REPUBLIC OF KAZAKHSTAN

The Ministry of Energy of the Republic of Kazakhstan

Barrier Analysis and Enabling Framework

FOR MITIGATION TECHNLOGIES

July 2016

Supported by:

UNEP

GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

UNEP RISØ CENTRE
ENERGY, CLIMATE AND SUSTAINABLE DEVELOPMENT

AIT Asian Institute of Technology

Disclaimer

This document is an output of the Technology Needs Assessment project, funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) and the UNEP DTU Partnershipin collaboration with the Regional Centre, Asian Institute of Technology, Thailand for the benefit of the participating countries. The present report is the output of a fully country-led process and the views and information contained herein are a product of the National TNA team, led by the Climate Change Coordination Center (C4) and the Ministry of Energy of the Republic of Kazakhstan.

Preface

Kazakhstan is rich in oil, coal, gas and uranium resources to provide affordable energy supply to economy development. Share of power production by sources in 2013 was as follows: on coal - 73.2%; gas - 18.4%; Large Hydro Power - 8.1%; Renewable energy sources (RES) (including small hydro power) - 0.3% (about 570 million kWh). The energy sector of Kazakhstan is the most carbon intensive because power generation is mostly coal based; Nevertheless, Kazakhstan took a course on the development of the Green Economy and incorporated the environment issues into all strategic documents.

The Government of Kazakhstan is implementing policy of supporting renewable energy sources (RES) development since 2013, considers the new technologies of more efficient combustion of coal- the prevailing fuel used in energy sector. It also looks at increasing local content while implementing the "State Program on Industrial Development of Kazakhstan for 2015-2019" (further "the Program" or SPAIID-2) which is the main driver of Kazakhstan economy development. Principles of "Green Economy" development are incorporated in all strategic documents and a number government support mechanisms for innovative and energy saving technologies are provided by the legislation. The strategic targets, such as: 3% of RES in total electricity production and 25% reduction of energy intensity of GDP by 2020 are in our focus.

However, specific measures are necessary in order to overcome barriers to introducing prioritized technologies in the power production and cement production sub-sectors in order to contribute to voluntary overall target to reduce 7% of greenhouse gas (GHG) emissions below 1990 level by 2020 and 15% reduction by 2025 compared with the 1992 GHG emissions level.

Implementation of pilot projects will reduce electricity shortages in the energy deficit regions, provide coverage of semi-peak loads, increase power quality, and reduce greenhouse gas emissions. In addition, during construction and operation, additional jobs will be created.

CONTENT

List of Tables

List of Figures

LIST OF ABBREVIATIONS

AIT	Asian Institute of Technology
BAT	Best Available Techniques
BFC	Billing and Financial Center
CO_2	Carbon-di-oxide
COP	Conference of the Parties
DNA	Designated National Authority
EE	Energy Efficiency
EEU	Eurasian Economic Union
ETC	Energy Transmission Company
EBRD	European Bank for Reconstruction and Development
FIT	Feed-in Tariffs
FS	Feasibility Study
GHG	Greenhouse Gases
GEF	Global Environment Facility
GCF	Global Carbon Fund
GOK	Government of Kazakhstan
HPP	Hydro Power Plant
IPCC	Intergovernmental Panel on Climate Change
JSC	Joint-stock company
KEGOC	Kazakhstan Electricity Grid Operating Company
LLP	Limited Liability Partnership
MID	Ministry of Industry and Development
MCDA	Multi Criteria Decision Analysis
ME	Ministry of Energy
MNE	Ministry of National Economy
NAMA	Nationally Appropriate Mitigation Action
NAP	National Allocation Plan
NGO	Non Governmental Organization
O&M	Operation and Maintenance
PMU	Project Management Unit
PPA	Public- Purchase Agreement
PPP	Public- Private Partnership
RES	Renewable Energy Sources

R&D	Research and Development
REC	Regional Energy Company
SPAID	State Program on Industrial Development
TAP	Technology Action Plan
TNA	Technology Needs Assessment
TPP	Thermal Power Plant
TA	Technical Assistance
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

This report is the second phase of the reports prepared for the Technology Needs Assessment and Technology Action Plan (TNA/TAP) for presenting the mitigation part of TNA project outcomes prepared by the Republic of Kazakhstan. The report aims to identify barriers and measures addressing barriers to the transfer and diffusion of each selected technology, and based on these findings to establish an enabling framework for these technologies.

Based on the Multi-Criteria Decision Analysis (MCDA) applied in the first – Technology Needs Assessment – report, the following technologies were selected for further examination of barriers and enabling framework:

-for power production (energy sector):

- Small Hydropower
- Pulverized Coal Combustion with higher efficiency

- For cement production (industry sector):

- Energy Efficiency and Saving
- Transition from wet to dry production technology

These technologies are related to a wide spectrum of economic, social, environmental and political factors. Barriers and enabling measures for these technologies are described in chapters 1 and 2 accordingly.

Identifying barriers and measures could be characterized by the following general steps applied to the prioritized technologies named above:

1. The TNA national consultants prepared the initial long list of barriers identified according to Questionnaire (Annex VI) and interview on the basis of own experience, existing studies and policy documents and UNEP RISOE Center Guidebook "Overcoming Barriers to the Transfer and Diffusion of Climate Technologies".

2. The long list containing the economic and financial barriers and non-financial barriers has been discussed with stakeholders via workshop. The purpose of discussion was to identify the essential barriers and non- essential barriers for each technology transfer and diffusion. Some additional barriers were added to initial list by participants during workshop in order not to miss the potential essential ones. Then each workshop participant was asked to give each barrier a score from 1 to 5 (5 is the most important and 1 is most insignificant) based on the participant's own perspective. The barriers with the scores 4-5 (as the most important and important) were considered for further analysis and barriers with the scores 1-3 (less important, insignificant and most insignificant) were ignored as less essential. This was defined through voting by participants of working groups during workshop. The initial long lists of barriers identified for prioritized technologies (Annex II) have been finalized at a workshop.

Barrier analysis was made at the workshop by screening and grouping them using brainstorm, Logical Problem Analysis tool, Market mapping, root cause analysis and arranging the key barriers for further identification of measures to overcome them.

Barriers related to technology implementation have been identified in ten categories (Economic and financial; Market failure/imperfection; Policy, legal and regulatory; Network failures;

Institutional and organizational capacity; Human skills; Social, cultural and behavioral; Information and awareness; Technical and Other barriers).

3. Identifying the relevant measures was also supported by detailed analysis of current practices at national and international level and by applying a participatory approach during this analysis. The same procedure and workshop named above were applied for identification of measures.

4. The final step of this phase of the project is consolidating results including assessing measures and grouping them for prioritized technologies based on grouped barriers.

The sectoral working groups involved into TNA at previous stage of the process were supplemented by national experts with specific knowledge of the technologies for providing more deep analysis of barriers and formed the working group of stakeholders per each prioritized technology. These 4 groups remain the same throughout the process, from barrier analysis to identification and proposing measures for the action plan. Stakeholders involve representatives from the ministries (Ministry of Energy, Ministry of National Economy, Ministry of Investments and Development), research and educational institutions, NGOs, business, international organisations, associations and independent consultants. The list of stakeholders involved is provided in Annex IV.

The working groups have discussed the political environment and functioning regulations influencing technology transfer taking into consideration economic and other data (Annex III). Among listed policies and regulations the groups have identified the policy directly impacting technology implementation. In this respect the crucial policy instruments were described in the form of Policy Fact Sheets (Annex V).

Using Logical Problem Analysis **(**LPA) the working groups were able to bring together the key elements of problems, apply logical analysis of interrelated elements, and identify linkages between problem elements and external factors. The cause/effect relations were organized in Problem tree, having the main problem put as starter problem, causes at the bottom of the tree and their effects in the upper part of the diagram. LPA analysis was also applied to identification of measures process in order to get from problems to solution.

In addition**,** Market mapping analysis for both sub sectors was applied to better understand the opportunities for development of local market for technologies. The whole system was considered in the context of its three main components: Enable business environment; Market chain actors and linkages and Service providers. Support of early adopters via pilot projects is important for facilitating transfer and diffusion of technology is important.

LPA analysis and Market maps for prioritized technologies are presented in Annex1.

Diffusion of technologies is linked to market conditions. While identifying barriers it is important to classify the technologies, the categories of the selected technologies are presented as follows:

Table 1. The category of the selected technology

Selected technologies	Category of technology	Classification
Small Hydropower	Market	Capital goods
Pulverized Coal Combustion with higher efficiency	Market	Capital goods
Energy Efficiency and Saving in cement	Non-market	other non- market

production		goods
Change from wet to dry production technology in cement production	Market	capital goods

Additional data including List of planned projects on small hydro power (2013-2019) and Status of projects in cement production subsector of Kazakhstan by 2020 are presented in Annex III.
The outcomes of this report are the major barriers and proposed enabling measures for prioritized technologies.

Finally, barriers identified for power production subsector and for cement production subsector are summarized in the following categories:

- Economic/financial
- Policy/regulatory
- Capacity building and Information
- Other related to market imperfection and network failure

Measures to overcome barriers of prioritized technologies have been identified according to grouped barriers for each technology.

Summary of barriers for power generation subsector is presented in Table 5 (Section 1.5) and for cement production subsector in Table 12 (Section 2.5).

Summary of enabling environment, service providers and services provision, measures in terms of common and specific for considered subsectors are presented sections 1.6 and 2.6 accordingly.

Proposed measures will be considered by policy-makers to be included into Technical Action Plan (TA) which will be the third report of this project.

CHAPTER 1. Power production subsector

1.1. Preliminary targets for technology transfer and diffusion

During the Technology Needs Assessment (TNA) process 11 technologies (6 for energy and 5 for cement sector) were presented for the approval of the Project Steering Committee. The following prioritized technologies were identified in the power production subsector with best potential for mitigation purposes:

- Small hydropower
- Pulverized Coal Combustion with higher efficiency

Transfer and diffusion of prioritized technologies in power production subsector will help to achieve the strategic objectives of environmental improvement and energy efficiency set in the strategic governmental documents. More detailed description of the State programs could be found in "Policy Fact Sheets." (Annex V).

General preliminary targets for power production development by 2030 compiled based on the main strategic documents and taking into consideration operating information from the Ministry of Energy for the year 2015 are presented in Table 2.

Table 2. General targets for power production subsector

Parameters	2020	2030
Commissioning of new generating capacity	+ 3884 MW relative to the level of 2015	+ 1645 MW relative to the level of 2020
Cover the energy demand from own sources	100%	-
The share of renewable energy sources (RES) in power production(including wind, solar, small hydropower less than 35 MW)	3%	30%
31 RES facilities put into operation (including wind, solar, small hydropower less than 35 MW) with total capacity 1040 MW	14 small HPP with 170 MW capacity	
Reducing carbon dioxide emissions in the power subsector	Up to level of 2012 (or 95.7 million tons of CO_2 eq.)	minus15% (relative to the level of CO_2 eq. in 2012)
Reducing the energy intensity of Kazakhstan's GDP	by 25% comparing to the GDP in 2008	by 30% comparing to the GDP in 2008
The total volume of attracted investments in the sector (in 2011 prices)	8.3 trillion KZT	

According to "Concept of development of fuel and energy complex of the Republic of Kazakhstan till 2030" (approved by the Government of Kazakhstan (GOK) on June 28, 2014 № 724) the share of generating sources by fuels is distributed as follows: on coal - 73.2%; gas - 18.4%; hydropower plant (without small HPPs) - 8.1%; renewable (including small hydropower) - 0.3%. Electricity production in 2013 amounted to 91 972.7 million kWh, including: thermal power plants (TPP) - 77 672 million kWh; hydropower plants (HPP) - 7 701 million kWh; gas turbine power plants - 6 645 800 000 kWh; wind power - 3.1 million kWh and solar power - 0.8 million kWh. The main tasks of development among others identified in Concept include modernization and introduction of new technologies and improving the environmental

performance of coal generation. This is planned to be achieved by meeting the balance of supply and demand of electricity while increasing consumption; reducing equipment wear, increase in the electric power and reserve capacity of power transmission equipment; development of renewable energy sources (RES) and their integration into the power grid; strengthen links between Northern and Southern energy network, as well as connection to the power grid of Western energy zone; increase in gas generation in Western energy zone and attracting large-scale investments into the sector.

Coming back to the prioritized technologies named above the preliminary targets for technology transfer and diffusion could be summarized as the following:

For small hydropower:

According to Strategic Plan 2020 approved in 2010 it was planned to construct 14 small HPP with capacity 170 MW by 2020, while according to Action Plan for RES, approved by GOK later in 2013 and 2014 the targets for small hydropower development include construction of 41small HPPs with total capacity 539 MW which will be 17.65% of total RES capacity (3054.55 MW) to be built by 2020. The list of planned small hydro power projects (2013-2019) could be found in Annex III.

For promotion of small hydropower and in context of the general targets (Table 2) the Government of Kazakhstan (GOK) has also introduced the feed in tariffs (FITs) in 2014, in particular for small hydro power FIT is set at 16.71 KZT/kWh (without VAT) for the period of 15 years with indexation for inflation according to the current legislation.

For Pulverized Coal Combustion with higher efficiency (hereinafter in this report "efficient coal combustion technology"):

Selected course to diversify electric power generation in the transition to a "green economy" involves preservation of coal generation as a primary energy source till 2030. As about 73% of electricity is generated on coal the Carbon Emission Factor (CEF) in Kazakhstan is 1000 g of CO_2 per kWh. Preliminary target to improve this parameter is to decrease this index to 350 g of CO_2 per kWh by 2050 according to "Concept of Kazakhstan joining one of the 30 most developed countries in the world".

The energy efficiency of power plants in Kazakhstan is quite low. The indicated efficiency of coal condensing power plants is an average of 32%, whereas in advanced foreign countries - 42% and higher. In order to achieve the target indicators (Table 2) it is necessary to introduce the efficient coal combustion technology along with increasing share of gas power plants. This requires attracting large-scale investments (up to 5.0 trillion KZT) during 2016 - 2030. Preliminary estimates show that construction of new thermal power plants (TPPs) with efficient coal combustion technology will help to reduce the overall CO_2 emissions by 21. 9 million tons per year by 2030.

1.2. Barrier analysis and possible enabling measures for small hydro power technology

1.2.1 General description of the small hydro power technology

Potential of small hydropower in Kazakhstan was defined by experts as 7.56 billion kWh. About 65% hydropower resources are concentrated in Mountain Rivers in the south areas of the country. At the end of 2014, 67% (or 17.87 MW) of renewable energy generating capacity was small hydro power plants (HPP) commissioned in 1940-1950, accounting for 96% of electricity generated by RES, and having a significant level of depreciation of generation, transmission and auxiliary equipment. In 2015 the installed capacity increased dramatically up to 110.05 MW according to monitoring report on implementation of SPAID during 2010-2014 issued by Prime-Minister of April 11, 2014 No. 17-17/1404 Therefore, a construction and commissioning of new renewable energy facilities is necessary.

The specific small hydropower technology that has been selected as part of the TNA in Kazakhstan is based mostly on international equipment; the capacity is up to 35 MW. The market potential by 2020 has been estimates based on the "Action Plan on development of renewable and alternative energy sources 2013-2020" in amount of 539 MW (see List of potential projects, Annex III) with technical and economic life-time of 30 years. The capital costs required are about 1040 million USD (cost of 1 MW small HPP- 1.929 million USD). Cost of GHG reduction will be 0.013 USD per kg CO_2.

According to SPAID - 2 the small hydropower will be implemented in the following regions of Kazakhstan: Almaty, Jambyl, East-Kazakhstan and South –Kazakhstan.

The consumers of small hydropower are the households, municipalities and business in rural area, who are domestic and non-domestic users of electricity, industrial and service providers.

Modern technologies of use of small rivers and streams allow constructing the mini and small hydro power plants (HPP) with the existing waterworks. This is additional reserve in small hydro power development in Kazakhstan. The presence of significant untapped hydropower potential in the large irrigation canals and reservoirs allows developing hydropower in the irrigated areas, where there is a shortage of electricity. According to general estimates, to date, the country has 1,200 farms and pastures, which have no connection to the electricity grid.

Another type of small and mini HPP are the most effective water pressure mini hydroelectric diversion type HPP. Development of such HPP can reduce the cost of HPP: from 350 -700 USD per kW to 100 – 250 USD per kW, at a cost of 0.05 - 0.4 cents US per 1 kWh of electricity and organize mass production of hydroelectric power station with pipelines in some foothill regions of Kazakhstan with the realization of products to customers, installation and service work. At present, the rotary HPP with capacity of 13 - 15 kW were developed and tested on the rivers Talgar and Turgen. The project of rotary diversion hydropower plant cascade on the river Right Talgar with total capacity of 16.8 MW and a cost of $ 12 million have been prepared by the company LLP"Nasip Energy".

Among the economic, environmental and social benefits of small hydropower one can identify savings of fossil fuel and building materials, minimum impact on the environment. According to TNA report of Kazakhstan, the shortcomings of the small hydropower may make impact on its efficiency including the instability of electric power generation due to hydrological regimes of

small rivers, the probability of accidents at small hydro units in case of high water, seasonal operation of small HPPs and fast salting of water reservoirs at small HPPs dams.

Application of small HPP technology lines with the country's social, economic and environmental development priorities. From the point of national economic development priorities, the technology will reduce energy production costs. With regard to national environmental development priorities, the technology has zero emission and will help create a better environment. With regard to social development priorities, application of the above-mentioned technology has a positive influence on public opinion and will create new employment opportunities.

The general problem concerning small hydropower in C.I.S. countries are insufficient study of hydrological regime and small water courses flow, lack of equipment production in series and maintenance services and in many cases a comparatively high specific cost for installed capacity. The regulatory and normative documentation, as well as standard specifications on designing and construction of objects and assemblage of the equipment is not sufficiently developed.

Because of the problems in the global economy, investments in renewable energy around the world are on the decline. Investors again are focusing attention on the traditional energy assets. Therefore, Kazakhstan should soberly assess the risks that come with excessive enthusiasm for alternative energy.

1.2.2. Identification of barriers for small hydro power technology

The methodology of identification of barriers for prioritized technologies is described in Executive Summary. This section of report aims to explain what is currently preventing wide-scale diffusion of the small hydropower technology while screening the barriers.

The working group representing relevant stakeholders was formed including members from sectoral working groups involved into TNA at previous stage of the process and new participants –representatives with specific knowledge of the small hydropower technology. The following types of organizations and experts were involved by stakeholders from Ministry of Energy, Information Analytical Center, Expert on RES, Association of Renewable Energy of Kazakhstan, LLP "Billing and Financial Center in support of renewable energy sources" under KEGOC, Association of alternative energy in Kazakhstan, LLP «Samruk-Green Energy», JSC DAMU Entrepreneurship Development Fund/Ministry of national economy.

As an initial step a desk study of policy papers and other pertinent documents was conducted in order to identify the primary reasons why the technology is not currently applied widely. The discussion was focused on the question why the private and public sectors have not enough financial incentives to implement the projects on small hydropower. Participatory approach for barrier analysis and identification of enabling measures in power generation subsector has been applied.

The consultation process was conducted through interviews, questionnaires and brainstorming during workshop. The initial long list of barriers compiled based on questionnaires (Annex E) was screened. The barriers were grouped under ten different categories (Economic and financial; Market failure/imperfection; Policy, legal and regulatory; Network failures; Institutional and organizational capacity; Human skills; Social, cultural and behavioral; Information and awareness; Technical and Other Barriers). The initial list of barriers was supplemented by barriers, proposed by participants during the discussion and the summarized list was screened (Table 1 Annex 2). The decomposition of barriers within category, with elements of barriers and

dimension of barrier elements was applied. While screening the stakeholders gave scores according to criteria (1-5) based on their own experience, using the score 5 as the most significant to effect on small hydropower technology diffusion. For the purpose of analysis the participants agreed to exclude barriers with scores (1-3) as less important. Finally, the barriers with scores (4-5) were discussed and prioritized as the key ones by voting by participants.

In order to enable stakeholders to approach and delimit a problem area, the Logical Problem Analysis (LPA) tool was applied as an analysis technique. LPA tools help to create systematic and logical analysis of problems and to bring together all elements of the problem.

1.2.2.1 Economic and financial barriers

Small hydropower technology in Kazakhstan is financed by own sources of investors and by loans. State provides only conditions for promotion of small hydropower technology.

While screening economic and financial barriers presented in Table 15 (Annex II) the working group discussed what currently preventing wide-scale diffusion of the small hydropower technology. Analysis is based on thorough economic analysis. Both the elements and dimensions barriers were taken into consideration. At last the barriers such as: uncertain financial environment, uncertain macroeconomic environment and high cost of capital were ignored.

The major barriers in economic and financial sphere identified for small hydropower technology diffusion include:

- High capital cost
- High transaction cost
- Inappropriate financial incentives
- Inadequate access to acceptable financial resources

The explanations of main causes for resulting key financial barriers identification are provided below.

High capital cost

High capital cost is one of the main barriers of the technology diffusion. The small hydro power technology is mostly imported into the country. There is a need for studying best international practices and applying more modern technologies. The cost of equipment for hydro power plants can reach even half or more than half the total cost of construction. The investments required for construction of small HPPs by 2020 is about 1040 million USD for 539 MW (about 2 million USD per unit). For comparison, the cost of construction of Balkhash Thermal Power Plant is 2272 USD/MW.

a) The small hydropower technology is mostly imported to Kazakhstan as the local production is very small, this lead to high investment capital costs. There are very few local manufacturers for small HPPs, the equipment is mostly imported from Russia, China and Europe. In case of organization of local production of equipment for mini HPPs (diversion type) the cost will go down from USD 350 -700 USD per kW to 100 – 250 USD per kW, at a cost of 0.05 - 0.4 US cents per 1 kWh of electricity.

The scale and pace of development of small hydropower depends on the presence and degree of elaboration of appropriate technologies and ultimately - of the cost of generated energy.

According to estimates of the report "Recent status and perspectives of small hydropower development in CIS countries" developed by Eurasian Bank of Development in 2011, the investment costs of HPP (> 10 MW) estimated in the range of $ 1750 to $ 6250 per 1 kW of installed capacity and an average of about $ 4 thousand per 1 kW. Investment costs of small HPP (1-10 MW) and very small hydropower plants (≤1 MW) can vary from $ 2000 to $ 7500 per 1 KW and from $ 2500 to $ 10000 per 1 kW, respectively, and for the named types of HPPs in an average of $ 4500-5000 per 1 kW.

Operating and maintenance (O&M) costs are 1.5 to 2.5% per year of the investment cost. As a result, the total cost of generation for large hydropower plants could be $ 40-110 per 1 MW (an average of $ 75 per 1 MW); for SHP - $ 45 and $ 120 for a 1 MW (average $ 83) and for micro hydro - from $ 55 to $ 185 per 1 MW (Average $ 90).

b) High interest rate at 17.3% in local banks since 2013 and there is difficulty for private sector in obtaining government guarantees to facilitate access to "soft" loans or purchasing equipment abroad.

Inadequate access to acceptable financial resources

High interest rate (17.3%) at local banks is also the basic reason of this barrier. The private sector does not have adequate access to low- interest and long-term loans and credits to acceptable financial resources at local and international market, so the private sector is unable to provide sufficient investment for introduction of the small hydropower technology.

High transaction cost

The lack of experience of local consultants and the weak capacity of R & D institutions are the reasons why the costs of the feasibility study are high in Kazakhstan. The local consultants and capacity of local R&D institutions are low and do not meet the modern requirements. Thus the private sector has to order feasibility study to foreign consultants with more expensive service. This happens mostly because the government does not provide sufficient fiscal support to R&D institutions.

The bureaucracy itself limits possibilities to implement projects and increases costs to conduct project baseline surveys.

Verification of potential carbon credits is provided either by international company or by national certified company (using 10-15% of total cost), in both cases the fee is high for project owner.

Inappropriate financial incentives

a) There is lack of financing instruments. The customers of small HPP construction are mainly the regional and municipal executive authorities, small and medium-sized businesses (SME). State budget does not provide enough funding for small HPP construction. Though there is state support of SME by allocation of funds from the republican budget to the Entrepreneurship Development Fund "DAMU" but the volume of concessional lending is not enough, in particular for small hydropower projects. There is lack of risk insurance for investors in the financing of innovative RES projects.

The is lack of guarantees on return on investment from the government or from the system state operator KEGOC through the institution created under the Law on RES ,single purchaser - LLP Renewable Financial Center under KEGOC .

Such mechanism as NAMA was never used for development small hydropower in Kazakhstan because of there is lack of information on it.

b)Tariff mechanism applied recently according to legislation does not cover the financial viability of small hydropower projects and does not create a favorable economic environment, which leads to a decrease in the interest level of private sectors investing in the technology. Tariff rates applied assume the social aspects and general limitation of raising rates according to policy in the power sector.

Kazakhstan has adopted a number of amendments to the laws on electricity, which guaranty an investor in renewable the feed-in tariffs in KZT up to 15 years, make it easier to connect to networks and give investors some other preferences. However, almost all the major funded renewable energy projects in Kazakhstan financed by international structures as the European Bank for Reconstruction and Development (EBRD) or even directly by the Government of Kazakhstan. The Islamic bank also is interested in financing RES in Kazakhstan and highlighted the special credit line for this.

Current tariff rates for small hydropower are low, around 0.05 USD (or 16.71 KZT/kWh without VAT), and are not attractive to private sector. Though the FIT for small hydropower was established according to GOK Decree “On approval of the fixed tariffs” No.645 dated 12 July, 2014 it could not cover the capital and O&M costs. Today this is due to lack of tariff adjustment in accordance with the exchange rate of tenge (KZT). KZT depreciated at least by 2 times in the last year.

The existing FIT for small hydropower also could not compete with consumer tariffs (6.5–8.6 KZT/ kWh, without VAT) for electricity generated by coal based Power Plants. The market for small hydropower technology is not economically viable for technology producers/importers, as electricity consumers are accustomed to the use of cheap energy.

The LPA analysis was also applied to identification of barriers for small hydropower technology in order to get from causes to effects, see Annex I. The start problem is- inefficient private initiatives for small hydropower technology. The causes are explained above. The environmental effects include less decrease of GHG emissions, could be expected due to low introduction of small hydropower technology, less preservation of the quality of water flowing for domestic use and irrigation. Unsustainable energy supply in rural areas and delay in improvement of social and living conditions represent social effects; less time of receiving electricity in rural areas represent economic effects.

Based on the results of Market mapping analysis for power generation subsector (Annex I) it could be assumed that the number of market players (technology developers- research organizations; technology owners and suppliers; product buyers and users; representatives from donor organizations/. international organizations; consultants, NGOs, associations, information providers, ministries, educational institutions.) in the current small hydropower technology market is low, as existing market opportunities do not provide suitable conditions for involvement of other key players (input suppliers, business service and technical service providers) to the market chain. Besides, business extension services (research development, financial services, market information, and etc) are very weak and almost non-functional in the

market chain. Enabling environment also does not provide suitable opportunities for development of local market for technology diffusion.

1.2.2.2 Non-financial barriers

Lack of private investment is considered through analysis of non-financial barriers and why enabling environment is weak for small hydropower. The similar steps of methodology described in section1.2.2.1 are applied in identification of non-financial barriers. The analysis is supplemented by the root cause analysis.

The non-financial barriers for small hydropower technology diffusion were analyzed by participants of workshop based on summarized Initial long list of barriers (Table 15, Annex II) in eight categories (Market imperfection, Policy, legal and regulatory, Network failures, Institutional and organizational capacity, Human skills, Information and awareness, Technical and Other Barriers). Finally the four key categories for non-financial barriers are identified by voting as the following: policy, legal and regulatory; institutional and organizational capacity, technical and information and awareness. The explanations for the main reasons what prevents the diffusion of technology (those marked by scores 4-5) are presented below.

Policy, legal and regulatory barriers*:*

Weak promotion tools for small hydropower

Promotion tools to support small hydropower development – package including policy instruments such as permits system; tariff regulation (FIT) and supporting institutions; availability of long-term program. Good connectivity between actors favoring the new technology is important for success of policy development. Below we consider each tool.

a) The mechanism for providing permits

There is Action Plan on development renewable energy sources including small hydropower by 2020, but the administrative procedures (including permissions system) are non-transparent and insufficient. The mechanism for providing permits for the construction is still complicated in spite some steps for streamlining the process were taken by the government based on regulation supporting the "Law on RES support"(2009) and amendments to it (2013, 2014). The mechanism for providing permits for the construction of small HPP is complicated and needs to be simplified. Also there are problems in import of technology or equipment due to restrictive policies. Thus the technology is not freely available in the Kazakhstan's market and those local developments need to be tested more and need additional research.

At the same time the subsidies are provided mainly to wind turbines, but issues on local manufactory of equipment for small hydro power as well as spare parts are still open.

To activate the market penetration further legislative and regulation base should be developed and improved in order to promote the diffusion of technology, including regulations on permits, preparation and approval of projects (including JI projects, etc.), updating values of FITs and related procedures.

b) Tariff regulation (FIT)

It is important tool for promotion of small hydropower technology. As mentioned in Table 15 (Annex II) tariff regulation is inefficient. There are two aspects. Firstly, FITs are approved for 15 years in KZT only. There is lack of tariff adjustment in accordance with the exchange rate of tenge (KZT). Secondly, according to legislation on renewable energy sources (RES) one institution is appointed as a single buyer (billing and financial center) of electricity from renewable energy sources. This institution is not a state-owned enterprise. Thus, there is no strong enough guarantee fund for providing solvency payments RES tariffs for banks. The current legislation in the field of support for renewable energy does not provide guarantees to ensure the financial stability of LLP "Billing and Financial Center to support renewable energy" (BFC) to investors and, accordingly, the financial institutions that provide credit facilities to producers of renewable energy. And in case of bankruptcy, or other negative consequences, BFC cannot meet its obligations to pay for producers generating electricity by RES. This is an extremely high risk for investors in the sector.

c) Inefficient regulation regarding the import of technology.

As long as there is no appropriate regulation aimed at promoting investment in the advancement of this technology in terms of innovation. This adversely affects the conditions created for the development of innovation.

b) Law on power capacity market is still under development.

This negatively affects on conditions for development of innovations in particular small hydropower diffusion into market.

d) Absence of program or clear strategy on small hydropower development for long-term period (2030-2050).

Lack of program on small hydropower development up to 2030-2050 brings uncertainty for investors. Existing State Programs pay more attention to development of Wind and Solar power plants and only Action Plan on RES development contains only list of potential projects to be constructed by 2020 (Annex III).Development of Atlas for RES is included into state program but not developed yet. Delay of strict planning and forecasting of small hydropower for long term effects on environmental effects- achievement of GHG emission reduction due to substitution of traditional energy sources by small hydropower technology with zero GHG emissions.

The government over-regulates renewable energy investors by specifying the areas of location of objects and the allowable amount of renewable energy, including small hydropower.

While discussing during workshop the attention was drawn to another barrier- Technical, and it was considered a higher priority than market imperfection barrier.

Technical barriers

Uncertainty regarding the ability of networks to carry additional load

Small HPPs generate electricity on season basis and do not provide stable uninterrupted supply on the annual basis. Also there is high seismic risk in the South Kazakhstan and the small HPPs could be destroyed. Thus special measures need to be taken in the design of and while research of water regimes and etc. Though there is regulation on connection to network, the technical aspects such as ability to carry additional load when the new capacity will be put into operation.

If the network is old the losses of electricity could be increased. It will lead to unsustainable energy supply in rural area.

Institutional and organizational capacity barriers:

One of the important barriers is poor institutional and organizational capacity. We note two points:

Weak capacity of R&D institutions

There is weak capacity of research and development (R&D) institutions responsible for providing research/investigation on the potential of small rivers. There is lack of consultants in R&D to develop Feasibility study, to develop projects, NAMA, etc.) Weak capacity of R&D institutions is because of lack of financing of this activity from national budget from one side and weak training programs from the other side. This fact characterizes the insufficient R&D activity.

Weak capacity of local authorities to support policy on regional level

Local authorities (Akimats) are responsible for promotion of small hydropower in the regions, work with bureaucracy and have poor capacity in all spheres. This is due to lack of training programs for local authorities, high staff turnover and weak organizational capacity of local authorities (to establish special department dealing with renewable promotion including small hydropower technology).

Information and awareness

Capacity barrier is close related to information and awareness barrier. First this is poor access to information on opportunities of small hydropower technology, especially on advantages of this technology application with environmental effects (GHG emissions in power subsector) and insufficient private investments.

There is lack of market information, on modern equipment provided on the governmental level and by international resources. Though Association on RES and some business companies were established to promote RES, these provide information mostly on wind and solar power technologies development. Very little operational information is provided by the Ministry of Energy. No special info on financial opportunities is provided by Associations related to small hydropower except some articles from the local authorities (Akimats) of Almaty Oblast, South Kazakhstan and East Kazakhstan who are involved into construction of small hydropower. It is difficult to monitor what is really done and what is only declared. Some general information could be found but not specific.

More important is to understand the linkages between barriers, including which barriers are only symptoms of problems and which are real problems. For this purpose, root cause analysis has been applied. Root cause analysis is a method of reaching a deeper understanding of a problem by asking why a problem occurs, and then continues to ask why it does so until the fundamental problem is reached.

Example of using technique on root causes of non-financial barriers for small hydropower technology is described below.

The problem is "Policy, legal and regulatory issues". Why policy and regulatory is insufficient? Because there is not strong enough guarantee fund for solvency payments RES tariffs for banks.

Why legislation on FITs is inefficient? Because there is no tariff adjustment in accordance with the exchange rate of tenge (KZT). For example, FITs are established for 15 years and expressed only in local currency (KZT) and are not indexed to USD, thus recently became almost three times cheaper than a year ago. Tariff could not cover the cost of equipment purchased abroad. Why permits procedures are insufficient? Because permission system is complicated, not simplified, procedures are delays. Why the system is complicated? Because the procedures are too bureaucratic.

The problem is "*Institutional and organizational capacity".* Why organizational capacity of local authorities (Akimats) to support policy on regional level is weak? Because there is lack of capacity of authorities, lack of training programs of stuff. Why there is lack of capacity of consultants in R&D institutions? Because there is lack of training programs and there is information gap.
The problem is "*Information and awareness".* Why access to information is poor? Because no special info is provided by Associations related to small hydropower. So the information gap and lack of capacity is root cause for information and awareness and for institutional and organizational capacity.

Due to these non-financial barriers, small HPPs development is hampered in Kazakhstan. Such conditions have negative impacts on the national economy.

The leakage of barriers was analyzed. In was found that weak connectivity between actors favoring the new technology is interrelated with policy, legal and regulatory problems. The *problems of local capacity of consultants in R&D institutions to develop* feasibility study are interrelated to high transaction cost. The private sector is forced to address to international consulting with higher costs. Information and awareness barriers can affect the overcoming of institutional and organizational capacity barriers and policy, legal and regulatory barriers.

The LPA for non-financial barriers for small hydro power technology is presented in Annex I, Figure 2.

1.2.3 Identified measures

The present chapter has described how measures to overcome the barriers are identified, assessed and categorized and how they form part of a wider enabling framework for the transfer and diffusion of small hydropower technology.

Identify measures. This process is taken during a facilitated workshop with the group which has been involved in the barrier analysis. During this workshop the participatory approach has been used to identify measures to overcome the identified barriers, including the own experience of consultants from working groups supplemented by documented experience on policy measures from other countries, would in general be a very important input into this process. Besides, some participants made notes on potential measures while thinking of barriers, As the LPA analysis has been used to identify barriers the same tool is used to move form problems to solutions.

In general, while identification of measures the same categories as used when identifying the barriers, described in the relevant section and these could include:
1. Economic and financial measures
2. Measures to address market failures
3. Policy, legal and regulatory measures
4. Measures to prevent network failures

5. Measures to increase institutional and organizational capacity
6. Measures to improve human skills
7. Social, cultural and behavioral measures
8. Measures to increase information and awareness
9. Measures to address technical barriers
10. Other measures

Assessing measures to overcome barriers aims to help to prepare an optimum selection of measures for policy-makers (a socio-economic assessment) and for the future owners and users of the technology (a financial assessment). This is often done by means of a Cost-Benefit Analysis, see Table 3 and Table 4 below.

The effects of establishing small hydropower turbines are many: the combination of high initial investment and no fuel costs will have a high influence on the trade balance initially. The effects of the feed-in tariff: the premium is paid by the Government; it will impact on the fiscal budget. Environmental benefits (reduction of GHG emissions). These impacts are to be presented to the policy-makers.

G**rouping measures** is provided in two main categories: financial and non-financial measures, as it is of importance to policy-makers which measures can be implemented by legal or other interventions, and which measures need to be financed (nationally or externally).

1.2.3.1 Economic and financial measures

Economic and financial measures are described in accordance to the major economic and financial barriers identified for small hydropower technology.

Measure to overcome high capital investment costs

This barrier is the most important. The Government should provide the favorable financing conditions and get the reasonable interest rates and to facilitate the development of local production of equipment. Besides, import is desirable to be simplified. Enabling environment could include joint or licensed production of local equipment.

Measure to overcome high transaction costs

The pool of trained local consultants should be established in order to make costs for feasibility study and for verification reports affordable. Besides, more local companies should be certified responsible for verification of carbon projects in order to increase competitiveness and to decrease service costs.

Additional funds must be assigned for training and creating a pool of local consultants to provide affordable costs for feasibility study, for preparation of carbon projects and other project needs (verification, expertise, etc.)

Measure to achieve adequate access to financial resources

The government should support the investors in this field by providing long-term grants or credits through different state funds (such as State Fund Samruk-Kazyna), private sources

(different banks) and international funds (GEF, GCF), should increase the concessional financing through State Fund for Support to Entrepreneurship, DAMU Fund, at affordable interest rates.

Measure to overcome inappropriate financial incentives

The Government of Kazakhstan should focus on improvement of existing financial instruments, and create conditions for establishment of appropriate package of financial instruments. The three ministries involved into process should focus on building a performance-based valuation/monitoring system according to their competence on using of these mechanisms on the subject of effectiveness. In this way, the interest of promoting of small hydropower technology is to be increased in the country.

It is necessary further improve tariff mechanism (FITs) and long term Power Purchase Agreements (PPA) in order to promote small hydro power. This regulation on improvement of tariff system should be provided in order to promote private investments in the subsector. Market oriented tariff system will contribute to attract investment from private sector.

Diffusion of technology should be supported by subsidy mechanisms to promote private investments. It could be tax discounts on import in addition to existing compensation of 50% of costs but not more than 7.5 thousand KZT.

Necessary state funds must be assigned for enhancement adequate financial instruments and institutions: apply NAMA mechanism, provide R&D activities to identify the potential of Mountain Rivers and designing standardized units and assemblies, and prepare electronic atlas, for developing special programs to promote small hydro power by local authorities.

Existing FITs for small hydropower should be adjusted according to the exchange rate of KZT from one hand and from the other the FITs should be reconsidered on annual basis instead of each 3 years.

Assessing measures

According to the Guidebook, the assessment of financial measures by economical, social, environmental aspects is presented in Table 3 below using Cost benefit analysis for further presenting to policy-makers. Stakeholders discussed during workshop the financial measures according to their types described below and provided scores following method of Cost-Benefits analysis used during TNA assessment.

Stakeholders considered the financial measures according to their types as recommended in the Guidebook (production incentive, power-purchasing agreement, loan guarantees, investment subsidies, other financing mechanisms) for the purpose of assessment financial measures, see table below.

Table 3.Scores of assessment of financial measures for small hydropower technology

Measures	Benefits				costs		Benefits considering W
	economic	social	GHG reduction	environmental	capital	O&M	
Weighted coefficient, W	0.1	0.1	0.3	0.2	0.2	0.1	1
Financial measures							
Loan guarantees (in	100	20	0	0	90	90	40

case of no subsidy)							
Standard Power Purchase Agreements (PPA)	100	80	30	0	80	100	53
Production incentives	70	100	0	100	80	60	60
Investment subsidies	100	80	0	100	90	60	61

Based on results of assessment it is recommended to use investment subsidies along with standard PPA through LLP Billing Renewable Center. FITs are used as regulation mechanism for stimulating introduction of small hydropower technology.

LPA for economic/financial measures of small hydro power technology is presented in Annex I.

1.2.2.2 Non financial measures

The Government of Kazakhstan needs to strengthen the implementation of the policy for promotion of small hydropower technology because there is risk of delay of achievement of goal indicator on RES development set in strategic documents including small hydropower technology development. In order to overcome existing non-financial barriers to the implementation of small hydro-powers technology, the following measures are proposed according to major non-financial barriers identified.

Measures to overcome policy, legal and regulatory barriers

Improved regulation to promote small hydropower suggests the following:

For improving policy/regulatory environment the Government should:

- Streamline and simplify the permission procedures and import procedures and overcome bureaucracy. Local production should be increased and import procedures should be simplified.
- Improve FIT for small hydro power by make it transparent, based on investment structure and to peg to hard currency; to ensure financial stability of the LLP "BFC" in order to decrease risks for investors.
- Develop a long-term Program on small hydropower for perspective 2030-2050 (including electronic Atlas on small hydropower, forecasting of demand, consumption of electricity provided by small hydro power, R&D research and GHG emissions reduction).

For improving communication the State, NGOs, Associations, companies should strengthen the coordination between actors, public community, different stakeholders and in special attention should be paid for activating stakeholders participating in the decision – making process regarding to setting long term clear policy related to small hydro power.

Measures to improve institutional & organizational capacity

Measures to increase institutional capacity

These measures include the development of specific training programs for R&D institutions and local authorities. For improving institutional and organizational capacity the state and international assistance should be provided to improve professional capacity of R&D institutions, local consultants, representatives from ministries and local authorities, SME to

support policy and decrease of FS costs; it is necessary to strengthen technical capacity of respective institutions responsible for research/observation activities in order to facilitate the implementation of best international experience and technology.
R&D institutions are recommended to strengthen international research network programs in order to learn from best international practices.

Measures to improve information &awareness

Specific training program for R&D institutions and local authorities, awareness-raising campaigns

A strong need for technical assistance is required to enable Kazakhstan's institutions to adopt appropriate methods and practices for the development of renewable energy sources under a market economy. Participation in international seminars and workshops should also be encouraged. Assistance will be needed in training of personnel in the areas of economic and financial analysis and management of small hydro power projects, making the projects bankable.

It is necessary to organize specific capacity building activities for private sector representatives and local communities in order to increase capacities and awareness level on advantages of small hydropower technology;

In addition it will be needed to support and strengthen the interaction of nongovernmental organizations with reputable organizations in other countries. There are qualified personnel in the various research establishments, such as the Kazakhstan Energy Research Institute, the Kazakhstan Energy Center, Nazarbayev University, as well as in other university departments. Nevertheless, assistance is needed to facilitate access to and interaction with scientific and technical establishments in the industrial countries especially to be able to incorporate cost and economic return considerations in their work.

All these measures will result in sufficient private investments into sector, increase R&D activity; support the sustainable supply of energy in rural area and decreasing of GHG emissions in sub-sector. Besides, the local authorities, communities, private sector and ordinary consumers will begin applying the technology more widely.

The LPA for non-financial measures of small hydro power technology see Annex I.

1.3. Barrier analysis and possible enabling measures for efficient coal combustion technology

1.3.1. General description of the technology

In the next 15-20 years in the world most of the commissioning of new capacities for large units (400 MW and above) will be carried out on the basis of a pulverized coal technology flaring. Power units designed for supercritical (25 MPa and a temperature of 565 C°) and a ultra-supercritical (30 MPa, and more than 600° C) steam parameters will be installed, which enhances the efficiency of coal-fired plants from the current 34-36% to 44-46%. This growth of efficiency makes the new coal generation cost competitive with other forms of generation. Supercritical and ultra-supercritical plants are more expensive because of the higher requirements to the steel needed to withstand 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.

Most coal plants in Kazakhstan are physically and morally obsolete old (wear is up to 60%), has a high percentage of harmful emissions and the efficiency about 35%. Out of date technology is a consequence of the low energy efficiency of the industry and a large amount of pollution of the environment by power (43 - 45% of total emissions of pollutants into the atmosphere from stationary sources; 68 - 73% of total greenhouse gas emissions). The need to improve the efficiency of plants and stricter environmental regulations require the development of new coal generation based on advanced coal technologies. According to Energy Development Concept until 2030 the main source of demand for thermal coal will remain an internal coal generation of Kazakhstan. Given the plans for commissioning and disposal of generating capacity demand for coal will continue to grow: in 2030 the power of new coal-fired power plants will be 20% of the total installed capacity, and the old share will decline from the current 60% to 39%.The combination of modern steam turbines at supercritical steam parameters and combustion technology in boilers with circulating fluidized bed (CFB) will provide tangible benefits of their application for burning high-ash Ekibastuz coal. In the reconstruction and construction of new coal plants it is recommended to introduce large power units with supercritical steam parameters and for the lower power units (300 MW) - boilers with circulating fluidized bed (CFB). The combination of supercritical steam parameters and technology of high-CFB combustion of Ekibastuz coal will improve the thermal efficiency of the steam turbine units of both new and existing thermal power plants and CHP Kazakhstan to 42-46% and a reduction in specific fuel consumption from 350-360 g/KWh to 270-300 g/KWh. CO_2 emissions while also decrease by ≈ 20%, and ash emissions (NOx and SOx) will comply with the European Union standards. These technologies for the purpose of this report are named in text “efficient coal combusting” technology.

In the US, EU, Japan, there are long-term national program for the creation of modern equipment samples of the solid fuel designed for 15-30 years. Funding is provided by budgetary sources, or through public-private partnership (PPP), such as American project "Future Gen". The aim of the project is to create models of equipment that will get the efficiency of coal-fired power generating units at the level of 55-57%, which is comparable to the efficiency of the gas block.
It is important because the short- term energy policy in Kazakhstan according to strategic documents (see Policy Fact Sheets in Annex V) makes focus on introduction of gas blocks. While for long-term perspective (2030-2050) the strategic documents assume the use of environment friendly technologies for coal-fired power generation. By 2030, the share of electricity production in coal-fired power plants will be still 75% to cover the growing energy demand (in amount of 160 billion kWh in total, 2030). Thus, the construction of new coal TPPs is necessary with using modern technologies aimed to decrease GHG emissions.

1.3.2. Identification of barriers for efficient coal combustion technology

This section of report aims to explain what currently preventing wide-scale diffusion of the efficient coal combustion technology while screening the barriers. The general approach and methodology is presented in Executive Summary.

As an initial step in the process of barrier analysis, a desk study of policy papers and other relevant documents was conducted in order to identify the primary reasons why the efficient coal combustion technology is not currently applied widely. Next, a consultation process was conducted with stakeholders through direct interviews and questionnaires (Annex VI). After compiling a long list of barriers, a stakeholder workshop was organized in order to screen

barriers and group them under different categories (Economic and financial; Market failure/imperfection; Policy, legal and regulatory; Network failures; Institutional and organizational capacity; Human skills; Social, cultural and behavioral; Information and awareness; Technical and Other Barriers). For identification of most important barriers, a simple method was applied grouping them into key and non-key barriers and providing marks (1-5) according to criteria on the significance of the barriers, such as starter, most important, important, less important and insignificant barriers, with marking the most important as 5. The decomposition of barriers within category, with elements of barriers and dimension of barrier elements was applied (see Table 16, Annex II). Participants checked if all barriers were considered in Initial list and the supplementary barriers were added during discussion according to the Guidebook used for the purpose of this report. Then the barriers from the list with mark (4-5) were prioritized by voting by participants of thematic working group excluding those marked as (1-3) as not essential for consideration. The leakage and interaction of barriers were discussed. The summary of initial list of barriers to the efficient coal combustion technology is presented in the Table 16, Annex II)

The thematic working group includes members from sectoral working groups involved into TNA at previous stage of the process and new participants –representatives with specific knowledge of the efficient coal combustion technology. The following types of organizations and experts were included into this group: Nazarbayev University; Ministry of Energy; JSC DAMU Entrepreneurship Development Fund/Ministry of national economy; expert from Eurasian Development Bank and independent expert on Energy Efficiency and Climate Change.

The key barriers related to efficient coal combustion technology implementation have been identified in five categories (economic/financial barriers, policy/regulatory barriers, Technical, institutional and organizational capacity, and information & awareness).

1.3.2.1 Economic and financial barriers

All the procedure of identification of economic and financial barriers is the same as described in the section 1.3.2 and 1.2.2.1 of the report.

While screening the Initial list of barriers developed for the received and summarized for workshop (Table 16, Annex II) the working group has tried to explain what currently preventing wide-scale diffusion of the efficient coal combustion technology. Analysis is based on economic analysis.

With a view to the ongoing recession of the national economy, foreign investors have reduced the volume of investment. Barriers constraining the development of the investment processes considered during workshop:
-: the level of depreciation of fixed assets,
-a high rate prevents obtaining cheap loans,
- the market mechanisms which does not work properly to create favorable conditions for investments.

As a result of discussions and consultations the following key barriers have been identified for efficient coal combustion technology diffusion:

- High investment cost
- High transaction cost
- Inadequate financial initiatives
- Weak access to acceptable financial means

The explanations of main causes for resulting key financial barriers identification are provided below.

High investment cost

The power plants with supercritical steam cycle (USCSC), working at temperatures of about 700 ° C, require further research. It is expected that the cost of power plants with USCSC technology will be 12-15% higher than the costs of power plants with subcritical steam cycle (1350-1600 USD /kW).

The costs of construction and installation of power plants in Kazakhstan is two times higher than in Europe because of absence of large-scale power input. Installation of gas purification is also expensive: 350-400USD/kW of the installed power capacity, resulting in a significant rise in the cost of equipment for coal-fired plants - 30% or more.

According to other estimates (data from UNDP expert of Kazakhstan Suleimenov K.A) a start-up investment required for constructing TPP with higher efficiency amounts 2000-2500 USD/kW. Given that the technology USCSC steam cycle coal power plants are still at a relatively early stage of development, the uncertainty of the cost of production, the cost of construction and new materials suggests the possibility of changes in the above figures.

Technology for creating thermal power plants with CCS technology requires further research. It is expected that the cost of the creation of such power plants amount to 1380-1400USD/ kW, i.e, 15-20% higher than conventional coal. On the other hand, a decrease in the cost of coal preparation and purification of flue gases can lead to the fact that the total cost of the construction of power plants with CCS technology will account for 1325-1340 USD / kW.

If half of planned capacities will be installed with the efficient coal combusting technology it will be required about 6750 millions USD.

There are two major environmental constraints for technology diffusion in Kazakhstan. The first - the ash, but it can be disposed of in the road construction and building materials, second - nitrogen oxides, which are emitted more than burning gas. Gas cleaning technology is approximately 30% of the cost of the unit, and the process in step of combustion is 10% of the cost.

The review of existing literature shown that the fuel component is 60—65 % and deductions for depreciation only about 15% of total cost.

a) Dependence on imported equipment.
So far, up to 95% of power equipment and spare parts are purchased abroad. The consumers (local authorities, private sector) are lacking in financial means to invest in/purchase the technology. The reason for these high investment costs is that the technology is still imported and local production has not developed yet.

There is a threat when importing equipment to become dependent on suppliers 100%.It is necessary to have qualified personnel while purchasing equipment. Modern standard equipment reduces harmful emissions to a minimum. But environmental requirements will only increase, which will require the introduction of new advanced energy efficient technologies.

b) High interest rates.

Loan interest rate of local commercial banks is 17.3 % per year since 2013. This makes difficulty for private sector to take a loan and cover costs for the projects.

High transaction cost

High cost for feasibility study and verification reporting

Gathering and processing information for development feasibility studies is complicated because information is often closed in private sector, so the costs for development feasibility studies increase dramatically. Another issue is undeveloped technical capacity of R&D institutions dealing with efficient coal combusting technology and research activities on these matters. This depends on the insufficient state fiscal support. This makes private sector to apply to international R&D institutions, their services related to feasibility study development and also potential verification reporting and other necessary reporting related to carbon projects preparation are expensive.

The issue of construction of new large power units with CSP technology should be resolved through a serious of feasibility studies, to provide the professional economic and technical comparison between existing and new technology. This requires attracting international suppliers and international consulting.

Inadequate financial initiatives

Financial initiatives are necessary until the technology will be fully competitive with traditional power generation. These may include some economic privileges (e.g. exemption from import/export taxes, income taxes, etc.) for private investors. Taking in mind the limitations on the tariff growth rate (7% annually), one of the ways of financing of capital investments is to attract private investment. Lack of clear tariff mechanism is a big barrier to technology diffusion.

a) Unclear tariff mechanism

Recently used the so called “marginal rates” have proved their ineffectiveness, because they did not cover the implementation of investment programs of the power plants and the innovative environmental technologies were not introduced. Methodologies of tariff calculation are also complicated. Tariffs are intended to provide a profit and be adapted to the social conditions. Though “benchmark” was recommended to be used as tariff mechanism it is not spread because of low capacity of R&D institutions deal with tariff development. Besides electricity tariffs are increasing at least semi annually and this depends on many factors, one of which is unclear methodological issue.

b) Non-usage of market mechanisms

One of the problems is absence using market mechanisms. Here by we consider two market mechanisms that have potential to be used in Kazakhstan.

One of potential mechanism is electric power market mechanism which is uncertain now. This mechanism is not yet developed. Nevertheless this mechanism is incorporated into the “Concept of fuel complex development up to 2030” (with the goal to install new capacity by 2030 in amount of 5529 MW relative to the level in 2015) and other strategic documents and programs related to energy sector development. Private sector cannot use this mechanism until the law on establishment of power market will be approved and come into force. Recently this law is drafted and not considered. So, the relations and interaction between main actors in the market chain could be changed according to this new expected law.

The second mechanism is a market mechanism that could be used in Kazakhstan for promotion of the low carbon technology. It deals with the issuance of carbon quotas based on Emissions Trading Scheme which was launched in Kazakhstan in 2013 and is suspended until 2018, so it is unclear what will be later. The National Allocation Plan 2016-2020 was developed and its implementation was stopped in 2016 (see Annex V). Besides, internal carbon projects are not implemented in Kazakhstan because private sector does not receive efficient state incentives.

All these makes difficult the achievement the state goal to decrease GHG emissions by 15% compared to 2012 level in power sector by 2030.

Weak access to acceptable financial means

Weak access to affordable financial means, such as loans, credits, investments, is another barrier for consumers (local authorities, private sector) to purchase the relevant equipment. There is lack of provision of long-term and low-interest loans or grants through state funds (for instance, State Fund for Support to Entrepreneurship – DAMU Fund), private sources (different Banks and international companies) and international funds (GEF, GCF).

a) High interest rates.
Loan interest rate of local commercial banks is 17.3 % per year since 2013. This makes difficulty for private sector to take a loan and cover costs for the projects. This dimension of barrier is the same as for high investment cost barrier. So, these barriers are interrelated.

The LPA Problem Tree for economic/financial barriers of efficient coal combustion technology is presented in Annex I.

Based on the results of market mapping analysis (Figure 18, Annex I) it could be assumed that the current condition of the efficient coal combusting technology market in general is similar to small hydropower technology. The number of market players in the current technology market is low, as existing market opportunities do not provide suitable conditions for involvement of other key players (input suppliers, business service and technical service providers) to the market chain. Along with this, business-extension services (research development, financial services, market information, input suppliers and so on) are practically non-functional in the market chain. So, enabling environment does not provide suitable opportunities for development of full power market for technology diffusion.

1.3.2.2 Non-financial barriers

The thematic group of stakeholders related to efficient coal combustion technology screened the non-financial barriers presented in the Table 16 (Annex II) and defined the key non-financial barriers impeding technology deployment in the four categories (with scores 4-5):

- Policy/ regulatory;
- Technical;
- Institutional and organizational capacity
- Information and awareness.

According to LPA method used the start problem is weak enabling environment for efficient coal combustion technology. The major four barriers named above are the causes of the problem, which lead to such effects as poor environmental (GHG emissions), insufficient R&D activity and inefficient investments.

Other four categories (Market imperfection, Network failures, Human skills and Other Barriers) were agreed by participants as non essential, mostly with scores (1-3). Root cause analysis supplemented the definition of key non-financial barriers. The methodology of this analysis is similar and described in previous sections.

Human skills barrier was considered during workshop as its elements (inadequate capacity of personnel for preparing energy efficient or carbon projects and lack of service and maintenance specialists) were marked by score 4 (Table 16, Annex II). The route cause analysis of this problem showed that both elements of this barrier point to inadequate capacity of specialists and inadequate working skills of technical service provided. Thus barrier is linked with such barriers: Institutional and organizational capacity and Information and awareness. So, it could be hidden under one of the named barriers and excluded from the major list.

The explanations why major barriers hamper the efficient coal combustion technology diffusion are presented below.

Policy/regulatory barriers:

The attention of participants of workshop was focused on discussion of two points of inefficient regulation: administration and tariff mechanisms.

a) *Non-transparent and cumbersome administrative procedures*
Governance in power subsector is characterized non-transparent and cumbersome administrative procedures. Though the Government has strict policy of energy complex development up to 2030, the law on market power capacity is still under development, market is still undeveloped; and mechanism to guarantee the investment in electricity generation is inefficient. Regulation should improve tax regime, import duty for technology diffusion into market.

Local banks should improve the internal policy and give a good signal to investors by making the interest rate affordable in order to lead to efficient investments and improve market.

Here we consider two mechanisms that can attract more investments into sector and for deployment of efficient coal combustion technology into market and lead to reduce GHG emissions and better environment.

b) Inefficient tariff regulation
Tariff system is not transparent .Grid tariffs are approved by organizations on a residual basis, after approval of tariffs for energy producing organizations. The current mechanism for limiting tariff does not provide sufficient incentives for the construction of new generating facilities. Tariff regulation does not create incentives to improve the efficiency of electricity producers. The system of maximum tariffs reduces the transparency of transactions between suppliers and consumers in the market of bilateral contracts.

.The limited tariffs were introduced since 2009 in Kazakhstan in order to help energy plants to prevent further depreciation of fixed assets for the period 2009-2015. The limited tariffs were approved for the specific groups of power plants on annual basis and to provide for approved investments, which must master energy production organizations. But the existing tariff system is not transparent. Recently the power plants are developing the proposals on improving the tariffs, but there is delay for making decision on improvement of tariffs. Due to the last information from the Ministry of Energy it is expected that Kazakhstan will abandon marginal

electricity tariffs in 2016. Definition of tariffs based on benchmark principle is only still being studied by experts.

The annual increase in the maximum tariffs laid down in the Government Decree "On approval of maximum tariffs" is 7%, which can be equated to the level of inflation in the country, with annual growth of electricity tariffs for end consumers is around 20% a year. Thus, the principle of voluntary participation in the centralized bidding in the construction of an efficient market has not justified itself: the overwhelming volume of electricity sold by private bilateral contracts, and centralized trading market have not received proper development. There is no effective control of the market and no effective mechanism for monitoring the work of the electricity market. There is necessity to improve market and develop necessary legislation and regulation.

c*) Inefficient market mechanisms regulation*
This problem concerns the question of insufficient mechanism of state regulation of Emissions Trading Scheme (ETS) available in Kazakhstan since 2013.National Allocation Plan (NAP) for 2016-2020 was developed, suspended since 2016 and it is unclear for future. The situation is characterized by insufficient control over the observance of transparency when granting a quota, lack of support for internal projects to reduce GHG emissions, as well as non-participation of the State in the implementation of the quotas under the terms of the auction. The Policy Fact Sheets can be found in Annex V.

Technical barriers

Non-compliance of standards and certification to Energy Efficiency
Standards on efficiency for coal-fired thermal power plants have not been established and the certification mechanism is not in place. Lack of qualified specialists in this field is also an important barrier.
Low efficiency of coal generation effects the achievement of improvement of energy intensity of countries economy, in particular, the result of an increase in energy intensity by 2020 by 25% compared to 2008 and 2030- 30% from the level of 2008. One of the primary reasons is high wear (up to 70%) of the equipment. Another reason is that equipment does not meet energy efficiency technical standards and certification.

The technical potential of energy saving is estimated at about 18 million t.o.e., while economic energy potential is estimated at about 12 million t.o.e. The necessary investments for this purpose were estimated by the Government in amount of 4 billion USD.

Institutional and organizational capacity barriers

This barrier is important because it leads both to inefficient R&D activity in the country and to inefficient investments.

a) Lack of organizational mechanism to promote effective investments
The mechanism of public-private mechanism (PPP) or Technology Alliance for technology deployment is not used for technology diffusion. This mechanism became widespread abroad to facilitate private investments for technology diffusion. This best practice could be applied to this concrete technology in Kazakhstan. It should be noticed that there is PPP Center in Kazakhstan to implement large projects included into state investment program SPAID-2, but it is funded 100% by the state. Unfortunately this organizational mechanism was not applied for promotion of efficient coal combustion technology.

b) Weak capacity of R&D institutions

One of the important barriers is weak capacity of R&D institutions, dealing with research, design, development of feasibility study and etc. This leads to insufficient R$D activity prevailing technology diffusion into market.

Information and awareness barriers

.a) Low level of knowledge of ecological advantages
One of the important barriers to the implementation of the technology is lack of information for consumers on use and ecological advantages of the technology. The same could be said for local authorities, state and private organizations.

Kazakhstan Energy Association (76 organizations are involved) is performing coordination of activities on energy market. Nevertheless, low level of awareness on the negative impact of climate change and advantages of application of efficient coal combustion technology was specified by working group as a barrier for coal efficient technology diffusion.

The root cause analysis shows that there is lack of training programs for specific audience, including R&D institutions, local authorities, and technical specialists.

Root causes of non-financial barriers

Due to these non-financial barriers, promotion of coal efficient combustion technology is hampered in Kazakhstan. Such conditions have negative impacts on the national economy:

- There is risk not to achieve indicators of GHG emission reduction n power production sub sector from coal-fired thermal power plants and improvement of energy efficiency indicators;
- There is risk for investors associated with the undeveloped policy which delays attractiveness of sufficient investments to deploy the technology into market.
- There is risk not to revive R&D activity dues to low capacity and lack of training programs to specific stakeholders involved into promotion of the efficient coal combustion technology.

The LPA for non-financial barriers of efficient coal combustion technology see Annex I.

1.4. Identified measures

As noted above identifying relevant measures is the process of analyzing necessary actions to be taken in order to overcome current barriers to the implementation of prioritized technologies. These measures should have sustained the diffusion.

The detailed analysis of existing practice at national and international levels was provided for the purpose of identification of relevant measures. The same group of consultants participated in barriers and measures analysis. Measures have been indentified based on grouped barriers.LPA analysis was applied to identification of measures process in order to get from problems to solution.

The explanations to enabling measures are provided below in text of the report.

1.4.1. Economic and financial measures

To overcome economic and financial barriers to efficient coal combustion technology diffusion the following measures were proposed by working group in detail:

Measure to achieve reasonable investment costs

The Government should provide the favorable financing conditions and get the affordable interest rates from one hand and to create import duty exemption and other possible tax preferences for investors. Import procedures should be simplified. Additional measures could be taken to develop adequate regulation for technology import (customs or tax privileges).

Measure to achieve reasonable transaction costs

The pool of trained local consultants should be established in the frames of R&D institutions in order to make costs for feasibility study affordable. Besides, more local companies should be certified responsible for verification of carbon projects in order to increase competitiveness and to decrease service costs.
Reasonable transaction costs could be achieved by providing more funds by state to R&D institutions. Another measure to facilitate investments to improve market and sustainable energy supply is to create public-private partnership (PPP) for technology diffusion into market.

Measure to achieve adequate access to acceptable financial resources

The government should support the investors in this field by providing long-term grants or credits through different state funds (such as State Fund Samruk-Kazyna), private sources (different banks) and international funds (GEF, GCF), should increase the concessional financing through State Fund for Support to Entrepreneurship, DAMU Fund, at affordable interest rates.

Measure to achieve appropriate financial incentives

The Government of Kazakhstan should focus on creating affordable tariff mechanism and use of market mechanisms (carbon projects, Emission trading scheme) and a complex of financial mechanisms such as loan guarantee or subsidies and public-private partnership (PPP) mechanism.

Subsidies are most spread instrument of the state regulation of economy. Subsidies- the losses arising in consequence of the establishment of the state of relatively low prices for the products compared to the cost of production. The provision of a separate category of state support grantees the opportunity costs borne by society as a whole, since the appointment of subsidies of one category of persons in the budget constraint conditions leads to a reduction in appropriations for the benefit of other categories

International practice recognizes the important role of subsidies and does not exclude the possibility of state support of individual sectors of the economy. For example, for infrastructure development the subsidies are given for the construction,, in order to facilitate the development of the market the tax breaks for export / import of goods are introduced as a measure of indirect state subsidies.

The focus needs to be done on the expansion of state guarantees (payment of interest or reimbursement of the cost of the loan agreement). PPP mechanism includes state and business

processes of investment; it is recommended for efficient coal combustion technology diffusion, It is important to achieve synergies from the simultaneous application of the mechanisms.

The assessment of financial measures in economical, social, environmental aspects is presented in Table 4 below using Cost benefit analysis for further presenting to policy-makers. The analysis is provided similar to small hydropower technology. LPA for economic/financial measures of coal efficient combustion technology is provided in Annex I.

Table 4.Scores of assessment of financial measures for efficient coal combustion technology

Measures	Benefits				Costs		Benefits considering W
	economic	social	GHG reduction	environmental	capital	O&M	
Weighted coefficient, W	0.1	0.1	0.3	0.2	0.2	0.1	1
Financial measures							
Loan guarantees (in case of no subsidy)	100	80	0	100	90	60	61
Using PPP mechanism	100	50	0	0	100	90	44
Production incentives	100	20	0	0	100	90	40
Investment subsidies	70	100	0	100	80	60	60

Based on results of assessment it is recommended to use investment subsidies and using public-private partnership (PPP) mechanism. In case of no subsidy, the mechanism of loan guarantees is more attractive. Using mechanisms together will bring synergistic effect.

1.4.2 Non-financial measures

In order to overcome existing non-financial barriers to the implementation efficient coal combustion technology, the following measures should be provided:

Policy/regulatory measures

For improving policy/regulatory environment and to improve investment climate the Government should improve tariff regulation in order to support investors and other administration regulation, such as import tax duty, regulation on subsidy mechanism, complex of financial mechanisms to support investments and R& D institutions.

Until 2018 is necessary to solve at least three important issues. The first: the issuance of a quota on the basis of benchmarking, which encourages the entry of new low-emission technologies, such as efficient coal combusting technology. The second: a revitalization of the carbon markets to raise liquidity and reduce the costs of meeting the obligations. And the third: it is necessary to stimulate the state of internal projects to reduce GHG emissions and to channel funds from the auctioning of allowances for the development of "green economy".

For ensuing developed market the State should approve and launch the law on power capacity market, develop necessary mechanism of efficient control, monitor electricity market and provide specific supporting regulation. It is expected that in 2016 the long-term power capacity

market will come into force and guarantee investors a return on investment through the compulsory purchase of power.

Measures to improve organization and capacity

For improving institutional and organizational capacity the state and international assistance should be provided to improve professional capacity of R& D institutions, local consultants, representatives from ministries, business and local authorities, involved into the development of FS (to decrease of FS costs); it is necessary to strengthen technical capacity of technical stuff to provide qualified service. As supplementary measure assistance will also be needed to support and strengthen the interaction of nongovernmental organizations with reputable organizations in other countries.

Measures to improve information and awareness

Additional funds must be assigned by State and by other donors for training and raising level of ecological advantages of the proposed technology.

LPA for non-financial measures of coal efficient combustion technology see Annex I.

1.5 Linkages of the barriers identified

As it was indicated in previous sections, barriers related to the implementation of both technologies for power production subsector have been identified in six categories (economic/financial, policy/regulatory, technical, institutional and organizational capacity and information &awareness).

The working group provided LPA analysis. The problem tree was elaborated with causes/effects relations and the linkages between barrier's elements were identified. LPA with problem tree for each technology is presented in associated Chapter of the report.

While providing analysis it could be seen that some barriers of two technologies are similar and could be linked for the purpose of optimization.

For example, weak capacity and lack of information for consumers on use and ecological advantages of the technology are similar for all prioritized technologies.

Regulations on import producers and import duty are applied to both technologies, in order to promote investments in this sector.

Technical barriers are interrelated with policy/regulatory and could be combined under its umbrella.

High capital cost is another barrier to the development of the sector. Not having access to low-interest and long-term financial means, the private sector is unable to provide sufficient investment for the development of the technologies.

Regarding to small hydropower technology, technical barriers and policy/regulatory are considered to be important ones. There is a need to check technical potential and ability to carry

additional load up to 2030, development of the program for small hydropower development up to 2030-2050 in order to apply more modern technologies.

Regarding to efficient coal combustion technology development energy efficient standards and certification mechanism is important for technical barrier along with use of PPP mechanism for facilitating private investments into sector.

It is possible to achieve synergy between the identified barriers as both technologies are currently coordinated by one organization – Ministry of Energy (ME), although energy efficiency and standards/certification issues are under responsibility of the Ministry of Investments and Development (MID). Ministry of National Economy (MNE) deals with economic instruments for both technologies and Ministry of Finance- with financial instruments accordingly Local authorities and business are responsible for implementation of small hydro power technology, while MID and ME coordinate introduction of the efficient coal combustion technology.

While providing analysis it could be seen in the table below that all barriers identified have common and specific features of two technologies.

Common barriers are the following:

- Capacity building and information barrier (Lack of market information, on modern equipment, of knowledge of ecological advantages; weak capacity of R&D institutions).
- Economic/financial barrier (inadequate subsidy mechanism)
- Policy/regulatory and technical barrier (Lack of law on power market capacity, inefficient regulation on tariffs)
- Other barriers (related to market imperfection and network failure) are similar for both technologies

Specific barriers are the following:

- Economic/financial barrier: inefficient carbon market mechanism, loan guarantee, PPP mechanisms for efficient coal combustion; inadequate use of PPA and FIT for small hydro power
- Policy/regulatory barrier: inefficient regulation on permits, import procedures and lack of long –term program up to 2030,2050 for small hydropower and non-compliance of standards and certification, inefficient regulation on import duty, tax privileges for efficient coal combustion technology.

Thus, barriers related to the implementation of technologies in **power production subsector** are summarized in table below.

Table 5.Summary of barriers identified for prioritized technologies in power production subsector

Barriers	Technologies	
	Small hydropower	efficient coal combustion
Economic/financial	Inadequate subsidy mechanism (PPA, FIT)	Inadequate subsidy mechanism, loan guarantee, PPP mechanisms Inefficient carbon market mechanism
Policy/regulatory	Lack of long-term program on small hydro 2030-2050	Non-compliance of standards and certification

	Inefficient regulation on FITs, Inefficient regulation on providing permits, import procedures Lack of law on power market capacity	Inadequate tariff mechanism Inefficient regulation on import duty, tax privileges Lack of law on power market capacity
Capacity building and information	Weak capacity of R&D institutions Lack of market information, on modern equipment	Weak capacity of R&D institutions Low level of knowledge of ecological advantages
Other	Weak coordination between market actors Inefficient donors and local authorities coordination for implementation of pilot projects a	Weak coordination between market actors Inefficient donors and local authorities coordination for implementation of pilot projects

1.6. Enabling framework for overcoming barriers in power production subsector

Proposed technologies for power production subsector aim to be implemented at the national level starting with pilot projects with following replication. The promoting and facilitating the transfer and diffusion of technologies (IPCC, 2000) is covered by institutional, regulatory and political framework conditions that are conducive to country-specific circumstances that: encompass existing market and technical conditions, institutions, resources, and practices.

For analysis LPA method and Market Mapping were used (Annex I). It covers enabling environment and service providers, see in tables below.

Table 6. Enabling business environment of power subsector technologies considered

No	Enabling environment	Comments	Responsible entity
1	Approve and implement the law on market capacity	Providing required reserve of capacity for sustainable development of power generation subsector	ME
2	Develop and introduce financial incentives through implementing subsidy mechanisms, FITs and carbon market mechanism	Stimulate implementation of environment friendly power subsector technologies (small hydro and efficient coal combustion)	ME,MNE,MF, international organizations
3	Improve regulation in different fields related to each priority technology in	Making rules and the monitoring of the	ME,MNE,MF

	power subsector	quality of regulation improved	
4	Support from the state in ensuring the equipment necessary to implement the technology	Low interest loans and longer grace period	ME, owners of equipment for prioritized technologies
5	Business, Ministry of Energy, relevant bodies of the local authorities of the process of technology implementation	Administrative and organizational support in the process of technology implementation	ME, local authorities KEGOC, RECs, O&M companies,

Table 7.Service providers and services provision of power subsector technologies considered

No	Service providers	Service provided
1	Ministry of Energy	Organizes and coordinates the large scale implementation of the technology
2	Local authority/Associations, international organizations	Develop informational marketing, organizes training of special audience
3	Ministry of Finance	Create condition to subsidize the business-owners of technology by enabling low interest loans and grace period
4	Companies /owners of specific machinery, equipment	Provide equipment, devices, spare parts
5	Association and business	Ensure quality of the products by monitoring the quality in specialized laboratories
6	ME, the research and education institutes	Develop informational marketing, organizes training of stakeholders on technology implementation
7	ME, research and education institutes, NGOs, business, international organizations	Create awareness and training centers for power generation subsector professionals at local and national level.
8	KEGOC/BFC, RECs	National operator KEGOC/ Head of the Renewable Billing Center, transmission company

Implementation of measures in power subsector leads to the following results: improvement environment (lower GHG emissions), developed market, sustainable energy supply in rural area, effective R&D activity and sufficient private investments. In order to overcome the main barriers in power subsector the following measures are proposed in two categories: common and specific.

A set of common measures:

- Approve and use law on power market capacity
- Improve and use economic and financial mechanisms to facilitate use of both prioritized technologies (such as subsidy mechanism, loan guarantee; standard PPA through LLP Billing Renewable Center in case of small hydropower and PPP mechanism in case of efficient combustion technology).
- Create favorable financing conditions by provision of long-term and low-interest loans or grants or concessional loans for business through state funds (such as State Fund DAMU, Samruk Kazyna Fund), private sources (different Banks) and international funds (GEF, GCF), to facilitate receiving grants and credits at affordable rates through national and international sources (USAID, EBRD, IFC, UNDP, EU, UNIDO, The World Bank).
- Provide Technical Assistance and state support of R&D institutions.
- .Increase awareness about ecological advantages of technologies (through information campaigns on the advantages of applied technology through magazines, mass media, TV (State budget and TA).
- Improve capacity of R&D institutions, local authorities and consultants by developing of specific training programs and provide training in cooperation with international organizations

A set of specific measures:

- Improve regulation on import simplifying procedures and providing permits for small hydropower technology.
- Improve FIT mechanism for small hydropower and provide guarantee on financial sustainability of LLP Billing Renewable Center.
- Improve tariff mechanism and regulation on import duty, tax privileges for efficient coal combustion technology.
- Improve regulation and implementation of carbon market mechanism for efficient coal combustion technology(including issuance of a quota on the basis of benchmarking revitalization of the carbon markets to raise liquidity and reduce the costs of meeting the obligations and to stimulate the state of internal projects to reduce GHG emissions and to channel funds from the auctioning of allowances for the development of "green economy", develop – National Allocation Plan (NAP) 2021-2025 and revive the implementation of NAP 2016-2020 after 2018.
- Ensure compliance of, standards and certification, including on energy efficiency for efficient coal combustion technology.
- Establish PPP and technical alliance to transfer of modern efficient coal combustion technology in power sector.
- Use PPA mechanism in addition to FIT for small hydropower technology.
- Elaborate and implement Program (or NAMA) on small hydropower technology diffusion up to 2030-2050 including research and checking technical and economic potential, development of electronic atlas.

For the further political process the following supplementary measures for both technologies, are important.

A set of supplementary measures:

- Improve donor coordination in order to enhance support pilot project implementation and providing cooperation, coordination between market actors, improve government control for implementation of laws and regulations.
- Strengthen research network programs and coordination with international donors, business, NGOs and market players.

CHAPTER 2. Cement production subsector

2.1. Preliminary targets for technology transfer and diffusion

The prioritized technologies in cement production subsector selected as part of the TNA in Kazakhstan are: "energy efficiency in cement production" and "transfer from wet to dry process in cement production".

Manufacture of cement, clinkers including, and manufacture of fiber cement are the priority types of activity (priority subsector of industry) according to the "State Program on Industrial Development of Kazakhstan for 2015-2019" (further SPAIID-2) which is the main driver of Kazakhstan economy development. Cement is included in the list of competitive products in the development of local content. The goal of technology transfer and diffusion in cement production subsector is to increase of competitiveness of domestic producers in domestic and foreign markets and creation of appropriate conditions for production.

The cement production subsector is the largest energy consumer of the construction materials subsector in the frames of the industry sector. Its share is 18.2% in the structure of construction materials sector (while the share of construction materials in GDP was 8% in 2009). Cement production market is defined as 16.55 million Tons per year and domestic consumption in amount of 14.0 million Tons per year. The last 5 years of cement production growth is 12-15% annually. The CO_2 emissions from cement production amounted 12.7% of total emissions from Industrial Processes in 2013, or 1653.30 Gg CO_2.

The preliminary targets for both prioritized technologies:

- **regarding to GHG emissions reduction in cement production subsector** the target is the limitation of CO_2 emissions growth by 2020 in amount of 16.6 million Tons towards baseline (a baseline on the level of the average value of the total carbon dioxide emissions for 2013-2014) which is 5.53 million Tons per year. This target was set by "National Allocation Plan 2016-2020" (NAP), approved by GOK Decree No.1138 on 30 January, 2015 and it corresponds to the national goal for the whole economy to reduce total GHG emissions by 15% relative to the base 1990;
- **regarding to reduction of energy intensity** in industry and the construction sector (including cement production) the overall target is reduction of energy intensity at least 25% from 2008 levels till 2020 according to SPAID -2;
- **regarding to improvement of energy efficiency in the industry (in particular to "energy efficiency in cement production" technology**) the target is improvement of energy efficiency as a whole by 30% by 2020 according to the "Program on Energy Efficiency 2020"
- **Regarding to** "transfer from wet to dry process in cement production" technology the replacement of wet kilns, the use of heaters as examples of applications of Best Available Technologies (BAT) by 2020 according to SPAID -2 (construction of seven plants with this technology is included into state program).

The Industrialization Map under SPAID-2 – a list of 144 projects supported by state includes construction of two cement plants by dry method (“Kaspi cement” LLP, “Standard cement” LLP) during 2015-2019.

Unfortunately the implementation of NAP was suspended by 2018 according to the Law of the Republic of Kazakhstan "On amendments and additions to some legislative acts of Kazakhstan on environmental issues", approved by the Senate of the Parliament on 10 March of 2016. According to these amendments the implementation of Article 94-2 (excluding paragraph 6), 94-3, 94-4, 94-7, 94-9) of Chapters 9-1 of the “Environmental Code of the Republic of Kazakhstan” are suspended prior to 1 January 2018, taking into account the global crisis effecting economy. This has caused some uncertainty in politics.

An analysis of the data (benchmark for Kazakhstan) of the research indicated that emissions from processes for “dry” and “wet” methods are approximately the same range: 0,520-0,536t.CO_2/t. clinker (Unfired benchmark for the EU-0.766 tCO_2 / t clinker).This research was implemented in the frames of the “Plan of measures on realization of the Concept of transition of the Republic of Kazakhstan to the "green economy" on 2013 - 2020 years” approved by GOK Decree No. 750 dated 31 July.2013 with amendments No.969 approved by GOK Decree dated 04.09.2014.

Diffusion of both prioritized technologies is important for the implementation of state infrastructure projects and consistent with the priorities of development mentioned within such strategic documents as: Strategic Development Plan of Kazakhstan till 2020”,: “Development of regions until 2020”, “Business Road Map – 2020”, the “State program of infrastructure development "Nurly Zhol" for 2015 – 2019” (development of industrial infrastructure, provision of infrastructure projects business “Road map – 2020”, improving the competitiveness of businesses);”Nation Plan - 100 steps” to implement the five institutional reforms of the President (49 step). Review of these documents could be found in Annex V.

The list of perspective projects in cement production to be constructed by 2020 is presented in Annex III.

2.2. Barrier analysis and possible enabling measures for energy efficient cement production technology

2.2.1 General description of the energy efficient cement production technology

In the case of wet raw materials or non-homogeneous composition, it is recommended that the use of a wet process of creation of clinker - the feedstock is diluted with water to the consistency of sour cream, shredded and then goes to feed firing. This “wet” method is very energy intensive. Process of producing clinker is the following. The raw meal (dried pulp) is exposed to high temperatures in a rotary kiln, where there is a burning reaction (its end products are lime and CO_2). Lime further is sintered (at 1400 - 1450 ° C,) resulting into a clinker. At the final stage of production of cement clinker is finely ground and mixed with the mineral components, such as slag, fly ash or gypsum.

The advantage of wet process is that in the presence of water facilitates easier grinding materials and homogeneity of the mixture is achieved. The disadvantage of wet process is that

consumption of heat for firing the raw material mixture is 30-40% higher compared to dry process. In addition, the required capacity of the furnace during firing "wet" raw mix significantly increases, since a significant part of its functions as evaporator.

As mentioned in TNA report, the firing system in the EU and the US are working at efficiency below 35%, which is fairly low figure. In developing countries (including Kazakhstan), the efficiency is even lower. Introduction of energy efficient technology include the improvements in the management of energy consumption and the modernization of existing equipment. Reduced energy consumption leads to a decrease in the market price per Ton of cement, which has a positive impact on the economy. The price of cement varies differently between regions in Kazakhstan and main indicators of cement production for the period up to 2015 (Annex III). The increase of price is mostly due to an increase in electricity tariffs (54% over 5 years) and rail transport (32% over 3 years).

According to analysis of cement market in Kazakhstan based on operating data from the Ministry on Investments and Development (MID) the total cement capacity was 13.45 million Tons per year in 2015 with potential to increase up to 16.5 mln. Tons per year by 2020. Currently, the share of existing cement plants with dry process was increased up to 59% in total production; while with wet process it is 41%, see table below.

Table 8. Review of cement production market in Kazakhstan for 2015

Dry process technology		**Wet process technology**	
Name of cement Plant, location	**Capacity , t/yr**	**Name of cement Plant, location**	**Capacity , t/yr**
Kazakhcement, EK	100,000	Sastobecement,SK	350,000
Standardcement, SK	3000,000	Korday cement Zhambul	60,000
ACIG Zhambul	500,000	Almaty Cement Company	240,000
Kaspi cement Mangustau	800,000	Buhtarmin cement Company, EK	1600,000
Shimkent cement(dry line)	1200,000	Shimkent cement.Sk	1600,000
KarCement(Karaganda)	1200,000	Central Asia Cement, Karaganda	400,000
Semey Cement Plant, EK	1200,000	Munaralski Cement Plant, Zhambul	1200,000
Subtotal (dry)	8000,000	Subtotal (wet)	5450,000

Source: http://www.kazpromstrom.kz/index.php/rezultaty-deyatelnosti

According to rough estimations, the share of energy efficient cement plants with “dry” method should increase up to (78%) of total market capacity by 2020 or 3.15 million Tons of cement towards 2015.

The main potential for reducing energy consumption and CO_2 emissions by implementing the energy efficient cement production technology is founded in improving the raw mix burning process. Another option for potential energy reduction and CO_2 accordingly could be defined through energy audit, including verification of the performance of the furnace and the calculation of mass and heat balances, you can identify opportunities to improve energy efficiency and reduce CO_2 emissions. Energy audit of the cement plant is obligatory in Kazakhstan and should set the lowest possible level of energy use and recommend possible actions to achieve it. As an

example, the following parameters are related to CO_2 emissions in cement production in Kazakhstan according to data received from Jambyl Cement Clinker production:

- CO_2 emissions per Ton of cement account 835 kg CO_2/ t cement taking in mind the energy component;
- The target indicator for energy efficiency in cement production is the reduction of CO_2 in amount of 83.5-250.5 kg CO_2/t cement, at the price 11.4-34 USD/ kg CO_2.

According to benchmark for CO_2 emissions in cement production for Kazakhstan:

- 0.57-0.86 tCO_2/t clinker taking in mind the energy component in wet process,
- 0.31-0.48 tCO_2/t clinker taking in mind the energy component in dry process.

Norms of energy consumption per unit of production for cement production subsector we adopted in 2009 and reconsidered in 2012 without any change. For the equipment introduced by 19980 this indicator is 90-111 kWh/ Ton of cement (40.6-250 kWh/Ton of cement for some enterprises). Cement production with wet process consume 93-115 kWh/t (on coal);70-99 kWh/t(on gas) and 90-120 kWh/t (on mazut), and with dry method- 115-118 kWh/t; while for equipment introduced after 19980-1990 years these indicators are more strong: 135 kWh/t(dry method) and 105-110 kWh/t(wet method).

2.2.2 Identification of barriers for the energy efficient cement production technology

In order to identify barriers for energy efficiency in cement production it is important to follow the methodology of identification of barriers for prioritized technologies is described in Executive Summary. This section of report aims to explain what currently preventing wide-scale diffusion of the energy efficient cement production technology while screening the barriers.

The working group representing relevant stakeholders was formed including members from sectoral working groups involved into TNA at previous stage of the process and new participants – representatives with specific knowledge of the small hydropower technology. The representatives from the following types of organizations participated in the working group: Ministry of Industry and Development (MID), Kazakh scientific institute on ecology and climate, UNDP project on energy efficiency, JSC "Kazakh Research Institute of Energy named after Academician SH.CH. Chokin", Union of Power Engineers of the Republic of Kazakhstan, Kazakhstan Association of Energy Auditors, JSC "Kazakhstan Industry Development Institute", business representative from "United Cement Group". List of stakeholders involves see Annex II. The same group worked for identification of barriers and measures.

As an initial step in the process of barrier analysis, a desk study of policy papers and other available documents was conducted in order to identify the primary reasons why the energy efficient cement production technology is not currently applied widely. Next, a consultation process was conducted with stakeholders through direct interviews and questionnaires (Annex VI). For each type of technology the Mitigation working group representing relevant stakeholders was formed for providing the barrier analysis. The initial long list of barriers compiled based on questionnaires (Annex VI) was screened by working group representatives from the institutions named above. The barriers were grouped under ten different categories (Economic and financial; Market failure/imperfection; Policy, legal and regulatory; Network failures; Institutional and organizational capacity; Human skills; Social, cultural and behavioral; Information and awareness; Technical and Other Barriers). The initial list of barriers was

supplemented by barriers, proposed by participants during the discussion and the summarized list was screened (Table 17, Annex II) during workshop.

For identification of most important barriers, a simple method was applied grouping them into significant (with scores 4-5) and not significant (with scores 1-3) by voting. While screening the stakeholders gave scores according to criteria (1-5) based on their own experience, using the score 5 as the most significant to effect on energy efficient cement production technology diffusion while score 1 reflects the lowest level of importance. The interview was done by Heads of thematic groups by phone or Skype with representatives of ministries, while others involved in TNA at previous stage and new ones involved at this stage filled the questionnaires.

Both tools: Logical Problem Analysis (LPA) and Market Mapping techniques were used. The participants have arranged the problems into hierarchy of causes and effects having as central starting problem a generic problem for technology transfer. The LPA Problem Tree emphasized the main links between causes and effects and organized them into logical inter-relations, addressed the basic issues and highlighted linkages with external factors. On the Problem Tree diagram the causes are shown below the starter problem and effects above. In addition by Market Mapping on cement production subsector (Figures 17, Annex 1) the enabling environment and service providers were defined for each considered technology
Key barriers were defined in five categories for energy efficient cement production technology deployment:

- Economic/financial barriers
- Policy/regulatory
- Institutional &capacity
- Information and awareness
- Technical

2.2.2.1 Economic and financial barriers

While screening economic and financial barriers presented in summarized initial list of barriers for energy efficient cement production technology (Table 17, Annex II) the participants took into consideration data on economic and financial issues. For example, the economic parameters of implementing both prioritized technologies are presented based on the analysis of *JSC "BRK Leasing" of Kazakhstan Development Bank, see* Table 13 below.

Table 9.Economic parameters of both prioritized technologies in cement production subsector

Technology	Investments ($/Ton)	Annual economy of labor ($/ Ton)	Annual economy of energy ($/Ton)	Total annual economy ($/Ton)	Payback period at discount rate 25%
Energy Efficiency technology in cement production					
Transition from coal to gas in wet technology	10	0.2	5	5.2	2 years
Modernization of old equipment, using wet technology and gas(transition to semi-wet technology)	5	0.2	2.5	2.7	2 years
Transition from a "wet" to "dry' process of cement production					
Transition to dry technology	50(from	0.5	5	5.5	disadvant

by modern production from technology with wet process and gas use	zero)				ageously
Transition to dry technology by old production technology with wet process and gas use	50(from zero)	0.7	7.5	8.2	20 years

As it could be seen the each 1 USD invested into modernization of old equipment for better energy efficiency with wet method can bring an annual economy in amount of 0.52-0.54 and US cents per Ton and Pay Back period is short, while transitions from wet to dry process can bring 0.11-0.16 US cents per Ton, while Pay Back period is long.

Finally the barriers for energy efficient cement production technology were grouped during workshop as the following:

- Inadequate access to financial resources
- High transaction costs
- Inadequate financial incentives

The explanations of main causes for resulting key financial barriers identification are provided below.

Inadequate access to financial resources

Inadequate access to financial resources is one of the main barriers of the technology diffusion. The cause is high interest rate. Current loan rate in the local financial market (17.3% annual rate) is not attractive or effective for private sector. Government provides support only for projects included into Industrialization MAP and by 2020 these are only two projects from list of potential projects. However, the list of potential projects in cement manufactory by 2020 accounts more than 15 projects, as presented in Annex III. There is difficulty in obtaining credits to facilitate access to "soft" loans. There is lack of provision of long-term and low-interest loans or grants through state funds.

High transaction cost

There is lack of capacity of local consultants and institutions to prepare a feasibility study or develop an internal carbon project for the construction or modernization of cement production plants with modern energy efficient technologies. Thus the companies often address to foreign consulting which is expensive. Providing energy audit each 5 years is mostly obligatory according to legislation and is for the company's own funds.

Inadequate financial incentives

No-usage of ESCO mechanism

ESCO mechanism/ Energy Performance Contract (EPC) use was approved in Kazakhstan (2015) by the amendments to the Law on Energy Efficiency (2012) .There is delay on practical implementation of ESCO mechanism in industry and in particular for promotion of energy efficient cement production technology in Kazakhstan.

Today ESCO - a completely new mechanism for Kazakhstan, which is based on the principles of PPP, when energy efficiency is not achieved at the expense of the budget, and at the expense of the involved companies. It is now in the initial stage.

Energy conservation includes more than 250 measures. One of them - this is a simple replacement and transition to LED - system, which is already yielding savings of the order of 32%. So the task of Kazakhstan related to reduction energy consumption to 25% up to 2020 and improve energy efficiency is planned by using this mechanism among others.

The state national plan "100 concrete steps" sets the task of attracting strategic investors in the country's energy efficiency. Their main aim is to stimulate the development of private energy service companies to provide complex services in the field of energy saving. Moreover, the company should compensate its own costs and gain financial profit only from actually achieved energy savings. By itself, the Energy Performance Contract (EPC) is aimed at savings in operating costs through the introduction of technologies for energy saving and energy efficiency. In this energy service company (ESCO) can invest their own funds, which are reimbursed by the savings achieved. According to common international practice, the company is able to attract investors, resulting in no need of loans. In both cases, the company's revenues depend on the quantity and quality of savings achieved, which ensures their high motivation to the result. As a result, ESCO shall receive part of the profits, which it will provide to the enterprise, industry, or even the country, as in the case of Kazakhstan.

Inadequate concessional financing or subsidy mechanism

Concessional financing used through DAMU Fund is inadequate: there is no practical support of energy efficient projects in cement production, although the financing of priority activities occurred. It is necessary to increasing the volume of concessional lending through the DAMU Fund and to improve allocation of funds.

Inefficient carbon market mechanism

One of the problems is suspending of using carbon market mechanism. This happens due to suspending of implementation of Emissions Trading System in Kazakhstan by 2018 (see Annex V). Also the implementation of internal carbon projects is suspended for cement production subsector. This problem is similar to diffusion of efficient coal combustion technology and its detailed explanation is provided in section 1.3.2.1.

LPA for economic/financial barriers of energy efficient cement production technology are presented in Annex I.

Market mapping analysis for cement production subsector (Figure17 Annex 1) identified that the number of market players in the current technology market is low, as the technology is not widely applied and existing market opportunities do not provide suitable conditions for involvement of other key players (for instance, financial service providers, ESCO) to the market chain. Along with this, business extension services are very weak and almost non-functional in the market chain. Enabling environment also does not provide suitable opportunities for technology diffusion.

Root causes of the economic and financial barriers

Root cause analysis shown that this barrier as interrelated with financial barrier (high interest rate) in case local companies will come to the market. There is lack of provision of long-term

and low-interest loans or grants through state funds. Attractiveness experienced international companies will increase transaction costs for consulting.

According to analysis, credits are expensive and very heavy for small and medium enterprises (SME) in order to install the energy efficiency equipment for modernization of existing plants. So up to now the energy efficient technologies in cement production financially are not viable for local business. To date, the energy efficient technology for cement production is imported and is supported by the foreign sources (EBRD projects) or in case of new plants- all belong to foreign companies.

Existing market opportunities do not provide suitable conditions for involvement of other key players (for instance, financial service providers, such as DAMU Fund, ESCO) to the market chain. Enabling environment also does not provide suitable opportunities for technology diffusion.

The analysis showed that the proportion of counterfeit products in private consumption is on average 48%, with distribution through small construction companies - 26%, through a chain of stores selling building materials - 11%..

Expenses in 2014 compared with 2013 year show that the utmost growth was the costs of depreciation of fixed assets - their growth was 28.3%. At the same time the cost of borrowed capital (loans, loans, leasing and factoring) increased by 18.4% over the same period.

Sources for financing: despite the fact that many respondents pointed to the deterioration of the conditions of borrowing bank funds, 29% of respondents continue to regard them as one of the possible options for financing the modernization of cement production.

Energy efficient equipment leasing: 17% of the participants from manufacturers are interested in participating in DAMU Fund mechanism, which is implemented by allocation of funds in the local banks or leasing companies for on-lending business projects. The terms of borrowing in the local banks are the following: the maximum amount per borrower - 150 million KZT, the loan term - up to 84 months, the nominal interest rate - not more than 14% per annum. (7% is covered by Fund as preferential financing). The problem is that this Fund has never funded any project related to energy efficiency cement production technology. This mechanism should be improved. The enterprises of cement subsector use mostly own funds (37% of enterprises confirm this during questionnaire).

Economic and financial barriers prevent the deployment of the energy efficient technology and provide the following affects: weak market, environment effects (GHG emissions and energy intensive economy.

2.2.2.2, Non-financial barriers

The non-financial barriers related to energy efficiency cement production technology were discussed by the thematic group of stakeholders while screening the non-financial barriers presented in the Table 17, Annex II).

Finally, the key non-financial barriers impeding technology deployment were defined in the four categories (with scores 4-5):

- Policy/ regulatory;
- Technical;

- Institutional and organizational capacity
- Information and awareness.

Other categories of barriers (Market imperfection, Network failures, Human skills and Other Barriers) were agreed by participants by voting as non essential, with scores (1-3).

According to LPA analysis used, the start problem is a "weak enabling environment for energy efficient cement production technology". The major four barriers named above are the causes of the problem, which lead to such effects as poor environment (GHG emissions), insufficient R&D activity, weak market and energy intensive economy.

Root cause analysis supplements the definition of key non-financial barriers. The methodology used for this analysis is similar and is described in previous sections.

The explanations why major barriers hamper the energy efficient cement production technology diffusion are presented below.

Policy/regulatory barriers

Inefficient regulation on tariff, customs

There is lack of customs regulation because many energy efficient goods to be used for implementation of our technology are imported. This affects the economy of implementation of the energy efficient technology in cement production and market development.

There is inefficient technical regulation on the national level related growth of electricity tariffs, which is important for energy efficient cement production technology diffusion. The existing standards and norms on energy efficient equipment should be reconsidered on annual basis in order to provide implementation of recommendations of the energy audit in effective manner. For example, according to TNA report the US legislation is strict for the purpose of reducing energy consumption; this made a promising production of blended cements. The use of blended cements could save up to 40% of electricity.

Lack of standards, code and certification

There is lack of technical regulation, lack of certification, standards and codes on Eurasian Economic Union ((EEU) level and needs to be improved in short term. Kazakhstan is participant of EEU. There are proposals from cement business actors and Association for improvement of existing legislation related to protecting of domestic cement producers, about improvement of complex procedure to promote energy efficient technology in cement production which could be considered by the state bodies.

Lack of standards, certification affects the market by low competitiveness of goods allowing improving the energy efficiency in a production process is important barrier. Another aspect deals with undeveloped competition between the companies producing cement with/without energy efficient cement production technology. There is dumping from Russia and Iran. 240,000 Ton of cement in 2014, 140,000 Ton during 6 months of 2015 was sold to Kazakhstan from Iran according to the law "On Exchange". The price of cement from Russia in August 2014 was less than 9 000 KZT (without VAT), which is lower than the price of domestic cement (12500 KZT/t). All these have negative effect directly on market development in the whole and indirectly on reduction of energy intensity of economy.

Institutional and organizational capacity barrier

Lack of ESCO

Up to now there is no any ESCO working in cement industry though legal conditions are created since 2015 by the Amendments to the Law on Energy Efficiency (2012). It was pointed out during workshop that this process is at its initial stage,

Weak capacity of R&D institutions

This cause was mentioned by participants as important. Four training Centers on energy efficiency were created in regions of Kazakhstan according to the Law on energy saving and energy efficiency (2012). Nevertheless, the training provided is not enough, more over there capacity of R&D institutions, local experts, local administrations is weak and dramatically poor for diffusion of energy efficient cement production technology.

Information and awareness barrier

One of the causes of the problem is weak access to information and poor dissemination of information related to energy efficient technology in cement production for users are in place, in particular: lack of market information, lack of information on raw material availability and procedures for the implementation of new standards quality related to energy efficiency; lack of knowledge or access to climate technologies resource assessment data, implementation requirements.

High-expertise professionals to conduct workshop and training on implementation of energy efficient technologies in cement production are very few in the country; and not training system is set up.

It was noted that these problems could be solved by measures, such as improving cooperation with international institutes and organizations to improve capacity building issues, organizing training system, such as “teachers teach” and other associated techniques

Root causes of non-financial barriers

The main root causes of non-financial barriers are the following:

- High energy and resource consumption and, as a consequence of high cost production and high GHG emissions.
- -Lack of competition between market actors to implements energy efficient technologies in cement production and lack of energy efficient goods to be used for implementation of technology.
- Inefficient customs regulation related to EE goods affects the development of market
- Undeveloped system of quality control of imported goods/equipment due to the lack standards and requirements.
- Imperfect system of technical regulation and the uncontrolled growth of electricity tariffs affect the growth of competitiveness.

The LPA for non-financial barriers of energy efficient cement production technology is presented in Annex I.

2.3. Identified measures

This section of report describes measures aimed to overcome the identified barriers in two categories: economic & financial and non-financial. Methodology and approach used for identification of measures in cement production subsector is similar to those used for identification of measures in power production subsector and is described in sections above.

The same group of consultants participated in barriers and measures analysis. Measures have been indentified based on grouped barriers. LPA analysis was applied to identification of measures process in order to get from problems to solution (measure-result) (Annex I).

Finally, the major measures for diffusion of efficient coal combustion technology were grouped into five categories:

- Economic and financial measures
- Measures to improve policy/regulatory environment
- Measures to improve institutional& organizational capacity
- Measures to improve information and awareness
- Measures to overcome technical barriers

The affects of measures implementation are: developed market, less GHG emissions, improved R&D institutions and economy less energy intensive.

The explanations to enabling measures are provided below in text of the report.

2.3.1 Economic and financial measures

In order to overcome existing economic and financial barriers to the implementation of energy efficient technology in cement production, the following measures proposed by working group:

Measure to achieve adequate access to financial resources

Government should enable provision of long-term and low-interest loans or grants through state funds (for instance, JSC “DAMU Entrepreneurship Development Fund”), private sources and international funds (GEF, GCF, IFC). Improve access to concessional finance through Fund DAMU.

Ensuring the availability of borrowed funds due to lower interest rates, longer grace period, and binding payments to the seasonality of consumption goods companies; improving cost management practices.

Measures to get appropriate transaction costs:

Arranging and providing adequate training for local consultants in developing feasibility study, carbon projects preparation and energy audit for appropriate costs is important. This should be done with State support and international assistance.

Measures to achieve adequate financial initiatives for local business

Measures assume the following:
Implement ESCO mechanism on the national level by involvement of local private capital or foreign sources .Provide necessary fiscal support to ESCO institutions.

Government should provide support financing of the cement industry (assistance at the local level, preferential lending), arrange adequate concessional financing development through state fund (for instance, JSC "DAMU Entrepreneurship Development Fund"), private sources using subsidy mechanism.

Improvement of using carbon market mechanism is also important. The conditions of its usage are similar as described for efficient coal combustion technology.

Measures to reduce and optimize costs are also of high interest. According to review of literature the following results could be achieved in relative terms: optimization for the repair costs of fixed assets (28%), electricity (17%) and gas (14%), as well as the transition to cheaper modes of transportation (17%).

The assessment of financial measures in economical, social, environmental aspects is presented in table below using Cost benefit analysis for further presenting to policy-makers. The analysis is provided similar to small hydropower technology.

Table 10.Scores of assessment of financial measures for energy efficient cement production technology

Measures	Benefits				Costs		Benefits considering W
	economic	social	GHG reduction	environmental	capital	O&M	
Weighted coefficient, W	0.1	0.1	0.3	0.2	0.2	0.1	1
Financial measures							
Subsidy mechanism	100	80	0	100	90	60	61
ESCO mechanism	100	50	30	20	100	90	57
Production incentives	100	20	0	0	100	90	40
Carbon market mechanism	50	30	100	30	80	60	64

Based on results of assessment the most effective are carbon market and subsidy mechanisms. Using complex of mechanisms (subsidy, ESCO and carbon market mechanism) will bring synergistic effect.

LPA for economical and financial measures is presented in Annex I.

2.3.2 Non-financial measures

In order to overcome existing non-financial barriers to the implementation of energy efficient cement production technology, the following measures should be provided:

Measures to improve policy/regulatory environment

Two measures were considered by working group: (i) adequate standards, codes and certification; (ii) improvement of regulation on tariffs and customs.

The Government should provide conditions for development competitive energy efficient technology in cement production, including exclusion from the national market the counterfeit cement, defend the local business and local enterprises (SME). Necessary regulations related to customs, electricity tariffs should be provided in order to implement energy efficient cement production technology.

The adoption of adequate standards, codes and certification will allow applying innovative materials and goods for implementation of energy efficient cement production technology. Government should participate in development of technical regulations and certification, standards and codes for EEU members in the short term.

Government should improve customs and tax regulations to stimulate application and local production of the technology.

Government should improve control on growth of electricity and railway tariffs on national level.

Necessary regulations related to customs, improvement tariff system in electricity subsector should be provided to do energy efficient technology attractive for private sector on national level.

Measures to improve institutional & organization and capacity

Discussion was focused on two major measures: (i) introduction of Energy Performance Contract (EPC) and (ii) improvement of capacity of R&D institutions.

Current market in cement production should be supported by introduction of energy efficient equipment via Energy Performance Contracts (ESCO activity) in cement production industry and creation of ESCO itself;

For improvement of capacity of R&D institutions required training programs should be developed and associated training provided. It is important to gain international experience and best practice. For this purpose study tour could be organized or strengthen international cooperation with donors and institutions to get Technical Assistance for this purpose.
Activity should be focused on:

- Securing involvement of a research organization at technology introduction; development of ESCO activity for energy efficient technology. Strengthen ESCO, R&D activity for promoting energy efficient technology.
- Improving awareness of R&D institutions, local authorities, business and other stakeholders and improving network between them.
- Strengthen international research network programs in order to learn from best international practices related to energy efficient technology in cement production.
- Rising of a technical qualification level, correspondence to international standards, and certification. Support of technology introduction by service centers.
- Strengthen specific technical capacity building activities for R &D institutions and technical experts.

- Strengthen cooperation with international institutions and organizations (EBRD, UNIDO, UNEP, etc.) for arranging adequate training for improvement of capacity building of experts.
- Adequate training of personnel for preparing projects and feasibility study, baseline research, etc.
- International experience shows that the development of a detailed energy strategy allows cement companies to choose the most effective ways to solve the problem of reduction of dependence on energy consumption, taking into account the market, Technical and economic conditions.

Measures to improve information and awareness

It was recommended by working group to focus on the following activities in order to improve access to information and improve its dissemination:

- Adequate information access and dissemination of information on markets, costs, benefits of technology by arranging internet platform on energy efficiency (including in cement production), creation of institution aimed to issue review of different aspects related to cement production subsector analysis on regular basis on national level and on Central Asia level.
- Involvement more types of stakeholders for awareness raising (the population, enterprises, local banks, international institutions and other stakeholders participating in this process).
- Information campaigns and capacity building activities on the advantages of applied technology must be organized and funded in order to increase capacity and awareness level.
- Information campaigns for local residents, local authorities and private sector, by involving NGO sector in the process.
- Implementing demo projects according to energy efficient program developed by enterprises at local level in order to demonstrate advantages and promote use of the energy efficient technology.

Measures to improve market imperfection

In order to improve market imperfection it is necessary to develop competition of energy efficient goods used for implementation of energy efficient cement production technology. The activities could include the following and not limited for:

- Government should improve conditions for competition development in cement production
- Government and Local administration of regions (Akimats) should promote rational distribution of the cement production and clinker terminals according to the needs of a large territory of Kazakhstan for developing market and competition
- Government should improve control on counterfeit cement and develop and adopt the certification, technical regulation and codes on EEU level
- Government should take measures against the increasing import: introduction of countervailing duties

Participants of working group noted that measures to improve market imperfection concern mostly policy issues and regulatory aspects, responsibilities of the ministries and local administrations. Thus these measures could be addressed to policy/regulatory.

Measures to improve technical barriers

Adequate technical competence

Fuel economy or energy saving could be achieved by using energy efficient technologies (the use of fuel containing materials), new progressive equipment and new materials. The literature provides a lot examples related to technical improvements that lead to energy saving, some of them are provided below:

- For instance, about 50% of energy costs could be reduced by improving existing technology for crushing and grinding operations. Therefore, it is advisable to use wastes that have passed the grinding process: mining wastes, waste coal preparation plants, mining and processing of stone, etc. By replacing 10% of cement by 5% of mixed little binder clinker and of 5% mixed demon clinker binder can bring annual saving of 500 thousand Tons of liquid fuel.

-Introducing raw material and grinding of cement in a closed loop. This measure will improve the quality of cement and 15-20% reduction in energy consumption for cement grinding.

-Fuel economy could be achieved by the use of diluents slurry: each percentage reduction of sludge moisture reduces specific fuel consumption for the clinker calcining at average of 117-146 kJ / kg, or 1.7-2%. The use of innovative thermal insulation materials for the lining of rotary kilns preparation areas contributes the reduction of fuel consumption by 2-3 kg /t clinker.

- The use of new types of ovens: conveyor calciner and the cyclone heat exchangers are highly efficient thermal units. Therefore, specific heat consumption is reduced to 900 kcal in the short rotary furnaces working together.

The advantage of the technical options named above is that the system becomes more energy efficient. The disadvantage of the technology is that investment costs for the equipment are high. For example, the cost of new cement plant with installed capacity of 1 mln. tons per year with the energy efficient technology is up to 120-150 million USD. Thus, modernization of the existing process and make it more energy efficient could be done by cheaper way. A set of technical measures, economically acceptable, can be determined on the basis of the energy audit. According to legislation energy audit is conducted at the expense of the business company.

While implementing some of the technical options describes above the barrier of inadequate technical competence or expertise should be overcome. This measure was noted as the most important during workshop. The result of this measure improvement is measure could me could be improved by specific training programs to improve the developed and organized

LPA for non-financial measures of energy efficient cement production technology is presented in Annex I.

Non-financial measures are summarized as following:

Policy/ Regulatory

- Strengthen the technical regulations and standards, codes and certification (-develop obligatory technical regulation and certification, standards and codes according to EU, EEU requirements)
- Improve technical regulation and regulation on tariff mechanisms (to force control by Antimonopoly Committee of Ministry of Economy on growth of tariffs on electricity railway . This could be proposed by developing recommendations.
- Improve regulation on carbon market mechanisms (implementation of ETS and internal carbon projects). This could be proposed by development of National Allocation Plan (NAP) 2021-2025; NAP 2025-2030; establishment of monitoring system of GHG emissions in cement production.
- Develop a package of regulations on customs, tax privileges in order to simplify import of energy efficient goods and to stimulate application of energy efficient cement production technology.

Capacity building and information measures

- Improve the capacity of R&D institutions, technical experts : to develop and arrange training programs on capacity building, on best international practices on EE technologies in cement production and educational seminars on international standards, certification, including on management of costs, logistics' and effectiveness's improvement.
- Improve access to information and its dissemination (i) create a national institution for dissemination of info for regular review of cement market on annual basis; energy efficient technologies in cement production and monitoring of implementation of certification; (ii) Provide information campaigns, seminars on the advantages of applied technology through magazines ,mass media, TV (State budget and TA), in cooperation between the government, NGOs, Associations, business and international organizations; (iii) creation of internet platform on EE technologies in cement production (it could be done in the frames of development NAMA for example)
- -Develop and implement pilot project (with establishment of ESCO in cement production subsector) for promotion of energy efficient cement production technologies based on energy audit reports and included into Energy Efficient Map. This could be done by attracting international resources (TA), state and private financial resources or Energy Efficient Fund creation of which is under discussion in the Government.

2.4. Barrier analysis and possible enabling measures for transition from wet to dry cement production technology

2.4.1 General description of the transition from wet to dry cement production technology

At the end of 2013 Kazakhstan's cement consumption per capita was 482 kg / person (for comparison, the figure in 2012 was 425 kg / person).This fact demonstrates the growth of cement market capacity in Kazakhstan and the importance to transit from wet to dry technology for the purpose of environmental protection and GHG emissions reduction.

The transfer from wet to dry process came quickly during 2010-2014 to a certain extent as a result of implementing the State "Program on the Development of Construction Industry and Production of Construction Materials in the Republic of Kazakhstan for 2010 - 2014 "(approved on 30.09.2010 No.1004), see Policy Factsheets in Annex V.

The main advantage of the technology on cement production using the dry method is less heat energy consumption for clinker burning: the heat consumption for roasting raw material mixture in wet process is by 30-40% higher than when dry.

The dry method is more efficient, but at the same time requires significant financial expenses for production modernization. In order to begin producing cement using such a method, new equipment should be installed and people should be trained.

Average fuel consumption per Ton of clinker in case of dry process of production is 183.9 kg. This means replacing the wet process with dry process can save 56.1 kg of fuel for each Ton of clinker production. For example, in Kazakhstan to produce 1 Ton of cement, the fuel consumption is 100 kilograms of fuel equivalent and 900 kWh of electricity more than in foreign countries.

The list of existing cement plants with dry method is presented in Annex III. As it was mentioned the share of dry method is expected to grow up to 78% in total capacity of cement manufactory in Kazakhstan by 2020.

The 3 projects with a total capacity of 2.1 million Tons will be implemented before the end of 2016: LLP «BI-Cement» in Akmola region (under construction), built already by LLP «Rudny cement plant" in Kostanay region (0.5 million) and LLP "Cheese Cement" in Kyzylorda region (0.5 million Tons). Greater impact will be the launch of the new plant KokshеTsement in the II half of 2016, with a design capacity - 2 million Tons of cement per year and 5500 Tons of clinker per day.

After purchasing the company Heidelberg Cement, Italcementy Group holding, including plant "Shymkent Cement", its modernization is planned: transfer from wet to dry process. This company owns 3 cement plants - Bukhtarma Cement Company (since 2005), Shymkent Cement (2016), the Caspian Cement (starting in 2014), with capacity of 0.8 million Tons per year, of which a fifth is -planned export to Russia, Turkmenistan and Azerbaijan.

Labor productivity in the new cement plant, with the dry method, will be 4322.3 Tons of cement per person per year. Taking into account the cost of cement in the amount of 12 500 KZT, 1 worker productivity per year is: 4322.3 x 12 500 = 54 029.1 thousand KZT (US $ 360,194).

Other example: Expanding and modernizing the Karaganda cement plant. The Project involves the refurbishment and re-commissioning of a production line that is presently mothballed to manufacture cement using the "dry-process" method. Upon completion, capacity of the plant will be doubled to at least 1.3 million Tons per year. This will help satisfy rapidly increasing demand for cement in Kazakhstan, which is presently significantly outpacing supply capability.

Based on optimization evaluations of potential reduction of CO_2 emissions from Caspi Cement Production base data (dry method used), done by IFC, the results show average 25 -34 kg CO_2/t cement and total CO_2 emissions reduction based on average blended cement (80% clinker / 80% electricity optimized on Coal) and a total production of 0.80 M Tons of cement per year: 19.8-28.8 kg CO_2/year. Actions, involving optimization of slag additive and further electricity reduction are considered, with the goal of achieving 750 kg CO_2/ t cement emissions in the long run.

The norms of energy consumption per Ton of cement produced with dry method are presented above in the section related to energy efficient technology in cement production subsector.

2.4.2. Identification of barriers for the transition from wet to dry cement production technology

Identifying barriers for the transition from wet to dry cement production technology is similar to identifying barriers for energy efficient cement production technology, so the same approach and methodology are applied.

The working group representing relevant stakeholders was formed including members from sectoral working groups involved into TNA at previous stage of the process and new participants – representatives with specific knowledge of the transition from wet to dry cement production technology. The representatives from the following types of organizations participated in the working group: Information Analytical Center under Ministry of Energy, Joint-stock company "Center for Engineering and Technology Transfer", the Union of Builders of Kazakhstan ULE, Association of Legal Entities "Kazakhstan Association Building Materials Industry, JSC KazWaste", Manager of Third National Communication of the RK under UNFCCC (UNDP project), business representative from LLP "JAMBYL Cement Production Company". List of stakeholders involved is presented in Annex IV. The same group worked for identification of barriers and measures.

As an initial step in the process of barrier analysis, a desk study of policy papers and other available documents was conducted in order to identify the primary reasons why the energy efficient cement production technology is not currently applied widely. Next, a consultation process was conducted with stakeholders through direct interviews and questionnaires (Annex VI). For each type of technology the Mitigation working group representing relevant stakeholders was formed for providing the barrier analysis. The initial long list of barriers compiled based on questionnaires (Annex VI) was screened by working group representatives from the institutions named above. The barriers were grouped under ten different categories (Economic and financial; Market failure/imperfection; Policy, legal and regulatory; Network failures; Institutional and organizational capacity; Human skills; Social, cultural and behavioral; Information and awareness; Technical and Other Barriers). The initial list of barriers was supplemented by barriers, proposed by participants during the discussion and the summarized list

was screened (Table 18 Annex II) during workshop. While screening the stakeholders gave scores according to criteria (1-5) based on their own experience, using the score 5 as the most significant to effect on energy efficient cement production technology diffusion while score 1 reflects the lowest level of importance. The barriers with scores 4-5 were considered as significant, the rest were considered as not significant by voting. The questionnaires were disseminated among representatives of TNA group and among new participants from business.

Logical Problem Analysis (LPA) and Market Mapping techniques were used (Annex I). The LPA Problem Tree emphasized the main links between causes and effects and organized them into logical inter-relations, addressed the basic issues and highlighted linkages with external factors. On the Problem Tree diagram the causes are shown below the starter problem and effects above. In addition by Market Mapping (Figures 17, Annex 1).the enabling environment and service providers were defined for each considered technology.

Key barriers were defined in five categories for transition from wet to dry cement production technology deployment:

- Economic/financial barriers
  And non-financial barriers, including:
- Policy/regulatory
- Institutional &capacity
- Information and awareness
- Technical

2.4.2.1. Economic and financial barriers

All the procedure of identification of economic and financial barriers is the same as described in the section 1.3.2 and 1.2.2.1 of the report.

While screening the Initial list of barriers developed for the received and summarized for workshop (Table 18, Annex II) the working group has tried to explain what currently preventing wide-scale diffusion of the transition from wet to dry cement production technology. Analysis is based on economic analysis.

As a result of discussions and consultations the following major economic and financial barriers have been identified for transition from wet to dry process in cement production technology diffusion:

- High capital cost
- High transaction cost
- Inappropriate financial initiatives

The explanations of main causes for resulting key financial barriers identification are provided below.

High capital costs

High capital cost is the main barrier to technology deployment. According to information sources reviewed (List of references) the capital cost varies 120-160 million USD per 1 million Ton of cement production capacity. Only big companies or international owners could raise the costs for transition from wet to dry technology. The economic parameters for technology

deployment are presented in section 2.2.2.1. The capital cost is high because technology is only imported.

High transaction cost

The costs management and consulting service is expensive because high personnel and experts are foreign. Rent production warehouse or offices is also barrier for increasing transaction cost to deployment of transition from wet to dry cement production technology.

Inadequate financial incentives

Inefficient subsidy mechanism

This barrier is characterized by:

- Insufficient support for imported equipment for technology
- Inadequate State support financing of deployment of technology through DAMU Fund (only two projects are included into Industrialization Map of the SPAID-2)

Inefficient carbon market mechanism

This barrier is characterized by:

- The potential market players are not involved widely business-extension services are very weak. Enabling environment also does not provide suitable opportunities for technology diffusion.
- Implementation of carbon market mechanism is suspended up to 2018.

The main disadvantage of the system is the lack of an effective mechanism of state regulation of the system restrictions and permit trading of GHG emissions, including monitoring of compliance of transparency when granting a quota, lack of support for internal projects to reduce GHG emissions, as well as non-participation of the State in the implementation of the quotas under the terms of the auction.

Root causes of the economic and financial barriers

Existing business support program "Business Road Map 2020" and "Productivity 2020" give enterprises of construction materials industry access to funding sources, allowing implementing long-term projects. However, financial barriers exist to further expand the use of technology segment by dry method.

The main causes of financial barriers are:

- Suspension of Emission Trading Scheme and internal or external carbon projects implementation in cement production
- Insufficient policy to support local business development to promote transition from wet to dry cement production technology
- Inefficient local bank’s system to provide credits for technology diffusion
- Customs regulation is inefficient to promote import of technology
- Lack of capacity and training for local experts to do qualified work at reasonable transaction costs

LPA for economic/financial barriers of the transition from wet to dry cement production technology see Annex I.

2.4.2.2 Non-financial barriers

Non-financial barriers for transition from wet to dry cement production technology deployment were screened (Table 19, Annex II) according to approach described above in section 2.4.1.2.

As a result of discussions and consultations the following key non-financial barriers have been identified by working group in four categories as mentioned above.

The explanations of main causes for resulting key non-financial barriers identification are provided below.

Policy, legal and regulatory

Inadequate technical regulation, import duty

The technical regulation is one of the important barriers as noted by participants of working group. The regulation is not harmonized in the frames of the Eurasian Economic Union (EEU) countries. As the technology is imported the regulation on import duty is important for investors.

Not harmonized standards, codes certification

This barrier is characterized by inadequate regulation framework on national level and on the level of Eurasian Economic Union; the absence of a mandatory certification of cement.

According to results of interview presented in "Review of cement industry in the countries of Custom Union" the 92% of respondents were in favor of mandatory certification of cement sold in the territory of the EEU countries. They also supported the inclusion of cement in the Unified list of products subject to mandatory conformity assessment in the framework of the EEU with the issuance of uniform documents confirming compliance with quality standards. The proportion of counterfeit bagged cement on Kazakhstan market is 13%.

Harmonization with EU standards and codes is recommended in the Strategic document "100 Steps".

There is need to develop and implement special requirements for mandatory recycling of certain types of waste from metallurgy in cement plants. It is necessary at the legislative level to take measures to prevent the ingress of harmful substances into the environment and to make the disposal of such waste in kilns of cement production at the expense of individuals and legal entities that make up the waste without the participation of the state.

Technical barriers

Poor access to technology of transition from wet to dry process in cement production is the main technical barrier. It happens so because there is low competence, inadequate access to

information and lack of financing resources. The new technology has high capital costs as mentioned above.
This barrier is interrelated with information & awareness barrier, capacity barrier, policy/regulatory and financial barriers.

Institutional and organizational capacity barriers

Weak capacity of R&D institutions is another barrier. The research infrastructure, device-instrumental base, training base does not meet modern requirements because of inefficient state support of R&D institutions. The educational, scientific and production complex of the industry does not provide it with the necessary innovative development.

Information and awareness barriers

Inadequate access to information and poor dissemination is the main barrier identified by participant of working group during workshop.

There is limit in access to adequate information on benefits and cost of technology, market information, technical issues related to transition from wet to dry cement production technology. The problems with information are similar to energy efficient cement production technology, the details described above.

In should be noted that defined non-financial barriers affect development of market, environment effects (GHG emissions reduction, wastes issues) and development of R&D activities. Weak enabling environment for transition from wet to dry cement production technology is caused by non-financial barriers (see LPA analysis for non-financial barriers of transition from wet to dry cement production technology, Annex I).

Root causes of the non- financial barriers

The main causes of non-financial barriers are:

- Weak capacity of R&D institutions is connected to inadequate access to information, relative education improved. So lack of capacity building and information dissemination are basic for these barriers, both barriers could be combined as capacity& information barrier.
- Poor access to technology depends upon inefficient customs policy for import and upon inadequate standards and certification.

Leakage of barriers and enabling environment are considered in sections further.

2.4.3. Identified measures

Identifying relevant measures is the process of analyzing necessary actions to be taken in order to overcome current barriers to the implementation of prioritized technologies. These measures should have sustained the diffusion.

In this regards, the same working group participated in barriers analysis worked for identification of measures for transition from wet to dry cement production technology.

Measures were defined based on grouped barriers using LPA method in order to overcome barriers from measure to result (Annex I).

Similar to identification measures for energy efficient cement production diffusion the major measures for diffusion of efficient coal combustion technology were grouped into five categories:

- Economic and financial measures
- Measures to improve policy/regulatory environment
- Measures to improve institutional& organizational capacity
- Measures to improve information and awareness
- Measures to overcome technical barriers

The affects of measures implementation are: developed market, improved environment (less GHG emissions), improved R&D activities and economy less energy intensive.

The explanations to enabling measures are provided below in text of the report.

2.4.3.1 Economic and financial measures

In order to overcome existing economic and financial barriers to the implementation of transition from wet to dry process in cement production, the following measures were proposed by working group:

Reasonable capital costs

Government should support the investors in this field by providing long-term and low-interest loans through different state funds (such as State Fund for Support to Entrepreneurship functioning within the Ministry of Economic Development, DAMU fund), private sources (different banks) and international funds (GEF, GCF). As the technology is imported additional measures could be taken to develop adequate regulation for technology import (import duty, tax privileges).

Reasonable transaction costs

Government should improve financial support for R&D institutions to assist making consulting at affordable costs.
Specific training related to diffusion of transition from wet to dry cement production technology is necessary.

Rent cost for product warehouses could be reduced by providing support or privileges by arranging special economic zones, in particular for diffusion of this technology. Other transaction costs could be reduced by improving management policy such as cost optimization by each company.

Appropriate financial incentives

Improved carbon market mechanism

Government should develop a National Allocation Plan (NAP) 2020-2025 and allow its further implementation, including implementation of NAP 2020. .

It was proposed to develop further carbon market mechanism: to issue a quota on the basis of benchmarking, to intensify the work of carbon markets to raise liquidity and reduce the costs of meeting the obligations and to strengthen the state stimulation of internal projects to reduce GHG emissions and to channel funds from the auctioning of allowances for the development of "green economy".

It is necessary to strengthening of human and technical capacity of all institutions involved in state regulation of quota and trading systems. Training programs and seminars for a wide range of stakeholders will help with these.

Supportive subsidy mechanism

Government should support the investors through different state funds (for instance, State Fund for Support to Entrepreneurship functioning within the Ministry of Economic Development, DAMU fund), private sources (different banks) and international funds (GEF, GCF). Specific training for the project developers and R&D institutions should be necessary and strengthening international cooperation.

The assessment of financial measures in economical, social, environmental aspects is presented in table below using Cost benefit analysis for further presenting to policy-makers. The analysis is provided similar to energy efficient cement production technology.

Table 11.Scores of assessment of financial measures for transition from wet to dry cement production technology

Measures	Benefits				Costs		Benefits considering W
	economic	social	GHG reduction	environmental	capital	O&M	
Weighted coefficient, W	0.1	0.1	0.3	0.2	0.2	0.1	1
Financial measures							
International financial assistance (grants and loan guarantee)	100	80	60	30	90	60	66
Carbon market mechanism	100	50	30	20	100	90	57
customs preferences	60	20	0	0	50	50	23
Subsidy mechanism	100	40	50	30	80	60	57

Based on results of assessment the most effective are International financial assistance (grants and loan guarantee is necessary), carbon market and subsidy mechanisms. Using complex of all mechanisms considered (subsidy, international support with loan guarantee and carbon market mechanism and customs preferences) will bring synergistic effect.

2.4.3.2 Non-financial measures

In order to overcome existing non-financial barriers to the implementation of transition from wet to dry cement production technology, the following measures should be provided:

Measures to improve technology barriers

The main measure to overcome the technology barrier is defined ad better access to technology. For this purpose better access to information on technical options is necessary.

The desk study of different sources of information related to technology recommended the following examples:

- Reduced gas losses at the exit from the oven by installing equipment for better heat transfer from the gases to the material, such as furnaces cascade; optimization of the level of oxygen (control air for combustion); optimization of the temperature and the shape of the burner flame; improve and increase the capacity of preheating.
- Reduction of moisture absorption of raw materials and fuel, to avoid having to evaporate adsorbed water.
- Reduce the amount of dust in the exhaust gases by minimizing the gas turbulence. Dust takes energy out of the oven - it should be captured by dust collectors, returned to the raw materials and sent into the furnace again.
- Reduction of clinker temperature to keep more heat in the firing system.
- Reduction of the clinker cooling temperature.
- Reuse of excess air for cooling.
- Return of cool air and use it for drying of raw materials and fuel or fuel for heating or air.
- Reduction of losses in the furnace radiation by using more energy efficient refractory materials and their correct combination:
- Optimization of furnace operation.

Measures to improve institutional capacity

Improvement of capacity of R&D institutions is important measure. For improvement of capacity of R&D institutions required training programs should be developed and associated training provided. It is important to gain international experience and best practice.

Activity should be focused on:

- Improving awareness of R&D institutions, local authorities, business and other stakeholders and improving network between them.
- Strengthen international research network programs in order to learn from best international practices related to transition from wet to dry cement production technology.
- Strengthen cooperation with international institutions and organizations (EBRD, UNIDO, UNEP, etc.) for arranging adequate training for improvement of capacity building of experts.
- Adequate training of personnel for preparing projects and feasibility study, baseline research, etc.

Measures to improve information and awareness

It was recommended by working group to focus on the following activities in order to improve access to information and improve its dissemination:

- Adequate information access and dissemination of information on markets, costs, benefits of technology by arranging internet platform on energy efficiency (including in cement production), creation of institution aimed to issue review of different aspects related to cement production subsector analysis on regular basis on national level and on Central Asia level.
- Involvement more types of stakeholders for awareness rising by arranging of seminars, workshops (the population, enterprises, local banks, international institutions and other stakeholders participating in this process).
- To support implementation of more demo projects to demonstrate advantages of modern technology.
- The creation of a supranational authority is necessary at the EEU platform for market regulation.

Measures to overcome policy/regulatory barriers

Two measures were considered by working group: (i) harmonization of standards, certification, codes with Customs Union regulation and (ii) improvement of regulation on complex procedures and tariffs.

Government should improve tariff regulation system, complex procedures, improved technical regulation of Eurasian Economic Union, mandatory certification of cement sold in the territory of the EEU countries.

The adoption of the Technical Regulation of EEU "On safety of buildings, building materials and products" will provide the unification of requirements to the product and the protection of the EEU market, and will also allow the rights holder to effectively deal with the manufacturers and sellers of low-quality counterfeit cement.

On the national level it should be considered the reduction of tariffs for electricity and rail freight for domestic producers to increase their competitiveness in relation to imported products.

LPA for non-financial measures of transition from wet to dry cement production technology is presented in Annex I.

The following supplementary measures were proposed by working group:

- Involvement of a research organization/service centers, associations, international business for technology introduction.
- Improvement of a qualification level, correspondence to international standards, certification;
- Technical advice and trainings as capacity building activities for R & D institutions;
- Strengthen international research network programs in order to learn from best international practices.

2.5. Linkages of the barriers identified

Barriers faced by different prioritized technologies in the cement production sub-sector appear to be very similar with minor specific. The barriers for this subsector have been identified in six categories (economic/financial, policy/regulatory, technical, institutional and organizational capacity and information &awareness).

It is possible to achieve synergy between identified barriers, particularly with regard to economic/financial barrier, institutional and organizational capacity, information and awareness and partially policy/regulatory.

The working group provided LPA analysis. The problem tree was elaborated with causes/effects relations and the linkages between barrier's elements were identified. LPA with problem tree for each technology is presented in associated Chapter of the report.

Technical barriers and institutional and capacity barriers could be could be linked for the purpose of optimization because both deal with weak capacity, only audience should be clarified per interests before arranging training for stakeholders.

While providing analysis it could be seen in the table below that all barriers identified have common and specific features of two technologies.

Common barriers are the following:

- Information and awareness barrier (weak access to information and poor dissemination; weak capacity of R&D institutions).
- Economic/financial barrier (inadequate subsidy mechanism and inefficient carbon market mechanism) and
- Policy/regulatory and technical barrier (not harmonized standards, codes certification)

Specific barriers are the following:

- Economic/financial barrier: no-usage of ESCO mechanism related to energy efficient cement production technology; lack of grants and loan guarantee mechanism for transition from wet to dry cement production technology.
- Policy/regulatory barrier: inefficient regulation on tariff, customs related to energy efficient cement production and inadequate technical regulation, import duty related to transition from wet to dry cement production.

It is possible to achieve synergy between the identified barriers as both technologies are currently coordinated by one body- Ministry of Investments and Development (MID).

Thus, barriers related to the implementation of technologies in **cement production subsector** are summarized in table below.

Table 12.Summary of barriers identified for prioritized technologies in cement production

Barriers	Technologies	
	Energy efficiency cement production technology	**Transition from wet to dry in cement production**
Economic/financial	No-usage of ESCO mechanism Inadequate subsidy mechanism Inefficient carbon market mechanism	Inadequate subsidy mechanism Inefficient carbon market mechanism
Policy/regulatory and Technical	Lack of standards, codes and certification Inefficient regulation on tariff, customs	Not harmonized standards, codes certification Inadequate technical regulation, import duty
Information and capacity building	Weak capacity of R&D institutions Weak access to information and poor dissemination	Weak capacity of R&D institutions Inadequate access to information and poor dissemination
Other	Weak coordination between market actors Inefficient donors and local authorities coordination for implementation of pilot projects a	Weak coordination between market actors Inefficient donors and local authorities coordination for implementation of pilot projects

2.6. Enabling framework for overcoming the barriers in cement production subsector

The range of institutional, regulatory and political framework conditions that are conducive to promoting and facilitating the transfer and diffusion of technologies (IPCC, 2000) are country-specific circumstances that: encompass existing market and technical conditions, institutions, resources, and practices. For analysis LPA method and Market Mapping were used (Annex I). It covers enabling environment and service providers, see in tables below.

Table 13. Enabling business environment of cement production subsector technologies considered

No	Enabling environment	Comments	Responsible entity
1	Activate use of ESCO mechanism	Stimulate implementation of energy efficient technologies in cement production	Local administration, business, MID
2	Setting up an Energy Efficient Fund for providing financial incentives for business implementing technologies	Stimulate implementation of environment friendly technologies in cement production	MID, MF

3	Introduce standards, codes and certification	Making the long term rules and the monitoring of the quality of cement	MID, business, EEU Commission
4	improve regulation on customs	Import duty	MNE
5	Improve work of carbon market mechanism (Develop and implement National Allocation Plan (NAP) 2020-2025; restore implementation NAP 2020; internal carbon projects)	Stimulate implementation of environment friendly technologies in cement production	ME, international organizations, R&D institutions
6	Support from the state in ensuring the equipment necessary to implement the technology	Low interest loans and longer grace period	MID, MNE, business owners of the technology
7	Organization and management by the Ministry of Innovations and Development, relevant bodies of the local administration and EEU of the process of technology implementation	Administrative and organizational support in the process of technology implementation	MID, local administrations, business, KIDI,EEU Commission

Table 14.Service providers and services provision of power subsector technologies considered

No	Service providers	Service provided
1	Ministry of Investments and Development (MID)	Organizes and coordinates the large scale implementation of the technology
	Ministry of Energy (ME)	Coordinate implementation of environment aspects of implementation of technologies including GHG emission reduction, ETS, internal carbon projects
2	Local authority/Associations, international organizations	Develops informational marketing, organizes training of special audience
3	Ministry of Finance (MF), Ministry of National Economy(MNE)	Create condition to subsidize business by enabling low interest loans and grace period including customs and tax issues
4	Ministry of Foreign Affairs (MFA), and also ME.MID,MNE,MF	Coordination of international cooperation for pilot projects and capacity building programs
5	Eurasian Economy Union (EEU)	Technical regulation in the frames of EEU
6	Companies /equipment suppliers	Provide equipment meeting modern requirements
7	Business, Associations, KIDI	Ensures quality of the products by monitoring the quality in specialized laboratories
8	MID , research and education institutes	Develops informational marketing, organizes

	and Energy Efficient Centers	specific training on technology implementation
9	MID, research and education institutes, local public administration, NGOs, business, international organizations	Create awareness and training programs for professionals of cement production subsector at local and national level

Implementation of measures in cement subsector leads to the following results: improvement environment (decreasing GHG emissions), improvement of market, making economy less intensive and intensifying R&D activity. Measures are grouped according to grouped barriers and are also considered in two categories: common and specific.

The government of Kazakhstan is implementing initiatives for application of new technologies in order to mitigate CO_2 emissions from this subsector by supporting construction of two new Plants with dry method technology. In spite of the measures undertaken, specific measures are necessary in order to overcome barriers to the application of prioritized technologies. The use of high tech equipment will decrease environmental pollution and GHG emissions.

The list of measures are presented first in broad (see below) and then could be shorten for the purpose of optimization in order to be included into Technology Action Plan (TAP) report at the next stage of the TNA project.

A set of common measures:

- Improve and use economic and financial mechanisms to facilitate use of both prioritized technologies (such as subsidy mechanism, loan guarantee).
- Enable provision of long-term and low-interest loans or grants or concessional loans for business through state funds (such as State Fund DAMU, Energy Efficient Fund), private sources (different Banks) and international funds (GEF, GCF) facilitate receiving credits at affordable rates through national and international sources.
- Provide Technical Assistance and state support of R&D institutions.
- Develop and ensure compliance of obligatory technical regulation and certification, standards and codes according to EU, EEU requirements.
- Improve regulation on carbon market mechanism implementation (including issuance of a quota on the basis of benchmarking revitalization of the carbon markets to raise liquidity and reduce the costs of meeting the obligations and to stimulate the state of internal projects to reduce GHG emissions and to channel funds from the auctioning of allowances for the development of "green economy", develop – National Allocation Plan (NAP) 2021-2025 and monitoring system of GHG emissions in cement production.
- Increase awareness about ecological advantages of technologies (through information campaigns on the advantages of applied Technology through magazines, mass media, TV (State budget and TA).
- Strengthen capacity of R&D institutions, local authorities, technical experts by organizing several specific capacity building programs and seminars for R&D, experts on best international practices on EE technologies in cement production, improvement of capacity building, correspondence to international standards, certification, including on management of costs, logistics' and effectiveness's improvement.; providing TA seminars for improving organizational capacity of stakeholders, enterprise, local banks, international institutions .

A set of specific measures:

- Develop recommendation on exemption of import duty of equipment for EE technology in cement production.
- Encourage use of Energy Service Contracts for promoting of EE technology in cement production and create Energy Efficient Fund and use it.
- Develop recommendations to improve customs and tax regulation to simplify import of EE technology and to stimulate application EE technology, introduction of countervailing duties to develop competition.
- Develop and approve/implement of special requirements for mandatory recycling of certain types of waste in cement plants at the legislative level.
- Create of internet platform on EE technologies in cement production.
- Provide Technical Assistance (TA) and support to R&D institutions, ESCO.

For the further political process the following supplementary measures for both technologies, are important.

A set of supplementary measures:

- Donor coordination in order to enhance support pilot project and providing cooperation, coordination between market actors to develop competition (seminars, trips to exchange experiences), need government control for implementation of laws and regulations.
- Strengthen research network programs and coordination with international donors, business, NGOs and market players.
- Create national institution for regular review of cement market on annual basis; EE technologies and monitoring of implementation of certification.
- Control of tariffs on electricity generation and railway by Antimonopoly Committee of Ministry of National Economy (develop recommendations).
- Implement pilot projects based on EE Map and disseminate Best Available Technology (BAT), lessons learned.
- Organize training programs on capacity building for expert, personnel, R&D representatives, government bodies, NGOs and technical training to prepare bankable projects.
- Provide training facilities for Energy Efficient Training Centers for energy audit in cement production if necessary.

Conclusion

This report is a logical extension of the TNA report for Mitigation in Kazakhstan and is the base for preparation of the further one- a TAP report and aims to outline the barriers and enabling measures for technology application and diffusion.

The power generation and cement production subsectors have been considered main sources of GHG emission, as emissions from these sectors have had an increasing tendency over the years. The proposed measures meet the objectives set out in the national strategic documents and Intended nationally determined contribution (INDC) (Annex V) on GHG emissions reduction and decrease energy intensity of economy.

The findings are the following:

1. Measures for overcoming existing barriers of prioritized technologies have been grouped according to grouped major barriers. The barriers were grouped as follows:
- Economic/financial
- Policy/regulatory
- Capacity building/ Information
- Other

2. There are three cross-cutting issues that constitute common barriers for all prioritized technologies presented in brief below.

Need for fiscal Support Mechanisms

Private initiatives must be supported through different subsidy (loan guarantee, PPA, PPP) using funding from the Energy Efficient Fund, Renewable Energy Fund and the State Fund for Support Entrepreneurship DAMU).market mechanisms (ESCO and carbon market) and grant mechanisms using funding from State, international resources and private banks.

Strengthening capacity building of R & D institutions, stakeholder consultations and access to information at different levels

Improved capacity of R & D institutions with targeted programs and effective coordination with ongoing programs is significant for the successful deployment and dissemination of high priority technologies. Different groups of stakeholders should be involved, such as relevant R & D institutions, Energy Efficient Centers, Associations and NGOs, business, local authorities and experts. Adequate dissemination of information could be organized through the dedicated internet platform on Energy Efficient technologies and websites, as well as more knowledgeable experts. International cooperation should be strengthened for obtaining adequate information and learning material and implementation pilot projects.

Stakeholder Coordination

Better coordination between the donor agencies, private sector initiatives, local administrations and NGOs is needed for application of technologies. This is an opportunity for improving the quality of the projects and achieving better joint results. It will also help to avoid replicated activities and measures in technology deployment. The quality of pilot projects can be significantly improved with stronger coordination and emphasizing of information and outreach components. This will help to collect, analyze and disseminate the practical information, thereby increasing general awareness of the population and the decision makers who would be willing to take the necessary policy decisions.

List of References

Overcoming Barriers to the Transfer and Diffusion to Climate Technologies, TNA Guidebook Series, UNEP Risø Centre on Energy, Climate and Sustainable Development, January 2012.

State Program on industrial development of Kazakhstan for 2015-2019, Decree of the President the Republic of Kazakhstan of August 1, 2014, No.874. Retrieved from www.kaznexinvest.kz/about/files/Ukaz_Prezidenta_RK-GPIIR.docx

Strategic Development Plan of Kazakhstan till 2020, Presidential Decree Republic of Kazakhstan of February 1, 2010, №922. Retrieved from www.akorda.kz/.../Стратегия%20развития%20до%202020%20г..doc

Concept of the Republic of Kazakhstan for the transition to a "Green Economy", Presidential Decree of the Republic of Kazakhstan of May 30, 2013, No. 577. Retrieved from http://www.adilet.gov.kz/ru/node/52403; https://strategy2050.kz/ru/news/1211/

Program on Energy Saving 2020, Kazakhstan Governmental Decree of August 29, 2013.No.904. Retrieved from http://adilet.zan.kz/rus/docs/P1300000904

The State Program of infrastructure development "Nurly Zhol" during 2015 – 2019. Presidential Decree of the Republic of Kazakhstan of April 6, 2015, No.103. Retrieved from http://kfm.gov.kz/ru/activity/strategy-and-program/state-program-on-infrastructure-development-nurly.html

Action Plan for implementation of the State Program "Nurly Zhol" during 2015 – 2019. Governmental Decree of April 27, 2015, No.344. Retrieved from http://tengrinews.kz/zakon/prezident_respubliki_kazahstan/hozyaystvennaya_deyatelnost/id-U1500001030/

Concept of Kazakhstan joining one of the 30 most developed countries in the world, Governmental Decree No.1385 dated 23.12.2013, Retrieved from http://www.nomad.su/?a=3-201312270020

Action Plan for alternative and renewable energy sources development for 2013-2020, Governmental Decree of July, 28, 2014, No.835. Retrieved from http://adilet.zan.kz/rus/docs/P1300000043

Nation plan "100 concrete steps", President N. Nazarbayev reform of September 22, 2015. Retrieved from https://strategy2050.kz/ru/page/message_text2014/

Concept of development of fuel and energy complex of the Republic of Kazakhstan till 2030, Resolution of the Government of the Republic of Kazakhstan of June 28, 2014 № 724. Retrieved from http://tengrinews.kz/zakon/pravitelstvo_respubliki_kazahstan_premer_ministr_rk/promyishlennost/id-P1400000724/

On approval of the feed in tariffs, Kazakhstan Governmental Decree of July, 12, 2014, No.645. Retrieved from http://www.rfc.kegoc.kz/

Linch T., Omarov J. (2010). RETA-6488: CAREC action plan in the energy sector. *Diagnostic study on ratio demand / supply of electricity and infrastructure constraints (pp33-35).* Retrieved from http://www.carecprogram.org/uploads/docs/Foundation-Studies/Diagnostic-Study-CAREC-Energy-Strategy-Pillar1-Full-Report-ru.pdf

Suleimenov K. (2010, December). Energy sector: tendencies and projections. Potential and measures in the field of GHG emissions. Paper presented at UNDP workshop for Academic Purposes, Astana.

Utegenov A,Utegulov N. 2013, 1, *Coal-fired technology for Kazakhstan CHP-Plants on the basis of combination of supercritical steam parameters and fuel combination in a circulating fluidized bed* Messenger 3(22) Almaty Institute of Energy and Communications, ISSN 1999-980, (pp 4-15). Retrieved from www.aipet.kz/university/vestnik/13_322.pdf

Kazakhstan's National Allocation Plan 2013-15. , Kazakhstan Governmental Decree of December, 31, 2013. Retrieved from http://www.ieta.org/resources/Resources/Case_Studies_Worlds_Carbon_Markets/kazakhstan_case_study_may2015.pdf

Cherednicehnko, A. (2014, October 28*).The approaches to the allocation of quotas of Emissions in Kazakhstan based on the principle of benchmarking in cement industry.* Presentation presented at USAID KCCMP workshop, Astana. Retrieved from www.kazccmp.org/OpenLibrary/presentation%201.pdf

International Finance Corporation. World Bank Group.*Jambyl Cement LLP*. Retrieved August 7, 2008, Retrieved from www.ifc.org/ifcext/spiwebsite1.../SPI_DP26891

Kazakhstan Norms of energy consumption. GOK Decree of October,21, 2012. No. 1346. Retrieved from http://www.kazee.kz/userfiles/ufiles/magazine/31284160.pdf

Hrustalev Y., Gavrilov V. (2015).EY-overview of the cement industry of the Eurasian Economic Union. Retrieved from http://www.ey.com/Publication/vwLUAssets/EY-overview-of-the-cement-industry-2015/$FILE/EY-overview-of-the-cement-industry-2015.pdf

Program for the development of construction industry and production of construction materials in the Republic of Kazakhstan for 2010 - 2014 years. Retrieved from http://adilet.zan.kz/rus/docs/P1000001004

Republic of Kazakhstan Technology Needs Assessment for Climate Change Mitigation (n.d.). Retrieved from http://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNR_CRE/e9067c6e3b97459989b2196f12155ad5/447548a763b44013a124ceecc8bd26f5.pdf

State Program Business Road Map -2020. Resolution of the Government of the Republic of Kazakhstan of March 31, 2015, No. 168. Retrieved from http://adilet.zan.kz/rus/docs/P100000301_

International Finance Corporation. World Bank Group. (2005, June).*IFC oversight of expected CO2 emissions from Caspi Production base data and optimization evaluations*. Retrieved from http://www. ifcext.ifc.org/.../CO2%20emissions%20estimate

Ministry of National Economy of the Republic of Kazakhstan (2015, April). Presentation *Reforms to improve Kazakhstan's position in the ranking «Doing Business» in 2016, "Taxation".* Retrieved from kgd.gov.kz/sites/default/files/KGD/nalogooblozhenie.pptx

Eurasian Economic Commission (2012, December).*Technical regulation*. Retrieved from http://www.eurasiancommission.org/ru/Documents/EEC_booklet_Tehreg.pdf

Annex I. LPA and Market maps for prioritized technologies

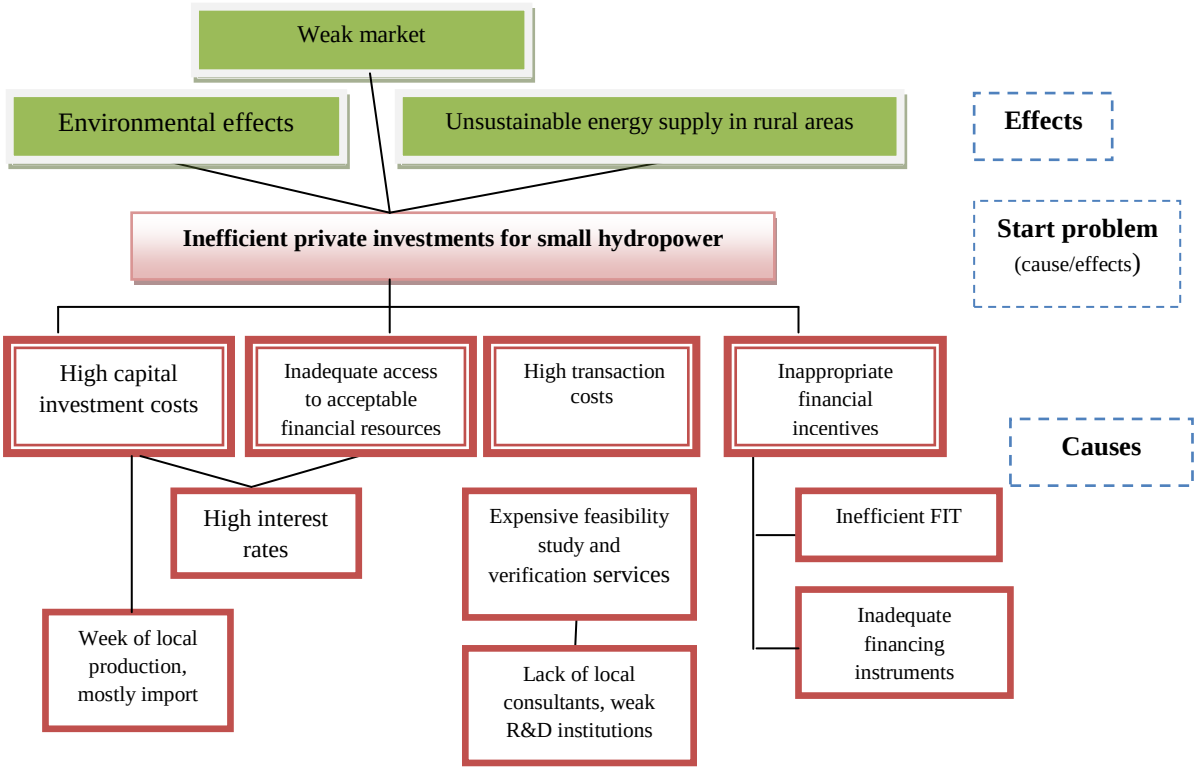

Figure 1: LPA for economic/financial barriers for small hydropower technology

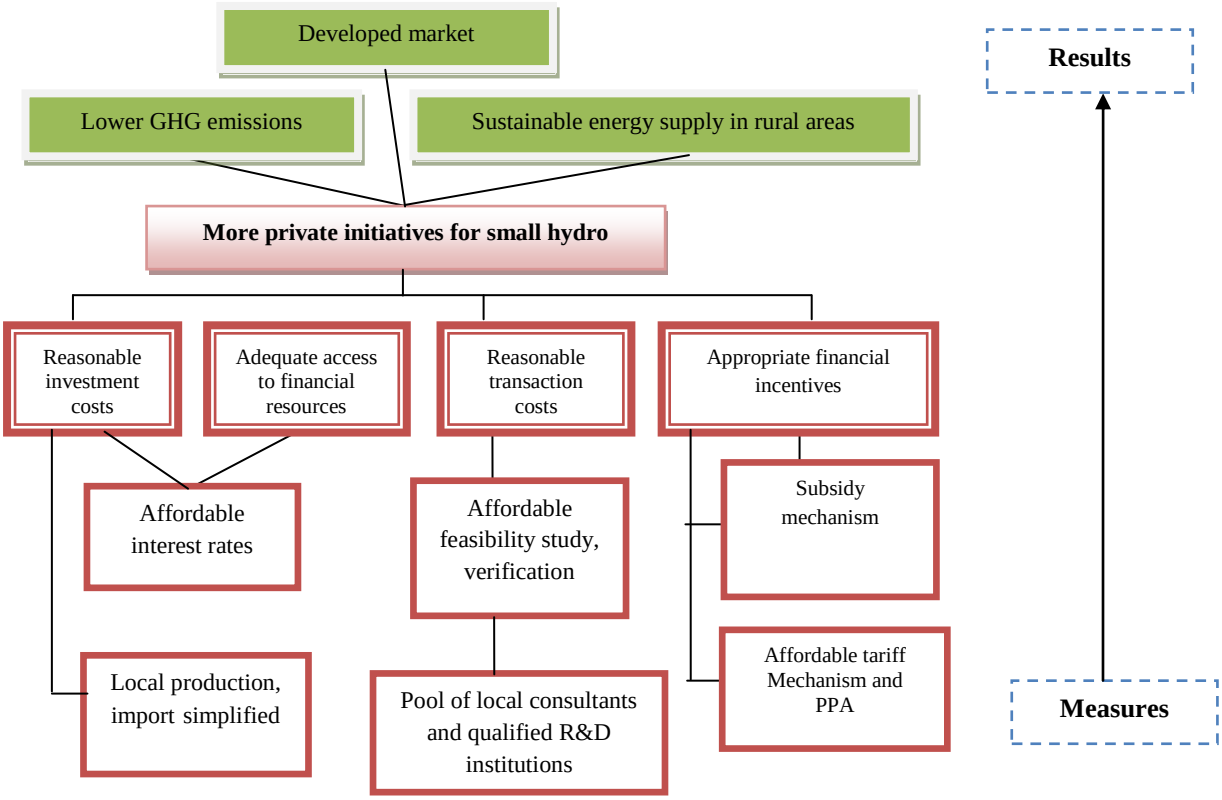

Figure 2: LPA for economic/financial measures for small hydro-power

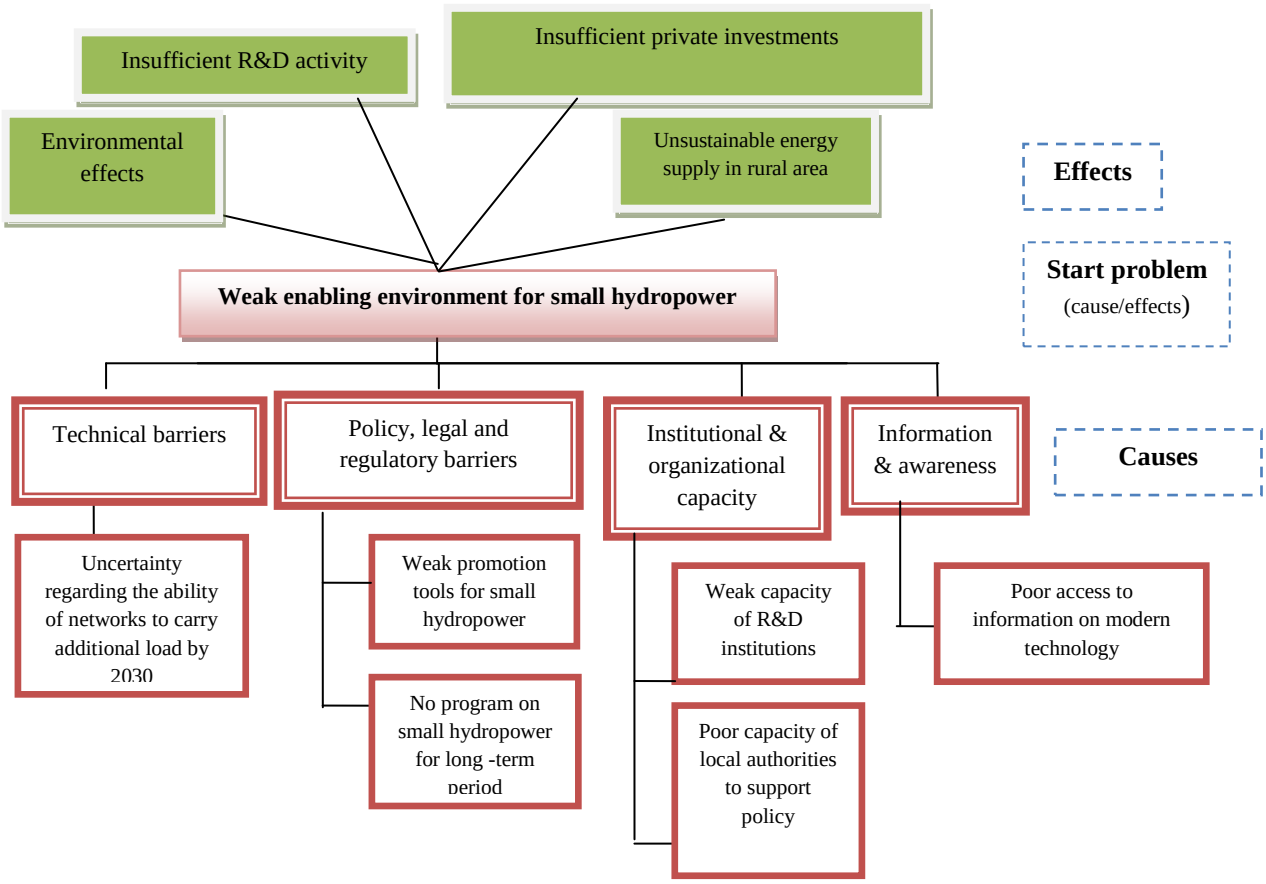

Figure 3: LPA for non-financial barriers of small hydro-power technology

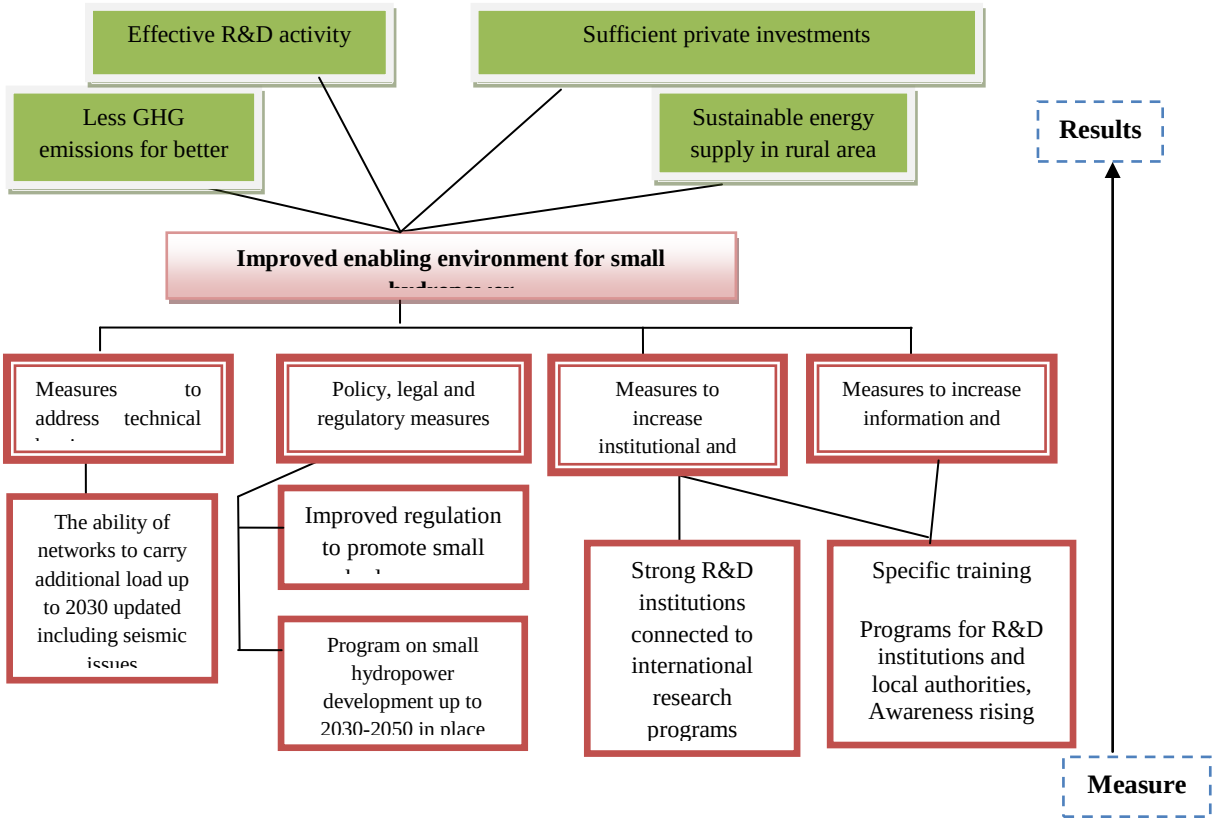

Figure 4: LPA for non-financial measures of small hydro-power technology

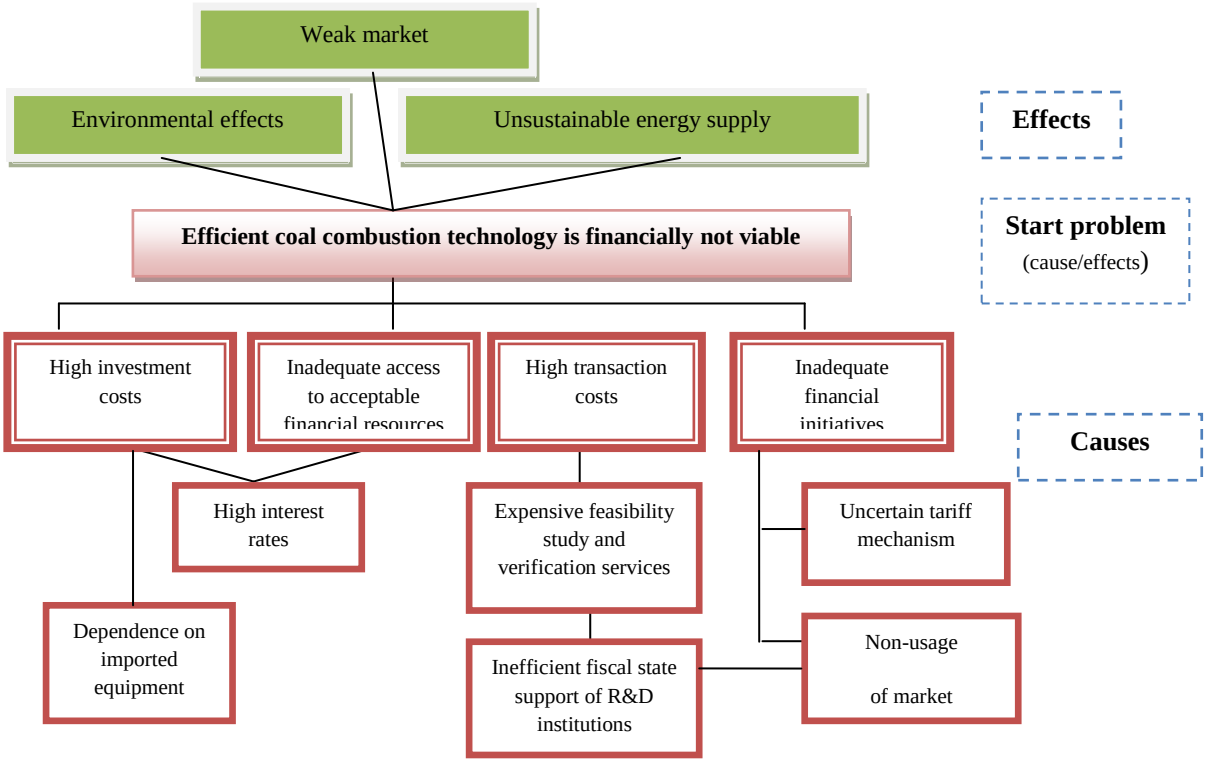

Figure 5. LPA for economic/financial barriers for efficient coal combusting technology

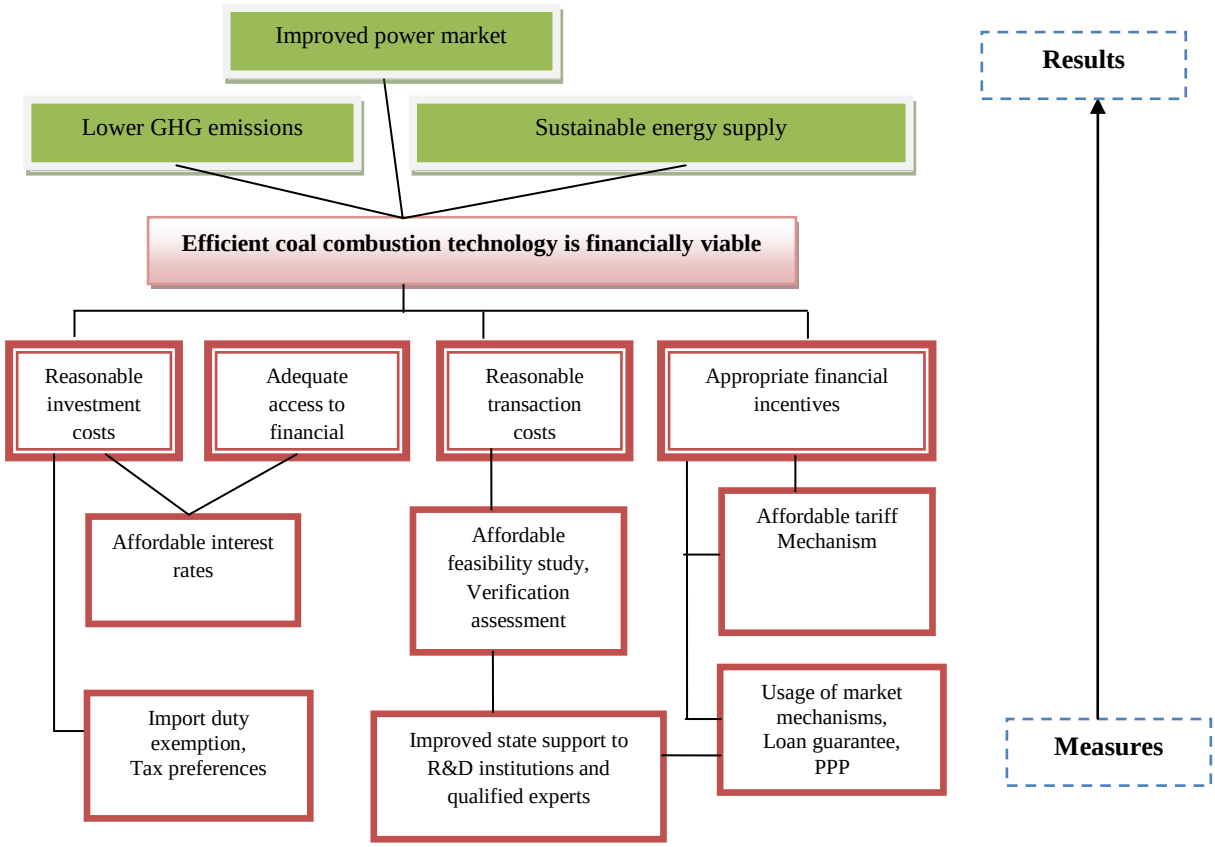

Figure 6. LPA for economic/financial measures for efficient coal combusting technology

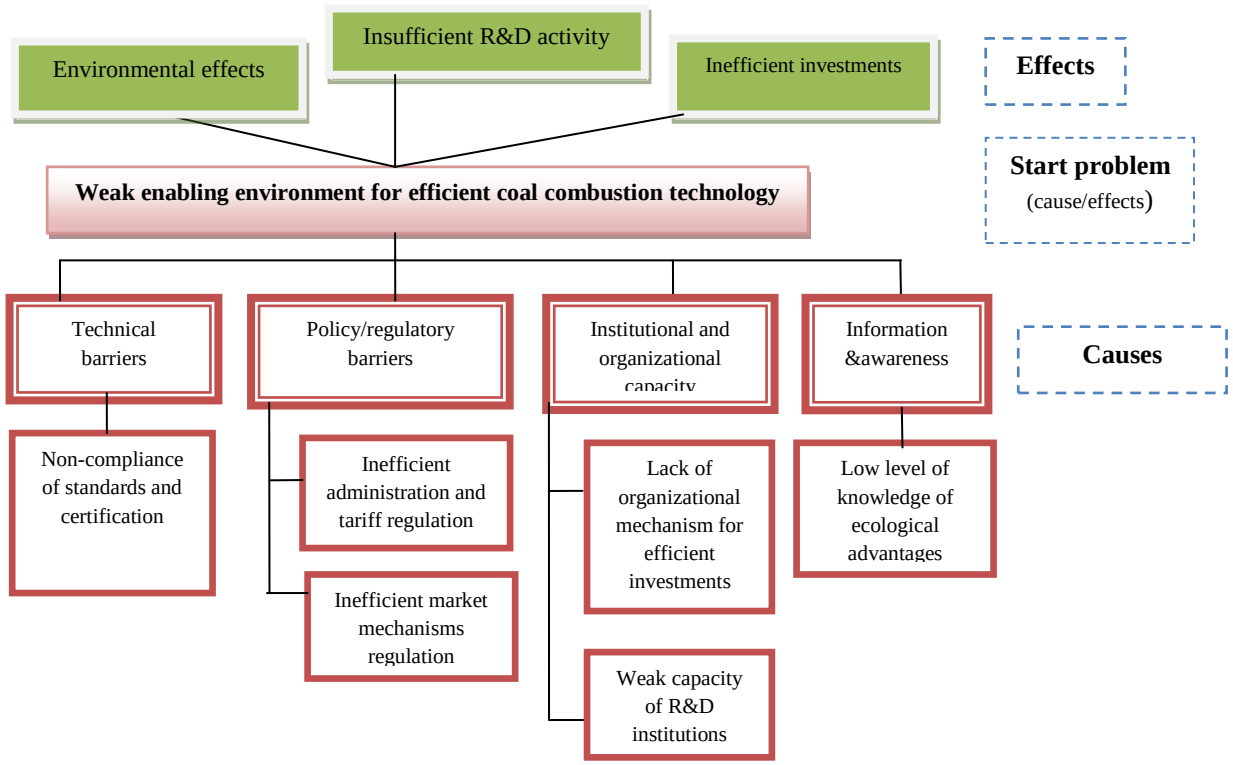

Figure 7: LPA for non-financial barriers for efficient coal combustion technology

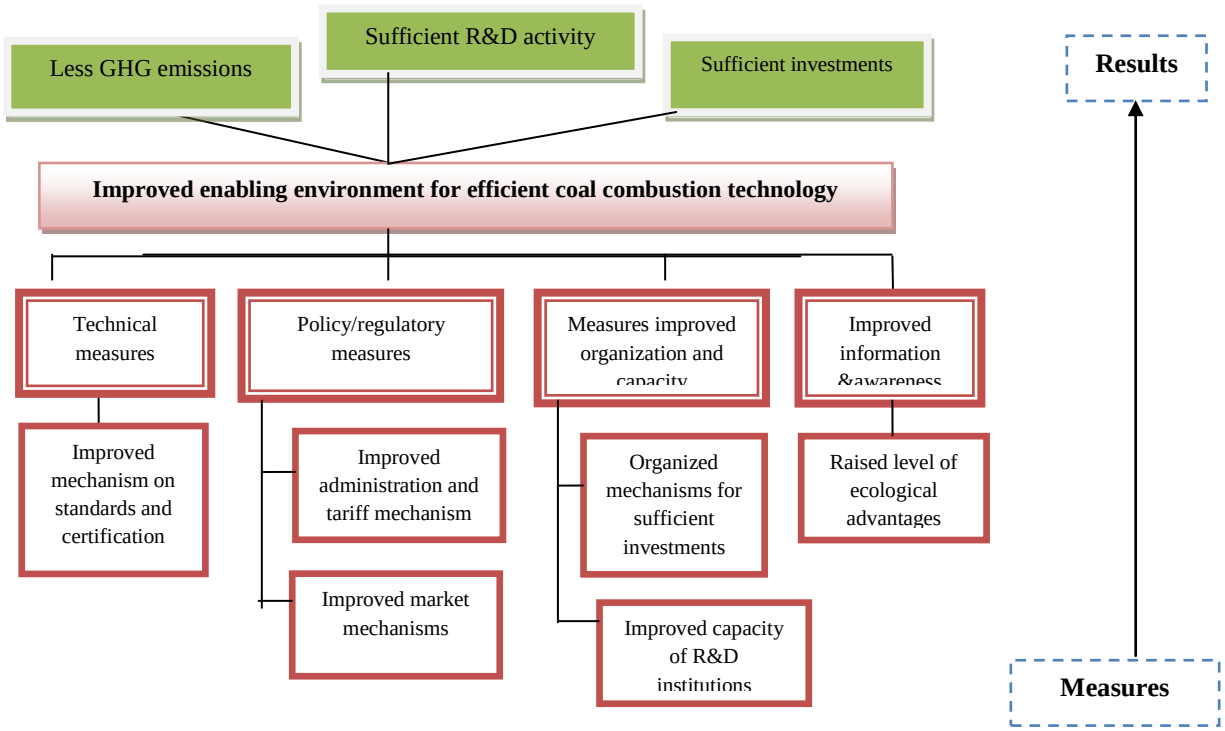

Figure 8: LPA for non-financial measures for efficient coal combustion technology

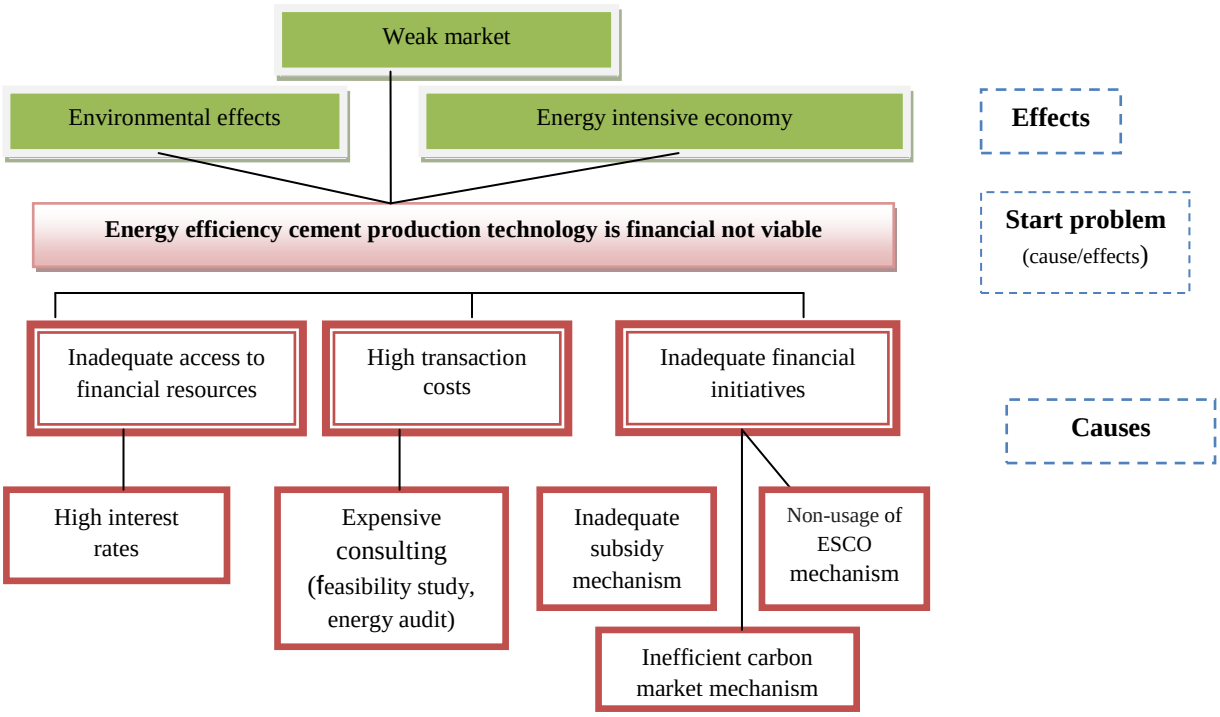

Figure 9: LPA for financial barriers related to energy efficiency cement production technology

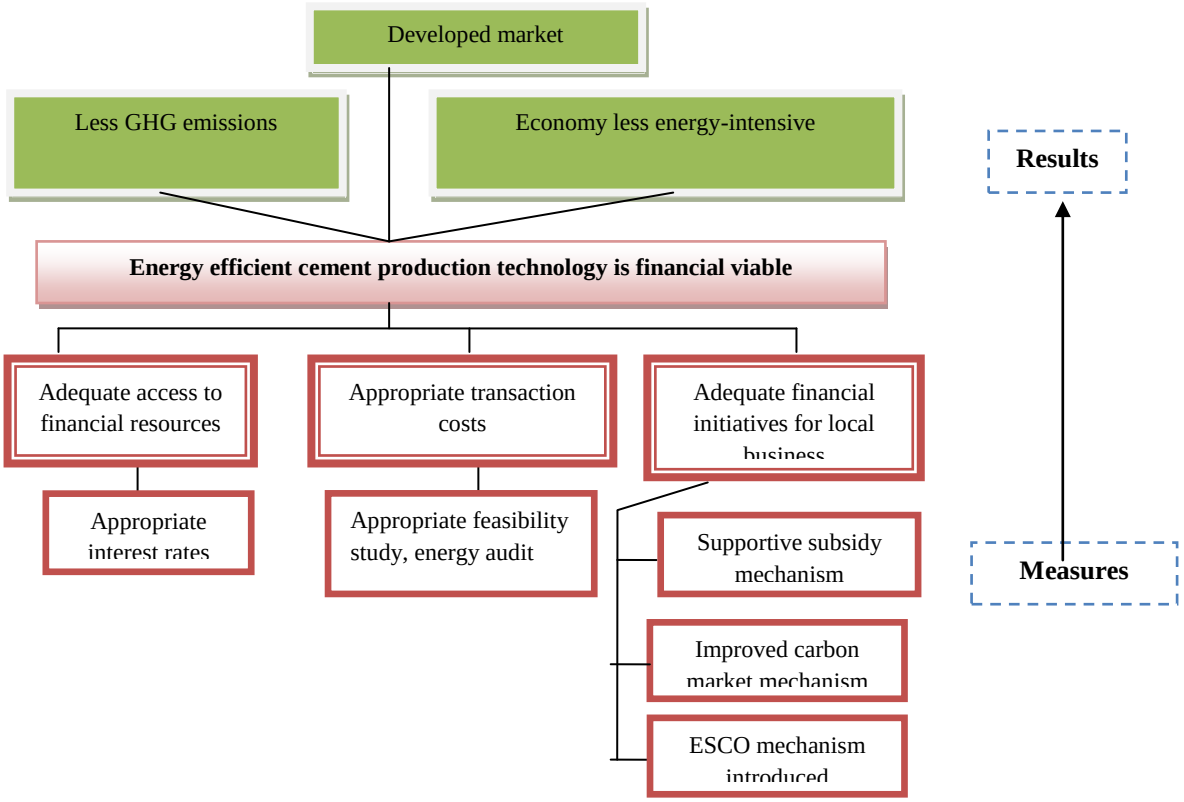

Figure 10: LPA for economic/financial measures related to energy efficiency technology in cement production

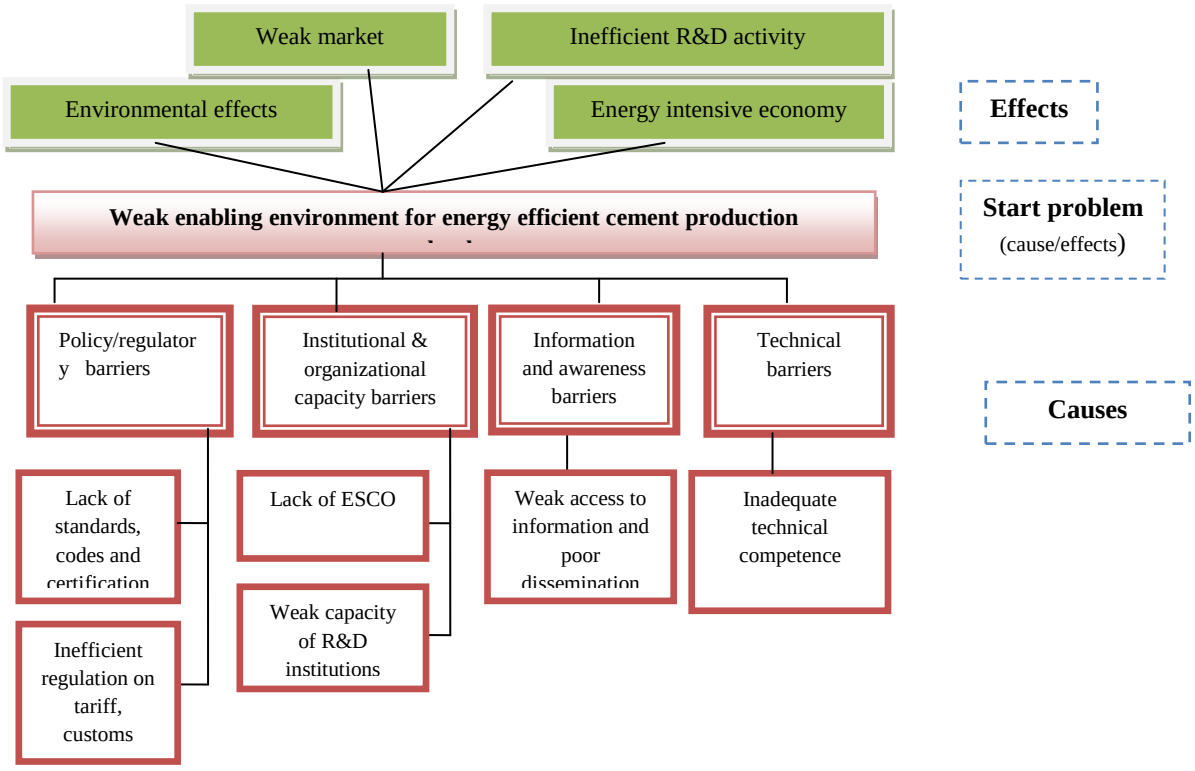

Figure 11: LPA for non-financial barriers related to related to energy efficiency cement production technology

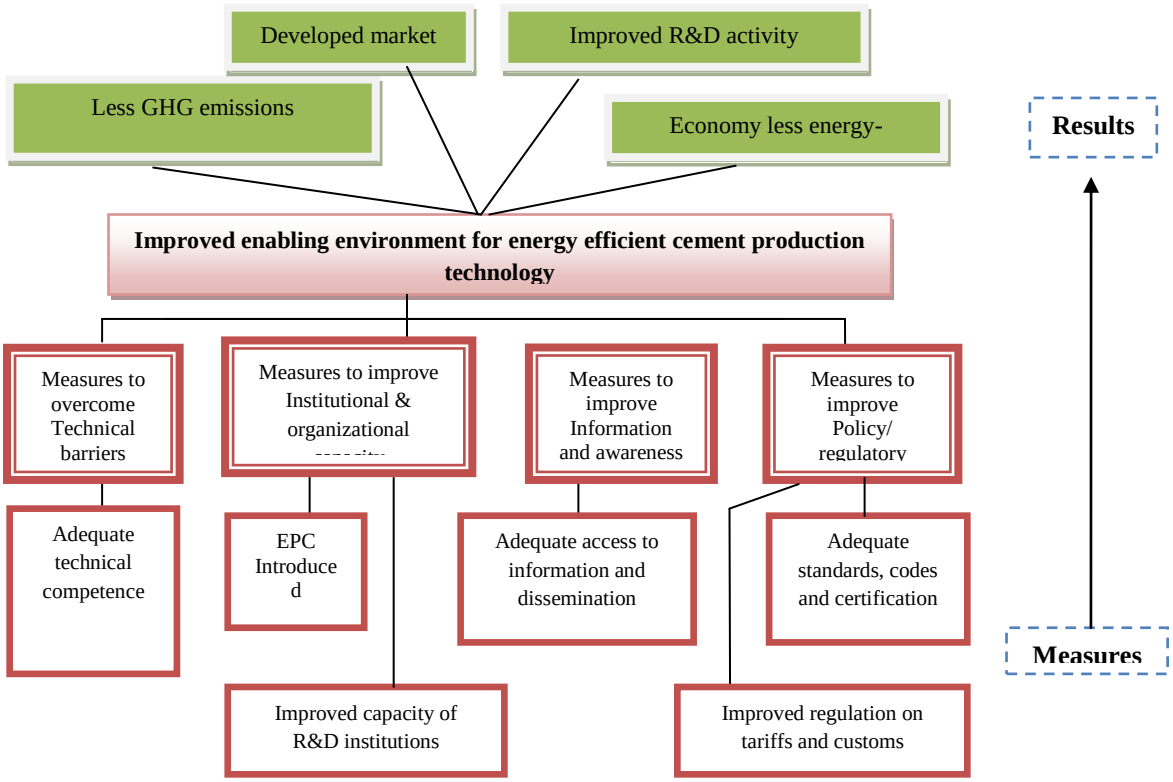

Figure 12: LPA for non-financial measures related to related to energy efficiency cement production technology

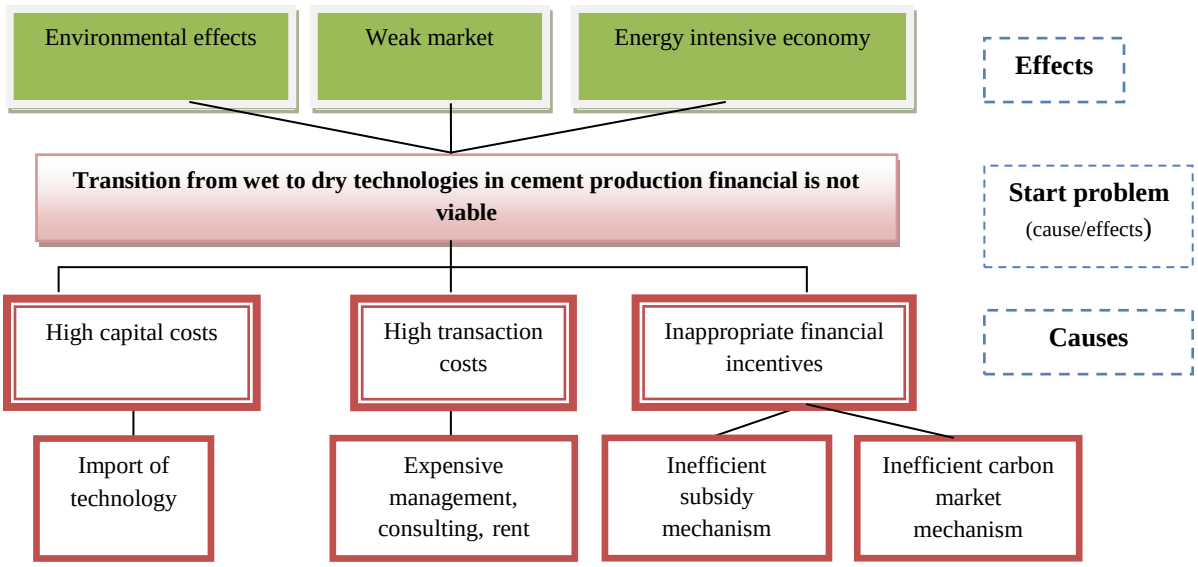

Figure 13: LPA from wet to dry technology in cement production

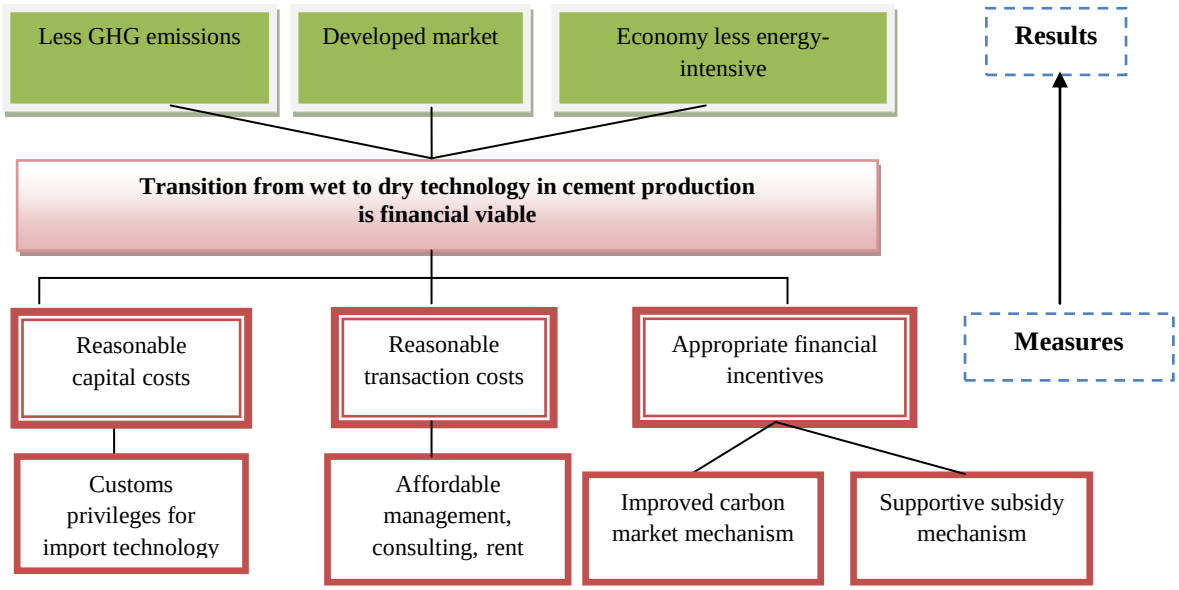

Figure 14: LPA for financial measures from wet to dry technology in cement production

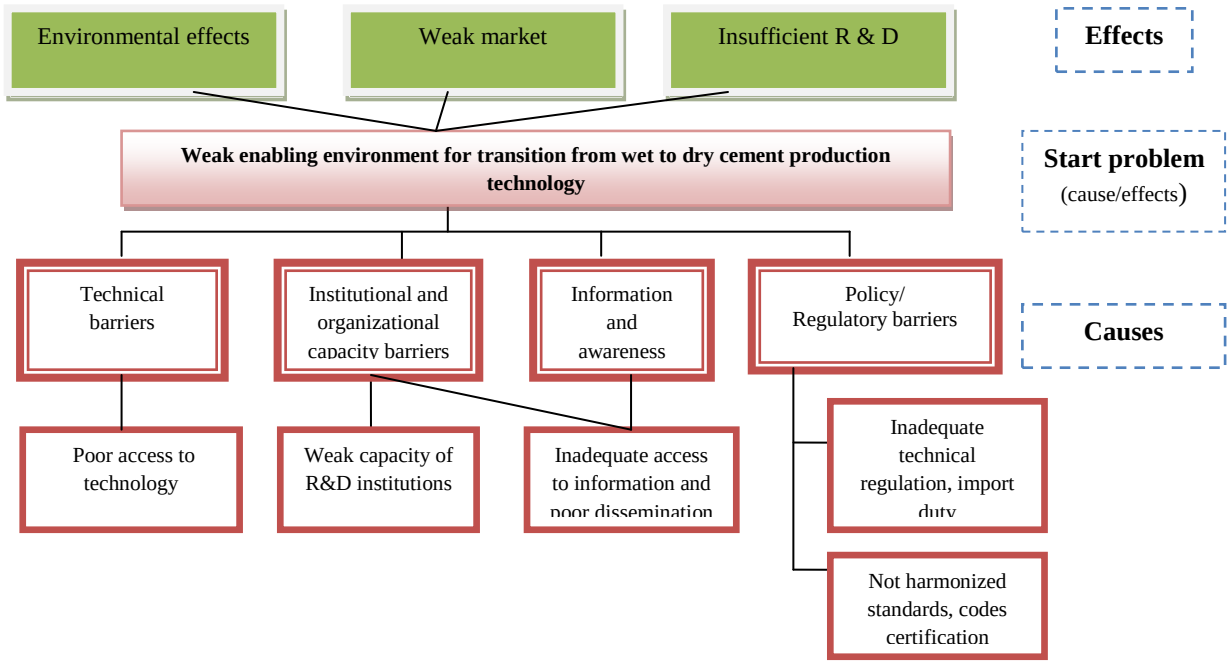

Figure 15: LPA for non-financial barriers related to transition from wet to dry technology in cement production

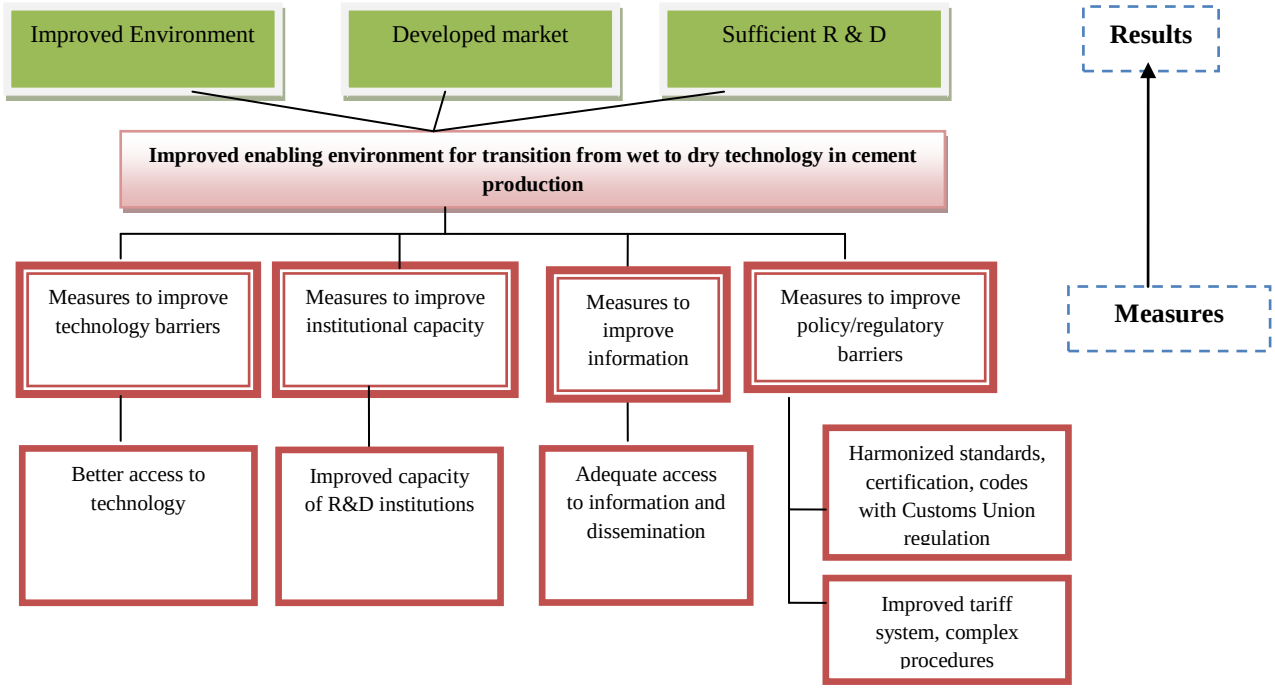

Figure 16: LPA for non-financial measures related to transition from wet to dry technology in cement production

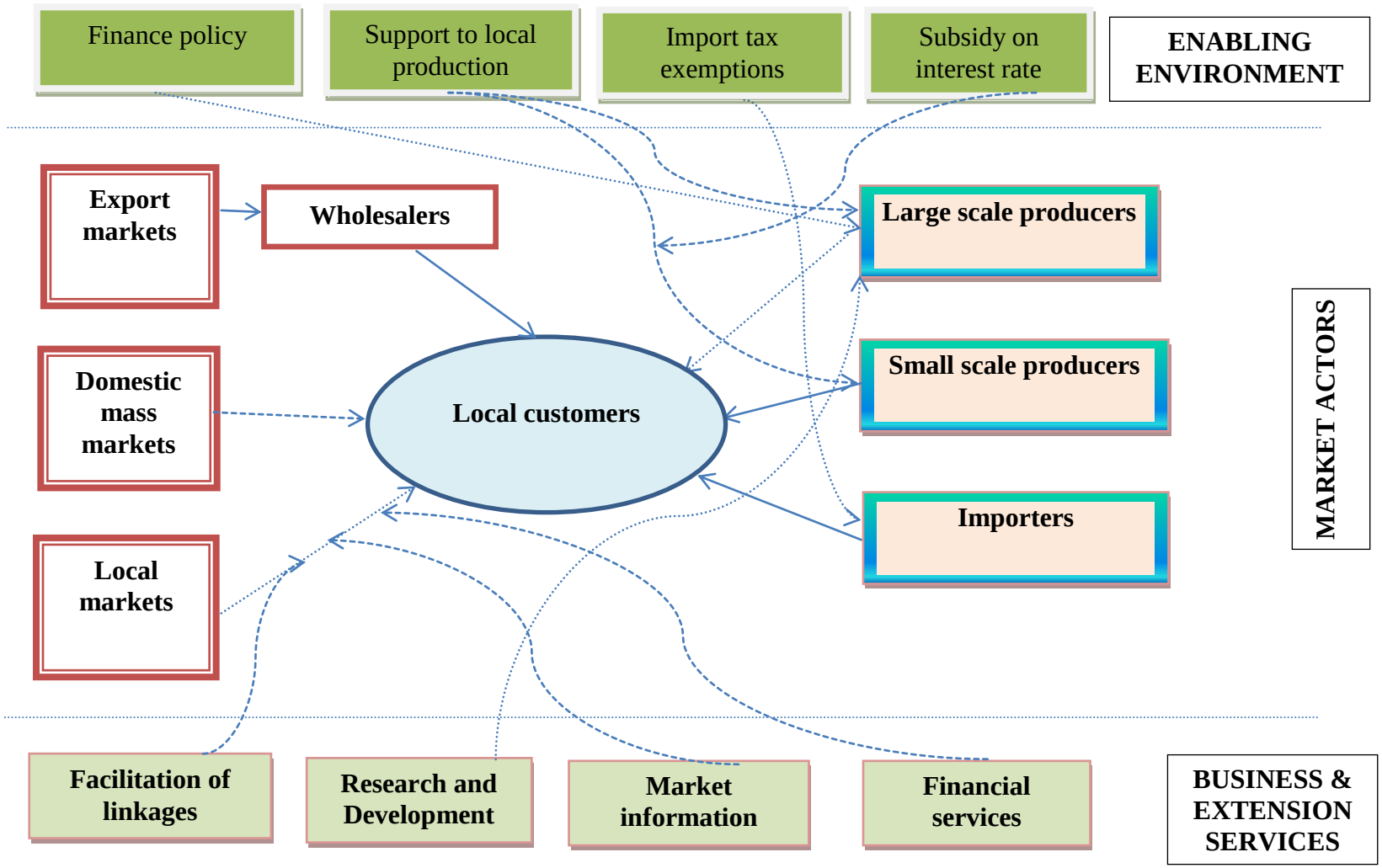

Figure 17. Market mapping for prioritized technologies in cement production subsector

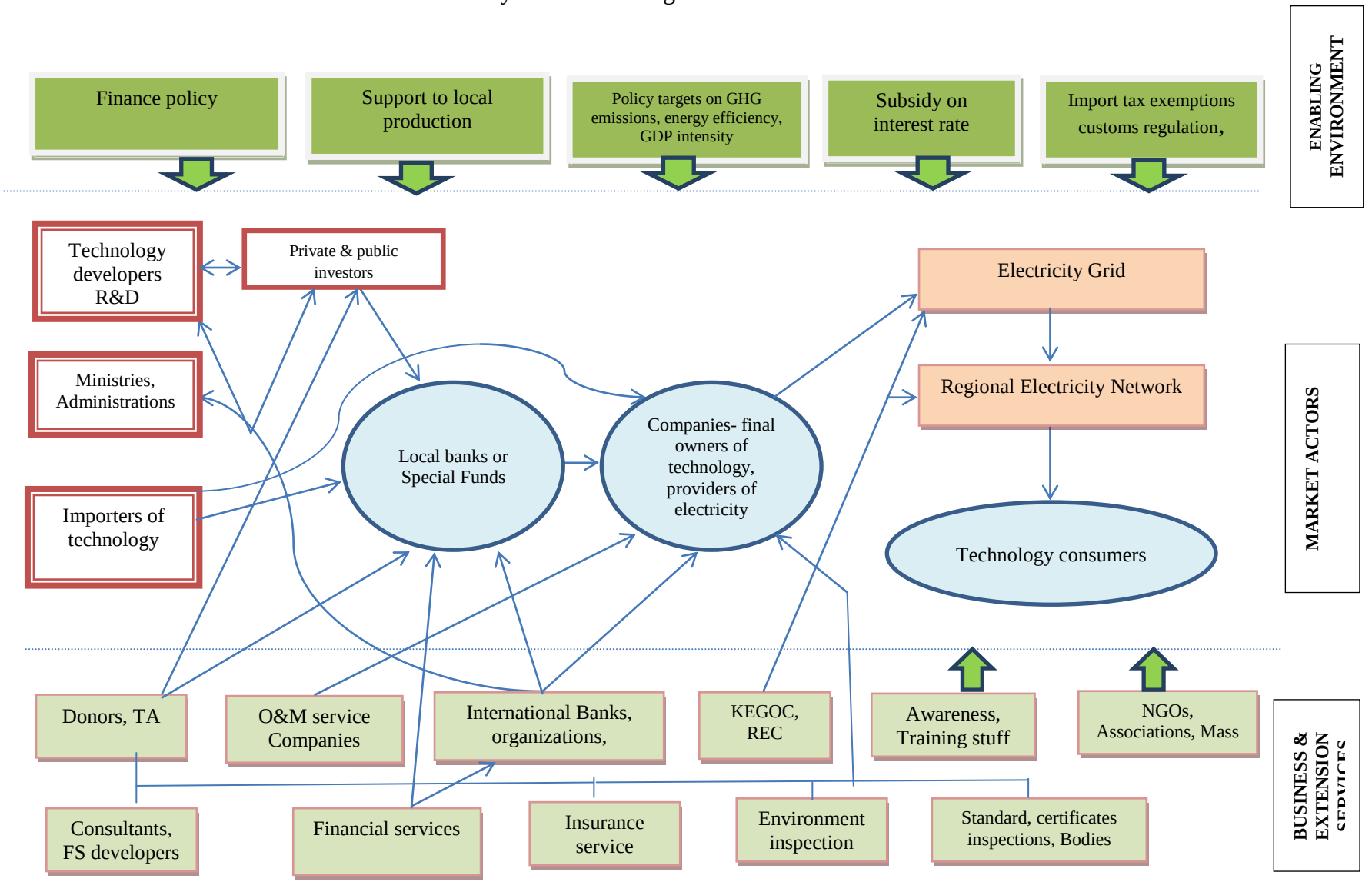

Figure 18. Market mapping for prioritized technologies in power production subsector

Annex II. Summary of initial lists of barriers for prioritized technologies

The summary of each prioritized technology has been completed based on Questionnaire (Annex VI) filled by members of working groups related to technologies and while discussing between participants of working groups during workshop.

Table 15. Summary of initial long list of barriers for small hydropower technology

Barrier within category	Score (1-5)	Elements of barriers	Dimensions of barrier elements
1. Economic and financial barriers			
High cost of capital	3	Capital market is undeveloped	The establishment of Fund for RES financing is delayed and still under consideration. There is lack of venture funds in Kazakhstan for financing small hydro power.
High capital costs	5	High interest rates Weak local production	Loan interest rate of commercial banks is 17 % per year So far, up to 95% of power equipment and spare parts purchased abroad
high transaction costs	5	High cost of preparing project (-feasibility studies expensive -gathering information is difficult, difficult to develop baseline studies - -High verification costs	There is lack of local capacity to develop Feasibility Study for construction of small scale HPP. Verification costs are about 10-15% of project costs.
Lack or inadequate access to financial resources	4	-distorted capital market (poor creditworthiness -Lack of access to credit for certain consumers - Lack of financing instruments and institutions	It is impossible to get long term credit for construction of small scale HPP, no loan guarantee. Banks are not interested in such projects because payback period is 4.5-7 years
Inappropriate financial incentives	5	Insufficient incentives to develop climate technologies Existing FITs do not cover costs of small HPP projects	There is Action Plan on RES to be financed from private donors and loans but There is no reduction of import taxes for Climate Change Technologies. VAT -12% official inflation will be around 10-12 % in 2016 according to finance.nur.kz' Uncertainty among rural population, lack of information and readiness of local authorities in climate projects
Uncertain financial Environment	2	Reform of local banks (bank merger or bankruptcy of some banks)	Political decision
Uncertain macroeconomic Environment(inflation rate, currency exchange	1	Unstable exchange rates	Fluctuating exchange rate of Tenge (KZT), 1USD -150 KZT(2015), 1 USD- 360 KZT(2016),

rate)			no coherent monetary policy The sector looks for foreign and local investments, Small HPPs are imported.
2. Non-financial barriers			
Market imperfection			
Restricted access to technology	1	- Technology not freely available in the market - problems in import of technology or equipment due to restrictive policies, taxes etc.	RES development is restricted by 3% by 2020. Custom taxes are average 7.5-7.8% and only the equipment for EXPO 2017 will be zero
Underdeveloped Competition	2	The cost of electricity generated at conventional sources is twice cheaper than electricity generated by small scale HPP	Considerable importance is given to large scale hydro power plants in energy sector (this is apolitical nature). FIT (small scale HPP)- 16.71 KZT/kWh (without VAT or 18.72 KZT/kWh with VAT)while other traditional tariff for consumers= 9.64 KZT/kWh (with VAT)
Market control by dominant incumbents	3	Legislation on market capacity is still under development	Share of RES is 0.5% in 2014 (the implementation of goal indicator delays because the Government provides weak conditions for market development
Policy, legal and regulatory			
Insufficient permits procedures	5	Complicated permission system, not simplified, procedures are delays	A lot of documents need to provide to different organizations in order to get access to capital or permission, provision of land Procedures need to be streamlined
Problems in land acquisition for construction of small HPPs	1	Land cadastre in regions are not updated and there is haziness of land purchasing for construction of HPPs	Land could be sold only to local population, the cadastre was updated five years ago only and there is unclear situation at regional level
Inefficient legislation/regulation on FITs and single purchaser organization Billing Financial Center	5	FITs are approved for 15 years in KZT only. Single buyer (a Billing and financial center) of electricity from renewable energy sources is not a state-owned enterprise. Not strong enough guarantee fund for solvency payments BFC tariffs for banks	lack of tariff(FIT) adjustment in accordance with the exchange rate of KZT due to recent devaluation in 2015(rate jumped at least twice)
Lack of long-term political commitment	5	Absent of sectoral program on small hydropower development for long term(up to 2030 and 2050)	Only RES Action Plan up to 2020 was developed and it contain only list of potential projects for the technology. There is investor's risk: how the company can guarantee the return of recoupment from all RES including small hydro

Network failures			
Weak connectivity between actors favoring the new technology	4	Stakeholders' consultation culture missing Difficult communication because no network between actors	Roles of the stakeholders in implementation of small scale HPP projects are uncertain. Gaps in communication and there are technical problems for communication in rural areas because of big territory of the country
Lack of involvement of stakeholders re small hydro technology in decision-making process	3	Less information and privileges could be found in State programs related to small hydro power	Lack of NGOs are care on small hydro power promotion, lack of stakeholders are involved into process
Institutional and organizational capacity			
Weak organizational capacity of local authorities (Akimats) to support policy on regional level	4	Lack of local authorities to support policy on small hydro power promotion	Lack of programs developed by some local authorities to develop small hydro power
Lack of capacity of consultants in R&D institutions (to develop FS, develop projects, NAMA, etc.)	5	Weak capacity of R&D institutions because of lack of financing of this activity Feasibility Study as a rule is prepared by international consultants when foreign investment is expected	There is specialized research institute but staff turnover brings to low capacity of researches
Small size of local companies	2	Small SME have lack of financing , low capacity of management and inadequate knowledge of benefits of small hydro power	Low capacity building of stuff for preparing projects
Human skill			
Inadequate personnel for preparing projects	3	Lack of domestic consultants (to reduce transaction costs)	Lack of local consultants for construction, bankable projects development/.
Inadequate training facilities	2	Lack of experts to train	High-expertise professionals to conduct workshop and training on implementation of TPP project are very few in the country; and not training system is set up.
Social, cultural and behavioral			
Traditions and habits	2	Resistance to change, due to cultural reasons	The most used language in South Kazakhstan is Kazakh while technical and economic information is mostly in Russian
Information and awareness			
Poor dissemination of information to technology users	5	Poor dissemination of information on product, benefits, costs, financing sources, potential project developers related to small hydropower technology -	least 3-4 articles could found in Internet relating to small hydropower implementing in Kazakhstan and it is impossible to monitor the status of promotin of small hydropower

Inadequate information on market and financing opportunities	5	Lack of market information provided on the governmental level and by international resources	No special info is provided by Associations related to small hydropower market
Lack of media interest in promoting technologies	2	Absence of TV show related to small hydropower, only general phrases on RES development	No TV translation on small hydropower, at least 3-4 articles could found in Internet relating to small hydropower implementing
Technical			
Poor O&M facilities	3	Lack of skilled personnel	No skilled personnel for small scale HPPs
Poor performance in annual terms	5	Small HPPs work on season basis. Irrigation requirements could decrease the performance by decreasing of water flow(depending on season)	The share of electricity produced by SHPP is less 0,4% in total generation per year. There are constrains due to high seismic activity in the South of Kazakhstan, so need additional technical calculations and specific equipment
System constraints	3	According to policy the development of RES is limited and development of traditional power is priority.	The government over-regulates renewable energy investors by specifying the areas of location of objects and the allowable amount of renewable energy
Uncertainty regarding the ability of networks to carry additional load	4	Uncertainty regarding the ability of networks to carry the load, related to the implementation of renewable energy sources, even for already announced plans	This load is 3,055 MW by 2020
Other Barriers			
Administrative requirements complicated	3	Administrative requirements from different donors, finance institutions and government branches including local authorities for providing grid connection	There is high probability that donor and funding organizations might put additional requirements on reducing negative impacts on environments Bureaucracy in work of local authorities has place from one hand and local capacity from the other

Table 16. Summary of initial long list of barriers for efficient coal combustion technology

Barrier within category	Score (1-5)	Elements of barriers	Dimensions of barrier elements
1. Economic and financial barriers			
High cost of capital	2	high tax on profit	20% in Kazakhstan
High capital costs	4	High interest rates	Loan interest rate of commercial banks is 17.3 % per year since 2013

	3	expensive gas cleaning system	Unit cost of cleaning system is $ 350-400 /kW of installed power capacity, which leads to a significant rise in the cost of equipment coal-fired plants - 30% or more. However, in the territory of the existing thermal power station, as a rule, there are no opportunities for placing bulky and costly gas purification devices
	5	Import of equipment and spare parts	So far, up to 95% of power equipment and spare parts purchased abroad
	3	High cost for construction and installation work	The absence of large-scale power inputs inevitably leads to a rise in the cost of construction and installation works in the electric power industry as a whole. The cost in Kazakhstan is 2 times higher than in Europe
High transaction costs	4	Feasibility studies expensive, gathering information is difficult High verification costs for carbon projects	Technical and Economic Feasibility study of large scale TPP is conducted by foreign experts and costs are high, the same verification is provided by foreign companies, thus costs are high. Verification costs at local level are 10-15% of total cost.
Economies of scale only at high investment level	3	Modernization of energy infrastructure could be required for technology implementation	The increase of investment costs could be expected at least 30-50%, more detailed feasibility study could be necessary to develop again
Inadequate access to financial resources	5	High cost of loans Lack of access to credit for certain consumers	It is difficult to get long term credit for construction of Thermal Power Plant using effective coal combusting. Cross-subsidization mechanism is available in power and heat generation and provides non transparent situation.
Inadequate financial incentives	**5**	Uncertain tariff mechanism	Methodologies of tariff calculation (on the cost method) is complicated non-use of economies of scale in the distribution of costs for maintenance of electrical networks and overheads by A large number of energy transmission organizations Tariffs calculation not transparent high specific costs of electricity transmission services as part of tariff
	4	Non-usage of market	National Allocation Plan 2016-

		mechanisms	2020 was developed and suspended up to 2018. Internal projects and JI or CDM are not registered
	2	high import duties on equipment	There is regulation on exemption of import duty for equipment in the countries of Customs Union (including Kazakhstan) for projects included into Investment program such as SPAID 2
Uncertain macroeconomic environment	1	Unstable exchange rates	1 USD= 150 KZT (2015) 1 USD= 360 KZT(2016)
2. Non-financial barriers			
Market imperfection			
Limited access to technology	1	Difficult access to international market	Kazakhstan has rich experience of operating conventional TPPs but has no any experience in constructing and operating supercritical high-efficiency TPPs
Unstable market situation	2	Procurement of international technical investment from donors is hindered	Risk on decrease of oil prices effect the procurement of investments and poor developed markets
Low level of preparing contracts for transfer of technology to the market	3	Low capacity of specialists	Lack of training on the specific issues
Inefficient management of market of power capacity	3	Lack of liberalization in energy sector - Missing or under-developed supply channels (e.g., logistic problems)	Market competition is not introduced fully, non-transparent markets Policy to improve energy generation efficiency and introduce advanced technology is unclear. Roles and responsibilities matrix of the sectoral administration and regulatory authorities is inefficient.
Underdeveloped competition	2	Insufficient number of competitors	Difficulties to raise large investments in the unstable economic situation
Policy, legal and regulatory			
Non-transparent and cumbersome administrative procedures	4	Power generation permit are complicated Law on market power capacity is still under development	Existing regulation on permits needs to be simplified, developed further. Business is in opposition for implementation of climate technologies because of high fines, other restrictions available in regulation thus there is lack of government faith in climate technologies
Inefficient tariff regulation	5	Tariff system is not transparent	Recent limited tariffs work for 2009-2015 and need to be improved. There is delay in decision making process. The

			tariffs defined based on benchmark principle is complicated. The annual limited growth rate is 7%
Inefficient enforcement	1	Insufficient willingness or ability to enforce laws and regulations	Lobby of business slows the enforcement of some legislation
Inefficient market mechanisms regulation	4	National Allocation Plan (NAP) for 2016-2020 was developed Insufficient mechanism of state regulation of Emissions Trading Scheme available in Kazakhstan since 2013	NAP 2016-2020 is suspended since 2016 and it is unclear for future. Insufficient control over the observance of transparency when granting a quota, lack of support for internal projects to reduce GHG emissions, as well as non-participation of the State in the implementation of the quotas under the terms of the auction.
Network failures			
Weak coordination between actors favoring the new technology	3	Insufficient cooperation between industries and R&D institutions	Roles and inputs of relevant ministries and authorities, local administration and local community are uncertain. Collaboration among these organizations is weak.
R&D institutions are not involved into international research network programs	2	Weak coordination of E&D institutions with similar international institutions for research	No network of research programs related to efficient coal combusting technology with other countries and weak R&D capacity of local R&D institutions
Institutional and organizational capacity			
Lack of organizational mechanism to promote effective investment Lack of capacity of R&D institutions	5	Poor capacity to organize mechanisms for efficient investments of private sector into introduction of efficient coal combusting technology Lack of institutions to develop Feasibility studies	Public –Private Partnership or Technology Alliance with technology provider to transfer technology are not established in Kazakhstan to attract private investment to introduce efficient coal combusting technology Lack of interest or capacity in existing institutions. No consolidated information database of the energy sector is available
Weak capacity of local authorities to support environmental policy for efficient coal combusting	4	Local authorities have not adequate capacity to support environmental policy for coal efficient combustion	Local authorities do not include such projects into program of development of the region
Lack of institutions to generate and disseminate	3	The existing Research and Design power system design institute in Almaty does not	There are institutions on oil and gas and lack of institutions who could deal with efficient coal

information		does not deal with this problem	combusting technology, Lack of capacity. GOK provides some support R&D institutions but it is poor
Human skills			
Inadequate personnel for preparing projects	4	Lack of domestic consultants (to reduce transaction costs)	Training programs are not enough for local consultants for this technology
Lack of service and maintenance specialists	4	Lack of local technical specialists	Lack of training and educational programs for local specialist in order to provide adequate service and maintenance of equipment
Information and awareness			
Language	2	Lack of people who could read in English	There are certain language barriers.
Inadequate information	4	Lack of knowledge or access to information on technical data, market information, financial resources	Lack of activities to increase public awareness about the importance of efficient coal combusting technologies for thermal power plants
Poor dissemination of information to technology users	3	Few reports in Kazakhstan are available related to this technology	Reports and papers are mostly available in international organizations or in Samruk-Kazyna, widely not available, lack of institutions to disseminate professional info
Low level of knowledge of ecological advantages	5	Lack of training programs for specific audience	Poor trained R&D institutions, technical stuff and local authorities (the level is at least 20%)
Technical			
Poor O&M facilities	3	Limited availability of spare parts (few suppliers, long supply routes) Lack of skilled personnel	All of spare parts and equipment of TPPs are imported. Lack of training for personnel
Equipment does not meet energy efficiency technical standards and certification	5	Efficiency of existing turbine plant is 35% while efficiency of modern for supercritical parameters is 45-46% with potential to increase to 53-55%	According to the forecast it is expected to increase the level of total electricity production up to 150.2 billion kW h (without energy efficiency this indicator will be 170 billion kWh) by 2030.There is lack of information and capacity of institutions to set standards, no regulation on these issues
High wear of the equipment	4	Out date technologies on coal fired power plants are use	The wear of existing coal fired plants is 45- 70% according to the Concept of energy Complex development up to 2030
Low skills of technical services	3	Lack of capacity of personnel	Lack of educated personnel to provide sufficient technical services
Insufficient expertise	2	Lack of capacity and awareness	No facilities and educated

		on expertise issues for this technology	personnel to provide sufficient **expertise**
Other Barriers			
Environmental impacts	3	Local air pollution (lot of ash has place and negative impact on environment.)	43 - 45% of total emissions of pollutants into the atmosphere from stationary sources. Emissions from CHP are prevalent - up to 70%.

Table 17. Summary of initial list of barriers identified for energy efficient cement production technology

Barrier within category	Score (1-5)	Elements of barriers	Dimensions of barrier elements
1. Economic and financial barriers			
High cost of capital	3	Capital market is undeveloped	There is lack of venture funds in Kazakhstan. There are four venture funds but their activity is not well developed
High transaction n costs	4	Expensive feasibility studies and energy audits	There is lack of local capacity to develop feasibility study, baseline, and verification reports. Business is forced to address to foreign consulting (expensive)
Lack or inadequate access to financial resources	5	Lack of access to credit for certain consumers and high interest rates	Innovation grants are available for technology only for projects included into industrialization Map of the Program. Only two projects are included into this MAP by 2020
Inadequate financial initiatives for local business	5	Lack of ESCO mechanism Inefficient carbon market mechanism Lack on not effective of subsidy mechanism for energy efficient cement production technology	Carbon market mechanism implementation was suspended uo to 2018 No any ESCO in cement production established Lack of state support through DAMU fund(no any project on energy efficiency in cement production was supported)
High cost of capital	2	Lack of venture capital	Only 4 venture funds work
Uncertain macroeconomic environment	1	Unstable exchange rates	floating exchange rate of Tenge, 1USD -150 KZT(2015), 1 USD-360 KZT (2016), no coherent monetary policy
2. Non-financial barriers			
Market imperfection			
Low competitiveness	4	Energy efficient (EE) goods that could be used are purchased abroad and/or very low competitive on local market	Local goods or devices often do not compete with those produces abroad on technical or other characteristics , so SME purchase import goods for higher price to

			use for promoting energy efficient cement production
Dumping	3	There are examples of dumping with Russia and Iran	The price of cement purchased from Russia in August 2014 was less than 9 000 KZT (without VAT), which is lower than the price of domestic cement (12500 KZT/t). But this happens not very often
Policy, legal and regulatory			
The uncontrolled growth of tariffs for transportation of raw materials and energy,	4	non-transparent tariff adjustment procedure	the reason for rise in price of domestic cement to customers in Kazakhstan are a great distance, and the uncontrolled growth of tariffs for electricity (54% in the last 5 years) and rail transport (32% over the last 3 years).
Inefficient customs and tax regulation	4	Regulation is according to existing legislation	No special measures are included into customs (no special import duty) and tax regulation for construction of new energy efficient cement plants
Inadequate standards, codes and certification	5	National standards are not harmonized with EEU regulation On the territory of Eurasian Economic Union (EEU) (other countries than Kazakhstan) standards are not obligatory	Technical regulation is not adequate for standard and certification, standards should be obligatory
Network failures			
Weal coordination between market actors, energy audit centers	3	Stakeholders' consultation culture missing -Difficult communication	Four energy center are established only (each for one region). Due to long distances there is poor coordination, lack of seminars and consultations
Lack of involvement of stakeholders re small hydro technology in decision-making process	1	Less information and privileges could be found in State programs related to energy efficient cement production technology	Lack of NGOs are care on energy efficient cement production technology promotion, lack of stakeholders are involved into process
Institutional and organizational capacity			
Lack of ESCO	4	The ESCO mechanism in industry is at initial phase	No any energy service company (ESCO) was established in cement industry or provide service for cement industry up to middle of 2016 according to the Ministry of energy
Weak capacity of R&D institutions	5	Lack of training for R&D institutions experts	Training of experts from R&D institutions, engineers cover at least 5-7%
Small size of local companies (SME) in cement production for promotion of this technology	3	Limited ability to absorb new techniques and information	Small SME have very small share in cement production market(less than 1%)

Human skills			
Low capacity for providing energy audit in cement production	3	Weak knowledge of specifics of energy efficient cement production technology	There are four Centers to train on energy audit in regions(few), lack trainers
Lack of equipment for energy audit	2	The equipment is purchased abroad	Lack of skills for making specifications of necessary equipment
Information and awareness			
Poor access to information	5	Few reports could be found from international reports mostly	No national strong analytical institution providing market, economic and technical information. Only international agency for provide adequate information on Kazakhstan market of cement industry. Though state bodies arrange conferences and seminars but they are not so specific
Poor dissemination	4	Associations have not qualified stuff to arrange adequate info Lack of agencies or agencies-equipped to provide information Poor dissemination of information to technology users,	Some associations have websites, some not, dissemination technique is weak Poor network with research programs useful for penetration of technology and inadequate coordination with international organizations, NGOs, funds
Language	3	Information is mostly in Russian and English, access is not adequate	Less info is provided in Kazakh language
Technical			
Lack of scale and experience	3	Energy audit provided is not very effective, technical stuff staff turnover ,poor management	Local experts have experience but it is not broad. The principle "learning by doing" is used
Weak infrastructure	2	Sometimes need strong physical infrastructure such as roads and electric grid	Depending on specific situation, to be explored in feasibility study
Other Barriers			
Instability of prices on cement	1	seasonal demand	spare capacity in the winter affect the increase in the price of 1 Ton of cement The seasons demand is out of regulation
Lack of skilled personnel for the installation and operation	3	Lack of local entrepreneurs	Market is occupied by foreign business, which displaces the local one
. Social, cultural and behavioral			
Traditions and habits	1	Resistance to change, due to cultural reasons	the transition to new technology requires some getting used to and adapt

Table 18. Summary of initial list of barriers identified to transition from wet to dry cement production technology

Barrier within category	Score (1-5)	Elements of barriers	Dimensions of barrier elements
1.Financial barriers			
High capital costs	5	High interest rates	The construction costs of the cement plant with annual capacity of 1 mln. Tons, accounts for at least 120-150 mln. euro based on the German equipment The local banks increase interest rated on domestic market up to 17.3%(2013)
High transaction n costs	4	Feasibility studies expensive	There is lack of local capacity to develop feasibility study and international consulting is used
Lack or inadequate access to financial resources	3	Lack of access to credit for certain consumers	Cement production with modern technology with dry method in Kazakhstan all import the technology and owners are foreign business
Inadequate financial initiatives	5	Lack of subsidy mechanism	State support via DAMU Fund is weak and needs the subsidy mechanism to be developed further (DAMU provides reimbursement of 50%, but not more than 7.5 mln of costs for the development of integrated enterprise development plan)
		Inefficient carbon market mechanism	The ETS and implementation of NAP 2016-2010 is suspended up to 2018. The internal carbon projects are still not proposed while regulation exist
		Inefficient electricity and railway tariffs	High cost of gas compared to the cost of coal. Coal is the cheapest fuel in Kazakhstan: the price is 6594KZT/t of coal, while gas is 10.5 KZT /m3, source: http://www.nomad.su/?a=3-201411240033
Uncertain macroeconomic environment	1	Unstable exchange rates	floating exchange rate of Tenge, 1USD -150 KZT(2015), 1 USD-360 KZT (2016), no coherent monetary policy
2. Non-financial barriers			
Policy/regulatory			
Insufficient regulatory framework	5	Insufficient technical regulation, complex procedures including import duty Lack of standards ,codes, requirements, certification in	The absence of the passage of the actual mechanical and mineralogical testing of imported cement according to "Review of cement industry in the countries of Custom Union". Standards are not obligatory in EEU recently. There is non-

		the framework of Custom Union cooperation between countries-members; imperfect system of technical management	compliance with national regulation, the regulation on certification, standards is not developed properly according to the Review named above.
Inefficient enforcement	3	Insufficient willingness or ability to enforce laws and regulations	There is some delay to enforce regulation (External factors)
Network failures			
Lack of involvement of stakeholders re small hydro technology in decision-making process	1	Less information and privileges could be found in State programs related to energy efficient cement production technology	Lack of NGOs are care on energy efficient cement production technology promotion, lack of stakeholders are involved into process
Weak connectivity between actors favoring the new technology	3	Lack of cooperation with major investment banks and large companies and International ones(EBRD) for modernization or construction of new cement plants	In today reached an agreement with such advisers as Boston Consulting Group, McKinsey, as well as major investment banks Citigroup, of JPMorgan
Institutional and organizational capacity			
Weak capacity of R&D institutions to develop and promote modern technology(transition from wet to dry method)	5	Lack of training of R&D institutions experts	The gap between university research and the educational process from the production (in most universities and research infrastructure device-instrumental base training of engineers does not meet modern requirements)
Lack of professional institutions	3	Lack of institutions to support technical standards and certification	Certification is provided by Ministry of Energy, there are institution on standards at national level dealing with a broad issues
Information and awareness			
Inadequate information	5	Poor dissemination of information to technology users Inadequate access to information	Lack of agencies and agencies-equipped to provide information Poor information is found on different local websites of Associations, Ministry of Energy, Ministry of Innovative Development Difficult to analyze the poor information Local Business have weak access to market information, financing sources, potential project developers The reviews are done by Russian sources, the review on national is done once during 5 years
Lack of media interest in promoting	2	Information could be found on specific issues, few agencies providing information on	Ministry of Innovative Development provides mostly information on

technologies		promoting technology	legislative/regulation base related to industry
Technical			
Poor O&M facilities	3	Need to import spare parts Lack of skilled personnel	Foreign business have mostly skilled personnel and provide training on regular basis
Inadequate technical competence, poor access to technology	5	Inadequate standards, codes and certification	Standards not obligatory
Human skills			
. Inadequate training facilities	4	Lack of experts to train	Inadequate Training programs without aspects to promote transition from wet to dry method in cement production
Lack of skilled personnel for the installation and operation	3	Lack of local entrepreneurs	Market is occupied by foreign business, which displaces the local one
. Social, cultural and behavioral			
Traditions and habits	1	Resistance to change, due to cultural reasons	the transition to new technology requires some getting used to and adapt
Other Barriers			
Environmental impacts	2	Local pollution	Could need additional sanitation due to specific of transition from wet to dry method in cement production

Annex III. Additional data

Table 19. List of planned projects on small hydro power (2013-2019

№	Project name, location of HPPs	Responsibility	Year of commissioning	Estimated budget of funding, million KZT	Capacity, MW
1	Construction of HPP-1, 2 Uzyn River in Zhambyl district of Almaty region with total capacity of 9 MW	Akim of Almaty region LLP "Aksu Hydro" (as agreed)	2014-2015	4 554	9
2	Construction of hydroelectric power station - 1.2 on the Cox River Kerbulak District, Almaty Oblast with total capacity of 42 MW	Akim of Almaty region LLP "Datang TT-Energy" (as agreed)	2016	11 324	42
3	Construction of HPP-5 at the Karatal River in Almaty region Eskeldi District 5 MW	Akim of Almaty region LLP "ASPMK-519" (by agreement)	2014	4 650	5
4	Construction of hydroelectric power plants in the Upper Baskanskoy Sarkand district of Almaty region with the capacity of 4.35 MW	Akim of Almaty region LLP «Alakol Power» (as agreed)	2015	1 410	4,35
5	Construction of hydroelectric power station on the river in the Aksu Aksu district of Almaty region with the capacity of 3.6 MW	Akim of Almaty region LLP "Aksu Hydro" (by agreement	2016	2 214	3,6
6	Building Lower Baskanskoy HPP - 1-3 Sarkand district of Almaty region 15 MW	Akim of Almaty region LLP «Alt Energy» (as agreed)	2015	5589	15
7	Construction of hydroelectric power station - in Issyk river Enbekshikazakh district of Almaty region with total capacity of 4.8 MW	Akim of Almaty region, "Energoalem" LLP (as agreed)	2015 год	876	4,8
8	Construction of HPP 2 Lepsy river Sarkand district of Almaty region with capacity of 4.8 MW	Akim of Almaty region LLP "Amanat A"	2015	1 029	4,8
9	Construction of power plant 1, 2 on the Grand Canal Almaty Almaty region with total capacity of 12 MW	Akim of Almaty region, "Kazgidrotehenergo" LLP (as agreed)	2015	in the design and analysis	12
10	Construction of HPP on 19-22	Akim of Almaty	2015	in the	60,8

	Shelek river Enbekshikazakh district of Almaty region with total capacity of 60.8 MW	region LLP "Kazgidrotehenergo"		design and analysis	
11	Construction Tekesskoy HPP 2 on p. Tekess in Raiymbek district of Almaty region 3.3 MW	Akim of Almaty region LLP "KazGidro Cascade" (as agreed)	2015	1 193,5	3,3
12	Construction of the Upper Baskanskoy HPP 2 on p. Baskan in Sarkand district of Almaty region with the capacity of 4.35 MW	Akim of Almaty region LLP «Baskan Power» (by agreement)	2016	1 317,5	4,35
13	Construction of hydroelectric power station on the river Kerbulak. Or in Ili district of Almaty region with the capacity 33 MW	Akim of Almaty region LLP «Samruk Green Energy» (as agreed)	2016	10 850	33
14	Construction Tekesskoy HPP-1, 3 and 4 on the Tekes river Raiymbek district of Almaty region with total capacity of 10.2 MW	Akim of Almaty region LLP "KazGidro Cascade" (as agreed)	2016	3 394,5	10,2
15	Construction of hydroelectric-1-5 on Kaskelen waterpipe Almaty region with total capacity of 25 MW	Akim of Almaty region LLP "Kazelektrosetstroy" (as agreed)	2016	9 720	25
16	Construction Bartogai GES - 27 and 28 on the river Shelek Enbekshikazakh district of Almaty region with the capacity of 33.1 MW	Akim of Almaty region LLP "Zharyk Su LTD" (as agreed)	2016	11036	33,1
17	Construction of the Upper Baskanskoy HPP 3 Baskan river Sarkand district of Almaty region with capacity of 5.2 MW	Akim of Almaty region LLP «Baskan Power» (by agreement	2017	1 317,5	5,2
18	Construction Shelek HPP-29 Shelek river Enbekshikazakh district of Almaty region with total capacity of 34.8 MW	Akim of Almaty region, "Kazgidrotehenergo" LLP (as agreed)	2017	10 865,5	34,8
19	Construction Tekesskoy HPP-5, 6 and 7 on the Tekes river Raiymbek district of Almaty region with total capacity of 11.3 MW	Akim of Almaty region LLP "KazGidro Cascade" (by agreement	2017	3 766,5	11,3
20	Construction of hydroelectric Panfilov Usek 1-4 on the river in the Panfilov district of Almaty region with total capacity of 25.6 MW	Akim of Almaty region LLP "National Power Company" Zharyk Energy "(as	2018	7 750	25,6

		agreed)			
21	Construction Turgusunsky hydropower plant on the river Turgusun in Zyryanovsk district of the East Kazakhstan region with the capacity of 24.9 MW	Akim of East Kazakhstan region, LLP "Turgusun-1" (by agreement)	2016	7 719	24,9
22	Construction of hydroelectric power plant in Cato-Karagai and Zyryanovsky areas of the East Kazakhstan region with the capacity of 27.1 MW	Akim of East Kazakhstan region LLP «EcoEnergy» (as agreed)	2018	10 119	27,1
23	Construction of hydroelectric power station on the river in Kaldzhir Kurchum district of the East Kazakhstan region with the capacity 19 MW	Kazakhstan, LLP "Kalzhyr Hydro" (by agreement	2016	16 380	19
24	Construction of hydroelectric power station on the river Kedrovka in Ridder of the East Kazakhstan region with the capacity of 24.8 MW	Akim of East Kazakhstan region, JSC "" LIC "The group of companies (as agreed)	2018	3 570	24,8
25	Construction of hydroelectric power plants in Zyryanovsk district of the East Kazakhstan region with the capacity of 25.4 MW	Akim of East Kazakhstan region, LLP «EcoEnergy» (as agreed)	2019	10 628	25,4
26	Construction of hydroelectric power station in Ulan district on the river Ablaketka East Kazakhstan region 3 MW	Akim of East Kazakhstan region, LLP "AltayEnergoStroy " (as agreed)	2018	in the design and analysis	3
27	Construction of hydroelectric power plants in 28 Kurchum district on the river Kurchum East Kazakhstan region 3 MW	Akim of East Kazakhstan region, LLP "AltayEnergoStroy " (as agreed)	2016	in the design and analysis	3
28	Construction of hydroelectric power plants in Karakystakskoy T. Ryskulov district of Zhambyl region 2,1 MW	akim of Zhambyl region, LLP "Energy Story Project" (by agreement)	2013	1018	2,1
29	Construction of hydroelectric power plants in Tasotkelskaya Shu district of Zhambyl region with the capacity of 9.2 MW	akim of Zhambyl region, LLP «A & T-Energo" (as agreed)	2013	1 050	9,2
30	The construction of HPP cascade Merke 18 MW in Merke district of Zhambyl region	akim of Zhambyl region, LLP "Taraz Grinpauer Genco"	2016	7 391	18

		(as agreed)			
31	Construction of HPP "Aksu" Tolebi in the district of South Kazakhstan region with the capacity of 10 MW	Akim of South Kazakhstan region LLP «Discovery-Energy» (as agreed)	2014	6 820	10
32	Construction of HPP "Mankent" in Sairam district of South Kazakhstan region 2,5 MW	Akim of South Kazakhstan region, LLP "Aksu-Energo" (as agreed)	2014	745	2,5
33	Construction of hydroelectric power plants in Ordabasy district of South Kazakhstan region 0,5 MW	Akim of South Kazakhstan region, farm "Ədilhan" (as agreed)	2014	100	0,5
34	Construction of HPP "Raushan" on the river Keles in Saryagash district of South Kazakhstan region 2 MW	Akim of South Kazakhstan region, "Kelesgidrostroy" LLP (as agreed)	2015	193	3
35	Construction of HPP "Azamat" on the river Keles in Saryagash district of South Kazakhstan region 3 MW	Akim of South Kazakhstan region, "Kelesgidrostroy" LLP (as agreed)	2016	315	3
36	Construction of HPP "Darkhan" on the river Keles in Saryagash district of South Kazakhstan region 2 MW	Akim of South Kazakhstan region, "Kelesgidrostroy" LLP (as agreed)	2015	200	2
37	Construction of HPP "Shanyshkaly" on the river Keles in Saryagash district of South Kazakhstan region 3 MW	Akim of South Kazakhstan region, "Kelesgidrostroy" LLP (as agreed)	2017	in the design and analysis	3
38	Construction of HPP "Mamytov" on the river Keles in Saryagash district of South Kazakhstan region with the capacity of 1.8 MW	Akim of South Kazakhstan region, "Kelesgidrostroy" LLP (as agreed)	2018	in the design and analysis	1,8
39	Construction of HPP "Kiyat" on the river Keles in Saryagash district of South Kazakhstan region with the capacity of 1.5 MW	Akim of South Kazakhstan region, "Kelesgidrostroy" LLP (as agreed)	2019	in the design and analysis	1,5
40	Construction of HPP "Keltie-Mashat" in Tyulkubas district of South Kazakhstan region 3 MW	Akim of South Kazakhstan region, "Seyhun" LLP (as agreed)	2019	in the design and analysis	3
41	Construction of HPP "Sairam-su" in Tyulkubas district of South Kazakhstan region 6 MW	Akim of South Kazakhstan region, "Seyhun" LLP d)	2019	in the design	6

(*source: Action Plan on alternative and RES development 2013- 2020,* http://energo.gov.kz/index.php?id=2095)

Table 20. Status of projects in cement production subsector of Kazakhstan by 2020

Name of project	Object location	The volume of investments, bn	production capacity, ton/year	Commissioning	Status
Kazakh cement	East Kazakhstan region	$ 130 mln.	1 mln	2014	implemented
Zhambyl cement	Zhambyl region	$56.6 mln.	*1,1 million*	2010	implemented
Hantausky cement plant	Zhambyl region	$42.5 mln	400,000	2017	Under implementation
LLP «BI-Cement»	*Akmola region*	$320 mln	*1,1 million*	2014	Under implementation
JSC "ACIG"	Zhambyl region	$42.4 mln	400,000	2017	Under implementation
LLP" Kokshcement"	*Akmola region*	$202 mln.	*2 million*	2014	Under implementation
LLP "SouthCement"	*South Kazakhstan region*	$160 mln.	*1 million*	2015	Under implementation
LLP "KaspiCement"	*Mangystau region*	$300 mln	*1 million*	2013	implemented
JSC" Investment"	*SK region*	$120 mln	400,000	2015	Under implementation
JSC "PK South Polimental"	*SK region*	$220 mln	*1,6 mln*	2016	Under implementation
LLP "Uralsk Cement Company"	*West Kazakhstan region*	$213 mln	*1,2 mln.*	2020	Under implementation
LLP "KazCementProduct"	*Pavlodar region*	$227.5 mln	*930,000*	2020	Under implementation
LLP "CCT"	Zhambyl region	$204 mln.	*1,5 mln*	2020	Under implementation
LLP"Matay Tau-Ken"	*East Kaz region*	$465 mln.	400,000	2015	Under implementation
LLP "Mynaral cement invest"	Zhambyl region	$180 mln.	*1 million*	2017	Under implementation
LLP "KazCement Company"	*Almaty region*	$100 mln.	*830,000*	2018	Under implementation
LLP "InderCement"	*WestKaz region*	$83mln.	*600,000*	2017	Under implementation
LLP "South Cement LTD"	*SK region*	$39,6mln.	*1 million*	2020	Under implementation
LLP "Aktau cement Product"	*Mangistau region*	$251,8 mln.	*2,5 mln.*	2020	Under implementation
LLP " Merkuriy"	*Aktube region*	$125 mln.	*1,2 mln.*	2020	Under implementation

LLP " Kostanaicalciprom"	*Kostanai region*	$125 mln.	*1,5mln.*	2016	Under implementation
LLP «Rudny cement factory"	*Kostanai region*	$61 mln.	*500 ,000*	2015	Under implementation
LLP "Cheese Cement"	*Kyzylorda region*	$85 mln.	*500,000*	2015	Under implementation

Source: http://kursiv.kz/upload/tablica33.png

Table 21.Range of cement costs and prices in Kazakhstan (January 2014)

Regions	Cost of thousand ton, KZT	price in KZT per bag of 50 kg
East Kazakhstan	14000-28000	1100-1400
West Kazakhstan	18000-34000	950-1700
South Kazakhstan	10000-22500	750-1600
North Kazakhstan	15000-22000	1200-1450
Almaty	18000-24000	850-2400
Astana	16500-25000	950-12500

Source: *http://kursiv.kz/upload/tablica44.png*

Table 22.Main indicators of Kazakhstan cement market development during 2008-2014

Parameters of cement market	2008	2009	2010	2011	2012	2013	2014
cement production, thousand tons	5837	5694	6683	4181	6392	7107	8187
Import, thousand tons	1826	782	1010	1890	1300	1550	1230
Export, thousand tons	131	25	199	4	180	205	415
Consumption, thousand tons	7532	6451	7494	6067	7512	8452	9002
Import, % of consumption	24.2%	12.1%	13.5%	31.2%	17.3%	18.3%	13.7%
Export, % of consumption	2.2%	0.4%	3%	0.1%	2.8%	2.9%	5.1%
Increase of production,%	2.4%	-2.4%	17.4%	-37.4%	52.9%	11.2%	15.2%
Increase of consumption,%	- 18.2%	-14.4%	16.2%	-19%	23.8%	12.5%	6.5%

Source: Review of the cement industry in countries of Customs Union, 2015, http://cmpro.ru/

Annex IV. List of stakeholders involved and their contacts

Name/Surname	Field of expertise / position	Contact information	Group for technology
Kanat Baigarin	Nazarbayev University, National Focal Point, Advisor of Minister of ME RK	+7 7172 70 60 07	Coal
Nurym Ayazbayev	Ministry of National economy (MNE) Department of budget investments and PPP development	+77172 74 28 85	Coal
Olghas Alibekov	Ministry of Investments and Development (MID) Director of Department on energy efficiency, Committee of Industrial Development and Industrial Safety	+77172-754915 al.alibekov@mid.gov.kz	Cement EE
Daulet Ahmetov	Kazakhstan Energy Association (KAZENERGY), AES companies head office in Astana	+7 (7172) 68-96-51 kea.astana@mail.ru	Coal
Gulmira Sergazina	Ministry of Energy (ME), Director of Department on Climate Change	+7 7172 74 02 58	Coal
Ainur Sospanova	Ministry of Energy, Director of RES Department	+7 7172 74 02 59	SHPP
Aiymgul Ismagulova	Nazarbayev University, specialist	+7 7172 70 60 07	Coal
Ludmila Shabanova	Information Analytical Center under ME	+7 7172 79 96 41	Cement dry
Irina Yesserkepova	Kazakh scientific institute on ecology and climate	+7 7272 55 84 24	SHPP
Aleksyi Cherednichenko	USAID Kazakhstan climate change mitigation program, expert	+7 7272 55 84 48	Cement EE
Aida Makazhanova	Ministry of Energy Specialist of Department on Sustainable Development	+7 7172 74 08 74	Cement EE
Dinara Dauletova	Ministry of Energy Specialist of Department	+7 7172 74 08 74	Coal
Saulet Sakenov	Manager of Third National Communication of the RK under UNFCCC, UNDP project	+ 7 7172 90 16 69	Cement dry
Syrym Nurgaliev	Manager of UNDP project on energy efficiency	+7 7172 58 09 39	Cement EE
Lyubov Inyutina	Expert on Energy Efficiency and Climate Change	+77013353441 lyubov.inyutina@mail.ru	Coal
Kalyk Abdullaev	Chairman of the Board of JSC "Kazakh Research Institute of Energy named after Academician SH.CH. Chokina Chairman of the Union of Power Engineers of the Republic of Kazakhstan	(727) 292 24 54 www.kaznie.kz	Cement EE

Doroshin Gennady	Independent expert on renewable energy sources	+77772130647 g_doroshin@mail.ru	Small HPP
Sultan Tudukpayev	Director General of the Association of Renewable Energy of Kazakhstan	7(7172) 516955 info@renergy.kz	Small HPP
Ella Baybikova	Head of Strategic Planning and Marketing, Eurasian DevelopmentBank	7 (727) 244 40 44 baybikova_er@eabr.org	Coal
Nurmaganbetov	General Director of LLP "Billing and Financial Center in support of renewable energy sources" under KEGOC	(7172) 693704	Small HPP
Nikolai Tyryatkin	Director General of the Association of alternative energy in Kazakhstan	(7172) 790182 kense@kazenergy.com	Small HPP
Islambek Kairbekov	JSC DAMU Entrepreneurship Development Fund, representative	(7172) 559-214 http://www.damu.kz/	Coal
Gulmira Esengazina.	Joint-stock company "Center for Engineering and Technology Transfer", Deputy Director	51-69-21 http://www.cett.kz/	Cement wet
Mominbaev F.	Director General of LLP «Samruk-Green Energy»	7(7172) 55-30-21	Small HPP
Rinat Ramazanov	Director of the Union of Builders of Kazakhstan ULE	87172 57 81 27 ssk_rk@ mail.ru	Cement dry
Maral Tompieyv	President of the “Association of Legal Entities "Kazakhstan Association on Building Materials Industry”	87017119239	Cement dry
Vera Mustafina	President of “ JSC KazWaste”	8(7272)255 84 21 csd.vera@gmail.com	Cement dry
Dauren Tokbayev	President “ULE Kazakhstan Association of Energy Auditors”	+(727) 349 3999 dtokbayev@kazep.kz	Cement EE
Anuar Buranbayev	JSC "Kazakhstan Industry Development Institute" (KIDI)	www.kidi.kz/ (7172) 79 64 72 +	Cement EE
Erkin Salimov	LLP "JAMBYL Cement Production Company" sales representative	+7 (727) 244 02 32 Erkin.Salimov@jambylcement.kz	Cement dry
Alexander Zuev	United Cement Group Deputy General Director	7 (727) 277-77-20 info@unicementgroup.com	Cement EE

Annex V. Policy Fact Sheets

1)The "State Program on industrial development of Kazakhstan for 2015-2019"

Policy name	**The "State Program on industrial development of Kazakhstan for 2015-2019" (SPAIID)**
Data effective:	1 August 2014 #874
Date of completion	2019
Unit	Energy Efficiency(EE),Climate Change (CC)
Country	Kazakhstan
Year	2015-2019
Policy status	In force
Agency:	Ministry of Industry and New Technologies of the Republic of Kazakhstan
Funding:	Total investments: 8.587 billion KZT, including State budget (1 717 billion KZT
Further information	SPAID is approved by the Decree of the President of the Republic of Kazakhstan. Innovative Development Tasks of the Program are: • Promote technology transfer and localization of high-tech industries in priority sectors; • Promote increased demand for innovation; • Increase Technical and managerial competencies. Action Plan is a tool of implementation of the SPAID, was approved by the GOK Decree on 30 October 2014, No.1159, with amendments approved by GOK Decree No.42 dated 05.02.2015, available at: http://adilet.zan.kz/rus/docs/P1400001159#z9 (point 2.2.14;3.2.3.2.; 3.4.3); http://tengrinews.kz/zakon/pravitelstvo_respubliki_kazahstan_premer_ministr_rk/hozyaystvennaya_deyatelnost/id-P1400001159/ The mechanism of Program's implementation is its Action Plan, as amended by Decree of the Government of 2/5/2015 number 42. According to it for technology diffusion it is assumed: - providing Grants for industrial research; Grants for the purchase of technology; Strengthening the technical regulations and standards, including energy efficiency, productivity, sustainability for the purpose of increasing demand for innovation; -Reimbursement of 50%, but not more than 7.5 mln of costs for the development of an integrated development plan for the enterprise, loan guarantees in priority sectors, taking into account regional specialization, creating targeted credit programs for energy efficient investment projects, subsidizing interest rates to 7% o -financing up to 80%, but not more than 8 million tenge, for SMEs and up to 16 million tenge for large enterprises in conducting technical diagnostics.
Policy type:	State industrial development Program
Policy target:	Goal of Program: Promote diversification and competitiveness of the manufacturing industry. Among other general objectives: 1) Advanced development of the manufacturing industry; 2) Improving the efficiency and added value in the priority sectors;

	5) reducing energy intensity of manufacturing industry at least by 15%; Besides, other target indicators related to the construction materials production which in 2019 are expected to the level of 2012 according to SPAID: 1) growth of gross value added no less than 1.4 times in real terms; 2) The share of domestic production in total resources 80% 3) The volume of investments in fixed assets : growth 1.3 times
URL:	www.kaznexinvest.kz/about/files/Ukaz_Prezidenta_RK-GPIIR.docx
Legal reference:	Approved by the Decree of the President the Republic of Kazakhstan dated 1 August 2014 #874
Description	The program is a logical continuation of the State program for accelerated industrial-innovative development of Kazakhstan for 2010 - 2014 years (hereinafter - SPAIID) and takes into account the experience of its implementation. Among14 priority sectors of manufacturing industry to support by Program is production of construction materials (Manufactory of cement including clinker). In the field of technologies diffusion the main challenge will be to move from a simple purchase of equipment to more complex forms of transfer and adapt them to local conditions. Systemic measure will promote and support strategic projects through the provision of innovative grants for the acquisition of foreign technology. Providing state support measures will be carried out within the framework of existing programs, "Business Road Map 2020", "Productivity 2020", "Agribusiness 2020", as well as state support for the promotion and advancement of domestic processed goods, services and foreign investment. Financial support measures will be ranked on the cost of the project and priorities. Individual approach will be applied to large enterprises implementing large-scale projects (more than 4.5 billion KZT). A tool of realization is ***Kazakhstan's Industrialization Map*** - a list of major investment projects mainly in the 14 priority sectors that form new industries, developing clusters, which include measures of state support. Criteria: (a) activities in 14 priority sectors; (B) investments by 4.5 billion KZT.; (C) the conformity of products to accepted international standards; (G) labor productivity and energy efficiency; (D) the expansion of markets for non-primary goods; (E) manufacturing, developing value-added chain in the issuance of the final product; (G) the contribution to the strategic objectives of the Program. Introduction of carbon market mechanism is included with a target 100% of GHG emissions in 2018 towards the level of GHG emissions in 2012.

2) Strategic Development Plan of Kazakhstan till 2020

Policy name	**Strategic Plan 2020**
Data effective:	2010
Date of completion	2019
Unit	
Country	Kazakhstan
Year	

Policy status	active
Agency:	President, ministries
Funding:	
Further information	Goal: the gradual development of the extractive industries, especially oil and gas sector, with the subsequent transition of primary production to higher conversion stages; the development of related extractive industries sectors, including the manufacturing industry on the basis of raw materials; the development of new industries, especially manufacturing industry, unrelated to the commodity sector and focused mainly on exports. The strategic objectives of economic diversification: indicators of development by 2020 established in priority sectors, in particular: In energy sector: energy production from own sources, satisfying the requirements of economy, it is 100%; - alternative energy sources in the total energy consumption will be more than 3% - In construction: 80% of construction materials produced domestically, 20% of output in the construction sector and construction materials exported. Construction sector is connected with cement production. - General improvement of legislative system; - The share of manufacturing in GDP be not less than 13% - Participating in global international policy While creating innovative system the mechanism of financing of priority projects in the field of science and education will be done in grant basis.
Policy type:	Strategy Plan 2020 is the next stage of implementation of the "Kazakhstan - 2030" Strategy for the period from 2010 to 2019.
Policy target:	- alternative energy sources in the total energy consumption will be more than 3% - 80% of construction materials produced domestically (related to cement production for I the purpose of implementing this indicator) - Introduction of 106 new objects of RES by 2020 of total capacity 3054.55 MW, including small hydro power- 539 MW(41 Power Plants)
URL:	www.akorda.kz/.../Стратегия%20развития%20до%202020%20г..doc
Legal reference:	Presidential Decree Republic of Kazakhstan from February 1, 2010 №922
Description	During 2010-2020, a priority in the activities of the state are five key areas: 1) preparation for the post-crisis development; 2) sustainable economic growth through accelerated diversification through industrialization and infrastructure development; 3) investment in the future - improving the competitiveness of human capital in order to achieve sustainable economic growth, prosperity and social well-being of Kazakhstan; 4) providing the population with social and housing and communal services; 5) strengthening of international relations.

3) INDC (Intended nationally determined contribution)

Policy name	INDC (Intended nationally determined contribution)
Data effective:	12 December 2015
Date of completion	31 December 2030
Unit	GHG emissions
Country	Kazakhstan
Year	2015
Policy status	active
Agency:	Government of Kazakhstan (Ministry of Energy)
Funding:	State, International, business
Further information	This is contribution to the International Climate agreement wich should contain global goal of the States Parties to hold temperature rise at 2 ° C compared to pre-industrial levels.
Policy type:	National obligations
Policy target:	Reduction of anthropogenic greenhouse gas emissions until 2030 by 15% (absolute target) and 25% (conditional target in the case of international support) with respect to the base year of 1990.
URL:	www.climate.kz/UserFiles/File/INDC%20Kz_rus-3(3).doc
Legal reference:	
Description	Kazakhstan supports the inclusion of market mechanisms in the treaty of 2015, and the use of carbon credits generated from CDM, JI or other units recognized by the UNFCCC. The current emissions of Kazakhstan, which reached 80-85% of the 1990 baseline. Kazakhstan intends to contribute to international efforts to combat climate change. All the IPCC sectors, namely energy, agriculture, waste, land use, land use change and forestry will be covered.

4) Concept of the Republic of Kazakhstan for the transition to a “Green Economy”

Policy name	CONCEPT the transition of the Republic of Kazakhstan to "Green economy"
Data effective:	2013
Date of completion	2050
Unit	Energy, Energy efficiency, renewable energy sources, GHG emissions reduction
Country	Kazakhstan
Year	
Policy status	active
Agency:	Ministry of Environment(2013), Ministry of Energy since 2015
Funding:	State, other
Further information	Goal: the transition to a new economy formation by increasing welfare, quality of life of the population of Kazakhstan and the country's entry into the top 30 most developed countries of the world while minimizing the impact on the environment and degradation of natural resources

	Priority tasks: 1) improving the efficiency of use of resources (water, land, biological, etc.) and management.; 2) modernization of existing and construction of new infrastructure; 3) the welfare of the population and the quality of the environment through cost-effective ways to mitigate the pressure on the environment; 4) improving national security, including water security.
Policy type:	Concept 2013-2050, Action Plan to its implementation2013-2020
Policy target:	Mid and long term targets are the following: -Reduction of GDP energy intensity: 2% by 2020; 30% by 2030; 50% by 2050 -Reduction of current CO_2 emissions in electricity production: levels of 2012 by 2020: - 15% by 2030; -40% by 2050 -Development of alternative and renewable sources of energy: -By 2050 in country the sources should be less than half of overall energy composition
URL:	http://www.adilet.gov.kz/ru/node/52403 https://strategy2050.kz/ru/news/1211/
Legal reference:	Concept is approved by Presidential Decree of the Republic of Kazakhstan on May 30, 2013, No. 577. Action Plan to it 2013-2020 is approved by resolution of the Government of the Republic of Kazakhstan from July 31, 2013 № 750 with amendments made by the Resolution of the Government of the Republic of Kazakhstan from 9/4/2014 № 969.
Description	Concept should be implemented in three stages: 2013-2020; 2020-2030; 2030-2050. Action Plan to its implementation 2013-2020 is adopted for the first stage. Measures for transition to "green economy", according to the concept will be implemented the following areas: sustainable use of water resources, the development of a sustainable and highly productive agriculture, energy conservation and energy efficiency, the development of electric power industry, waste management system, reducing air pollution and conservation and efficient management of ecosystems . It is estimated that by 2050 the conversion in the "green economy" will further increase the GDP by 3%, create more than 500 thousand new jobs, create new industries and services, to provide universally high quality of life for the general population.

5) Action Plan for alternative and renewable energy sources development for 2013-2020

Policy name	**Action Plan on RES 2020**
Data effective:	2013
Date of completion	2019
Unit	
Country	Kazakhstan
Year	2013-2019
Policy status	active
Agency:	Ministry of industry and new technologies, local authorities(Akimats of Oblasts, cities of Astana, Almaty)
Funding:	State funding,
Further	Goal: AP aims to support the implementation of SPAID

information	
Policy type:	State Action Plan
Policy target:	3% of power generation form RES
URL:	http://energo.gov.kz/index.php?id=2095 http://www.til.kostanay.gov.kz/ru/component/k2/item/118-ob-utverzhdenii-plana-meropriyatij-po-razvitiyu-alternativnoj-i-vozobnovlyaemoj-energetiki-v-kazakhstane-na-2013-2020-gody
Legal reference:	GOK Decree # 43 dated 25.01.2013),amendments to the Law on Renewable energy sources (# 165-IV, 04.-7.2009), amendments to AP-28/07/2014
Description	AP has the following directions: 1)The adoption of measures aimed at supporting the use of renewable energy sources 2) Development of studies and experts in the field of renewable energy sources 3) The development of local content 4. Information development of renewable energy sphere By 2020 it is planned to put into operation about 106 renewable energy facilities with a total installed capacity of 3054.55 MW, including: 34WPP - 1787 MW; 41 hydropower plants - 539 MW –the list of HPP is presented in Annex III; 28 SES - 713.5 MW; 3bio power plant - 15.05 MW. It is planned to develop Republican information guide for investors to provide monitoring of RES; to develop guide books for local authorities; to identify promising sites for placement of renewable energy facilities; to develop technical specifications and criteria for the connection of renewable energy facilities to power grids.

6) Regulation related to FITs, PPA for RES development

Policy name	**Feed-in tariffs**
Data effective:	2014-
Date of completion	-
Unit	RES
Country	Kazakhstan
Year	2014-
Policy status	active
Agency:	KEGOC, ministry of Energy, Akimats of Oblasts, Astana, Almaty authorities, LLP “Financial Billing Center”
Funding:	
Further information	According to subparagraph 8) of Article 5 of the Law of the Republic of Kazakhstan from July 4, 2009
Policy type:	Regulation to the Law on RES support
Policy target:	Target: to provide achievement of indicators of development according Strategic Plan 2020, etc. Related to power production and use of RES
URL:	http://kazenergy.kz/ http://www.zakon.kz/4648298-utverzhdeny-tipovye-formy-dogovorov.html http://energo.gov.kz/index.php?id=2045; http://www.rfc.kegoc.kz/

Legal reference:	
Description	1)GOK Decree No.645 dated 12.06.2014 about FITs: The feed in tariff (FIT) for small hydropower- 16.71 KZT/kWh (without VAT) FIT for wind power -22.68 KZT/kWh (without VAT) FIT for solar -59.7 KZT/kWh (without VAT) FIT for bio-32.23 /kWh (without VAT 2)GOK Decree No.878 dated 05.08.2014 about PPA: "On approval of standard forms of purchase contract Billing and financial electricity center at power generation companies using renewable energy sources at fixed rates and the rates do not exceed the selling price specified in the approved and agreed with or authorized by the local executive body of the feasibility study of the project construction of the facility for the use of renewable energy sources, the sale of Billing and financial center conditional consumers of electric energy produced by objects on use of renewable energy sources "

7) **Nation Plan - 100 steps to implement the five institutional reforms of the President**

Policy name	**Nation Plan - 100 steps**
Data effective:	20 May of 2015
Date of completion	-
Unit	
Country	Kazakhstan
Year	
Policy status	active
Agency:	Government of Kazakhstan
Funding:	State
Further information	Goal: this plan is for implementation of 5 President reforms: • formation of the modern state apparatus • the rule of law • industrialization and economic growth • One nation for future • Transparency of public accountability Mechanism of implementing: National Commission at President on modernization including five working groups. The working body of the National Commission is the Prime Minister's Office of the Republic of Kazakhstan
Policy type:	State Plan
Policy target:	Plan o f nation to implement 5 Presidents reforms
URL:	https://strategy2050.kz/ru/page/message_text2014/
Legal reference:	Action Plan of nations: 100 Steps
Description	The document contains 100 steps to implement the five main reform identified by President. Below are the steps that relate to subject matter of the report. 47. The phase-out of the state monopoly on the expertise and pre-design estimates. Passing the examination of projects in a competitive

	environment. 48. IMPLEMENTATION OF RESOURCE method of determining the estimated cost of construction. Introduction of a new method of pricing in construction will allow to determine the estimated cost of construction of objects in current prices to the real market value of materials, products, equipment and wages, as well as provide operational update estimate and regulatory framework with new materials, equipment and technologies. 49. Implementation of Eurocodes replace the outdated building codes and regulations (SNIP), applied to the Soviet period. The adoption of the new standards will allow applying innovative technologies and materials that enhance the competitiveness of Kazakhstani specialists in the construction market, as well as create an opportunity for release of Kazakh companies to foreign markets for services in the field of construction. 50. Reorganization of the electricity industry. IMPLEMENTATION OF MODEL "Single Buyer". This will smooth out the differences in electricity tariffs between regions. 51. The enlargement of regional electricity companies (RECs). This will improve the reliability of power supply; reduce the cost of electricity transmission in the regions and to reduce the cost of electricity for consumers. 52. **Implementation of the new tariff policy in power**, encourages investment in the industry. Changing the tariff structure. The tariff will be allocated two components: a fixed part to fund capital expenditures and payment for electricity used to cover the variable costs of power production. This will change the current situation, when the tariffs are approved by "cost-plus" method. 59. The attraction of strategic investors in energy conservation through the international **energy service contract recognized mechanism**. Their main aim is to stimulate the development of private energy service companies to provide complex services in the field of energy saving with reimbursement of their own costs and financial gain from actually achieved energy savings. 56. Establishment of the priority sectors of the economy of joint ventures with "anchor investor" - international strategic partners to attract highly qualified specialists from abroad. 53. CHANGE OF THE CONCEPT OF WORK Antimonopoly Service and to bring it into conformity with the standards of the OECD. Update Service should focus on the promotion of free competition. 54. Strengthening Institutions Business Ombudsman to protect the interests of entrepreneurs. The composition of the new institute will include representatives of business and the National Chamber of Entrepreneurs

8) Concept of development of fuel and energy complex of the Republic of Kazakhstan till 2030

Policy name	**Concept of development of fuel and energy complex of the Republic of Kazakhstan till 2030**
Data effective:	2014
Date of completion	2029

Unit	
Country	Kazakhstan
Year	
Policy status	active
Agency:	Ministry of Energy
Funding:	The plans for the construction and rehabilitation of power plants require substantial investments to 5,0 trillion KZT from 2016 to 2030 (in 2011 prices of the year), including 0.9 trillion KZT for electricity production with the use of alternative and renewable energy sources (excluding hydro).
Further information	As a result, the installed capacity of power production plants using alternative and renewable energy sources will increase from 2.7 GW in 2012 to 8 GW by 2030.The share of electric power facilities necessary: 43 - 45% of total emissions of pollutants into the atmosphere from stationary sources, a third of which are ash emissions. Emissions from CHP are prevalent - up to 70%. 68 - 73% of total greenhouse gas emissions; 10% of the annual volume of waste
Policy type:	
Policy target:	Within the framework of realization of the Concept is expected to achieve four main objectives: 1) a significant reduction in the average level of deterioration of power equipment in the Republic of Kazakhstan in 2030; 2) to attract investments in the power sector of about 7.5 trillion KZT from 2016 to 2030; 3) providing moderate growth in electricity tariffs for end consumers until 2030; 4) ensuring the independence and self-sufficiency of the Unified
URL:	http://tengrinews.kz/zakon/pravitelstvo_respubliki_kazahstan_premer_ministr_rk/promyishlennost/id-P1400000724/
Legal reference:	Resolution of the Government of the Republic of Kazakhstan from June 28, 2014 № 724
Description	Energy System of Kazakhstan in 2030.General parameters for the development of electric power industry of the Republic of Kazakhstan: -Increase the share of electricity production from alternative and renewable energy sources to 30% by 2030 and to 50% by 2050 within the framework of the transition of the Republic of Kazakhstan to the "green economy." - The preservation of a significant share of power production in coal-fired power plants in the total electricity production. - Reducing the negative impact of the power industry on the environment. - Introduction of advanced technologies in the power industry. Expected results include: The share of Wind, Solar power plants and HPPs in the development of electric Power- 3% by 2020 (relative to 3884 MW level of 2015), 10% by 2020 (relative to 1645 MW level 2020)-GHG emissions reduction towards 2012 level: -15% The main direction of the Development include: development of renewable energy technologies; increasing the investment attractiveness of the industry; increasing environmental heat and power production; effective involvement of alternative and renewable energy sources in the energy balance.

9) State Program on infrastructural development "Nurly Zhol" on 2015 - 2019 years

Policy name	**State Program Nury Zhol**
Data effective:	2015
Date of completion	2019
Unit	
Country	Kazakhstan
Year	
Policy status	active
Agency:	Ministry of National economy, involved the central and local implementing agencies
Funding:	National Fund of the Republic of Kazakhstan: 2015- 796 billion KZT, 2016-379 billon KZT, 2017- 3 billion USD, International funding-8.97 billion USD. Funds of business 241.4 billion KZT
Further information	Action Plan on implementation of Tate Program "Nurly Zhol" 2015 – 2019, approved by Prime-Minister No.344 dated 27.04.2015
Policy type:	State Program
Policy target:	achieving the following target indicators: 1) in 2019 to ensure GDP growth of 15.7% in 2014; 2) in 2015 - 2019 to create jobs in the 395.5 thousand people, including: permanent - 86.9 thousand people; part-time - 308.6 thousand people. 3) in 2019, increasing the WEF rankings of quality of basic infrastructure up to 57 seats
URL:	http://tengrinews.kz/zakon/prezident_respubliki_kazahstan/hozyaystvennaya_deyatelnost/id-U1500001030/
Legal reference:	State Program approved by Presidential Decree of the Republic of Kazakhstan, dated on April 6, 2015 № 030
Description	Program is targeted on: formation of a single economic market by integrating macro-regions of the country on the basis of building an effective infrastructure hub principle for long-term economic growth of Kazakhstan, as well as the implementation of anti-crisis measures to support specific sectors of the economy in the conditions on external markets conjuncture worsening. The Action Plan to it 2015-2019 is approved for its implementation.

10) **The "Environment Code of the Republic of Kazakhstan"**

Policy name	**Kazakhstan Emissions Trading Scheme (KZ ETS)**
Data effective:	9 January,2007
Date of completion	-
Unit	Code No. 212-III
Country	Kazakhstan
Year	2007, additions in 2016
Policy status	Active
Agency:	Ministry of Environment (2007), then Ministry of Energy (2016)
Funding:	Business, State
Further	Introduction of Emissions Trading Scheme (ETS).

information	Further National Allocation Plans (NAPs) were developed according to Art.94-5 Chapter 9-1 of the Environmental Code The following Kazakhstan's National Allocation Plans 2013-2015, Kazakhstan's National Allocation Plans 2016-2020 were developed and approved (in 2016 suspended up to 2018)
Policy type:	Law
Policy target:	Overall Target: 7% reduction below 1990 levels by 2020 and 15% reduction by 2025 compared with the 1992 GHG emissions level.
URL:	http://energo.gov.kz
Legal reference:	(p.7art.16, dated 09.01.2007), Rules on quota allocation for GHG emissions(7 May 2012)(07.05.2012 # 586) with amendments #48 art.655 dated 2012, amendments # 1138 dated 30.12.2015 –NAP 2016-2020; of amendments on 3 December 2013: introduction Kazakhstan Emissions Trading Scheme (KZ ETS), trade quotas on greenhouse gas emissions and carbon credits. p29 art/17
Description	The energy sector's target is 3% reduction by 2015 relative to 2012 levels. Cap: 155.4 million Tons of CO_2 I n2014 and 152 million Tons of in 2015 Carbon price: 455 KZT (March 2014). National Allocation Plan covers 166 entities and the following sectors: oil, coal and gas production; the power sector; mining and metallurgy; chemical industry; agriculture (under debate) and transport(inclusion currently debated). Threshold >20.000 tCO_2 per year (based on 2010/2012 levels).55% of total emissions are covered by NAP. The scheme began with a pilot phase focused on reporting and verification; in the second phase (2014-2015) companies were required to hold CO_2 emissions constant (0% growth) and reduce CO_2 emissions 1.5% in 2015. In addition to CO_2, companies are also required to report their emissions of CH4, N2O and PFCs. On March 28, 2014 the first trades were conducted in Kazakhstan through the Caspian Commodity Exchange. Each year companies have through early August to trade emissions. Offsets from domestic projects in key sectors are also allowed.

11) Amendments and additions to some legislative acts of Kazakhstan on environmental issues

Policy name	Law of the Republic of Kazakhstan "On amendments and additions to some legislative acts of Kazakhstan on environmental issues."
Data effective:	10 March 2016
Date of completion	-
Unit	amendments to Environmental Code and some other environmental legislation
Country	Kazakhstan
Year	2016
Policy status	active
Agency:	Ministry of Energy
Funding:	Business, State
Further	These amendments will improve the system of reporting, monitoring and

information	verification of greenhouse gas emissions, as well as the ultimate goal of the functioning of the system of quotas and domestic trade quotas on greenhouse gas emissions effectively.
Policy type:	Law
Policy target:	
URL:	http://energo.gov.kz/index.php?id=5181
Legal reference:	
Description	Amendments dated10 March 2016 deal with the improving the regulation of greenhouse gas emissions. It was supported the suspension of Art. 94-2 (excluding paragraph 6), 94-3, 94-4, 94-7, 94-9) of the Chapters 9-1 of the Environmental Code prior to 1 January 2018, taking into account the global crisis, which caused certain consequences on the economy. In addition, changes were made and amendments to the articles 329 and 330 of the Code of the Republic of Kazakhstan "On Administrative Offences", resulting from the substantive rules of the RK Environmental Code (http://online.zakon.kz/Document/?doc_id=31577399)

12) Amendments to the Law on Renewable energy sources support

Policy name	**Law on Renewable energy sources support**
Data effective:	2009, amendments to it since 4 July,2013
Date of completion	
Unit	
Country	Kazakhstan
Year	
Policy status	Law
Agency:	Ministry of Energy
Funding:	-
Further information	Key issues: -introduction of FITs, the centralized sale / purchase of electricity through LLP “Financial Billing Center”, targeted support to individual consumers (hereinafter - targeted assistance), State compensation of the individual consumers the cost of acquisition systems for the use of renewable energy sources in Kazakhstan producers”
Policy type:	GOK Decree # 43 dated 25.01.2013),amendments to the Law on Renewable energy sources (# 165-IV, 04.-7.2009) with additions dated 29.10.2015
Policy target:	Target: to provide achievement of indicators of development according Strategic Plan 2020, etc. Related to power production and use of RES
URL:	www.windenergy.kz/files/1236336134_file.pdf http://online.zakon.kz/Document/?doc_id=30445263
Legal reference:	Law No.165-IV dated 04.07.2009; the Law "On introducing amendments and addenda to some legislative acts of Kazakhstan on the issues of support of renewable energy sources." was adopted at 4 July 2013.
Description	The Law on RES includes chapters on State regulation and support of RES development; the competences of the Government, the authorized body, local authorities, FITs are approved for 15 years and indexed annually for

	inflation, issues of connecting objects of RES. The new law is aimed at both the support of investors financing RES and the support of ordinary consumers. The law provides for: 1) the introduction of fixed tariffs, which will allow the law to act as guarantor for the repayment of investors invested funds, will help to clarify largest rates of renewable energy projects. 2) Distribution of renewable electricity through renewable energy specialized support center to all consumers - guaranteed purchase of electricity from renewable energy sources and ensure a fair distribution of the costs of renewable energy support among electricity consumers. 3) Providing a transparent state compensation schemes 50% of the costs of the individual user, having no connection to the network for the purchase of renewable energy sources, which will stimulate the development of renewable energy sources; 4) Creation of conditions for an individual user on the feasibility of electric energy surplus generated from renewable energy sources in the public network.

Annex VI. Questionnaire on barriers to the diffusion of a climate technology

1. Information on the respondent
Name:
Organisation / Department:
Designation:
Particular interest in the technology: E.g., manufacturer, trader, user, legislator.

2. Please choose the barriers (or specify your own) from the Proposed list of barriers(below) in each of 10 categories:

1. Economic and financial
2. Market failure/imperfection
3. Policy, legal and regulatory
4. Network failures
5. Institutional and organisational capacity
6. Human skills
7. Social, cultural and behavioural
8. Information and awareness
9. Technical
10. Other Barriers

Please rank them in order of importance (No. 5 is most important, 1 the lowest important etc. Cross if not applicable.).Please feel free to add more items to the list and add detailed descriptions to the items in the tables below.

1.Economic and financial issues

Barriers	Rank (1-5)

2Market failure/imperfection issues

Barriers	Rank (1-5)

3.Policy, legal and regulatory issues

Barriers	Rank (1-5)

4.Network failures

Barriers	Rank (1-5)

5. Institutional and organisational capacity

Barriers	Rank (1-5)

6.Network failures

Barriers	Rank (1-5)

7. Social, cultural and behavioural

Barriers	Rank (1-5)

8. Information and awareness

Barriers	Rank (1-5)

9. Technical

Barriers	Rank (1-5)

10. Other Barriers

Barriers	Rank (1-5)

The proposed list of barriers according to TNA_Guidebook

1. Economic and financial

a. Lack or inadequate access to financial resources

i. Lack of financing instruments and institutions
ii. Under-developed or distorted capital market (poor creditworthiness, poor recovery regulations)
iii. Lack of venture capital
iv. Lack of access to credit for certain consumers

b. High cost of capital

i. Scarcity of cheap capital (high interest rates due to high risk perception by financial institutions)
ii. Government policies on cost of capital (e.g., high tax on profits)

c. Financially not viable

i. High up-front costs
ii. High resource costs (material, labour, capital)
iii. High modification and implementation costs
iv. High discount rates (customers have a strong preference for the money they have today over the same amount of money tomorrow; in particular, private manufacturers and very poor people have a short economic horizon, while utilities have a longer horizon; discount rates for climate technologies may be higher than usual due to risk or uncertainty being perceived as high)
v. Use of payback time criterion limits consideration of overall economic lifetime benefits
vi. Low affordability amongst rural and peri-urban dwellers
vii. Inadequate resource base (due to actual lack of or fierce competition for resources)

d. High transaction costs

i. Gathering and processing information (feasibility studies; due diligence)
ii. Technology acquisition, implementation etc.
iii. Bureaucracy, procedures and delays
iv. Costs underestimated in economic analysis

e. Inappropriate financial incentives and disincentives

i. Favourable treatment for conventional energy and large-scale projects (subsidies, low taxes)
ii. Insufficient incentives to develop climate technologies
iii. Split incentives (the decision-maker, e.g., a property developer of collective dwellings, receives little or no incentive, whereas the users, e.g., the tenants, receive the benefits of energy savings)
iv. Non-consideration of externalities (negative externalities (pollution, damage from this) from conventional energy not considered in pricing, positive impacts of climate technologies not valued)
v. Taxes on climate technologies (high import duties on equipment, duty exemption limited to small products, other direct or indirect taxes on climate technologies)
vi. Difficult or expensive to export profits
vii. Non-tariff barriers on import/export of climate technologies
viii. Consumers pay below marginal cost
ix. Average cost pricing is done

f. Uncertain financial environment

i. Uncertain electricity tariffs (e.g., non-transparent tariff adjustment procedure)

g. Uncertain macro-economic environment
i. Volatile inflation rate and high price fluctuations
ii. Unstable currency and exchange rates
iii. Balance of payment problems and uncertain economic growth

2. Market failure/imperfection
a. Poor market infrastructure
i. Poorly articulated demand
ii. Difficult procurement (by consumers; e.g., inconvenient product location)
iii. Missing or under-developed supply channels (e.g., logistic problems)
iv. Disturbed or non-transparent markets
v. Lack of liberalisation in energy sector
vi. Mismanaged energy sector
b. Underdeveloped competition
i. Insufficient number of competitors (property developers and rental market have no incentive to invest)
ii. Regulations prohibiting entry into the energy sector
iii. Unwieldy requirements for entry
iv. Lack of level playing field (fair competition)
v. Market control by dominant incumbents implies that the selection process may not involve a free choice by customers
c. Restricted access to technology
i. Technology not freely available in the market
ii. Lack of product visibility
iii. Technology developer not willing to transfer technology
iv. Problems in import of technology or equipment due to restrictive policies, taxes etc.
d. Inadequate sources of increasing returns
i. Economies of scale and experience of new technologies cannot be achieved
ii. Economies of scale only at high investment level
iii. Market size small (small market potential, low density of consumer demand, limited or difficult
access to international market)
iv. Low ability or willingness to pay among consumers
e. Market control by incumbents
i. Well-established and more competitive or cheaper alternatives
ii. Barriers created by existing suppliers
iii. Monopolistic or quasi-monopolistic utility model (prevents new market entrants)
f. Lack of reference projects in country
g. Unstable market situation, which hinders the procurement of international technical investment from donors
h. Fair trade policies

3. Policy, legal and regulatory
a. Insufficient legal and regulatory framework
i. Absence of laws and bylaws on climate technologies (contract law, IPR protection)
ii. Complex procedures, e.g., power generation permits, customs formalities
iii. Legislation may favour incumbent technology
iv. Lack of government faith in climate technologies, unsupportive policies
v. Inadequate or unwieldy regulations for climate technologies
vi. Lack of coherent economic policies (e.g., alignment of fiscal policy with tax regimes)
vii. Absence of plans and programmes (e.g., rural electrification plan or programme)

viii. Inappropriate balance between the protection of IPR and the promotion of technology transfer
ix. Unclear arbitration procedures

b. Inefficient enforcement
i. Missing or ineffective executive and regulatory bodies
ii. Insufficient willingness or ability to enforce laws and regulations
iii. Lax attitude

c. Policy intermittency and uncertainty
i. Uncertain government policies (= political risks for investors)
ii. Lack of long-term political commitment
iii. Stability of laws (frequent amendments)
d. Clash of interests (struggle in the political arena between proponents of new and incumbent technologies)
i. ESTs go against the perceived interest of the dominant actors in the sector
ii. ESTs perceived as a threat to utility monopoly and to utility profit
e. Highly controlled energy sector (may lead to lack of competition and inefficiency)
i. Government or utility monopoly of energy sector
ii. Private sector entry restricted (e.g., independent power producers)

f. Red tape (bureaucracy)
g. Rent-seeking behaviour and fraud

4. Network failures
a. Weak connectivity between actors favouring the new technology
i. Stakeholders dispersed and poorly organised
ii. Multiple stakeholder collaborative learning and knowledge transfer activities absent or weak
iii. Insufficient coordination between relevant ministries and other stakeholders
iv. Insufficient cooperation between industries and R&D institutions
v. Absence of trade associations and effective consumer bodies (problems and views on barriers cannot reach the policy-makers effectively; no or weak lobbying to facilitate technology transfer)
b. Incumbent networks are favoured by legislation etc.
c. Difficult access to external manufacturers
d. Lack of involvement of stakeholders in decision-making
i. Stakeholders' consultation culture missing
ii. Difficult communication
iii. Fear of opposition

5. Institutional and organisational capacity
a. Lack of professional institutions
i. Lack of institutions or mechanisms to generate and disseminate information
ii. Lack of institutions to promote and enhance market
iii. Need for specialised agencies at planning level and operational level (ESCOs)
iv. Lack of a regulatory body in the energy sector
v. Lack of institutions to support technical standards
b. Limited institutional capacity
i. Lack of interest or capacity in existing institutions
ii. Limited institutional capacity to solicit ideas and encourage potential entrepreneurs
iii. Limited R&D culture (R&D facilities missing, lack of capacity for R&D, lack of appreciation of R&D
role in technology adaptation)

c. Small size of local companies (limited ability to absorb new techniques and information)

6. Human skills
a. Inadequate training facilities
i. Lack of experts to train
ii. The educational system may fail to react quickly enough to the emergence of new generic technologies
b. Inadequate personnel for preparing projects
i. Lack of domestic consultants (to reduce transaction costs)
ii. Lack of experts in negotiating IPR contracts
c. Lack of skilled personnel for the installation and operation of climate technologies
i. Lack of entrepreneurs (relatively low profitability, unwieldy or restrictive regulations; may lead to lack of competition and supply constraints)
d. Lack of service and maintenance specialists

7. Social, cultural and behavioural
a. Consumer preferences and social biases
i. Aesthetic considerations, product lacks appeal
ii. High discount rates of consumers (mentioned under 'Economic and financial')
iii. Lack of social acceptance for some climate technologies (e.g., landfill or manure gas for cooking
may not be acceptable)
iv. Technology stigmatisation (a technology is perceived as 'for the poor', e.g., mud-stoves)
b. Traditions and habits
i. Resistance to change, due to cultural reasons
ii. Need for users to modify behaviour (e.g., solar cookers certainly require people to modify their
cooking habits)
c. Lack of confidence in new climate technologies
i. Unknown product, due to inadequate information, lack of local participation
ii. Technology seen as alien and of no use
d. Dispersed or widely distributed settlements
e. Inadequate understanding of local needs
i. Lack of stakeholder involvement
f. Gender participation

8. Information and awareness
a. Inadequate information
i. Poor dissemination of information to technology users (on product, benefits, costs, financing sources, potential project developers etc.)
ii. Poor infrastructure for communication of small-scale project support
iii. Lack of market information
iv. Lack of knowledge or access to climate technologies resource assessment data, implementation
requirements
v. Lack of agencies or agencies ill-equipped to provide information
b. High risk perception of climate technologies
i. Uncertain new technology
ii. Uncertain benefits
iii. High investment risks
iv. Irreversibility of investment and a lack of flexibility of plant and machinery for other uses

v. Perception of complexity
c. Lack of media interest in promoting technologies
d. Language
e. Feedback mechanism lacking or inadequate
f. Lack of awareness about issues related to climate change and technical solutions

9. Technical
a. Product not reliable
i. Lax quality control
ii. Poor documentation of reliability
iii. Need to modify and demonstrate unfamiliar products to local conditions
b. Poor O&M facilities
i. Lack of skilled personnel
ii. Slow after-sales service
iii. Limited availability of spare parts (few suppliers, long supply routes)
iv. Need to import spare parts
c. Inadequate standards, codes and certification
i. Lack of institutions or initiatives to set standards
ii. Lack of facilities for testing and certification
iii. Insufficient quantity and quality of controlling and measuring equipment
iv. Standards not obligatory
d. Technical risks
e. Uneven technical competition
i. Lack of scale and experience
ii. Poor performance in relative terms
iii. Weak infrastructure (ESTs may need strong physical infrastructure such as roads and electric grid)
f. System constraints
i. Capacity limitation with grid system (e.g., intermittent RET electricity)
g. Complexity of new technology, insufficient expertise

10. Other Barriers
a. Environmental impacts
i. Local pollution
ii. Ecological aspects
iii. Competition for resources
iv. Divergent plans, incentive structures and administrative requirements from different donors