# NUCLEAR ENERGY IN TURKEY:
## *PAST, PRESENT, AND FUTURE*

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### INTRODUCTION

Turkey does not have any nuclear power plants to date, but it interestingly has a long and complicated history concerning nuclear energy. For the last six decades, Turkish governments have been advocating the construction of a nuclear power plant on the grounds that it is necessary for the development of the country, in particular for energy independence and technological advancement. To this end, in 1970s, a small bay on the eastern Mediterranean coast, Akkuyu, was selected for the construction of Turkey's first Nuclear Power Plant (NPP). However, the first attempts in late 1970s provoked an immediate reaction from the civil society, concerned over the controversies such as the impacts on environment and health, waste management, and risks of nuclear accidents, which are associated with issues of ecological complexity, uncertainty, and irreversibility, giving rise to a long-standing ecological distribution conflict that is yet to be settled.

In order to better understand Turkey's previous and current motivations to build a nuclear power plant and hence the background of this ecological distribution conflict, this study will try to recount the country's history of nuclear power, by first providing a brief overview of the current energy policy practices in Turkey and the current state of nuclear energy in the world.

### TURKEY'S ENERGY POLICIES

Turkey's energy policies have been predominated by concerns over the security of supply, affordability of energy prices, and competitive power. These concerns entail a number of important challenges and responsibilities for the country, both in terms of energy and environmental policies. With a population of more than 75 million and GDP of approximately 900 billion dollars, Turkey sees the consumption of more energy as a precondition for the economic and social development of the country in line with its comprehensive ideology of modernization and progress. Accordingly, there are two main trends that have shaped the energy strategy of Turkey: the rapid increase in the demand for energy and electricity (as presented in **Figure 1**), and country's dependence on imported fossil fuel, mainly natural gas, oil, and hard coal, as presented in **Figure 2**, leading to a significant deficit in its current account. Currently, around 76 percent of all energy consumed in the country is imported from abroad.

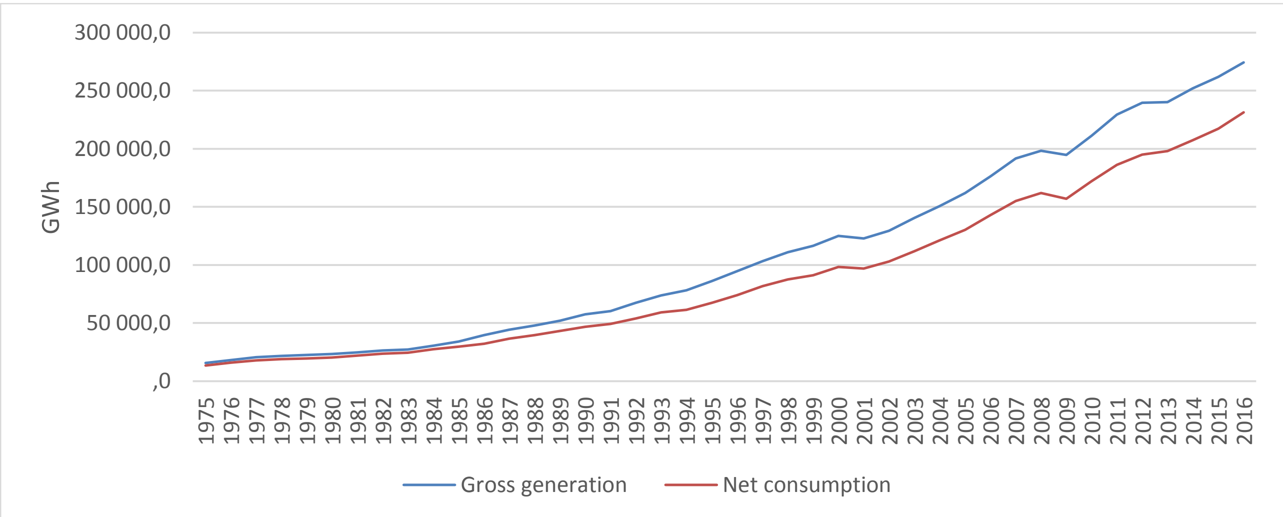


**FIGURE 1: TRENDS IN GROSS GENERATION AND NET CONSUMPTION OF ELECTRICITY IN TURKEY, *SOURCE: TURKSTAT*[1]**

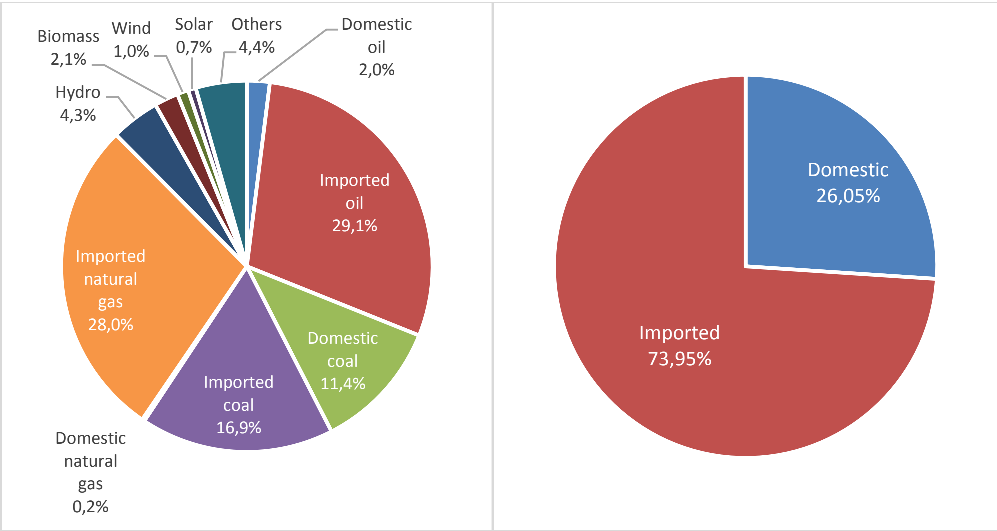



**FIGURE 2 : DISTRIBUTION OF PRIMARY ENERGY SUPPLY IN TURKEY BY** A) **RESOURCE TYPE,** B) **PROVISION, SOURCE: *IN 2016, SOURCE: EİGM*[2]**

The case for electricity production is similar to the distribution of primary energy supply. As of September 2016, Turkey produces a notable bulk of its electricity from coal and natural gas (as described in **Figure 3**), a large share of which is imported into the country. As a result, the strategic plans are made in accordance with scenarios projecting an increase in energy demand with increasing rates and matching this demand with domestic resources.

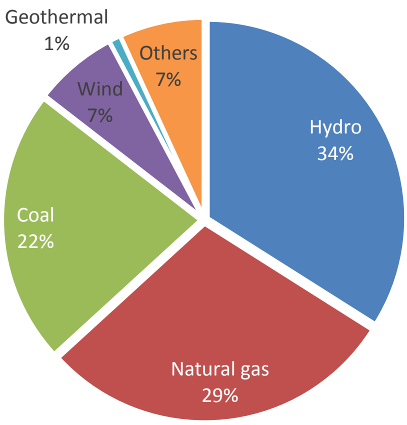
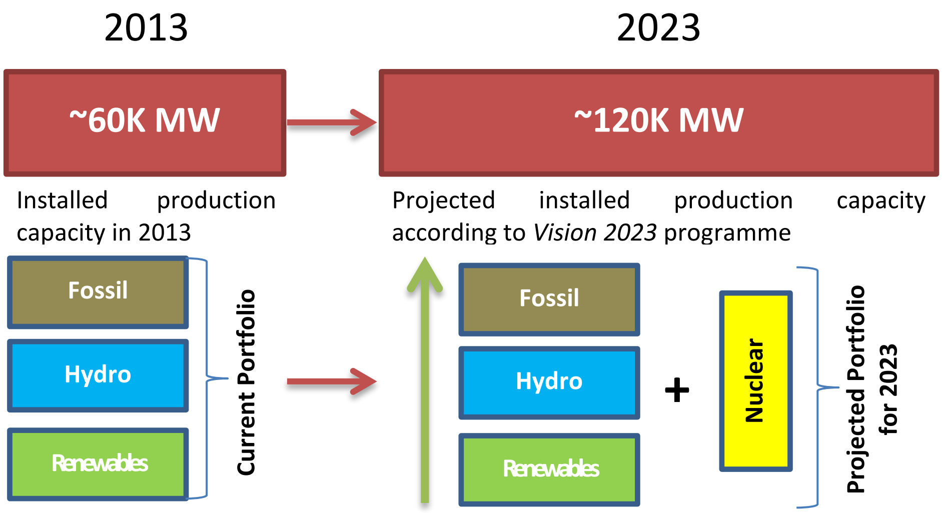



**FIGURE 3 : THE DISTRIBUTION OF INSTALLED ELECTRICITY GENERATION CAPACITY BY PRIMARY ENERGY RESOURCES IN 2016, *SOURCE: TEİAŞ*[3]**

As part of its development targets for the centennial of the country called "Vision 2023" (as summarised in **Box 1**), Turkey wants to enjoy a total installed capacity of 120,000 MW, by relying mostly on domestic potential, where fossil fuels (especially domestic lignite) will be an important contributor, together with nuclear, hydro, and renewables. As a matter of fact, the roots of the strategy above date back to the Energy Supply Security Strategy published by the Higher Planning Council Secretariat in 2009[4], at the aftermath of the 2007-2008 global economic crisis. In an attempt to reduce import dependence on energy resources (especially the hydrocarbons), which had a quite significant impact on the country's current account deficit, Turkey adopted a new coal exploration scheme and 2012 was declared as the "Year of Coal" with newfound lignite reserves in different regions.

[1] TURKSTAT, Turkish Statistical Institute, Power Installed of Power Plants, Gross Generation and Net Consumption of Electricity, http://www.turkstat.gov.tr/PreTablo.do?alt_id=1029 [Accessed 01.03.2018]
[2] Ministry of Energy, General Directorate of Energy Works (Enerji İşleri Genel Müdürlüğü), Energy Balance Table 2016, http://www.eigm.gov.tr/tr-TR/Denge-Tablolari/Denge-Tablolari [Accessed 01.03.2018]
[3] TEIAŞ, Electricity Statistics, Installed Capacity by Primary Sources https://www.teias.gov.tr/tr/i-kurulu-guc [Accessed 01.03.2018]
[4] Higher Planning Council Secretariat (2009) Energy Supply Security Strategy. Available: http://www.enerji.gov.tr/File/?path=ROOT%2F1%2FDocuments%2FBelge%2FArz_Guvenligi_Strateji_Belgesi.pdf [Accessed 09.03.2017]

**BOX 1 TURKEY'S VISION 2023 PLANS IN DETAIL *(SOURCE: INVEST TURKEY)*[5]**




The country plans to expand its capacity as follows:

- Increasing installed power to 120,000 MW
- Increasing the share of renewables to 30 percent
- Increasing the coal-fired installed capacity from the current level of 15.9 GW to 30 GW
- Maximising the use of hydropower
- Increasing installed capacity of wind power to 20,000 MW
- Consuming/exploiting all domestic resources until 2023, to decrease dependence on imported energy
- Commissioning two nuclear operational power plants (in Akkuyu and Sinop with a total capacity of 9200 MW) with the third under construction

Turkey's "Vision 2023" energy strategy also involves the construction of three nuclear power plants (NPPs) in different regions of the country, namely in Akkuyu, Sinop and İğneada. In fact, the interest in nuclear power is not new, as Turkey has had rudimentary plans to build a nuclear plant for almost six decades now. The primary argument in favour of the construction of the NPP is that the country needs nuclear energy for its economic growth, and more importantly, the plants mark a milestone in Turkey's modernisation aspirations and they are seen as a source of high prestige. However, national and local opposition has also been there from the beginning, as old as the initial plans. Having experienced the catastrophic effects of the Chernobyl disaster, Turkey has a very active anti-nuclear movement.

Since construction of a nuclear power plant is not an easy task due to the large scale of the operation and requirement of high-level technical knowledge, the attempts for finding a private company to build and operate the plant failed several times. Turkish governments attempted to find an international investor at least four times and organised open tenders, which failed due to different economic, political, and legal reasons (Şahin, 2011). For instance, the last tender in 2009 had only one bid from Rosatom (from Russia) despite all the efforts to invite other nuclear giants in the world (Aydın, 2014). After recognising that classic build-operate-transfer methods would not work in the case of nuclear plants, the Turkish government took an opposite route, in 2010, after the last failed attempt. Two inter-governmental agreements were signed for Akkuyu (in 2010) and Sinop (in 2013), with Russia and Japan, respectively.

[5] Energy and Renewables, *Invest Turkey* (Investment Support and Promotion Agency) http://www.invest.gov.tr/en-US/sectors/Pages/Energy.aspx [Accessed 09.03.2017]

## NUCLEAR ENERGY IN THE WORLD

After World War II, in the 1950s and 1960s, the commercial nuclear energy was developed, and was lauded as a miraculous and limitless way of creating energy, which would be able to meet all the future demands in the world. This was followed by a rapid growth in the nuclear industry in the 1960s and 1970s (Brunnengräber & Schreurs, 2015). According to the International Atomic Energy Agency (IAEA, 2018), at the end of 2017, there were 449 operational reactors in the world, distributed in 30 countries, with a total net electricity capacity of 392.54 GW, and 54 reactors with a total capacity of 57.92 GW in the pipeline. The map in **Figure 4** provides a global overview of the status of all reactors in the world including those in operation, those taken off the grid, those shut down, and those under construction as of early 2016 (Evans & Pearce, 2016).

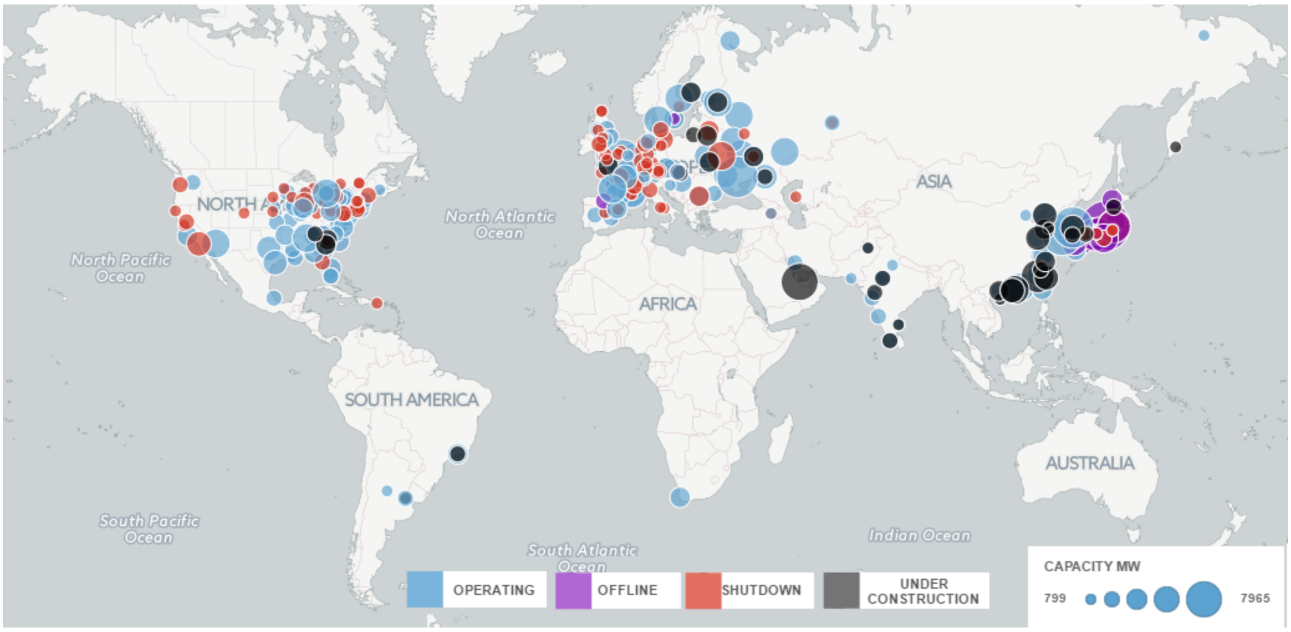



**FIGURE 4 :THE WORLD'S NUCLEAR POWER PLANTS, *SOURCE: EVANS & PEARCE, 2016***

As can be noticed in **Figure 4**, the majority of nuclear reactors are located in the western and former Soviet countries, while new constructions are concentrated mostly in China and India. With 99 reactors, the USA has the largest fleet of nuclear power followed by France (58 reactors), Japan (42 reactors), China (39 reactors), and Russia (36 reactors) (IAEA, 2018). Below is a brief summary of how the civil nuclear programme expanded around the world and reached its current status over the years:

*Early years – 1940s and 1950s*

The first attempts to harness the large amount of energy released by the splitting of the atom (i.e. nuclear fission) did not aim towards peaceful and commercial purposes of electricity production, but towards building a powerful bomb that would help win wars. The early experiments for the nuclear fission were conducted in late 1930s and two German physicists, Otto Hahn and Fritz Strassman, successfully split the uranium atom and released energy in 1938, by bombarding it with neutrons (Chater, 2005). They also found out that the fission released not only energy, but also additional neutrons which could initiate a fission reaction in other uranium atoms: a chain reaction leading to an even greater release of energy (WNA, 2017). Although Hahn and Strassman's experiment was successful, it was not enough for building a nuclear bomb since it was not yet possible to achieve a chain reaction. With the onset of the Second World War, the UK, Germany, and the USA raced to build the first nuclear bomb. In 1942, President Roosevelt, warned by Albert Einstein that Germany would soon build the first atomic bomb, launched a massive research program, called the Manhattan Project (Chater, 2005).

The Manhattan Project is considered to be one of the most noteworthy scientific projects of the twentieth century. A large international team of experts led by Robert Oppenheimer collaborated with the US military to build a nuclear bomb before Germany (Chater, 2005; Scurlock, 2007). The first experimental nuclear reactor was constructed in late

1942 in Chicago, and shortly after, the first nuclear bomb was built and tested in Los Alamos, New Mexico (Chater, 2005; Scurlock, 2007). Several sites were set up in the USA to enrich uranium and produce plutonium. All these efforts resulted in the subsequent development of two atomic bombs, dropped on Hiroshima and Nagasaki in 1945 (Chater, 2005).

Earliest nuclear reactors were designed to produce plutonium for atomic bombs, and they were simply comprised of graphite piles. Uranium was loaded into these piles and was transformed into plutonium which was more readily fissionable, facilitating the functioning of an atomic bomb (Scurlock, 2007; WNA, 2017).

It was not until 1951 that nuclear power was used to produce electricity; the first was when a small experimental reactor in Idaho, USA, named EBR-1, produced a small amount of electricity (Scurlock, 2007). The use of nuclear power was still mostly limited to military applications, in particular, nuclear submarines[6] and aircraft carriers, since these were prioritized for being strategically more important; and hence the amount of electricity generation in the 1950s remained negligible. Yet, the pressurised water reactors developed for military applications were to become the most widely used reactor types for electricity generation in the following years in the USA (Chater, 2005). Meanwhile, the Soviet Union, France, the UK, and Canada had their own nuclear programs and they were developing different types of reactors to produce plutonium.

In 1953, President Eisenhower addressed the United Nations and launched the “Atoms for Peace” programme, calling for international cooperation for the development of nuclear technology for peaceful purposes, mainly for electricity production (Chater, 2005). Meanwhile, some countries had already made some efforts to develop nuclear energy programs out of weapons programs. For instance, Soviet Union adjusted their existing graphite-moderated channel-type reactors (which were designed initially for plutonium production) to suit heat and electricity generation, and in 1954, they connected the world's first nuclear electricity generator to the grid (WNA, 2017). Two years later, the UK followed suit and connected another nuclear power station comprising four 50MW reactors to the grid in Calder Hall (Chater, 2005).[7] In 1957, the USA’s first large scale nuclear power plant began operating in Shippingport, Pennsylvania: a 60MW unit pressurised water reactor, modified from the US military submarine design (Scurlock, 2007). France built its commercial models in 1959, and Canadians started their first electricity-generating unit in 1962.

*Scaling up and fast growth – 1960s and early 1970s*

With the beginning of 1960s, several governments in the world sought to build up a nuclear electricity generation industry (Scurlock, 2007). However, there was little incentive for the private companies to invest in this new sector since other types of energy were readily available for low prices at that time. For instance, utility companies in the USA refused to participate in the nuclear power program arguing that the country abounded with cheap oil and coal, and there was simply no need to bear the high costs and risks of building nuclear reactors (Scurlock, 2007). As a result, the US government first had to heavily subsidise the industry and build several demonstration reactors using different technologies, among which only Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) types were deemed good enough for electricity production (Scurlock, 2007). In order to build up a market for nuclear energy, several loss-making fixed-price contracts were made by General Electric and Westinghouse, where losses of up to one billion dollars would be sustained by the manufacturers (Scurlock, 2007). This strategy paid off and 44 plants (around 40 GW of capacity) were ordered by several utility companies during the so-called “Great Bandwagon” of orders (Scurlock, 2007).

The oil embargo in 1973, imposed by the Arab members of the Organization of Petroleum Exporting Countries (OPEC) on the USA and other western countries, quadrupled the oil prices, and as a result, nuclear energy emerged as a reliable energy alternative. Countries started to phase out their power plants using petroleum in favour of nuclear power (Chater, 2005). A rush of orders came from the industrialised world in order to attain a comparative independence of energy supply since uranium was considered as a more “strike-proof” energy source (Scurlock, 2007). It was more widely distributed around the world than oil, and quantities of uranium for a given amount of energy were small compared to oil and coal, facilitating the trade and storage of large amounts of energy (Scurlock, 2007).

[6] A nuclear submarine can remain underwater for months without requiring air for its engines. The first nuclear submarine, i.e. USS Nautilus, which was powered by a small pressurised water reactor, entered in service in 1954 (Scurlock, 2007).

[7] Although the reactors were producing electricity, it was no secret that they were also intended for plutonium production (Scurlock, 2007).

As a result, several new orders came from throughout the industrialised world. For instance in the USA, between 1973 and early 1990s, the share of nuclear power in electricity production increased from 4 percent to 20 percent, while oil's share decreased from 17 percent to 4 percent (Chater, 2005). In France, following Électricité Distribution de France's (EDF; Electricity of France) launch of the intensive nuclear programme, the share of nuclear electricity went up from 8 percent in 1974 to 78 percent in late 1990s (Chater, 2005). Similar trends were observed in Soviet Union, Germany, Canada and Japan, as well. In sum, this brief period was arguably as close as nuclear power would get to what could be called its golden age. Caught up in the nuclear hype, the USA went even so far as to predict that they would own approximately 1000 nuclear power plants in operation by the year 2000 (Scurlock, 2007).

*The turning point – late 1970s and 1980s*

Despite the highly ambitious future projections of the industry, the nuclear enthusiasm of early 1970s was short-lived. The reasons for this loss of interest are twofold: First the economic crisis at the aftermath of the oil shock increased the costs of capital-intensive investments such as nuclear power plants (Scurlock, 2007). Next, the manufacturers had incurred huge losses from the turnkey contracts made in late sixties and the hope that electricity from nuclear power would be "too cheap to meter" was never materialised (Chater, 2005). A good case in point is the Washington Public Power Supply System, which lost over two billion dollars after cancelling four power plants (Scurlock, 2007). Meanwhile in France, the nuclear construction programme and low electricity prices resulted in approximately 50 billion dollars of accumulated debts by the end of 1980s (Scurlock, 2007).

When the accident in the power plant in Three Miles Island occurred in 1979, the industry had already been experiencing a slowdown. After 1979 no new plants were ordered in the USA and several existing projects were cancelled (Chater, 2005). In Europe, Austria and Sweden opted out of nuclear energy after referenda and several reactors were cancelled, or never operated (Chater, 2005). Lastly with the nuclear catastrophe in Chernobyl in 1986, the nuclear industry entered into an era of depression: The nuclear programme in Soviet Union lost considerable momentum and Italy decided to shut down all its four power plants in 1987. However, despite all these setbacks, reliance on nuclear power never completely disappeared.

*Recent trends – 1990s onwards*

Nowadays, there are two different camps among countries regarding nuclear power. For some, nuclear power is already outdated: Italy and Lithuania shut down all their reactors long ago and Japan took all its nuclear reactors off the grid, after the accident in Fukushima caused by the earthquake and the following tsunami in March 2011. Germany started to phase out its reactors after Fukushima, as well. For others, however, nuclear energy continues to occupy a prominent role in electricity production. For instance, according to (IAEA, 2018), the share of nuclear energy in the total supplied electricity in France was 72.3 percent in 2016. The USA continues to have the largest nuclear capacity in the world (100.35 GW), although it only accounted for 19.7 percent of the country's electricity supply in 2016. Ukraine, Slovakia, Belgium, and Hungary produced more than half of their total electricity generation from nuclear in 2016. Furthermore, there are newcomers such as China, which increased its total nuclear capacity substantially in the last two decades. As shown in **Figure 5**, while the total amount of electricity supplied from the nuclear energy is either static or decreasing in western countries, in China, it is increasing fast, and in South Korea and Russia, it is expanding steadily (BP, 2017).

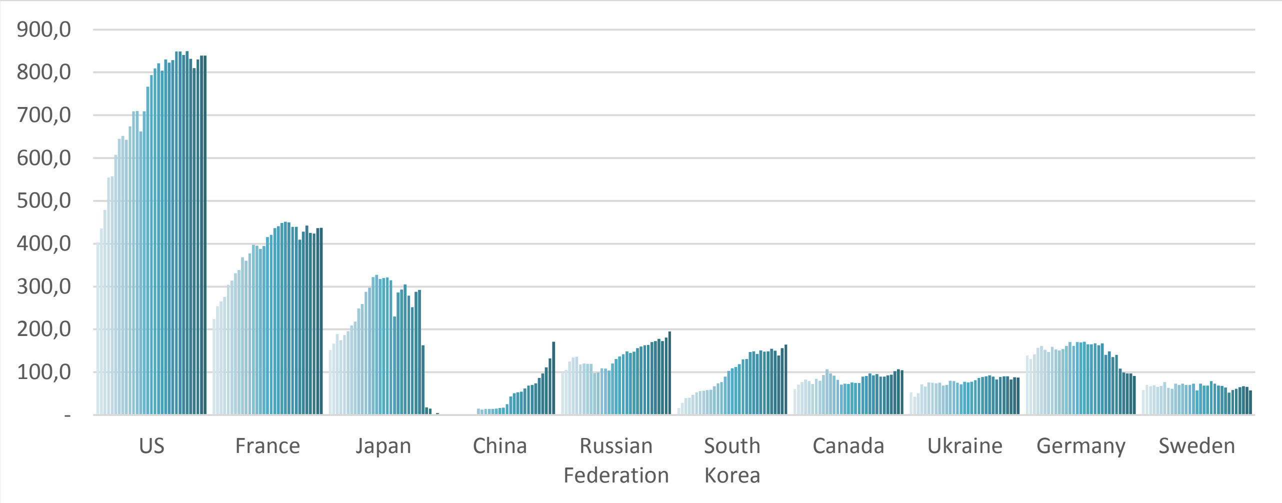



**FIGURE 5: CUMULATIVE ELECTRICITY CONSUMPTION FROM NUCLEAR POWER PLANTS IN OPERATION IN THE TOP 10 COUNTRIES WITH LARGEST CAPACITIES, BETWEEN 1985 (LIGHT BLUE) AND 2016 (DARK BLUE),** ***SOURCE: BP, 2017***

The effect of Fukushima disaster clearly manifests itself in **Figure 5**, underlined by the sharp decline in consumption levels in Japan and Germany in recent years. However, the USA's decision to cease nuclear expansion predates the Fukushima disaster, going back to late 1970s. No new nuclear power plant licenses were granted in the USA after the Three Miles Island accident in 1979 (the first large scale accident to raise suspicions over nuclear safety) and no new constructions were started after mid-1980s (Van Gerven, 2014). The Chernobyl disaster in 1986 had also made countries reconsider the safety of nuclear energy and the expansion of their nuclear capacity which decelerated afterwards. As shown in **Figure 6**, although the level of total electricity produced in the world from nuclear seems to be increasing in absolute terms, the share of the nuclear in total electricity production first stalled and then decreased from 1986 onwards, hinting at the tentative conclusion that the new additions to the world's total electricity capacity are coming from sources other than nuclear.

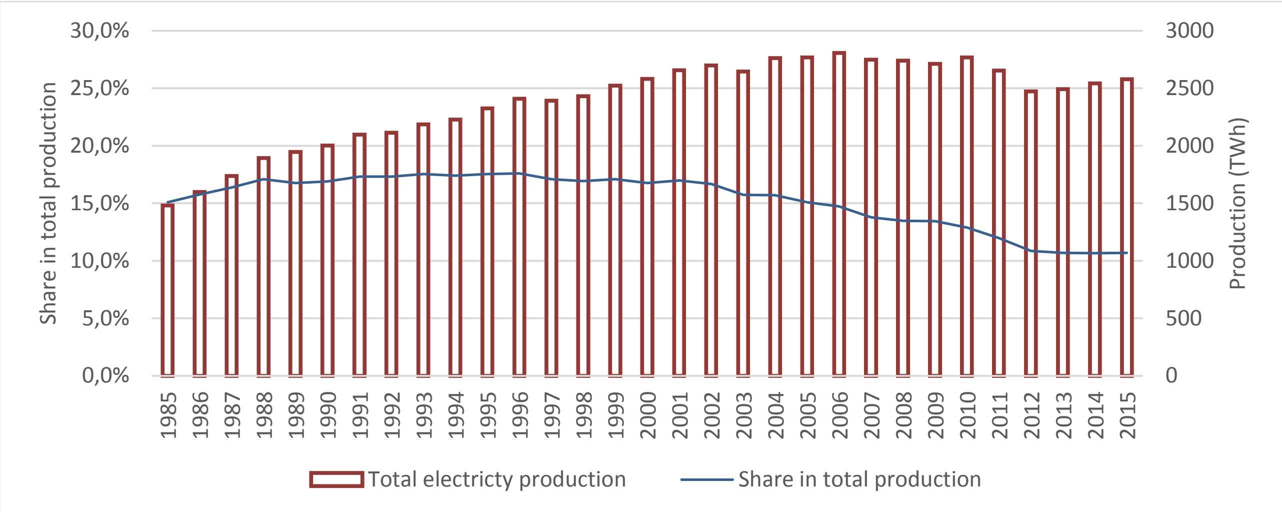



**FIGURE 6 : TOTAL ELECTRICITY PRODUCED BY NUCLEAR REACTORS AND ITS SHARE IN TOTAL WORLD CONSUMPTION SINCE 1985,** ***SOURCE: BP, 2017***

In fact, as mentioned earlier, the new nuclear capacity comes mostly from the Asian countries, particularly from China, where there are 20 reactors under construction with a capacity of 20.6 GW. In contrast, the reactor fleet in the western countries is quite old. As shown in **Figure 7**, the majority of the reactors in the world are old, the average age being 29.5. However, the distribution of the reactor age varies also from country to country. That is, while the average reactor age is 36 in the USA, and 31 in the EU and former Soviet countries (both of which clearly reflect the timing of Three Miles Island and Chernobyl disasters), China has a much younger fleet with an average age no higher than 8 (Evans & Pearce, 2016). **Figure 7** shows that a large share of the nuclear reactors is approaching the end of their lifetime and in the coming decades they will be shut down, resulting in a substantial decline in the total nuclear capacity.

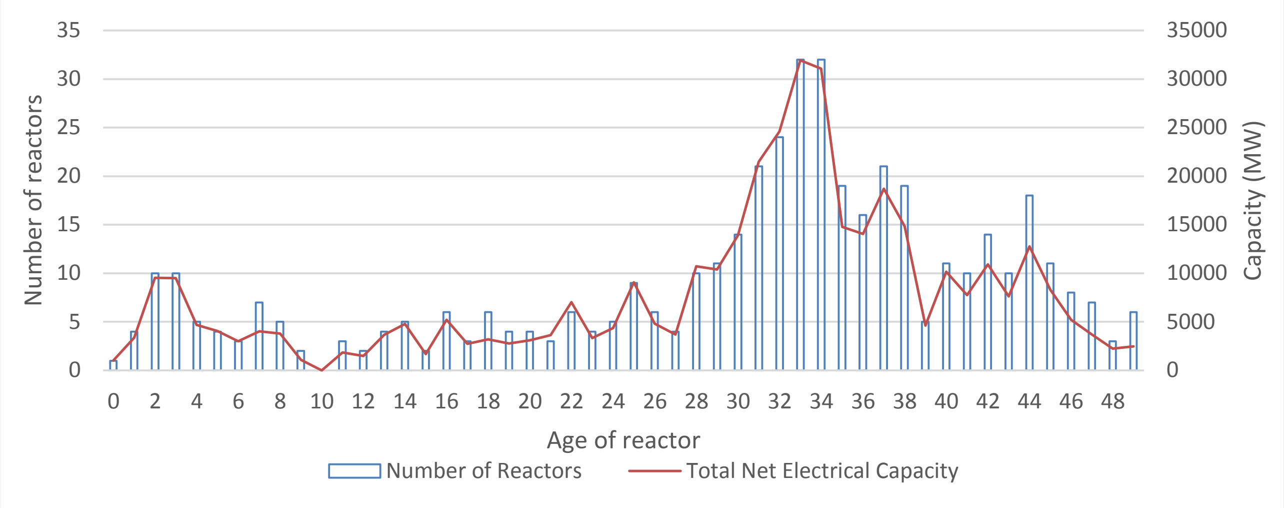



**FIGURE 7 : DISTRIBUTION OF NUCLEAR REACTORS IN THE WORLD BY AGE, *SOURCE: IAEA, 2018***

It is clear that the three major nuclear disasters in the history have had a substantial negative impact on nuclear energy development. However, accident risk is only one facet of the many unresolved central problems surrounding the nuclear energy, and this is accepted by both the proponents and opponents of the technology (Van Gerven, 2014). The other problem embedded within nuclear energy is the management of the high-level radioactive waste (HLW) – the long-lived and highly radioactive waste such as the spent fuel. For decades, governments and the nuclear industry strived to find disposal solutions for HLW, such as burying it in deep geological disposals. However, due to issues regarding the societal acceptance, there has been little progress in even finding suitable sites, let alone construct the storage facilities. (Brunnengräber et al., 2015). In the USA, Yucca Mountain in Nevada was selected as the repository site; however, the project has been stalling due to the local opposition. Currently, the spent fuel is stored in the pools at the reactor sites, or in centralised interim sites not suitable for long-term storage. There are, as yet, no countries in the world with a long-term storage in operation (Brunnengräber et al., 2015).

In the early 1990s, despite the two major accidents and the problems related to the long-term waste storage, nuclear energy was still promoted by the industry who were assuring the governments that Chernobyl was Soviet technology and that a similar accident would not happen in the West (Brunnengräber et al., 2015). In fact, the accident in Three Miles Island was promoted as a disaster management success, showing how the western safety standards worked effectively for keeping the meltdown inside the protective shell (Bowonder, 1986).

*Prospects for the future*

The industry introduced the concept of "nuclear renaissance" by promoting the nuclear technology as "clean energy" for its potential to mitigate the greenhouse gas emissions. From 1995 onwards, nuclear power even received the support of the United Nations Framework Convention for Climate Change (UNFCCC) as a viable option to combat climate change (Brunnengräber et al., 2015). However, a new construction wave similar to that of 1970s, which can be dubbed "a renaissance", never materialised due to several reasons including but not limited to the recent Fukushima disaster (Mez, 2011).

Whether nuclear energy can truly be a part of the transition to a sustainable energy future has been a widely debated issue since early 1990s. It is claimed that, in comparison with fossil fuels, nuclear energy produces less greenhouse gas emissions, even after accounting for the emissions associated with the nuclear fuel chain (Ramana, 2016). Some others claim that nuclear energy is good for some sustainability indicators such as ozone depletion or photochemical smog (Stamford & Azapagic, 2011). However, well-known problems associated with the technology, such as radioactive waste, risk of catastrophic accidents, and linkage with the atomic bombs, raise doubts over the sustainability of nuclear energy (Ramana, 2016).

Nowadays, the new nuclear reactors are being constructed mostly in the developing countries, whereas in the industrialised countries of the Global North, the prospects for nuclear energy are not good (Ramana, 2016). The location of their construction has shifted from countries that host several reactors to countries with few or no reactors. In a similar fashion, the suppliers of these new reactors are no longer companies from the USA, France or Canada, but those from Russia, or South Korea, and potentially China in the near future (Ramana, 2016). At this background, the following section focuses on Turkey's attempts to build two new nuclear power plants in Akkuyu and Sinop provinces.

## HISTORY OF AKKUYU AND SINOP NUCLEAR POWER PLANTS

The history of nuclear power in Turkey dates as far back as 1955, following Turkey's involvement in the "Atoms for Peace" initiative (Şahin, 2011). In 1956, the national agency, i.e. "General Secretariat of Atomic Energy Commission", was established (TAEK, 2017b). Briefly after this, Turkey became a member of the International Atomic Energy Agency (IAEA) in 1957 and adopted its first legislation for the "Implementation of Nuclear Power in Turkey" in 1959 (Şahin, 2011). From that point onwards, Turkish governments, regardless of their political stance, attempted several times to build a commercial nuclear power plant in Turkey. However, all these attempts failed since the government was not able to secure the high amounts of initial financing. The continuous civil society resistance in the legal front arguably played a role in stopping the projects as well (Şahin, 2011). Six major attempts to build a nuclear power plant since 1960s, each lasting approximately a decade, can be summarised as follows:

### *1960s – Initial Plans.*

After the establishment of the Atomic Energy Commission (AEC) and the membership of Turkey to International Atomic Energy Agency (IAEA), the first research reactor called TR-1 (with capacity of 1 MW) was commissioned to "American Machine and Foundry". It was constructed between 1959 and 1962 and became operational in 1962 (TAEK, 2017a). From 1965 onwards, the first studies were carried out by the AEC and EİEİ (*Elektrik İşleri Etüd İdaresi* - Electricity Works Study Department) with the advisory support of an international consortium formed by American, Swiss, and Spanish firms. The consortium published their final report in 1969, where they recommended a 400 MW pressurised heavy water reactor, which was planned to be built as a conventional purchase and expected to become operational in 1977 (Jewell & Ates, 2015; Özemre, 2001). Meanwhile, the goal of building a nuclear power plant was officially (although vaguely) mentioned in Turkey's Second Five Year Development Plan as "[t]he possibilities of exploiting nuclear energy sources will be investigated and efforts will be made to establish nuclear power plants" (State Planning Organisation, 1968, p. 559). However, these plans were discontinued due the military coup in 1971 and the political and economic instability that followed it (Jewell & Ates, 2015).

### *1970s – First Site Selection and Issuing the License*

Following the coup, the Department for Nuclear Power Plants was founded within the Turkish Electricity Authority (Türkiye Elektrik Kurumu - TEK) in 1972 and the plans for building a nuclear power plant came into the agenda once again (Özemre, 2001). The first nuclear reactor prototype was planned in 1973, followed by the search for a suitable plant site. After feasibility studies for site selection, Akkuyu, a small bay in Mersin province along the Mediterranean, was selected for the construction of Turkey's first NPP. The reasons for this preference can be listed as follows (Akcay, 2009; Aydın, 2014; Özemre, 2001):

- The region was seismically stable
- It was well-situated along the coast and hence would provide convenient transportation to bring in heavy machinery by sea
- Its low population density would make it safer in the unlikely event of an accident
- Closeness to sea would provide adequate cooling water at the site

The site license was acquired in 1976 and the first full-scale project for Akkuyu started under the administration of the centre-left Republican People's Party (CHP). A tender was organised in 1977 with the Swedish company ASEA ATOM (today Westinghouse Electric Sweden AB) being the only firm to make a bid, with their BWR type model (Adalıoğlu, 2009). The firm was chosen to construct the power plant, but the attempt came to a halt for several reasons, including the presence of a new, mostly local Turkish anti-nuclear movement and disagreements about the financing between the government and the company. The Swedish government withdrew its credit guarantee in 1980, and the project was cancelled (Jewell & Ates, 2015; Şahin, 2011; Udum, 2010).

The seeds of the anti-nuclear movement in Turkey were planted against this first full scale attempt even before the infamous Three Miles Island and Chernobyl accidents. Inspired by the anti-nuclear movements in France, the chairman of the local fishing cooperative, Arslan Eyce, along with his two journalist friends, Ömer Sami Coşar and Örsan Öymen, launched the first ever awareness raising campaign against nuclear plants by informing the fishermen in the region about the potential risks and dangers those plants bear (Künar, 2002). They later managed to attract the attention of both local and national civil society by organising conferences and meetings, circulating their views through the newspapers and posters. They even collaborated with the Swedish civil society against the first attempt (Künar, 2002; Şahin, 2011).

*1980s – After the Coup and The Effects of Chernobyl*

After the cancellation of the last attempt and a two-year pause in the aftermath of the 1980 military coup, the military administration restructured the AEC as Turkish Atomic Energy Authority (TAEK) and initiated another attempt for Akkuyu in 1982 (Şahin, 2011). Studies for the site selection for new plants followed shortly after and Inceburun (in Sinop, a small Black Sea city) was finally selected as a candidate site for the second nuclear power plant (Udum, 2010). In 1983, this time without a tender process and through direct negotiations, Atomic Energy of Canada Limited (AECL) from Canada (now CANDU), Siemens-Kraft Werk Union (KWU) from Germany, and General Electric (GE) from the USA were asked to submit their offers. However, due to several controversies surrounding the project, all three of the firms withdrew their offers.

First, GE, asked by the government to build on the site in Sinop, withdrew from the project since they were reluctant to work in this site, due to safety concerns. The experts in GE thought that a nuclear power plant in Sinop was not feasible since there were not enough studies about the seismic zone in the region. Hence, GE did not submit any bids and the negotiations were stalled. The government continued the negotiations with the Germans and Canadians, and a tentative agreement was reached in 1984 (Şahin, 2014). However, soon after the agreement, the Turkish government announced changing the bid into a Build-Operate-Transfer (BOT) model instead of the previously agreed upon "Turn Key" model (Udum, 2010) which discouraged Kraftwerk Union (KWU) since it had experience in nuclear plant construction but not in operating them. Atomic Energy Canada Limited (AECL) accepted the BOT model and a pre-agreement was finally reached. However, later the Canadian government did not want to proceed with the project with a BOT model unless there was a guarantee from the Turkish State, which was rejected by the Turkish government resulting in another failed attempt.

Kibaroglu (1997) argues that, apart from the financial and technical problems at hand, what impaired Turkey's nuclear program was western countries' concerns over nuclear proliferation due to Turkey's close relations with Pakistan, who at that time was known to be trying to enrich uranium for proliferation purposes. Kibaroglu (1997) attributes the withdrawal of the American and Canadian firms partly to the suspicions that if Turkey had acquired the nuclear technology, it might use it for building nuclear weapons, as Pakistan had done. Accordingly, opposition from Greece, France, India and Israel over the concerns about nuclear proliferation also affected the efforts to secure the necessary financing for the project (Kibaroglu, 1997).

While Turkish government did not have a clear international support, it lost the national public support as well, after the Chernobyl disaster in 1986. The large radioactive fallout had a catastrophic impact especially on the Black Sea, a region famous for tea and hazelnut cultivation. Although the government and TAEK tried to cover-up the fallout and claimed that there was nothing to worry about, it was later revealed that the tea and hazelnut production in the region was heavily affected, followed by the increased numbers of cancer cases in the region (Şahin, 2011). Despite the heightened political pressure on the civil society at the aftermath of the military coup, there were mobilisations (although not at large scale) against the project, such as petition and awareness raising campaigns (Künar, 2002). Public concerns about the safety of the nuclear power plants increased even further, putting political pressure on the government (Şirin, 2010). TEK closed down the Department of Nuclear Power Plants on the grounds that it was no longer useful (Adalıoğlu, 2009). Even though the Özal government tried to reach a deal with Argentina by signing a cooperation agreement for the transfer of technical knowledge and the construction of modular 25 MW reactor, this minor attempt also failed due to international political factors and lack of public support (Künar, 2002; Şahin, 2011).

*1990s – The Era of Coalition Governments and the Birth of the Anti-Nuclear Platform*

Even after the Three Miles Island and Chernobyl accidents, Turkey was still pursuing the construction of a nuclear power plant. A fourth attempt was initiated by the right-left coalition government in 1992, following a report by the Ministry of Energy and Natural Resources. The report argued that Turkey might face an energy crisis in 2010, unless it diversifies its energy production resources. Nuclear power was put forth as a necessary option for preventing the energy shortage expected in the coming decades (Adalıoğlu, 2009; Özemre, 2001). Following this report, nuclear power was once again prioritised by the government. However, the materialisation of these plans was delayed due to several political, economic and technical reasons, since beginning in the early 1990s, Turkey entered a decade of coalition governments and economic instability.

In an effort to liberalise the economy and bolster privatisation, in 1994, TEK was restructured and divided into two, as the Turkish Electricity Generation and Transmission Company (TEAS), and the Turkish Electricity Distribution Company (TEDAS), which further retarded the preparations of the bidding process (Martin, 1997). From this point onward, TEAŞ became the focal point for the development of the nuclear power plant, and it started seeking consultancy services to call for bids from international companies. In early 1995, Turkey started to receive consultancy from the Korean Atomic Energy Research Institute (KAERI) and made efforts to initiate a bidding process and bid specifications for the nuclear plant shortly after (Martin, 1997).

TEAŞ finally released the bid specifications in late 1996, and the three consortia identified for bidding were as follows (Martin, 1997)

- Westinghouse (USA) and Mitsubishi Heavy Industries (Japan) with Raytheon (USA) and Enka (Turkey), bidding for a single 1200 MW PWR
- Atomic Energy of Canada Limited (AECL) (Canada), leading a consortium bringing together Kvaerner-John Brown (UK), Gama-Güriş-Bayındır (Turkey), Hitachi (Japan), Korea Electric Power Corporation (KEPCO), Hanjung (Korea Heavy Industries and Construction Company - KHIC), and Daewoo (South Korea) bidding to supply two 700 MW CANDU PHWR
- Nuclear Power International (NPI), a partnership lead by Siemens (Germany), and Framatome (France) together with Campenon Bernard (France), Hochtief AG (Germany), Garanti Koza, STFA, Tekfen & Simko (Turkey) bidding for a Siemens 1400 MW Convoy PWR

Meanwhile, the revival of the plans for a nuclear power plant triggered a visible and vocal mobilisation by the anti-nuclear movement. A large public demonstration was organised by the Turkish Green Party in Silifke, Mersin (Şahin, 2011). In 1992, Greenpeace organised their very first direct action in Turkey, in Izmir, against nuclear power (Künar, 2002). A nationwide movement gained momentum rapidly and in 1993, more than a hundred different civil society organisations, including unions, political parties, independent activists and individuals, professional organisations and environmental NGOs united and formed a large coalition which was later called the “Anti-Nuclear Platform” (Şahin, 2011). The Platform became the flagship of the anti-nuclear movement in the country and organised several successful demonstrations, rallies, direct actions, conferences, publications, and festivals to keep public attention awake and create a strong opposition (Künar, 2002; Şahin, 2011).

Despite bid specifications from three consortia were received in 1996, the tender deadline was postponed several times in four years due to technical and economic reasons and sometimes corruption claims (Udum, 2010). The frequent changes in the coalition government, financial constraints and strong opposition made it difficult for the governments to keep the pace with the project (Şahin, 2011). Finally in 2000, the Ecevit Government decided to cancel the project for good, drawing attention to the fact that alternatives for the nuclear energy, such as wind and solar were gaining prominence and that the nuclear technology would become a financial liability for the country in the future (Udum, 2010). This marked a clear victory for the Anti-Nuclear Platform and in the history of environmental mobilisations in Turkey.

*2000s – Back to the Single Party Government*

Although the coalition government led by Ecevit abandoned this attempt, the nuclear energy debate was revitalised with the change of government in 2002. The conservative Justice and Development Party's (AKP) rise to power by winning an outright majority of the seats in the parliament marked a turning point in the history of nuclear power for Turkey. Following the growing concerns over the import dependency for natural gas, particularly on Russia, nuclear power was reintroduced in the government's agenda as an alternative energy source to reduce the supply security risks (Jewell & Ateş, 2015; Şahin, 2011). In 2004, the Ministry of Energy and Natural Resources re-launched studies for a long term nuclear power program and signed a cooperation agreement with USA on the peaceful uses of nuclear power (Şahin, 2011). According to the initial plans, TEDAŞ expected a 4500 MW nuclear capacity to be connected to the grid between 2011 and 2015 (Udum, 2010). Akkuyu was considered as the first option and Sinop was the selected site for a second plant (Şahin, 2011). TAEK and the Ministry of Energy put forth a collaborative effort in preparing the legal background of the proposed nuclear program. In 2007, a law was established to regulate the rules for the tender (mentioned as competition in the law), the selection process, and the principles on the sale of the electricity generated (Şahin, 2011; Udum, 2010).

The tender process for Akkuyu started in 2008 (Jewell & Ates, 2015). Initially, six international vendors were planning to participate in the tender process; however, the state received only one bid from the Atomstroyexport-Inter Rao-Park Teknik consortium, a subsidiary of the Russian state-owned Rosatom. The consortium proposed to build four units of VVER1200 pressurised water reactors with a price offer of 21.16 dollar cents per kWh (Udum, 2010). The price tag was deemed unaffordable by the government which believed that the acceptable price range should be between 10-12 dollar cents. In late 2009, the high court halted the execution of some articles of the nuclear power tender regulation, and the tender was cancelled eventually (Şahin, 2011).

Meanwhile, the Anti-Nuclear Platform, which ceased its activities following the cancellation announcement by the Ecevit government in 2000, reunited in 2005, as the nuclear energy once again became an agenda item for the government (Gürbüz, 2016). In 2006, after TAEK announced that Sinop was selected for the second nuclear power plant, one of the biggest street mobilisations in Turkey was organised in Sinop with the participation of over 15 thousand people (Demircan, 2014). The date of the protests coincided with the 20$^{th}$ anniversary of the Chernobyl disaster and people coming from all around the country, fishermen from Mersin and the like, participated in the mobilisations. In 2007, while the bill on the regulation of the nuclear power program was being discussed in the parliament, 165 scientists signed an "Anti-Nuclear Declaration", citing the negative effects of nuclear power plants both on the environment and on human health (Anonymous, 2007; Demircan, 2014).

*2010s – Intergovernmental Agreements*

After facing impediments such as the cancellation of nuclear legislation by the High Court, various legislative and administrative difficulties, court cases, and failed tenders, the government eventually decided to continue the project directly with Russia (the only country that expressed an interest in the previously failed tender). In order to avoid the legislative "chaos" and delays due to another tender process, the government signed a bilateral intergovernmental nuclear cooperation agreement with Russia in 2010 (Şahin, 2011). According to this agreement, Rosatom would build, own, and operate the Akkuyu NPP until the end of its decommissioning (a new scheme different from the previous BOT strategies), and Turkey would provide the Akkuyu site free-of-charge and guarantee to purchase the electricity generated from Akkuyu for 15 years, at a price of 12.35 dollar cent per kWh. The fuel would be provided by the Russians, and again, the Russians would be in charge of the nuclear waste disposal. In addition, in line with the agreement, in order to build up the necessary human capital, Turkey would send several students to universities in Russia to study nuclear technology and engineering, starting from 2015 (Akkuyu NGS, 2015).

In one respect, Turkey sub-contracted the costly construction, operation, fuel provision, and waste disposal matters to Rosatom, with all the risks borne (and compensation guaranteed) by the state of Russia, and avoided a large portion of potential future costs and risks, by giving the higher share of the plant (which can never be less than 51 percent) to Rosatom. Ultimately, according to this agreement, Akkuyu will be the first ever nuclear plant on a state's sovereign land, owned and operated by another state (Şahin, 2011). This exceptional deal prompted a strong reaction from the antinuclear movement and even a considerable number of pro-nuclear engineers and academics opposed the agreement (Şahin, 2011). The construction of the plant was expected to start in 2013, but it has been delayed due to the administrative difficulties and civil society opposition.

Shortly after the agreement with Russia, the disaster in Fukushima happened in 2011; however, Turkish government did not withdraw or even suspend the project. In contrast, a similar agreement for nuclear cooperation was signed with Japan, with another BOT scheme, for the construction of Sinop NPP, with capacity of 4480 MW and an expected cost of 22 billion dollars. According to this agreement, a Japanese led consortium would build the plant and own no less than 51 percent. The consortium would consist of Mitsubishi and Itochu from Japan, and GDF Suez (now Engie) and Areva from France. Again, similar to the agreement with Russia, an electricity purchase guarantee was granted with a price of 11.80 dollar cent per kWh (Jewell & Ates, 2015).

Overall, Turkey currently plans to build two nuclear power plants, with a total capacity of 9280 MW, in Akkuyu and Sinop, using similar strategies of BOT. The details of the two projects can be found in **Box 2.**

**BOX 2 PLANNED NUCLEAR POWER PLANTS IN TURKEY**


**Akkuyu NPP**

Akkuyu NPP is a planned nuclear plant at Akkuyu, in Büyükeceli, Mersin Province, Turkey. It will be Turkey's first nuclear power plant.

**Reactor type:** VVER-1200/491 PWR

**Reactor supplier:** Atomstroyexport

**Units planned:** 4 × 1,200 MW

**Nameplate capacity:** 4,800 MW

**Expected Cost:** US$20 billion

- The governments of Turkey and Russia signed a bilateral nuclear cooperation agreement in 2010. Since it is an intergovernmental agreement, the opposition cannot seek recourse at the courts.
- Turkey sub-contracts the costly construction, operation, fuel provision, and waste disposal matters to Rosatom, with all the risks borne (and compensation guaranteed) by the state of Russia, by giving the higher share of the plant to Rosatom (at least 51%).

**Sinop NPP**

The Sinop (İnceburun) NPP is a planned nuclear plant located at Sinop in northern Turkey. It will be the country's second nuclear power plant after Akkuyu.

**Reactor type:** Atmea I Gen. III (PWR)

**Reactor supplier:** Atmea

**Units planned:** 4 x 1,120 MWe

**Nameplate capacity:** 4,480 MW

**Expected Cost**: US$22 billion

- The deal for the project was signed between Turkish Prime Minister Recep Tayyip Erdoğan and his Japanese counterpart Shinzo Abe on May, 2013.
- The project will be carried out by a joint venture consortium of Japanese Mitsubishi Heavy Industries and French Areva.
- French electric utility company GDF Suez (recently re-branded as Engie) will be in charge of the operation of the nuclear plant, which is expected to start electricity production in 2023.

This new Build-Own-Operate (BOO) strategy, facilitated through an intergovernmental agreement, helped the government to evade a possible court case from the opposition which, unlike in a regular tender process, could not bring an international agreement to the court (Şahin, 2011). However, the opposition against the nuclear energy gained even more momentum, especially after the Fukushima disaster in 2011. According to a poll conducted by Greenpeace Mediterranean in April 2011, shortly after the Fukushima disaster, 64 percent of respondents declared they would say "no" in a possible referendum on nuclear power plants, while 86.4 per cent said they would not want to live near the nuclear power plant (Yavuz, 2015). Furthermore, a study by Ertör-Akyazı et al. (2012) showed that, even before the Fukushima accident, a strong popular anti-nuclear sentiment prevailed in the society and was marked by an opposition of 62.5 percent to nuclear power as opposed to only 7.2 percent endorsement.

Even though the intergovernmental agreements themselves are immune to court cases, the Environmental Impact Assessment (EIA) report of the Akkuyu project (a 5500 pages long report) was not and it was brought to the court by several organisations in 2012. In fact, the first version of the EIA report for Akkuyu was heavily criticized by both the proponents of nuclear energy and the opposition on the grounds that it did not thoroughly analyse the full nuclear fuel chain (including mining, upgrading, and fuel production) and fuel and waste transport. Failing to address all the questions and controversies that surrounded the project, the Ministry of Environment and Urbanisation eventually rejected the report in 2013. The court process is still ongoing and hence, the construction of the power plant, which was expected to start in 2013, could not officially start yet due to administrative delays. However, the site preparation in Akkuyu is claimed to have begun under the disguise of a stone quarry (Yavuz, 2015).

Legal action was not the only means used by the opposition. Large anti-nuclear mobilisations were organised in Sinop and Mersin, as well as in big cities such as Istanbul, Izmir, and Ankara. The mobilisation in Sinop in April 2015 was one of the largest environmental protests the country has ever witnessed (Gürbüz, 2016). Local branches for Anti-Nuclear Platform, which was previously a predominantly national platform, are now established in many major cities, including not only Sinop and Mersin, but also Adana, Ankara, Antalya, Bursa, Istanbul, Izmir, Kocaeli, Ordu, and Samsun (Yavuz, 2015). The Anti-Nuclear Platform still maintains a strong, vocal opposition.

## CONCLUSION

To recap, Turkey's nuclear program, albeit one of the oldest in the world, is also arguably among the most unsuccessful ones (Jewell & Ates, 2015; Şahin, 2011). Nearly every government since 1960s, regardless of their political stance (conservative or left-wing), has pursued the aspirations of building nuclear power plants, but failed to realise them due to financial constraints, lack of administrative or technical capacity, civil society opposition, or as some claim (Kibaroglu, 1997; Udum, 2010), due to the proliferation concerns of the western countries. Turkey seems to have overcome these problems by adopting BOO strategy through intergovernmental agreements with Russia and Japan. Although this strategy solves the challenges such as lack of financial and technical capacity, it creates new problems. Over the years, the proponents of nuclear energy have based their arguments on the much-needed energy security and energy independence. Especially, the increasing dependence on Russia for natural gas imports in the recent years is presented as a strong argument in favour of NPP construction by the government. However, civil society opposition argues that the intergovernmental agreement will not reduce the overall dependence on Russia: if anything, it will only exchange the dependence on gas imports (to the Russian gas company GazProm), for the dependence on nuclear power (to the Russian nuclear power company Rosatom).

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