# Comparative analysis of public opinion for the acceptance of nuclear energy use in Mongolia

**Sambuu Odmaa[1,2],* Suren Davaa[1,3], Garmaa Nyamdulam[2], Gun-Aajav Manlaijav[3]**

[1]*School of Engineering and Applied Sciences, National University of Mongolia, Ulaanbaatar, Mongolia*

[2]*Nuclear Research Centre, National University of Mongolia, Ulaanbaatar, Mongolia*

[3]*Nuclear Energy Commission, Government of Mongolia, Ulaanbaatar, Mongolia*

The Mongolian government has a policy to opt a nuclear power as one of the sources of energy in the future. Analysis of public opinion based on the standard survey questionnaire to identify the general public attitude towards nuclear energy use in Mongolia was conducted for the first time in Mongolia in 2011 and for the second time in 2015 for the purpose of further tendency redefining of the public acceptance. The objective of the present paper was to compare the results of the surveys held in 2011 and 2015, and to discuss the alteration and/or the same status in public attitude to nuclear energy use in Mongolia. Based on the results, the main and contributing factors influencing the public opinion for the acceptance of nuclear energy use in Mongolia and the possible reasons forming the public attitude were determined. The results show that Mongolian public opinion on the nuclear energy benefits is likely to be more positive, reasoned mainly by some inevitable factors.

PACS number: 01.75.+m, 01.78.+p

Key words: survey on nuclear energy, public acceptance of nuclear energy, energy policy

## INTRODUCTION

The Mongolia faces an increasing energy demand. Energy generation in Mongolia is currently provided by thermal power plants, diesel, small hydro, solar & wind technology [1] and import, and among them, the dominant source is a coal firing (Figure 1). Air pollution caused by coal-burning power plants and coal-fired ovens in traditional Mongolian homes creates major problems in wintertime. In recent years, a number of citizens living in traditional Mongolian homes in Ulaanbaatar city has increased due to population migration from countryside. Additionally, air pollution in the form of black carbon, and carbon dioxide (CO2) emissions from coal-burning sources contributes to global warming and regional climate effects [2]. The outdoor and indoor air pollutions cause a spread of certain diseases in urban areas, especially in Ulaanbaatar and in other major cities of Mongolia. One conservative calculation estimates that approximately one of ten deaths in Ulaanbaatar is related and attributable to outdoor air pollution [3]. Air pollution in Mongolia, leads to public health deterioration, locally, and to climate change, globally.

Mongolia is a part of the international agreements such as Kyoto protocol in 1997 and Paris agreement in 2016, and participated in the high level meeting of the United Nations in Rio de Janeiro, Brazil in 1992. Mongolia has a certain obligation and responsibility to reduce a greenhouse gas emission, therefore, puts effort to minimize, in extend possibility, the fossil fuel consumption for the energy generation.

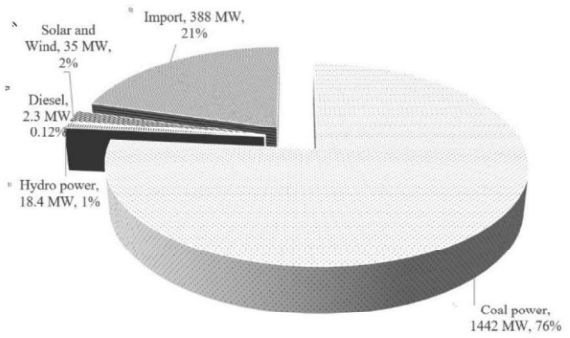


*Figure 1. Utilization of energy sources [1].*

Normally, it is always not effective that one resource for energy generation is dominant for whole country. It is essential to save organic, raw material resource in the world for the purpose of high technology utilities, therefore, an optimal combination for energy mix is one of the key aspects for the energy savings. Also, it is important to achieve a country's independence in terms of energy

* Electronic address: odmaa@seas.num.edu.mn

supply and sustainable supply of energy demand in the future.

Various natural resources have been discovered in Mongolia as a consequence of intensive exploration and investigation performed by world-class companies in recent years. Uranium ore exploration and investigation have been also intensively conducted in Mongolia in recent years. It is assumed that future energy demand in Mongolia would be increased dramatically because of the continuing expansion of mining, infrastructure, construction and improvement of the nation's quality of life. In addition, the lengthy cold seasons in Mongolia require an extended production of thermal energy. The Mongolian government has a policy to make nuclear power as one of the sources of energy supply in the future [4-7]. This policy will serve as a core policy for strategic goal and an action program of Mongolia with regard to its radioactive minerals resources, exploitation, processing and nuclear energy utilization. The Nuclear Energy Law of Mongolia was approved in 2009 [8]. The use of nuclear energy can be one of the possible ways to resolve the issues of air pollution, sustainable energy independence and potential energy demand in Mongolia.

The standard survey questionnaire developed from WNU (World Nuclear University) and Korea Nuclear Energy Promotion Agency (KONEPA) [9] to identify the general attitude of the public towards nuclear energy was conducted for the first time in Mongolia in 2011 and the results were published in the report [10]. The circumstance that the Fukushima Daiichi nuclear power plant (NPP) accident occurred few months before the first survey, Mongolian TV channels broadcasted about this accident and its aftermaths, the rumor and public debates about radioactive waste possible disposal in Mongolia and Germany's refusal to nuclear energy could have negative impact on people's opinion on nuclear energy. However, the number of negative responses was less than a half of all the respondents, about forty-four percent.

It was important to investigate if any changes in public opinion on nuclear energy have occurred after four years and if people have got more familiar with the relevant policy, programs and activities in nuclear energy field during the period. The purpose of the present paper was to describe the results of the second survey conducted in 2015 for the purpose of further redefining of the public acceptance tendency. The results of the surveys held in 2011 and 2015 were compared and the alteration and/or the same status in public attitude to nuclear energy use in Mongolia were discussed. The main and contributing factors influencing the public opinion for the acceptance of nuclear energy use in Mongolia and the possible reasons forming the public attitude were determined. Generally, the Mongolian public opinion on nuclear energy benefits is likely to be more positive due to some inevitable factors such as the country has only two big neighboring states, the geographical location as the landlocked country and an air pollution due to utilization of fossil fuel-coal as a dominant source for the energy generation. Furthermore, Mongolian youth more favors a construction of new NPPs in Mongolia, in comparison to other age groups. Unfortunately, the survey results showed that the public has a lack of a systematic information on the subject of nuclear energy.

## METHODS

The standard survey questionnaire consisted of 6 questions on demographics and 20 main questions to identify public attitudes towards nuclear energy which were developed from WNU (World Nuclear University) and Korea Nuclear Energy Promotion Agency (KONEPA) (WNU and KONEPA, 2011a). The survey questionnaire was collected in a paper form and also through the internet-based arrangements during 4 weeks between July 24 and 19 August 2011 for the first time survey and 2 weeks between September 21 and October 3 in 2015 for the second time. Locations where the both surveys were conducted were exactly identical. All the paper-based surveys were conducted in seven districts of Ulaanbaatar city, in Darkhan and Erdenet cities, as well as in 4 provinces. Two of those provinces are Dornod, Dornogobi, where the exploration of uranium resources is currently under way. The others, Khovd and Zavkhan provinces, are located in western part of Mongolia. One province imports electricity from Russia, while the latter one has not enough coal resources. For these reasons, respondents chosen from those locations were expected to demonstrate multi-position responses regarding to the future energy supply options. The places where the survey was conducted were shown in Figure 2 as red dots.


*Figure 1. Chosen locations for the survey questionnaire (red dots)*

The first and second survey included 1671 and 1810 participants, respectively. Paper-based surveys accounted for 1513 and 1700 opinions, while 158 and 110 questionnaires were polled by internet. About 800 were polled from Ulaanbaatar, 150 were collected from each Darkhan and Erdenet, and about 100 were collected from each provinces in both cases. The representative capability of sampling was very high covering 1,689,922 and over 2 million people whose age higher than 18 in both cases (Mongolian Statistical yearbook, 2010; Monthly bulletin of statistics, 2014). The confidence level was 99% and the confidence interval was 3. The quantitative research technique was used to evaluate the survey results and the representative sampling was made in the majority (Creative Research Systems survey software). The collected data was processed by using SPSS.17 program (SPSS Statistics 17.0 software), the relation factors were analyzed by the frequency table creation and the results comparison was done by cross-tabulation.

*General characteristics of participants*:

Due to the fact that the majority of the Mongolian population is represented by youths (Mongolian Statistical yearbook, 2010; Monthly bulletin of statistics, 2014), 56% and 64% of the survey participants in 2011 and 2015 were youths of ages between 18 and 34 years and 44% and 41% of participants were male respectively. This ratio correctly reflects the general tendency of population age and sex composition in Mongolia, therefore, the results representativeness may be applied to the total population.

As a matter of fact, 58% and 56% of all participants in 2011 and 2015 had university degree of bachelor and master what indicates that the educated parts of the Mongolian population have participated more actively in the surveys in comparison to the parts of the general education level. On the other hand, this result shows that even the certain portion of the educated population does not know whether the country currently uses a nuclear energy or not.

With regard to the locations of participants, 70% of them live in urban areas, 27% of them live in rural areas, 51% and 18% live in foreign countries for 2011 and 2015 survey cases respectively. Employed people were represented by 68% in 2011 and 52% in 2015 survey cases, while the remaining unemployed participants consisted from students and others. Evaluation of participant's economic situation indicated that most participants' families have about the same typical living standard as other people living in the same locations.

It can be seen from the survey data and results that the characteristics of participants like location, economic situation, life behavior (e.g., working hours, education level, living conditions, etc.), age and sex were typical for the common population of Mongolia. Therefore, the educated people were represented more in the survey than the general Mongolian population

## RESULTS AND DISCUSSIONS

Mongolia has a large resource of minerals and mostly uses coal to produce energy. However, the number of rural herders who uses solar and wind energy as an energy source has increased in the last few decades. Most of the survey participants support the use of renewable energy as an energy source for Mongolia, while 45% of 2011 and 36% of 2015 survey participants favor the use of nuclear energy as an energy source (Table 1). However, a number of people in favor of coal energy is reduced by 15% within 4 years while the number of people opposing nuclear and coal energy remained the same for 2015 survey. Possibly, a public attitude on energy source became inactive, or probably they did not fully recognize the meaning of the survey question. Therefore, a number of the answer with "don't know" has increased almost twice in 2015 survey. Generally, the public does not favor the use of only one energy source to meet the nation's energy supply requirements and expressed their preference to use of various energy sources.

Most of participants answered that they don't know whether they are in favor of use of oil, nuclear energy and natural gases or not, and that there is not enough information about those energy sources. In fact, this is a reflection of the reality. Mongolia has no resource of natural gases. Some companies have explored the oil resource, Mongolian origin oil is exported to China without refining and oil is

imported from the neighboring countries, Russia and China.

*Table 1. Public opinions on energy sources.*

| Source of energy | Favor | | Opposed | | Don't know | |
|---|---|---|---|---|---|---|
| | 2011 | 2015 | 2011 | 2015 | 2011 | 2015 |
| Natural gas | 61% | 42% | 13% | 14% | 26% | 44% |
| Oil | 68% | 44% | 15% | 16% | 17% | 40% |
| Coal | 60% | 45% | 32% | 27% | 9% | 28% |
| **Nuclear energy** | **45%** | **36%** | **34%** | **27%** | **21%** | **37%** |
| Hydroelectric energy | 70% | 61% | 17% | 13% | 13% | 26% |
| Wind energy | 84% | 73% | 7% | 4% | 10% | 23% |
| Solar energy | 90% | 82% | 4% | 3% | 7% | 15% |

One-third of the participants opposed the use of coal as an energy source mainly because of the increased and disastrous level of wintertime air pollution in last few years. The survey results show that the public and especially the youth prefers introduction of high-tech and a mix of various energy sources in adequate proportion to meet the nation's energy demands.

*Table 2. Public opinion on nuclear energy by locations.*

| Location | favor | | oppose | | Don't know | |
|---|---|---|---|---|---|---|
| | 2011 | 2015 | 2011 | 2015 | 2011 | 2015 |
| Urban | 48% | 37% | 33% | 26% | 19% | 37% |
| Rural | 33% | 31% | 39% | 32% | 28% | 37% |
| Foreign country | 77% | 72% | 10% | 22% | 14% | 6% |

It is interesting that 76% of 2011 and 72% of 2015 survey people who live in foreign countries were in favor of using nuclear energy as an energy source of our country (Table 2). It can be explained by the fact that the countries where they live use nuclear energy and they are more familiar with benefits of nuclear energy. However, a number of people living in foreign countries who opposed nuclear energy use was increased from 10% to 22% while a number of participants living in Mongolia with negative opinion on nuclear energy use was reduced by 7% within 4 years. The possible reason for this might be that the people living in abroad do not feel the severely negative impact on public health due to air pollution in Mongolia.

As listed in Table 3, many Mongolians, regardless their age, tend to favor the use of coal, traditionally used to produce electricity as an energy source, however, this trend was reduced by 8% in average in 2015 survey compared to 2011 survey. So far, the coal was the almost only the energy source in Mongolia and people hope that it would be the dominant one in future. However, the public opinion on opposition to coal use was increased by 8% within 4 years.

Participants' attitude on benefit and risk of nuclear energy was compared in Table 4. Their knowledge or information on these issues was not improved within 4 years. Most of people answered that they do not know on either benefit or risk of nuclear energy. It shows that for the purpose of general education, delivery to public, of the information related to risk of nuclear energy and general knowledge on importance of nuclear energy utilization, needs to be improved.

53% and 54% of participants for 2011 and 2015 survey cases respectively indicated that nuclear energy is important to meet the future energy needs of the country, while 31% and 27% of them pointed out that the nuclear energy is not important, and the remaining 16% and 19% of the participants did not know (Figure 3). It is revealed that more than a half of the public have a positive attitude toward nuclear energy use. The reason is that the existing thermal power plants are almost to reach the end of their lifetime and many people think that their frequent maintenance and repair are too expensive and becoming technically and financially not efficient. In addition, many people may believe that more safe, reliable and advanced nuclear reactors will be developed soon even though they answered the question as nuclear energy utilization risk overweigh its benefits.

As shown in Table 5, many people have a positive attitude toward the benefits of nuclear energy. In recent years, much of research work results showed that the average air temperature has increased significantly and a sand movement is observed in most provinces in Mongolia. As a consequence, surface water and groundwater levels have decreased and many rivers and springs have dried up. The ecological unbalance happened due to environmentally unfriendly energy production methods.

*Table 3. Public opinion on coal (by age).*

| | | 18-24 | 25-34 | 35-44 | 45-54 | 55-59 | 60+ | Average |
|---|---|---|---|---|---|---|---|---|
| Favor | 2011 | 50% | 57% | 65% | 68% | 75% | 69% | 64% |
| | 2015 | 63% | 54% | 44% | 46% | 54% | 51% | 52% |
| Oppose | 2011 | 38% | 36% | 26% | 23% | 19% | 19% | 27% |
| | 2015 | 28% | 36% | 39% | 42% | 34% | 29% | 35% |
| Don't know | 2011 | 11% | 7% | 8% | 9% | 6% | 12% | 9% |
| | 2015 | 9% | 11% | 17% | 12% | 12% | 20% | 14% |

Coal burning and car overusing contributed to an increase of greenhouse gaseous emissions. People think that the use of nuclear energy is one of the ways to limit those negative phenomena.

*Table 4. Public opinion on benefits and risk of nuclear energy.*

| | 2011 | 2015 |
|---|---|---|
| The benefits of nuclear power as an energy source outweigh the risks it poses. | 24% | 24% |
| The risks of nuclear power as an energy source outweigh its benefits. | 34% | 31% |
| Neither. | 11% | 9% |
| Do not know. | 31% | 36% |

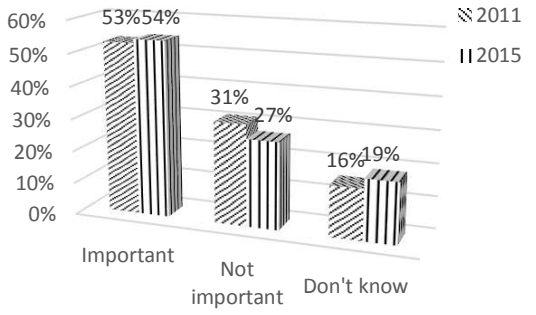


*Figure 3. How important is nuclear energy to meet future energy needs?*

As is a landlocked country between two big countries, the Mongolian oil import depends from them. A few months ago, Mongolia had issues with oil and oil products supply import due to the oil export limitations from Russia. Oil and oil products prices increased and the increase had impact on the prices of everyday foods and goods for final consumers. The public have understood an importance of a reliable supply for oil. The people, who have understanding an importance of the independent energy sources, might prefer the use of nuclear energy. Thus, the people, who think that it is possible to reduce oil import dependence from other countries by using nuclear energy, might be 58% of 2011 and 48% of 2015 survey participants. Almost a half of the participants agree that nuclear energy ensures more a competitive and a more stable price.

Besides, it is clearly seen from the tables that a knowledge of the public about energy, especially about nuclear energy is very low.

A public opinion on possibility to operate NPP was compared in Table 6. From Table 6, 44% of participants believe in the possibility to operate NPP in a safe manner, while 37% did not in 2011. The reason of not believing might be fears of nuclear power plant accidents caused by operator fault, over-aged reactor operation and natural disasters. These results were improved in 2015 survey as 50% and 27%. Many people think that the legal environment of the country is not sufficiently established yet and nuclear energy development is in the beginning stage in Mongolia. Furthermore, the country does not have enough national human resources in nuclear energy and engineering, and this issue is at the starting point to be taken a care by the education system. Thus, it is possibly too early to talk about a public belief on nuclear safety since there is no operating nuclear power plant yet in Mongolia. That is why a number of people does not know anything relevant to nuclear safety. The negative attitude toward radioactive waste might have been formed due to the rumors about secret agreement on radioactive waste disposal in Mongolia was spread out among the public.

*Table 5. Public opinion on nuclear energy benefits.*

| | agree | | disagree | | Don't agree | |
|---|---|---|---|---|---|---|
| | **2011** | **2015** | **2011** | **2015** | **2011** | **2015** |
| Nuclear energy helps to limit climate change. | 43% | 37% | 33% | 29% | 24% | 34% |
| Nuclear energy helps to make us less dependent on fuel imports, such as gas and oil. | 58% | 48% | 23% | 23% | 19% | 28% |
| Nuclear energy ensures more competitive and more stable energy prices. | 47% | 51% | 22% | 28% | 31% | 21% |

*Table 6. Public opinion on nuclear safety.*

| | agree | | disagree | | don't know | |
|---|---|---|---|---|---|---|
| | **2011** | **2015** | **2011** | **2015** | **2011** | **2015** |
| It is possible to operate NPP in a safe manner. | 44% | 50% | 37% | 27% | 19% | 23% |
| The legislation of our country sufficiently ensures nuclear safety. | 24% | 26% | 47% | 37% | 28% | 37% |
| The nuclear safety authority in our country sufficiently ensures the safe operation of NPPs. | 23% | 28% | 44% | 36% | 32% | 36% |
| You trust companies operating NPPs. | 23% | 24% | 47% | 36% | 30% | 40% |
| The disposal of radioactive waste can be done in a safe manner. | 24% | 22% | 44% | 39% | 32% | 39% |
| NPPs are sufficiently secured against terrorist attacks. | 18% | 18% | 44% | 33% | 38% | 49% |
| Nuclear materials are sufficiently protected against malevolent use. | 20% | 22% | 37% | 30% | 43% | 48% |

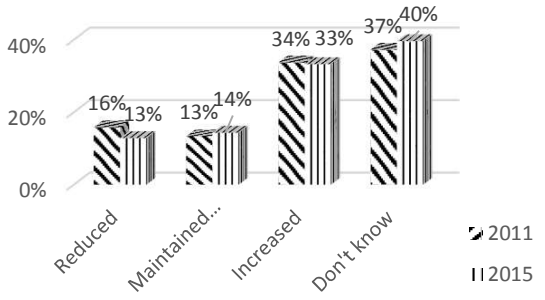


*Figure 4. How will be nuclear energy proportion in future?*

The one-third of participants answered that the current proportion of nuclear energy will be increased, 37% to 40% of them do not know about the issue, as displayed in Figure 4. 13% to 14% of participants guess that utilization of nuclear energy in the future will be maintained at the same level, while 13-16 % of them said that the trend of nuclear energy use might be reduced. The people, thinking that nuclear energy proportion will be increased, might have considered that China, as a leading country by energy supply, will continuously keep its policy about nuclear energy. But, those participants guessing that utilization of nuclear energy will be reduced, might have heard that some European countries have decided to refuse nuclear energy. It is assumed that the participants answered this to question were guided by the global attitude toward nuclear energy.

Table 7 shows the comparison results of public opinion on possible construction of new NPP in Mongolia. More than a half participants prefer the construction of new NPP in the country, while 34-36% of them oppose. The results presented by Figure 3 are well supported by Table 7 data. If consider the participant's age, the youth prefer the construction of new NPP as illustrated by Figure 5. Compared to 2011, the favor for new NPP construction within the participant's age is slightly increased in average in 2015.

*Table 7. Public opinion on construction of new NPP in our country.*

| | **2011** | **2015** |
|---|---|---|
| Favor | 55% | 54% |
| Oppose | 36% | 34% |
| Don't know | 9% | 12% |

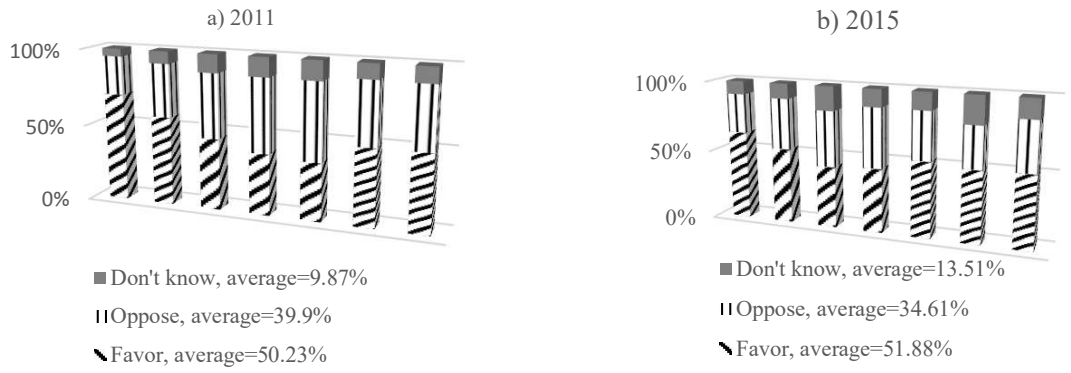


*Figure 5. Public opinion on construction of new NPPs in Mongolia (by age in 2011 and 2015).*

*Table 8. Public opinion on NPP.*

| | Agree | | Oppose | | Don't know | |
|---|---|---|---|---|---|---|
| | **2011** | **2015** | **2011** | **2015** | **2011** | **2015** |
| New nuclear power plants are expensive to build. | 59% | 53% | 17% | 35% | 24% | 12% |
| Most people in our country do not support building new NPP. | 35% | 54% | 37% | 19% | 28% | 27% |
| Renewable energy can meet all of our country's energy needs, without nuclear energy. | 49% | 37% | 30% | 35% | 21% | 28% |

As shown in Table 8, more than a half of participants have an impression that new nuclear power plant is expensive to build. However, the answer as "don't know" was decreased by 12% and the number of participant having an opinion that the cost to build new NPP is not so expensive, was increased by 18%. It means that people have got somewhat information on comparison cost of new power plant construction. 35% to 54% of respondents were agree that most of people in the country do not support building of new NPP. This result might be explained by the fact that the most of herders prefer to use small, portable solar batteries since rural population of the country is dispersed in wide areas and their life style is nomadic. A number of participants who have an opinion that our country's electricity demand can be provided by renewable energy without nuclear energy was decreased by 12%. The reason of this might be that more people have realized that renewable sources are not enough to satisfy the basic energy demand.

Figure 6 indicates the comparison of contribution of various sources for obtaining of nuclear information. It shows that public could get the information about a nuclear energy from TV, Internet, newspapers and magazines. Therefore, the public thinks that journalists, Nuclear Energy Commission, international organizations as International Atomic Energy Agency (IAEA) and scientists can provide them a true information as provided in Figure 7.

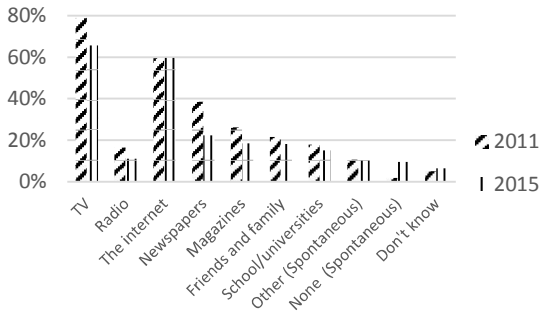


*Figure 6. Utilization of information sources in 2011 and 2015.*

Journalists should give information about a nuclear energy to public only after checking and confirming its correctness. Otherwise, the public may be easily mislead and a public may have a negative opinion about nuclear energy. To combat the issue, it is necessary to give adequate information and training to journalists about nuclear energy. The answer as "don't know" is more than the answers as "schools". It tells us the information schools offer is not sufficient to acquire a basic knowledge on nuclear energy and nuclear safety for children. The school curriculum should include the basic contents and concepts on these issues.

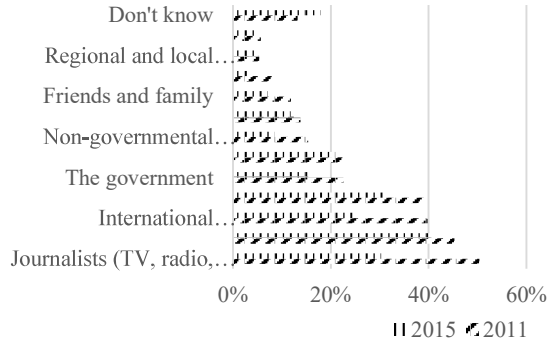


*Figure 7. Reliable three sources that give true information about nuclear energy.*

Nuclear incidents sometimes raise major concerns in the media and the public. Table 9 lists the public opinion on nuclear risks. A number of participants who are convinced that nuclear risks are exaggerated in comparison to other safety risks in their lives such as coal smog in city, its radioactivity, car accident, food safety, alcohol, smoking, crime and cancer, is reduced by 6%. It might be because there was an increased number of cancer occurrence due to air pollution. However, about 20% of participants have an opinion that the nuclear risks are perceived correctly. 17% of participants of the surveyed have answered that they do not know about the issue.

*Table 9. Are the nuclear risks big or not in comparison to others?*

| | 2011 | 2015 |
|---|---|---|
| Exaggerated | 48% | 42% |
| Underestimated | 15% | 18% |
| Nuclear risks are perceived correctly | 21% | 22% |
| Do not know | 17% | 17% |

Participants' interest in knowing more about main safety mechanisms and procedures at the nuclear power plants, radioactive waste management and environmental monitoring procedures and as well the impact of nuclear energy on electricity prices is increased by 10% from 2011 to 2015 as compared in Table 10. It means that people are focusing to know about these issues. The public opinion on some issues such as emergency preparedness and response plans did not change while contributions of nuclear energy to the security of energy supply and to fighting of climate change were less likely interesting subject to the public. However, these are the most considerable and crucial issues for every country. Generally, people do not have enough information and knowledge about nuclear energy, but, they would like to increase their basic conceptual knowledge about nuclear energy use.

*Table 10. Public is interested in knowing more about…*

| | 2011 | 2015 |
|---|---|---|
| Main safety mechanisms and procedures at the nuclear power plants. | 25% | 35% |
| Radioactive waste management and environmental monitoring procedures. | 18% | 27% |
| Contribution of nuclear energy to fight climate change. | 15% | 15% |
| Emergency preparedness and response plans. | 16% | 16% |
| Contribution of nuclear energy to the security of energy supply. | 10% | 12% |
| Impact of nuclear energy on electricity prices. | 9% | 19% |
| Other. | 3% | 4% |
| None. | 3% | 2% |
| Don't know. | 12% | 12% |

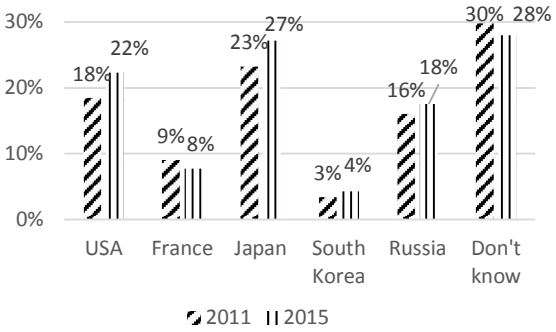


*Figure 8. Public opinion about the countries from which the country should import NPP technology.*

Final question was about choice of nuclear technology transfer country as shown in Figure 8. 23% to 27% of the survey participants have expressed their preference to import nuclear power plant technology from Japan, despite the Fukushima accident. Most of the participants (or 28%-30%) have answered "don't know" about selection of the NPP import country possibly due to a lack of information and advertisement on construction and utilization NPP in Mongolia. In addition, the survey participant against the use of nuclear energy could answer as "don't know".

People are more familiar with Japan as a technologically developed donor country, which is most likely ready to help to Mongolia, what makes Japan more suitable for this purpose, in comparison with other countries. Most of the operating nuclear power reactors in the world have technologies based on a USA design and USA is the preferred country for import of NPP technology, next to Japan. Russia

is the country traditionally maintains a cooperation with Mongolia for a long time and many people custom to operate Russian techniques and still have a trust in Russian technology and reliability. It is shown that 16% to 18% of the participants prefer to import Russian NPPs, if Mongolia decides to build. A small part of the participants have a knowledge about French NPP technology, although France generates around 80% of its energy supply by nuclear energy. It should be mentioned that Areva, France was exploring uranium ore and was planning a construction of uranium conversion plant in Dornogovi province since 1997, in the location which is one of the chosen locations of this survey. However, many local citizens do not know about French nuclear energy technology.

Preference for the South Korea technology import was minimum, 3% to 4% of the total answers, possibly due to the situation that many people are not informed about the Korean nuclear energy technology. The Korean NPPs are reliably operating without major accidents. Nuclear Energy Agency of Mongolia has an interest in SMART (System-integrated Modular Advanced Reactor) developed by South Korea.

It is necessary to frequently disseminate the information and advertisements about the safe, reliable nuclear power reactors designed, approved and operated in the developed countries.

## CONCLUSIONS AND SUGGESSIONS

1. General characteristics of the survey participants like location, economic situation, life behavior, age and sex can generally represent a whole population of Mongolia. The nuclear energy issue requires a certain knowledge and only the relevant professionals can answer to the specific questions, therefore, the educated parts of the public were involved more in this survey. On the other hand, this survey, conducted in Mongolia for the first time, has covered all the representatives of each society level of the public.
2. The first survey was conducted in the wake of the Fukushima accident in Japan and under the influence of the rumors about the alleged final disposal of nuclear waste in Mongolia, spread through TV, Internet, and newspapers. Nevertheless, 36% to 45% of all the participants favored the use of nuclear energy in Mongolia as one of the ways to provide electricity and heat. Over 50% of the participant understood that nuclear energy importance meeting the future energy demand of the country.
3. Public opinion on the issues like nuclear energy benefits, limitations of climate change, fuel import independence from the neighboring counties and stable energy price are likely to be more positive than negative. More than a half of respondents, especially youth support a construction of new NPP in the country.
4. TV, internet, newspapers and journals were selected as the most important sources to obtain the information on nuclear issues. Many respondents hope that reliable information on nuclear safety issues can be obtained from journalists, the Nuclear Energy Commission, scientists and from the organizations working on uses of nuclear technology. An importance of giving to journalists a comprehensive and correct information related to nuclear energy by appropriate effective measures like organization of nation-wide symposium for them, was emphasized.
5. The public has a lack of the correct statistical information on all type of risks related to nuclear technology.
6. It is necessary to intensify measures focused on the systematic approach for the creation of national resource of professionals in the nuclear energy field. In this regard, education of Mongolian students and training of the concerned professionals in the developed countries play an important role.
7. Professionals, scientists, professors in the nuclear related field and governmental organizations are obliged to provide a correct information on the details of advantages and risks of nuclear energy and on the world status and future trends of nuclear issues, to the public. Journalists of TV, radio and newspaper play an important role in spreading of the nuclear related information to the public.
8. In the future, such survey on the use of nuclear energy needs to be conducted periodically taking into account the following proposed essential points:

a. Questions should be designed and adjusted to reflect Mongolia's specific situation and the public knowledge level.
b. Systematic information on nuclear energy should frequently be provided to the public via the media.
c. The professionals, scientists and professors have to reach a consensus on the unified concepts on the important current nuclear issues, follow the concepts established by the consensus while communicating to the public and be responsible for their own opinion on all the nuclear business issues if different. The governmental organizations are responsible for making decisions and recommendations based on discussions with nuclear professionals and scientists.

9. The following policy related general points are brought up:
   a. Public communication to promote better understanding of nuclear power is a long term process that requires a strong commitment and dedication. The role of government is one of the important factors. The government establishes a legal framework, takes responsibility and gives a guarantee to the public. By establishing legal conditions to use nuclear energy, the correct information about nuclear-related technology can be disseminated. The information can be disseminated using communication techniques, such as mass media, local radio, museums and science café to reduce public fear about nuclear radiation and nuclear power. Journalists have a very important role to deliver information to public and they should possess a correct conception on nuclear energy, as a result of discussion with nuclear professional experts and relevant organizations. The information should include the geographical and climatic specific advantages of the country territory such as no tsunamis and no typhoons. The information about safe, reliable reactors and nuclear power plants designed, approved and accident free operated in the developed countries, is needed to be delivered to the public. Also, it is important to introduce a subject about modern aspects of nuclear energy in a high school curriculum. It is also very important to explain and elaborate general risk analyses as well a comparison of nuclear risk to other types of risk. This kind of information plays a crucial role in convincing and influencing community, political leaders, social leaders, spiritual leaders, high school principals and presidents of universities , etc., such that they could further convey and spread the message to people.
   b. The system needs to provide a correct and transparent information related to important current nuclear issues.
   c. In order to gain a public acceptance of nuclear energy use, Mongolia should have a sufficient number of nuclear experts working reliably and honestly. It is essential to start as soon as possible a nuclear engineering education program in Mongolia although the education program in nuclear physics and non-power technology is existing since 1970s. Mongolia needs to send students to the developed countries for graduate study and professionals for training courses for the purpose of education of well qualified national nuclear experts.
   d. Mongolia needs to have our own nuclear research reactor to educate and train nuclear professionals locally. It should be a reactor with well-proven technology and a design with inherent passive safety features. It is essential to demonstrate to the public that nuclear energy can be beneficial socially and economically. Fears about nuclear energy can be reduced and beliefs on the positive side of the nuclear energy can be enhanced by providing guided tours to the nuclear research reactor facilities for non-nuclear people such as high school students, local residents and experts in different field.

## ACKNOLEDGEMENTS

The authors would like to express our colleagues for their valuable efforts to collect the participant's poll from the chosen locations. Assistance with data processing provided by Ms. D.Davaasuren was

greatly appreciated. Our special thanks are extended to Dr. Ch.Jargal for providing language help on the article.

## FUNDING

This work has been done under the subproject named “The study on public opinion on nuclear energy use in Mongolia“ within the framework of the project “Study on policies providing nuclear and radiation safety and nuclear technology transfer to Mongolia” supported by the Nuclear Energy Commission of the Government of Mongolia

## REFERENCES

[1] Ministry of energy of Mongolia, 2015. The current situation of the energy sector of Mongolia (in Mongolian). http://www.erc.mn/mn/ (accessed 2015.09.05).

[2] Ramanathan, V., Feng, Y., 2009. Air pollution, greenhouse gases and climate change: Global and regional perspectives. Atmospheric Environ. 43, 37–50.

[3] Ryan, A.W., et al., 2013. An Assessment of Air Pollution and Its Attributable Mortality in Ulaanbaatar, Mongolia. Air Quality, Atmosphere and Health. 6, 137-150. http://dx.doi.org/10.1007/s11869-011-0154-3.

[4] The State Great Hural (Parliament) of Mongolia, 2009. State policy of Mongolia on exploitation of radioactive minerals and nuclear energy (in Mongolian), Ulaanbaatar, Mongolia. www.parliament.mn (accessed 2010.06.15).

[5] The State Great Hural (Parliament) of Mongolia, 2009. Implementation program of the state policy on exploitation of radioactive minerals and nuclear energy (in Mongolian), Ulaanbaatar, Mongolia. www.parliament.mn (accessed 2010.06.15).

[6] Ministry of mineral resource and energy of Mongolia, 2011. The current situation of the energy sector of Mongolia (in Mongolian). http://www.mmre.energy.mn/branch/now/104/detail/1004090001 (accessed 2012.05.23).

[7] The State Great Hural (Parliament) of Mongolia, 2016. Concept of Sustainable Development-2030 (in Mongolian), Ulaanbaatar, Mongolia. www.parliament.mn (accessed 2017.01.17).

[8] The State Great Hural (Parliament) of Mongolia, 2009. Nuclear Energy Law of Mongolia (in Mongolian), Ulaanbaatar, Mongolia. http://www.legalinfo.mn (accessed 2010.06.15).

[9] WNU (World Nuclear University) and Korea Nuclear Energy Promotion Agency (KONEPA), 2011. The guidebook on 2011 international nuclear energy Olympiad. Seoul, South Korea. www.nuclearolympiad.org (accessed 2011.05.29).

[10] WNU and KONEPA, 2011. Reports of First International Nuclear Energy Olympiad. Seoul, South Korea. 26-30 September 2011. On CD-ROM.

[11] Mongolian Statistical yearbook, 2010. National Statistical Office of Mongolia. www.1212.mn/en (accessed 2011.06.24).

[12] Monthly bulletin of statistics, 2014. National Statistical Office of Mongolia. www.1212.mn/en. (accessed 2015.11.06).

[13] Creative Research Systems survey software. http://www.surveysystem.com/sscalc.htm (accessed 2011.08.26 and 2015.10.11).

[14] SPSS Statistics 17.0 software. http://www.spss.com.