Assessment of
Turkey's Nuclear Energy Policy

By

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Outline

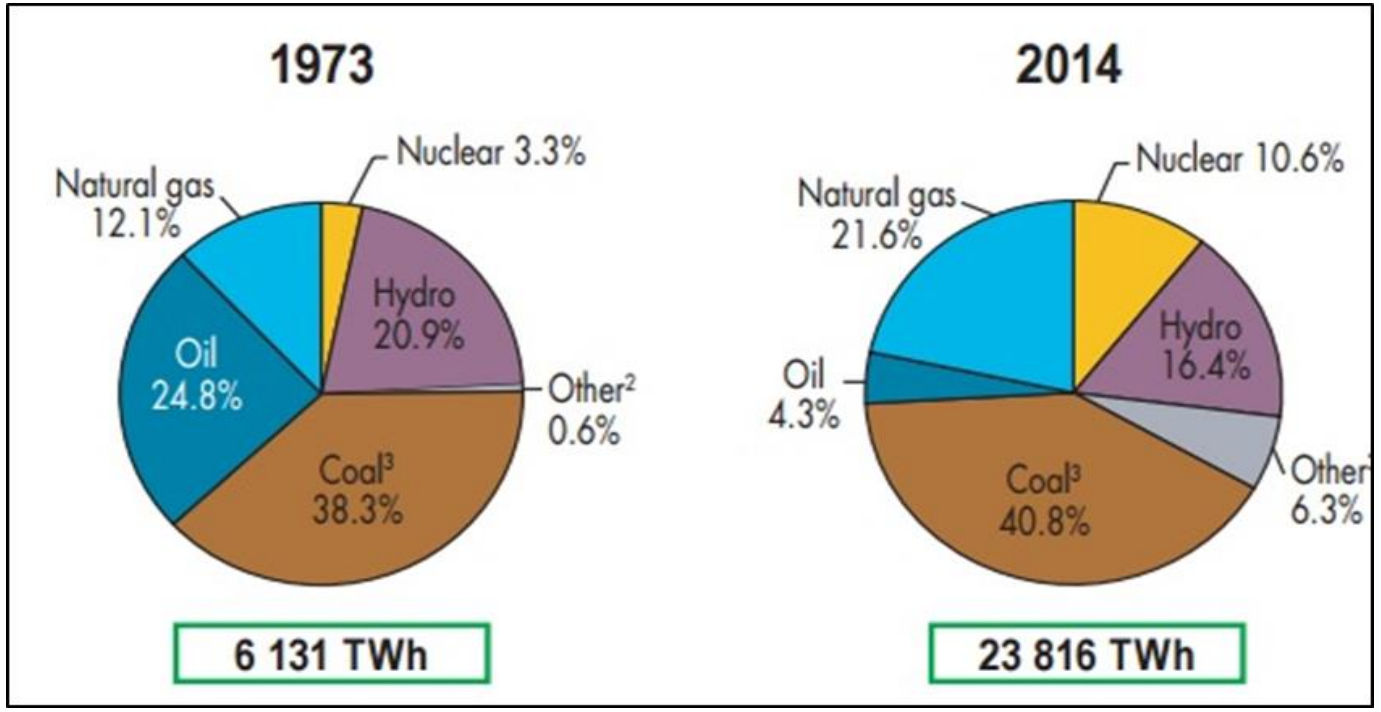
1. Introduction
2. Past and Current Energy Context
3. Challenges to Achieve Sufficient Nuclear Capacity
4. Current Legal Framework on Nuclear Energy in Turkey
5. Assessment and Recommendations
6. Conclusion

1. Introduction

- By the second half of the 20th century, obtaining energy from reliable resources has become the most significant concern of almost every country in the world.
- Especially the energy crises of the 1970s accelerated the search for reliable energy resources and highlighted nuclear power plants.
- Currently, there are over 440 commercial nuclear power reactors operable in 31 countries.

1. Introduction

Electricity Generation by Fuel Type in the World (IEA,2016)



- Nuclear power stations provide almost 11 % of the world's electricity as continuous and reliable base-load power, without any carbon dioxide emissions (World Nuclear Association, 2017).

1. Introduction

- Technical and economic **advantages of NPPs** can be summarized as follows:

1. Fuel is a low proportion of power cost, (5%) compared to Natural Gas Power Plants (40-60 %),
2. The fuel (uranium) is on site (not depending on continuous delivery),
3. They have relatively quick ramp-up capacity,
4. They contribute to clean air and low-CO_2 objectives while producing good voltage support for grid stability.

1. Introduction

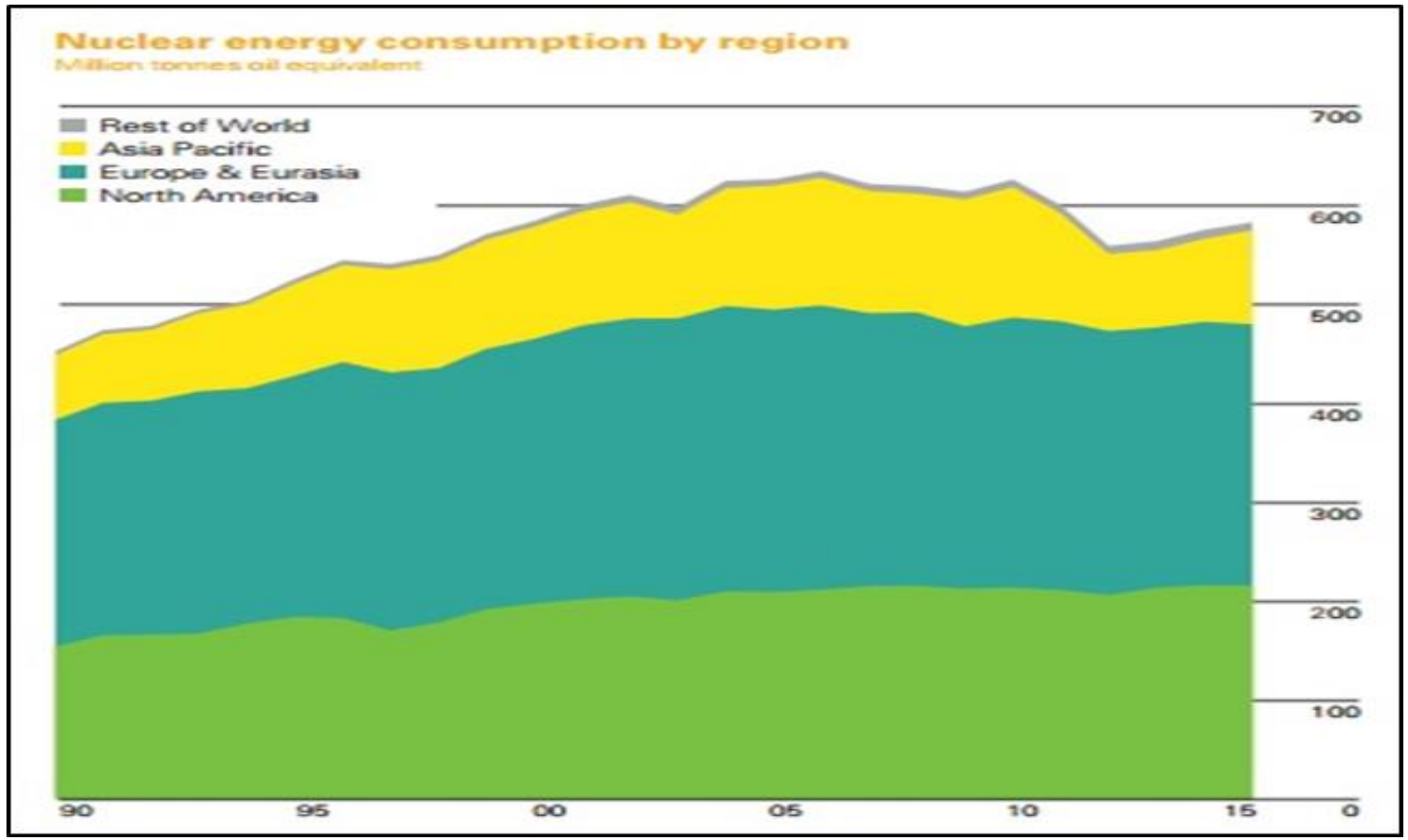
Reliance on Nuclear Energy to Supply Electricity in Selected Countries

Country	Reliance (%)	Reactors	Country	Reliance (%)	Reactors
France	76.3	58	Finland	33.7	4
Ukraine	56.5	15	Switzerland	33.5	5
Slovakia	55.9	4	Czech Republic	32.5	6
Hungary	52.7	4	South Korea	31.7	25
Slovenia	38	1	Bulgaria	31.3	2
Belgium	37.5	7	U.S.A.	19.5	100
Armenia	34.5	1	U.K.	18.9	15
Sweden	34.3	9	Russia	18.6	35

(World Nuclear Association, 2017)

1. Introduction

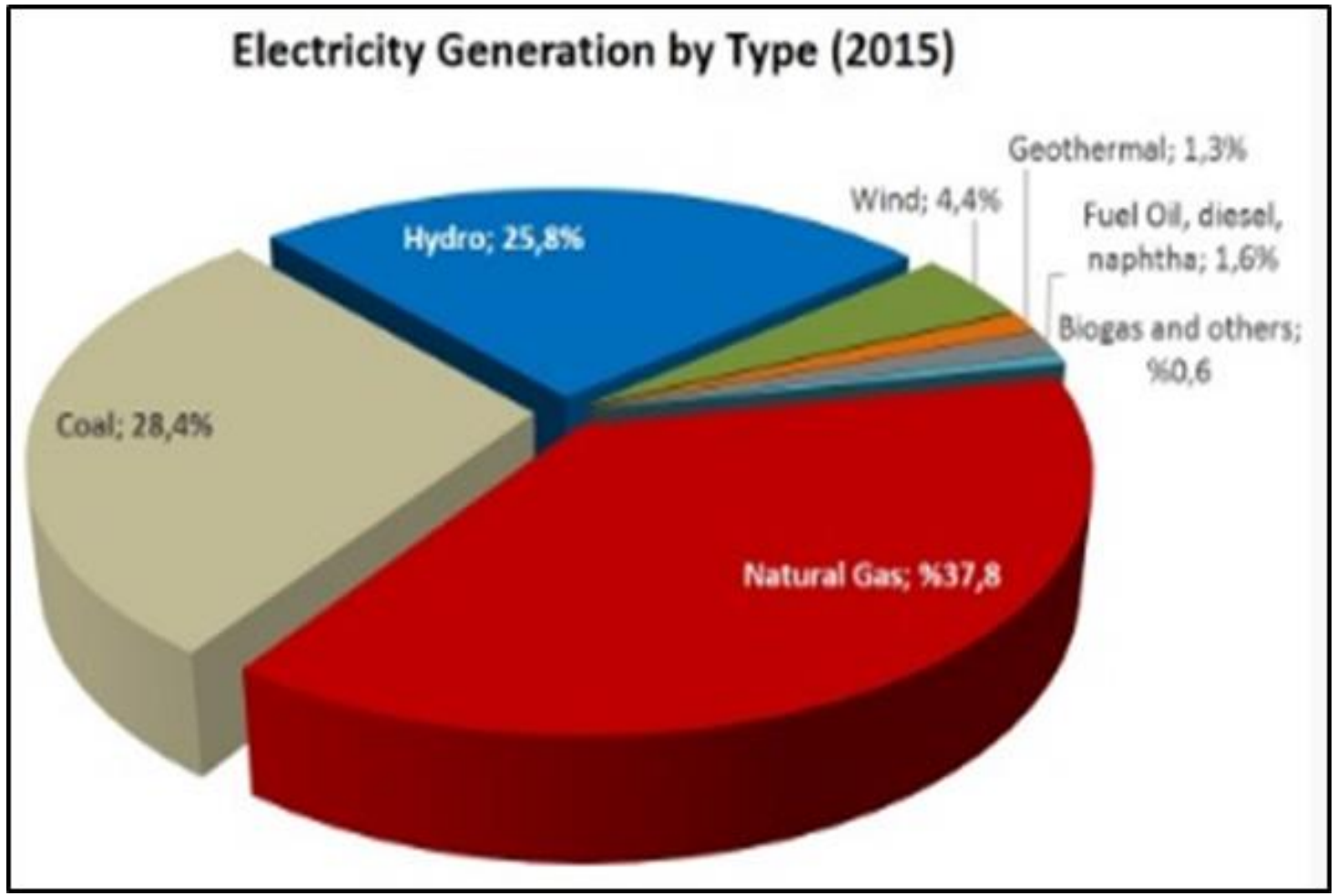
- **The Asia Pacific region** is responsible for all of the net increase, driven by growth in China (+28.9%).



1.2. Current Energy Outlook in Turkey

- **Turkey** - rapidly growing economy and energy demand.
- 16th Largest Economy in the World.
- Population : 80 million
- GDP per capita growth rate: 5 % between 2002 and 2015.
- Over the past decade, gross electricity demand has almost **doubled**
- Natural gas demand increased even faster and climbed up to 49 billion cubic meters (bcm) in 2015.
- However, Turkey is incapable of meeting overall energy consumption by its domestic resources.
- Only 25 % of the total energy supply is met by indigenous resources.
- Although the energy bill is relatively lowered due to recent decline in global oil prices, in 2014 this amounted to nearly $55 billion, 23 % of country's total import (AA,2015).

1.2. Current Energy Outlook in Turkey



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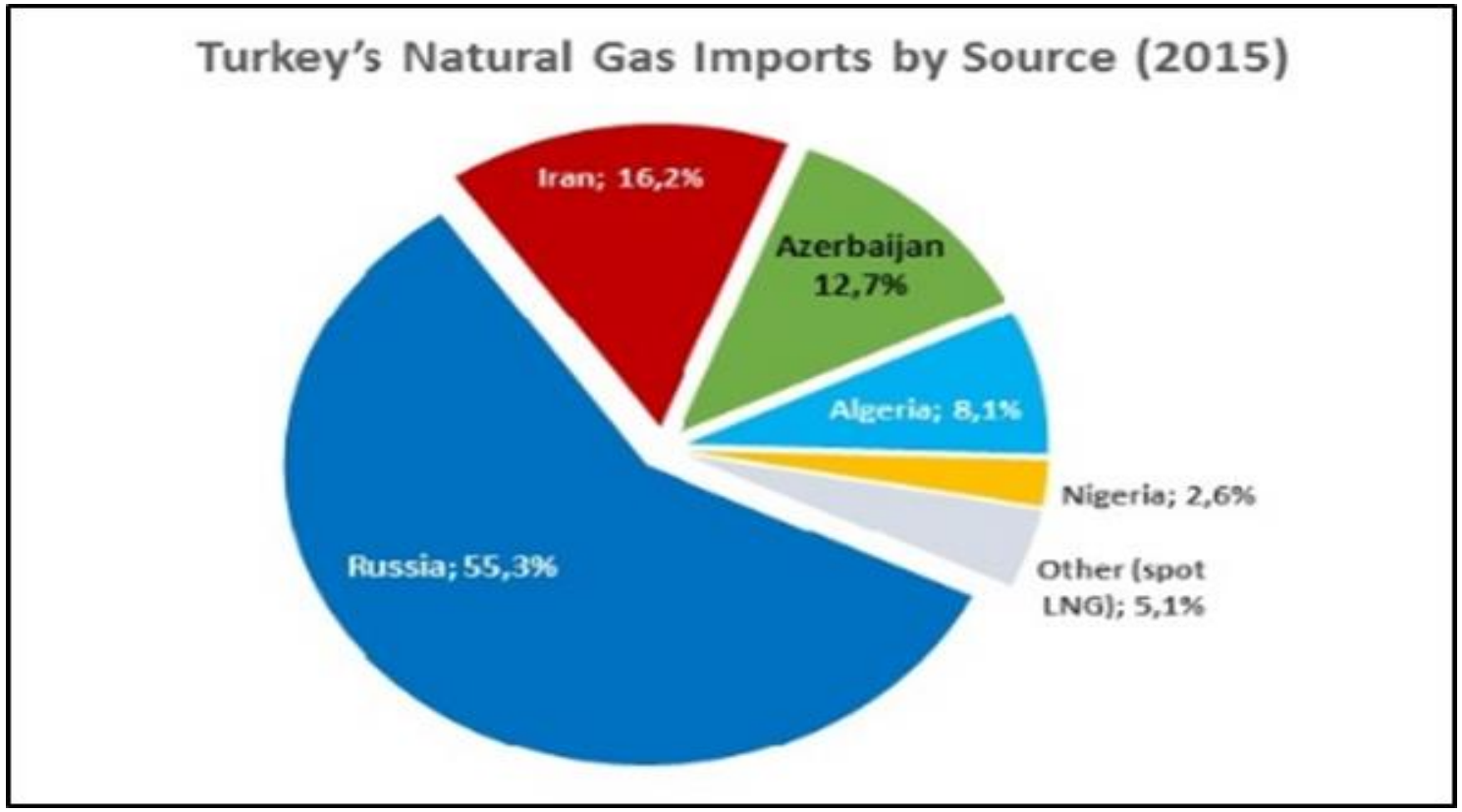
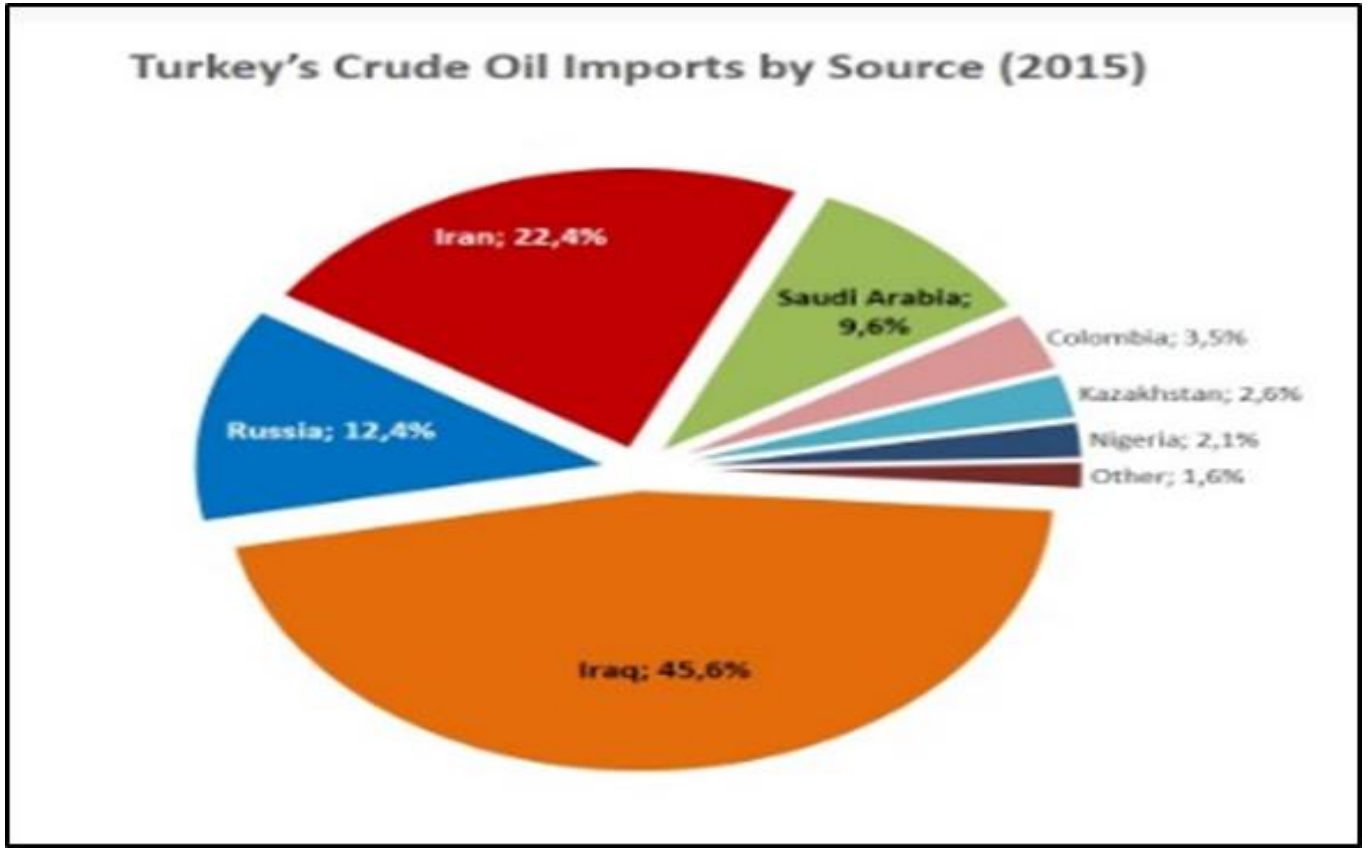


- Over the last decade, Turkey has been **the second country, after China,** in terms of natural gas demand growth.
- Russia is the biggest supplier of natural gas to Turkey with a share of 55,3 %. It is followed by Iran.

1.2. Current Energy Outlook in Turkey



- Regarding oil, Turkey imports approximately 90 % of its oil supplies mainly from Iraq (45,6 %), Iran (22,4 %) and Russia (12,4 %).

1.3. Drivers for Nuclear Power Generation

- Renewable resources (intermittent nature) + absence of efficient power storage systems = too expensive to generate sufficient energy by only renewables.
- This not only complicates the things for system operators, but also increases the uncertainty of future electricity prices.
- Nuclear energy, on the other hand, is an important sustainable resource which generates electricity for 24/7 without any GHG emissions.
- Today's drivers for nuclear build;
  - Increasing energy demand
  - climate change,
  - security of supply,
  - increasing fossil fuel price volatility
  - grid stability.

1.3. Drivers for Nuclear Power Generation

- In Turkey, some additional reasons put nuclear energy up on the top of the government's energy agenda.
- MENR forecasted that even if all renewable resources are fully utilized, only the half of the projected electricity demand can be supplied in the year 2023 (MENR, 2015).
- Turkey imports huge amounts of fossil fuels

  → significant risks in financial, political, social, and environmental frameworks.
- The solution to mitigate such risks = diversification of energy sources.

1.3. Drivers for Nuclear Power Generation

- Unless Turkey starts nuclear power generation,
  - will be more obliged to lean on imported fossil fuels ,
  - will be more dependent on its top suppliers, Russia and Iran.
- Probable disagreements with these countries put Turkey **into tremendous risk** in terms of energy supply.
- Countries able to obtain cheap, high-quality, sustainable energy, are among the most successful ones in global trade and development contest.
- Turkey has set an ambitious target to become **one of the ten largest economies** in the world by 2023
- With rapidly increasing energy demand as well as having no other sufficient indigenous energy resources to meet the growing demand, it is **almost inevitable** to utilize nuclear power in near future.
- The sooner the country has nuclear power the better. At this point, the question is **“How”?**

2. Past and Current Energy Context

- Although Turkey has no nuclear power generation facility yet, the county has made many efforts to build nuclear power plants since 1960s (6 attempts in the last 50 years).

2. Past and Current Energy Context

Attempt No.	Years	Model and Actions	Status/ Causes for Failure
1	1953-1971	*Conventional Purchase *TAEC established (1956) *First research reactor (1961) *Plan to build first NPP in 1977	Failed due to political and economic instability
2	1972-1980	*Conventional Purchase *Feasibility studies in Akkuyu and Sinop *License issued, negotiations for financing and construction with vendors (1976)	Failed due to military coup in 1980.
3	1982-1988	*Build-Operate-Transfer *Bids invited from seven major suppliers *Letters of intent issued to three firms	Proliferation Concerns in West, Chernobyl Disaster.
4	1993-2000	*Build-Operate-Transfer *International tender issued for a turnkey project *Bids received but tender cancelled	Negotiations failed due to proliferation concerns and no purchase guarantee.
5	2002-2009	*Build-Own-Transfer *Plan to build first NPP in 2015 *Sinop is selected	Too expensive bid from Rosatom
6	2010-present	*Intergovernmental Agreement (IGA) *Signed with Russia for the construction of a Build-Own-Operate NPP in Akkuyu (2010) *Another IGA signed with Japan to build the second NPP in Sinop (2013)	In Progress

2.2. The Akkuyu NPP Project

- After a total of five failed attempt, Turkey has changed its strategy to build nuclear power plants.
- Rather than issuing tenders for bids from international co-operations, Turkey has signed an intergovernmental agreement (IGA) with Russia in 2010, to build the Akkuyu NPP.

2.2. The Akkuyu NPP Project

05/2010	IGA signed
2010	Ratification by both Parliaments
12/2010	Akkuyu JSC founded.
2011	Application for EIA and Pre-License
12/2014	EIA Decision by MEU
2015	Decision on Electricity Generation Pre-License
05/2016	Application for the Construction License
12/2017	Approval of the construction license (Expected)
2023	Start of operation of Unit 1 (Expected)

2.2. The Akkuyu NPP Project

- The IGA = legal framework for the project.
- The Akkuyu NPP project will be the **first NPP project in the world** to be built using a **Built-Own-Operate** (BOO) model.
- In this model, the plant will be owned and operated by the Akkuyu NPP's Joint Stock Company (JSC).
- This BOO model is a "**full-service" model** under which Rosatom, Russia's state-owned nuclear company, will provide all the necessary services in exchange for a guaranteed electricity price.
- Rosatom is currently holding the 100 % of the shares of the JSC and financing the project.
- Turkish Electricity Trade & Contract Corporation (TETAS) will buy 50% of the power **at a fixed price of 12.35 cents/kWh for 15 years**. The remainder of the power will be sold on the Turkish electricity market.
- **600 Turkish students** will be sent to Russian universities to supply the required domestic expertise in the field of nuclear energy

2.2. The Akkuyu NPP Project

Planned NPPs in Turkey

Details of the Akkuyu and Sinop NPPs

	AKKUYU NPP	SINOP NPP
Type of Reactor	VVER-1200 (AES-2006)	ATMEA-1
Number of Units	4 Unit (1200 x 4)	4 Unit (1120 x 4)
Installed Capacity	4800 MW	4480 MW
Approximate Cost	$ 25 Billion	$ 22 Billion
Service Life	60 Years	60 Years

3. Challenges to Achieve Sufficient Nuclear Capacity

- In Turkey, nuclear energy policy is surrounded by a variety of risks
- These challenges can be categorized as;
  - Political
  - Institutional / Human Resource Capacity
  - Financial
  - Public Perception and Safety

3.1. Political Challenges

- Build-Own-Operate Model- Akkuyu NPP
- Shortens the duration and secures the finance, but it is highly dependent on sound international relationship, which can also be quite risky.
- The loose international diplomacy can deteriorate at unexpected moments.
  - Ex: Russian Jet Shutdown in 2015
- The unending war in Syria has the great potential to cause further conflicts.
- Turkey still ranks in the top 25 most unstable countries in the world. (65 governments in 93 years, on average 17 months)
- Recent terrorist attacks by PKK, ISIS and FETO, worsened the country's stability index and poses a remarkable risk on the successful completion of the current projects.

3.2. Institution and Human Resource Capacity Challenge

- Common problem in newcomer countries.
- Long-term Solution: Human resource development policy
- Only 1 university offering undergraduate nuclear engineering program, Hacettepe Univetsity.
- The application in the field of NPP is lacking
- Short term solution: Turkish students are being sent to Russia for education and practice.
- 190 students already started to study in Russia.

- Not only engineers but also regulators are required.
- No independent Regulatory Authority yet.
- TAEK has a complex and faulty organization structure
- TAEK relies heavily on IAEA and other Technical Safety Organizations.

3.3. Financial Challenges

- Turkey avoids taking major financial risks.
- Two NPPs costs $50 billion.
- Per Akkuyu agreement, the main financial risk is on Akkuyu JSC, indirectly on Russia.
- Some financial risks are also born by TETAS as power purchaser.
- USD cents 12.35/kWh for 15 years.
- But, the volatility of the exchange rate and the recent depreciation of the TL has a potential to change the financial picture.

3.4. Public Perception and Safety

- For a sustainable nuclear program, creation of positive public perception is essential.
- Three Mile Island (1979)
- Chernobyl (1986)
- Fukushima (2011)
- Drastically changed public opinion.
- Main causes of the accidents
  - Old Technology
  - Poor management
  - Poor Design

- 2 characteristics
  - Technological Advance
  - Public Perception

- Generation III and III+ NPPs; safety and nuclear waste issues are solved but creation of positive public perception is still inadequate.

- In fact, except for nuclear accident times, public opinion seems to change slowly.

3.4. Public Perception and Safety

- Terrorism, proliferation concerns and radioactive waste disposal further reduce public support.
- It is not easy to ensure public in Turkey due to recent terrorist attacks.
- What should gov. do?

- Ongoing relationship b/w policy makers and nuclear industry, scientists, environmentalists, media and society
- Public involvement in decision making progress is essential.
    - Transparent, honest and balanced relation.

4.Current Legal Framework on Nuclear Energy

Regulatory Authority

- TAEK is mixing regulatory functions with operational activities and supporting R&D in the field of nuclear energy.
- Not Independent, but rather under the supervision of MENR.
- The law is 35 years old and needs to be updated
- Must ratify the new Nuclear Law as soon as possible since the construction of the Akkuyu NPP is expected to start in 2017.

4.Current Legal Framework on Nuclear Energy

- New Nuclear Law is expected to cover;
  - Nuclear Safety Principles
  - Establishment of the Regulatory Authority
    - Separation of functions and other activities of TAEK
  - Responsibilities of the main institutions and licensing process
  - Detailed enforcement rules
  - Radioactive waste management policy and its fund
  - The decommissioning of the NPPs.

4.3. National Laws and Regulations on Nuclear Power

- The current legal framework of Turkey is consistent with international agreements and treaties, and IAEA safety requirements in most of the aspects of nuclear safety and security.
- Council of Ministers' decision in 2008, specified that prospective nuclear law shall be in conformity with EU standards and offer a high level of nuclear safety.
- There are several regulations related to nuclear safety. (See Appendix)

4.4. International Conventions and Agreements

- Turkey has been a dynamic member of the International Atomic Energy Agency (IAEA) since 1957 and of the Organization for Economic Co-operation and Development (OECD)'s Nuclear Energy Agency (NEA) since 1958.
- Regarding international treaties, Turkey is part of a full range of International Instruments related to nuclear safety and security.
- A list of international multilateral agreements/ conventions is provided in Appendix 1.

5.Assessment and Recommendations for the Implementation of Current Policy

Assessments

1. The major drawback is that Turkey **has no comprehensive and official Nuclear Policy**, yet.
2. **New Nuclear Law**, which is expected to be the framework national law, has not been ratified yet.
3. Turkey does not have a sufficiently developed, **independent and organized regulator** to ensure the safety of nuclear power plants. TAEK must be reorganized.

5.Assessment and Recommendations for the Implementation of Current Policy

4. Although Akkuyu and Sinop NPP appear to be financially advantageous projects for Turkey, the **inadequacy of the oversight capacity poses extreme safety and security risks**.
5. Finally, Turkey has no long-term and **comprehensive Human Resource Development Program** in the field of Nuclear Energy, yet.

5.Assessment and Recommendations for the Implementation of Current Policy

Recommendations for Implementation

1. Complete a comprehensive national Nuclear Energy Policy.
2. Proceed urgently for the adoption of the new Nuclear Law.
3. Ensure the independence and competence of the nuclear regulatory body by providing necessary resources.
4. Consider wide support from international organizations
5. Develop long-term Human Resource Plan by collaborating with universities and other competent international organizations
6. Be more proactive to negotiate bilateral agreements to exchange experts and training students in nuclear energy to be able to construct its own nuclear power plant in the future.
7. Avoid political appointments for the regulatory body. Competency and expertise must be ensured.

5.Assessment and Recommendations for the Implementation of Current Policy

8. Try to use the same nuclear technology (Pressurized Water Reactor) at least for the first couple of NPPs to avoid increased knowledge challenge.
9. The current model (power purchase for a fixed price) is encouraging cost saving for the company to gain more profit. The costliest part of NPPs is related to safety and security. Thus, regulatory authority must be fully competent to be able to inspect the NPPs as soon as possible.
10. Power purchasing rates should be renegotiated considering current and future market rates and can be flexible rather than being fixed. Also, the exchange rate should be taken into account.
11. Ensure public participation in developing its national nuclear policy by focusing on the adopted high level safety and security measures.

6.Conclusion

- Turkey is incapable of meeting overall energy consumption by its domestic resources.
- Has rapidly growing electricity demand,
- The country has been closing the gap between the energy demand and supply by imports
- Causes significant risks in financial, political, social, and environmental frameworks.
- The solution lies in the diversification of energy sources
- Nuclear energy seems to be an economically viable alternative to secure energy supply to achieve sustainable development goals as well as reducing GHG emissions.
- Also to cut back its vulnerable reliance on Russian and Iranian gas for electricity, Turkey opted to build NPPs.
- Although Turkey has sufficient capacity and willingness to initiate nuclear power, she needs to fulfill several requirements in the following years to achieve successful and sustainable integration of nuclear power into its energy mix.

6.Conclusion

- First, **Turkey must develop a comprehensive and official nuclear policy by ensuring public participation** and try to create positive public perception by not only explaining the benefits of NPPs, but also focusing on the adopted high level safety and security measures, considering country's recent situation (national security)
- Second, **Turkey should ratify New Nuclear Law as the framework national law as soon as possible** together with related regulations addressing the major specific lacking areas such as decommissioning, radioactive waste management and, third party liability.
- Third, **Turkey should establish an independent, well-equipped, and well-organized regulator** to ensure the safety of current and prospective nuclear power plants.
- Finally, **Turkey must develop a long-term and comprehensive Human Resource Development Program** in the field of Nuclear Energy by collaborating with universities and other competent organizations, to ensure having sufficient nuclear plant operators, engineers, as well as regulators for the next decades as nuclear power is a long-term commitment affecting not only the current but also subsequent generations.

THANK YOU… Questions ?

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