Islamic Republic of Iran
Ministry of Energy

Tavanir Holding Company

ELECTRIC POWER INDUSTRY IN IRAN

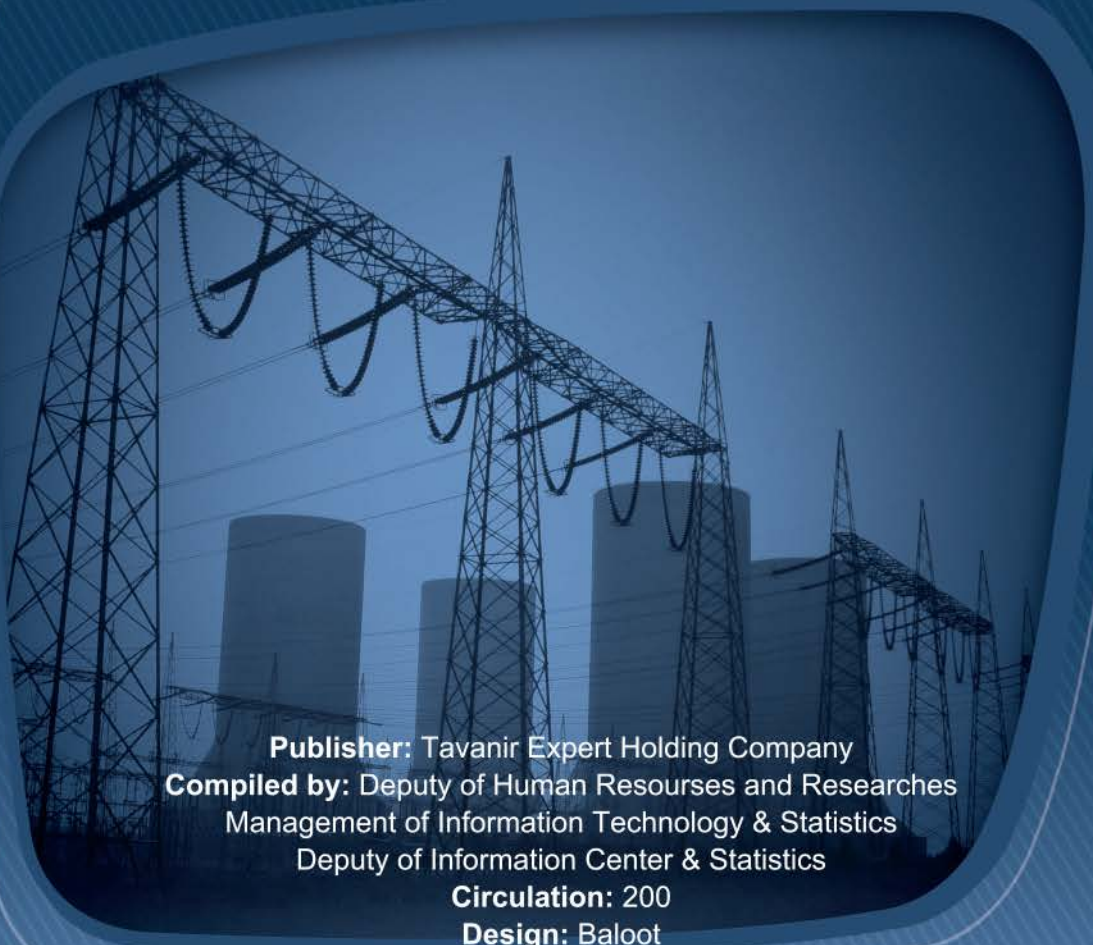
(2014 - 2015)

11 - 11

In the Name of God

ELECTRIC POWER INDUSTRY IN IRAN

2014 - 2015



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Foreword

Electricity as an infrastructure industry plays a significant and key role in infrastructure-based economic development. It provides necessary context in order to develop and promote of the country in economic, industrial, cultural and social aspects.

So far, considerable efforts have been made to achieve main goals of the electric power industry led to optimal competition for private investment, self-sufficiency in engineering design of electricity industry, technology upgrading, economic efficiency of electricity industry, power system stability improvement and making excellence among industrial institutions in Iran.

There is a special pay attention to electric power industry in Iran and fortunately the influence and effectiveness of this industry has been concerned.

This publication presents electric power industry circumstances in 2014 that its summaries are as follows:

- At the end of 2014, 100 per cent of the urban and 99.8 per cent of the rural areas have full access to the blessing electricity.
- Considering the operation of 21 new power plants (and renewable and diesel energies and distributed generation) with a total capacity of 2944 MW, the overall nominal capacity of the nation's power plants reached 73152 MW which reveals a 4.1 per cent growth comparing with the previous year.
- Gross generation of the power plants was 274,480 GWh (with 4.7 per cent of growth compared 2013).
- Per capita generation with 3.4 per cent growth rate compared to the previous year has reached 3505 kWh.
- The power transmission and sub-transmission lines length with 1.0 and 1.6 percent growth compared to the previous year has reached 50,726 and 70,024 km, respectively.
- Power transmission and sub-transmission substations capacity with 5.0 and 3.5 percent growth has reached over 132,167 and 94,330 MVA.
- Length of the lines and capacity of distribution network transformers (medium and low voltage) with 2.7 and 4.4 percent growth compared to the previous year has reached 735000 km and 105,356 MVA, respectively.
- Lengths of the operational, ready to commercialization and in preparation of fiber optic lines are 16178, 1943 and 1773 km, respectively.
- The total number of electrified villages reached over 55,664 in 2014.
- The number of customers with 4.6 percent growth compared to the previous year has reached over 31,672 subscribers.
- Electricity consumption including residential, public, agricultural, industrial and other sectors has reached 219.7 TWh; 8.1 percent increase compared to the previous year.
- Electricity energy interchanges with neighboring countries including Turkey, Azerbaijan, Turkmenistan, Armenia, Pakistan, Afghanistan, Iraq and Nakhjevan has reached 9659 and 3772 Million kWh in export and import, respectively during 2014.

- During the past decade by developing the investigation and innovation in the electric power industry of the country the bases for development and expansion of the existing capabilities and creating new capacities in innovation has been prepared throughout the electric power industry. Deployment of privatization, development of the quality and quantities related to the electricity market, utilizing renewable energy sources, efficiency improvement, development of demand side management, loss reduction, value engineering, information technology, maturity and exaltation of human resource and optimization of the existing installations are seriously following.
- In 2014 with an overlook to the future increasing the installed capacity in power generation section the focus were included considering the policies to utilize gas power plants equipped to the newest technologies and combined cycle power plants , development of profiting from renewable energy sources, increasing the spinning reserve of the power generation system and power system reliability, securing the environmental issues and reducing the amount of pollutants and preparing a competitive environment to attract the private sector participation in power plant construction through B.O.O and B.O.T schemes. In addition, the private sector participation in Combined Heat & Power (CHP)[1] generation systems construction in other to simultaneous production of electricity and heat from a single fuel source and development of Distributed Generation (DG)[2] units in other to provision of demand locally and loss reduction of distribution network and reaching to higher efficiency in electric power generation acclaimed and supported.

According to demands, the main development programs of the electricity industry in 2015 are as follows.

- About 2000 MW of new power plant installation
- 15000 km of new power transmission and sub-transmission overhead lines
- 9000 MVA new power transmission and sub-transmission substations capacities
- 17000 km medium voltage and low voltage power distribution lines and
- 4000 MVA new power distribution substations capacities

At the end, I would like to thank all my sincere colleagues in the electric power industry who are working with their excessive generosity. I would ask almighty God for helping us have growing success.

Arash Kordi,
Chief Executive Officer (CEO)
Dec. 2015

[1] Combined Heat & Power
[2] Distributed Generation

Power Generation

- Power Generation
- The Composition of Various Types of Power Plants in the End of Year (2014)
- Power and Production of electric energy per capita
- Power Electric Generation
- Fuel Mix
- Domestic Construction of Power Plant Equipments

Power Generation

Power plants convert existing energies in fossil fuels, earth, sun, wind and etc. into electrical energy. Regarding to limitation of fossil energy resources in the world, increasing of the using amount of renewable resources has been attractive for experts of electricity industry. On the other hand, due to environmental pollutants the importance of reducing fossil fuels is promoted.

The Composition of Various Types of Power Plants in the End of Year 2014

Steam Power Plants

The overall nominal capacity of steam power plants reached 15830 MW and it is contained 21.6 percent of the country's power plants. The overall operational capacity and gross generation of this kind of power plants was 15252 MW and 85623 GWh in the year 2014. The power factor and average efficiency of this kind of power plants were 64.1 and 35.2 percent respectively. The amount of fuel consumption of this kind of power plants constitutes from 12917 million m^3 of natural gas, 106 million litter of gas oil and 10273 million letter of furnace oil.

Diagram (2):Nominal Capacity of Steam Power Plants Based on age, march 2015

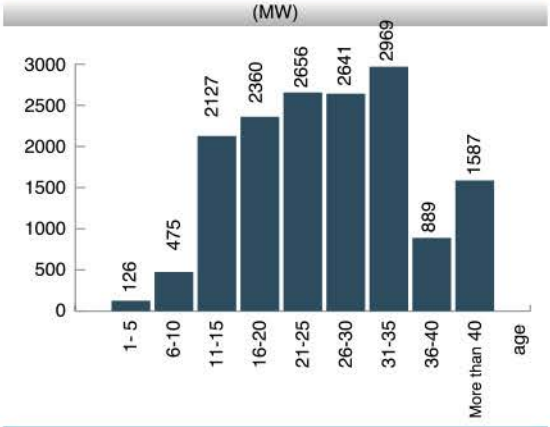


Diagram (3): Nominal Capacity of C.C and Gas Power Plants Based on age, march 2015

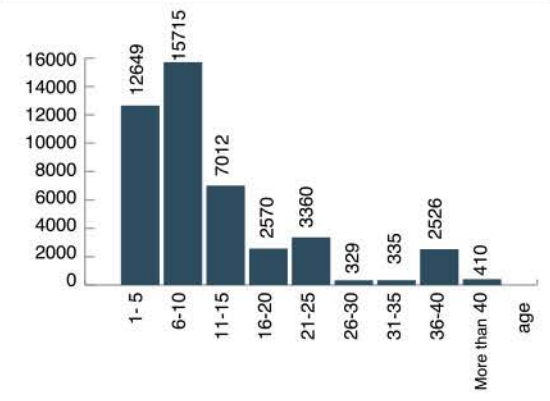
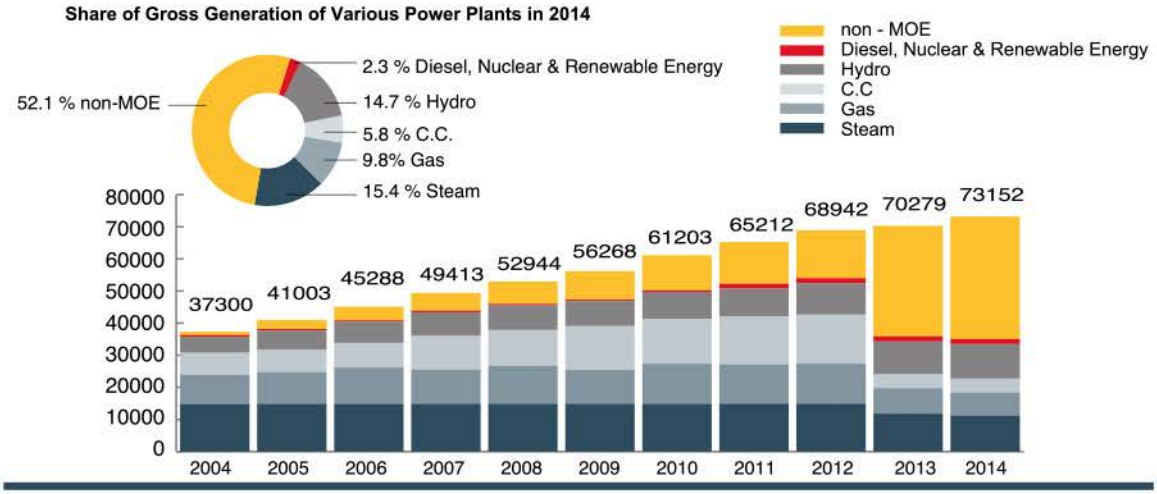


Diagram (1): Installed Nominal Capacity of the Power Plants at the end of the Years 2004 through 2014



Gas Power Plants

The overall nominal capacity of the gas power plants reached 26412 MW. The points which make this type of power plants attractive are low price, increasing the efficiency (with convert to combined cycle) and domestic manufacturing possibility of major parts of this type of power plant. The 36.1 percent of the country's power plants are gas power plants type. The overall operational capacity and gross generation of this kind of power plants was 21368 MW and 73340 GWh in the year 2014. The power factor and average efficiency of this kind of power plants were 39.2 and 30.3 percent, respectively. The amount of fuel consumption of this kind of power plants constitutes from 19477 million m^3 of natural gas and 4778 million litter of gas oil.

Combined Cycle Power Plants

In the year 2014, the total capacity of combined cycle power plants reached 18494 MW, which reveals a 3.6 percent growth comparing with the previous year. In the electricity industry, these power plants are attended due to high efficiency and less environmental pollution. The share of these Plants of total capacity of country's power plants is amounted to 25.3 percent. In the year 2014, the overall operational capacity and gross generation of this kind of power plants were 15105 MW and 96823 GWh, respectively. The power factor and average efficiency of this kind of power plants were 73.2 and 44 percent respectively. The amount of fuel consumption of this kind of power plants constitutes from 17778 million m^3 of natural gas and 3963 million litter of gas oil.

Diesel Power Plants

In the year 2014, diesel power plants were participated with a nominal capacity 439 MW in the process of electrical energy generation and their share of installed capacity was equal to 0.6 percent. The gross generation and the amount of fuel consumption of this kind of power plants were 83 GWh and 24 million litter of gas oil in the year 2014.

Diagram (4):Nominal Capacity of Hydro Power Plants Based on age, march 2015

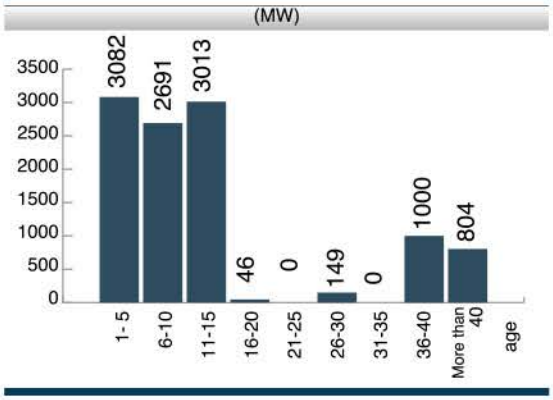
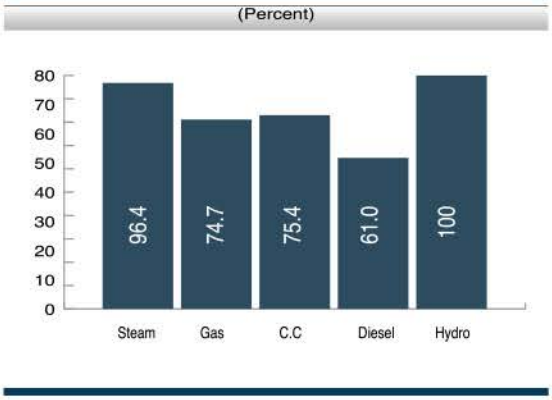


Diagram (5): Ratio of Actual Capacity to Nominal Capacity of Power Plants During Summer Season of 2014



Hydro-Electric Power Plants

The overall nominal capacity of hydro-electric power plants reached 10785 MW, which reveals a 5.1 percent growth comparing with the previous year. The 14.7 percent of the country's power plants are of this kind of power plant. Hydro-electric power plants due to the ability to control torrents, providing drinking and agriculture water, lack of fuel consumption, lack of environmental pollution, readily operation, inappreciable domestic consumption, stop and launching quickly, frequency control, inappreciable repair and maintenance cost and domestic manufacturing possibility, the Ministry of Energy has special attention to the development of such power plants. With a 4.2 percent growth comparing with the previous year, gross generation and power factor of this kind of power plants were 13862 GWh and 14.7 percent in the year 2014, respectively.

Renewable Power Plants

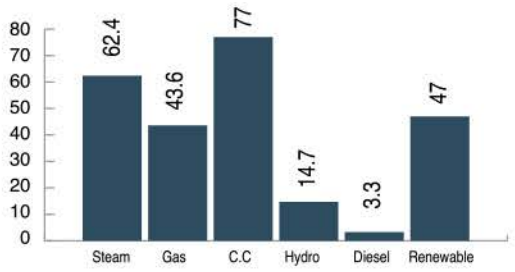
The clean and renewable energies have been taken great attention due to their special characteristics. The related projects have had good progress. The overall nominal capacity of renewable power plants reached 1193 MW in the year 2014 and gross generation of this kind of power plants was 4748 GWh.

Power and Production of electric energy per capita

Power and energy production per capita income are two indexes of the electricity industry development. In the case that these indicators are more than the population growth, indicates

Diagram (6): Operational Coefficient of Average Nominal Capacity of Power Plants In 2014

(Percent)



widespread activity in electricity industry. In the year 2014, these indicators reached 934 Watts and 3505 kWh respectively which shows an annual increase of 2.9 percent and 3.4 percent. The population growth was 1.2 percent at the same time interval (Diagrams (7) and (8)).

Power Electric Generation

In 2014, electric energy generated by the country's power plants amounted to 274,480 Million kWh with 4.7 percent growth comparing with the previous year. 44.9 percent of the total generation was supplied by MOE and the remaining 55.1 percent by non-MOE sector. From the total energy generated, the share of thermal plants was 93.2 percent, hydro plants reached 1.5 percent and nuclear and renewable power plants' share was about 1.7 percent. With regard to outside vendors' overseas policy and privatization in electricity industry, we have witnessed an increase in capacity share and production of power plants of the private sector in recent years. This policy has been continued in the year 2014 and it will increase in the future.

Diagram (7) : Trend of Per Capita Capacity at the end of march 2005-2015

(W)

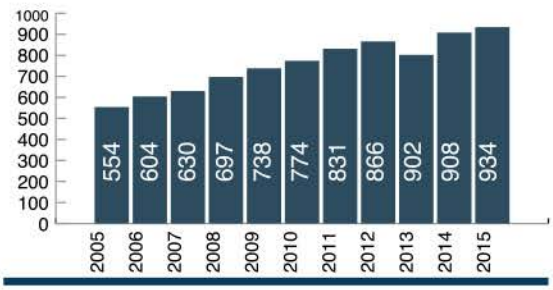
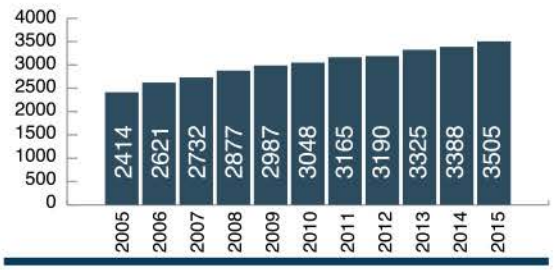


Diagram (8) : Trend of Per Capita Generation at the end of march 2005-2015

(Kwh)



Fuel Mix

Main fuel used in the majority of the Iranian thermal power plants is natural gas. Alternative fuel for the steam power plants is fuel-oil and for the gas-turbine and combined-cycle units is gas-oil.

IRANSHAHR and ZARAND steam power plants and the gas-turbine units such as KAHNOJ, KONARAK, CHABAHAR, ZAHEDAN and GENAVEH consume only liquid fuels because of not yet having been connected to the country's natural–gas–supply network.

The total fuel consumption was 50172 million liters gas Fuels and 19145 million liters liquid Fuels in 2014.

Chart (11) shows consumption amount of each kind of fuels for MoE's power plants.

Diagram(10): Internal Consumption of Power Plants in 2014

(Percent)

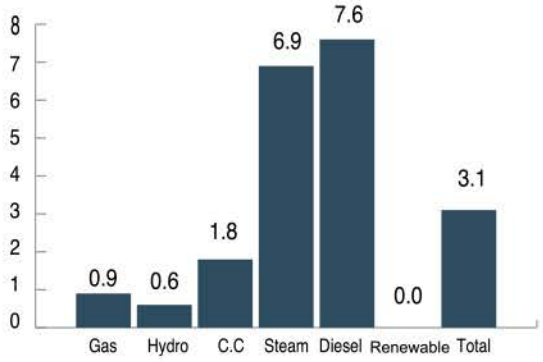


Diagram (9): Electicity Gross Generation of Power Plants In 2003 through 2014

(GWh)

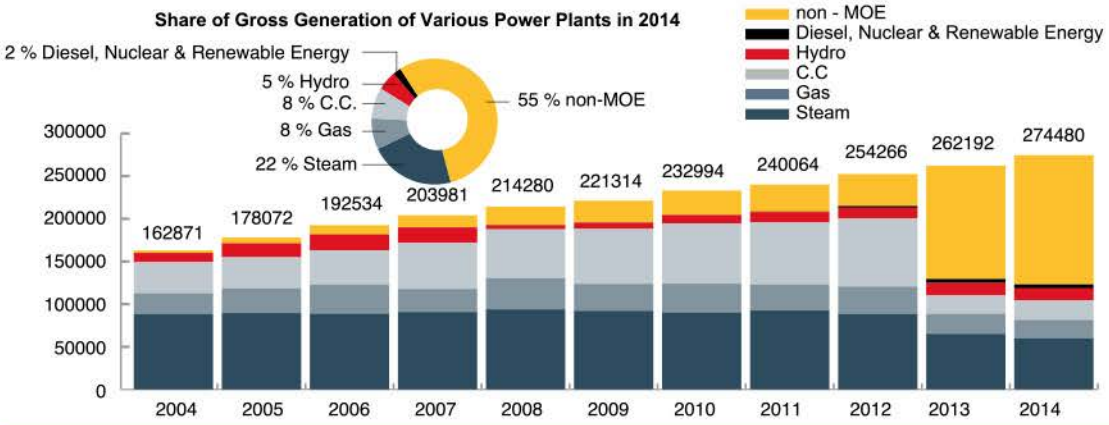
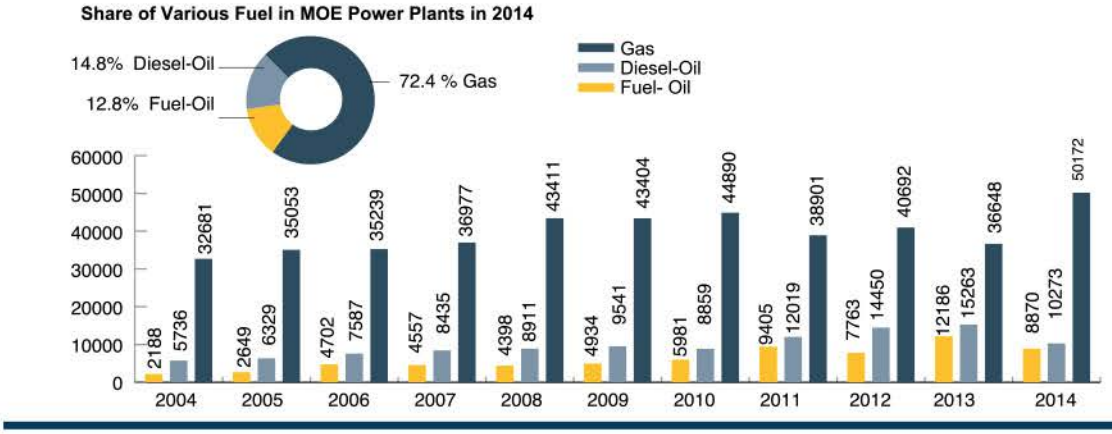


Diagram (11) : Fuel Consumption of MOE Power Plants

(10^6 m^3 or 10^6 Liter)



Domestic Construction of Power Plant Equipments

To be native of technology, transfer of technical knowledge and national technology growth are requirements for stable development and if in-developing countries cannot realized this important condition, those would removed from global competition soon and would be as weak countries and for doing the development plans would be dependent on developed countries with a great cost.

Self-reliance, transfer of technical knowledge and domestic construction in electricity industry in Iran are as one of the important issues in various sections so that great practical measures in establishing the necessary capacity in affairs of engineering and design, contractor and project management has been done and in addition to providing domestic needs, export of equipments and technical and engineering services to overseas in considerable volume and quality in a way that has increase its share in global markets with presence in international markets and participate in bids and implementation of power plant projects in some countries like Iraq, Indonesia, Pakistan and Turkey.

In this regard, considering high potential and available resources to make all equipments in the country and due to economic construction of products in Iran and a short distance from factories to sites, design for launching different factories for different types of power plant equipments in the country is justifiable and economic.

Construction of main equipments of power plants including gas and steam turbines, heating recovered boilers, common boilers for electrical equipment, instruments and control of power plant, construction more than 14 types of wing and stripes is advances in power plant industry.

Diagram (12): Trend of Generation Reserve in Different years (Ratio of Meximum Simaltaneous Consumption to Actual Capacity in a day)

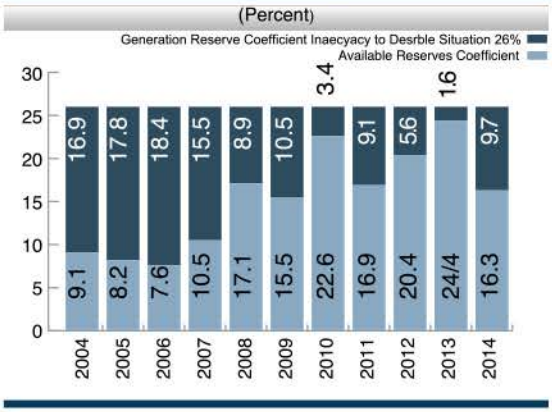


Table (1): Activities regarding to development of small-scale generators by the end of year March 2015

Companies	Number and Capacity of Agreements		Construction Licenses	
	Number	Capacity (MW)	Number	Capacity (MW)
TAVANIR	116	4598.96	89	2165.266
Regional Electric Companies	92	1058.04	68	830.461
Distribution Electric Companies	190	845.63	122	565.605
Total	398	6502.63	279	3561.332

Renevable Energy

- **Benefits of Renewable Energy Use for Iran**

Benefits of Renewable Energy Use for Iran

Some experts mention that the use of renewable energy in the country is not a priority. The supported reasons are since our country has huge proved oil and natural gas reserves and the use of these energy sources are economically more affordable. However, there are reasons to answer to the aforementioned points that can prove the need for allocation of an appropriate share of the country's energy mix to renewable energy sources as follows.

- The need for diversity of energy sources to enhance energy security
- Distributed generation and reducing reliance on transmission network (Active protection system)
- Using of huge potential of renewable energy sources in the country and optimum use of regional resources
- The problems of current energy sources for the environment and prevention of greenhouse-gas emissions
- Increasing employment and development of remote areas
- Business opportunities and creating new jobs
- Reducing the amount of municipal waste
- Enhance the strategic position of Iran in energy diplomacy in the international environment

Power Transmission

- Transmission of Electrical Energy
- Transmission and Sub-Transmission Line Extension

Transmission of Electrical Energy

Electrical energy generated in power plants is transmitted and delivered to distribution networks through transmission and sub-transmission lines and substations. The transmission and sub-transmission lines and substations are answerable to subscribers and increase the system stability and exchange energy with neighboring countries.

The important issues regarding to the transmission sector are as follows:

- Due to extent of Iran electricity network and its geographical situation in the region, centrality of management of electricity networks of neighboring countries can be assigned to Iran. Iran's electricity industry has a valuable experience in establishing connection with the electricity networks of neighboring countries such as Republic of Azerbaijan, Armenia, Turkey, Turkmenistan, Afghanistan, Pakistan and Iraq and this is the same as what was in Europe in the past.
- At present, the voltages for transmission lines are in 400 and 230 kV levels. However transmission line and substation projects with 765 kV voltage (HVAC)[1] from south to north have been currently confirmed and is going to pass the study stages.
- Also for first time, a HVDC[2] plan between center and eastern north networks has been notified by TAVANIR to ESFAHAN and SEMNAN Regional Cos. Based on this plan, power transmission will be done through high voltage DC[3] where the final studies is doing.

Transmission and Sub-Transmission Line Extension

Planning and development studies and construction of transmission and sub-transmission networks are done based on the forecasting of consumption of electricity in the future years by power system studies office. These planning studies are for short-term, mid-term and long-term periods. Short-term planning is reviewed after occurrence of peak load every year. After reviewing the status of network and the amount of load of substations and transmission and sub-transmission lines, difficulties and weak points of network are identified and by the software of power system studies for simultaneous peak load of next summer and with regard to in-progress projects, their priority is determined. In middle and long-term studies, time horizon more than a year until even 2 to 10 next year is considered and in these studies the weaknesses of transmission and sub-transmission networks are identified and with regard to load forecasting for mentioned time, the required proposals will be presented for network optimization and strengthening and development.

1. HVAC=High Voltage Alternative Current
2. HVDC=High Voltage Direct Current
3. DC=Direct Current

Diagram (13): Extension-Trends of Power Transmission Lines

(KM-Circuit)

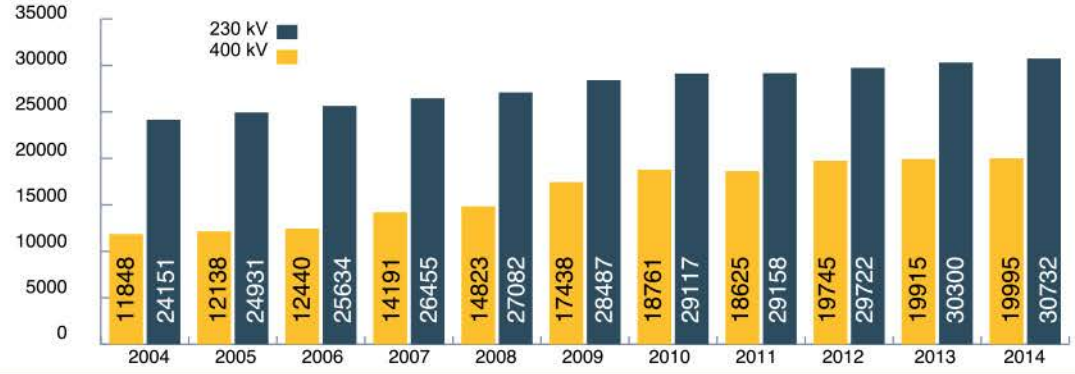


Diagram (14): Trend of Increase of Sub-Transmission Lines

(KM-Circuit)

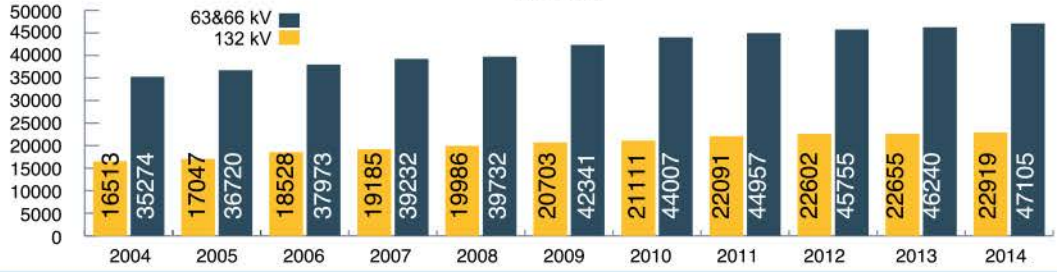


Diagram (15): Trend of Increase of Transmission Substations Capacity

(MVA)

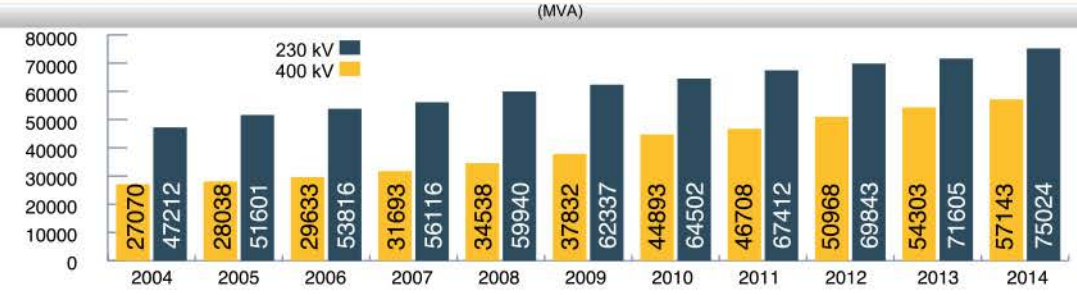


Diagram (16): Trend of Increase of Sub-Transmission Substations Capacity

(MVA)

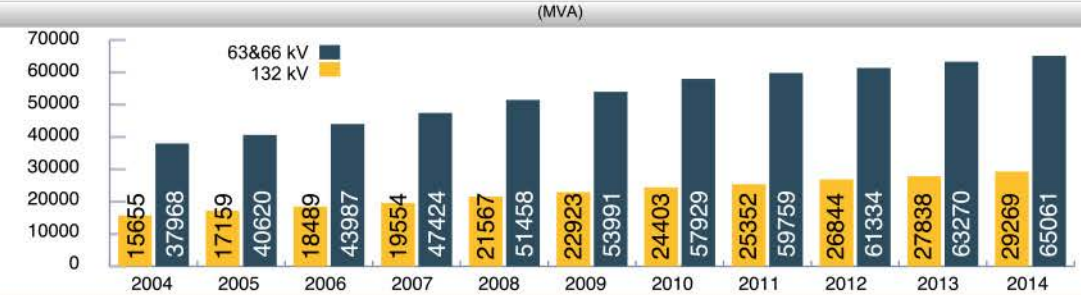


Diagram (17): Capacity of Transmission Substations Isolated by Age in 2014

(MVA)

400 kv 230 kv

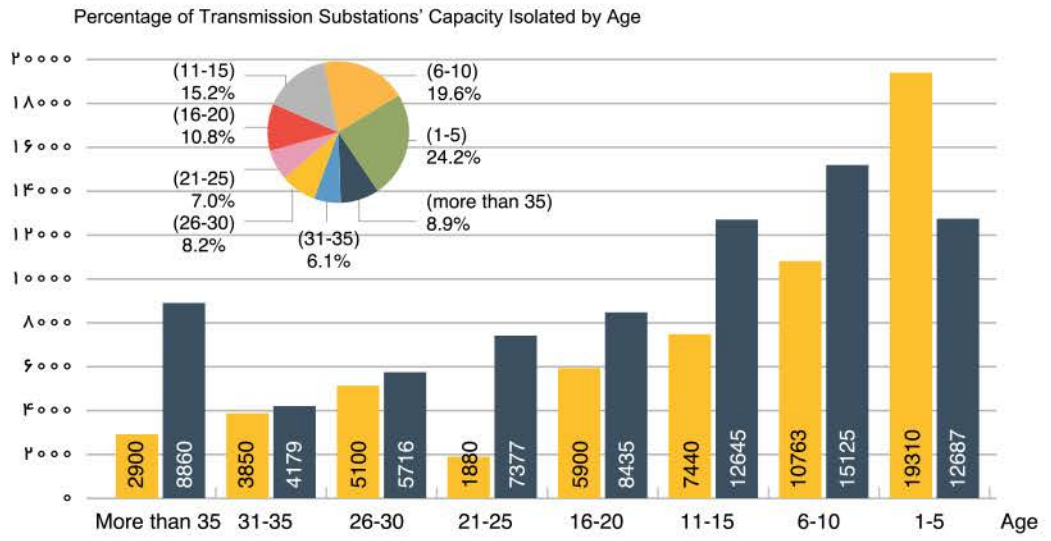
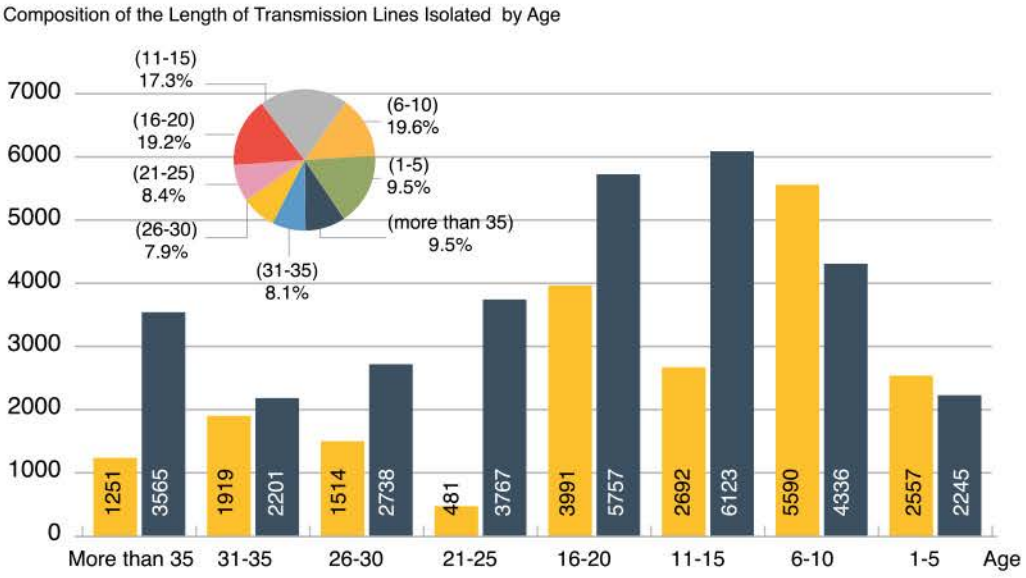


Diagram (18): Length of Transmission Lines Isolated by Age in 2014

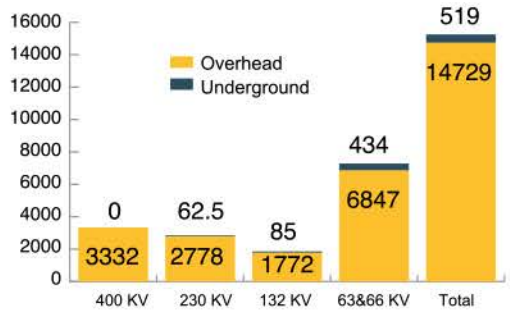
(Km Circuit)

400 kv 230 kv



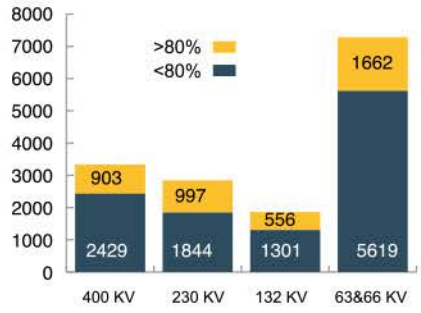
Diagram(19): Overhead and Underground Transmission Lines Length on Physical Progress in 2014

(Km-Circuit)



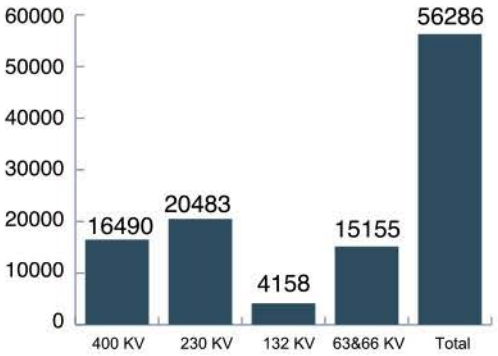
Diagram(21): Transmission Lines Length Based on Physical Progress Percent in 2014

(Km-Circuit)



Diagram(20): Sub-Transmission and Transmission Transformers and Substations Capacities on Physical Progress in 2014

(MVA)



Diagram(22): Transmission Transformers and Substations Capacities based on Physical Progress Percent in 2014

(MVA)