.

Today, Iranian nuclear technology is somewhat the product of METU Mechanical Engineering Department Nuclear Division of the 1968s.

We wish the great human resource of METU Nuclear graduates could have been utilized to establish the local nuclear power plants in Turkey and solve our prevailing energy problem.

We shall enter into a serious energy crisis in 2008-2009, which is foreseen by all parties. Our big players of public and private enterprises have foreseen the bottleneck. They had meetings one after another. Turkish energy market is not so easy, not so profitable. It is a very tough sector. It is a very difficult market. Public enterprises cannot make new investments, they have no financial resources to allocate, no money to spend.

Nobody wants to make new big investments, just because our Energy market lost its bankability, its reliability in the financial markets. International investors are reluctant to make investments; they do not want to finance any project, since they foresee high risk.

For that high risk, they calculate a high interest rate.

Why our energy markets/ projects are not “bankable?” The documents created to finance the new energy projects are not “bankable documents.” They are not real/ internationally recognized “bankable documents.” Our legal framework is very new, not properly tested yet. Very few show any interest on new energy projects. If you ask any international reputable company to prepare any proposal for your new energy project, you cannot get their response. The pre-feasibility / feasibility documents are not in international standards.

Public tenders are not bankable; they ask impossible clauses, so these are not

bankable

The feasibility documents prepared in the local market for billion US Dollar projects are created at low cost, at low quality, hence they are not acceptable if not miserable

Today go to any reputable International Engineering Company,

And ask a proposal for any of your energy projects, see if they respond

You are at the mercy of Eastern World/ Indian- China- Korean companies, or Canadian Candu, if you eliminate USA and French companies due to unnecessary international disputes of the near past.

Eastern World companies are newcomers to the international nuclear energy business, at low prices with their own developing/ untested technology

We should not exaggerate the nuclear power plant requirement. 5000 MWe tender for nuclear power plant is an exaggeration. It will create pure foreign domination.

Turkey couldn't create her own technology in nuclear energy business, yet

Although we had huge human engineering/ intellectual power in 1968s

Turkish companies could not create high value added energy products in energy business for her own local market to generate cheap energy

Not only Nuclear technology

We even cannot construct our own Thermal power plant, not even simple coal firing plants, which are a number of steel tube fabrications, not a space shuttle,

Our own local private companies cannot cover scope other than "civil works, foundations, and site installation", at so low profit margins, with low value added levels, based on unqualified or semi-qualified labor work

Nobody wants to leave that unqualified or semi-qualified labor work to foreign companies, local workers resist to foreign participation as in Kazakhstan, Ireland, Gulf,

We still hope that we can complete huge works with so little early preparation,

We still think that we can handle/ create “bankable feasibility documents” at low cost with in-house excel sheets

This writer, a veteran of energy business for more than 30 years, has occupied seats at the foreign side of the negotiation table many times in the past

Foreign side comes to the negotiation table well prepared with all calculated risks of the subject project, they make serious and expensive “due diligence” works, they pay serious money for that early preparation, they evaluate the project risks carefully

When they receive your "In-house prepared so-called bankable feasibility document"

They will advise that they will carefully review the document

That review will not be finalized for years

And you wait for their final decision in years and years

Turkish people should know that they should create their own technology

They should support their own human resources, more funds to be allocated to R&D, more money for young engineering graduates, more software and hardware supplies

Believe me that our young engineering graduates are no different than those of their counterparts in the reputable foreign companies. In some of foreign engineering companies, there are even high level managers / directors with Turkish origin

Nuclear power plants are basically a kind of improved thermal power plants. There is one cycle more. You have to employ high safety measures, and solve waste problem. We can consider further advantages of a nuclear power plant in energy security. It is good test to train your people on nuclear technology, on nuclear safety, on nuclear awareness.

Your geography imposes your foreign policies as well as your energy policies. In your geography you have no luxury of staying anti-nuclear, in nuclear free environment. You need to develop your own nuclear technology, educate your nuclear intellectual power, train your staff/ your human resources. By being an anti- nuclear activist, you cannot learn details of the nuclear

technology. You learn by doing as elsewhere as always.

We should also appreciate that nuclear technology is a very dear, very precious, very expensive issue. It is not free of charge. It is not even possible to get only with bare money as in the case of thermal power generation.

The level of development in your own country in Nuclear technology will obviously warn other parties that you are no longer at the vulnerable developing stage but in the high tech league. That has also a deterrence factor for the rival parties to think twice for any action they take against yourselves.

If you do not wish to give any concession in your foreign policy, then you should depend on your own talent at a lower and independent cost. You can only get it through your own hard work by employing your young talents with their latest scientific and intellectual capability.

You can only get it through your own hard work by employing your young talents with their latest scientific and intellectual capability on a long tedious journey with blood, sweat and tears.

It is also a matter of survival of the fittest in the region.

Final wording, as the old saying goes, "If you think you can, you can."

Your comments are always welcome. Thank you & best regards

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## Nuclear Energy and Turkey

It is very likely that several power companies in the United States, the pioneer in the atomic energy, will soon begin investing in nuclear power plants again, possibly followed by some European countries, Russia and others. Finland began building the world's largest single unit nuclear power plant (1) in December 2005, Europe's first in 15 years, and Constellation Energy in Baltimore, US announced last year that it would apply to the Nuclear Regulatory Commission for a permit to build a pressurized water reactor similar to the one being built in Finland in upstate New York or Maryland. China has already announced building 30 to 40 new nuclear power plants through 2020, India up to 30 and Japan 18 in the next 15 years (Table 1).

There is a new interest (which began in the 70s) and an ongoing debate whether Turkey should also include nuclear energy in its long term plans that envisions more than doubling its present installed capacity of **39,000MW** within the next 17 years. **Turkish Atomic Energy Agency (TAEK)** has been working on a "Nuclear Technology and Energy Development Project" report for some time which is scheduled to be submitted to the Office of the Prime Minister. The Minister of Energy has stated that an announcement will be made soon for Turkey's first nuclear power plant, estimated to cost over \$2 billion, to be operational by 2012, and plans for **building three to five nuclear power plants with a total capacity of 5,000 MW.**

On the financing model, the Minister of Energy has indicated that the **Private/Public Participation (PPP)** model could be used, however emphasizing that the preference would be total private sector participation. One of the conditions for building nuclear power plants by the private sector in Turkey, among others that would require amendments to the Electricity Market Law 4628, is that the electricity distribution companies, which are yet to be privatized, purchase 7 to 10 percent of the energy produced by the nuclear power plants. Earlier reports have stated that there would be **no treasury guarantees** in order not to jeopardize the free market conditions which are expected to be provided by the energy sector itself.

During a presentation at the Ministry of Energy and Natural Resources conference center on Dec 27, 2005, the chief economist for the **International Energy Agency (IEA)** Dr. Fatih Birol, while emphasizing the importance of increased investments in oil and gas production around the world to meet the increasing energy demand, also made reference to Turkey's need for nuclear energy (2). Dr. Birol, who was in Turkey to publicize the IEA's annual report on the world's energy situation "**World Energy Outlook – 2005**", stated that Turkey must consider nuclear energy seriously without wasting time in order to reduce Turkey's growing dependence on imports. Dr. Birol also emphasized that the nuclear option should be seriously debated before proceeding to build a nuclear power plant, especially the financing model to be used and the processing of the nuclear waste, which is a major problem in all countries with nuclear power plants.

The purpose of this article is to present an update on the status of the nuclear power debate in Turkey and discuss some of the major issues that need to be addressed by organizations involved in the energy sector with some basic information on the sector (3). It seems that the main reason for the cancellation of many nuclear power plants in

late 70s and early 80s, especially in the United States, was economics rather than safety concerns following the accidents at the Three Mile Island nuclear power plant in the US and the Chernobyl nuclear plant in Ukraine. The total cost of the first nuclear power plant that I worked on as a young engineer in the 70s was around \$390 million (Millstone I in Connecticut, 620 MW). The two unit Comanche Peak Nuclear Power plant in Texas (2X1,100 MW) where I worked as the Project Manager for the modifications, cost the utility close to \$10 billion by the time the plant became operational after the fixes were completed following the initial faulty design and construction by an inexperienced company, one of the major considerations that needs to be taken into account before a contract is awarded. The cost of nuclear power plants have increased due to new conditions and redundancy systems mandated by the regulations, cost of components, security and safety concerns, among others.

## Nuclear Power Plants

Utilities in the United States started building nuclear power plants following the announcement in the early fifties of "Atoms for Peace" project by President Dwight Eisenhower. This was followed by other countries through the purchase of nuclear reactors from the United States and technology transfer in the 60s and created their own modified systems. According to the International Atomic Energy Agency reports, **there are 443 nuclear power plants in operation today with a total net installed capacity of 369,545 MW (more than 10 times the installed capacity of Turkey) and 25 Nuclear power plants under construction in several countries (Table 1.) According to the latest reports, 16% of world's electrical energy is provided by nuclear power plants.** Price of oil and eventual depletion, greater safety and greenhouse issues require that the nuclear option be considered for meeting Turkey's increasing demand for electricity.

Nuclear power plants, like hydro, have a very large capital cost, but relatively low operating and fuel costs with a 40 year lifetime that can be extended to 60 years with refurbishments. One of the biggest issues that everyone faces today is the global warming which is caused by the carbon dioxide emissions by the coal fired power plants, among others, something that nuclear power plants do not contribute. Therefore, incentives for providing pollution free power could be given to nuclear operators for contributing to the fight against global warming which is becoming the number one issue in the world today.

Most important factors that should be studied and considered in depth before proceeding with the plans to build nuclear power plants in Turkey could be grouped under eight headings:

1. Investors, developers and operators with proven experience in the nuclear field
2. A licensed design with advancements factored into the latest systems
3. A site with minimum impact to the environment, evacuation plans and minimum seismic risks
4. Reputable engineering companies and contractors, and reliable construction schedule
5. A waste site for storage until a solution is found for the radioactive waste disposal
6. Long term power purchase agreement with distribution companies

7. Regulatory climate for licensing and operating nuclear power plants
8. Technology Transfer

## 1. Investors, developers and operators with proven experience in the nuclear field

The new Electricity Market Law No. 4628 that went to effect in 2001 mandates that all future investments in the sector be made by the private sector although Law No. 4749 on the Regulation of Public Finance and Debt Management (adopted in 2002) allows for companies to be established through public-private partnership. Therefore, the task of building nuclear power plants will probably fall on the private local and foreign companies working together who have been successful during the last decade with joint venture partnership. If nuclear power plants are to be realized through the Private Public Participation scheme, as suggested by the Minister of Energy, necessary legislation will have to be enacted. Furthermore, it may also be necessary to include some arrangements that will allow the state owned Electricity generation Corporation (EUAS) to engage in nuclear energy investments. (4)

## 2. Nuclear Steam Supply System Providers and Fuel

When President Eisenhower announced the peaceful use of atom in the 50s, stating that nuclear energy will be too cheap to meter, many energy companies started investing in nuclear power plants, such as Westinghouse (5) and General Electric in the US and began exporting their technology to other countries. These companies over the years have been working on advanced reactors which would provide a better design, not old technology as some claim. Westinghouse, which has provided NSSS for almost half the operating nuclear power plants around the world, has been actively promoting their new design, AP1000. General Electric has been working with Japanese companies in the development of an advanced boiling water reactor for many years. Canadian company AECL has several operating power plants utilizing the CANDU system, including several plants installed in Japan and Argentina, however many problems with the system have resulted in the abandonment of some of these plants, according to a report published by "Campaign for Nuclear Phaseout" (Ref. ) CANDU has also been working on an advanced design which has improvements over the earlier designs.

French company Framatom ANP and German company Siemens have introduced an advanced reactor that is being offered to several countries, although Germany has officially declared closing down its operating nuclear power plants gradually by 2023. The Russian nuclear energy agency has started talks with private investors in their participation in new nuclear power plants in Russia as well as in Bulgaria. Several Japanese companies have advanced the design and construction of reactors that they imported back in the 70s and are building more nuclear power plants (6 of 25 nuclear power plants under construction are in Japan.) There are 23 nuclear power plants in the United Kingdom. However, UK companies do not seem to be interested in exporting nuclear technology to other countries as far as I know.

One of the new players in the nuclear field is China which has an ambitious plan of its own and also exports nuclear technology to several countries. The 300 MW Chasma nuclear power plant in Pakistan was developed by Chinese companies and has agreed to sell two more nuclear power plants, 325 MW each. Several reports indicate that the Chinese companies are also interested in the Turkish market, both nuclear and coal

power plants.

Most nuclear power plants use **enriched uranium as the fuel**, although the CANDU reactors use natural uranium but require heavy water as the moderator, which in itself is a costly technology. Many reports have been issued stating that Turkey is rich in uranium ore, but this would require imported technology for its processing, which may be delegated to countries that are already active in the field, as Russia has offered to Iran for its controversial plant which is in the news extensively.

### 3. Site Selection

Selection of a proper site that would minimize the impact on the environment with an evacuation plan and low seismic risk is very important. A completed nuclear power plant at a cost of over \$4 billion in Long Island, NY was converted to a thermal power plant when the evacuation plans were found to be inadequate. Among the sites selected for Turkey's first nuclear power plant are the **Mersin – Akkuyu** (where site investigations were started almost 30 years ago, but with claims that it is near a fault), **Sinop**, Konya and areas adjacent to Sakarya river, where the high water demand of nuclear power plants can be met. Site studies may take several years, therefore, Akkuyu and Sinop sites, where the infrastructure is already in place, may be selected for the first nuclear plant, with studies to continue at the other sites.

### 4. Engineering and Construction Companies and Equipment Suppliers

There are many Turkish and foreign companies which have a proven record in building power plants and have shown interest in expanding into the nuclear field. ENKA, DOGUS, ALARKO, Zorlu, Sabanci Enerji Group, are some of the large companies, some of which are among the 11 Turkish companies included in a List of companies worldwide just published by the Engineering News Record magazine in the US. Some power plant components are now being manufactured in Turkey also, although major components, such as the reactor, steam generators, turbines, will have to be imported. Ukraine has already stated that they could be helpful to Turkey in building nuclear power plants by supplying many components, a country that meets 50 % of its electricity needs through nuclear power stations.

### 5. Radioactive Waste and Storage

The management of the spent fuel is the most important factor that needs to be taken into account. The spent fuel rods presently are stored in steel lined concrete pools which are an integral part of the plants. There is also ongoing study for building reactors that use spent fuel rods in order to reduce the radioactive waste. All nations that have nuclear power plants (over 22) should work together in order to find a solution for the safe disposal of radioactive waste.

### 6. Long term Power Purchase Agreement

Since the new law does not allow any sort of guarantees (power purchase or treasury), the developers will be looking for long term Purchase Agreements with the distribution companies, which by the time the new plants go on line, will have been privatized, according to the latest news.

## 7. Regulatory Body for Licensing and Operating Nuclear Power Plants and Energy Institutes

The organization responsible for the research, licensing and the regulation of nuclear energy in Turkey, is the **"Turkish Atomic Energy Institution (TAEK)** located in Ankara, which reports directly to the Prime Minister. TAEK is expected to be re-structured along two separate lines, one for licensing of nuclear power plants and the other for regulation. Ministry of Energy has already started talks with leading nuclear power plant constructors in the US, England, France, Russia and China. The type of nuclear power plant (boiling water, pressurized water, natural uranium, advanced reactor) has not been selected yet, which is one of the critical issues.

**International Atomic Energy Agency (IAEA)** located in Vienna is the world's center for cooperation in the nuclear field. The Agency works with its Member States worldwide to promote safe, secure and peaceful nuclear technologies. [www.iaea.org](http://www.iaea.org).

## 8. Technology Transfer

When the Mexican state utility, Commission Federal de Electricidad (CFE), decided to build its first nuclear power plant in the 80s, Ebasco Services Inc, a New York based international company, was selected as the design and construction contractor (a company with over 1,000 power plants around the world in its portfolio, including the Keban HEPP and Gokcekaya HEPP in Turkey, which has since been incorporated into Washington Group International.) One of the conditions agreed between CFE and Ebasco later was to set up an office in Mexico city where some of the plant design work would be performed by Mexican engineers under Ebasco supervisors. This was done and most of the engineers went on working on the second unit at the Veracruz site, but the plans to build up to 20 nuclear power plants were later abandoned due to economical reasons.

Beginning in 1976, Turkish expatriate experts working in the US in various fields, including on nuclear power plants were sponsored by United Nations Development Program to work in Turkey for short periods. In 1977, I worked with the newly established Nuclear Energy Department of Turkish Electricity Authority (TEK) for 3 weeks and the following year, with Fenni-Gama, a private company representing Westinghouse at the time.

## Nuclear Nonproliferation

Iran's nuclear program has attracted much attention and several countries have opposed to the development of nuclear power plant due to the possibility of using nuclear technology in manufacturing nuclear weapons. As stated in many articles (Ref 2), strengthening the nonproliferation regimes has been the key issue in Turkey's official stance towards the spread of weapons of mass destruction. Therefore, most believe that Turkey does not need to have nuclear weapons for its protection.

## Anti-nuclear lobbies

As in most countries, there is also a strong opposition to building nuclear power plants in Turkey. A new group formed in Sinop (**Nuclear Information Center – NUKBIL**) has openly stated that they do not support a nuclear plant near their city which hopes to become a tourist center in the near future. **Greenpeace**, long active in environmental issues in Turkey, has also voiced its opposition to building nuclear power plants for a number of reasons. As the Minister of Energy stated during the December 27 meeting, all organizations related to nuclear energy are working together to come up with the best solution since the demand for electricity will keep increasing each year. The Electricity Market Regulatory Authority (EMRA) has estimated that over 5,000MW new capacity will need to be added to the system by 2010.

Table 1. Nuclear Power Plants in Operation and Under Construction

Country	Operating	Installed Capacity MW	Under Construction	Planned Or Proposed	Percent Of Electricity	Total
1. USA	103	99,210	1	3	20%	107
2. France	59	63,363	-	1	78%	60
3. Japan	55	47,839	6	7	29%	68
4. Russia	31	21,743	4	9	16%	44
5. UK	23	11,852	-	-	19%	23
6. S. Korea	20	18,810	8	2	38%	30
7. Canada	17	12,599	1	4	15%	22
8. Germany	17	20,339	-	-	32%	17
9. India	15	13,107	8	24	3%	47
10. Ukraine	15	3,040	-	1	51%	16
11. Sweeden	10		-	-	52%	10
12. China	9		2	8	2%	19
13. Spain	9				23%	9
14. Belgium	7			-	55%	7
15. Czech Rep.	6		-	2	31%	8
16. Slovakia	6				55%	8
17. Switzerland	5				40%	5
18. Bulgaria	4				42%	5
19. Finland	4		-	1	27%	5
20. Hungary	4		-		34%	4
21. Armenia	1		-		32%	1
22. Turkey	-		-	3	0%	3
<b>TOTAL</b>	<b>443</b>	<b>369,545</b>	<b>25</b>	<b>115</b>	<b>16%</b>	<b>578</b>

From Various sources, such as IAEC.

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## Notes.

- (1) Olkiluoto 3, 1,600 MW. The plant, which was proposed in 2002, will be operational in 2009, bringing the total number of nuclear power plants in Finland to
- (2) The conference was attended by the representatives of all the institutions and departments under the Ministry of Energy and many organizations, such as Ministry of Foreign Affairs, Ministry of Environment, Ministry of Forestry, Electricity Market Regulatory Authority (EMRA), TÜBİTAK, The Undersecretariat of Treasury and the State Planning Organization and the press.
- (3) The nuclear energy issue was also covered during the Dec 15/16 panel discussions at the Middle East Technical University (ODTU) in Ankara under the title, **"Is Nuclear Energy the solution?"** Another panel discussion took place during the Dec 21 – 23 **Fifth Energy Symposium** organized by the Association of Electrical Engineers (EMO) at the National Library in Ankara. The proceedings of the panel, **"Energy Policies and Nuclear Power Plants"** has been issued by the EMO of Ankara (2).Panel yöneticisi, Necati Ipek, EMO Ankara Subesi YK Baskani
- (4) EUAS is a shareholder in the Birecik HEPP BOT Power plant that went on line in 2002.
- (5) Westinghouse was recently purchased by Toshiba
- (6) A new group has been formed to disseminate information on nuclear energy, which is open to anyone interested in this subject ([nuclearturkey@yahogroups.com](mailto:nuclearturkey@yahogroups.com))

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## Which one is more economic for Turkey: Natural Gas or Nuclear?

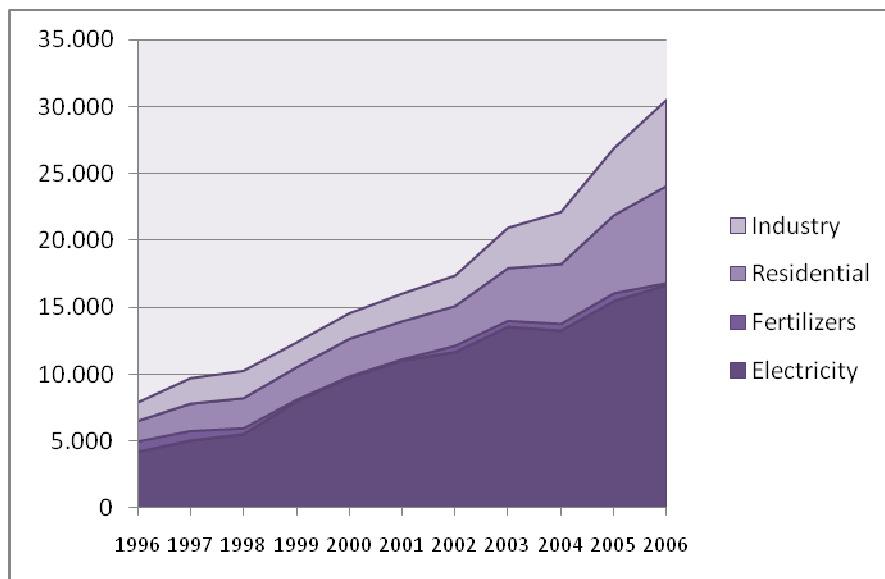
USAK Energy  
Review

TurkishWeekly.net

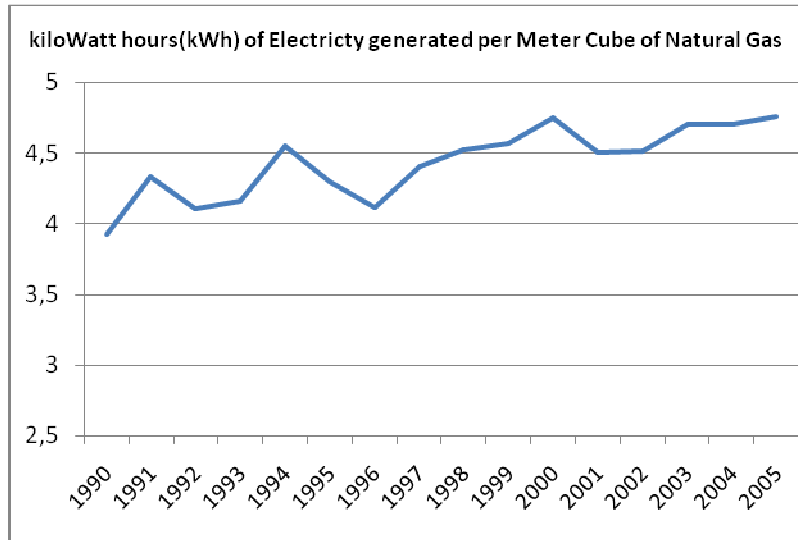
Turkey's choice for nuclear power has been echoed in the international press a couple of weeks ago. But this is not something well understood. Why Turkey is desperately trying to make a nuclear plant? Is Turkey trying to develop a nuclear bomb? In this essay a different view about the subject will be given.

If Turkey's growing electricity demand is considered (more than 8% in 2006), the urgency to built new capacity becomes obvious. It is not only to build new plants but also to reduce import dependency on primary energy sources. The natural gas used for electricity generation as well as the price of natural gas. Although the price of natural gas is a mystery for the Turkish public, it should be floating around the international prices due to infrastructure costs.

Turkey's natural gas consumption has increased to 30 Billion Cubic Meters (BCM) in 2006 from 8 BCM in 1996. There are certain pitfalls of this accelerating demand. One of them is the increasing dependence on Russian gas, the other is the cost of natural gas to the national balance. Nearly all of the gas is exported from several countries including Iran and Russia.



On the other hand there are good effects of the natural gas. One of them is the pollution prevention. Before natural gas, during the winter days the air quality in big cities was quite bad. The environmental and human health cost of this problem was a serious problem. Another important thing is the efficiency of natural gas power plants. As new natural gas plants were built, the efficiency of the average natural gas production has increased. The following graph has been sketched from the data provided from BOTAS (Pipeline operator) and TEIAS (Transmission operator)'s web page.



In this graph, kWh of electricity generated from 1 meter cube of natural gas has drawn. The production is close to 5 kWh per cubic meters. This means roughly 50% efficiency, which is approximately standard. (not best example).

But the problem is the increasing cost of natural gas. This is one of the motivations behind nuclear motivation. If we assume natural gas price around 300 USD/ 1000 cubic meters, 30 bcm of Turkish natural gas exports corresponds to 9 billion USDs. If Botas's forecasts turn out be accurate, 66 bcm in 2020 with a natural gas price of 350 USDs will take away 23,1 billion dollars from Turkish economy.

Therefore, a simple comparison between building a gas plant and nuclear plant has been made.

## Assumptions

Although the assumptions are arguable, this is to make a simple comparison.

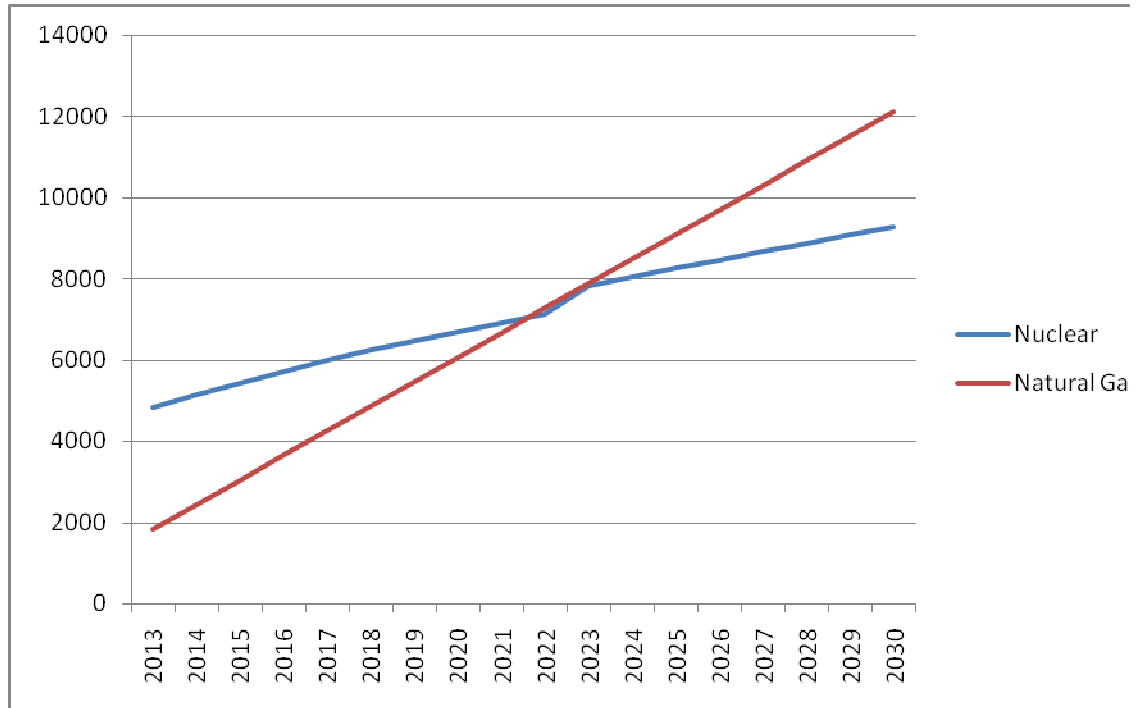
A nuclear power plant is to be constructed starting from 2008 to 2013. From the 2013 the power plant starts generating electricity. In 2008, it works with a utilization rate of 45% and increases to 84%. The price of uranium is 100 USD per pound. There are other assumptions based on information from various government web sites.

The comparison is made between 1500 MW of natural gas and nuclear power plant. The natural gas prices is 8 USD/Mcf(thousand cubic feet), which is 282 USD per cubic meter. From 2013 to 2030 these assumptions held constant.

The cost of building a 1500 MW nuclear power plant is 4 billion USD and the same capacity natural gas plant costs 1,2 billion USD. There are other assumptions, like building a 500 million USD storage facility (including certain operational costs for a certain period) for nuclear wastes. For every 10 Terawatt hours of electricity generation around 250 tons of fuel is used. This determines the capacity of storage facility, that is 2500 tons.

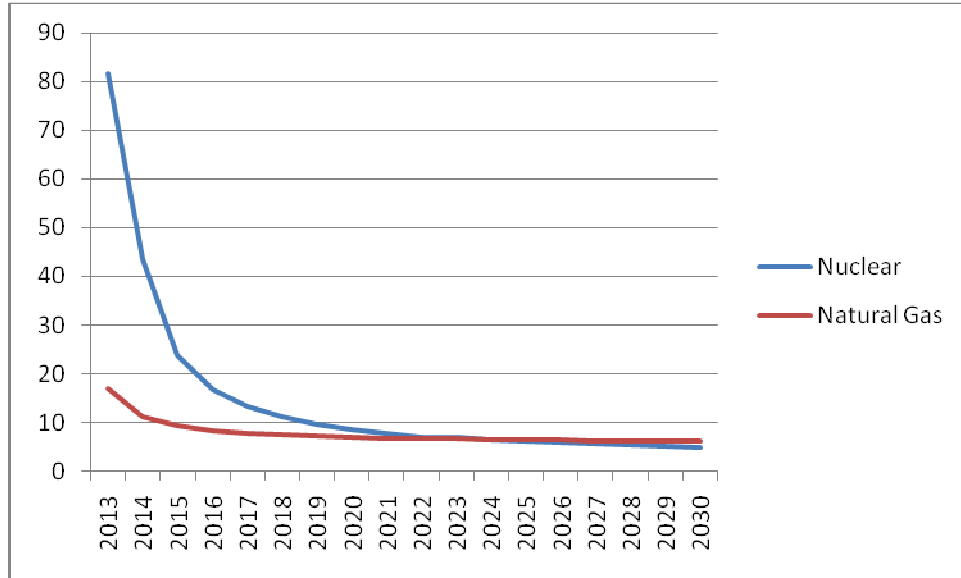
No carbon taxes have been considered. But operating cost of the nuclear plant is 5 times of the natural gas plant in the early period, which slowly settles to 3 times the cost.

As a result, with 2006 prices, the total costs of generating nearly same amount of electricity appear as in the graph below. (y axis : in Million 2006 USD, starting from the plant and relevant costs)



The cost of kWh of electricity generated in US cents is as follows. By 2025, natural gas power plant's kWh price is higher than the nuclear power plant. This means, when we divide total cost to cumulative electricity generation, nuclear becomes favourable.

The fuel cost of natural gas is nearly 10 times of nuclear plant for nearly equal electricity generations. On the other hand the nuclear operation costs are more than 5 to 3 times of natural gas plants.



Cost from the first production to 2030. (Cents/kWh) .

Note:Nuclear Plant starts with half capacity and recovers next year.

## Conclusion

It is not to say that nuclear is more favourable to natural gas. The short term advantage of natural gas and long term advantage of nuclear power plant is obvious. But what matters is the price of steel, natural gas, starting a new technology, storing wastes and carbon emissions.

Keeping in mind that nuclear is more dangerous than natural gas, there is one more benefit of having nuclear and that is its mitigation effect on foreign trade balance. As the fuel cost is paid to a foreign country, 10 fold difference between nuclear and gas makes a huge difference in the long run. There is only one problem left. Whether one can find a very safe place to built a nuclear plant on a country of earthquakes

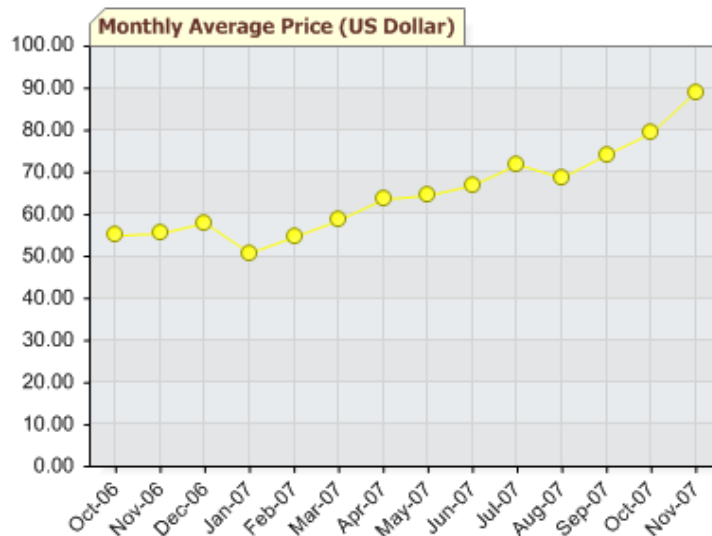
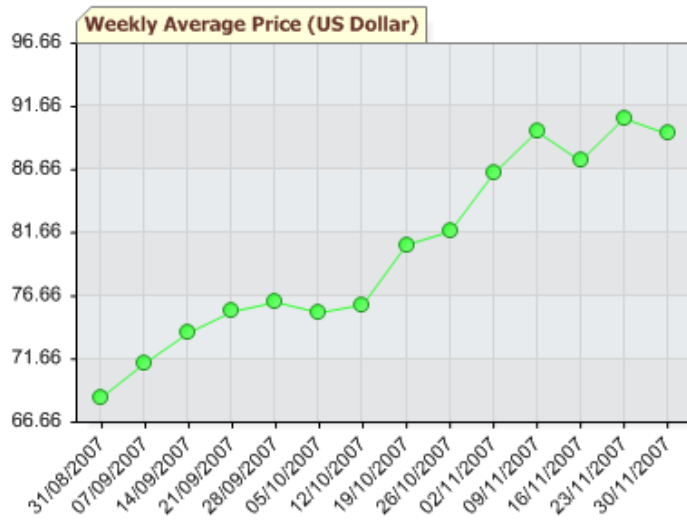
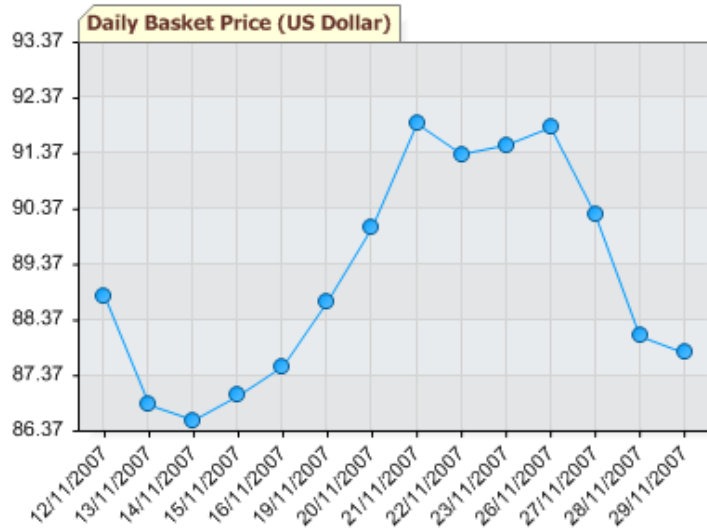
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## Indicators

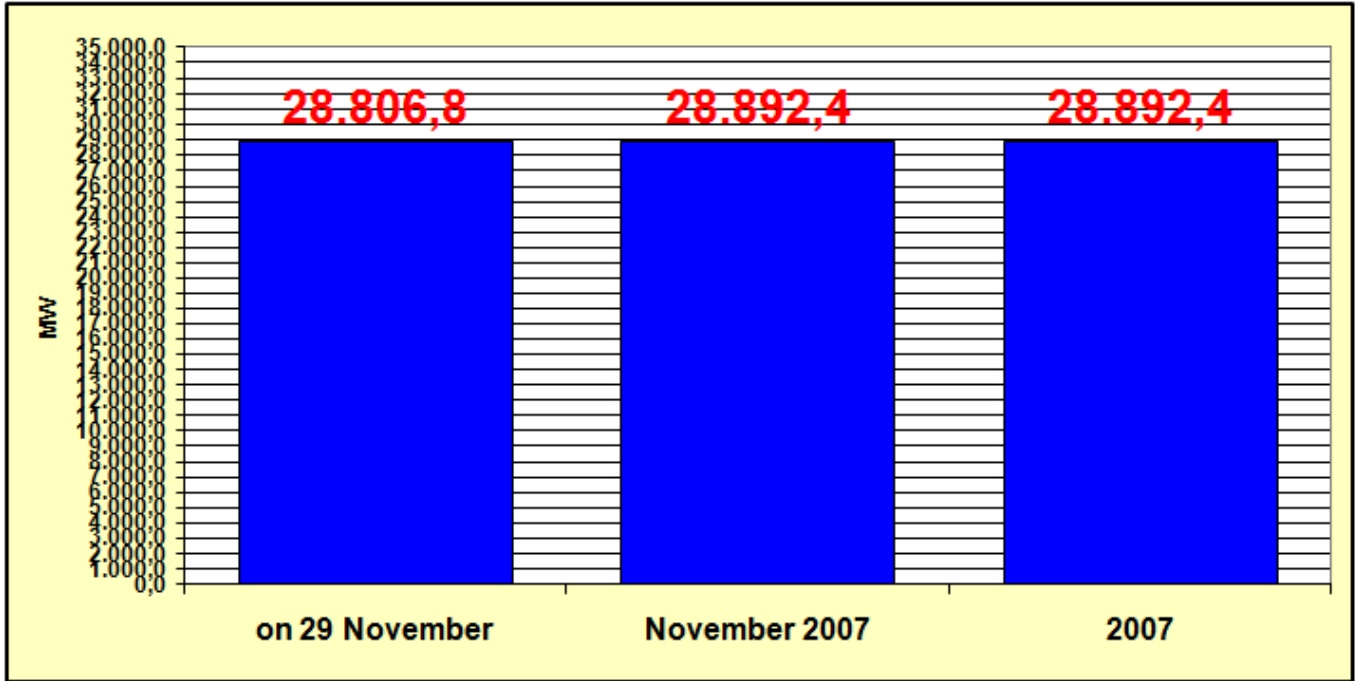
### OPEC's Basket Price



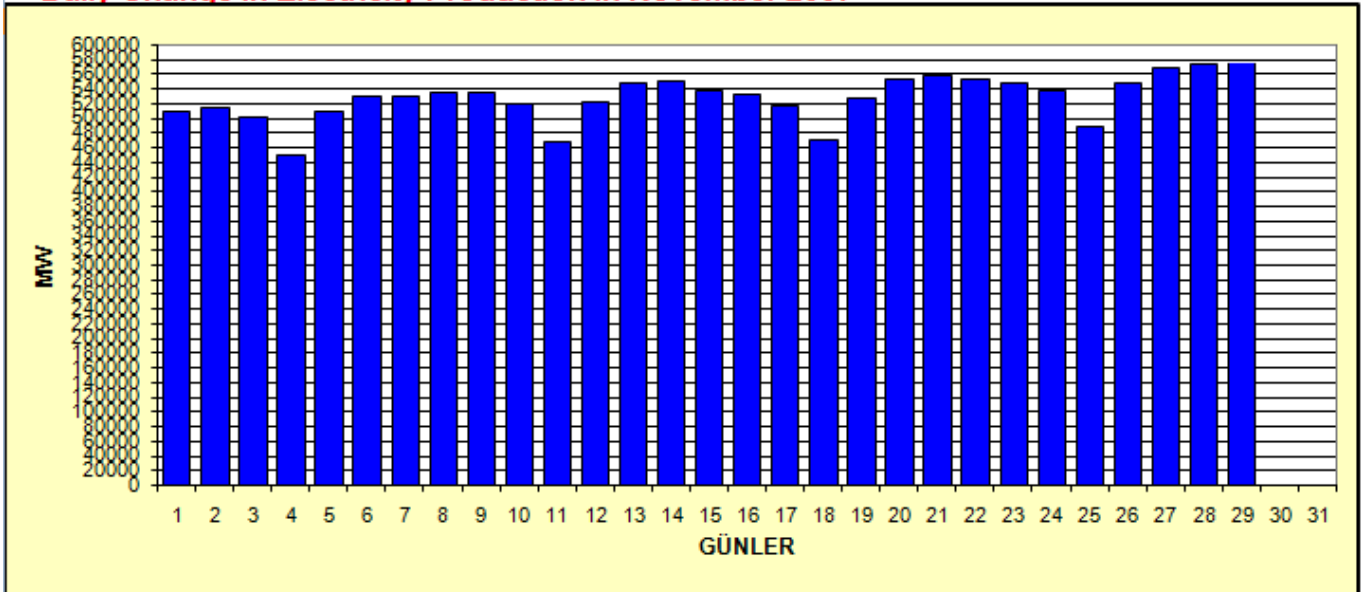
## Indicators

### Turkish Electricity Consumption for November 2007

#### Peak Consumptions



#### Daily Change in Electricity Production in November 2007





## Indicators

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Indicative Exchange Rates Announced at 15:30 on 26/11/2007 by the Central Bank of Turkey

<b>CURRENCY</b>		<b>EXCHANGE RATES</b>	<b>EXC.RATES ON BANKNOTES</b>		
		<i>Buying</i>	<i>Selling</i>	<i>Buying</i>	<i>Selling</i>
USD/TRY	1 US Dollar	1.1715	1.1772	1.1707	1.1790
EUR/TRY	1 EURO	1.7295	1.7378	1.7283	1.7404
GBP/TRY	1 British Pound	2.4209	2.4336	2.4192	2.4373