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Recent Attainments and Regulations in the Field of Geothermal Energy in Iran

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ABSTRACT

Development of renewable energy without the participation of private sector investment will not be possible. A look at the statistics and circumstances leading countries in this field, suggests those governments by purchase renewable electricity from private power plants with attractive rates within the tariff laws (Feed-in-Tariff Law) is done. And thereby pave the way for the development of renewable energy. Ministry of the energy of Iran purchases the electricity produced in non- governmental power plants from renewable energy sources at a guaranteed tariff. The base tariff for Geothermal Systems is 4900 IRRs per kWh (about 0.5 USD per kWh- Note: Conversion rate is valid for the reporting time) this rate included all excavation, Drilling and equipment. In this paper will be described as the potential of geothermal energy in Iran and also will be proposed the Technical packages for development of Sabalan Geothermal Field in the north west of Iran.

1. INTRODUCTION

Iran is situated in Western Central Asia in the area commonly referred to as the Middle East with a land mass of 1,648,195 km2. The electricity production in Iran with a population of 83 million, amounts to 313000 GWh/yr. as of 2019; which renewable energies with 639 GWh/yr. It has 0.2% of the share of electricity production in Iran, Of course, the installed capacity is a bit more than 1%. Nowadays there is 5MWe power plant project for electricity from geothermal energy in Iran. This is first geothermal power plant which is expected to begin work in 2020 and there is some Research, academic and exploratory projects for utilization form geothermal across the country by the universities and Ministry of Energy, which in this regard SATBA has a key role. Now the government has decided to do significant support from the private sector of renewable energy.

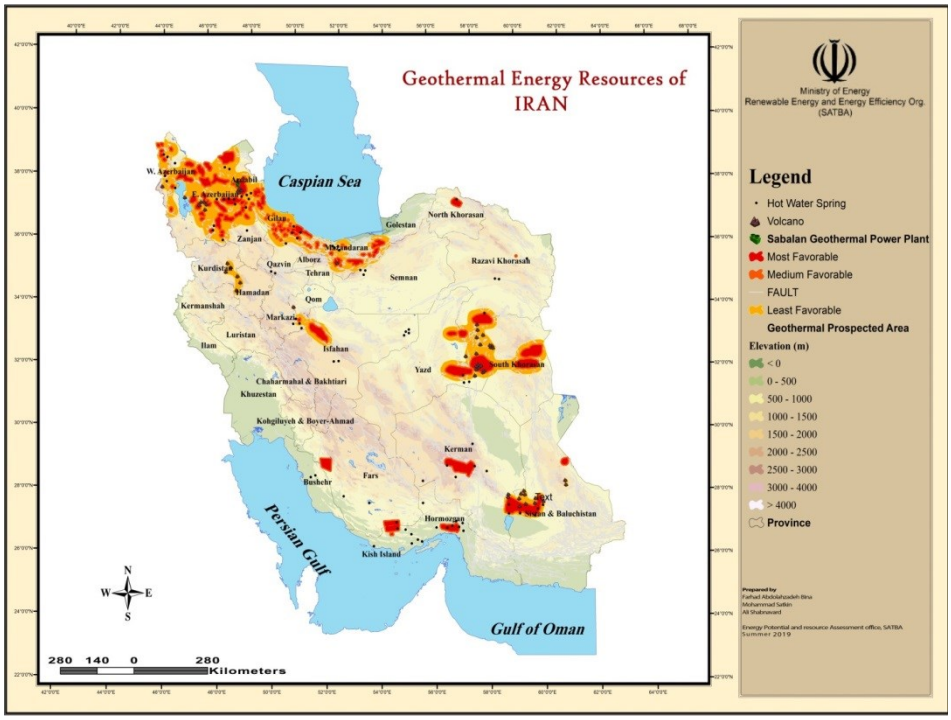

Figure 1: Geothermal Energy Resources of Iran. (F.Abdolahzadeh bina, M.Satkin, A.Sahbnavard, 2019)

2. GEOTHERMAL RESOURCES AND POTENTIAL

Regarding geothermal energy potential in Iran, some studies have been done, and are being completed the summary of the results is presented below. Accordingly, first Iran's geothermal atlas is prepared by the Energy Potential and Resource Assessment Office (EPRA) of SATBA. The Atlas is currently prepared based on geological studies, drilling and reservoir engineering in 15 provinces of the country. The names of provinces are as follows: Ardabil, East Azerbaijan West Azerbaijan, Gilan, Fars, Mazandaran, North Khorasan, Khorasan Razavi, South Khorasan, Sistan and Baluchestan, Hormozgan, Markazi, Isfahan and Qazvin.

The country's geothermal resources were estimated at about 450 MW, only in North West Sabalan by volumetric assessment and numerical modelling methods which, goes back many years ago. In Iran, no new estimates about geothermal electric potentials have been put forward. But as stated, many areas have been identified for supplementary studies. The three western provinces of Iran will be explained in this paper. Also, the Name of the geothermal field, brief specifications about the reservoir temperature and the existence of wells drilled in Iran are summarized in table Number 1. It is obvious to calculate or determine the reservoir temperature we need a collection of the down hole and the surface data.

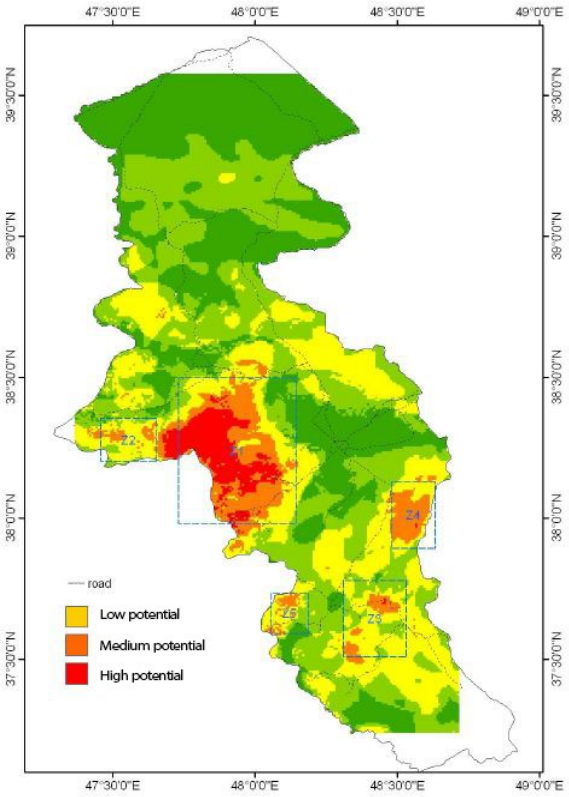

Figure 2: Geothermal potential map in the Ardabil (Shahroud University of Technology, 2009)

2.1 Geothermal Energy in Ardabil Province

About 16 percent of the province's area has geothermal energy potential. According to the geothermal potential map which is prepared with the different exploration layers, Observations and field visits and the presence of evidence based on hydrothermal characteristics, Hydro geochemical and thermometric studies, 5 geothermal susceptible areas were identified and for further studies were introduced. Figure 2 shows the geothermal potential map in the Ardabil.

2.2 Geothermal Energy in East Azerbaijan Province

Based on gravimetric surveys in the East Azerbaijan province, the 24 potential areas of geothermal resources have been identified. From these 24 geothermal areas that are prone to 5 geothermal regions, they have more priority than others which, is for more detailed examination additional exploration studies should be conducted in the region. Figure 3 shows the preferential geothermal priorities in East Azerbaijan.

2.3 Geothermal Energy in West Azerbaijan Province

Existence and potential of geothermal prospects are observed considerable especially in 11 regions of West Azerbaijan Province. Field exploration surveys revealed the existence of alteration zones and travertine deposits that both implicate getting close to hydrothermal prospects. After confirming the existence, more detailed characteristics such as origin and reservoir temperature of hot fluids are evaluated in which all fluids fall within bicarbonate family having 50–150 °C in the reservoir and suffered severe mixing during ascending path. Silica and cation geothermometers such as Na-K-Ca, Na/K and K/Mg are exerted to find the proposed temperature range and also Mg content revealed the mixture. The mixture decreased the reliability of geothermometric results.

Geophysical data obviously revealed the distribution of faults and persuade anyone about their role in warm fluids circulation. Almost all the major faults resulted in finding two adjacent sections with different gravity anomaly responses in Takab Region.

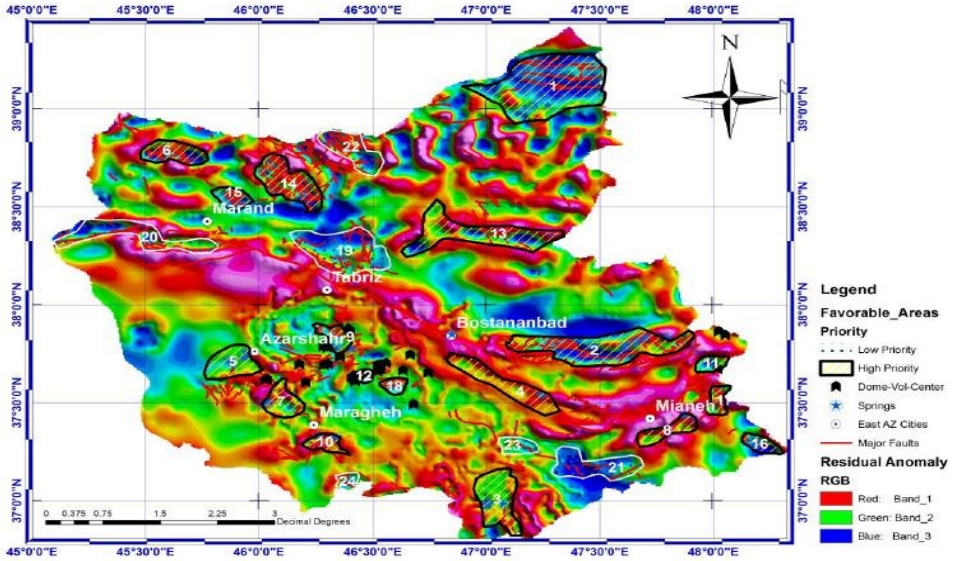

Figure 2: geothermal priorities in the East Azerbaijan (Shahroud University of Technology, Esfahan University of Technology, 2013)

Table 1: Geothermal Energy locations in IRAN

No.	Provinces	Main Field name	Reservoir Temp.	Geothermal wells/borehole
1	Ardabil	North west of Sabalan	240	✓
2		Sarein	N.A.	
3		Viladare	N.A.	
4		Sardabeh	N.A.	
5		Arjestan	N.A.	
6		Shabil	N.A.	
7	East Azerbaijan	Bostan Abad	170	
8		Maraghe	150	
9		Tabriz	130	
10	West Azerbaijan	Bash-Kandi	50	
11		Shoot	57	✓
12		Arab-Dizaj	94	✓
13		Siah-Cheshme	69	✓
14		Agh-Bolagh	102	✓
15		Qotour	100	✓
16		Salmas	116	✓
17		Silvana	62	✓
18		Shahin-Dezh	51	✓
19		Qeynarjeh	57	✓
20		Ahmad-Abad	57	
21		Derik	53-90	
22	Sistan and Baluchestan	Taftan	180	
23		Bazman	N.A.	
24	Southern Khorasan	Dige rostam	90	
25		Tabas	110	
26		Fardows	115	
27		Lut	160	
28		Morteza Ali	110	
29		kandegan	N.A.	
30		Ghazik	N.A.	
31	Esfahan	Khur	N.A.	
32		Golpayegan	N.A.	

33	Markazi	Mahallat	100	✓
34		Vartun	N.A.	
35		Tafresh	N.A.	
36	Mazandaran	Ramsar	N.A.	
37		Damavand	N.A.	✓
38		Larijan	N.A.	
39	Tehran	Damavand -Tarshakchal	N.A.	✓
40	Hormozgan	Bandar abbas	N.A.	
41		Lar	N.A.	
42		Bastak	N.A.	
43	Bushehr	Bushehr	N.A.	
44	Fars	Kazerun	N.A.	
45		Lar	N.A.	
46	Ghazvin	Abgarm	N.A.	
47		Yaleh gonbad	N.A.	
48	North Khorasan	Cheshmeye Ayub	N.A.	
49	Razavi khorasan	Garab - Molkabad	N.A.	

3. INVESTMENT PROCESS FOR PRIVATE GEOTHERMAL POWER PLANTS

In line with legal enactments, Power Purchase Agreement (PPA) for electricity production from the geothermal power plant is concluded for a 20-year period between the Renewable Energy and Energy Efficiency Organization (SATBA) and Private investors. This period starts at the time of signing the contract and includes the operation and construction of the power plant.

The geothermal electricity purchase tariffs are based on the following table. All tariffs will be multiplied by 0.7 starting from the first day of the second 10 years till the end of the contract. Moreover, the tariffs will be annually adjusted during the contracts based on currency exchange rate fluctuations and product retail prices. Despite the mentioned coefficients, the hourly coefficient which is announced by Iran Grid Management Co. will be also multiplied in the initial factor. Tariffs can be increased up to a maximum of 30 % for power plants constructed, using local know-how, design, and manufacturing. The geothermal exploration operations to power-plant construction period will be varied to 30 months.

Table 2: Purchase of electricity from geothermal energy

Technology type	Guaranteed electricity purchase tariff (IRRs per kWh) or (USD/kWh)
Geothermal (including excavation and equipment)	4900 IRR or 0.5 USD Note: Conversion rate is valid for the reporting time

During the period of the PPA contract and after that, the investor is allowed to sell electricity in the form of a bilateral contract, power exchange, electricity market, or any other form approved by the Ministry of Energy. Furthermore, the export of renewable electricity will be possible after obtaining separate permits.

4. SUPPORT FOR THE LOCALIZATION OF THE RENEWABLE AND CLEAN POWER PLANTS IN IRAN

Based on the Minister of Energy announcement dated 2018.08.21, renewable power plants using local equipment shall benefit from an incentive factor in the guaranteed power purchase rates and proportional to the localized technology, the electricity purchase rate of these power plants will increase by 30 % compared to the base rate. The technology score of the equipment is calculated based on the three indicators of the power plant's components construction, the internal design, and the local technical know-how developed for each component of the power plant. Local construction score proportional to the share of production and job creation in Iran, the local design score based on the share of the Iranian engineering potency in designing, and the development of local technical know-how score proportional to the share of technical know-how developed in Iran that each up to 10 % and the total of 30 % is determined in accordance with the procedure approved by the technical working group.

5. EXECUTIVE PROCESS OF CLEAN AND RENEWABLE ENERGY POWER PLANTS INVESTMENT

Executive process of geothermal and other Clean and Renewable Energy Power Plants Investment is as follows:

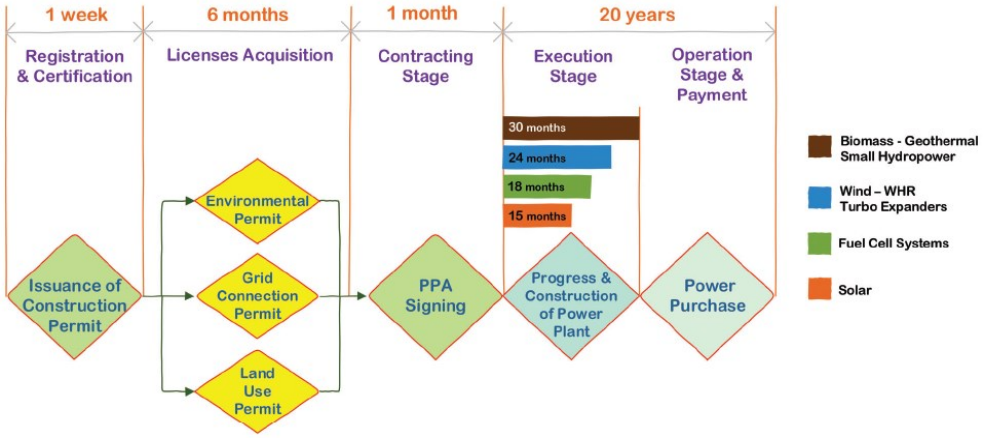

Figure 3: Executive process of Clean and Renewable Energy Power Plants Investment (www.satba.gov.ir)

Renewable and clean construction permit applicants should send the related worksheets and submit to the deputy of non-governmental sector development of SATBA. The documents include a written application which specifies the type, capacity, and coordinates of the candidate location along with the company's documentation such as registration in the gazette, statute, and its latest amendments.

The rates of this announcement are valid for the PPA contracts which the geothermal power plant will be constructed and commercially operated within a maximum of 30 months, since the signing date of the PPA. In case of delay, the last tariff bases which are announced by the ministry of energy at the commercial operation time or the tariff mentioned in the PPA contract, whichever is lower, will be applied on the remaining time of the contract.

The request for guaranteed power purchase by power plants constructed with governmental grants is prohibited. The investor should ensure and commit that he/she does not use the governmental grant for the construction of the power plant.

Foreign investors can apply for the construction permit and concluding the PPA contract by either establishing a company in Iran or joining the Iranian companies. Withdraw of the investment principals and benefits will be guaranteed based on rules and regulations of Foreign Investment for Promotion and Protection Act (FIPPA) by the Organization for Investment, Economic and Technical Assistance of Iran.

6. GUIDE ON INVESTMENT IN GEOTHERMAL POWER PLANTS FOR ELECTRICITY EXPORT

In order to support investors interested in the investment of the geothermal electricity generation in Iran and generated electricity exports to the neighbouring countries, Renewable Energy and Energy Efficiency Organization (SATBA) has provided the opportunity for all legal and natural persons by offering necessary policies and procedures. This is subject in order to the implementation of the Minister of Energy's announcement dated 2018.07.04 for all eligible applicants. The geothermal and other renewable power plants construction in order to export electricity is as follows:

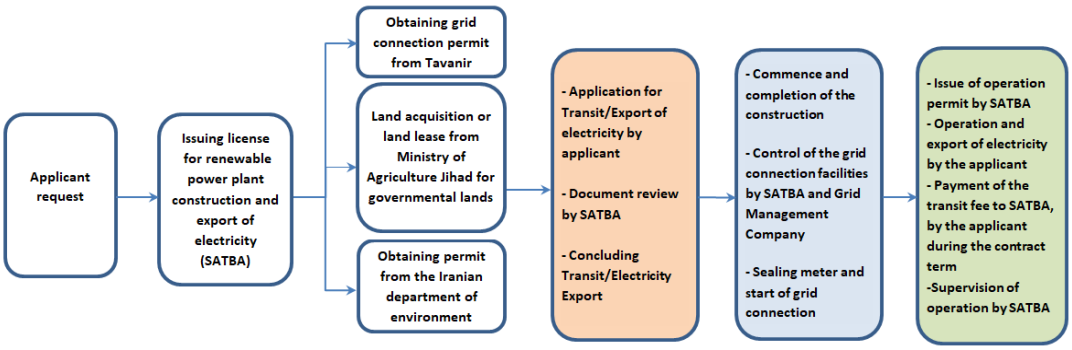

Figure 4: Guide on Investment in geothermal power plants for Electricity Export

7. CONCLUSION

- In 2019, only 0.2% of the country's electricity production, it has been through renewable power plants. Given the high capacity factor of geothermal energy power plants relative to other renewable power plants and the potential of this energy in Iran, and according to mathematical and thermodynamic calculations, the share of renewable energy in electricity production will increase by exploiting geothermal power plants. Furthermore, the development of this energy in Iran is necessary.

- In the new geothermal atlas of Iran, there is potential for geothermal energy in at least 15 provinces and 49 fields of Iran.
- There is 5MWe power plant project for electricity from geothermal energy in Iran, which is expected to start generating electricity in the near future.
- Renewable Energy and Energy Efficiency Organization (SATBA) is one of the major organizations in the Ministry of Energy that the engagement of the private sector and supporting it, setting the incentive policies, developing renewable energies in industrial level and accomplishing the target are at the top organization's agenda.
- In line with legal enactments, Power Purchase Agreement (PPA) for electricity production from the geothermal power plant is concluded for a 20-year period between the Renewable Energy and Energy Efficiency Organization (SATBA) and Private investors.

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