## 1.4 Action Plan for Pulverized coal combustion technologies (Super-critical)

### 1.4.1 Description of the technology

Pulverized coal power plants account for around 97% of the world's coal-fired electricity generation capacity. The conventional types of this technology have an efficiency of around 35%. For a higher efficiency supercritical and ultra-supercritical coal-fired technologies have been developed. These technologies can combust pulverized coal and produce steam at higher temperatures and under a higher pressure, so that an efficiency level of 45% can be achieved (ultra-supercritical plants). Supercritical and ultra-supercritical plants are more expensive because of the higher requirements to the steel forwithstanding the higher pressure and temperature, but the higher efficiency results in cost savings during the technical lifetime of the plants.

The emissions of $CO_2$ per MWh delivered to the grid could be reduced from 830 kg to 730 kg. Pulverized coal power plants can have a size of up to 1000 MW and are commercially available worldwide.The capital costs assumed range from 800 US$/kW to 1350 US$/kW from the largest 1000 MW USC plant to the smallest to unit of 150 MW CFBC plant. The plant's own use of electricity has been estimated to range from 6% to 9% and the plant efficiencies is in the range from 45% to 34%, respectively from largest unit to the smallest.

In coming years several Thermal Electric Power Stations will be built with significant capacity near coal mines in Mongolia. For all the Coal fired power plants to be constructed in Mongolia should be implemented supercritical (SC) and ultra-super critical USC) technologies.

An efficiency improvement from 30 to 45% would bring about a 33% decrease in $CO_2$ emissions. As two-thirds of all coal-fired plants are over 20 years old with an average efficiency rate below 30%, replacing this capacity with supercritical and ultra-supercritical plants could contribute significantly to global GHG emission reductions

Supercritical power plants are highly efficient plants with the best available pollution control technology; they reduce pollution levels by burning less coal per megawatt-hour produced and capturing the vast majority of the pollutants. Introduction of the Pulverized coal power plants has the potential to reduce fuel consumption of existing thermal power plants by 25-30 %.

Because of the above techno-economic benefits, along with its environmentally-friendly cleaner technology, more and new power plants are being developed with this state-of-the-art technology. As environmental legislation is becoming more stringent, adopting this cleaner technology has led to benefits in all respect. As LHV (lower heating value) is improved (from 40% to more than 45%); a one percent increase in efficiency reduces specific emissions such as $CO_2$, $NO_X$, $SO_X$ and particulate matter by two percent.

### 1.4.2 Target for technology transfer and diffusion

Coal is the primary energy source in Mongolia. The share of coal and coal products in total primary energy supply is about 70%. Coal is expected to remain the most important primary energy source in the foreseeable future because of the large coal reserves in Mongolia and the much smaller reserves of oil and gas. Mongolia's total geological coal reserves are estimated at approximately 150 billion metric tons, including about 24 billion metric tons explored. Over 70 percent of the total domestic coal consumption happens at thermal power stations with the remainder taking place at heating plants, industry, households and the service sector.

The energy consumption of Mongolia will continue to increase rapidly due to population growth and economic development. In particular, energy consumption in the industrial sector has beenincreasing rapidly due to the development of the mining and quarrying industry.

In order to meet this growing energy demand, new energy sources are needed. Currently, a 600MW Combined Heat and Power Plant (CHP) in Ulaanbaatar is planned to be constructed in the coming years. In the long term, the construction of more coal-fired thermal power plants under consideration. The future coal fired thermal power plants should be modern, energy efficient and environment friendly, such as pulverized coal thermal supercritical (or ultra-critical) power plants. These technologies can combust pulverized coal and produce

steam at higher temperatures and under higher pressure, so that the efficiency is much higher than traditional coal-fired thermal power plants and the environmental pollution is much less.

The target for technology transfer and diffusion of super critical and ultra-super critical thermal power plants is to construct thermal power plants with a totalcapacity of 1200 MW in 2020 and 3200 MWin 2030 in order to meet thegrowing energy demand, which is expected to reach 7800 million kWh annually in 2020 and 13200 million kWh annually in 2030.

### 1.4.3 Barriers to the technology's diffusion

**Table 68: Barriers to the technology's diffusion**

| **Key barriers identified** | | **Enabling measures** |
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| Category | Barriers | |
| Economic and financial | The country does not have sufficient financial resources for the construction of power objects of high power | The country's export has increased with intensive development of the mining sector in the last few years. At the same time, the political parties distribute cash to the population so they can fulfill election campaign promises. The cash distribution shall be stopped and instead a fund support development of the country shall be established to pool and more effectively use the fund. |
| | High cost of capital | In near future, over USD 1.8 billion will be required to construct large-scale, high-efficiency TPPs. In order to raise the capital, attracting foreign investment or applying for international soft loans are essential for implementing the TPP projects |
| | High transaction cost | The Ministry of Energy is a policy-making authority; howeverinvolvement of some specialists of the Ministry in project activities implemented by Implementing Authorities tends to increase barriers.This shall be limited and discouraged. To build a team of national experts and professionals able to study national demand, review and select technologies appropriate for country's characteristics, and to design project and provide recommendations. Introduce practice that supports active involvement of national expert team in design of large-scale projects, and applies responsibility mechanisms |
| | Inappropriate financial incentives | The Government of Mongolia shall include improving fuel efficiency of energy production as a major activity of the Ministry of Energy, and shall focus on building a performance-based evaluation system. In this way, the interests to produce energy from less possible fuel will increase country-wide. |
| Policy, legal and regulatory | Policy intermittency and uncertainty | Intensify the Energy Ministry's activities to introduce new advanced technology, and increase energy efficiency; and improve overall implementation. A practice to follow and enforce action plans stated in the government's action plan and an accountability mechanism, furthermore, shall be established. |

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| Market | Poor market infrastructure | To build mechanism that supports activities and initiatives to increase production efficiency of the state-owned TPPs. Privatization is the solution of the problem. There are many successful experiences to operate state-owned TPPs in other countries. There shall be systems distinguishing the roles and responsibilities between sartorial organizations. Scientific approaches shall be applied for the selections of project technologies, so that there will be less hesitations and suspicions related projects and technologies |
| Network | Incumbent networks are favored by legislation | To support employment of edge-cutting, and experienced engineers and scientists at the Ministry of Energy. To prioritize improvement of their professional skills and sustainable employment with staff development programs and benefits and at the same time to increase responsibility mechanisms at higher levels |
| | Weak connectivity between actors favoring the new technology | It has been years since the adoption of the Law on Investment of Mongolia. Some articles of the law are inadequately enforced and shall be revised and amended. At project design level, the following shall be considered as a mandatory.<br>• Public opinions, local community requests shall be solicited and taken into account;<br>• Recommendations and requests of scientists and researchers of project-implementing sectors, especially involvement of relevant scientific and research institutes shall be reflected in.<br>Establish a working group of national scientists and experts to conduct technical research on the energy sector, specifically on the thermal power plant technology and its efficiency. Regular discussions and meetings shall be organized for information exchange as well. Currently, a team of foreign expert teams are conducting technical baseline survey of a larger research project on the energy sector – these results often fails to cover the unique conditions of Mongolia. |
| Institutional and organizational capacity | Lack of professional institutions | A system that carries out regular research on determining solutions for the energy sector barriers, and development tendencies shall be introduced using existing capacity of scientists' team of the Mongolian University of Science and Technology (MUST). Final results of the new energy projects highly depend on implementing personnel; preparation of engineer and technical staff shall take place based on MUST capacity. |

**Table 69: Proposed action plans for Pulverized coal combustion technologies (Super-critical)**

| *Measures* | *Actions* | *Why need to take these actions?* | *Responsible organization* | *Time frame* | *Expected budget, 1000USD* | *How can be fund* |
|---|---|---|---|---|---|---|
| ***Policy, legal and regulatory*** | | | | | | |
| Long term political commitment. | Development and approval of a long-term programfor the development ofenergy sectorof Mongolia | In the near future, electricity demands will continue to increase.To enable TTP to meet 85 percent of the demand for electricity, it is necessary to build large scale TTP near local deposits. This should be included in the program | Ministry of Environment andGreen Development; Ministry of Energy; Ministry of EconomicDevelopment | 1 year | 150.0 | State budget |
| | Follow instructionson enhancing TPP in the National Climate Change Program | Currently, a master plan for energy sector development of Mongolia is the major policy document. Some revisions are needed | Ministry of Energy; Ministry of EconomicDevelopment | 0.5 year | 100.0 | State budget |
| | For the energy sector, it is necessary to develop a special program forthe introduction of new technologies and more efficient energy production | These provisions are embedded in the National Program of Climate Change therefore, they should be coordinated and implemented | Ministry of Environment and Green Development; Ministry of Energy; | 1 year | 120.0 | State budget |
| ***Economic and financial measures*** | | | | | | |
| Improve the financial capacity of the country | Create a financial fund for capital building area of major strategic targets | The country's export has been increasingwith intensive development of the mining sector in the last few years. At the same time, the political parties distribute cash to the population so they can fulfill election campaign promises. The cash distribution shall be stopped and instead a fund to develop the country shall be established to make better use of the funding. | Government, Parliament | 1 year | No need | - |
| | Obtaining loans or issuing bonds | In the near future, over USD 1.8 billion will be required to construct large-scale, high-efficiency TPPs. In order to raise the capital, attracting foreign investment or applying for international soft loans are essential for implementing the TPP projects. | Ministry of EconomicDevelopment; Ministry of Finance | 1 year | No need | - |

| Market | | | | | | |
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| Create and develop a system that increases the responsibility of employees to improve the efficiency of energy production | Development and adoption the law onenergy saving | Establish a working group to draft the Law of Energy Conservation | Energy Regulatory Committee of Mongolia | 1.5 year | 100.0 | State budget |
| Create a market price systemfor the energy sector | development and approval ofguidelines ofthe energy price | Establish a workinggroup to develop guidelines on energy pricing /tariffing system | Government of Mongolia, Energy Regulatory Committee of Mongolia | | No need | -- |
| Train skilled local experts who could develop project development study including feasibility Studies | Training of specialistsin developed countries | The development of the project should be made highly knowledgeable | Ministry of Educationand Science;<br>Ministry of Energy; | 3 year | 5000.0 | State budget |
| Preparation of specialists on thermal power plants operate at super critical pressure of steam | Recruiting trainers and teachers from developed countries | Currently prepares a program for education and trainingTPP engineers. The Institute can train graduate engineersfor the new technology | Ministry of Educationand Science;<br>Ministry of Energy; | 5 year | 10000.0 | State budget |

| Network | | | | | | |
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| Improving the performance of any real decisions and programs on energy development | Establishing the principle of solutions of global importance necessarily based on the recommendation and findings of leading scientists and specialists | Newly establish an energyresearch instituteunder the Ministry of Energy Initiators of this project - the ministries and authorized agents – do not support involvements and requests of scientists, local authorities and community in the decision-making and this results in later on unexpected barriers during the implementation, in some cases even lead to cancellation of project implementation. | Government of Mongolia,<br>Ministry of Energy | 1 year | 10000.0 | State budget |
| Establishmentof the principle ofin the "Ministry work only highly qualified employees of the industry" | Continuous training of workers. To support employment of edge-cutting, and experienced engineers and scientists at the Ministry of Energy. To prioritize improvement of their professional skills and sustainable employment with staff development programs and benefits and at the same time to increase responsibility mechanisms to higher level | Administration of the Ministry of Energy is unsustainable; each time after the political elections, non-professional and political activists are appointed to major positions and who in turn build their own team consisted of non-professionals with little experiences. This inappropriate phenomenon is very common. | Government of Mongolia.<br>Parliament | yearly | 1000.0 | State budget |