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Choosing Appropriate Technology based on CDM and UNFCCC:

(THE STUDY: The Electricity Industry)

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ABSTRACT

In the modern world, energy is an essential factor in any society. The increasing use of energy, environmental pollution, extensive climate change on earth, and the considerable costs of fossil fuels have created a considerable trend towards renewable sources. The ever- increasing use of different kinds of energy in Industry and agriculture will cause the demand for energy supplies to continue to grow. Whereas, the methods of energy production is one of the determining factors for polluting the environment, causing negative consequences. Such as; on increase in green-house gases, the rise in temperature levels, further damage of the ozone layer, and many other of environmental effects in different areas. In this essay, while we explain the concepts of technological transition, the convention of climate change and a clean development mechanism, the technologies of electricity production have been distinguished. And based on it a questionnaire has been prepared and at the end, the results have been analyzed using the Topsis technique and the technologies of electricity production determined and ranked in order of priority. It consists of water and wave energy, wind energy, bio-fuel energy from seaweed. Hydroelectric, geothermal energy, solar energy, Hydrogen energy, fuel cell nuclear energy, Biomass energy, alive Hydrocarbon energy, lifeless Hydrocarbon energy.

Keywords: *CDM, UNFCCC, Topsis technique, choosing of technology*

1. INTRODUCTION

Human life has always depended on energy and the methods of its utilization. Distinguishing energy sources and their benefits are important devices for economic growth and self- sufficiency in each country. The known primary sources of energy available to humans now, consist of natural sources like fossil fuels (coal, oil, natural gas), wood, the waste matter of humans, animals and Plants, food material (energy consumption for humans and animals), flowing water on the surface of the earth like rivers and water falls, the sun, wind, sea waves, ebb and flow, geothermal, the temperature of the sea levels and Nuclear reactions. With regards to various human needs concerning energy and the inability of directly using many of these primary sources, humans are required to change these energies based on their necessities. i.e, they change them into a desirable form of energy, e.g. electric energy. The process of changing energy definitely includes an amount of energy loss.[1]

Humans have an inseparable relation with the process of technological development. Making use of tools, the invention of the wheel, building baked clay, the using of bronze and discovering iron have shown the progress of technology in the past. But what has given technology a new dimension is it's speed, depth and uninterrupted

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process which has led to the industrial and economic growth of many countries. Technological development is more organized and inter-connected in the modern world. And unlike the past, it is expanding and developing faster than ever before. [2] The transition of technology is a complicated process and without the necessary study and analysis not only will it not be usefull but in addition to the possible loss of time and money, it may weaken the national technology as well.[3]

The question is, can the development of energy production meet the vast demand for electric energy by making use of renewable sources while, the world is concerned about its dependency on fussil fuels, global warning and the problem of accessing suitable sources [4]

The choice of technology is the first and most difficult step for accessing it. In order to choose technology correctly, the right technological facilities, needs and limits at the national, industrial and production unit levels should be properly recognized. This recognition needs the capability of analyzing the available technology at hand, determining it's levels and predicting the changes to come in the future. The search for the appropriate technology should start only after specifying the necessities [5]

Energy management consists of a whole set of inter-connected activities between the electricity industry and its consumers for decreasing the peak point usage of the gride and it's load and to reduce the consumer energy consumption while surfacing the curve of peak point usage of the gride in general. So that the consumers needs are provided more efficiently and less expensively. [6]

In fact in today's world, with the indicators of environmental conditions reaching critical levels, what kind of technology is chosen, is of major importance.

Sometimes, the criteria for choosing technology are just economic, financial and cultural. But in addition to these criteria, environmental factors are also of significance in this research. Three criteria have been distinguished namely technological indicators, expenditure indicators and environmental pollutant indicators which are environmental considerations based on the criterion of The Convention on Climate Change. With the presentation of these criteria (indicators) in the electricity industry which are adaptable and can be applied for evaluating other industries we can make it possible for decision-makers to evaluate their choices with adequate knowledge by having the proper indicators for technologies identified in this way. At least, they can choose a technology which is more suitable for the environment. Choosing the appropriate technology will decrease environmental pollution and make a great stride towards development and access of permanent development.

2- REVIEWING THE SOURCES AND BACKGROUND RESEARCH

1-2- *The transferring of technology is a complicated process*:

Without the necessary research and analysis not only is it not useful but in addition to a waste in time and capital, it can weaken the national technology. Before we define the process of technology transfer, it is necessary to provide machinery and build the necessary facilities and establishments. Although it requires most of the necessary investment, but because of it's concrete nature during the transfer process it can be done easier whereas, the software components of technology which consists of a professional workforce, a technical method of production and finally a technological organization are abstract meanings which unfortunately we can never be completely sure that they have been fully achieved. Unfortunately experience has shown that in the demand for technology, due to a lack of attention to hidden details in the transfer process of software properties, the technology is not transferred to the receptor correctly and not only does the receptor encounter problems in the developing of such high technology, but also faces difficulties in using the purchased technology. [3]

The transfer of technology means that science and technology is given and passed on from one group to another. Historically, the transfer has always been defined as hardware transfer. Today this transfer consists of the transfer of information like a software program in a computer or a new idea that might totally distance itself from aspects of hardware. [7]

Technology means the use of knowledge, perception, skills, and having efficiency for initiating, employing, maintenance, improvement and the developing of productive facilities [2]

The transfer of technology should continuously show the process of added value which includes a set of inter-connected activities in relation to lab innovations determined by market consumption. [8]

Technology transfer consists of an extensive group of processes which covers the experience and equipment for decreasing and adapting to climate changes among beneficiaries like, governments, the private sector, financial

institutions, and educational and research institutions. Clean/ green energies are being increasingly considered because of the minimal ecologic effect they have on conventional energy sources. Clean/ green energy is being considered within many technical, organizational and personal structures. [9] The transfer of energy in UNFCCC has a common purpose of showing the advanced groups performing their tasks that they are under the observation of UNFCCC programs to support the transfer of energy. The structural decision for performing the transfer of technology according to UNFCCC is listed below:

1- Evaluating the necessities of technolgy transfer
2- Technological information
3- A capable atmosphere
4- Structural capacity
5- Financial and institutional mechanisms and methodology for the transfer [10]

2-2- ***Clean development mechanism*:**
CDM is a mechanism of participation under the Kyoto protocol. It has the potential for helping developing countries to achieve permanent development through encouraging investment among the environmental friendly by governments and institutions of developed countries. CDM which is presented in the 12th article of Kyoto protocol would allow governments and institutions to perform projects to decrease emissions in developing countries, and they can obtain a credit as a certification for the deduction of emissions. And it can be included as a national commitment for emission deduction. [11]

In fact, the purpose of CDM in developing countries is for them to achieve permanent development, by helping to reach the final aim of the convention and giving economic aid, and also helping developed countries reach the deduction levels of emission in the Kyoto protocol. Based on this mechanism developing countries profit from the activities of a project which leads to an issuance of certification for emission deduction. For a one ton decrease of CO2 , a certification of an emission decrease is given to the project owner [12]

CDM makes it possible for developed countries to gain credits for a decrease of green house gases and provide some facilities for developing countries.

The most important advantages of CDM are:
1 – Economic varieties
2 – Environmental and social aspects
3 – Improving of energy revenue
4 – Introducing progressive ways for producing energy which is adaptable with the environment
5 – Job creation
6 – Protecting the environment and decreasing poverty

The developed countries perform the projects because of their commitments for decreasing the emissions and helping the permanent development in developing countries and they will adopt a CER certification in return for this decrease. [14]

3-2- ***convention on climate changes*:**
The first conference about the world climate was held in 1979. In 1999, in the Toranto conference , it was asked from the countries of the world to decrease CO2 emissions about a million tons (equal to y20) until 2005 and set up a convention on protecting the atmosphere. In this year an international council for climate changes was formed in parallel with the earth meeting in Rio de Janeiro and the convention on climate change was also put forward [15].

The convention on climate change has 26 articles and 2 appendixes. In the convention text, after describing the generalities and giving definitions, the aims, commitments, principals, main directions of education and research, and the methods for the exchanging of views among countries were considered.

It requires the countries to decrease green- house gases. The main aim of the convention on climate change is the stabilization of green- house gases density in the atmosphere and to prevent their dangerous effects on the climate so, it can provide an adaptation to the environment with regard to climate changes and protecting food production and permanent development in economy [16].

The main aims of the convention are the stabilization of the density of green – house gases in the atmosphere to prevent the dangerous effects of human activities on the climate system. The presentation of periodic reports about national climate changes to the secretariat of the convention, the preparation of a list of green- house gas

emissions and absorption by small wells, periodically arranging and accomplishing programs for decreasing emissions, cooperation and development of methods for technology transfer for decreasing emission in different parts of energy, transportation, industry, agriculture, forests, liquid and solid waste, local and international cooperation, for providing adaptable methods for the climate change phenomenon, considerating climate change in policies and plans of development[17]

4-2- ***The technologies of electricity production*:**
Three general groups electricity technologies have been presented:
1) The technologies based on fossil fuels
2) The technologies based on new energies
3) The technologies which depend on the storing of energy [18].

Energy is produced by two renewable and non- renewable sources

1-4-2- *renewable energies* : solar energy , photovoltaic technology, wind water, geothermal biomass , hydrogen , fuel cell , nuclear energy , sea weed bio fuel [6]

1-1-4-2- *solar energy or fuotovoltaeek technology*:
The sun is the energy source and beginner of life. It is a source for all other energies. According to scientific estimates, the birth of the sun goes back to 6000 million years ago. And 4.2 million tons of the sun's density is changing into energy per each second. Thus, based on the sun's weight , it is 333 thousand time bigger than earth. This bright star can be a big source of energy for 5 billion years [19]

2-1-4-2- *wind energy*: wind turbines are the energy transferers which change wind energy into a mechanical one [1]

3-1-4-2- *water energy*: water – electricity energy is obtained by pouring water into a turbine. By pouring water into the turbine and turning it along with it's alternator energy is produced. And the produced electricity depends on the amount of water and the height of it falling into the turbine [20]

4-1-4-2-*Geothermal energy*: heat energy in the earth's solid crust is called geothermal energy.

5-1-4-2- *biomass energy* : it is obtained by a set of chemical – physical and environmental processes on different parts of biomass (industrial and city sewage , animal waste , garbage , ….) like disintegration and fermentation and etc. From this process a gas is adopted in a container, which is called biogas.

6-1-4-2- *hydrogen energy and fuel cell*; Hydrogen is the lightest element and gas in nature. It is an energy which carries clean energy which will be substituted instead of fossil fuels in the coming century. And it is also acceptable for energy authorities. There are different methods for producing hydrogen. The most common one is the electrolysis of water and thermolysis of organic substances [23]

7-1-4-2- *nuclear energy*: A nuclear plant is an electric plant which uses the energy produced from the breaking up of the nucleus of uranium and plutonium. Because the breaking of nuclear fuels basically produces heat, nuclear reactors use this heat for producing the steam that is used for moving the turbines and generators. Finally it is used for producing electricity [24]

8-1-4-2- *bio- fuel energy of seaweed*: The required sea weed is cultured in a pool with a ten meter length and a three meter width and a depth of 50 cm. It absorbs CO2 garbage after five days. The produced liquid is changed into bio- fuel [25]

The first obvious characteristic for these kinds of energy is the fact that they are endless. On the other hand they are recreated naturally and the sources are not limited, unlike oil, gas, and coal which are limited and if we use them as complementary energy beside fossil fuels we will have saved much of the common fuels and have made them much more economically viable, and there will be no more concerns about the limitation of sources. So, we will have more sources of fossil fuels for our future generations [26]

The second characteristic of renewable energies is its flexibility. These sources can be controlled locally and independently in important areas and there is no need for having an entire grid or complicated energy transfer system. The people from different areas can choose a technology with better efficiency according to their job or local conditions.In principle, each area can be different and it is one of the advantages for renewable energies.

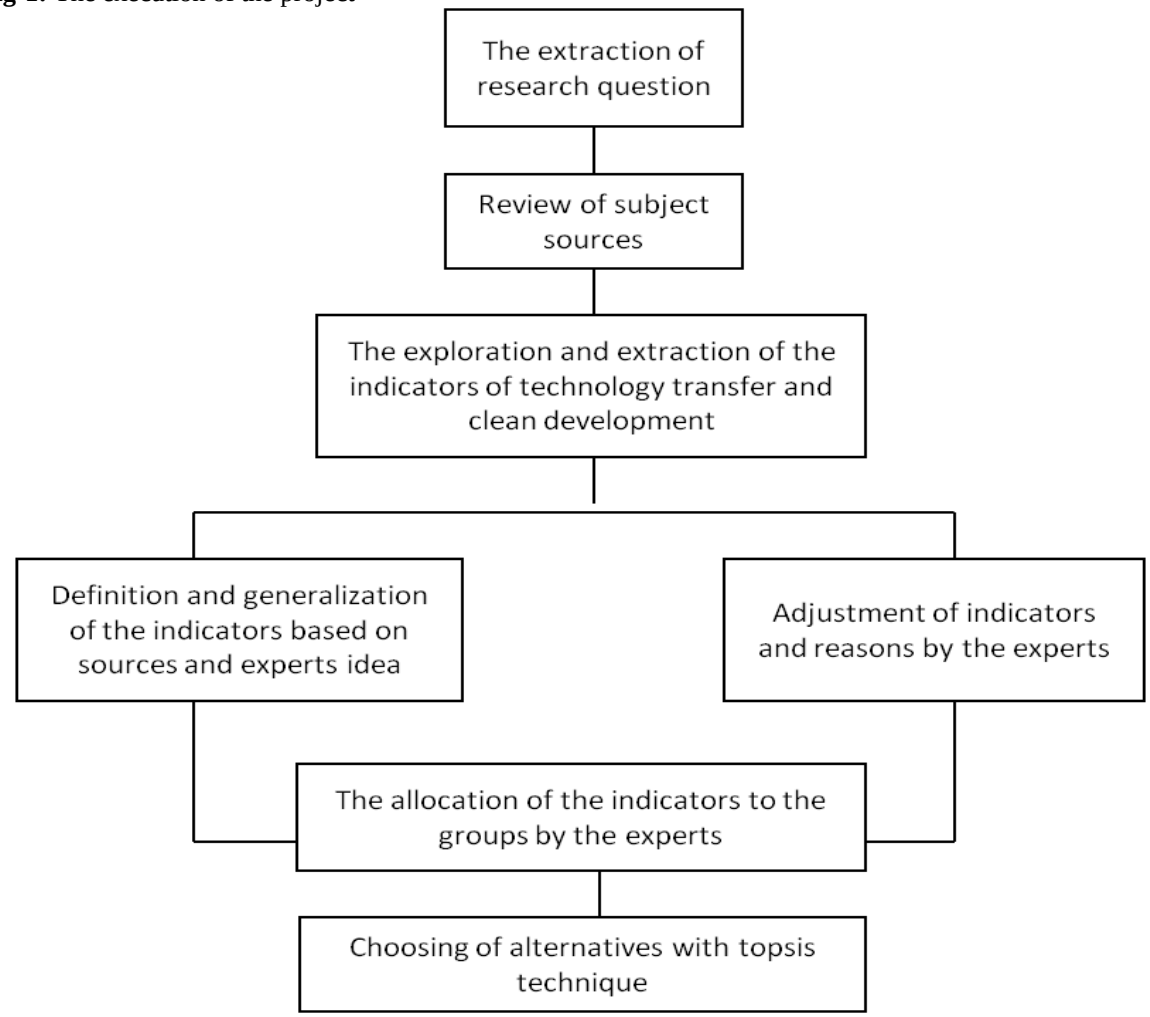
The third characteristic of renewable energy in comparison with the other kinds of energy is being devoid of all natural and environmental pollutants thus, with regards to the environment the using of renewable energies will minimize the emission of CO2 and green- house gases and the possibility of terrible events such as acid rain.
The fourth characteristics of using renewable energies is technological development of new energies and creating jobs because using renewable energy sources should also be considered with a view of having job creation and economic development in mind. [26]

2-4-2- *non – renewable energies:* non – renewable energies are two groups, the live hydro carbonic sources like kind of plants trees bushes and non – hydro carbonic sources like coal , oil and gas. [27]

3-5-4- *environmental indicators*: basically member countries invest in projects which have less gas emissions than other similar projects.As a result using this mechanism causes the deduction of local and eventually global effects [29].

3- THE METHOD OF RESEARCH
In this part, a brief explanation has been presented about the stages of the execution

Fig-1: The execution of the project



After recognizing the technologies of electricity production, the most important technologies have been determined and a questionnaire was designed to put them in the order of priority

4- STATISTICAL COMMUNITY
According to the few experts working on new energies in iran, basically working on them does not have much practical precedence. The professional community able to present proper information in this field are very limited in numbers. This society consists of the executives of electricity industries, university professors and new energy researchers who are experts in electricity industry and new energies. Because of the limitation on

the availability and the very limited number of experts we will use the decisions of groups instead of using statistical analysis research methods.

5 – SUBSTANCES AND TECHNIQUES

Topsis techniques is one of the comprehensive techniques for decision making. In this method, the alternatives will be ranked based on the similarity they have to the ideal solution. Thus, if the alternative is more similar to the ideal solution, it will have a higher rank [30]. In addition to considering the distance of the alternative to the positive ideal point, its distance to the negative ideal point will also be considered. It means that the best choice should have the least distance to the positive ideal solution and also have the furthest distance to negative ideal solution [31]. First, for normalizing the number of the questionnaire , the geometric average formula is used:

(1) $$G = \sqrt[n]{X^{1} * X^{2} * .... * X_{n}}$$

Then for standardizing and changing it to the percentage , the below formula is used

(2) $$g = (G - 1) * 100$$

For equaling of the scale of the indicators, we use

(3) $$r_{ij} = \frac{xij}{\sqrt{\sum_{i=1}^{m} x_{ij}^{2}}}$$

The indicators are shown in the figure number 1.1.

Fig-1.1: The weight of indicators based on the entropy technique

	Technological indicators				The indicators of the expense						Environmental pollution		
Alternative/indicator	The capability of protection	The capability of development	The capability of extraction	Agreement on policies	The total expense of power	The expense of extraction	The expense of Net	The of foundation	The expense of Transfer	The expense of fuel	The green house gases	Basic pollution	Aerosol
Live hydrocarbon energy	0.0849	0.0517	0.0771	0.0485	0.0640	0.0797	0.0654	0.0824	0.0894	0.0950	0.2291	0.2028	0.2093
Dead hydrocarbon energy	0.1509	0.0639	0.1001	0.0773	0.0985	0.0978	0.1060	0.0953	0.1015	0.2218	0.3213	0.2658	0.2499
Solar energy	0.0636	0.1164	0.1054	0.0989	0.1099	0.0708	0.0895	0.0913	0.0801	0.0554	0.0436	0.0373	0.0488
Wind energy	0.0494	0.1193	0.1054	0.1049	0.0960	0.0868	0.0975	0.0876	0.0917	0.0444	0.0436	0.0373	0.0488
Geothermal energy	0.0688	0.1026	0.0944	0.0886	0.0913	0.0952	0.0910	0.0953	0.0836	0.0468	0.0487	0.0416	0.0488
Biomass energy	0.0937	0.1033	0.0993	0.1058	0.0868	0.0906	0.0836	0.0790	0.0917	0.0770	0.0795	0.1048	0.1045
Hydrogen energy and fuel cell	0.1330	0.1183	0.1045	0.1220	0.1099	0.1011	0.1033	0.0985	0.0787	0.0994	0.0436	0.0373	0.0488
Water and wave energy	0.0670	0.0942	0.0618	0.0717	0.0921	0.0559	0.0795	0.0921	0.1024	0.0419	0.0436	0.0373	0.0488
Nuclear energy	0.0941	0.0844	0.0897	0.1210	0.1155	0.1452	0.1143	0.1345	0.1180	0.2515	0.0543	0.1520	0.0944
Water- electricity energy	0.0828	0.0544	0.1027	0.0932	0.0629	0.0818	0.0775	0.0745	0.0795	0.0496	0.0436	0.0416	0.0488
Bio fuel energy from seaweed	0.1086	0.0910	0.0598	0.0676	0.0726	0.0945	0.0918	0.0690	0.0828	0.0468	0.0487	0.0416	0.0488
total	1	1	1	1	1	1	1	1	1	1	1	1	1

6 – THE TOPSIS MODEL FOR DECIDING

This model is presented by Howang and Yunin 1981. It is used for the ranking of the choices (alternatives) and solution. It is a famous model for deciding because of having many indicators [32]

In this technique , an m (the alternative) is evaluated by an n (the indicator) it is based on the meaning that the alternatives should have the least distance from the positive ideal solution (the best condition) and the most distance from the negative ideal solution (the worst condition) [33].

Solving this problem needs six steps:
The first step:
The matrix of decision should be quantative and non – scaled. In this stage if they are qualitive indicators, they will be changed to the quantative numbers by the techniques of quantative change like two – electrode scale.

Then it is turned into the matrix by the

$$n_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i}^{m} = 1 a_{ij}^2}}$$

Relation (1-2)

n_{ij} = is the quantity which is not scaled by the alternative (i) from the view point of indicator(j)

Fig-2: The matrix of the first decision

	The Matrix the first decision												
Alternative/indicator	The capability of protection	The capability of development	The capability of extraction	Agreement on policies	The total expense of power	The expense of extraction	The expense of Net	The of foundation	The expense of Transfer	The expense of fuel	The green house gases	Basic pollution	Aerosol
Live hydrocarbon energy	4.393	3.439	5.032	2.903	3.876	4.470	3.680	5.244	4.828	1.822	5.251	5.431	4.289
Dead hydrocarbon energy	7.803	4.251	6.533	4.623	5.961	5.484	5.961	6.066	5.477	6.213	7.360	7.117	5.121
Solar energy	3.240	7.740	6.881	5.911	6.648	3.969	5.032	5.809	4.322	1.551	1.000	1.000	1.000
Wind energy	2.556	7.937	6.823	6.269	5.809	4.866	5.484	5.573	4.951	1.245	1.000	1.000	1.000
Geothermal energy	3.556	6.823	6.165	5.296	5.536	5.337	5.121	6.066	4.514	1.311	1.116	1.116	1.000
Biomass energy	5.032	6.870	6.483	6.322	5.255	5.077	4.705	5.032	4.951	2.157	1.822	2.807	2.141
Hydrogen energy and fuel cell	6.876	7.869	6.823	7.292	6.648	5.664	5.809	6.309	4.251	2.785	1.000	1.000	1.000
Water and wave energy	3.465	6.269	4.036	4.284	5.573	3.135	4.470	5.865	5.526	1.174	1.000	1.000	1.000
Nuclear energy	4.866	5.616	5.858	7.230	6.991	8.139	6.428	8.558	6.371	7.045	1.245	4.071	1.934
Water- electricity energy	4.284	3.619	6.705	5.573	3.809	4.588	4.359	4.745	4.289	1.390	1.000	1.116	1.000
Bio fuel energy from seaweed	5.616	6.056	3.906	4.044	4.393	5.296	5.160	4.393	4.470	1.310	1.116	1.116	1.000

Fig-3: The matrix of the normal decision

	The Matrix the Normal decision												
Alternative/indicator	The capability of protection	The capability of development	The capability of extraction	Agreement on policies	The total expense of power	The expense of extraction	The expense of Net	The of foundation	The expense of Transfer	The expense of fuel	The green house gases	Basic pollution	Aerosol
Live hydrocarbon energy	0.268	0.166	0.251	0.156	0.402	0.318	0.404	0.319	0.299	0.269	0.069	0.071	0.084
Dead hydrocarbon energy	0.476	0.205	0.326	0.249	0.261	0.259	0.249	0.276	0.264	0.078	0.049	0.054	0.070
Solar energy	0.197	0.373	0.344	0.319	0.234	0.358	0.295	0.288	0.334	0.316	0.362	0.387	0.363
Wind energy	0.156	0.383	0.341	0.338	0.268	0.292	0.271	0.300	0.292	0.393	0.362	0.387	0.363
Geothermal energy	0.217	0.329	0.308	0.285	0.281	0.216	0.290	0.276	0.320	0.374	0.324	0347	0.363
Biomass energy	0.307	0.331	0.324	0.341	0.296	0.280	0.316	0.332	0.292	0.227	0.198	0.138	0.169
Hydrogen energy and fuel cell	0.412	0.355	0.322	0.375	0.228	0.226	0.245	0.256	0.322	0.167	0.340	0.361	0.341
Water and wave energy	0.211	0.302	0.202	0.231	0.279	0.453	0.332	0.285	0.261	0.417	0.362	0.387	0.363
Nuclear energy	0.297	0.271	0.293	0.390	0.222	0.174	0.231	0.195	0.227	0.069	0.291	0.095	0.187
Water- electricity energy	0.261	0.174	0.335	0.300	0.409	0.310	0.341	0.353	0.337	0.352	0.362	0.347	0.363
Bio fuel energy from seaweed	0.343	0.292	0.195	0.218	0.354	0.268	0.288	0.381	0.323	0.374	0.324	0.347	0.363

The second step:
concluding the balanced and non – scaled matrix in this stage, we multiply the weight of each indicator by the non – scaled matrix. The weights of each indicators (the importance of each criteria) is applied by each decision maker's idea or it is obtained by AHP and the Antropi technique.

Fig-4: The matrix of the balanced and normal decision

	The Matrix of balanced and Normal decision												
Alternative/indicator	The capability of protection	The capability of development	The capability of extraction	Agreement on policies	The total expense of power	The expense of extraction	The expense of Net	The of foundation	The expense of Transfer	The expense of fuel	The green house gases	Basic pollution	Aerosol
Live hydrocarbon energy	0.008	0.003	0.002	0.002	0.004	0.005	0.002	0.002	0.001	0.039	0.014	0.013	0.027
Dead hydrocarbon energy	0.014	0.004	0.003	0.004	0.002	0.004	0.001	0.002	0.001	0.011	0.010	0.010	0.023
Solar energy	0.005	0.008	0.003	0.005	0.002	0.005	0.002	0.002	0.001	0.046	0.077	0.072	0.119
Wind energy	0.004	0.008	0,003	0.006	0.003	0.004	0.001	0.002	0.001	0.057	0.077	0.072	0.119
Geothermal energy	0.006	0.007	0,003	0.005	0.003	0.004	0.001	0.002	0.001	0.054	0.069	0.064	0.119
Biomass energy	0.009	0.007	0.003	0.006	0.003	0.004	0.002	0.002	0.001	0.033	0.042	0.025	0.055
Hydrogen energy and fuel cell	0.012	0.007	0.003	0.006	0.002	0.003	0.001	0.002	0.001	0.024	0.072	0.067	0.112
Water and wave energy	0.006	0.006	0.002	0.004	0.003	0.007	0.002	0.002	0.001	0.061	0.077	0.072	0.119
Nuclear energy	0.008	0.005	0.003	0.007	0.002	0.002	0.001	0.001	0.001	0.010	0.062	0.017	0.061
Water- electricity energy	0.007	0.003	0.003	0.005	0.004	0.004	0.002	0.002	0.001	0.051	0.077	0.064	0.119
Bio fuel energy from seaweed	0.010	0.006	0.002	0.004	0.003	0.004	0.001	0.003	0.001	0.054	0.069	0.064	0.119

The third step: determining the positive and ideal solution and negative ideal solution are defined below:

The positive and ideal alternative V_j^+ = the vector of the best quantities in each indicator of matrix of v decision

The negative and ideal alternative V_j^- = the vector of the worst quantities in each indicator of matrix of v decision

About the unfavorable criteria , the above definitions are in reverse order.

Fig-5: Positive and Negative ideal

Positive ideal	0.0143	0.0082	0.0035	0.0071	0.0045	0.0071	0.002	0.003	0.001	0.061	0.077	0.072	0.119
Negative ideal	0.0047	0.0036	0.0020	0.0028	0.0025	0.0027	0.001	0.001	0.001	0.010	0.010	0.010	0.023

The fourth step: concluding the quantity of the space for each alternative of the positive and negative ideal

Distance for each alternative of the positive ideal (d_i^+) and the distance for each alternative of the negative ideal (d_i^-) are calculated based on the following formulas :

$$d_i^+ = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^+\right)^2} \qquad i = 1,2,3,\ldots,m$$

Relation (2-2)

$$d_i^+ = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^-\right)^2} \qquad i = 1,2,3,\ldots,m$$

Relation (3-2)

Fig-6: The distance from the positive ideal and negative ideal

	The space from Positive ideal	The space from Negative ideal
Live hydrocarbon energy	0.1278	0.0303
Dead hydrocarbon energy	0.1415	0.0101
Solar energy	0.0173	0.1374
Wind energy	0.0107	0.1408
Geothermal energy	0.0155	0.1329
Biomass energy	0.0907	0.0538
Hydrogen energy and fuel cell	0.0381	0.1238
Water and wave energy	0.0089	0.1420
Nuclear energy	0.0957	0.0652
Water- electricity energy	0.0147	0.1357
Bio fuel energy from seaweed	0.0142	0.1330

The fifth step: determining the relative proximity of one alternative to the ideal solution

$$cli^* = \frac{d^-}{d_i - d_i^+} \qquad i = 1,2,3,\ldots,m$$

Relation (4-2)

Thus, each alternative (V_i) is closer to the ideal solution the quantity of d_i will be closer to the number one .

Fig-7: Ranking based on the indicator of proximity

	The calculation of proximate indicators
Live hydrocarbon energy	0.1919
Dead hydrocarbon energy	0.0666
Solar energy	0.8883
Wind energy	0.9291
Geothermal energy	0.8985
Biomass energy	0.3725
Hydrogen energy and fuel cell	0.7649
Water and wave energy	0.9409
Nuclear energy	0.4052
Water- electricity energy	0.9024
Bio fuel energy from seaweed	0.9033

The sixth step: ranking of the alternative: if each alternative that its relative proximity of cli is more than the ideal solution (more proximate to the number 1) it will be more preferable

Fig-8: the Final Ranking

	The order of priority for alternatives	Ranking
Water and wave energy	0.9409	1
Wind energy	0.9291	2
Bio fuel energy from seaweed	0.9033	3
Water- electricity energy	0.9024	4
Geothermal energy	0.8958	5
Solar energy	0.8883	6
Hydrogen energy and fuel cell	0.7649	7
Nuclear energy	0.4052	8
Biomass energy	0.3725	9
Live hydrocarbon energy	0.1919	10
Dead hydrocarbon energy	0.0666	11

7- CONCLUSION

Achieving economic growth has both opportunities and dangers in the world. Environmental studies are new subjects in developing countries and we do not have much experience about them. Since these countries use the technologies of the developed countries attention should be paid to environmental indicators. First, in this research, technology transfer and clean energy have been introduced.

Then , the technology of electricity production and effective indicators on clean energy were considered, and from them, the most important criteria were chosen. Afterwards, for analysis and prioritizing, a questionnaire was designed based on recognized criteria. Then, the results of the questionnaire have been analyzed by the Topsis technique and the technology of electricity production is distinguished in the order of priority.

Thus, water and wave energy has the highest priority, wind energy , befoul from sea weed , water – electricity energy, geothermal , solar ,hydrogen and fuel cell , nuclear biomass , live hydro carbonic , dead hydro carbonic energies are in the order of priority. According to the importance related to the weight of the indicators which is determined by experts , the wind technology has the highest priority because of less expense related to the expense indicator, less emission , and from the point of view that it has more agreement with the technological indicators. Although the technology of geothermal energy is in the fifth priority because all parts of earth do not have a good potential for employing this kind of energy. The solar energy has the next priority because we do not have full access to this energy in all seasons. The nuclear energy is our eighth priority , because of nuclear waste which is very dangerous for the environment. But one of the reasons for biomass being in the next order of priority is because it is a new and novel energy and the other reasons can be its dangerous effects on soil, because the agricultural and animal waste is used for compensation of organic substances and it revives organisms and micro – organisms. By using of biomass for producing electricity, it can cause both dangerous effects on soil and produce environmental pollutants. The dead hydro carbonic energies which have the popular name of "fossil fuel" have the lowest priority, because they are not renewable , and they have a high expense in relation to the expense indicators and produce a lot of environmental pollutants.

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