THE REPUBLIC OF KAZAKHSTAN

TECHNOLOGY NEEDS ASSESSMENT FOR CLIMATE CHANGE MITIGATION

REPORT III

TECHNOLOGY ACTION PLAN (TAP) FOR MITIGATION TECHNOLOGIES

August 2017

Disclaimer

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ABBREVIATIONS

BAU	Business as usual
BAT	Best Available Technology
CCS	Carbon capture and storage
CHP	Combined Heat Production
CO_2	Carbon dioxide
CO	Carbon monoxide
CTIEC	China Triumph International Engineering
DENA	The German Energy Agency (Deutsche Energie-Agentur, Dena)
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
ESCO	Energy Service Company
EU	European Union
EEU	Eurasian Economic Union
ESPC	Energy Saving Performance Contract
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GOK	Government of Kazakhstan
GEF	Global Environmental Facility
g.c.e.	Grams of coal equivalent (specific fuel consumption)
FIT	Feed in Tariff
FS	Feasibility Study
FBC	Fluidized Bed Combustion (technology)
HPP	Hydro Power Plant
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
IFC	International Finance Corporation
ICD	The Islamic Corporation for the Development of the Private Sector
JSC	Joint Stock Company
LLP	Limited Liability Partnership
KZT	National currency (Tenge or KZT)
KEGOC	Kazakhstan Electricity Grid Operating Company
KIDI	Kazakhstan Institute of Development of Industry, JSC
KAZREFF	Kazakhstan Renewable Energy Financing Facility
MJ	Ministry of Justice
MID	Ministry of Investments and Development
ME	Ministry of Energy
MNE	Ministry of National Economy
MF	Ministry of Finance
MH	Ministry of Health
MJ	Ministry of Justice
MLSD	Ministry of Labor and Social Defend
MRV	Monitoring, reporting, verification
MOU	Memorandum of Understanding
NAMA	National Appropriate Mitigation Actions
NAP	National Allocation Plan
NATD	National Agency of Technology development
NDC	Nationally Determined Contribution
NGO	Non-Government Organization
NOx	Oxides of nitrogen
O&M	Operating and maintenance costs
PMU	Project Management Unit
PDD	Project Design Document
PB	Pay Back period

PPA	Power Purchase Agreement
RES	Renewable Energy Sources
REC	Regional Electricity Company
R&D	Research and Development
SME	Small and Medium Business
SPAID	State Program on industrial development of Kazakhstan for 2015-2019
TA	Technical Assistance
TNA	Technology Needs Assessment
TAP	Technology Action Plan
TEC	Technology Executive Committee
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
USCSC	Ultra-supercritical and supercritical (combustion technology)
USAID	The United States Agency for International Development
UNDP	United Nations Development Program
UNEP DTU Partnership	UN Environment (UNEP) Collaborating Centre within the Department of Management Engineering, Technical University of Denmark
VAT	Value Added Tax
WHR	Waste Heat Recovery (technology)
WB	World Bank

FOREWORD

The Republic of Kazakhstan attaches great importance to the climate change, which is considered as one of the priority global environmental problem facing by the humanity today. In November 2016, Kazakhstan ratified the Paris Climate Agreement. To achieve the global climate goal of keeping the temperature rise below 2 degrees Celsius, Kazakhstan submitted its Nationally Determined Contribution, expressed in 15% unconditional and 25% conditional decrease in GHG emissions compared to the base year 1990.

The Government of Kazakhstan has consistently advocated for measures to prevent climate change, and considers own ways to reduce its greenhouse gas emissions and adapt to climate change. The priority areas for us are development of renewable energy sources, energy efficiency and energy saving, diversification of crop production, use of no till technology and water-saving technologies that contribute to reducing greenhouse gas emissions and adapting to climate change.

Thus, Kazakhstan's Green Economy Concept, the Law on Energy Saving and Energy Efficiency, the Agro-industrial Complex Development Program for 2017-2021 and other legislative and regulatory acts are aimed at upgrading infrastructure and technologies to reduce greenhouse gas emissions and adapt to climate change. Implementation of these initiatives and state programs requires introduction of new technologies.

Technology Needs Assessment for mitigation and adaptation was the first important step in achieving the objectives of the governmental plans. The methodological aspects of Barrier Assessment for technologies introduction, and development of Technological Action Plans and Project Ideas for mitigation and adapting to climate change will be the starting point for their advancement.

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EXECUTIVE SUMMARY

The Technology Needs Assessment (TNA) process for Climate Change Mitigation in Kazakhstan results in three reports: the TNA report itself, the report on Barriers and Measures and this final one - report on Technology Action Plan (TAP), which is focused on the development of the technology action plans for prioritized technologies for application and diffusion. The report also presents the project ideas (PI) related to introduction of these technologies, which are incorporated into each technology action plan.

During the first stage of TNA process and TNA report the selection of sectors for mitigation technologies and the mitigation technologies were summarized by the team of mitigation experts, a project coordinator in cooperation with representatives from the ministries, in close cooperation with representatives of various interested stakeholders. The team took into consideration strategic priorities of the country and general criteria, such as economic impact, social impact, environmental impact, and Greenhouse Gases (GHG) mitigation potential. For power production, 6 technologies were considered, and **Small Hydropower** and Pulverized Coal Combustion with higher efficiency (here in the text – an **Energy Efficient Coal Combustion**) were prioritized as technologies having best potential for development in the country for mitigation purposes. For cement production, 5 technologies were considered, and Energy Efficiency and Saving (here in the text – an **Energy Efficiency in Cement Production**) and Transition from wet to dry process of cement production (here in text a **Wet –to Dry Modernization**) were prioritized.

During the second stage the same sectoral/technology working groups representing relevant stakeholders were formed for assessment of barriers and measures for these technologies. presented in the second report named "Barriers and measures for Mitigation". National consultants have applied a participatory approach during the stakeholder consultation process. Measures for overcoming existing barriers of prioritized technologies have been finally grouped in the following categories: policy/regulatory; economic/financial; institutional & organizational capacity; network; market; information & awareness; human skills. During analysis the cross cutting issues, the common barriers for all prioritized technologies were identified and presented in the second report named "Barriers and measures for Mitigation". For example, Policy/ regulatory issues have many common points for cement production sub-sector and for electricity sub-sector with some specifics for small hydro power technology. It was revealed that the fiscal support mechanisms, strengthening capacity of Research and Development (R&D) institutions, strengthen cooperation between stakeholders at different levels are very important. These issues have effect on insufficient development of climate change mitigation technologies in the country and create common barriers to their implementation. Barriers and measures were explained in the report respectively.

During this third stage the measures agreed at the second stage have been assessed by the sectoral teams of stakeholders involved into the TNA process during previous steps taking into account the changes and achievements in the policy, time scale, benefits and funding resources. Target groups for TAP include policy makers, national public and private stakeholders and investors; international funding institutions. The TNA team screened measures using criteria: effectiveness, efficiency, suitability, and costs-benefits. Those with highest rank are included as actions into the TAP. The TAP for each mitigation technology is developed per requirements of the Guidebook on TAP ("the Guidance for Preparing a Technology Action Plan" issued by United Nations Framework Convention on Climate Change (UNFCCC) Secretariat and UN Environment (UNEP) Collaborating Centre within the Department of Management Engineering, Technical University of Denmark (UNEP DTU Partnership) issued in July 2016. The information for detailed TAP development is presented as required in the form of unified spreadsheets. Some of the actions and/or activities presented in the TAPs are delivered as Project Ideas, which aim to attract funding for the implementation of a TAP, or some specific elements of the TAP.

The TAP can be called a "keystone" between TNA analysis and technology implementation. At the same time, it is technology-specific. The approach used during a TAP development process for each technology could be formulated in the following steps presented in the main text and Annexes of the report accordingly:

- Step 1: Ambition
- Step 2: Actions and activities
- Step 3: Identification of stakeholders and determination timelines
- Step 4: Capacity needs and costs estimates

- Step 5: Management planning including risks and next steps

The uncertainties imply the risk that a TAP will be less effective in supporting technology implementation than expected. In order to mitigate these risks, the step 5 helps to identify potential risks and formulate possible contingency measures.

Finally, the key information is summarized into the TAP overview (Tables 1-4). Categories, barriers and measures were taken from the report on Barriers and Measures (second stage) for each technology for consideration by stakeholders. The measures were reconsidered, ranked and transformed into actions and activities accordingly to each technology. Each section on the TAP development contains risk assessment and definition of the proposed actions to control or mitigate the risks.

Chapter 1 is devoted to prioritized technologies in the power production sub-sector. Chapter 2 describes the development of prioritized technologies in the cement production sub-sector. Cross cutting issues were considered during the process and are presented in Conclusion. Chapter 3 contains the description of Project Ideas for both sub-sectors of economy. Annexes 1-4 contain spreadsheets which support the TAP development process for each technology according to steps 1-5, named above.

In conclusion, these TAPs could be an important source of information for the ministries, other stakeholders at national and international levels for the purpose of planning, improvement of coordination and cooperation and mitigation technologies diffusion. The TAPs could contribute to environmental and energy policy improvement, implementation of commitments under Nationally Determined Contribution (NDC) and Paris Agreement, in particular, the implementation of the following main indicators of the national policy mentioned in the strategic documents.

- Kazakhstan intends to reduce energy intensity of Gross Domestic Product (GDP) by 25% by 2020 and 50% by 2050
- In 2016, Kazakhstan ratified the Paris Climate Agreement, according to which Kazakhstan will make its contribution by 2030 to reduce greenhouse gas emissions in 15% relative to the base year 1990.

CHAPTER 1. Technology Action Plans for prioritised technologies in the power production sub-sector

Power production sub - sector can be characterized as the most intensive emitter of greenhouse gas (GHG) emissions in Kazakhstan: this annual indicator is 68-73% of total GHG emissions according to the "Concept of development of fuel and energy complex of the Republic of Kazakhstan till 2030". The efficiency of coal condensing power plants in Kazakhstan is 32% in average, whereas in advanced foreign countries about 42%. Specific consumption of coal equivalent for 1 kWh generation is 388 grams of coal equivalent due to national data and exceeds the performance of Russia and Belarus by 15 and 33%, respectively. The share of renewable energy sources (RES) was less than 1.0% in total electricity generation mix in 2015. According to the "Concept of Kazakhstan on transition to Green Economy" (2013), the renewable and alternative energy sector is expected to achieve a 50% share (including wind, solar, hydro and nuclear power stations) in total electricity production by 2050 and build new Thermal Power Plants (TPPs) in accordance with the best technologies for fuel efficiency and environmental parameters (to reduce the specific consumption of coal equivalent for 1 kWh by 14% by 2020).

It is estimated that the transition into a green economy will be further increased by 3% of Gross Domestic Product (GDP), more than 500 thousand new jobs, new industries and services to provide universally high standards of quality of life for the population will be created. Thus, the recent policies of the Republic of Kazakhstan on climate change mitigation are aimed at promoting energy efficiency and renewable energy sources in all sectors of the national economy. The main indicators for power production sub-sector are in line with the main indicators approved by the Government of Kazakhstan in strategic documents for the whole economy, which are:

- Reduction of energy intensity of GDP by 25% by 2020 and 50% by 2050
- Reduction of greenhouse gas (GHG) emissions on 15% towards the base year 1990 by 2030.

According to experts estimates the total reduction of GHG emissions is expected to be about 8.6 million tCO_2/year by 2030, and only in the period 2025-2030 the carbon dioxide (CO_2) emissions can reach almost the level of 1990 in the power sub- sector.

1.1. Technology Action Plan Development for Small Hydropower

The preparation of a Technology Action Plan (TAP) in general is the responsibility of the TNA coordinator in collaboration with national consultants and the sectoral or technology working groups within the TNA team, in collaboration with a group of relevant stakeholders (Table 7, Annex 1). The information on the development of TAP for Small Hydropower is covered by the five steps named above and presented in Annex 1 (Tables 7-11). The final information formulated the TAP for Small Hydropower, is put into Table1. Characteristics of key issues related to the development of this TAP are described below.

Technology description

The hydropower plants with the capacity of less than 35 MW are defined as small hydropower plants (HPPs) in Kazakhstan. The possibility of decentralized electricity supply for remote areas is very important. About 65% of hydropower resources are situated in the mountain rivers of southern regions of the country.

Application of small HPP technology lines with the country's social, economic and environmental development priorities. The potential of small hydropower mentioned in the strategic national policy documents is 7.6 billion kWh per year. Economic parameters can be characterized as follows:

- Investment costs for small hydropower are $500-$10,000/kW (low -where there are good hydropower resources and there can be high local content; more expensive investment costs when hydro requires expensive civil works and import of expertise and major components), according to International Renewable Energy Agency (IRENA), data provided at Event - Webinar: Why mini-grid technologies -

PV, biomass, diesel, micro/mini hydro, wind, and hybrid systems -- need to be differentiated, dated 24 April,2017.

- Price of energy (US 0.05 to 0.30/kWh) Hydro typically produces 3-4 times as much kWh per kW installed compared to solar and wind (hydro runs: 24 hours, solar: 6, wind: 8). Higher the plant load factors the cheaper the energy effectively becomes. Low cost of energy enables productive end uses and higher revenue from productive loads means lower cost energy for everyone. Opportunities for using flexible pricing to increase sales of energy during off-peak hours.
- Pure operation and maintenance (O&M) cost (assuming overall system lifetime of about 20 years; without depreciation) is 2-5 % of investment.

Currently, South-Kazakhstan region generates only 60% of electricity on their own and the rest is bought from the neighboring regions. With small mountain rivers and irrigation canals system available, one of the most promising directions of development of alternative energy is the construction of small hydropower plants (HPP). According to experts estimates the region can obtain an additional order of 100 megawatts of electricity. The first small HPP was built in 2001. Due to monitoring data provided by Akimat, it generates now 1.3 MWh of electricity. Another one was launched in Saryagash district of South Kazakhstan region in December 2014, it generates 600 kWh. The cost of the project was 260 million KZT and it was implemented with support from the Government because of participation in the state program "Business Road Map 2020" (2013). This HPP provides electricity for local population of 8000 habitants and helps to increase the irrigated area by 450 hectares. Recently, members of the working group at Akimat, South Kazakhstan region developed 28 proposals on potential small HPP projects; these proposals are the base of the potential investment projects on small HPPs aimed to develop small hydro power in the region.

Five small HPPs with a total installed capacity of 19.4 MW are already commissioned in the mountain rivers of Almaty region. It is expected to increase to 43 MW after construction of small HPPs on the river Cox. There are similar projects in other areas of Kazakhstan. Until 2017 it is planned to implement 23 projects for construction of small hydropower plants with total installed capacity of 270 MW.

At the end of 2014, the Central Asia Renewable Energy Fund LP was established as venture fund by the National Agency for Technological Development (NATD), Islam Corporation on Development of private investors (ICD) for the purpose of investing in renewable energy projects in Kazakhstan for a period of 8 to 10 years. A target size of the fund at the initial stage amounts to $ 50 million, and in the future up to $ 100 million. Over two-thirds of the Fund's authorized capital will be formed at the expense of private and foreign investment, and the state represented by the National Technological Development Agency will invest at least one third of the total authorized fund capital. It could be expected that partially the projects on small hydro power will be financed from this fund.

In spite of presence of several mechanisms to support small and medium business (SME) such as Business Road Map 2020", “DAMU Fund”, Central Asia Renewable Energy Fund LP, there are delays in implementation of small HPP projects.

Targets for technology transfer

The government has identified initial targets for small hydro technology diffusion within application of “Action Plan for the development of alternative and renewable energy in the Republic of Kazakhstan for 2013-2020”. According to it, there is a potential for construction of 41small hydro-power plants with total capacity potential of 539 MW, which will be 17.65% of total RES capacity (3054.55 MW) to be built by 2020.

There is no target for small hydropower directly set by 2030. The target for energy generation from small hydro, wind, solar and alternative energy sources is defined as 10% of total generation by 2030, 30% - respectively by 2050.

Feed in Tariffs (FITs) for electricity generated by RES are in force since 27 May, 2014, including for small HPPs (with capacity less than 35 MW) – 22.68 KZT per kWh without VAT (about 7 US cents).

In order to ensure achieving planned targets, the Government plans to make a renewable energy sources map (or electronic atlas), which will indicate suitable locations, types of sources and capacity in terms of climatic conditions and in terms of power system stability and network bandwidth, but this works is postponed because of lack of resources. In addition to FIT mechanism, it is planned then to launch auctions for the purchase of electricity in the regions. The winning companies will sell it at market price. These plans could be realized only with international support. The recent policy of the Ministry of Energy (ME) in the field of RES development described above coincides with the proposed TAP for Small Hydropower presented below.

Overview of barriers, measures, transformation of measures into actions and activities

Categories of barriers, measures considered for Small Hydropower diffusion were the following: Economic/financial; legal/regulatory (or policy), Capacity building and information, and others. Thus, for Small Hydropower the barriers were defined in the report on Barriers accordingly:

- Inadequate work of subsidy mechanisms, such as: Power Purchase Agreement (PPA), Feed in Tariff (FIT);
- Lack of long-term program on small hydro 2030-2050, Inefficient regulation on FITs, on providing permits, import procedures, and lack of law on power market capacity
- Weak capacity of R&D institutions; lack of market information, on modern equipment
- Weak coordination between market actors, inefficient donors and local authorities' coordination for implementation of pilot projects

The proposed measures to overcome the barriers named above were discussed, negotiated and agreed upon by relevant stakeholders (Tables 7- 9, Annex 1) and then by the ministries involved before selecting the final set of measures to be presented in the Technology Action Plan (TAP). The following criteria were used when selecting measures through ranking for transforming them into Actions or Activities of the TAP:

- The effectiveness of the measures toward technology implementation;
- The efficiency of the action to achieve this effectiveness
- Possible positive or negative interactions or conflicts with other measures
- Suitability of the action within the country or sector context
- The costs and benefits of the measures.

The measures were grouped more realistically while formulating Actions through the process of assessment, according to the recent improvement of the policy and measures taken place during the period after an issue of the report on Barriers.

Identification of stakeholders and determination of timelines, capacity needs and cost estimates

Capacity building as well as financial, technical assistance and other requirements to implement the Actions and Activities that will strengthen the enabling framework for a given technology are important. Responsible bodies and stakeholders were defined taking into consideration national conditions, in particular the local administrations (Akimats) of the regions (Oblasts) of Kazakhstan that are responsible for planning, preparing and implementing the RES projects, the Government of Kazakhstan (GOK) develops policy and is responsible for legislation/regulation issues and providing mechanisms for policy implementation. Existing Association on RES is involved into the process of preparation of regulation proposals, open discussions and gathering comments before the Government approve any legal act and into the process of information sharing through websites) and participating in workshops and roundtables. Representatives from R&D institutions, consultants could be involved into research, forecasting, technical design and calculations, training. Engineers and other technical and administrative personnel or consultants could be involved into management, installation of equipment, services, etc. Financiers, bankers could be involved into projects assessment as well as into issues related to financing. Identification of stakeholders, determination timelines, capacity needs are described in the Table 10, Annex1. Example of cost estimated for proposed activity 3 (about workshops) is presented in Table 27.

Identification of risks and Contingency actions for mitigation

It should be noted that uncertainties will remain about the actual implementation of the TAP. These uncertainties imply the risk that a TAP will be less effective in supporting technology implementation than expected. The potential risks for all types of activities/actions were identified mostly in three types: cost, scheduling and performance, information on possible contingency measures was formulated in the Table 11, Annex 1. The TAP is considered as an overall strategy document and we assume that actions (and activities) face similar risks, thus need common monitoring, evaluation, and joint contingency planning to be developed.

Project Idea

The following Project Idea is developed as Activity of the TAP: Construction of 3200 kW hydropower plant in the South Kazakhstan region (Chapter 3).

Table 1. TAP Summary overview for Small Hydropower

TAP Summary overview for Small Hydropower										
Sector	Energy sector									
Sub-sector	Power production subsector									
Technology	**Small hydropower**									
Ambition	The scale is construction of up to new 41 Hydro Power Plants (HPPs) of various sizes totaling 539 MW by 2020 according to the State "Action Plan for alternative and renewable energy sources (RES) development for 2013-2020" (2013). Recently hydropower contributes to 96% of total renewable energy sources (RES). The ambition is to contribute to the achievement of the overall RES target in energy mix (including small, hydro, wind, solar) – 10% by 2030.									
Benefits	**Climate change mitigation**	Considering that the electricity generation from Hydro Power Plant (HPP) practically results in zero CO_2 emissions. Experts estimates on GHG emissions reduction: 38 Mt CO_2 by 2050, 7.6 Mt CO_2/year because of introduction of Small hydropower into energy generation mix.								
	Social development	Social benefit is income increase, improved living conditions, energy access and creating new employment opportunities. At least 10,000 people will benefit from improved energy access (at least 50% - women) in the rural areas due to RES development (including small hydro). For example, according to data from JSC "Development Bank of Kazakhstan" the 300 new working places were created for construction of the Cascade of small hydropower plants with capacity 24.9 MW on the river Turgusun in West Kazakhstan Oblast, the expected output is 79.8 million kWh per year.								
	Environmental protection	Use of hydropower generators will lead to the reduction of air pollution, greenhouse gas (GHG) emissions. Small hydro power plants (HPPs) require little changes in the river current and, consequently, the existing ecosystem can continue functioning as before. Small HPPs are recognized as ecological safe power plants.								
	Economic development	Development of small hydropower contributes to sustainable economic development in the frames of energy sector development which is the driver of economic growth, green growth. The total hydropower potential of Kazakhstan (including small hydropower) was estimated as 170 billion kWh per year.								
Action	**Activities to support Action**	**Responsible body and focal point preparation**	**Responsible body and focal point implementation**	**Time frame**		**Capacity needs**		**Cost summary**	**Sources of Funding**	**Risks (see with Table 11)**
				start preparation	**complete implementation**	**preparation**	**implementation**			
1 **Strengthen existing initiatives through implementing economic/financial and market-based mechanism**	1.1. Define weak points of existing financial support of small hydro through review, prepare recommendations for improving conditions for commercial financing (such as commercial subsidy up to 30% of total or financial incentives in the form of soft loan to cover at least 50% of the purchase total cost) (report)	ME	ME, International/ nation. experts	2017	2018	Project management; Financial Planning	Project management; Financing	USD 60, 000	Public Governmental/ International TA	Activities take longer to complete than originally planned Demand dependent on subsidies
	1.2. Improve (rework) methodology of FIT's definition keeping in mind	ME, KEGOK/ RFC	ME primary responsibility	2017	2018	Project managem	Project management;	USD 50,000	Public Governmental/	

s	expenses for Reserve Fund at RFC/KEGOK, structure of expenses		, TA experts			ent; Financial Planning	Financing Technology Deployment		International TA for R&D institutions	
	1.3. Develop a Feasibility Study (FS) report. This document could cover the following issues: design an auction system; modeling demand, forecast electricity up to 2030 (2050), and with focus on small hydropower, energy transmission evaluation; mobilization of financial resources through PPP programs (such as The Global Energy Transfer Feed-in Tariffs (GET FIT) or the Renewable Energy and Energy Efficiency Partnership (REEEP)).	ME, International organizations	ME, International organizations	2017	2019	Project managem ent; Financial Planning;	Project management; Business management, Financing Technology Deployment	USD 1,000,00 0	Government and donor funding (International TA): USAID, EBRD/KAZREFF, UNDP, WB	
	1.4. Develop and conduct roundtable discussions on the results of reports activities named above for finalization.	ME, International organizations, companies	ME (primary responsibility), International organization	2018	2019	Financial Planning Project managem ent Business managem ent Financing	Project management; Business management, Financing Technology Deployment	USD 200,000	Government and donor funding (International TA)	
2. **Improve legal and regulatory framework for replicable technology transfer**	2.1. Review of administrative procedures for the purpose of streamlining, by simplifying the permission procedures for submitting documents or receiving state full-scale grants and adoption of fast-track, one-stop approval process and review social programs and other relevant legal documents related to insurance regulation or loan guarantee and develop innovative policy recommendations for improvement (report)	ME, MNE, MID, MF International organizations, companies,	ME, MNE, MID, MF International organizations, companies	2017	2018	Financial Planning Project managem ent	Financial Planning Project management Business management Financing	USD 40,000	Government and donor funding (International TA)	Long state procedures and bureaucracy leading to slow endorsement of proposed recommendations An activity takes longer to complete than originally planned

	2.2. Develop a roadmap – 2030 for Small Hydropower, including a list of projects.	ME, R&D Institutions/International TA	ME, International organizations	2017	2018	Financial Planning, Project management, Business management	Project management, Business management, Financing, Technology Deployment	USD 300,000	Public Governmental budget, TA International	
	2.3. Develop an electronic atlas on Small Hydropower and monitor its changing once 2 years	ME, R&D institutions	R&D institutions	2017	2018	Project management, Financial Planning	Project management Financing Market development	USD 50,000	Public Governmental budget	
	2.4. Develop and endorse supportive legislation/ regulation for introduction of activities described above	ME, MNE, MID, MF Damu, R&D institutions, Akimats	ME, MJ, MNE, MID, MF Damu, R&D institutions, Akimats	2018	2019	Project management, Financial Planning, Technology Deployment, Market development	Project management, Market development, Financing, Technology Deployment, Technology Diffusion	USD 80,000	Public Governmental budget	
	2.5. Develop and conduct workshops on auctions, definition of risks for bidders to all the competitors, etc.	ME, R&D institutions, National and international experts	International donors/ international consultants	2018	2019	Project management, Financial Planning, Technology Deployment	Project management, Business management, Financing, Technology Deployment, Market development	USD 50,000	Government and International funding TA	
3 **Strengthen capacity building of representatives from institutions, business**	3.1 Develop specific training programs for R&D institutions and local authorities, SMEs in cooperation with international organizations. Conduct workshops for public service providers, regulatory bodies, business representatives, financial sector and other institutions accordingly.	ME, International organizations	International donors/ international TA	2018	2021	Project management, Financial Planning	Project management, Business management, Financing, Technology Deployment	USD 17652	International funding TA	Local suppliers do not see the benefits from participation in training An activity takes longer to complete than

	3.2. Develop different types of thematic documentation, publications (such as manuals, surveys, etc.), and distribute via meetings, workshops, etc.	ME, International donors/ international consultants, local consultants	ME, International donors/ international TA	2019	2021	Project management, Financial Planning	Project management Business management Financing Technology Deployment	USD 26425	Government and International funding	originally planned
4. **Improve Information Gathering and Sharing**	4.1. Compile and distribute existing site-specific pre-feasibility data (including technical information) for development of electronic atlas on Small hydropower.	ME, MNE, MH, MID, Akimats, R&D institutions	ME, Akimats, NGOs, International organization, Associations	2017	2029	Project management Financial Planning Business management	Project management, Business management, Market development, Financing, Technology Deployment	USD 150,000	Private sources, Public funding and Regional budget	Materials developed will not be useful if the policy changes
5. Support policy through implementing projects	5.1 Develop and implement small hydro projects on at the current pace in South, East, and Central regions of Kazakhstan (based on model Project Idea, Chapter 3).	ME, R&D Institutions/International TA, Akimats	Akimats, Business, ME	2017	2030	Financial Planning, Project management	Project management Business management Market development Financing Technology Deployment Technology Diffusion	USD 455,000 (projects up to 2019); USD 1-1,95 million/ MW	Private sources, international, regional budget	Local suppliers of electricity do not see the benefits from projects Technology does not perform as planned

Responsible bodies involved into TAP:
ME - Ministry of Energy, Focal Point
KEGOK/ RFC LLP for RES - Kazakhstan Electricity Grid Operating Company/ "RFC" Limited Liability Partnership for Renewable Energy Sources, branch organization
MNE - Ministry of National Economy
MID - Ministry of Investments and Development
MH - Ministry of Health, Ministry of Labor and Social Defend (MLSD)
MF/ Damu Fund - Ministry of Finance/ "Damu" Entrepreneurship Development Fund" JSC (hereinafter - Damu Fund)
Akimats
Research and Development (R&D) institutions, Small and Medium Business (SME)
International organizations, Technical Assistance (TA) Non-Government Organizations (NGOs), Associations

1.2. Technology Action Plan Development for Energy Efficient Coal Combustion

The process of the development of the Technology Action Plan (TAP) for Energy Efficient Coal Combustion is similar to the development of TAP for Small Hydropower as described in Section 1.1. The supporting tables for TAP development are presented in Annex 2 of the report, the characteristics of key issues and TAP summary overview (Table 2) are presented below.

Technology description

The conventional types of coal combustion technology have an efficiency of around 35%. For a higher efficiency supercritical and ultra-supercritical coal-fired technologies have been developed. These technologies can combust pulverized coal and produce steam at higher temperatures and under a higher pressure, so that an efficiency level of 45% can be achieved (ultra-supercritical plants). Supercritical and ultra-supercritical plants are more expensive because of the higher requirements to the steel needed to withstand the higher pressure and temperature, but the higher efficiency results in cost savings during the technical lifetime of the plants. Kazakhstan intends to use these ones in combination with the Fluidized bed combustion (FBC), (hereafter – Energy Efficient Coal Combustion).

FBC plants are capable of burning most types of coal (and other types of solid fuels) at high efficiency and without the necessity for expensive fuel preparation (e.g., pulverizing). FBC units operate at competitive efficiencies, cost less than today's conventional boiler units, and have NO_2 and SO_2 emissions below levels mandated by international standards.

Technical re-equipment of existing and construction of new power plants with the installation of modern Steam turbine plants which have the efficiency 45-46% versus 35% efficiency of existing plants, which would allow reduction in specific fuel consumption from 350-360 g/kWh to 270-300 g/kWh, respectively, reduction of at least by ≈ 20% of CO_2 emissions. The emissions of CO_2 per MWh delivered to the grid could be reduced from 830 kg to 730 kg.

The start of technology implementation is planned at least in the period 2025-2030, the preparation phase include works on the Feasibility Study development, project preparation, and negotiations which could start earlier.

Targets for technology transfer

Specific coal consumption for electricity generation in Kazakhstan (388 g/kWh) exceeds the performance of Russia and Belarus on the 15 and 33%, respectively. According to the State Program "On Energy Saving 2020" the preliminary target for Energy Efficient Coal Combustion is the reduction of specific fuel consumption by 14% by 2020.

Overview of barriers, measures, transformation of measures into actions and activities

Categories of barriers, measures considered for Small Hydropower diffusion were the following: Economic/financial; legal/regulatory (or policy), Capacity building and information, and others.

The barriers defined for this technology in the report on Barriers are the following:

- Inadequate subsidy mechanism, loan guarantee, PPP mechanisms
- Non-compliance of standards and certification, inadequate tariff mechanism, inefficient regulation on import duty, tax privileges
- Weak capacity of R&D institutions, low level of knowledge of ecological advantages
- Weak coordination between market actors, inefficient donors and local authorities' coordination for implementation of pilot projects

The proposed measures to overcome the barriers named above were discussed, negotiated and agreed upon by relevant stakeholders (Tables 12-13, Annex 2) and then by the ministries involved before selecting the final set of measures to be presented in the Technology Action Plan (TAP). The similar criteria (including: effectiveness, efficiency, interactions with other measures, suitability and benefits& costs) were used for ranking measures when selecting measures for transforming them into Actions or Activities related to the TAP on Energy Efficient

Coal Combustion, the process on transformation of measures into actions and activities, including ranking for the final selection of Actions is described in Annex 2 (Table 14).

Identification of stakeholders and determination timelines, capacity needs and cost estimates

Capacity needs for implementation of the Actions and Activities that will strengthen the enabling framework for Efficient Coal Combustion technology are important.

Identification of stakeholders, determination timelines, capacity needs and cost estimated are described in the Table 15, Annex 2. Costs for project implementation are based on the calculations provided in the associated Project Idea (Chapter 3).

Identification of risks and Contingency actions for mitigation

The potential risks for all types of activities/actions were identified mostly in three types: cost, scheduling and performance, information on possible contingency measures was formulated in the Table 16, Annex 2. The TAP is considered as an overall strategy document and we assume that actions (and activities) face similar risks, thus need common monitoring, evaluation, and joint contingency planning to be developed.

Project Idea

The following Project Idea is developed as Activity of the TAP: Use of coal-fired technology in CHP plants in North Kazakhstan on the base of combination of supercritical steam parameters and fluidized bed combustion (Chapter 3).

Table 2. TAP Summary overview for Energy Efficient Coal Combustion

TAP Summary overview for Effective Coal Combustion										
Sector	**Energy sector**									
Sub-sector	**Power production sub- sector**									
Technology	**Energy Efficient Coal Combustion**									
Ambition	Annual construction of up to 600 MW of new capacities or 9,000 MW for 15 years is required for sustainable development of the economy in the period up to 2025, to meet the electricity demand with an annual growth of 7%. Target is assisting to improvement of energy efficiency of GDP by reduction of energy intensity 25% by 2020 and 50% by 2050.									
Benefits	**Climate change mitigation**	Target indicator for power production is reducing carbon dioxide emissions in the power subsector up to level of 2012 (or 95.7 million tons of CO_2 eq.) by 2020 and reducing then 15% (relative to the level of CO_2 eq. in 2012) by 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.								
	Social development	At least 150-200 new jobs annually could be brought because of introduction of the technology								
	Environmental protection	Preventing from air pollution, improving local health improvement, reduction of GHG emissions (Kazakhstan intends to make its contribution by 2030 to reduce greenhouse gas emissions in 15% relative to the base year 1990).								
	Economic development	The promotion of technology corresponds to the priorities of sustainable development named in the strategic documents such as the Strategy of JSC "Samruk-Energo" for 2012-2022, Green Economy Concept, Kazakhstan Strategy 2050.								
Action	**Activities to support Action**	**Responsible body and focal point preparation**	**Responsible body and focal point implementation**	**Time frame**		**Capacity needs**		**Cost summary**	**Sources of Funding**	**Risks (see with a Table 16)**
				start preparation	**complete implementation**	**preparation**	**implementation**			
1. **Harnessing the Public –Private Partnership and market-based mechanisms to invest more in Energy Efficient Coal Combustion**	1.1. Review the best practices on the use of financing mechanisms to increase private financing for technology diffusion (PPP, ESCO, Risk-sharing Facilities, concessional financing) and develop report with recommendations	ME, MNE, MF, TNA Committee/International organizations, KIDI	ME, TNA Committee/International organization	2018	2019	Project management; Financial Planning	Project management; Financing	USD 100, 000	Public International TA	Low interest of policy makers and financial institutions
	1.2. Develop and conduct workshop relating to applying financial mechanisms in Kazakhstan	ME (primary), MF, TNA Committee, International organizations	ME (primary), MF, TNA Committee, International	2018	2022	Financial Planning Project management Financing	Project management; Financing Technology Deployme	USD 200,000	Government and donor funding (International TA)	

			organization				nt			
2. **Improvement of legal and regulatory framework**	2.1.Update the law and regulation for revitalize the carbon market (review the National Allocation Plan 2016-2020 and develop a National Allocation Plan 2021-2025	ME, MF/Damu Fund	ME, MJ, MF/Damu Fund	2018	2020	Financial Planning	Financing	In KZT from National budget (usually none), (approx. equivalent in USD 50,000)	Government resources	Long state procedures and bureaucracy leading to slow endorsements of proposed recommendation An activity takes longer to complete than originally planned
	2.2. Develop a roadmap – 2030 for Energy Efficient Coal Combustion, including a list of projects	ME, TNA Committee/International organizations	ME, TNA Committee/International organization	2018	2021	Financial Planning, Project management	Project management, Financing, Technology Deployment	USD 300,000	Public Governmental budget, International TA	
	2.3. Develop standards and regulation that ensure that any newly built coal fired power stations meet efficiency limits, and introduce the air quality standards for all (new and existing) coal - fired power plants that mirror those in Europe (the Large Combustion Plant Directive and Industrial Emissions Directive)	ME, International organizations	ME, International organizations	2020	2022	Financial Planning, Project management	Project management, Financing, Technology Deployment	USD 300,000	Public Governmental budget, International TA	
	2.4. Develop and conduct roundtable discussions related to the activities named above	ME, International organizations	ME, International organization	2020	2023	Project management, Financial Planning, Technology Deployment	Project management, Business management, Financing, Technology Deployment, Market development	USD 100,000	Public Government and International funding TA	
	2.5. Endorse and launch supportive legislation and regulation for introduction of this Action	ME, MJ	ME, MJ, MNE, MF Damu,	2020	2029	Financial Planning, Technology	Market development,	In KZT from National	Public Governmental	

			Akimats			Deployment, Market development	Financing, Technology Deployment, Technology Diffusion	budget (usually none), (approx. equivalent in USD 100,000)	budget	
3. **Strengthening capacity building of representatives from institutions, business**	3.1. Develop specific training program for the different stakeholders (R&D institutions, local authorities, engineers, other stakeholders) in cooperation with international organizations, and conduct training	ME, TNA Committee, International organizations, R&D institutions	ME, MNE, MF, International organization	2020	2025	Project management, Financing, Technology Deployment	Project management, Financing, Technology Deployment	USD 150,000	Public: International TA	Those for whom this training program is developed are not interested in participating
	3.2 Arrange study tours, organize bilateral meetings for establishment of PPP or Technical Alliance to transfer of modern energy efficient coal combustion technology (report), information on web-site of ME, MID	ME, TNA Committee, International organizations, MF/Damu Fund, MNE	ME, TNA Committee, International organization	2022	2025	Project management, Financing, Technology Deployment	Project management, Financing, Technology Deployment, Market development	USD 200,000	Public: International TA	
4. **Support policy through implementing projects**	4.1. Develop at least 2 projects on the base of a Project Idea (Chapter 3) and implement	ME, TNA Committee, International organizations	ME, Business	2020	2030	Project management, Financing Planning	Market development, Business management, Financing, Business management, Technology Deployment, Technology Diffusion	USD 1,140 Millions	Public: Government Private: Cost-sharing with International and or local Business	Project are not properly developed Human resource does not perform as planned

Kazakhstan: Technological Action Plan for Mitigation Technologies

Responsible bodies involved into TAP:
ME - Ministry of Energy, Focal Point
MNE - Ministry of National Economy
MJ - Ministry of Justice
Kazakhstan Institute of Development of Industry, JSC (KIDI)
MF/ Damu Fund - Ministry of Finance/ "Damu" Entrepreneurship Development Fund" JSC (hereinafter - Damu Fund)
Akimats
Research and Development (R&D) institutions, Business, ESCO company
International organizations
Technology Needs Assessment (TNA) Committee
JSC "Samruk-Energo"

CHAPTER 2. Technology Action Plans for prioritized technologies in the cement production sub - sector

The cement production sub - sector is the largest energy consumer of the construction materials subsector in the frames of the industry sector. In the last 5 years the cement production has grown 12-15% from 4181,000 ton of cement (2010) to 8187,000 tons of cement (2014).

Manufacture of cement clinkers, and fiber cement are the priority activities within the industry subsector according to the "State Program on industrial development of Kazakhstan for 2015-2019" approved by the Decree of the President the Republic of Kazakhstan No.874, dated 1 August, 2014, (further Program or SPAIID-2) which is the main driver of Kazakhstan economy development.

Two technologies were prioritized in cement production sub-sector:

- Energy Efficiency in Cement Production
- Wet - to Dry Modernization

An analysis of the data and the calculations indicated that the specific rate of CO_2 emissions per unit of production (benchmark for Kazakhstan, calculated by USAID Kazakhstan Climate Change Mitigation Program (KCCMP), 2014)) is less when the dry cement production process than the wet and varies from 0,830 to 1,001 tCO_2 / t clinker. In the wet process, the specific figure is 1.09-1.4 tCO_2 / t clinker.

2.1. Technology Action Plan Development for Energy Efficiency in Cement Production

As mentioned above, the preparation of a Technology Action Plan (TAP) is the responsibility of the TNA coordinator in collaboration with national consultants and the sectoral or technology working groups within the TNA team, in collaboration with a group of relevant stakeholders (Table 17, Annex 3). Preparation of the TAP for Energy Efficiency in Cement Production is done using approach of the five steps mentioned above. The final information is presented in a Table 3 below, and other supporting tables are described in Annex 3 (Tables 17-21). The key issues of the TAP preparation are described below.

Technology description

Analysis of the European cement market shows that about 78% of the cement is produced by dry technology; 16% through semi-dry and semi-wet processes, and the remaining 6% through wet processes. Several options from the list of the Best Available Technologies (BAT) such as: improvement in the management of energy consumption, replacement of wet kilns, use of heaters, could be considered by Kazakhstan for application in the long term in order to achieve the target policy indicators.

Currently, it is necessary to implement less investment intensive but rather efficient technologies, for example, implementation of raw materials and cement grinding in closed cycle. This will allow to increase cement quality by 15-20 % and to decrease energy consumption for cement grinding. This technology is especially effective with additives – super-plasticizing agents and hardeners. There is a range of tested technical solutions providing significant decrease of fuel consumption for clinker burning with wet process. Examples of these options are provided in the report on Barriers (second stage).

According to analysis of cement market in Kazakhstan, based on operating data from the Ministry on Innovations and Development (MID), the total cement capacity was 13.45 million tons per year in 2015 with potential to increase up to 16.5 million tons per year in 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%.

Targets for technology transfer

The goal of technology transfers 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 in the frames of production of construction materials. The development of cement sector should be done in such complimentary directions as modernization of existing production with use of best energy-saving and energy-efficient technologies and transfer of cement production from wet to dry process.

Cement production market is projected to be around 16.55 million tons per year by 2020 with domestic consumption around 14.0 million tons per year according to SPAID-2.

According to National Allocation Plan (NAP) 2016-2020 the CO_2 emissions growth by 2020 are estimated as not more than 16.6 million tons towards baseline (level of CO_2 in 2013-2014) or 5.53 million tons per year. These calculations were done taking into consideration the goal to reduce total GHG emissions by 15% relative to the base year 1990.

Overview of barriers, measures, transformation of measures into actions and activities

Categories of barriers, measures considered for this technology named in the report as Energy Efficiency in Cement Production were the following: economic/financial; legal/regulatory (or policy), capacity building and information, and others. The barriers were defined accordingly at the second stage of TNA as:

- No-usage of Energy Service Company (ESCO) mechanism; inadequate subsidy mechanism, inefficient carbon market mechanism
- Lack of standards, codes and certification; inefficient regulation on tariff, customs
- Weak capacity of R&D institutions, weak access to information and poor dissemination
- Weak coordination between market actors, inefficient donors and local authority's coordination for implementation of pilot projects

The proposed measures to overcome the barriers named above were discussed, negotiated and agreed upon by relevant stakeholders (Table 17, Annex 3) and then by the ministries involved before selecting the final set of measures to be presented in the Technology Action Plan (TAP). The similar criteria (including: effectiveness, efficiency, interactions with other measures, suitability and benefits& costs) were used for ranking measures during the process of selecting measures, transforming them into Actions or Activities, described in Annex 3 (Table 18).

China experience with ESCO described in "China Energy Service Company (ESCO) Market Study" developed by IFC (2013) is recommended to be taken into consideration.

Identification of stakeholders and determination timelines, capacity needs and cost estimates

The Ministry of Investment Development (MID) is the key ministry responsible for policy supporting the diffusion of both technologies. Recently the projects in this field are implemented mostly by big international business companies and few projects were supported from the state budget.
Identification of stakeholders, determination timelines, capacity needs are described in the Tables 19-20, Annex 3. Cost estimates in this TAP development are used on the base of Project Ideas related to each technology (Chapter 3).

Identification of risks and Contingency actions for mitigation

The potential risks for all types of activities/actions were identified mostly in three types: cost, scheduling and performance, information on possible contingency measures was formulated in the Table 21, Annex 3. The TAP is considered as an overall strategy document and we assume that actions (and activities) face similar risks, thus need common monitoring, evaluation, and joint contingency planning to be developed.

Project Idea

The following Project Idea "Introduction of the waste heat recovery system in cement production of Kazakhstan" has been developed as Activity of the TAP (Chapter 3).

Table 3. TAP Summary overview for Energy Efficiency in Cement Production

TAP Summary overview for Energy Efficiency in Cement Production										
Sector	**Industry sector**									
Sub-sector	**Cement production sub - sector**									
Technology	Energy Efficiency in Cement Production									
Ambition	Cement production market is projected to be around 16.55 million tons per year by 2020 and with consumption around14.0 million tons per year. The goal of technology transfers and diffusion in cement production subsector is to increase the competitiveness of the domestic producers in domestic and foreign markets, and to create the appropriate conditions for production in the frames of production of construction materials. 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.									
Benefits	**Climate change mitigation**	The target is to limit CO_2 emissions growth within the national goal to reduce total GHG emissions by 15% relative to the base year 1990 for the whole economy. Regarding GHG emissions reduction in cement production subsector, the target is to limit of CO_2 emissions growth by 2020 to 16.6 million tons as compared to baseline (a baseline is on the level of the average value of the total carbon dioxide emissions for 2013-2014) which is 5.53 million tons per year. With total production of 0.80 million 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.								
	Social development	Labor productivity in the new cement plant, with the dry method, will be 4322.3 tons of cement per person per year. Considering the cost of cement in the amount of 12 500 KZT the one worker productivity per year is: US $ 360,194. Creation of additional work places at least 10%; Public participation and awareness-raising- 50%								
	Environmental protection	Reducing air, land and water pollution								
	Economic development	Reduction of GDP energy intensity goals are: 25% by 2020; 30% by 2030; 50% by 2050. Goals to improve energy efficiency in cement production sub- sector correspond to priorities of economic development with principles of Green Economy.								
Action	**Activities to support Action**	**Responsible body and focal point preparation**	**Responsible body and focal point implementation**	**Time frame**		**Capacity needs**		**Cost summary**	**Sources of Funding**	**Risks (see with a Table 21)**
				start preparation	**complete implementation**	**preparation**	**implementation**			
1. Activate use of ESCO mechanism in cement production	1.1.Creation an energy service company (ESCO) (with international participation) in the cement production sub-sector	MID TNA Committee	MID, TNA Committee International organization	2018	2030	Project management, Financing planning, Technology deployment	Project management, Financing, Technology deployment	USD 500,000	Private: International Budge Public: Government, cost sharing	Delay, lack of interest of International community, business
	1.2.Organize meetings for signing the Memorandum of Understanding on ESCO	MID International Business	MID International Business	2018	2020	Project management, Financing	Project management, Financing	USD 100,000	Public and Private: Governme	

						planning			nt and Internatio nal	
2.Improve legal and regulatory framework	2.1.Develop a road map – 2030 for diffusion of Energy Efficiency in cement production, including list of projects	MID, MJ International EBRD	MID International EBRD	2018	2019	Project managemen t, Financing planning	Project managemen t, Financing	USD 300,000	Public Governme nt, EBRD	Bureaucra cy leading to slow endorsem ents of proposed recommen dations
	2.1. Introduce voluntary measure: labeling of the energy efficient equipment, introduction of ISO 50001	MID International Business	MID International Business	2018	2025	Business managemen t, Financing planning	Business managemen t, Financing	USD 700,000	Private Business	
3: Strengthen capacity building of representatives from institutions, business	3.1. Develop specific capacity building programs and seminars, webinars, conduct training on ESCO, best available technologies in cement production for engineers, bankers and other stakeholders	MID, MF, International organizations	MID, International organizations, NGO	2018	2025	Financing planning Project managemen t	Project managemen t Financing	USD 100,000 / year	Public Internatio nal TA	Lack of qualified developer s
4: Support policy through implementing projects on energy efficiency	4.1. Develop pilot projects in cement production sub- sector, based on a Project Idea (Chapter 3),	Business, Akimats, International organizations		2018	2030	Business managemen t Financing Planning Design	Business managemen t Financing Engineering	USD 3,340,00 0	Public : Internatio nal TA Private Business Internatio nal Sources	Lack of coordinati on between stakeholde rs. The projects are nor developed properly

Responsible bodies involved into TAP:

MID - Ministry of Investments and Development, Focal Point
MJ - Ministry of Justice
MF - Ministry of Finance
Akimats,
Non-Government Organization (NGO)
Technology Needs Assessment (TNA) Committee
Business, Energy service company (ESCO)
International organizations, European Bank for Reconstruction and Development (EBRD)

2.2. Technology Action Plan Development for "Wet - to Dry Modernization"

As mentioned in the previous section, the preparation of a Technology Action Plan (TAP) is the responsibility of the TNA coordinator in collaboration with national consultants and the sectoral or technology working groups within the TNA team, in collaboration with a group of relevant stakeholders (Table 22, Annex 4). Preparation of the TAP for Wet-to Dry Modernization in cement production has been done using approach of those five steps mentioned above. The final information was put in a Table 4 below, and other supporting tables are described in Annex 4 (Tables 22-26). The key issues of the TAP preparation are described below.

Technology description

The main advantage of the technology on cement production using the dry method is that it consumes less heat energy for clinker burning. The heat consumption for roasting raw material mixture in wet process is 30-40% higher than when dry. Replacing the wet process with dry process can save 56.1 kg of fuel for each ton of clinker production per data from the "Program for the development of construction industry and production of construction materials in the Republic of Kazakhstan for 2010 - 2014 years". For example, the fuel consumption for production of 1 ton of cement in Kazakhstan is 100 kg, in addition to 900 kWh of electricity. Technology description is provided in the TNA Report for Climate Change Mitigation (Technology Factsheets, Annex1) and in the report on Barriers and Measures (second stage).

International Finance Corporation's (IFC) provided optimization evaluations on using coal as fuel and associated CO_2 emissions from Caspi Cement Production base data (dry method is used), see Annex 5 of the report. This example illustrates the technical and environmental parameters of the technology. The goal is of achieving 750 kg CO_2/ t cement in the long run.

Targets for technology transfer

Total cement production market is defined as 16.55 million tons per year by 2020 and domestic consumption in amount of 14.0 million tons per year according to SPAID-2. Harmonization of standards and codes with EU norms is recommended in the Strategic document "100 Steps".

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 1980 this indicator for dry method-115-118 kWh/t (on fuel gas); 108 kWh/t for production of backfill, while for equipment introduced after 1980-1990 years these indicators are: 135 kWh/t, for production of Portland cement - 75-95 kWh per ton according to the Governmental Decree on "Norms of energy consumption" (2012) No. 1346, issued on 21of October,2012.

According to the National Allocation Plan (NAP) 2016-2020 the CO_2 emissions growth by 2020 are estimated as not more than 16.6 million tons compared to the level of CO_2 in 2013-2014 years or 5.53 million tons per year in order to coincide with national priorities named above.

Wet- to dry modernization is planned in Kazakhstan for the total capacity of 5,65 million tons per year. As a result of transfer to "dry" process, the amount of cement production with reconstructed capacities will reach 8.91 million tons. The Program named above mentioned that number of staff, working in the plants, will decrease to 30 % due this modernization.

Overview of barriers, measures, transformation of measures into actions and activities

Categories of the barriers and measures defined in the report on Barriers for this technology were the following: economic/financial; legal/regulatory (or policy), capacity building and information, and others. The barriers were identified accordingly at the second stage of TNA as:

- Inadequate subsidy mechanism, inefficient carbon market mechanism
- Not harmonized standards, codes certification, inadequate technical regulation, import duty

- Weak capacity of R&D institutions, inadequate access to information and poor dissemination
- Weak coordination between market actors, inefficient donors and local authority's coordination for implementation of pilot projects

The proposed measures to overcome the barriers named above were discussed, negotiated and agreed upon by relevant stakeholders (Table 22, Annex 4) and then by the ministries involved before selecting the final set of measures to be presented in the Technology Action Plan (TAP). The similar criteria (including: effectiveness, efficiency, interactions with other measures, suitability and benefits & costs) were used for ranking measures during the process of selecting Actions and Activities related to the TAP on Wet-to Dry Modernization, see Annex 4 (Tables 23-25).

Identification of stakeholders and determination timelines, capacity needs and cost estimates

The Ministry of Investment Development (MID) is the key ministry responsible for policy supporting the diffusion of both technologies. Recently, the projects in this field are implemented mostly by big international business companies, and few projects were supported from the state budget.

Identification of stakeholders, determination timelines, capacity needs are described in the Table 25, Annex 4. Costs estimates for projects were based on the calculations provided in a Project Idea (Chapter 3).

Identification of risks and contingency actions for mitigation

The potential risks identified for all types of activities/actions were mostly of three types: cost, scheduling and performance, information on possible contingency measures, and were formulated in a Table 26, Annex 4. The TAP is considered as an overall strategy document and we assume that actions (and activities) face similar risks, thus need common monitoring, evaluation, and joint contingency planning to be developed.

Project Idea

The following Project Idea "Wet-to Dry Modernization of the Chimkent cement plant" has been developed as Activity of the TAP (Chapter 3).

Table 4. TAP Summary overview for Wet-to Dry Modernization

TAP Summary overview for Wet-to Dry Modernization										
Sector	**Industry sector**									
Sub-sector	**Cement production sub - sector**									
Technology	**Wet-to Dry Modernization**									
Ambition	Ambition is to support the transition to Green Economy and implementation of indicators named in the strategic plans- 2020, 2050, to use modern production methods for cement using high-tech equipment, which will reduce greenhouse gas (GHG) emissions, and other pollutants, and comply with international environmental standards. Regarding Wet- to Dry Modernization, the replacement of wet kilns, using waste-heat recovery technology can reduce emissions and supply up to 30% of their own energy needs. The applications of the Best Available Technologies (BAT) by 2020 are supported by SPAID -2 (construction of seven plants with this technology is included into the state program). GHG emissions reduction is 0.26-0,38 tCO2/ton. The target is to increase the cement production with a technology "Wet-to Dry Modernization" up to 41 % by 2020 according to strategic documents.									
Benefits	**Climate change mitigation**	GHG emissions reduction for transfer from "wet" to "dry" method is: 0,260-0,38tCO2/t. clinker in Kazakhstan								
	Social development	15,000 jobs								
	Environmental protection	local health improvement, clear air								
	Economic development	Transition from wet to dry method in cement production can bring 0.11-0.16 US cents per Ton								
Action	**Activities to support Action**		**Responsible body and focal point preparation**	**Responsible body and focal point implementation**	**Time frame**		**Capacity needs**		**Cost summary**	**Sources of Funding**	**Risks (see with a Table 26)**
					start preparation	**complete implementation**	**preparation**	**implementation**			
1. **Strengthen implementation of market-based mechanisms**	1.1.Carry out a Market Study on cement production industry including investigation of market size up to 2030 and evaluation of the most effective economic mechanisms for technology diffusion in Kazakhstan (report, economic assessment)		MID, TNA Committee, International organizations	MID, International organization	2018	20218	Project management, Financing planning Technology deployment	Project management, Financing Technology deployment	USD 80,000	Public Government and International TA	An activity takes longer to complete than originally planned
	1.2. Organize a roundtable discussion on Market Study		MID TNA Committee	MID, International organization, NGO	2018	2019	Project management, Financing planning	Project management, Financing	USD 50,000	Public Government and International TA	
2: Improve legal and regulatory framework	2.1. Develop a roadmap – 2030 for Wet-to Dry Modernization, including a list of projects		MID International organizations	MID International: EBRD	2019	2020	Financing planning Project management	Project management Financing	USD 300,000	Public Government International TA	Long state procedures and bureaucra

	2.2. Harmonize regulation on certification, standards and codes per European Union (EU), the Eurasian Economic Union (EEU) countries and introduce standards, codes and certification	MID EU or EEU Committee	MID Business	2018	2025	Financing planning Project management	Project management Financing	USD 300,000	Public Government International	cy leading to slow endorsements
	2.3. Organize and conduct meetings, roundtable discussions for approval measures of this Action	MID, TNA Committee, International organizations	MID, International organizations	2019	2020	Financing planning Project management	Project management Financing	USD 150,000	Public International TA	
3. Improve Information Gathering and Sharing	3.1. Create a national institution for regular review of the cement market on an annual basis (such as Ernst &Young) This review could cover the economic analysis, market info, technical info, etc. for Kazakhstan and for Central Asia	MID, International organizations	MID, International organizations	2019	2022	Financing planning Project management	Project management Financing	USD 100,000 / year	Public Government, International TA	Human resource does not perform as planned
	3.2. Gather and share information on Best Available Technologies (BAT) in cement production through internet platform located at JSC "Institute for the Development of Electricity and Energy Saving"	MID R&D institutions. Business	MID, R&D institutions. Business	2020	2030	Financing planning Project management	Project management Financing	USD 80,000/ year	Public International TA	
4 Support policy through implementing projects	4.1. Develop pilot projects in cement production sub- sector, based on a Project Idea (Chapter 3), (at	MID, ME Business, International organizations	MID, Business	2020	2030	Financing planning Project management Business management Design engineering Technology deployment	Project management Financing Business management Engineering Technology diffusion	USD 128,400, 000	Private Business International	Weak collaboration between stakeholders. Projects are not developed properly

Responsible bodies involved into TAP:

MID - Ministry of Investments and Development, Focal Point
MJ - Ministry of Justice
MF - Ministry of Finance, ME – Ministry of Energy
Akimats, European Union (EU) or Eurasian Economic Union (EEU) Committee
Business, Research and Development **(**R&D) institutions
International organizations

CHAPTER 3. Project Ideas

The four Project Ideas (PIs) are developed in this report. Each of them supports promotion of the technologies discussed in previous chapters. The information is presented in brief based on the pre-feasibility data provided by experts. The Project Ideas (PI) are presented for the purpose of planning and are incorporated into TAP for each technology. These Project Ideas could be reworked further into PDD format or other formats suitable for bank's requirements.

3.1. Project Idea "The construction of 3200kW Hydropower Plant in South Kazakhstan"

Main parameters of the project idea on Small Hydropower are the following:

Project capacity	3200 kW
Project cost	USD 3.2 million
Electricity generation	17.2 million kWh per year
GHG emissions reduction	16.2 thousand tons of CO_2 per year during 5-7 years

- **Introduction/Background**

Hydro potential in Kazakhstan is high and mostly located in the East, South- East and South regions of Kazakhstan. By 2020, it is advisable to involve small hydro power plants (HPPs) in the power balance due to the recovery of abandoned and construction of 100 new small HPPs according to data from Kazakhstan's Second National Communication (2009).

At "Astana Economic Forum" on 26 May, 2016 the Minister of Energy announced that the Ministry plans to use special auctions to purchase renewable energy from energy-producing companies. The auctions will make the selection process for projects and investors transparent and clear, increasing the effectiveness of technologies and minimizing influence on tariffs. This gives new impulse in implementation of RES projects and small hydro.

Programs of small hydropower development in Kazakhstan include reconstruction and renovation of previously constructed small HPPs, adding small HPPs to water management projects with already existing water retaining structures with the aim of utilizing waste releases, and construction of new small HPPs for power supply of users in the outlying districts of the power system. Favorable factors for the development of hydro potential are:

- Interest of regional authorities in small hydro;
- Private investors of small hydro are provided with state short-term credits;
- Privileges, such as tax holidays, in realization of investment projects.

During TNA process the list projects on Small Hydropower, planned for construction during the period (2013-2019) was provided in Table 27 of the Report on Barriers. Accordingly, here we consider the project of construction of small HPP in Sairam district of South Kazakhstan region. Later it will be one of cascade small HPPs in South Kazakhstan, which is planned for construction.

South Kazakhstan region has considerable hydropower potential of small mountain rivers and irrigation canal systems, which is very promising for the generation of electricity. The construction of small hydropower plants is appropriate from both an environmental and an economic point of view. Bystrotok Right Bank Aksu channel has significant hydropower potential, which is not currently used to generate electricity.

- **Objectives**

The objective of the proposed project is the introduction and development of small HPP on Aksu channel with installed capacity of 3200 kW, hydro potential of which is not used. The new small HPP will secure electric power supply for remote areas of the Sairam district of South Kazakhstan region.

The goal is to save traditional fuel and energy resources, contribute to Mitigation, to reduce negative impacts on the environment, supply the remote area.

- **Measurable outputs**

The main output of the project is clean electricity generation to cover the needs of residents and industry of the Sairam district of South Kazakhstan region. The annual average electricity generation is expected to be around 17.2 million kWh (assuming 5400 working hours per year, proposed capacity 3200 kW). The electricity generation should be measured with a meter.
The expected GHG emissions reduction is estimated average 16.2 thousand tons of CO_2 per year during 5-7 years.

- **Relationship to the country's sustainable development priorities**

The Project will contribute to sustainable development in the following way:

- Making the least impact on the environment in contrast with other energy sources;
- Creation of new jobs;
- The use of small hydropower leads to decentralized use of power and contributes to the development of the region.
- Small Hydropower is one of prioritized Mitigation technologies.

- **Project deliverables**

The primary beneficiaries are inhabitants: at least 8000 existing houses of the Sairam district of South Kazakhstan region.

GHG emissions are expected to be reduced by 16 245 tCO_2/year according to the pre-feasibility study, the green power is expected to be about 17.2 million kWh.

Assistance to create suitable RES market and encourage the development of Small Hydropower, to gain the important economic, social and environmental benefits.

- **Project scope and possible implementation**

The motivating factors in the construction of small hydro power plants are:

- Constant renewability of water resources;
- Minimal impact on the environment;
- A significant savings of fossil fuel;
- Improvement of municipal and working conditions of the people;
- Small hydropower does not require long periods of construction;
- Low capital intensity, short investment cycle.

The pre-feasibility data showed that the water flow passing through the channel Aksu chute for years (1997-2007) is 11.7 m^3 per second (maximum), and the average value of the calculated flow rate is equal to 7.4 m^3 per second. According to the topographic survey and analysis of the known hydraulic units for HHP, produced by the enterprises of Commonwealth of Independent States the most acceptable is a hydroelectric unit with 800 kW capacity at a head of 50 meters and the number of revolutions of 1000 per minute. For the proposed capacity (3200 kW) it is needed four such units.
The proposed electricity capacity is calculated according to traditional formula:

$P = g* Q*H*\eta$,
where: P = electricity capacity, kW; Q = flow, m^3/s (7,4 m^3/s); H = head value, m (50 m); g = acceleration due to gravity (9.81 m/s^2); ŋ = overall efficiency (0.88, average turbine efficiency).

P= 9.81*0.88*50*7.4=3200 (kW)

The intake structures consist of the following elements, namely:
- Shutter with embedded parts and mechanisms arrange itself on the right bank below the chutes tailrace section of 2x3 m;
- Concrete forbears in terms of size 6x12 m and a depth of 3.5 m, equipped with two gates, with embedded parts and mechanisms trash screens;

- The entrance to the pipes in the form of two forks placed at the bottom forbears;
- Concrete (precast) floor slabs.

The implementation of this technology is supported by the Ministry of Energy and the Ministry of Investments and Development. The main legislative basis is the Law of the Republic of Kazakhstan dated 04.07.2009 N 165-4 "On the Support to Renewable Energy Sources Use".

- **Project activities**

First, the project owner (a local company) and the potential investor will sign the appropriate contract. After the contract enters into force, the investor/company selected will proceed to:
- Obtaining all permits;
-Contacting all local authorities;
- Making a power purchase agreement with electricity transmission company.

Construction work will include:
- Water intake facilities;
- Pressure pipelines;
- The building of the station.
Two pipe having a diameter of 1200 mm, a length of 1100 m.
Small HPP is designed to accommodate 4 hydraulic units with the size of 14hx9 m.

- **Project Timeline**

Project timeline is expected to be 18 months in real term during the period 2016-2019.It is assumed that the construction will be done in the summer season (from April to October). The timeline could be divided into three phases: preparatory, construction of HPP, and exploitation & monitoring.

- **Budget/Resources requirements**

As per experts' estimates, the preliminary project costs are expected as the following:
- Water intake facilities - USD 111,000
- Pressure pipelines - USD 723,500
- The building of the HPP- USD 75,000
Sub-total cost- USD 909,500 (see Table 5)
Electro-mechanical equipment- USD 2,000,000
Contingencies -USD 293,850
Total cost - USD 3,200,000
More detailed budget for civil works see in the Table 5 below.

Table 5. Estimation of civil works for construction of small HPP in Sairam district

	Name of works	Volume parameters		Costs, USD	
		units	amount	number	Total cost
1	*Water intake facilities*				
	excavation	m3	5000	3	15000
	reinforced concrete monolithic	m3	300	50	15000
	precast concrete	m3	20	1000	20000
	backfilling	m3	2000	5	10000
	holding dirty grill	t	2	3000	6000
	closures (3 pcs) with the mechanisms	t	15	3000	45000
2	*Pressure pipelines*				
	vertical planning	m3	4000	3	12000

	concrete pillars	m3	150	50	7500
	pipelines	m/t	2200/440	1600	704000
3	*The building of the station*				
	excavation	m3	1000	3	3000
	reinforced concrete monolithic	m3	300	50	15000
	precast concrete	m3	50		50000
	other construction	%	10		7000
	Sub-total cost, USD				**909,500**

If electricity generated by this small HPP s will be sold to local utilities at the price of 10 KZT/kWh, the Government will compensate the power plant 6.71 KZT/kWh according to existing supporting regulation.

- **Measurement/Evaluation**

The annual generation of electricity is expected to be around 17.1 million kWh/year, transmitted to the central grid, and will be measured by an electricity meter located in the power house of the HPP.

GHG emissions will be monitored according to the Monitoring Plan developed by the company-owner and will be estimated as per the national methodology approved by GOK.

- **Possible Complications/ Challenges**

The bureaucracy limits the possibilities to implement projects, the costs could be increased if it is required to conduct a project baseline survey. In general, the following challenges could be mentioned:

- Lack of financial resources
- Lack of hydrological studies and analysis;
- Difficulties related to granting of plots of lands;
- Difficulties related to connection to the electricity transmissions lines
- Low prices for traditional energy;
- Lack of policy support: delay of launching the mechanism of financing through RES Fund named above.
- Seasonal operation of power plants.

- **Responsibilities and coordination**

The Ministry of Energy, Akimat of South Kazakhstan region, LLP "Settlement and Financial Center to support renewable energy sources under the “KEGOC” (KEGOC/RFC) will be responsible in coordination with private companies and international financing organizations. In case of providing loans or grants or tax exemptions the following ministries will be involved: Ministry of National Economy, Ministry of Investments and Development, KAZENERGY Association (or other Association), Central Asia Renewable Energy Fund.

3.2. Project Idea "Use of coal-fired technology in Combined Heat Power plants in North Kazakhstan on the base of combination of supercritical steam parameters and fluidized bed combustion"

Main parameters of the project idea on Efficient Coal Combustion are the following:

Project capacity	150 MW of electricity and heat capacity 430 Gcal hour
Project cost	USD 570 million
Electricity generation	1700 million kWh per year
GHG reduction	486 t CO_2/MWh per year

- **Introduction/Background**

According to the concept of transition to a "green economy" the power production subsector is planned on coal generation as a primary energy source until 2030, and the use of environmentally friendly technologies for coal combustion. Kazakhstan is rich in coal reserves (balance reserves - 36 billion tons, geological - 178 billion tons). Ekibastuz coal is used mostly ($ 7-8 / ton or ≈ 12% of the world coal prices). Thus, up to 80% of total energy is produced by coal.

It is planned to modernize existing power plants, which will be used after 2020, with the installation of gas treatment for dust emissions, sulfur dioxide and nitrogen oxide, to achieve contemporary international standards. This equipment brings the additional to capital costs of 1100-1300 USD per kWh increasing the total costs of equipment to 30% or more (according to report named "Energy efficient measures to introduce clean coal technologies in Central Asia" for UNECE Project, 2007). However, the reconstruction with the introduction of combined cycle, gasification can improve the efficiency of coal-fired plant from 35% to over 40% and increase its productivity by 50-150%, increase of electricity price is not more than 0.2 cents per kWh.

The existing power boilers and steam turbines in Kazakhstan have been in operation for over 30 years and require replacement by modern steam-turbine plants that use supercritical steam parameters. The high ash content and difficulty dressing Ekibastuz coal cause environmental problems and their flaring as consequently, the need for bulky and expensive gas cleaning plants.

This Project Idea deals with the prospects for technical re-equipment of existing and construction of new power plants based on fluidized bed combustion technology of coal-fired Thermal Power Plants (TPP) and/ or Combined Heat Power (CHP) Plants. Supercritical and ultra-supercritical plants are more expensive because of the higher requirements for the steel that can stand higher pressure and temperature. However, the higher efficiency can result in cost savings during the technical lifetime of the plants. The emissions of CO_2 per MWh of electricity delivered to the grid could be reduced from 830 kg to 730kg in world term while the existing indicator for Kazakhstan is 1 ton CO_2/MWh (2016) according to data from the Ministry of Energy.

In this regard, there is a perspective to technical re-equipment of existing and construction of new power plants with the installation of modern steam turbines which have the efficiency of 45-46% versus 35% efficiency of existing plants, which would allow to reduce the specific fuel consumption from 350-360 g/KWh (this parameter is of Kazakhstan Ekibastuz District (Regional) Power Station (named GRES-1) to 270-300 g/KWh (the proposed technology at CHP Plant), respectively, GHG reduction of at least by ≈ 20% of CO_2 emissions.

- **Objectives**

The objective of the project is to construct the CHP in North Kazakhstan with electricity capacity up to 150 MW and heat capacity 430 Gcal hour to cover electricity demand of population and industry of Kokshetau city. The basic objective is to reduce fuel consumption per kWh of energy generation through implementation of energy efficient measures and technologies. The project coincides with the Strategy of JSC "Samruk-Energo" for 2012-2022.

The Memorandum of Understanding (MoU) was signed between Akimat of Kokshetau and JSC "Samruk-Kazyna".

- **Measurable output**

1700 million kWh per year of electricity is planned to be generated and delivered to the national grid.
Economy of fuel is about 106,000 tons of coal equivalent (t. c. e.). CO_2 reduction is expected in amount of 60 gCO2/t c. e. or 486 t CO_2/MWh per year.

- **Relationship to the country's sustainable development priorities**

The following relationship to the sustainable development priorities is defined:

- Improving the efficiency of electricity production in Kazakhstan;
- Increasing the reliability of the country's energy supply;
- Increasing the favorable conditions for introduction the advanced technologies in the energy sector;
- Reducing the negative impact on the environment;
- Reducing greenhouse gas emissions from the energy sector;
- Gain access to advanced technologies.

- **Project Deliverables**

Construction of the coal fired CHP with electricity capacity 140 MW-150 MW (condense mode), and 130 MW (heating mode) in order to generate 1800 million kWh per year of electricity, and 279 MW of heat capacity. The technology allows to increase parameters up to 1.3 times if compared to the existing CHP. Electricity capacity of cogenerating units of new CHP is 130-150 MW against 110-120 MW of existing CHP.

- **Project scope and possible implementation**

The unit includes: power boiler with fluidized bed combustion, with efficiency 550 t steam/hour and cogeneration turbine SST-900 (Siemens).

The parameters of steam turbine could be:
- a steam turbine inlet 17 MPa, 585-600/585-620^{0}C and efficiency 40-42 %, or the steam turbine with super critical 30 MPa, 580-600/600- 620^{0}C and efficiency 45-46 %.

Improving the thermal efficiency of coal fired power is the main way to reduce CO_2 emissions. Electric turbine power net in condensing mode is 140 MW. Coal consumption is 73,8 t per hour, and specific consumption of coal equivalent – 300 g c.e.

The boilers of fluidized bed combustion (FBC) allow to diversify the supply of fuel, to reduce the cost of its transportation.

- **Project activities**

a) Project activities at preparation phase are aimed to:

- Conduct pre-feasibility study (FS) and organize preparation of FS
- Organize discussion about the proposed technology between the specialists and senior decision makers and take the decision on the technology chosen
- Develop the engineering design for the project.

b). Project activities at implementation phase are aimed to:

- Decide to invest into the CHP in North Kazakhstan on the base of combination of supercritical (SC) steam parameters and fluidized bed combustion (FBC) (below in text- SC CHP);
- Change legislation, if necessary;
- Call for tenders for the SC CHP construction;
- Make Contract with a company that will build the SC CHP;

- Build the SC CHP;
- Train specialists for SC CHP
- Set up and configure the SC CHP;
- Commission for operation;
- Monitor and assess the economic and environmental efficiency of SC CHP.

- **Project Timeline**

Duration of project implementation is expected to be four years. The following timeline for implementing the project is to be expected:

- Conducting a feasibility study: 2016-2017
- Developing engineering design: 2017 - 2018
- Call for tenders: 2018;
- Contracting a company that will build the SC CHP:2018;
- Building the SC CHP:2018- 2020
- Commission for operation: 2020.

- **Budget/Resource requirements**

The following expert's estimates:
The preparation of FS –about 364,000 USD
Capital costs – 3700 USD/kW (518 million USD)
O&M costs- 10% of Capital costs (52million USD)
Total (preliminary) budget is 570 million USD (will be updated during conduction of FS)
The project can be financed by using mechanisms such as a soft loan or through encouraging private investment in Public-Private Partnerships (per Concession Law of Kazakhstan).
Pay Back period is in the range of 7-8 years.

- **Measurement/Evaluation**

The output is 170 million kWh/year of electricity generation, and heat required for the Kokshetau city based on heat capacity. This can be measured by the electricity meter installed.

GHG emissions reduction can be calculated and evaluated during monitoring, validation (if necessary) as per associated monitoring plan, which is to be developed by the owner of the project.

- **Possible Complications/ Challenges**

One of the challenges facing Kazakhstan's energy sector, is necessity to reduce GHG emissions, to manage costs of energy generation by reducing fuel consumption.

The main barriers to the deployment and dissemination of this technology are:
1. Lack of adequate access to financial resources;
2. Lack of public and specialist information about efficient SC TPP or SC CHP and energy use, as well as lack of information for policy makers to develop adequate strategy in this direction.

An important missing component of enabling environment is risks assessment of using the modern coal combustion technology for energy sector development in long-term.

- **Responsibilities and Coordination**

Government/Ministry of Energy, Akimat of Kokshetau, JSC "Samruk-Energy" will be responsible in coordination between bodies on national/local level and with international financing organizations.

3.3. Project Idea "Introduction of the waste heat recovery system in cement production of Kazakhstan"

Main parameters of the project idea on energy efficiency and energy saving in cement production are the following:

Project capacity	1600,000 t/year
Project cost	USD 1,668,240
Improvement efficiency	45 kWh/t of clinker
T CO_2 reduction	122.358 t CO_2e/year

- **Introduction/Background**

The cement production constitutes 83% of the total energy consumption in the production of nonmetallic minerals and 94% CO_2 emissions as mentioned in the report on Barriers. From 20% to 40% of the total costs for cement production are the costs for electric power. However, cement plants can reduce GHG emissions and provide up to 30% of its electricity needs by utilizing the waste heat (International Finance Corporation (IFC) report "A Concrete Energy Efficiency Solution", 2014)).

The cement industry in Kazakhstan is expected to grow for the next few years continuously supported by the robust domestic cement consumption. Although the cement industry in Kazakhstan already adopts energy-efficient technologies, improvement measures will be needed since the increase of CO_2 emissions and energy consumption cannot be avoided if the industry grows at the current pace. Waste heat recovery (WHR) system does not need any additional fuel and can reduce electricity import from the grid. This will result in the reduction of fossil fuel combustion at grid-connected power plants.

IFC has experience in supporting several projects for heat recovery. Improving energy efficiency is promoted and implemented by the World Bank for financing of energy efficiency measures program in China. In 2011, a national energy efficiency regulation mandated WHR on all new clinker lines constructed after January 2011. Regulatory measures and lower capital costs have been key factors behind China's success in mainstreaming WHR technology. Energy costs are responsible for 25% of total production costs while 75% of primary energy usage is thermal energy (IFC data). However, the process is characterized by significant amount of heat loss mainly by the flue gases and the air stream used for cooling down the clinker. Waste heat is generated by fuel combustion process or chemical reactions, and then dumped into the environment even though it could still be reused for some useful and economic purposes.

The leading manufacturers of waste heat recovery systems using conventional steam circuit technology are now marketing second generation systems with higher supercritical steam parameters and improved efficiencies that reach output levels as high as 45 kWh/t of clinker. This experience could be applied in Kazakhstan. The Waste Heat Recovery (WHR) technology could be applied at several cement plants in Kazakhstan, such as: Buhtarmin cement Company, East Kazakhstan with capacity 1600,000 t/year; or Chimkent cement with capacity 1600,000 t/year, Almaty Cement Company with capacity 240,000 t/year or Munaralski Cement Plant, Zhambul with capacity 1200,000 t/year as informed in the report on Barriers. Waste Heat Recovery for cement sector is described in IFC report on "Market and Supplier Analysis" (2014).

Engineering- Procurement-Construction (EPC) is a general contracting approach often referred to as "turnkey." The WHR supplier, the EPC contractor, assumes responsibility for design, engineering services, procurement of equipment and materials, construction, commissioning, and trial operation. Today the EPC business model is common in waste heat power generation in the China cement industry, accounting for more than 60 percent of market share. Introduction of EPC in Kazakhstan is approved by the amendments to the law on "Energy Saving Energy Efficiency" in 2015, thus a similar approach could be used.

- **Objectives**

The main goal of the project is reduction in power consumption per ton of cement produced and reducing the emissions intensity of cement production (emissions per ton of cement product) through introduction of energy saving WHR system.

Approaches include installing more fuel-efficient kilns, using less carbon-intensive fuels in the kiln, partial substitution of noncarbonated sources of CaO in the kiln raw materials, and partial substitution of supplementary cementitious materials, such as blast furnace slag, fly ash and limestone for finished cement products.

- **Measurable outputs**

In order to monitor electricity generated by WHR accurately, an effective power meter can be installed. The emissions can be calculated based on the net project electricity generation that replaces the import of grid electricity to the cement factory where the project is implemented.

Approach is like this (based on IFC estimates): for example, if the Carbon Emission Factor (CEF) = 0,741 tCO_2/MWh, the baseline emissions are defined as 122,358 t CO_2e/year. Project emissions are "zero" because WHR system utilizes only waste heat and does not utilize fossil fuels as heat source to generate steam for power generation. Therefore, GHG emission reduction is 122,358 t CO_2e/year.

- **Relationship to the country's sustainable development priorities**

By showing successful completion of the project and proving return on initial investment, WHR system is expected to spread out in Kazakhstan's cement industry. It will contribute the sustainable development priorities because this sector is one of priority according to existing legislation.

These actions are in line with national priorities of the country on greenhouse gas emissions reduction and transition to green economy. In addition, some other issues related to sustainability are considered under the project:

- Social well-being: the enterprises should clearly realize their social responsibility, and along with rendering services on education and health for their employees, the enterprises should participate in a few charitable actions.
- Environmental safety: the measures on the improvement of energy efficiency allow directly reducing energy consumption of an object and through that reducing the demand for power.

- **Project deliverables**

The cement plant can reduce GHG emissions and provide up to 30% of its electricity needs by utilizing the waste heat.

Using the Waste Heat Recovery (WHR) system can reduce the operating costs and improve additional margins of cement factories by about 10 to 15 percent. On average, electric power expenses account for up to 25 percent of total operating costs of a cement factory. WHR technology utilizes residual heat in the exhaust gases generated in the cement manufacturing process and can provide low-temperature heating or generate up to 30 percent of overall plant electricity needs. By introducing WHR system, electricity cost can be reduced by 20%, which means 6% of cement production cost can be reduced.

- **Project scope and possible implementation**

Typically, the potential electrical power generation, depending on waste heat losses and the number of preheater cyclone stages, ranges from 25-45 kWh/t of clinker. Assuming an average plant electrical drive power requirement of 106 kWh/t of cement and a clinker factor of 0.75, approximately 20 to 30 percent of the required electricity for the cement production process can be generated from the waste heat. Power conversion efficiencies range 18- 25 percent resulting in potential power capacities of 6 to 9 MW.

A WHR installation is a relatively complex system with multiple interrelated subsystems. The basic package for a steam-based system consists of heat recovery boilers or heat exchangers, steam turbine, gearbox, electric generator, condenser, steam and condensate piping, lubrication and cooling systems, water-treatment system, electrical interconnection equipment and controls.

The WHR system will utilize waste heat currently emitted from the factory in Kazakhstan without utilization. WHR boilers will generate steam using the waste heat exhausted from the cement plant, and the steam will be fed to the steam turbine generator to generate electricity. It can reduce power import of approximately 165,000 MWh/year from the grid, which will lead to the reduction of fossil fuel combustion at grid-connected power plants.

- **Project activities**

Engineering- Procurement-Construction (EPC) is a general contracting approach that could be used in Kazakhstan. The supply of WHR equipment could be considered from Japan, China and India.

The following activities are included in the project:

- Development of feasibility study (FS), develop Project Design Document (PDD) or National Appropriate Mitigation Actions (NAMA) if enquired, project design
- Tender activities for purchasing equipment, consultants, etc.
- Necessary negotiations, signing EPC, gathering necessary subsidies, permissions
- Organizing Project Implementing Unit
- Introduction of updated technology (installation, etc.)
- Monitoring of energy conservation and GHG emission reduction
- Providing stakeholders and investors consultations during all phases of the project.

- **Project Timeline**

The project is planned to start from May 2018, complete by March 2019 and - operational by April 2020. The details of project planning are being finalized in accordance with the planned schedule.

- **Budget/Resources requirements**

A detailed budget will be calculated at project designing in relation to a concrete cement plant. Nevertheless, preliminary total installed cost for WHR system is defined as US$2000/kW.
The following considerations should be considered based on the experience of the IFC report:

- Total installed costs for WHR systems are function of all the factors mentioned above, but costs can range from US$7,000/kWe for 2 MW systems to US$2,000/kWe for 25 MW systems (steam). Total installed costs include design, engineering, construction and commissioning.

- The total installed costs for WHR systems in Asia 1,600-2,200 $/kW, while, for instance European-manufactured WHR power systems could cost up to US$3,800 per kWe. Total capital cost (equipment and installation) is a strong function of size—smaller WHR systems will have a higher dollar cost per kW of generation capacity. Engineering, civil work and construction costs can represent as much as 34 to 45 percent of the total project cost.

- Operating and maintenance costs (O&M) are typically 2.5 percent of capital costs per year for steam systems.

- Operating hours, more hours are better for project economics. Typical values range from 7,200 to 7,800 hours per year.

- Value of displaced electricity, either purchased from the grid or avoided costs from a captive power plant. Purchased power prices vary widely—50 US$/MWh to over 150 US$/MWh depending on country and/or supplier.

- Project payback and financial return vary depending on the required investment and prevailing electricity prices, but simple paybacks for WHR systems typically range from 3 to 4 years in China to 10 years and more in Western countries.

- Annual savings depend on the hours of operation, the net annual output of the WHR system, the annual operating and maintenance cost of the system, and the price of the power that the WHR system is displacing. Typically, annual savings of US$0.5 to US$5 million can be achieved at an electricity price of US$80/MWh for 1 to 10 MW WHR systems.

As example, the costs and cost saving are calculated based on the following parameters of technology (It is noticed that the plant thermal efficiency was 26.6%, while the efficiency of exergy was 46.8%, based on IFC report):

Turbine work - 834.3 kW
Condenser heat rejected - 2594.6 kW
Pump work - 0.17 kW
Net power output - 834.12 kW
Thermal efficiency (%) 25.7
Energy efficiency (%) 46.83

Cost saving and Pay Back (PB) calculations:

Cost saving= energy saving × energy cost
Cost saving= $(6673 \times 10^{3} / 2000 \times 10^{3}) \times 0.07 = 0.23$ USD/ton

Due to capital budgeting, the payback period is the required time for the return on an investment to repay the original investment sum. The cost savings was expected of 467,110.00 USD/year.

If we consider the average costs of maintenance out to 30,000 USD/year, then the cost savings will come to 437,110.00 USD/year.

Budget estimation together with shipping and installation is 750,000 USD, consequently, a rough valuation for payback period would be:

Payback period = (Cost of implementation cost)/ (Annual cost savings)
Payback period = (750,000.00 USD / 437,110.00 USD/year) = 1.7 = 20 months

The results can be written in some points as following:
- The net power output was 834.12 kJ/kg and the generated electricity was 6.673×10^{3}MWh/year in cogeneration power plant.
- The cost saving was 0.233 USD/ton for the cogeneration power system.
- Payback period for this system will be roughly 20 month

- **Measurement//Evaluation**

Electricity generated by the WHR system is to be measured by meters and monitored.

Monitoring will be done by the cement plant staff according to the monitoring plan. It is planned to build up the MRV structure, which can prove that it is not a power meter problem in case a meter for electricity consumption shows “zero” by recording the operation condition of WHR system.

GHG emission reduction evaluated per the approach mentioned above (for instance, it is 122.358 t CO2e/year).

- **Possible Complications/ Challenges**

There will be not much barriers since Kazakhstan cement plant reaches the stage of budget determination process and the final step to be taken is only the approval by the commissioners.

Normal permission and authorization for facility expansion will be obtained by cement plants in Kazakhstan.

- **Responsibilities and coordination**

The owner of the cement plant cooperates with ministries, Akimat, international organizations for project planning, financial planning, MRV structure, a project implementation unit.

The ministries involved: Ministry of Energy, Ministry of National economy, Ministry of Finance and Ministry of Investments and Development.

3.4. Project Idea "Wet-to Dry Modernization of the Chimkent cement plant"

Main parameters of the project idea on wet- to dry modernization in cement production are the following:

Project capacity	3,200 tons of clinker per day
Project cost	€60 million (USD 64.2 Million)
Heat economy	4.06 MJ/kg clinker
CO_2 reduction	0.386 kg CO_2/kg clinker

- **Introduction/Background**

Chimkent is a major transportation hub in the south of Kazakhstan. It already has an estimated 900,000 inhabitants. Chimkent Cement is the Kazakh affiliate of Italcementi SpA. It produces cement and ready-mix concrete.

The Project aims to replace four existing "wet process" kilns with a new, energy-efficient "dry process" facility. The transition from "wet" to new "dry" line is expected to result in environmental benefits including reduced emissions and energy requirements, mitigate the associated environmental and social impacts and enhance the environmental benefits. This will bring the Project's emissions fully in compliance with EU Best Available Technologies (BAT) requirements.

The EBRD is considering supporting the refurbishment of this cement plant in Chimkent, Kazakhstan, owned and operated by Chimkent Cement, a member of the Italcementi Group. With the new 'dry process kiln' the plant is expected to have the best energy efficiency and lowest carbon intensity in the Kazakh cement industry. The Project will substantially reduce the plant's energy consumption and emissions and introduce of comprehensive energy (ISO 50001) and environmental management systems.

- **Objectives**

The objective of the new plant is to provide modern, efficient local production capacity to support the development of infrastructure, as well as helping to reduce carbon intensity in the Kazakh cement industry.

The wet cement production process will be fully replaced by a dry cement production process. The main benefit of the dry cement production process is a decreased fuel consumption in comparison with the wet cement production process and therefore a reduction of CO_2 emissions as well as water and energy consumption.

- **Measurable outputs**

By the modernization in the conditions of water defect (particularly in south regions) there is no need in its consumption for preparation of raw material slam.

The reduction of energy consumption: at the dry process the heat consumption is 2900-3750 kJ/kg clinker per the prefeasibility data from the factory, at the wet process -- 5400-6700 kJ/kg. The reduction of energy consumption will be measured with electricity meters.

The reduction of CO_2 emissions in the atmosphere: at the dry process, hot waste gasses may be used for drying of raw material, when it is grinded in ball mills.

Relationship to the country's sustainable development priorities

The project contributes to the sustainable development of the Kazakhstan and is in line with implementation of main strategic documents, such as concept of transition to "Green Economy", SPAID, Productivity 2020, 100 steps, etc.

The new dry line is expected to result in environmental benefits including reduced emissions and energy requirements.

The key environmental issues are associated with dust from point and fugitive sources. Due to lack of funds for maintenance and repairs, and overall lowering of demand for cement in the early 1990s, the dry lines where mothballed and not used. The plant has relied on the less efficient and more polluting wet lines for production purposes. The performance of the existing environmental abatement equipment has gradually declined and dust emissions are a problem at the plant. This affects the local ambient air quality as well as employee health and safety. A considerable amount of product is also lost because of the poor condition of dust arrestment equipment, which also has economic implications.

It is expected that Chimkent cement in turn will expand its comprehensive energy and environmental-management systems. The company will also undertake education initiatives, providing traineeships and placements in collaboration with local universities and colleges to spread knowledge about energy-efficient technology and environmental best practice.

The environmental and social impacts associated with the replacement of the existing wet production lines with a new dry line at Chimkent Cement can be readily identified and addressed through appropriate mitigation and management measures, addressed below.

Social and economic impacts: Demand for skilled jobs is created relating to the construction of the new cement line as well as the operation and maintenance of the installed equipment. The project generates both direct and indirect local employment. More cement will be produced that will be used as construction material for infrastructure development. New roads and highways will indirectly increase the employment rate. The project also helps to create a business opportunity for the local stakeholders such as bankers/consultants, suppliers/manufacturers, contractors etc. Through the lower fossil fuel consumption of the process, the project will contribute to the conservation of non-renewable natural resources, like coal, which is the main fuel for cement production in Kazakhstan.

Environmental impacts: The project focuses on the production of cement by modern dry method equipment, instead of using the old wet method equipment. Thus, dust and CO_2 emissions will be significantly reduced.

Technological impacts: The proposed dry cement production technology is relatively new for Kazakhstan and the property rights of the technology lie solely with the foreign technology licensor. A vital part of the project will be to provide appropriate training to the managerial and operational staff of a Cement plant. An intensive in-house knowledge base will be developed to build up scientific and technical expertise for running the process. Adoption of this technology also contributes to capacity building of the enterprise staff by stronger exposure to

modern technological developments in the cement industry. Moreover, this technology can be replicated by other cement producers in Kazakhstan

- **Project deliverables**

The new plant will provide modern, efficient local production capacity to support the development of infrastructure, as well as helping to reduce carbon intensity in the Kazakh cement industry.

The key parameters of effectiveness because of transfer from wet to dry technology in cement production are presented in Table 6 below.

Table 6. Comparison of parameters of two technologies in the production of cement

Parameters	Units	Recent Wet technology (2013)	Transition to Dry technology (2017)	Economy per year
Heat consumption	MJ/kg clinker	7.33(1)	3.27(2)	4.06
GHG emissions	kg CO_2/kg clinker	1.277(3)	0.891(4)	0.386
Electricity consumption	kWh/t clinker	89,9	65(5)	24.9
Consumption	l/t cement	1385(6)	215(6)	1170

(1) Based on the annual average consumption 1,750 kcal / kg
(2) Based on the annual average consumption of 780 kcal / kg
(3) Calculated fuel 1,750 kcal / kg
(4) Measured fuel consumption of 780 kcal / kg
(5) Guarantee of 59.5 kW / ton, plus about 5.5 kW / ton for coal grinding
(6) Based on the ratio of cement / clinker 1.3

A significant decline is expected for all parameters, as the new technology will be much more effective. Coal is the main fuel for the new furnace, although the main burner is designed for burning coal and gas.

Guaranteed release of nitric oxide, the proposed equipment supplier, is 700 mg / Nm3 on a dry basis at 10% O_2. This level is above the upper limit of the BAT and 450 mg / Nm3 of gas under the same conditions

- **Project scope and possible implementation**

The plant currently has four rotary kiln clinkers by wet method, preparation is made of raw materials for cement production, including career, raw mill. Raw materials for manufacture of cement - limestone, clay, iron ore - mined in quarries Chimkent cement; the sand is supplied by external suppliers. Activities Chimkent cement plant is carried out in accordance with the environmental management system that is certified under the international standard: ISO 14001. The present wet cement production method uses as coal and gas. With the new dry method, the coal is used. Chimkent cement plant has initiated the project of building a new, modern kiln with heat exchanger, with a capacity of 3,200 tons of clinker per day, which will be installed next to the existing furnaces operating on the wet method, which will then be dismantled.

The planned modernization will focus on re-commissioning one of dry cement process lines with key process elements being newly constructed incorporating relevant environmental abatement equipment. The modernized line will be designed in line with EU, IPPC requirements inclusive of dust, SO_2 and NO_x controls. An environmental management system will be incorporated into day-to-day operations at the plant as part of the investment program. A continuous monitoring system will be installed on the rehabilitated dry line.

Additional investments will be made at the wet lines focusing on air abatement equipment aimed at significantly reducing dust emissions and improving worker health and safety. The wet lines may remain in operation depending on market conditions and additional investments may be required in the future to ensure compliance with international best practice.

Asbestos is used at the plant, and the modernization program will include the development of an asbestos management plan to address this issue. Overall, the health and safety culture at the plant has been unsatisfactory and will be upgraded as part of developing an environmental, health and safety management system.

The new dry line is expected to result in environmental benefits including reduced emissions and energy requirements. The existing quarries will not be expanded because of the new line. For the new line, will be used by the existing crushing plant. Bag crusher filter will be upgraded as part of the project.

Production of raw mix is carried out using a new vertical roller mill with a capacity of 270 tons per hour of raw mix. The mill is equipped with an auxiliary burner for supplying hot air of a gas to be used while the kiln exhaust gases are not available. Selecting a vertical roller mill is considered as a BAT for raw material grinding.

Filter is designed for the purified gas containing particles of <10 mg / Nm3. Feeding the raw mix will be carried out by means of modern, energy-efficient bucket elevators. Equipment for the firing process includes oven, heat exchanger cyclone, the calcine and all associated ignition system and combustion, as well as environmental protection systems. Existing cement mills are used for grinding cement, along with two windmills to be transferred from open-loop to closed loop of grinding, resulting in increased grinding efficiency. The dynamic separator and a new dust collector with bag filters are to be shared for the two mills. New dust collector with bag filters will provide a guaranteed content of <10 mg / Nm3. Closed loop operation of the mill would reduce electricity consumption.

The impact of the construction and operation of the new dry line were evaluated as part of environmental impact assessment, which was approved by the Ministry of Environment and Water Resources of the Republic of Kazakhstan (recently- Ministry of Energy) and through environmental and social audit of the EBRD. The new dry process will significantly improve production efficiency (reduced fuel and energy consumption) and environmental impact (reduction of atmospheric emissions).

- **Project activities**

The technical aspects of the replacement of the 4 existing ‘wet process’ kilns with a new, energy efficient ‘dry process’ kiln are presented above. The Project will substantially reduce the plant’s energy consumption and emissions. The introduction and expansion of comprehensive energy (ISO 50001) and environmental management systems is planned.

Knowledge about energy efficient technology and about how to operate with high environmental standards will also be spread via the Company’s education initiatives. It will offer traineeships and placements for up to 10 students from the South Kazakhstan University every two years. It is also aiming to establish a vocational program with a local technical college in which the Company provides on-the-job learning related to energy efficient technology and training in environmental, health & safety standards while the college provides the theoretical education.

Wastewater is directed to the local sewage network. The Borrower has also agreed to fully decommission the old wet lines per the Project Borrower’s waste management plan, which further targets a 5% reduction in waste volumes.
The Project has undergone a local Environment Impact Assessment process and authorization has been granted.

- **Project Timeline**

Duration of project implementation is preliminary four years.

- **Budget/Resources requirements**

A loan of up to 5 billion KZT (€20 million equivalent) will be provided to Chimkent cement by the EBRD, in addition, the Bank is subscribing to up to 1 billion KZT (€4 million equivalent) of shares in Chimkent cement acquiring an equity stake of around 21 per cent. The contribution of Chimkent cement is 575000 EU.
Total project cost will by KZT 15,1bn (€60 million equivalent).

A detailed budget breakdown will be calculated by Company at project designing in relation to a concrete cement plant.

- **Measurement/Evaluation**

The main output is the reduction of electricity consumption and reduction of CO_2 emissions and other air pollutants named in this proposal.

- **Possible Complications/ Challenges**

Negative impact is expected for certain service providers that are associated exclusively with wet cement production as wet line will be dismantled.

Involuntary resettlement and disruption of stability in the economy and the impact on cultural heritage is not expected.

The road traffic management plan will be developed considering the future of transportation by trucks of clay.

The new line will be equipped with a system of continuous monitoring of emissions of nitrogen oxide and dust, for continuous monitoring of compliance with regulatory standards and BAT standards.

The Company will also continue to monitor the air quality (nitrogen oxides, SO2, CO and dust) within the sanitary protection zone, to ensure the protection of public health.

The opportunities of the dry process are significantly limited by the source moisture of raw material, since materials can be pulverized in the existing mills at moisture content of no more than 1%. So, pulverizing of source raw material with moisture content of 20 - 25% is related to high heat consumption for drying.

At the dry process, it is more difficult to secure sanitary conditions and environmental protection because of material dusting.

In summer, season cement plants operate in a frantic rush and are not able to fill in the cement production volume lost in winter season. This is the reason for roaring demand in warm periods, and prices for cement are growing up accordingly.

The major number of laws regulating the market relations in construction provides incentives for demand, but practically does not provide incentives for investments in the production of construction materials.

There is lack of investments.

- **Responsibilities and coordination**

The construction of the new dry kiln will be led by Chinese EPC contractor China Triumph International Engineering (CTIEC). The construction stage will include many contractors: the company will continue to monitor the environmental and social performance, as well as health and safety and ensure compliance with accident prevention and living conditions in the labor camp to international standards.

The Company aims to disseminate knowledge about energy efficiency, carbon emission reduction and environmental, health & safety standards in a workshop in cooperation with the Bank and open to all relevant stakeholders including other industrial players. It will offer traineeships and placements for up to 10 students from the South Kazakhstan University every two years. It is also aiming to establish a vocational program with a local

technical college in which the Company provides on-the-job learning related to energy efficient technology and training in environmental, health & safety standards while the college provides the theoretical education.

Chimkent cement plant has developed a plan of interaction with stakeholders to increase public awareness and involvement of stakeholders, especially in matters related to modernization of the plant. A Project specific Stakeholder Engagement Plan has been developed for the Project as part of the due diligence and will be implemented prior to and during construction and operation.

The ministries involved: Ministry of Energy, Ministry of National economy, Ministry of Finance and Ministry of Investments and Development.

CONCLUSION

This report is a final stage of the TNA process in Kazakhstan and aims to outline the development of Technology Action Plans for specific prioritized technology application and diffusion. The power generation and cement production subsectors have been considered as the main sources of GHG emission. The proposed TAPs meet the objectives set out in the national strategic documents, nationally determined contribution (NDC) on GHG emissions reduction and decrease energy intensity of economy.

The findings are the following:

1. Actions and activities for overcoming existing barriers of prioritized technologies have been grouped according to grouped major barriers (economic/financial; policy/regulatory, capacity building/ information, other)

2. Project Ideas are included into TAP as Activities for each specific technology, because they provide useful information on costs and resources estimates, aimed to demonstrate the policy implementation and could serve as indicators of effective TAP implementation.

3. Cross-cutting issues were examined. There are several cross cutting issues that constitute common barriers for all technologies prioritized under TNA process. These issues result in insufficient development of climate change mitigation technologies in Kazakhstan.

The common Actions for all technologies in the developed TAPs are the following:

- Improve legal and regulatory framework (activities are specific to each technology).
- Strengthening capacity building Initiatives and access to information (activities include development and conduct training specific to each technology, gathering of specific information and its distribution).
- Support policy through implementing projects (based on model Project Ideas developed for each specific technology).

The specific Actions for technologies are different types of economic/ financial and market-based mechanisms recommended.

Improvement of policy and regulation

Common activities regarding the policy, legal and regulatory aspects are a lack of long-term road map up to 2030 with concrete indicators on potential of technology diffusion in absolute manner, and insufficient varies types of elements such as tariffs, lack of other mechanisms, which could provide achievement of established targets in each sub-sector. Lack of appropriate national legal and policy frameworks prohibits technology development and its implementation. Effective technology implementation requires a long term policy plan with clear indicators at least up to 2030.

Improvement of policy and regulatory conditions is resulted in implementation of projects or real technologies diffusion, achievement of the set ambitions/targets.

Strengthening capacity building and access to information

Improved capacity building of R&D institutions with targeted programs and effective coordination with ongoing programs is significant for the successful deployment and dissemination of the priority technologies. Different groups of stakeholders should be involved, such as relevant R&D institutions, Associations and NGOs, business, local authorities and international organizations. Dissemination of information and lessons learned could be improved. Each TAP is the useful information to be disseminated. Success of the TAPs implementation could be achieved with the strong coordination of stakeholders at all levels.

4**.** Effective technology implementation requires a long term policy plan with clear indicators, ensuring sufficient financial resources, human capital.

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ANNEX 1. Supporting Tables: TAP for Small Hydropower

Table 7. Starting point information for TAP on Small Hydropower, ambition

Starting point information for TAP, ambition on Small Hydropower		
Prioritized technology for this TAP	**Small Hydropower**	
Stakeholders involved	**Name & Institute**	**Contact information (email, tel.)**
	Kanat Baigarin, National Focal Point and NU Vice President	kbaigarin@climate.kz ;kbaigarin@nu.edu.kz +7(7172) 68-9878
	Gulmira Sergazina, Former Director of the Department on Climate Change of the Ministry of Energy of the Republic of Kazakhstan	g.sergazina@energo.gov.kz +7(7172) 740258
	Ainur Sospanova, Director of the Department of RES Development of the Ministry of Energy of the Republic of Kazakhstan	a.sospanova@energo.gov.kz +7 (7172) 74 02 58
	Sergey Vassilyev, Coordinator of the Project on Mitigation, Climate Change Coordination Center	svassilyev@climate.kz +7 7172 519804
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	Irina Yesserkepova, Deputy Head of Kazakh scientific institute on ecology and climate	iyesserkepova@mail.ru +7 7272 55 84 24
	Gennady Doroshin, Expert on RES	g_doroshin@mail.ru +77772130647
	Sultan Tudukpayev, Director General of the	info@renergy.kz

	Association of Renewable Energy of Kazakhstan	7(7172) 516955
	Nurmaganbetov, General Director of LLP "Settlement and Financial Center in support of renewable energy sources" under KEGOC	+7(7172) 693704
	Nikolai Tyryatkin, Director General of the Association of alternative energy in Kazakhstan	+7(7172) 790182 kense@kazenergy.com
	F.Mominbaev, Director General of LLP «Samruk-Green Energy»	7(7172) 55-30-21
Benefits from this technology		
Climate change mitigation	Considering that the electricity generation from Hydro Power Plant (HPP) practically results in zero CO_2 emissions, it is expected that the situation concerning greenhouse gas emissions polluting the air will be considerably improved compared to "business as usual" power generation scenario. Experts estimates on GHG emissions reduction: 38 Mt CO2 by 2050, 7.6 Mt CO_2/year because of introduction of Small hydropower into energy generation mix (or energy balance).	
Social development	Social benefits include income increase, improved living conditions, energy access and creating new employment opportunities. At least 10,000 people will benefit from improved energy access (at least 50% - women) in the rural areas due to RES development (including small hydro). For example, according to data from JSC "Development Bank of Kazakhstan" the 300 new working places were created for construction of the Cascade of small hydropower plants with capacity 24.9 MW on the river Turgusun in West Kazakhstan Oblast, the expected output is 79.8 million kWh per year.	
Environmental protection	Use of hydropower generators will lead to the reduction of air pollution, greenhouse gas (GHG) emissions. Small hydro power plants (HPPs) require little changes in the river current and, consequently, the existing ecosystem can continue functioning as before. Small HPPs are recognized as ecological safe power plants.	
Economic development	Development of small hydropower contributes to sustainable economic development in the frames of energy sector development which is the driver of economic growth, green growth. The total hydropower potential of Kazakhstan (including small hydropower) was estimated as 170 billion kWh per year.	
Current status of technology at country level	Small HPP technology is close to deployment in the market. The wide use of Small Hydropower is expected during 2020-2030 per the "Concept of transition to Green Economy" (2013).	
Other explanations in support of prioritization of this technology	The technology has a great replicability potential in the country and reduces the need to import resources especially in the South of Kazakhstan.	

Ambition - Small Hydropower	
Proposed scale of technology implementation in country to deliver the socio-economic and environmental benefits in country, sector or area	Small Hydropower is proposed to be used in the power production subsector of economy. The scale is of up to new 41 projects of various sizes totaling 539 MW by 2020 according to the State "Action Plan for alternative and renewable energy sources (RES) development for 2013-2020" (2013). Recently hydropower contributed to 96% of total renewable energy sources (RES). The ambition of the technology is to contribute the achievement of the overall RES target in energy mix (including small, hydro, wind, solar) – 10% by 2030.

Table 8. Overview of barriers and measures, ranking, final selection of measures as Actions into TAP: Small Hydropower

Overview of barriers and measures: Small Hydropower		
Categories	**Identified barriers**	**Measures to overcome barriers**
Economic and financial	• High capital cost • Inadequate work of subsidy mechanisms (such as Power Purchase Agreement (PPA), Feed in Tariff (FIT) which really do not promote small hydropower projects implementation) • Inadequate access to acceptable financial resources • High transaction cost	• Develop a package of recommendations for improvement of enabling environment, aimed to decrease capital costs including improvement work of subsidy mechanism, exemption of import duty of equipment for small hydro, etc. • Develop mechanisms: to ensure the financial stability of LLP "Billing and Financial Center in support of renewable energy sources" under KEGOC; loan guarantee; auctions; facilitate receiving grants and credits at affordable rates, development of uniform format of power purchase agreement.
Legal and regulatory	• Lack of long-term political commitment on small hydro (no indicators for small hydropower development up to 2030, 2050) • Inefficient regulation on FITs (Financing of renewable energy objects is impossible without borrowing from financial institutions that are issued in the form of loans in foreign currency; absence of a stable mechanism for the fulfillment of financial obligations of LLP "Settlement and Finance Center" (RFC) to energy producing organizations using renewable energy sources for purchased electricity from them.)	• Improve regulation on import simplifying procedures and providing permits for small hydropower technology. • Improve regulation on FIT mechanism for small hydropower and provide guarantee on financial sustainability of LLP Billing Renewable Center. • Use PPA mechanism in addition to FIT for small hydropower technology. • Develop a road map on small hydropower technology diffusion up to 2030 (2050), list of projects, approve an electronic atlas. • Implement the pilot projects on small hydro in the regions of Kazakhstan using local technical achievements and purchasing

	• Inefficient regulation on providing permits, tax preferences for reducing greenhouse gas (GHG) emissions • Lack of law on power market capacity	equipment from abroad. This helps to work out the issues of equipment supply, installations, connections to grid and other issues of sustainable energy supply in rural area; • and create full-size green market
Institutional and organizational capacity	• Weak capacity of R&D institutions, local authorities to support policy on regional level	• Develop specific training programs and provide training for R&D personnel, local authorities, required research for and electronic atlas development in cooperation with international organizations
Information and awareness	• Lack of market information, on modern equipment	• Conduct adequate information campaigns on the advantages of applied small hydro power technology through print and electronic media
Other (A set of supplementary measures)	• Weak coordination between market actors • Inefficient donors and local authorities' coordination for implementation of pilot projects	• Improve donor coordination to enhance support pilot project implementation and providing cooperation, coordination between market actors, improve government control for implementation of laws and regulations, Involve more stakeholders from Business, Associations, relevant bodies of the local authorities into the process of technology implementation • Strengthen research network programs and coordination with international donors, business, non-governmental organizations (NGOs) and market players.

Framework for ranking measures for inclusion as Actions in TAP ("1"- low, "2" -middle, "3"- high)			
Measures to overcome barriers	**Considerations**	**Assessment**	**Ranking**
Develop a road map - 2030 on small hydropower technology diffusion, including list of projects Develop an electronic atlas on Small Hydropower (an electronic map with location and potential of generation in regions of Kazakhstan) Improve regulation on FITs (peg FIT in KZT to dollars, reconsider tariff rates each year, update methodology of FIT definition according to local conditions) Develop mechanisms: to ensure the financial	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Helps to plan or update the long-term policy and identify preliminary costs • Helps to save budget resources in future by attracting investors, help to make technology competitive in the market • Interaction with other economic/financial measures • Suitable within power production sub-sector. This measure contributes to a better mutual understanding among finance providers. Analysis of existing policy achievements and further estimates and recalculation of FITs are necessary. • For financial stability of BFC, the Reserve Fund is established per new amendments of law "On transition issues of the Republic of Kazakhstan to the "green	3 Supporting the diffusion of the technology

stability of LLP "Billing and Financial Center in support of renewable energy sources" (BFC) under KEGOC; develop standard power purchase agreements		economy" #506-V dated 28 Aprtil,2016 with changes of 26 July 2016 • Standard power purchase agreements (PPA) developed and approved • With measure below on FITs • Suitable within power production sub-sector • Benefits for investors, some additional cost for project owners	
Enhance access to finance for RES projects (including small hydro): facilitate receiving grants and credits at affordable rates	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Increasing access to finance through DAMU Facility is corresponding to Business Code • The base rate is decreased by National Bank up to 11% in 2017 • Interacts with some measures mentioned here • Suitable within country • Needs economical and financial analysis of projects for receiving additional financing by project owners	2
Conduct adequate information and awareness-raising campaigns	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Conducted, EXPO 2017 in Astana, is good example • Interacts with some measures mentioned here • Coincides within power production sub-sector • Benefits: assisting promotion of RES projects and achieve RES targets	1
Develop specific training programs and conduct training	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Training will help to introduce auctions, prepare bankable projects on small hydropower • Specific training is needed for personnel involved into introduction of RES auctions (including small hydro), representatives of small business to develop bankable projects, to do benefits & cost analysis. Improvement capacity building for small hydro power promotion and bring new energy solutions are important for diffusion of technology and improving energy sector in the end • Interacts with some measures mentioned here • Suitable within power production sub-sector • Benefits: training assist capacity building in promotion	3

		of technology diffusion,	
Compile and distribute existing site-specific pre-feasibility data. make new research and develop electronic atlas (map) with potential projects on small hydropower to identify, promote social, economic & financial and environmental benefits	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Promote social, economic & financial and environmental benefits of technology diffusion is important and coincides with the priorities • Accurate technical data will help to develop projects and decrease risk on uncertain costs	3
Develop and implement projects on small hydro in recommended regions (Oblasts) of Kazakhstan (per electronic atlas developed)	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• This helps to provide sustainable energy supply in rural area and create full-size green market • Interacts with policy and enabling environment • Suitable within power production sub-sector • To contribute achieving total RES target in the planned long term	3

Final selection of measures to be included as actions in TAP

Categories	**Identified measures to overcome barriers**	**Measures selected as Actions for inclusion in TAP**
Economic and financial	• Develop a package of recommendations for improvement of enabling environment, including subsidy mechanism, exemption of import duty of equipment for small hydro, simplifying administrative procedures, permits • Continue use the existing economic/financial mechanisms and introduce new ones (FIT, concessional loan, PPA, grants) • Introduce auctions on Small Hydropower • Expand access to finance	• Strengthen existing initiatives through implementing economic/financial and market-based mechanisms
Legal and regulatory	• Improve regulation on import simplifying procedures and providing permits for small hydropower technology • Improve regulation on FIT mechanism (Peg to the dollar, change timeframe of reconsideration, provide guarantee on financial sustainability of LLP Billing Renewable Center, etc.)	• Improve legal and regulatory framework for replicable technology transfer • Support policy through implementing projects

	• Introduce PPA mechanism, carbon projects mechanisms, auctions • Develop a roadmap - 2030 for Small Hydropower diffusion, list of projects, electronic atlas with adjusting it every two years • Implement projects to support policy, demonstrate advantages of the technology diffusion	
Institutional and organizational capacity	• Development of specific training programs and provide training for R&D institutions, local authorities in cooperation with international organizations	• Strengthening capacity building of representatives from institutions, business
Information and awareness	• Conduct adequate information campaigns on the advantages of applied technology through print and electronic media • Compile and distribute existing site-specific pre-feasibility data to identify, promote social, economic& financial and environmental benefits	• Improve information gathering and sharing

Table 9. Summary of Actions, identification and description of specific Activities

Summary of Actions, identification and description of specific Activities	
Action 1	**Strengthen existing initiatives through implementing economic/financial and market-based mechanisms** through the improvement of conditions for commercial financing, technical assistance and state support for R&D institutions to improve R&D activities; improvement of methodology of definition FITs taking in mind expenses for Reserve Fund at RFC/KEGOK, structure of expenses; feasibility studies related to the design of the auction system including transparent bidding process, definition of auction demand, the qualification requirements, the winner selection process and the sellers' liabilities
Action 2	**Improve legal and regulatory framework for replicable technology transfer** through the development of a roadmap -2030 for small hydropower diffusion with refined target indicators for small HPP, clarified demand, forecast balance of electricity and power up to 2030, development of electronic atlas of small HPP with biennial adjustment, list of projects
Action 3	**Strengthen capacity building of representatives from institutions, business** that promote diffusion of climate-friendly technology through development of specific training programs for R&D institutions and local authorities; SME related to holding auctions; bankable project's preparation, providing training by means of workshops and seminars for actions named above, in cooperation with international organizations. The specific programs could be related to holding auctions; training on preparation of bankable projects, investment projects per national requirements, participating in preparation of projects together with potential donors; on procedures, incentives (Business Code improvements for investors, etc.)
Action 4	**Improve Information Gathering and Sharing** through improving public awareness on advantages of the technology, improving research, gathering technical and other information for making economic analysis, definition of potential, development of electronic atlas
Action 5	**Support policy through implementing projects** to demonstrate advantages of the technology, diffusion into market,

	promotion of the objectives of RES (based on model Project Ideas (Chapter 3)
Activities for Action implementation	
Action 1: Strengthen existing initiatives through implementing economic/financial and market-based mechanisms	
Activity 1.1	Define weak points of existing financial support of small hydro through review, prepare recommendations on improving conditions for commercial financing (such as commercial subsidy up to 30% of total or financial incentives in the form of soft loan to cover at least 50% of the purchase total cost)
Activity 1.2	Improve (rework) methodology of FIT's definition taking in mind expenses for Reserve Fund at RFC/KEGOK, structure of expenses
Activity 1.3	Develop Feasibility Study (FS) related to the design of the auction system including transparent bidding process, definition of auction demand, the qualification requirements, the winner selection process and the sellers' liabilities; issues related to mobilization of increased financing through PPP programs such as The Global Energy Transfer Feed-in Tariffs (GET FIT) or The Renewable Energy and Energy Efficiency Partnership (REEEP) FS also should include report on modeling of demand forecast for electricity up to 2030, 2050, and with focus on small hydropower, transmission evaluation
Activity 1.4	Develop and provide workshops for discussion of updated proposed methodology of definition FITs and for presenting FSs related to auctions, proposed financial support improvements
Action 2: Improve legal and regulatory framework for replicable technology transfer	
Activity 2.1	Review of administrative procedures for streamlining, by simplifying the permission procedures for submitting documents or receiving state full-scale grants and adoption of fast-track, one-stop approval process and review social programs and other relevant legal documents related to insurance regulation or loan guarantee and develop innovative policy recommendations for improvement (report)
Activity 2.2	Develop a roadmap – 2030 for Small Hydropower, including a list of projects.
Activity 2.3	Develop an electronic atlas on Small Hydropower and monitor its changing once 2 years.
Activity 2.4	Develop and endorse supportive legislation/ regulation for introduction of activities described above.
Activity 2.5	Develop and conduct workshops on auctions, definition of risks for bidders and all the competitors, etc.
Action 3: Strengthen capacity building of institutions, business representatives	
Activity 3.1*	Develop specific training programs for R&D institutions and local authorities, SME in cooperation with international organizations. Conduct workshops for public service providers, regulatory bodies, business representatives, financial sector and other institutions accordingly.
Activity 3.2	Develop different types of thematic documentation, publications (such as manuals, surveys, etc.), and distribute via meetings, workshops, etc.

	Action 4. Improve Information Gathering and Sharing
Activity 4.1	Compile and distribute existing site-specific pre-feasibility data (including technical information) for development of electronic atlas on Small Hydropower.
	Action 5. Support policy through implementing projects
Activity 5.1	Develop and implement projects on small hydro in South, East, and Central regions of Kazakhstan (based on model Project Idea, Chapter 3).

Table 10. Planning of Activities for implementation of Actions – Small Hydropower

Planning of Activities for implementation of Actions – Small Hydropower										
Action 1: Strengthen existing initiatives through implementing economic/financial and market-based mechanisms										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Capacity needs	Start	Complete	Who	Capacity needs	Costs	Who will fund
1.1. Define weak points of existing financial support of small hydro through review, prepare recommendations on improving conditions for commercial financing (such as commercial subsidy up to 30% of total or financial incentives in the form of soft loan to cover at least 50% of the purchase total cost) (report)	Jul'17	Nov' 17	ME primary responsibility	Project management; Financial Planning	Jan'18	Dec '18	ME primary responsibility, International and national experts	Project management; Financing	USD 60, 000	Public Governmental/ International TA
1.2. Improve (rework) methodology of FIT's definition taking in mind expenses for Reserve Fund at RFC/KEGOK, structure of expenses.	Aug'17	Dec'17	ME primary responsibility, KEGOK/RFC	Project management; Financial Planning	Jan'18	March'18	ME primary responsibility, TA experts	Project management; Financing Technology Deployment	USD 50,000	Public Governmental/ International TA for R&D institutions
1.3. Develop a Feasibility Study (FS) report. This document could cover the following issues: design of an auction system; modeling of demand, forecast of electricity up to 2030 (2050), and with focus on	Jun'17	Nov'17	ME, International organizations	Project management; Financial Planning;	Feb '18	Jun '19	ME approval (primary responsibility) , International organization	Project management; Business management, Financing Technology	USD 1,000,000	Government and donor funding (International TA): USAID, EBRD/KAZREFF , UNDP, WB

small hydropower, energy transmission evaluation; mobilization of financial resources through PPP programs (such as The Global Energy Transfer Feed-in Tariffs (GET FIT) or the Renewable Energy and Energy Efficiency Partnership (REEEP)).								Deployment		
1.4. Develop and conduct roundtable discussions on the results of reports activities named above for finalization.	Apr;18	May;18	ME, International organizations, companies	Financial Planning Project management Business management Financing	Jul' 18	Aug '19	ME approval (primary responsibility) , International organization	Project management; Business management, Financing Technology Deployment	USD 200,000	Government and donor funding (International TA)
Action 2: Improve legal and regulatory framework for replicable technology transfer										
Activities	**Planning**				**Implementation**			**Costs and funding needs**		
	Start	Complete	Who	Capacity needs	Start	Complete	Who	Capacity needs	Costs	Who will fund
2.1.Review of administrative procedures for streamlining, by simplifying the permission procedures for submitting documents or receiving state full-scale grants and adoption of fast-track, one-stop approval process and review social programs and other relevant legal documents related to insurance regulation or loan guarantee and develop innovative policy recommendations for improvement (report)	Oct'17	Dec'17	ME, MNE, MID, MF International organizations, companies	Financial Planning Project management	Jan'180	Apr'18	ME, MNE, MID, MF International organizations, companies	Financial Planning Project management Business management Financing	USD 40,000	Government and donor funding (International TA)
2.2. Develop a roadmap – 2030 for Small Hydropower, including a list of projects.	Aug'17	April' 19	ME, R&D Institutions/International TA	Financial Planning, Project management, Business management	Jan' 18	Jun'18	ME, International organizations	Project management, Business management, Financing, Technology Deployment	USD 300,000	Public Governmental budget, TA International

2.3.Develop an electronic atlas on Small Hydropower and monitor its changing once 2 years.	Novr'17	Dec'17	ME, R&D institutions	Project management, Financial Planning,	Jan'18	Mar'18	R&D institutions	Project management Financing, Market development	USD 50,000	Public Governmental budget
2.4.Develop and endorse supportive legislation/ regulation for introduction of activities described above .	Jul'18	Aug'18	ME, MNE, MID, MF Damu, R&D institutions, Akimats	Project management, Financial Planning, Technology Deployment, Market development	Aug' 18	Aug' 19	ME, MNE, MID, MF Damu, R&D institutions, Akimats	Project management, Market development, Financing, Technology Deployment, Technology Diffusion	USD 80,000	Public Governmental budget
2.5.Develop and conduct workshops on auctions, definition of risks for bidders to all the competitors, etc.	Jun'18	Jul'18	ME, R&D institutions, National and international experts	Project management, Financial Planning, Market development	Sep' 18	May' 19	ME, International donors/ international consultant	Project management, Financing, Market development, Technology Deployment	USD 50,000	Government and International funding TA
Action 3: Strengthen capacity building of representatives from institutions, business										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Capacity needs	Start	Complete	Who	Capacity needs	Costs	Who will fund
3.1. Develop specific training programs for R&D institutions and local authorities, SME in cooperation with international organizations. Conduct workshops for public service providers, regulatory bodies, business representatives, financial sector and other institutions accordingly.	Oct' 18	Feb'19	ME, International organizations	Project management, Financial Planning	March' 19	Nov' 21	International donors/ international TA	Project management, Business management, Financing, Technology Deployment	USD 17,652	International funding TA
3.2. Develop different types	Apr'19	Dec '20	ME, International	Project management,	May' 19	Nov' 21	ME, International	Financial Planning	USD 26,425	Government and International

of thematic documentation, publications (such as manuals, surveys, etc.), and distribute via meetings, workshops, etc.			donors/ international consultants, local consultants	Financial Planning			donors/ international TA	Project management Business management Financing Technology Deployment		funding
Action 4:Improve Information Gathering and Sharing										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Start	Complete	Who	Start	Complete	Who	Start
4.1. Compile and distribute existing site-specific pre-feasibility data (including technical information) for development of electronic atlas on Small Hydropower.	May' 17	Oct'17	ME, MNE, MH, MID, Akimats, R&D institutions	Project management Financial Planning Business management	Nov.'17	Dec.'2029	ME, Akimats, NGOs, International organization, Associations	Project management, Business management, Market development, Financing, Technology Deployment	USD 150,000	Private sources, Public funding, regional funding
Action 5. Support policy through implementing projects										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Start	Complete	Who	Start	Complete	Costs	Who will fund
5.1 Develop and implement projects on small hydro in South, East, and Central regions of Kazakhstan (based on model Project Idea, Chapter 3).	Aug'17	April' 19	ME, R&D Institutions/International TA	Financial Planning Project management	2020	2030	Akimats, Business, ME	Project management Business management Market development Financing Technology Deployment Technology Diffusion	USD 455,000 (projects up to 2019); USD 1-1,95 million/MW	Private sources, international, regional budget

* Themes for training programs are and not limited to: best practice for auctions, bidding framework and Guidelines, definition of risks for bidders to all the competitors involving the government, Business, donors (for Action 3); related to holding auctions. Audience involved in Capacity Building process: ME, MNE, MF, NATD, NGOs, Akimats, R&D institutions, KEGOC, DAMU, business, other ministries (MF, MNE, MF), international donors, NGOs, banks. The cost estimates for this activity see in the Table 27 below.

Table 11.Overview of risks, possible contingencies, next steps –Small Hydropower

Overview of risks, possible contingencies, next steps –Small Hydropower				
Type of risk	**Related to Action or Activity**	**Description of risk**	**Contingency actions**	
1.Cost risk	All types of activities	An activity takes longer to complete than originally planned	**Time interval for M&E**	Annually
			M&E responsibility:	ME, Akimats, KEGOC/ Business, International organizations
			Contingency measures needed:	This might involve adding 25% to a construction estimate or 15% to the estimate for the cost of running a meeting of the public and private sectors in-country to discuss how to improve "doing business conditions"
			Responsibility contingency measure:	
			Timing contingency measure:	0-5 years
2 Scheduling Risks	All types of activities	An activity takes longer to complete than originally planned	**Time interval for M&E:**	Annually
			M&E responsibility:	Akimats, KEGOC/ RFC, Business, Financial institutions, ME
			Contingency measures needed:	Allow for step-by-step schedule slippage. Identify critical path items, whose delay stalls all progress on an Activity or even and Action Item
			Responsibility contingency measure:	Risks identified during the preparation of the TAP can be adequately handled if spotted during implementation of the actions. Unexpected risks and their consequences can be adequately spotted and handled.
			Timing contingency measure:	0-5 years
3 Performance Risks	All types of activities	A technology or human resource does not perform	**Time interval for M&E:**	Once in 6 months
			M&E responsibility:	Akimats, ME, Business, International organizations

		as planned or environmental and social benefits not being delivered	**Contingency measures needed:**	This is the most difficult contingency to plan for; performance risk belongs to the contractor or supplier before accepting delivery and commissioning.
			Responsibility contingency measure:	Akimat, Business, KEGOC/ RFC, Financial institutions
			Timing contingency measure:	0-5 years
Identify immediate requirements and next steps				
Immediate Requirements	The Ministry of Energy is recommended to activate work on technology promotion and improve cooperation between stakeholders			
Critical Steps	Critical steps are: an effective planning, project preparation, and peg FITs to dollars. Reservation of funds by project owners to cover unforeseen expenses.			

ANNEX 2. Supporting Tables: TAP for Energy Efficient Coal Combustion

Table 12. Starting point information for TAP on Energy Efficient Coal Combustion, ambition

Starting point information for TAP on Energy Efficient Coal Combustion, ambition		
Prioritized technology for this TAP	Efficient Coal Combustion	
Stakeholders involved	**Name & Institute**	**Contact information (email, tel.)**
	Kanat Baigarin, National Focal Point and NU Vice President	kbaigarin@climate.kz ;kbaigarin@nu.edu.kz +7(7172) 68-9878
	Gulmira Sergazina, Former Director of the Department on Climate Change of the Ministry of Energy of the Republic of Kazakhstan	g.sergazina@energo.gov.kz +7(7172) 740258
	Daulet Ahmetov Kazakhstan Energy Association (KAZENERGY), AES companies head office in Astana	kea.astana@mail.ru +7 (7172) 68-96-51
	Sergey Vassilyev, Coordinator of the Project on Mitigation, Climate Change Coordination Center	svassilyev@climate.kz +7 (7172) 519804
	Lyubov Inyutina Expert on Energy Efficiency and Climate Change	lyubov.inyutina@mail.ru +77013353441
	Aiymgul Ismagulova Nazarbayev University, specialist	+7(7172) 70 60 07
	Dinara Dauletova Ministry of Energy Specialist of Department	+7 (7172) 74 08 74
	Ella Baybikova Head of Strategic Planning and Marketing, Eurasian Development Bank	baybikova_er@eabr.org +7 (7272) 44 40 44
	Islambek Kairbekov JSC DAMU Entrepreneurship Development Fund,	http://www.damu.kz/ +7(7172) 559-214

	representative	
Benefits from this technology		
Climate change mitigation	Target indicator for power production is reducing carbon dioxide emissions in the power subsector up to level of 2012 (or 95.7 million tons of CO_2 eq.) by 2020 and further reducing just 15% (by 2030. Preliminary estimates show that construction of new thermal power plants (TPPs) with efficient coal combustion technology will help to reduce the overall CO2 emissions by 21. 9 million tons per year by 2030.	
Social development	At least 150-200 new jobs annually could be brought because of introduction of the technology	
Environmental protection	Reducing air pollution, improving local health improvement, reduction of GHG emissions (Kazakhstan intends to make its contribution by 2030 to reduce greenhouse gas emissions by 15% relative to the base year 1990).	
Economic development	The promotion of technology corresponds to the priorities of sustainable development named in the strategic documents such as the Strategy of JSC "Samruk - Energo" for 2012-2022, Green Economy Concept, Kazakhstan Strategy 2050.	
Current status of technology at country level	Target indicator for power production is reducing carbon dioxide emissions in the power subsector up to level of 2012 (or 95.7 million tons of CO_2 eq.) by 2020 and then just 15% (relative to the level of CO_2 eq. in 2012) by 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.	
Other explanations in support of prioritization of this technology	At least 150-200 new jobs annually could be created as a result of introduction of the technology	
Ambition - Scale of implementation of prioritized technology		
Proposed scale of technology implementation in country to deliver the socio-economic and environmental benefits	Annual construction of up to 600 MW of new capacities or 9,000 MW for 15 years is required for sustainable development of the economy in the period up to 2025, to meet the electricity demand with an annual growth of 7%. Target is assisting to improve GDP's energy efficiency through 25 % reduction in energy intensity by 2020 and 50% reduction by 2050.	

Table 13. Overview of barriers and measures, ranking, final selection of measures as Actions into TAP: Energy Efficient Coal Combustion

Overview of barriers and measures, ranking, final selection of measures as Actions into TAP: Energy Efficient Coal Combustion		
Categories	**Identified barriers**	**Measures to overcome barriers**
Economic and financial	• Inadequate subsidy mechanism, loan guarantee, PPP mechanisms • Inefficient carbon market mechanism	• Import procedures should be simplified • Establish public-private partnership (PPP) mechanism and the technical alliance to transfer of energy efficient coal combustion technology- and use other market mechanisms (carbon projects, Emission trading scheme)
Legal and regulatory	• Non-compliance of standards on air pollution control • Inadequate tariff mechanism • Inefficient regulation on import duty, tax privileges • Lack of law on power market capacity	• Enhance market mechanisms, such as carbon mechanism, risk-sharing and Energy Saving Performance Contracts (ESPCs) • Develop road map 2030 for technology diffusion in the frames of low carbon development (including list of pilot projects) • Ensure compliance of air quality control standards due to implementing efficient coal combustion technology
Institutional and organizational capacity	• Weak capacity of R&D institutions	• Improve capacity of R&D institutions, local authorities and consultants by developing specific training programs and provide on-the-job training for current engineers, authorities, of R&D institutions in cooperation with international organizations on areas of energy efficiency (level of ecological advantages of the proposed efficient combustion coal technology and application of financing mechanisms)
Information and awareness	• Low level of knowledge of ecological advantages	• Increase awareness about ecological advantages of technologies (at least by 35% through social research-questionnaire). Broad communication and education programs on national TV and radio to achieve this. The upcoming EXPO 2017, Green Bridge, government speeches, and written communication are tools that are used.
Other	• Non-compliance of standards on air quality control	• Ensure compliance of standards on air quality control by introduction of innovative technologies in the pilot projects

Framework for ranking measures for inclusion as Actions in TAP ("1"- low, "2" -middle, "3"- high)			
Measures to overcome barriers	**Considerations**	**Assessment**	**Ranking**

Establish public-private partnership (PPP) mechanism and the technical alliance to transfer of energy efficient coal combustion technology- and use other market mechanisms (carbon projects, Emission trading scheme)	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Improve financial conditions for promotion of technology • Contributes to a better mutual understanding between finance providers and technology program developers, as well as improved risk assessments within the country context. • There are no real interactions with other measures, at least not negative, and there are no suitability issues with country or sector. • Benefits to technology implementation are mainly indirect: we support financiers to make better informed risk assessments, but we have no guarantee that they will immediately make more funding.	3
Develop road map 2030 for technology diffusion in the frames of low carbon development (including list of pilot projects) Ensure compliance of standards on air quality control due to implementing efficient coal combustion technology Simplify Import procedures	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Assists technology diffusion and implementation of NDC • Per amendments to Business Code adopted on 28, February, 2017 import procedures are improved	3
Improve capacity of R&D institution's personnel, increase awareness about ecological advantages of technologies Training and raising level of ecological advantages of the proposed efficient combustion coal technology and application of financing mechanisms	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	Assists technology diffusion	3
Ensure compliance of standards on air control by introduction of pilot projects	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Achieve better air quality, GHG emissions reduction in power sector, introduction of innovative technology	3

Final selection of measures to be included as actions in TAP		
Categories	**Identified measures to overcome barriers**	**Measures selected as Actions for inclusion in TAP**
Economic and financial	• Establish public-private partnership (PPP) mechanism PPP and technical alliance to transfer of modern efficient coal combustion technology- and use of market mechanisms (carbon projects, Emission trading scheme)	• Harnessing PPP and market-based mechanism to invest more in projects on Energy Efficient Coal Combustion
Legal and regulatory	• Enhance market mechanisms, such as carbon mechanism, risk-sharing and Energy Saving Performance Contracts (ESPCs) • Develop road map 2030 for technology diffusion in the frames of low carbon development (including pilot projects) • Ensure compliance of standards on air quality control due to implementing efficient coal combustion technology	• Improvement of legal and regulatory framework
Institutional and organizational capacity	• Improve capacity of R&D institutions, local authorities and consultants	• Strengthening capacity building of representatives of institutions, business
Information and awareness	• Increase awareness about ecological advantages of the technologies (at least by 35% by 2020 through social research- questionnaire	
Other	• Introduce the pilot projects (at least 2 projects) developed on the base of Project Idea (Chapter 3)	• Support policy through implementing projects

Table 14. Summary of Actions, identification and description of specific Activities: Energy Efficient Coal Combustion

Identification and description of specific Activities to support Actions (Step 2.3)	
Action 1	Harnessing Public- Private Partnership (PPP) and market-based mechanisms to invest more in Energy Efficient Coal Combustion
Action 2	Improvement of legal and regulatory framework
Action 3	Strengthening capacity building of representatives of institutions, business
Action 4	Support policy through implementing projects (at least 2 projects), developed based on Project Ideas (Chapter 3)
Activities for Action implementation	
Action 1:Harnessing private-public partnership and market-based mechanism to invest more in Energy Efficient Coal Combustion	
Activity 1.1	Review the best practices on the use of financing mechanisms to increase private financing for technology diffusion (PPP, ESCO, Risk-sharing Facilities, concessional financing) and develop report with recommendations

Activity 1.2	Develop and conduct workshop relating to applying financial mechanisms in Kazakhstan
Action 2: Improvement of legal and regulatory framework	
Activity 2.1	Update the law and regulation for revitalizing the carbon market (review the National Allocation Plan 2016-2020 and develop a National Allocation Plan 2021-2025
Activity 2.2	Develop a roadmap – 2030 for Energy Efficient Coal Combustion, including a list of projects.
Activity 2.3	Develop standards and regulation that ensure that any newly built coal fired power stations meet efficiency limits, and introduce the air quality standards for all (new and existing) coal - fired power plants that mirror those in Europe (the Large Combustion Plant Directive and Industrial Emissions Directive)
Activity 2.4	Develop and conduct roundtable discussions related to the activities named above
Activity 2.5	Endorse and launch supportive legislation and regulation for introduction of this Action
Action 3: Strengthening capacity building of representatives from institutions, business	
Activity 3.1	Develop specific training program for the different stakeholders (R&D institutions, local authorities, engineers, other stakeholders) in cooperation with international organizations, and conduct training. Issues on risk definition and risk management are proposed to be included into training program.
Activity 3.2	Arrange study tours, organize bilateral meetings for establishment of PPP or Technical Alliance to transfer of modern energy efficient coal combustion technology (report), information on web-site of the ministries (ME, MID)
Action 4: Support policy through implementing projects	
Activity 4.1	Develop at least 2 projects based on a Project Ideas (Chapter 3) and implement

Table 15. Planning of Activities for implementation of Actions – Energy Efficient Coal Combustion

Planning table - characterization of activities for implementation of actions										
Action 1: Harnessing private-public partnership and market-based mechanism to invest more in Energy Efficient Coal Combustion										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Capacity needs	Start	Complete	Who	Capacity needs	Costs	Who will fund
1.1. Review the best practices on the use of financing mechanisms to increase private financing for technology diffusion (PPP, ESCO, Risk-sharing Facilities,	Jul'18	Nov' 18	ME, TNA Committee	Project management; Financial	Jan'19	Dec '19	ME, MNE, MF,	Project management; Financing	USD 100, 000	Public International TA

concessional financing) and develop report with recommendations				Planning						
1.2. Develop and conduct workshop relating to applying financial mechanisms in Kazakhstan	Aug'18	Dec'18	ME (primary), MF, TNA Committee, International organization	Project management; Financial Planning	Jan' 22	March'22	ME, MNE, International organization	Project management; Financing Technology Deployment	USD 200,000	Public: Government and donor funding (International TA)
Action 2: Improvement of legal and regulatory framework										
Activities	**Planning**				**Implementation**			**Costs and funding needs**		
	Start	Complete	Who	Start	Complete	Who	Start	Complete	Costs (Step 4.2)	Who will fund (Step 4.3)
2.1 Update the law and regulation for revitalize the carbon market (review the National Allocation Plan 2016-2020 and develop a National Allocation Plan 2021-2025	March'18	March'20	ME, JSC "Zhasyl Damu"	Financial Planning	Jan' 20	Aug' 20	ME, MJ, JSC "Zhasyl-Damu	Financing	In KZT from National budget (usually none), (approx. equivalent in USD 50,000)	Public: Government resources
2.2. Develop a roadmap – 2030 for Energy Efficient Coal Combustion, including a list of projects	May'18	Juy'18	ME, TNA Committee /International organization	Financial Planning, Project management	Jan' 21	Aug' 21	ME, TNA Committee/International organization	Project management, Financing, Technology Deployment	USD 300,000	Public Governmental budget, International TA
2.3. Develop standards and regulations ensuring that any newly built coal fired power stations meet efficiency limits, and introduce the air quality standards for all (new and existing) coal - fired power plants that mirror those in Europe (the Large Combustion Plant Directive and	Aug'20	Oct'20	ME, International organization	Financial Planning, Project management	Aug' 22	Oct'22	ME, International organizations	Project management, Financing, Technology Deployment	USD 300,000	Public Governmental budget, International TA

Industrial Emissions Directive)										
2.4. Develop and conduct roundtable discussions related to the activities named above	Nov'20	Dec'20	ME, International organization	Project management, Financial Planning, Technology Deployment	Jun' 22	Jun' 23	ME, International organization	Project management, Business management, Financing, Technology Deployment, Market development	USD 100,000	Public Government and International funding TA
2.5. Endorse and launch supportive legislation and regulation for introduction of this Action	Sept'20	Dec'20	ME, MJ		Feb' 23	Dec'29	ME, MJ, MNE, MF Damu, Akimats Financial Planning, Technology Deployment, Market development	Market development, Financing, Technology Deployment, Technology Diffusion	In KZT from National budget (usually none), (approx. equivalent in USD 100,000)	Public Governmental budget
Action 3: Strengthening capacity building of representatives from institutions, business										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Start	Complete	Who	Start	Complete	Who	Who will fund
3.1. Develop specific training program for the different stakeholders (R&D institutions, local authorities, engineers, other stakeholders) in cooperation with international organizations, and conduct training	Jun'20	Sept'20	ME, TNA Committee, International organization	Project management, Financial Planning,	Feb' 25	May '25	ME, MNE, MF, International organization, Technology Deployment	Project management, Financing, Technology Deployment	USD 150,000	Public: International TA
3.2. Arrange study tours, organize bilateral meetings for establishment of	Jun'22	Sept'22	ME, TNA Committee	Project management,	Jun' 25	Nov '25	ME, TNA	Project management, Financing,	USD 200,000	Public: International

PPP or Technical Alliance to transfer of modern energy efficient coal combustion technology (report), information on web-site of ME, MID			, International organization	Financial Planning, Technology Deployment			Committee, International organization	Technology Deployment, Market development		TA
Action 4: Support policy through implementing projects										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Start	Complete	Who	Start	Complete	Who	Who will fund
4.1. Develop at least 2 projects based on a Project Ideas (Chapter 3) and implement	Oct'20	Nov.20	ME, TNA Committee, International org./Business	Project management, Business management, Financial Planning	March'21	Dec'2030	ME, Business	Market development, Financing, Business management, Technology Deployment, Technology Diffusion	USD 1,140 Millions	Public: Government Private: Cost-sharing with International and or local Business

Table 16. Overview of risks, possible contingencies, next steps: Energy Efficient Coal Combustion

Overview of risk categories and possible contingencies –Energy Efficient Coal Combustion				
Type of risk	**Related to Action or Activity**	**Description of risk**	**Contingency actions**	
1.Cost Risks	All types of activities	An activity costs more than originally planned Disruption of agreements on loans, investments or credits	**Time interval for M&E:**	Annually
			M&E responsibility:	ME, TNA Committee, Business, International organizations
			Contingency measures needed:	A meeting of the public and private sectors in-country to discuss how to improve "doing business conditions"
			Responsibility contingency measure:	Business
			Timing contingency measure:	0-5 years

2 Scheduling Risks	All types of activities	An activity takes longer to complete than originally planned	**Time interval for M&E:**	Annually
			M&E responsibility:	ME, TNA Committee, Business, International organizations
			Contingency measures needed:	Identify critical path items, whose delay stalls all progress on an Activity or even and Action Item
			Responsibility contingency measure:	Risks identified during the preparation of the TAP can be adequately handled if spotted during implementation of the actions.
			Timing contingency measure:	0-5 years
3 Performance Risks	All types of activities	A technology or human resource does not perform as planned or environmental and social benefits not being delivered	**Time interval for M&E:**	Once 6 months
			M&E responsibility:	Business, International organizations, ME
			Contingency measures needed:	The performance risk belongs to the contractor or supplier before accepting delivery and commissioning; for missing speakers, get slides in "notes view" well in advance of meeting).
			Responsibility contingency measure:	Business
			Timing contingency measure:	0-5 years
Identify immediate requirements and next steps				
Immediate Requirements	It is needed to define the measures that will be taken to mitigate each risk and its impacts while developing roadmap-2030 for the technology diffusion.			
Critical Steps	Risk sharing between project participants. Define the stakeholders in the country who are responsible for this monitoring and evaluation.			

ANNEX 3. Supporting Tables: TAP for Energy Efficiency in Cement Production

Table 17. Starting point information for TAP for Energy Efficiency in Cement Production, ambition

Starting point information for TAP		
Prioritized technology for this TAP	**Energy Efficiency in Cement Production**	
Stakeholders involved	**Name & Institute**	**Contact information (email, tel.)**
	Olzhas Alibekov, Director of Department on energy efficiency, Committee of Industrial Development and Industrial Safety Ministry of Investments and Development (MID)	alibekov@mid.gov.kz +7(7172)-754915
	Gulmira Sergazina, Former Director of the Department on Climate Change of the Ministry of Energy of the Republic of Kazakhstan	g.sergazina@energo.gov.kz +7(7172) 740258
	Sergey Vassilyev, Coordinator of the Project on Mitigation, Climate Change Coordination Center	svassilyev@climate.kz +7(7172) 529804
	Lyubov Inyutina Expert on Energy Efficiency and Climate Change	+77013353441 lubov.inyutina@mail.ru
	Alexander Zuev United Cement Group Deputy General Director	+7(7272)77-77-20 info@unicementgroup.com
	Aleksyi Cherednichenko USAID Kazakhstan climate change mitigation program, expert	+7(7272) 55 84 48
	Syrym Nurgaliev Manager of UNDP project on energy efficiency	+7(7172) 58 09 39

	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	+7(7272)92 24 54 www.kaznie.kz
	Dauren Tokbayev President "ULE Kazakhstan Association of Energy Auditors"	+(7273)49 3999 dtokbayev@kazep.kz
	Anuar Buranbayev JSC "Kazakhstan Industry Development Institute" (KIDI)	+(7172) 79 64 72 www.kidi.kz/
Benefits from this technology		
Climate change mitigation	The target is to limit CO_2 emissions growth and the national goal is to reduce total GHG emissions by 15% relative to the base year 1990 for the whole economy. Regarding GHG emissions reduction in cement production subsector, the target is to reduce CO_2 emissions growth by 2020 to the tune of 16.6 million tons compared to baseline (a baseline is on the level of the average value of the total carbon dioxide emissions for 2013-2014) which is 5.53 million tons per year. At total production of 0.80 million 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 in the long run.	
Social development	Labor productivity in the new cement plant, with the dry method, will be 4322.3 tons of cement per person per year. Considering the cost of cement in the amount of 12 500 KZT the one worker productivity per year is: US $ 360,194. Creation of additional work places at least 10%; Public participation and awareness-raising- 50%	
Environmental protection	Reducing air, land and water pollution	
Economic development	Reduction of GDP energy intensity goals are: 25% by 2020; 30% by 2030; 50% by 2050. Goals to improve energy efficiency in cement production sub- sector correspond to priorities of economic development with principles of Green Economy. 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. (see the report on Barriers).	
Current status of technology at country level	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 the report on Barriers).	

Other explanations in support of prioritization of this technology	The introduction of Euro Codes including in cement sub sector (per "100 steps to implement the five-main reform identified by President" (Step 49)). Reserve fuel saving is the application of slurry thinners, as each percent of decrease in moisture content of sludge can reduce fuel consumption for clinker burning on average by 117-146 kJ / kg or 7-2%. (see the report on Barriers). The use of more effective insulation materials for lining of preparatory areas of rotary kilns will also reduce fuel consumption by 2-3 kg per ton of clinker. (see the report on Barriers).
Ambition - Scale of implementation of prioritized technology	
Proposed scale of technology implementation	According to World Bank analysis, the cement companies can get more reliable and cheaper energy and at the same time cut their greenhouse gas emissions. The share of energy efficient cement plants with "dry" method should increase up to 78% of total market capacity by 2020. 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. 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. (see the report on Barriers).

Table 18. Overview of barriers and measures, ranking, final selection of measures as Actions into TAP: Energy Efficiency in Cement Production

Overview of barriers and measures		
Categories	**Identified barriers**	**Measures to overcome barriers**
Economic and financial	• No-usage of ESCO mechanism • Inadequate subsidy mechanism • Inefficient carbon market mechanism	• Activate the use of ESCO mechanism: encourage use of Energy Service Contracts for promoting of energy efficient (EE) technology • Using other economic/financial and market mechanisms (subsidy, PPP, NAMA, grants and carbon market mechanism)
Legal and regulatory	• Lack of standards, codes and certification • Inefficient regulation on tariff, customs	• Develop a package of regulations on customs, tax privileges • Develop obligatory technical regulation and certification, standards and codes per European Union, Eurasia Economy Union requirements. • Implement the Emission Trading Scheme (ETS) and internal carbon projects).
Institutional and organizational	• Weak capacity of R&D institutions	• Organize several specific capacity building programs and

capacity		conduct seminars for R&D personnel, experts on best international practices on EE technologies in cement production. • Create a national institution for conducting regular reviews, conducting economic analysis and assessing other critical issues of the cement market, on an annual basis. This institution could work for Kazakhstan and for Central Asia.
Information and awareness	• Weak access to information and poor dissemination	• Adequate access to information and dissemination. The information could cover the following issues: markets, costs, benefits of technology

Framework for ranking measures for inclusion as Actions in TAP (Step 2.2.) "1"- low, "2" -middle, "3"- high

Measures to overcome barriers	**Considerations**	**Assessment**	**Ranking**
Activate the use of ESCO mechanism: encourage use of Energy Service Contracts for promoting of energy efficient (EE) technology Using other existing economic/financial and market mechanisms	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Assisting promotions of technology • Contributes to a better mutual understanding between finance providers and technology program developers, as well as improved risk assessments within the country context. • There are no real interactions with other measures, at least not negative, and there are no suitability issues with country or sector. • Benefits to technology implementation are mainly indirect: we support financiers to make better informed risk assessments, but we have no guarantee that they will immediately make more funding.	3
Develop a package of regulations on customs, tax privileges Implement the Emission Trading Scheme (ETS) and internal carbon projects).	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Benefits form trading carbon credits • Assisting the Emission Trading Scheme implementation in future (after 2018)	2

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Develop obligatory technical regulation and certification, standards and codes per European Union, Eurasia Economy Union requirements. A set of technical measures, economically acceptable, can be determined based on the energy audit. Introduce ISO 50001 at cement enterprises on voluntary basis	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Assists technology diffusion in Central Asia • Helps Kazakhstan to be competitive on world markets • Achieve GOK targets for cement production sub-sector development	3
Development of a road map – 2030 for Energy Efficiency in Cement Production, with a list of projects	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Assists technology diffusion and implementation of NDC	3
Implement the Emission Trading Scheme (ETS) and internal carbon projects).	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• There is uncertainty on ETS implementation after 2018, because now it is stopped by the Government Decree, postponed.	2
Adequate access to information and dissemination Create an institution aimed to issue review of different aspects related to cement production subsector analysis on regular basis on national and on Central Asia levels	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Information campaigns on advantages of applied technologies helps the population to understand promotion of technologies	3
Organize several specific capacity building programs and seminars, webinars on BAT in cement production for engineers, and for bankers regarding to technology diffusion	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Specific training is needed for promotion of energy efficiency in cement production and BAT	3

Final selection of measures to be included as actions in TAP		
Categories	**Identified measures to overcome barriers**	**Measures selected as Actions for inclusion in TAP**
Economic and financial	• Activate use of ESCO mechanism: encourage use of Energy Service Contracts for promoting of energy saving technologies in the cement production • Use economic/financial and market mechanisms	Activate use of ESCO mechanism
Legal and regulatory	• Develop a road map – 2030 for diffusion of Energy Efficiency in cement production, including a list of projects. The Roadmap should refine the target indicators bearing in mind implementation of NDC and Paris Agreement • Develop obligatory technical regulation and certification, standards and codes per European Union, Eurasia Economy Union requirements.	Improve legal and regulatory framework
Institutional and organizational capacity	• Organize several specific capacity building programs and conduct the seminars, webinars, training on energy audit for cement production, for engineers, bankers and other stakeholders • Introduce a voluntary labeling of the energy efficient equipment	Strengthen capacity building of representatives from institutions, business
Information and awareness	• Conduct information campaigns on the advantages of applied technology (through magazines, mass media, TV	
Other	• Develop and implement pilot projects in cement production	Support policy through implementing projects on energy efficiency

Table 19. Summary of Actions, identification and description of specific Activities Energy Efficiency in Cement Production

Summary of Actions	
Action 1	Activate use of ESCO mechanism
Action 2	Improve legal and regulatory framework

Action 3	Strengthen capacity building of representatives from institutions, business
Action 4	Support policy through implementing projects on energy efficiency
Identification and description of specific Activities to support Actions	
	Action 1: Activate use of ESCO mechanism
Activity 1.1	Creation an energy service company (ESCO) (with international participation) in the cement production sub-sector
Activity 1.2	Organize meetings for signing the Memorandum of Understanding (MOU) on ESCO
	Action 2: Improve legal and regulatory framework
Activity 2.1	Develop a road map – 2030 for diffusion of Energy Efficiency in cement production, including a list of projects
Activity 2.2	Introduce the voluntary measures: labeling of the energy efficient equipment, ISO 50001
	Action 3: Strengthen capacity building of representatives from institutions, business
Activity 3.1	Develop specific capacity building programs and seminars, webinars, conduct training on energy audit for cement production, on best available technologies (BAT) in the cement production for engineers, bankers and other stakeholders
	Action 4: Support policy through implementing projects on energy efficiency
Activity 4.1	Develop a pilot project based on the model Project Idea (Chapter 3) and implement

Table 20. Planning of Activities for implementation of Actions – Energy Efficiency in Cement Production

Table 3.7. Planning table - characterization of activities for implementation of actions										
Action 1:	**Activate use of ESCO mechanism**									
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Capacity needs	Start	Complete	Who	Capacity needs	Costs	Who will fund
1.1.Creation an energy service company (ESCO) (with international participation) in the cement production sub-sector	Feb'18	Aprl18	MID TNA Committee	Project management, Financing planning, Technology deployment	Jun '18	Dec' 30	MID, TNA Committee International organization	Project management, Financing, Technology deployment	USD 500,000	Private: International Budge Public: Government, cost sharing

1.2. Organize meetings for signing the MoU on ESCO	May'18	May'19	MID International Business	Project management, Financing planning	May' 18	Nov' 20	MID International Business	Project management, Financing	USD 100,000	Public and Private: Government and International
Action 2: Improve legal and regulatory framework										
Activities	**Planning**				**Implementation**			**Costs and funding needs**		
	Capacity needs	Start	Complete	Capacity needs	Start	Complete	Capacity needs	Start	Costs (Step 4.2)	Who will fund (Step 4.3)
2.1.Develop a road map – 2030 for diffusion of Energy Efficiency in cement production, including a list of projects	Apr'18	Aug' 18	MID International EBRD	Project management, Financing planning	Jan' 19	Dec'19	MID International EBRD	Project management, Financing	USD 300,000	Public Government, EBRD
2.2. Introduce the voluntary measures: labeling of the energy efficient equipment, ISO 50001	March' 20	Aug'20	MID International Business	Business management, Financing planning	Nov' 20	Dec'25	MID International Business	Business management, Financing	USD 700,000	Private Business
Action 3: Strengthen capacity building of representatives from institutions, business										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Capacity needs	Start	Complete	Capacity needs	Start	Complete	Capacity needs	Start	Complete	Capacity needs
3.1.Develop specific capacity building programs and seminars, webinars, conduct training on energy audit for cement production, on best available technologies (BAT) in the cement production for engineers, bankers and other stakeholders	Feb.'18	Mar'18	MID, International organizations	Financing planning Project management	Jul'18	Dec'25	MID, International organizations, NGO	Project management Financing	USD 100,000 / year	Public International TA

Action 4: Support policy through implementing projects on energy efficiency										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Capacity needs	Start	Complete	Capacity needs	Start	Complete	Capacity needs	Capacity needs	Costs	Who will fund
4.1. Develop pilot projects (at least 2 projects) based on the model Project Idea (Chapter 3) and implement	Jun'18	Nov'18	MID Business	Business management Financing Planning Design	Dec' 18	Dec'30	MID Business	Business management Financing Engineering	USD 3,340,000	Public: International TA Private International

Table 21. Overview of risks, possible contingencies, next steps: Energy Efficiency in Cement Production

Overview of risk categories and possible contingencies				
Type of risk	**Related to Action or Activity**	**Description of risk**	**Contingency actions**	
1.Cost Risks	All types of activities	An activity costs more than originally planned	**Time interval for M&E:**	Annually
			M&E responsibility:	MID, Business, R&D institutions, International organizations, Banks
			Contingency measures needed:	To develop the responsibilities of partners while introducing the ESCO mechanism, measures to overcome financial risk.
			Responsibility contingency measure:	Business
			Timing contingency measure:	0-5 years
2 Scheduling Risks	All types of activities	An activity takes longer to complete than originally planned	**Time interval for M&E:**	Annually
			M&E responsibility:	MID, Business, R&D institutions, International organizations, Banks
			Contingency measures needed:	To define critical path items, whose delay stalls all progress on an Activity or an Action.

			Responsibility contingency measure:	Risks identified during the preparation of the TAP can be adequately handled if spotted during implementation of the actions.
			Timing contingency measure:	0-5 years
3 Performance Risks	All types of activities	A technology or human resource does not perform as planned or environmental and social benefits not being delivered	**Time interval for M&E:**	Once 6 months
			M&E responsibility:	MID, Business, R&D institutions, International organizations, Banks
			Contingency measures needed:	The equipment supply should be done without delay, control at all steps of implementation, management according to schedule
			Responsibility contingency measure:	Business
			Timing contingency measure:	0-5 years
Identify immediate requirements and next steps				
Immediate Requirements	A task manager who will be responsible for task implementation and monitoring and coordination with partners, external stakeholders, Ministry of Energy and other international organization must be selected from the Ministry of Investment Development			
Critical Steps	Training of energy auditors for the specific issues related to the cement production is important. The technical staff and services should be trained to be able to introduce the technology.			

ANNEX 4. Supporting Tables: TAP for Wet - to Dry Modernization

Table 22. Starting point information for TAP on Wet to Dry Modernization, ambition

Starting point information for TAP		
Prioritized technology for this TAP	**Wet - to Dry Modernization**	
Stakeholders involved	**Name & Institute**	**Contact information (email, tel.)**
	Gulmira Sergazina, Former Director of the Department on Climate Change of the Ministry of Energy of the Republic of Kazakhstan	g.sergazina@energo.gov.kz +7(7172) 740258
	Sergey Vassilyev, Coordinator of the Project on Mitigation, Climate Change Coordination Center	svassilyev@climate.kz +7(7172) 519804
	Lyubov Inyutina Expert on Energy Efficiency and Climate Change	lyubov.inyutina@mail.ru +77013353441
	Erkin Salimov LLP "JAMBYL Cement Production Company" sales representative	Erkin.Salimov@jambylcement +7 (7272)44 02 32
	Ludmila Shabanova Information Analytical Center under ME	+7 (7172) 79 96 41
	Saulet Sakenov Manager of Third National Communication of the RK under UNFCCC, UNDP project	+7 (7172) 90 16 69
	Gulmira Esengazina Joint-stock company "Center for Engineering and Technology Transfer", Deputy Director	http://www.cett.kz/ + 7 (7172) 51-69-21

	Rinat Ramazanov Director of the Union of Builders of Kazakhstan ULE	ssk_ rk@ mail.ru +7(7172) 57 81 27
	Maral Tompieyv President of the "Association of Legal Entities "Kazakhstan Association on Building Materials Industry"	+77017119239
	Vera Mustafina President of "JSC KazWaste"	csd.vera@gmail.com +7(7272)255 84 21
Ambition - Scale of implementation of prioritized technology		
Proposed scale of technology implementation	Ambition is for transition into a more modern method of production of cement using high-tech equipment that will reduce GHG and other pollutant emissions and comply with international environmental standards. Regarding "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 per SPAID -2 (construction of seven plants with this technology is included into state program). GHG emissions reduction is 0.26-0,38 tCO_2/ton	

Table 23. Overview of barriers and measures, ranking, final selection of measures as Actions into TAP: Wet - to Dry Modernization

Overview of barriers and measures to overcome these (Step 2.1)		
Categories	**Identified barriers**	**Measures to overcome barriers**
Economic and financial	• Inadequate subsidy mechanism • Inefficient carbon market mechanism	• Develop a market study and feasibility study on the mechanisms to promote private sector initiatives (PPP, international support with loan guarantee and carbon market mechanism, customs preferences)
Legal and regulatory	• The technical regulation is not harmonized in the frames of the Eurasian Economic Union (EEU) countries. • Inadequate technical regulation, import duty	• Improve regulation on import duty • Harmonize regulation in the frames of the Eurasian Economic Union (EEU) countries, including s obligatory standards and certification.
Institutional and organizational	• Weak capacity of R&D institutions	• Organize several specific capacity building programs and

capacity		seminars for R&D, experts on best international practices
Information and awareness	• Inadequate access to information and poor dissemination	• Create national institution for regular review of cement market on an annual basis; BAT technologies
Other (A set of supplementary measures)	• Weak coordination between market actors	

Framework for ranking measures for inclusion as Actions in TAP (Step 2.2.) "1"- low, "2" -middle, "3"- high			
Measures to overcome barriers	**Considerations**	**Assessment**	**Ranking**
Using the mechanisms (PPP and carbon market mechanism	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• PPP mechanism is used by EBRD and Business for projects implementation in cement production in Kazakhstan • Carbon mechanism could be helpful • to gain additional profit from carbon credits • This measure duplicates the measure for Energy Efficiency in Cement Production and is omitted for the TAP here	2
Market Study on cement production industry including investigation of market size up to 2030 and most effective economic mechanisms for technology diffusion (transition from wet to dry method)	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Will help to make economic assessment, forecast demand to 2030 of transfer from wet to dry technology in cement production further diffusion • No interaction	3
Strengthen regulatory framework	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Will support the diffusion of technology Harmonization with EU standards and codes is recommended in the Strategic document "100 Steps". • Interacts with measures for the Energy Efficiency in Cement Production, but could be specific due to technical content of the measure itself	3

Implement Information Gathering and Sharing	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Promotion of environment friendly technology and diffusion • Interacts with measures for the Energy Efficiency in Cement Production, thus proposed only for this technology and is omitted for the previous one	3
Introduce pilot projects for diffusion of transition from wet to dry technology (at least 2 projects)	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Promotion of environment friendly technology and diffusion, GHG emissions reduction • Interacts with measures for the Energy Efficiency in Cement Production, but could be specific due to technical content of the measure itself	3
Organize several specific capacity building programs and seminars, webinars	Cost-effectiveness Efficiency Interactions with other measures Suitability within country/sector Benefits & costs	• Not to duplicated the activities planned already for energy saving in cement production here this measure is to be omitted	1

Final selection of measures to be included as actions in TAP (Step 2.2)

Categories	**Identified measures to overcome barriers**	**Measures selected as Actions for inclusion in TAP**
Economic and financial	• Using complex of mechanisms (subsidy, PPP, and carbon market mechanism) • Market Study on cement production industry including investigation of market size up to 2030 and most effective economic mechanisms for technology diffusion (report and economic assessment).	Strengthen implementation of market-based mechanisms
Legal and regulatory	• Improve regulation on import duty • Harmonize regulation in the frames of the Eurasian Economic Union (EEU) countries, including s obligatory	Improve legal and regulatory framework

	standards and certification. • Develop a roadmap – 2030 for	
Institutional and organizational capacity	• Organize several specific capacity building programs and seminars, webinars on BAT in cement production for engineers and for bankers for technology diffusion	
Information and awareness	• Adequate information access and dissemination of information on markets, costs, benefits of technologies by 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 (such as Ernst &Young)	Improve Information Gathering and Sharing
Other	• Develop at least 2 projects on the base of a Project Idea (Chapter 3) and implement	Support policy through implementing projects

Table 24. Summary of Actions, identification and description of specific Activities: Wet - to Dry Modernization

Table 4.6. (Step 2.3) Summary of Actions	
Action 1	Strengthen implementation of market-based mechanisms (PPP and carbon market mechanism)
Action 2	Improve legal and regulatory framework
Action 3	Improve Information Gathering and Sharing
Action 4	Support policy through implementing projects

Identification and description of specific Activities to support Actions

Action 1: Strengthen implementation of market-based mechanisms	
Activity 1.1	Carry out a Market Study on cement production industry including investigation of market size up to 2030 and evaluation of the most effective economic mechanisms for technology diffusion in Kazakhstan (report, economic assessment)
Activity 1.2	Organize a roundtable discussion on Market Study
Action 2: Improve legal and regulatory framework	
Activity 2.1	Develop a roadmap – 2030 for Wet-to Dry Modernization, including a list of projects
Activity 2.2	Harmonize regulation on certification, standards and codes per European Union (EU), the Eurasian Economic Union (EEU) countries and introduce standards, codes and certification
Activity 2.3	Organize and conduct meetings, roundtable discussions for approval measures of this Action
Action 3. Improve Information Gathering and Sharing	
Activity 3.1	Create a national institution for regular review of the cement market on an annual basis (such as Ernst &Young) This review could cover the economic analysis, market info, technical info, etc. for Kazakhstan and for Central Asia
Activity 3.2	Gather and share information on Best Available Technologies (BAT) in cement production through internet platform located at JSC "Institute for the Development of Electricity and Energy Saving"
Action 4. Support policy through implementing projects	
Activity 4.1	Develop pilot projects in cement production sub- sector, based on a Project Idea (Chapter 3), (at least 2 projects) and implement

Table 25. Planning of Activities for implementation of Actions – Wet - to Dry Modernization

Planning - characterization of activities for implementation of actions										
Action 1: Strengthen implementation of market-based mechanisms										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Start	Complete	Who	Capacity needs	Start	Complete	Who	Capacity needs	Costs	Who will fund
1.1 Carry out a Market Study on cement production industry including investigation of the market size up to 2030 and an evaluation of the most effective economic mechanisms for technology diffusion in Kazakhstan (report, economic assessment)	Feb'18	Apr'18	MID, TNA Committee, International organizations	Project management, Financing planning Technology deployment	Jan' 21	Nov' 21	MID, International organization	Project management, Financing Technology deployment	USD 80,000	Public Government and International TA
1.2. Conduct a workshop on Market Study	Feb'18	Apr'18	MID TNA Committee	Project management, Financing planning	Jan' 21	Nov' 21	MID, International organization, NGO	Project management, Financing	USD 50,000	Public Government and International TA
Action 2: Improve legal and regulatory framework										
Activities	**Planning**				**Implementation**			**Costs and funding needs**		
	Who	Capacity needs	Start	Who	Capacity needs	Start	Who	Capacity needs	Start	Who will fund
2.1. Develop a roadmap – 2030 for Wet-to Dry Modernization, including a list of projects	Jan'19	Nov'19	MID International: EBRD	Financing planning Project management	Jan' 20	Nov'20	MID International: EBRD	Project management Financing	USD 300,000	Public Government International TA
2.2. Harmonize regulation on certification, standards and codes per European Union (EU), the Eurasian Economic Union (EEU) countries and introduce standards, codes and certification	Aug'18	Sept' 18	MID EU or EEU Committee	Financing planning Project management	Oct' 18	Dec'25	MID Business of Countries EEU	Project management Financing	USD 300,000	Public Government International

2.3.Organize and conduct meetings, roundtable discussions for approval measures of this Action	Aug'19	Dec' 19	MID, TNA Committee, International organizations	Financing planning Project management Technology deployment	Oct' 18	Oct'24	MID, International organizations	Project management Financing Technology deployment	USD 150,000	Public International TA
Action 3: Improve Information Gathering and Sharing										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Who	Capacity needs	Start	Who	Capacity needs	Start	Who	Capacity needs	Costs	Who will fund
3.1. Create a national institution for regular review of the cement market on an annual basis (such as Ernst &Young) This review could cover the economic analysis, market info, technical info, etc. for Kazakhstan and for Central Asia	Feb'19	Sept' 19	MID, International organizations	Financing planning Project management	Oct' 19	Dec'22	MID, International organizations	Project management Financing	Public Government, International TA	Weak collaboration between stakeholders, Insufficient, state funds
3.2. Gather and share information on Best Available Technologies (BAT) in cement production through internet platform located at JSC "Institute for the Development of Electricity and Energy Saving"	Jan' 20	March' 20	MID R&D institutions. Business	Financing planning Project management	Apr 20	Dec'30	MID, R&D institutions. Business	Project management Financing	USD 80,000/year	Public International TA
Action 4. Support policy through implementing projects										
Activities	**Planning**				**Implementation**				**Costs and funding needs**	
	Who	Capacity needs	Start	Who	Capacity needs	Start	Who	Capacity needs	Costs	Who will fund
4.1.Develop pilot projects in cement production sub-sector, based on a Project Idea (Chapter 3), (at least 2 projects) and implement	Jan' 20	Dec'23	MID R&D institutions. Business	Financing planning Project management Business management Design engineering Technology deployment	Jan '24	Dec'30	MID, Business	Project management Financing Business management Engineering Technology diffusion	USD 128,400,000	Private Business International

Table 26. Overview of risks, possible contingencies, next steps: Wet - to Dry Modernization

Overview of risk categories and possible contingencies (Step 5)				
Type of risk	**Related to Action or Activity**	**Description of risk**	**Contingency actions**	
1.Cost Risks	All types of activities	An activity costs more than originally planned	**Time interval for M&E:**	Annually
			M&E responsibility:	MID, Business, International organizations, Banks
			Contingency measures needed:	To reserve the funds. The reserve is used to finance additional work, compensation for unforeseen changes in material and labor costs, overheads and other costs arising in the course of the project.
			Responsibility contingency measure:	Business
			Timing contingency measure:	0-5 years
2 Scheduling Risks	All types of activities	An activity takes longer to complete than originally planned	**Time interval for M&E:**	Annually
			M&E responsibility:	MID, Business, International organizations, Banks
			Contingency measures needed:	Identify critical path items, whose delay stalls all progress on an Activity.
			Responsibility contingency measure:	Unexpected risks and their consequences can be adequately spotted and handled.
			Timing contingency measure:	0-5 years
3 Performance Risks	All types of activities	A technology or human resource does not perform as planned or	**Time interval for M&E:**	Once 6 months
			M&E responsibility:	MID, Business, International organizations, Banks

		environmental and social benefits not being delivered	**Contingency measures needed:**	The distribution of risk involves risk sharing between project participants. The growth of the size and duration of investment, the introduction of new technologies, and the high dynamism of the external environment increase the risk of the project.
			Responsibility contingency measure:	Business
			Timing contingency measure:	0-5 years
Identify immediate requirements and next steps				
Immediate Requirements	Control of market from one side and improvement of coordination between stakeholders for promotion of the technology are important.			
Critical Steps	Legislation and supportive regulations on obligatory standards and certificates should harmonized with international standards to enable the incentives for technology diffusion.			

Table 27. Cost estimates for Activity 3.1 for the TAP on Small Hydropower (USD)

Staff / person	**Expected time (hours)**	**Costs / hour**	**total labour costs**	**travel costs**	**total**
Manager	120	100	12000	50	12050
Assistant	15	25	375	50	425
Expert	120	65	7800	50	7850
Consultants					
consultant1	120	40	4800	50	4850
Consultant 2	80	15	1200	50	1250
Total					***26425***

Meetings & Round Table	**Room/ equipment**	**Food /drinks**	**Accommodation**	**Travel cost**	**total**
Round Table 1 day /100 persons	789	2841	1136	4615	9381
Other Costs					
DSA (international &CIS)					6666
Unforeseen 10%					1605
total					***17652***

Total staff/person costs	26425
Meetings & other costs	17652
total preparation costs	**44077**

ANNEX 5. Supporting data: IFC oversight of expected CO_2 emissions from Caspi production base data and optimization evaluations (example)

IFC oversight of expected CO_2 emissions from Caspi Production base data and optimization evaluations		
	Value and unit	Data source:
Calcinations process	525 kg/t clinker	The Cement CO_2 Protocol, WBCSD working group Oct. 2001
Fuel firing	770 kcal/kg clinker = 3.22 GJ/t clinker	Design specifications for Caspi for ordinary Portland cement clinker
Electricity consumption	0.102 MWh/t cement 0.095 MWh/t cement 0.008 MWh/t cement	Design specification for Caspi plus 0,03 MWh/t due to slag incorporation, IFC expectation after optimization, and Add. not included under plant guarantee
Coal as fuel	96 t CO_2/ 1000 GJ	Based on WBCSD latest version
Electricity production	1157 kg CO_2 / MWh	WBCSD, CO_2 Accounting and Reporting Standards for the Cement Industry, June 2005. Kazakh national data
CO_2 emission from electricity	118 kg CO_2/ t cement 110 kg CO_2/ t cement 9 kg CO_2/ t cement	1157 kg CO_2/MWh * electr. consumpt. => Plant guarantee / IFC expect. optimization / add. not included under plant guarantee
Clinker percentage in cement (base data)		
	Value and unit	Data source:
Cement average blend	82% clinker	Caspi operational assumption with cement ration corridor planned to be 80-85% for M400 D20 (with 7% slag incorporation):

Fuel caused CO_2 emissions at Caspi (clinker based):		
Coal:	96 * 3.22 =	309 kg CO_2 / t clinker
Combined calcinations and fuel caused CO_2 emissions (clinker based):		
Coal	309 + 525 =	834 kg CO_2 / t clinker
Final emissions per unit cement, including electricity caused emission:		
Blends (clinker %): 0.82 initial 0.80 optimized electr.	 Initial: 0.82 *834+118 = Opt. elec. 0.8*834+110 =	 802 kg CO_2 / t cement 777 kg CO_2 / t cement +9 kg CO_2/ t cement outside guarantee for both.

Total CO_2 emissions based on average blended cement (80% clinker / 80% electricity optimized) and a total production of 0.80 M tons of cement per year:		
Coal	0.80 * 0.802 =	**641,400 tons CO_2 / year**
	0.80 * 0.777 =	**621,600 tons CO_2 / year**
Additional electricity outside guarantee:	**+0.80* 0.009 =**	**+7,200 tons 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.

Source: Microsoft Word – 20110421a CO2 emissions Caspi Cement.docx,
International Finance Corporation. World Bank Group. (2005, June). Retrieved from http://www.ifcext.ifc.org/.../CO2%20emissions%20estimate