WORLD BANK WORKSHOP ON CLIMATE RISKS AND VULNERABILITIES OF UZBEKISTAN'S ENERGY SECTOR




Workshop Report

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Overview

The energy sector is sensitive to changes in seasonal weather patterns and extremes, which can affect energy supply and demand, impact transmission capacity, disrupt oil and gas production, and impact the integrity of transmission pipelines and power distribution systems. As the climate changes, governments need to understand the inherent climatic sensitivities of their energy sectors and develop flexible adaptation strategies for existing and planned infrastructure.

The World Bank, together with the Government of Uzbekistan, is conducting an assignment in 2010 which aims to assess these issues, and thus support the development of climate-resilient energy sector policies and projects in Uzbekistan. As a first step, to build greater understanding of potential climate-related risks and opportunities, the World Bank, with the Government of Uzbekistan, held a workshop on March 24, 2010. The workshop brought together more than 100 of the key stakeholders in Uzbekistan's energy sector, including government ministries and agencies, utilities and corporations, private companies, expert consultants and university academics, as well as energy sector experts from the World Bank and other international organizations. A list of participants is provided in Annex A and the workshop agenda is shown in Annex B.

The workshop was opened by Loup Brefort, World Bank Country Manager and Jakhongir Turgunov, Cabinet of Ministers. A presentation by Dr Richenda Connell, Acclimatise, summarized the potential climatic changes that Uzbekistan may experience over coming decades, and highlighted some of the consequences for energy supply and demand, drawing on Uzbekistan's Second National Communication (SNC) under the United Nations Framework Convention on Climate Change (UNFCCC). Four parallel working groups then discussed the strengths, weaknesses, opportunities and threats ('SWOT') facing the energy sector:

- Strengths and weaknesses describes the current state of the energy sector, and its climatic vulnerabilities, sensitivities and critical climate-related performance thresholds,
- Opportunities and threats relate to the opportunities and risks for the energy sector from climate change.

The four working groups were organized as follows:

A. Oil, gas and coal exploration, production, transmission and distribution,
B. Thermal power generation and electricity transmission,
C. Hydropower generation and other forms of renewable energy generation,
D. Energy demand.

The participants in each working group are listed in Annex C.

The remainder of this report summarizes the key points raised in the working group discussions, presented as SWOT tables.

A copy of Richenda Connell's presentation is attached at Annex D.

Working Group A: Oil, gas and coal exploration, production, transmission and distribution

Brief overview of current context and future strategy

The oil and gas industry in Uzbekistan is more than 120 years old. There are 52 natural gas fields in Uzbekistan with 12 major deposits[a]. The industry is overseen by the Joint Stock Company, Uzbekneftegaz. This state organization manages and operates, with several subsidiary organizations, all oil and gas exploration, production, processing / refining and transmission in Uzbekistan. In recent years Uzbekistan has entered into discussions and agreements with foreign (primarily Russian and Chinese) oil and gas companies to develop exploration, production and refining[b].

Uzbekistan is self-sufficient in gas and currently exports approximately 30% of its gas production to Russia, Ukraine, Tajikistan, Kyrgyzstan and South Kazakhstan. Approximately 10% of the produced gas is transmitted to the Shurtan petro-chemical processing facilities for manufacture of ethylene and polyethylene. The remaining 60% of gas is for other industrial and domestic use. Future strategy is to increase the exportation of gas and associated products. This will be achieved through increased production in areas such as the northwest of Uzbekistan, as well as replacing / modifying some gas fired power plants to use coal in the future. In 2007, production of gas was 58.5 bcm (billion cubic meters), and consumption was 45.6 bcm (BP's Annual Statistical Report, 2009). The proven gas reserves are 1,744 bcm, indicating sufficient resources for the next 30 years at current consumption rates.

Gas is transmitted across Uzbekistan by pipeline. The transmission network consists of approximately 14,000 km of pipeline and the distribution system consists of approximately 2,000 km of pipeline.

Uzbekistan does not produce sufficient oil for its own market and is therefore partially reliant on importation. Its own oil supplies are principally light oil, though there is some heavy oil. Sulphur is present in some oil and is extracted at processing facilities. Uzbekistan refines and processes crude oil at three locations, including the Shurtan petro-chemicals facilities in the southwest of the country. In 2007, production of oil was 4.9×10^6 tonnes and consumption was 5.8×10^6 tones[c]. Proven reserves are 81×10^6 tonnes, indicating sufficient supply for 16 years at current production rates. Oil is transported across Uzbekistan by railway.

There are two principle areas of coal mining in Uzbekistan, Angren and Shargun. Angren is an open-cast mining facility with proven reserves of approximately 5bn tonnes. At present, production is approximately 3Mt/yr but it is intended that this will grow to 10Mt/yr, to support growing demand as Uzbekistan increases the amount of its coal-fired thermal power plant capacity, to reduce reliance on gas. Part of the strategy to meet this increased demand includes a US$120m modernization programme, which is currently underway. Shargun is an underground coal mine.

[a] www.uzbekneftegaz.uz
[b] www.uzbekneftegaz.uz
[c] BP's Annual Statistical Report, 2009

Summary SWOT analysis

Strengths	**Weaknesses**
'Shock-proof' design of facilities – designed to cope with earthquakes	Equipment and activities at oil and gas facilities temperature-sensitive, including: • Gas processing units (GPA), • Heat-exchange equipment, • Air cooling, • Cooling towers, • Gas pipelines, • Storage of oil products (losses), • Control devices, and • Staff.
Closed-cycle cooling systems use less water than open-cycle systems	Coal sector is vulnerable to: • Landslides, • Heavy precipitation events.
Drainage systems are well designed and can cope well with current rainfall events	Abnormally low temperatures require additional protection/insulation of sensitive equipment. (This should become less of a problem as temperatures increase).
High storage capacities provide reserves to cope with changes in demand and/or disruption to export routes	
Labor and industrial safety are high priority and facilities are used to dealing with harsh climatic conditions	
Early warning systems (from Uzhydromet-Uzbekneftegas-plant operations) provide plants with notice before storms or other climatic events occur, which could impact operation. This enables controlled shut-down.	
Opportunities	**Threats**
Cost saving due to decreased requirements for chemical reagent and fuel	Increases in groundwater levels (which could occur in some locations due to increased runoff) could cause increased heave / buoyancy of pipelines
New facilities are being installed (e.g. pipelines and booster stations) that could take account of climate change impacts if design codes/standards are modified to reflect future projected temperatures and so on.	Increase in soil salinity (due to increased evaporation) causing corrosion of pipelines
There are 2 CDM (Clean Development Mechanism) projects underway in relation to gas transmission and two more have been submitted. These may provide additional climate resilience, as well as mitigating emissions of greenhouse gases.	Hotter / drier conditions could increase erosion of soil undermining / exposing pipelines or other facilities

Revision of KMK-2.01.01-94 design standards could incorporate adaptation measures / updated information that takes account of climate change	Increase in frequency of equipment failures / emergency situations due to high temperature peaks
	Sand storms (*Afghanetz* wind) shutting down power supply and blocking filters (currently occurs several times per year in some places) may increase
	Increase in equipment failure frequency due to higher temperatures
	Shortage of water for technological processes would impact production and operation
	Fires could increase as average temperatures, and extreme high temperatures, increase. This would lead to increased frequency/duration of 'fire-readiness'/'Red' alerts, during which time more operators are required, and operation of production facilities may be impacted.
	Increased extremes of precipitation could leading to increased risks of landslides impacting pipelines
	Intensification of oil product evaporation in storage as average temperatures increase, leading to increased emissions to atmosphere and loss of product
	Increased exposure of people to harsh (hot) weather conditions as average temperatures increase.
	Increased demand for fuel from a growing population maybe exacerbated by increasing temperatures / climate change

It was not possible to complete the SWOT analysis for the coal sector during the workshop as relevant delegates were unable to participate throughout the whole workshop. This element will be followed up separately.

Top priority issues voted by group

1. Shortage of water for technical processes,
2. Increase in extreme weather conditions (heat – leading to increase in equipment failure, and precipitation – leading to landslides impacting pipelines),
3. Impact on workforce health and safety, due to increased average temperatures in summer and increased extremely hot weather,
4. Impact on gas processing units due to increased average and extreme temperatures,
5. Increase in equipment failure frequency due to increased average temperatures.

Working Group B: Thermal power plants and electricity transmission and distribution

Brief overview of current context and future strategy

The State Joint-Stock Company ‘Uzbekenergo’ is the managerial body with responsibility for power generation and transmission across Uzbekistan.

More than 90% of Uzbekistan’s installed power generation capacity is provided by 11 existing thermal power plants (TPP) with total installed capacity of 10.6GW. Two of them operate on coal (not all the time) and the remainder are natural-gas fired. Details are presented in the table below.

##	Name of HPP	Region	Installed capacity, MW	Number of units	Annual quantity of fuel used				Annual Output, GW h	Commission period
					natural gas, thou.m^3	RFO*, Mtonnes	coal, Mtonnes	gasified coal, thou.m^3		
1	Tashkent CHP	Tashkent	22.5	1	8,500.0				124.4	1954
2	Fergana CHP	Fergana valley	385	6	58,100.0	17.4			613.2	1956
3	Angren TPP	Tashkent	484	4		17.4	503.6	311,300.0	621.9	1957
4	Takhiatash TPP	Karakalpakstan	730	5	890,000.0	7.46			449.3	1961
5	Navoi TPP	Navoi	1250	7	2,033,600.0				2,636.1	1965-81
6	Tashkent TPP	Tashkent	1860	12	1,955,690.0	232.34			6,977.3	1963
7	Syrdarya TPP	Tashkent	2400	8	2,950,420.0	354.93			10,261.6	1972
8	Mubarek CHP	Kashkadarya	63	2	47,800.0				415.0	1985
9	Novo-Angren TPP	Tashkent	2100	7	1,300,000.0	22.1	2039.6		6,105.1	1985
10	Syrdarya TPP-7,8[1]	Tashkent	600	2	982,779.7	3.67			3,723.8	2002
11	Talimarjan TPP	Kashkadarya	800	1	1,336,930.0				4,953.3	2004
	TOTAL				11,563,819.7	655.3	2543.2	311,300.0	36,881.0	

* RFO - Residual Fuel Oil

**GC - gasified coal

[1]Units 7 and 8 of the Syrdarya TPP were upgraded in 2001-2002

(Source: www.mineconomy.uz/dna)

Uzbekenergo has a strategy in place for modernization and construction/expansion of power generation and transmission systems. The strategy includes projects that are underway or funded, projects at the feasibility stage that are awaiting funding and projects that are at the preliminary study stage. Overall, this programme is projected to increase the installed capacity of thermal power plants by 1240MW, and to decrease the fuel rate from 379 to 342g/KWh. As part of this programme, conversion of one of the existing power plants (Novo-Angren) to all-year burning of coal will increase coal consumption from 2Mt/yr to 6.8Mt/yr, and reduce gas consumption by 850Mm^3/yr.

The length of the existing electricity transmission and distribution system exceeds 238,500km (Uzbekenergo, 2009).

Summary SWOT analysis

Strengths	**Weaknesses**
Fossil fuel availability	High temperature of cooling water in hotter months leads to decreased efficiency
Fuel savings due to ongoing modernizations	Insufficient quantity of cooling water for some plants
Availability of skilled workforce	Age of assets
The sector is promoting the economic development of the country and providing employment	Emissions and discharges have negative impact on the environment
Large enterprises are sustaining communities and even new towns in their vicinities	Poor quality of cooling water (needs special treatment)
These facilities provide 50% of the power generation in Central Asia	High ash content coal
Geography – Uzbekistan's central location make it advantageous for transport/transit	Extreme events affect the transmission and distribution (T&D) system including frost, avalanches, wind, landslides, storms etc.
99% of the supply is centralized	Lack of diversification (i.e. burning mainly gas)
Availability of legal basis	Technical standards: There are Uzbek standards however they have to be counterchecked with the international standards.
United independent system	
Power systems 'ring'	
Opportunities	**Threats**
Implementation of new technologies and innovative ideas	Inconsistency of standards. Existing standards do not take account of climate change. Climate change may lead to new criteria being required and existing ones will be inconsistent with the changed conditions.
Power generation from renewable sources	Increase of electricity prime cost, mainly due to increased house loads (i.e. the plant's own consumption of energy) and decreased efficiency (higher temperatures of ambient air and cooling water).
Optimization of power plant work load due to decrease in peak demand in winter, as temperatures rise	Potential conflicts over water use between agriculture and energy sectors
Economy of fossil fuel due to use of renewable energy. Fuel saved will generate more income when sold on the international market.	Decreased output of TPP (gas and coal) due to increased temperatures.
Reduce impact on the environment	Increased deposits in cooling systems
Promote effective use of water resources	Reduction in reliability and quality of electricity supply
	Increased possibility for human error
	Change of criteria for selection of equipment
	Necessity for modification of equipment

	Increase technical losses from T&D system due to extreme events and heat
	Reduced productivity of workforce
	Increased house loads of plants
	Potential increase in tariffs[d] (due to electricity prime cost increase)
	Impact on mining and transportation of coal
	Full shut down of a plant due to unavailability of cooling water

Top priority issues voted by group

1. Implementation of new technologies and innovative ideas.
2. Power generation from renewable sources.
3. Optimization of power plant work load due to decrease in peak demand in winter, as temperatures rise.
4. Inconsistency of standards: Existing standards do not take account of climate change. Climate change may lead to new criteria being required and existing ones will be inconsistent with the changed conditions.
5. Increase of electricity prime cost, mainly due to increased house loads and decreased efficiency (higher temperatures of ambient air and cooling water).
6. Potential conflicts over water use between agriculture and energy sectors.

[d] In relation to the increase in the prime cost of electricity, three possible scenarios were identified and discussed during the workshop: 1. Increase in tariffs (this is the most logical one); 2. Keep tariffs low through use of governmental subsidies (i.e. the subsidies cover the plants for their losses but should come from some other source); 3. Even if the prime costs are increased, the plants continue to sell at the same price. This third scenario would lead to a loss of operating cash flows and therefore potentially to the inability to maintain and operate the plant properly. This is the worse scenario and its occurrence is considered unlikely. However, it is useful to consider it, because diminishing (or disappearance) of plant margins to the extent that plants work at a loss is dangerous for the whole system.

Working Group C: Hydropower generation and other forms of renewable energy generation

Brief overview of current context and future strategy

Uzbekistan currently has more than 30 hydropower plants (HPP) in operation, with installed capacities ranging from 2.4 to 620 MW. Some were built as long ago as the 1920s and are operating inefficiently. The largest, Charwak, on the Chirchik River, was constructed in the period 1963–1972. Currently, the level of power production from HPP is below the optimal level for the functioning of the energy system as a whole.

Uzbekistan's technically feasible hydropower potential has been estimated at about 27TWh, of which 23% has already been developed, and 3% is under construction. More than 120 sites have been proposed for development in the near future, 106 of which have been accessed as small hydropower plants (from 0.5 to 30MW).

Due to its sunny climate, Uzbekistan has enormous, unexploited potential for solar energy development, for both solar water heating and photovoltaics, estimated at 2 056 184 GWh. The country's wind power potential has also not been exploited, but there is currently a lack of information about all the locations that are suitable for its development. The production of biogas from waste from the livestock sector could also be a significant renewable energy resource for Uzbekistan and some biogas facilities are already in operation.

Uzbekistan does not currently have a law promoting renewables, though a renewables programme has recently been introduced for consideration by the Council of Ministers.

Summary SWOT analysis

Hydropower

Strengths	**Weaknesses**
Changes in seasonal river flows from glacial melt and snow melt are thought to be already leading to increases in river flows and HPP in some areas	Changes in seasonal river flows from glacial melt and snow melt are thought to be already leading to decreases in HPP in some areas
HPP can take peak load very quickly, as they can start up more rapidly than thermal power plants	Lack of methodologies for assessing risks to HPP from extreme climatic events
	HPPs working in irrigation mode provide water for farmers, and it is not always available for power production
	Run of river HPPs do not have any storage capacity to buffer variations in river flows
Opportunities	**Threats**
Less freezing over of rivers in winter will make operation of HPP easier and reduce risk of ice particles in the water which can stop turbines	Increased risk of extreme events which can damage facilities, including: • Risk of dam failure

from operating. This will lead to lower costs for heating the intakes of HPPs (currently done to melt ice particles in the water.)	• Mudflows / landslides • Floods • Dust storms • Wet avalanches in spring • Moraine lake formation and failure (as occurred in 1996 at Shakhimardan)
	Additional costs for cooling generators and transformers at HPP as temperatures rise
	More overflows from spillways may be needed to prevent flooding
	Increased mudflows or soil erosion could lead to increased siltation of reservoirs

Solar

Strengths	**Weaknesses**
Enormous potential for development of solar facilities (solar water heaters and photovoltaics)	High costs for solar systems at present and long payback periods. Payback periods are approximately 12 years according to EU cost recovery methods, unless systems are coupled with boilers, when the payback period is only 3 years.
Solar is a resource which is free of charge and inexhaustible	Cheapness of fossil fuels in Uzbekistan, which makes solar expensive by comparison
Solar facilities can be installed anywhere / universally in Uzbekistan	Lack of legal base promoting solar
	Maintenance is required to keep solar cells clean so they operate efficiently
Opportunities	**Threats**
Efficiency of heating elements in solar water heaters increases as temperatures rise	Increases in temperatures will decrease solar efficiency and causes degradation of solar cells
	Increases in dust storms in desert areas would lead to more dust coating solar cells and requiring them to be cleaned more frequently

Wind power

Strengths	**Weaknesses**
Wind power is cheap and payback periods are 10 times shorter than for solar	Lack of data on wind speeds measured at the correct height for wind turbines makes it difficult to assess best locations and designs for wind facilities
Easy to maintain	Lack of experience in wind energy in Uzbekistan
Wind energy can be used for pumping groundwater for agricultural irrigation	Wind turbines can be noisy
Opportunities	**Threats**

	Increased risk of sand storms would affect wind facilities
	Lack of knowledge of how climate change will affect wind speed and direction

Biomass / biogas

Strengths	**Weaknesses**
Biogas production from animal waste can provide energy to rural populations.	Climatic conditions in desert areas of Uzbekistan reduce the country's ability to produce biomass crops.
Biogas facilities have short payback periods	Biomass crops substitute production of food
Opportunities	**Threats**
	Livestock production may be affected by temperature increases and desertification (e.g. Astrakhan sheep) leading to less manure available for biogas production
	Production of biomass could be affected by climate change, e.g. increased desertification
	Biogas facilities require water for operation and reductions in water availability could affect them

Environmental and social performance

Strengths	**Weaknesses**
Absence of pollutant emissions from renewable energy facilities	
Biogas production generates 'ecologically sound' fertilizers which can improve land fertility and reduce pollution of groundwater compared to the application of untreated manure to land	
Hydropower facilities can start up rapidly to address peak loads	
Opportunities	**Threats**
Demand for heating energy will be reduced due to higher temperatures	

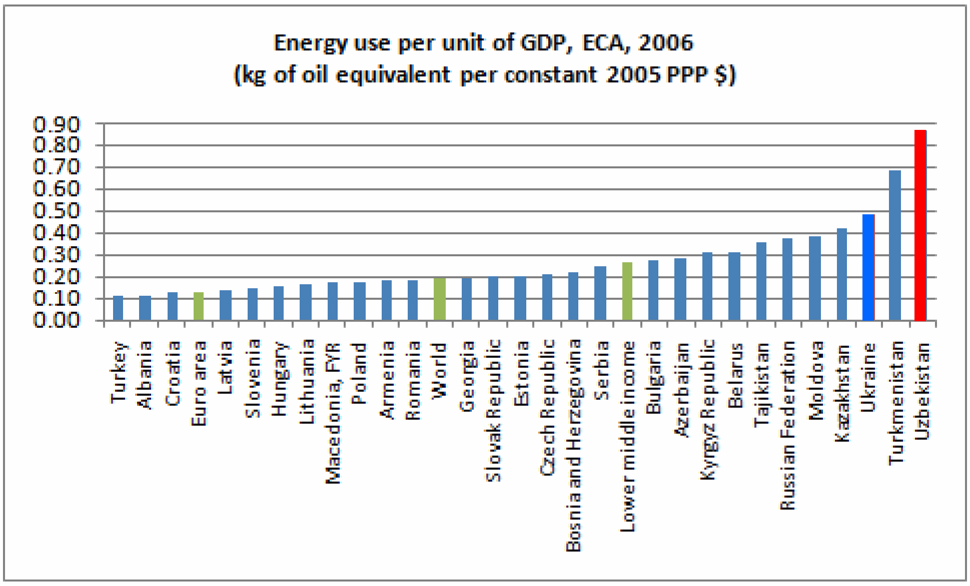
Top priority issues voted by group

1. Variations in river flows already affect HPP and climate change will increase uncertainties.
2. Renewables do not produce pollutant emissions. While climate change may lead to increased risks of pollution from some other forms of energy production, this will not be the case for renewables.
3. There is enormous unexploited potential for solar power generation in Uzbekistan.

Working Group D: Energy demand

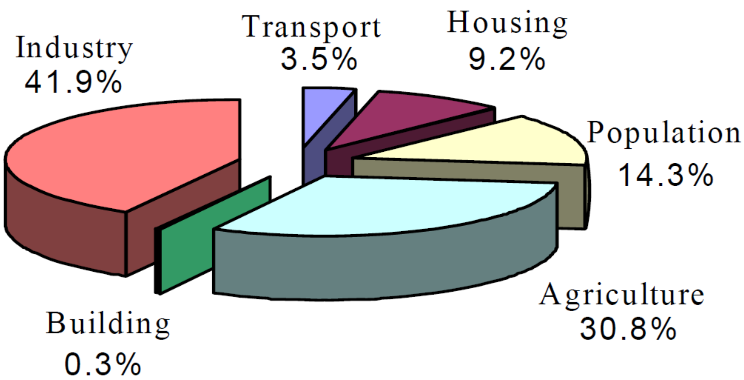
Brief overview of current context and future strategy

A key issue in relation to energy demand in Uzbekistan is the high energy intensity of the economy. Energy intensity is a measure of how much energy a country uses to produce a dollar of GDP. On average the Europe and Central Asia (ECA) region is five times more energy intensive than Western Europe (World Bank, 2008). Uzbekistan has the highest energy intensity of all countries in the ECA region (see figure below).



(Source: World Bank, 2008)

The primary users of electricity in Uzbekistan are industry, agriculture and the general population (see figure below). It is widely understood that population is forecast to grow in the future and industry will expand, both of which will impact energy demand. In the agriculture sector, current practices are very energy intensive (due to demand for pumped water for irrigation) and there are considerable opportunities for improvements in energy efficiency.



Power consumption in 2006 (Source: Uzhydromet, 2008)

Summary SWOT analysis

Industrial demand

Strengths	Weaknesses
	Energy consumption to keep equipment operational is temperature sensitive
	Deterioration of equipment is greater in hotter temperatures
	Increased water consumption in hotter weather
Opportunities	**Threats**
Modernization of technological processes and equipment could be designed to include climate change resilience	The weaknesses noted above will become more significant as average temperatures increase
Reconstruction of buildings and facilities could ensure energy efficiency	
Technological (processing) equipment should be consistent with climatic zones	
Personnel training in energy-efficiency techniques	
Improvement of regulatory and legal framework	
Reduced heat consumption for heating and technological processes due to increased temperature	

Energy sector demand

Strengths	Weaknesses
	Deteriorated performance capacity due to increased temperature and water shortage
	Infrastructure failures
	Increased use of reserve fuel
Opportunities	**Threats**
Duration of heating season may drop by about 8% by 2030 as average winter temperature rises	The weaknesses noted above would become more significant as temperatures increase
Use of renewable energy sources	Amounts of reserve fuel would need to be increased as extreme events become more pronounced
Modernization of thermal power stations (e.g. of gas turbines)	

Agricultural demand

Strengths	Weaknesses
Less energy is consumed by greenhouses in warmer winters	Rising temperatures in summer lead to increased energy consumption for irrigated crops due to increased evaporation
	Increased areas under risky agriculture
	Worsening hydrological regime (groundwater)
	Salination increasing
Opportunities	**Threats**
Reduced energy consumption in greenhouses in winter	Increase in energy consumption due rising temperatures
Introduction of up-to-date energy saving equipment	More areas become 'risky' for agriculture as climate change worsens
Water saving technologies (hydroponics and drip irrigation)	Increasing salination and worsening of hydrological regime as temperatures rise

Population demand

Strengths	Weaknesses
Reduced energy consumption by population during heating season	More energy is used for cooling in summer
Environmental literacy makes people save energy	Improved living standards result in increased consumption by population
	Energy supply system failures (mudflows, extreme weather events)
	Increased water use by population in summer results in increased energy consumption of water suppliers
	Migration of people
Opportunities	**Threats**
Duration of heating season may be reduced by about 8% by 2030	Increased energy used for cooling as average temperatures increase. Estimated increase of about 15% in use of energy for air conditioning, as hot periods increase in frequency.
Increasing environmental awareness will continue to increase energy saving	Increased water use and energy consumption as hotter and drier conditions occur
Modernization of distribution networks	
Decentralization of energy supply systems and use of renewable energy sources	Increased demand and strain on electricity transmission / distribution systems, as people migrate away from climatically unsuitable areas
Energy efficient housing	

Transport demand

Strengths	Weaknesses
	Use of fossil fuels in summer increases as temperature increases
	Increased use of fuel by aviation transport in summer
	Decreased efficiency coefficient of motor transport as temperature increases and thus increased use of fuel
	Increase in temperature in summer results in increasing depreciation of tires (more tire wear) and other parts
	Faster road wear due to climate change results in increased costs including energy consumption and road rehabilitation
Opportunities	**Threats**
Efficiency of cars may improve as less extreme cold and higher winter temperatures occur in the future	The weaknesses noted above all become more significant as average temperatures increase, and as extreme maxima increase.
Upgrading of vehicles to energy efficient cars	Road wear will increase if increased extreme rainfall, flooding and mudflows occur
Incentives to use energy efficient vehicles	
Updating of regulatory documents stipulating changed rates for fuel and lubricants	
Construction of roads with extended service life	
Use of fossil fuels in winter is reduced as temperature increases	

Top priority issues voted by group

1. Climate change impacts on water could result in a lack of power in Uzbekistan. Modernization of thermal power plants to increase their efficiency and reduce their consumption of fuel and water is essential.
2. Climate change could cause population migration from areas with extreme climatic conditions and this could mean that power is not being generated in the most efficient locations. Decentralization of the power system, including more renewables could help address this.
3. More energy will be required for pumping water for agricultural consumption, so rehabilitation of pumping stations and improvements in their efficiency is very important. The same applies to other industries which have inefficient equipment.

Annex A: Workshop participants

Name	Position	Organisation
Mr. B. Abdurakhmanov	1st Vice-Chairman	JSC "Uzbekenergo"
Mr. R. Artikov	Head of Perspective Development Department	JSC "Uzbekenergo"
Ms. S. Maksudova		JSC “Uzbekenergo”
Mr. E. Faizullaev	Head	National Dispatch Center of JSC "Uzbekenergo"
Mr. D. Isakulov	Chief Engineer	Unitary Enterprise "Uzelectroset"
Mr. M. Samatov	Director	Unitary Enterprise "Tashkent TPS"
Mr. O. Yatsenkin	Head of Production and Technology Unit	Unitary Enterprise "Tashkent TPS"
Mr. B. Serikbaev	PIU Head	Unitary Enterprise "Tashkent TPS"
Mr. K. Alimov	Chief Specialist	Unitary Enterprise "Tashkent TPS"
Ms. M. Muminova	Environmental Specialist	Unitary Enterprise "Talimarjan TPS"
Mr. A. Normuminov	Deputy Chief Engineer	Unitary Enterprise "Talimarjan TPS"
Mr. B. Mukhammadiev	Deputy Director	Unitary Enterprise "Talimarjan TPS"
Mr. A. Khamidov	Specialist	JSC "ORGRES"
Mr. S. Shaismatov	Director	JSC "Teploelectroproject"
Ms. T. Baymatova	Technical Director	JSC "Teploelectroproject"
Mr. R. Dovletov	Project Chief Engineer	JSC "Teploelectroproject"
Mr. R. Mansurov	Chief Specialist, Ecological Department	JSC "Teploelectroproject"
Mr. A. Sharipov	Engineer	JSC "Teploelectroproject"
Mr. D. Tertyshnikov	Project Chief Engineer	JSC "Teploelectroproject"
Ms. A. Drobova	Project Chief Engineer	JSC "SredazEnergosetproject"
Ms. I. Rapoport	Project Chief Engineer	JSC "SredazEnergosetproject"
Mr. T. Salikhov	Director	Institute of Energy and Automation under the Academy of Science
Ms. N. Agaltseva	Senior Staff Scientist of Hydrometeorology Research Institute	Uzhydromet
Mr. B. Kadirov		Uzhydromet
Mr. N. Nihei	Project Coordinator	JICA
Mr. D. Turgunov	Chief Specialist of Fuel & Energy Department	Cabinet of Ministers
Mr. J. Umurzakov	Head of Unit for Monitoring of Industrial Complex Projects, F&E, and IT	MFERIT
Mr. Khodjaev	Chief Specialist, Main Department for Ecological Expertise	State Committee for Nature Protection

Mr. A. Shabanov	Chief Specialist, Department for Control over the Atmosphere	State Committee for Nature Protection
Mr. N. Babaev	Chief Specialist of Expert Group	Uzbek Fund for Reconstructiona and Development
Mr. A. Nimatullaev	Head	State Inspection over Power Consumption "Uzgosenergonadzor"
Mr. B. Tashpulatov	Deputy Head	State Inspection over Power Consumption "Uzgosenergonadzor"
Mr. A. Yunusov	Department Head	State Inspection over Power Consumption "Uzgosenergonadzor"
Mr. D. Akramov	Chief Engineer	Uzenergosozlash
Mr. I. Gafur	Director	JSC “Uzgelioqurilish”
Mr. E. Makhkamov	Chief Engineer	Uzsuvenergo
Mr. I. Lutfullaev	Chief Specialist	Uzsuvenergo
Mr. M. Beilinson	Department Head	JSC "Hydroproject"
Ms. G. Sokolovskaya	Head of Hydrology Sector	JSC "Hydroproject"
Mr. A. Morozov	Chief Specialist	JSC "Hydroproject"
Mr. V. Tsoy	Chief Specialist	JSC "Hydroproject"
Mr. D. Rozubaev	Chief Engineer	Unitary Enterprise "N-Bozsu Hydropower Cascade"
Mr. E. Jumagulov	Chief Engineer	Unitary Enterprise "Kadiriya Hydropower Cascade"
Mr. I. Shepovalov	Hydraulic engineer	Unitary Enterprize “Tashkent series of hydroelectric power plants”
Mr. N. Yusupov	Deputy Head of Hydroengineering Service	JSC "Energosozlash"
Mr. Sh. Aripov	Chief Specialist of Hydroengineering Service	JSC "Energosozlash"
Mr. R. Begmatov	Head, Undeground water resources unit	State Comittee on Geology and Mineral Resources
Mr. A. Mavlonov	Director	State Enterprise "Institute of Hydrogeology and Engineering Geology"
Mr. T. Mavlanov	Head of unit	State Enterprise "Institute of Hydrogeology and Engineering Geology"
Mr. S. Miagkov	Deputy Director General of Hydrometeorology Research Institute	Uzhydromet
Mr. A. Yakovlev	Acting Head, Hydrometeorological Support Service	Uzhydromet
Mr. G. Trofimov	Professor of Land Hydrology Department of Geography Faculty	National University of Uzbekistan
Mr. U. Buranov	Director	GEF Agency, IFAS

Mr. A. Abdurakhmanov	Head of Environment Energy Unit	UNDP, Uzbekistan
Mr. Y. Lambert	Climate Change Specialist	UNDP, Uzbekistan
Mr. B. Mukhamadiev	Environment Protection Specialist	US Resident Mission in Uzbekistan
Mr. A. Kalashnikov	Project specialist	USAID
Mr. Gapparov		SIC ICWC
Mr. R. Murzakhanov	Expert	NGO "ARMON"
Mr. U. Egamberdiev	Chief Specialist of Fuel & Energy Department	Cabinet of Ministers
Mr. B. Muradov	Chief Specialist	Ministry of Economy
Mr. A. Sagaydachniy	Deputy Director General	JSC "Uzneftegazdobicha"
Mr. Y. Giyasov	Head of Department for Oil and Gaz Production	JSC "Uzneftegazdobicha"
Mr. V. Lee	Chief power engineering specialist	JSC "Uzneftegazdobicha"
Mr. A. Dusaev	Chief production engineer	Unitary Enterprise "Mubarekneftegaz"
Mr. R. Radjabov	Chief production engineer	Unitary Enterprise "Shurtanneftegaz"
Mr. B. Eshmuradov	Acting First Deputy Director General	JSC "Uztransgas"
Mr. A. Frits	Head of Dispatch Service	JSC "Uztransgas"
Mr. R. Lee	Head of Department for Gaz Transfer	Design Institute "UzLITIneftegas"
Mr. T. Nevzorova	Project Chief Engineer	Design Institute "UzLITIneftegas"
Mr. Umarov		JSC "UzbekCoal"
Ms. T. Spectormant	Head of Unit for transboundary monitoring of environment pollution of Pollution Momitoring Service	Uzhydromet
Ms. L. Zavyalova	Project Manager	UNDP, Uzbekistan
Mr. B. Ganikhodjaev	Deputy Director, Head of Expert Group	Uzbek Fund for Reconstructiona and Development
Mr. Sh. Makhmudov	Head	“Uzbekneftegazinspectsiya” (Uzbek State Inspection over Oil and Gaz Consumption under the Cabinet of Ministers)
Mr. K. Juraev	Chief power engineering specialist	JSC "UzBuildingMaterials"
Mr. A. Azimov	Chief power engineering specialist	JSC "Kizilkumcement"
Mr. D. Gumerov		JSC "Navoi Mning and Smelting Plant"
Mr. B. Abzalov	Head of Department for Pumping Stations Operation	Ministry of Agriculture and Water Resources", Department for Pumping Stations Operation

Mr. R. Abdullin	Chief Engineer	TashTeploEnergo
Mr. L. Skripnikova	Head of Unit of Economic Branches Hydrometeorological Support of Hydrometeorological Support Service	Uzhydromet
Mr. N. Abidjanov	Director, Center of Expertise and Cleaner Production (UNIDO Project)	Chamber of Commerce and Industry
Mr. P. Antheunissens	Coordinator	Europe House
Mr. L. Tashkhodjaeva	Operations Manager	Europe House
Ms. Miralieva	Expert	NGO "ARMON"
Mr. I. Tilokhodjaev	Chief Specialist, Fuel and Energy Sector Department	Ministry of Economy
Mr. N. Makhmudov	Deputy Head	“Uzbekneftegazinspectsiya” (Uzbek State Inspection over Oil and Gaz Consumption under the Cabinet of Ministers)
Ms. N. Shevaldova	Deputy Chief Editor	Economicheskiy Vestnik Uzbekistana
Mr. L. Brefort	Country Manager	World Bank
Mr. I. Buranov	Operations Officer, Energy & Infrastructure	World Bank
Mr. S. Croxton	Senior Natural Resources Specialist, Central Asia Region	World Bank
Mr. S.Arch	Senior EcoNomics Analyst	WorleyParsons
Mr. I. Mirchev	Projects Budget and Cost Controller	WorleyParsons
Ms. R.Connell	Chief Technical Officer & Co-founder	Acclimatise

Annex B: Workshop Agenda

Time	Item	Who
8.00 – 8.45	Registration, coffee and refreshments	
9.00 – 10.15	**Plenary session**	
9.00 – 9.10	Welcome and workshop objectives	Loup J. Brefort, World Bank
9.10 – 9.20	Opening remarks	Jakhongir Turgunov, Cabinet of Ministers
9.20 – 9.50	Briefing: • Overview of World Bank assignment • Aims of today's workshop • Climate variability, climate change and vulnerabilities of Uzbekistan's energy sector • Questions to discuss in working groups	Dr Richenda Connell, Acclimatise
9.50 – 10.00	Video: Climate Change Risks & Vulnerability of Energy Sector in Albania	
10.00 – 10.15	Question & answer session	All
10.25 – 10.45	Break	
10.45 – 12.30	**Workshop session 1**	
10.45 – 11.15	Four parallel working groups discuss overall strategies and objectives for Uzbekistan's energy sector: • Oil, gas and coal exploration, production, transmission and distribution • Energy demand • Thermal power generation and electricity transmission • Hydropower generation and other forms of renewable energy generation: solar, wind etc	All
11.15 – 12.30	Four working groups discuss climatic vulnerabilities, sensitivities & critical performance thresholds of existing & planned energy sector assets: • How do climatic conditions currently affect Uzbekistan's energy sector? • What are the effects of current climatic variability?	All
12.30 – 13.30	Lunch	
13.30 – 15.30	**Workshop session 2**	All
13.30 – 15.00	Working groups discuss climate change risks: • How could climate change affect the performance of energy sector assets?	

Time	Item	Who
	• If extreme climate events occur more frequently / more severely, what impacts could occur? • What are the effects of changes in average climatic conditions? • Could critical thresholds be exceeded due to climate change?	
15.00 – 15.30	Working groups agree on priority climate-related risks for report back to plenary session	All
15.30 – 16.00	Break	
16.00 – 17.00	**Plenary session**	
16.00 – 16.45	• Brief feedback from working groups • Final plenary discussion	All
16.45 – 17.00	Next steps, thanks and close of workshop	Simon Croxton, World Bank

Annex C: Working Group Participants

Group A. Oil, gas and coal exploration, production, transmission and distribution

Name	Organization
Ms. T. Spectorman	Uzhydromet
Mr. O. Makhmudov	Uzgostroy (State Construction Organization)
Ms. T. I Nevzorova	JSC “UzLITIneftegaz”
Mr. R. Lee	JSC “UzLITIneftegaz”
Mr. N. Makhmudov	“Uzgosneftegazinspectsiya” (State Inspection over oil products and gas consumption)
Mr. R. Mannonov	“Uzgosneftegazinspectsiya” (State Inspection over oil products and gas consumption)
Mr. R. Rajabov	Unitary Enterprize “Shurtanneftegaz”
Mr. A. Dusaev	Unitary Enterprize “Mubarekneftegaz”
Mr. V. Lee	JSC “Uzneftegazdobicha”
Mr. Y. Giyasov	JSC “Uzneftegazdobicha”
Mr. A. Fritz	JSC “Uztransgaz”
Mr. N. Umarov	JSC “Uzbekugol”
Mr. A. Arslanov	“Sof Energiya” LLC
Ms. I. Kondratieva	Workshop translator
Mr. S. Arch	Workshop facilitator, WorleyParsons

Group B. Thermal power generation and electricity transmission

Name	Organization
Mr. T. Salikhov	Director, Institute of Energy and Automation under the Academy of Science
Mr. M. Samatov	Director, Unitary Enterprise "Tashkent TPS" under JSC “Uzbekenergo”
Mr. O. Ertsenkin	Head of Production and Technology Unit , Unitary Enterprise "Tashkent TPS" under JSC “Uzbekenergo”
Mr. R. Dovletov	Chief Project Engineer, JSC "Teploelectroproject"
Mr. B. Serikbaev	PIU Head, Unitary Enterprise "Tashkent TPS"
Mr. K. Alimov	Chief Specialist, Unitary Enterprise "Tashkent TPS"
Mr. A. Reznik	National Dispatch Center of JSC "Uzbekenergo"
Ms. A. Drobova	Project Chief Engineer, JSC "SredazEnergosetproject"
Ms. I. Rapoport	Project Chief Engineer, JSC "SredazEnergosetproject"
Mr. A. Normuminov	Deputy Chief Engineer, Unitary Enterprise "Talimarjan TPS"
Mr. D. Isakulov	Chief Engineer, Unitary Enterprise "Uzelectroset" (Operator of the High voltage power transmission lines)
Mr. B. Mukhammadiev	Deputy Director, Unitary Enterprise "Talimarjan TPS"
Ms. N. Agaltseva	Senior Staff Scientist of Hydrometeorology Research Institute, Uzhydromet
Mr. R. Artikov	Head of Perspective Development Department, JSC "Uzbekenergo"
Ms. M. Muminova	Environmental Specialist, Unitary Enterprise "Talimarjan TPS"
Mr. D. Akramov	Chief Engineer, “Uzenergosozlash”

Ms. S. Maksudova	JSC "Uzbekenergo"
Mr. A. Yunusov	Department Head, State Inspection over Power Consumption "Uzgosenergonadzor"
Mr. A. Shabanov	Chief Specialist, Department for Control over the Atmosphere, State Committee for Nature Protection
Mr. A. Khamidov	Specialist, JSC "ORGRES"
Mr. B. Tashpulatov	Deputy Head, State Inspection over Power Consumption "Uzgosenergonadzor"
Mr. R. Mansurov	Chief Specialist, Ecological Department, JSC "Teploelectroproject"
Mr. A. Sharipov	Engineer, JSC "Teploelectroproject"
Mr. Sh. Abdinabiev	Workshop translator
Mr. Ivaylo Mirchev	Workshop facilitator, WorleyParsons

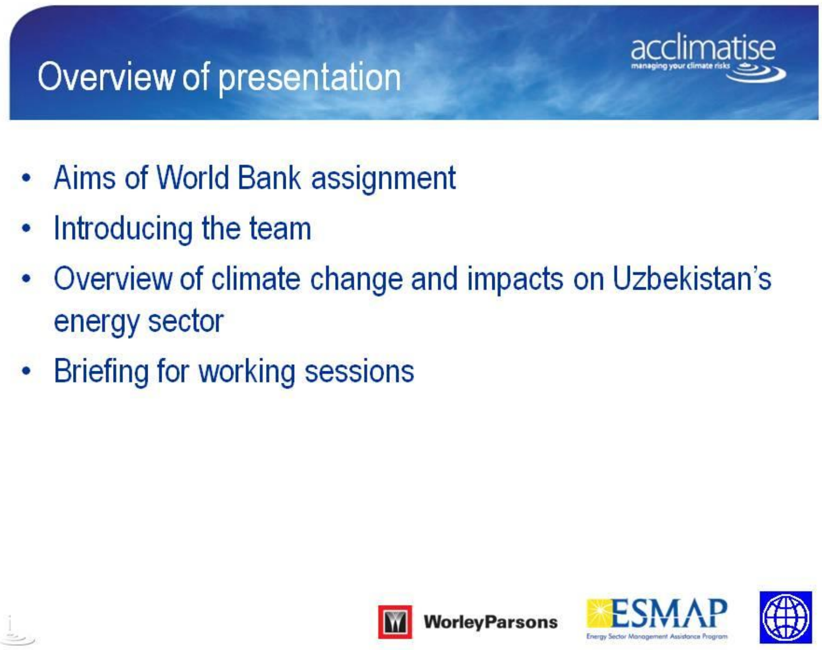
Group C. Hydropower generation and other forms of renewable energy generation

Name	Organization
Mr. M. Khodjaev	Director, Scientific Center "Eco-Energiya" under the State Committee for Nature Protection
Mr. A. Kalashnikov	Project Manager, USAID
Mr. O. Basov	Expert for energy and commercial sectors, UNDP
Mr. B. Muradov	Chief Specialist, Ministry of Economy
Mr. I. Shepovalov	Hydraulic engineer, Unitary Enterprize "Tashkent series of hydroelectric power plants"
Mr. G. Trofimov	Professor, National University of Uzbekistan
Mr. H. Marufkhodjaev	"Uzsuvenergo"
Mr. D. Rozubaev	"Lower Bozsu River series of hydroelectric power plants"
Mr. E. Djumagulov	" Kadiri series of hydroelectric power plants"
Ms. G. Sokolovskaya	JSC "Hydroproject"
Mr. E. Mahkamov	"Uzsuvenergo"
Ms. L. Tsoy	Agency for Technology Transfer under the Ministry of Economy
Mr. G. Ikramov	"Qurilishgelioservice" LTD.
Mr. M. Beilinson	JSC "Hydroproject"
Mr. V.Tsoy	JSC "Hydroproject"
Mr. A. Morozov	JSC "Hydroproject"
Mr. R. Murzakhanov	"Armon" Ecological Law Center
Ms. I. Tsoy	Workshop translator, World Bank
Dr. R. Connell	Workshop facilitator, Acclimatise

Group D. Energy demand

Name	Organization
Mr. K. Juraev	Chief power engineering specialist, JSC “UzBuildingMaterials”
Mr. A. Azimov	Chief power engineering specialist, JSC “Kizilkumcement”
Mr. D. Gumerov	Chief power engineering specialist, JSC “Navoi Mining and Smelting Plant”
Mr. B. Abzalov	Head of Department for Pumping Stations Operation, Ministry of Agriculture and Water Resources
Mr. R. Abdullin	Chief Engineer, TashTeploEnergo
Ms. L. Skripnikova	Head of Unit of Economic Branches Hydrometeorological Support of Hydrometeorological Support Service, Uzhydromet
Mr. N. Abidjanov	Director, Center of Expertise and Cleaner Production (UNIDO Project), Chamber of Commerce and Industry
Mr. L.Tashkhodjaeva	Europe House
Mr. P. Antheunissens	Europe House
Ms. Miralieva	Specialist, NGO "ARMON"
Mr. I. Tilokhodjaev	Chief Specialist, Fuel and Energy Sector Department, Ministry of Economy
Mr. N. Makhmudov	Deputy Head, “Uzbekneftegazinspectsiya” (Uzbek State Inspection over Oil and Gaz Consumption under the Cabinet of Ministers)
Ms. V. Eolian	Workshop translator
Mr. S. Croxton	Workshop facilitator, World Bank

Annex D: Plenary presentation by Dr Richenda Connell, Acclimatise



Aims of World Bank assignment

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- Overall aims: support development of **climate-resilient energy sector** policies and projects
- Today: discuss **climate vulnerabilities and risks** of energy sector
- Next: consultants develop **risk assessment**
- Second workshop (April 2010): discuss **priorities for climate change adaptation**

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Risk assessment

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Risk = (probability of hazard) x (magnitude of consequence)

Likelihood			Consequence: Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
A	Almost Certain	95%	16		6	3 4 7	1 2
B	Likely	80%	19	15	10 11 12 13 14	5	
C	Moderate	50%		18	8 9		
D	Unlikely	20%			17		
E	Rare	5%		20			

Risk Code No.	Description of risk	Magnitude of risk before adaptation	Asset class affected
1	Higher peak demand in summer due to higher temperatures could lead to lack of capacity	Extreme	All
2	Less summer electricity generation from hydropower facilities due to reduced precipitation and run-off could reduce energy security	Extreme	LHPP / SHPP
3	EU Carbon trading schemes add cost to thermal power generation	Extreme	TPP
4	Changes in seasonality of river flows (including more rapid snowmelt due to higher winter temperatures) combined with mis-management of water resources could decrease the operating time for SHPPs, resulting in decreased production	Extreme	SHPP
5	Increased CAPEX / OPEX due to climate change could lead to reduced shareholder value	Extreme	All
6	Higher peak summer demand across the region could increase import prices and reduce supply	Extreme	All
7	Paucity of hydro-met data makes it difficult to manage water resources and optimise operation of hydropower plants	Extreme	LHPP / SHPP
8	Sea level rise could lead to increased coastal erosion potentially affecting coastal infrastructure including ports for oil export and TPP	High	Oil Production & TPP

Acclimatise

acclimatise
managing your climate risks

- Acclimatise helps governments and businesses manage climate risks and opportunities by:
  - Bridging the gap between climate science and decision-making
  - Understanding climate change impacts
  - Assessing financial implications
  - Advising on strategies to manage risks and uncertainties and develop business opportunities

WorleyParsons ESMAP Energy Sector Management Assistance Program

WorleyParsons

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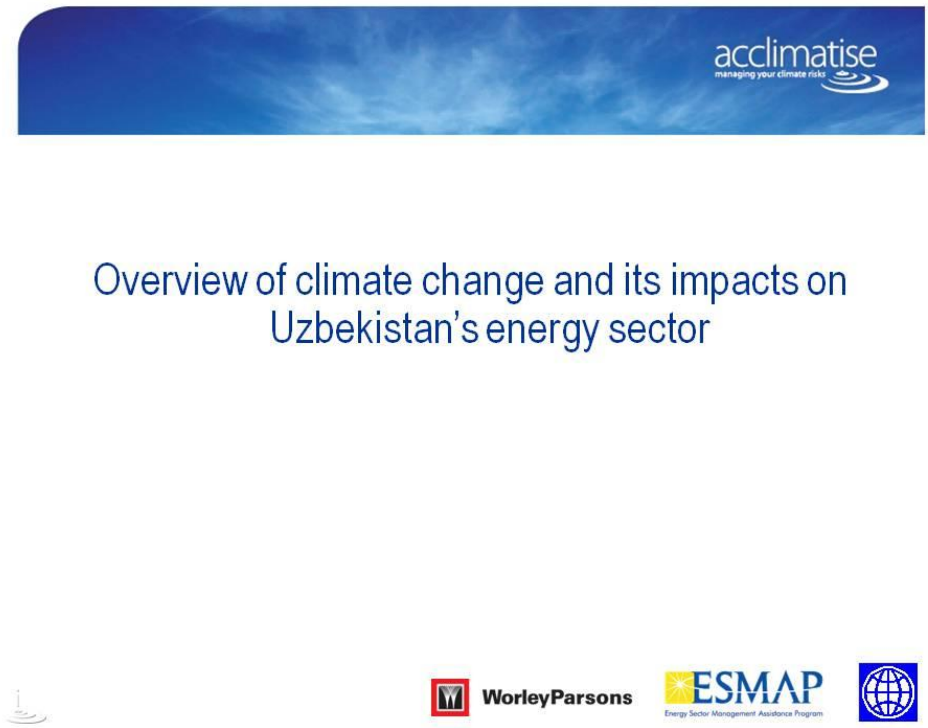
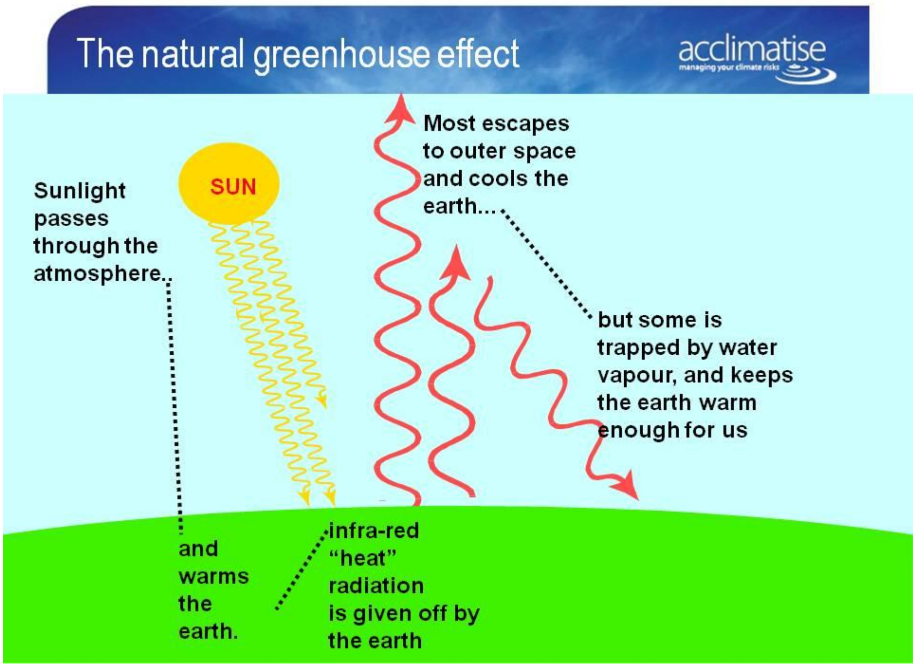
WorleyParsons – leading provider of professional services to resource & energy sectors & complex process industries

Infrastructure & Environment	Power
Hydrocarbons	Minerals & Metals

EcoNomics™

WorleyParsons ESMAP Energy Sector Management Assistance Program


acclimatise
managing your climate risks
Overview of climate change and its impacts on Uzbekistan's energy sector
WorleyParsons
ESMAP
Energy Sector Management Assistance Program


The natural greenhouse effect
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SUN
Sunlight passes through the atmosphere…
and warms the earth.
infra-red "heat" radiation is given off by the earth
Most escapes to outer space and cools the earth…
but some is trapped by water vapour, and keeps the earth warm enough for us

The enhanced greenhouse effect

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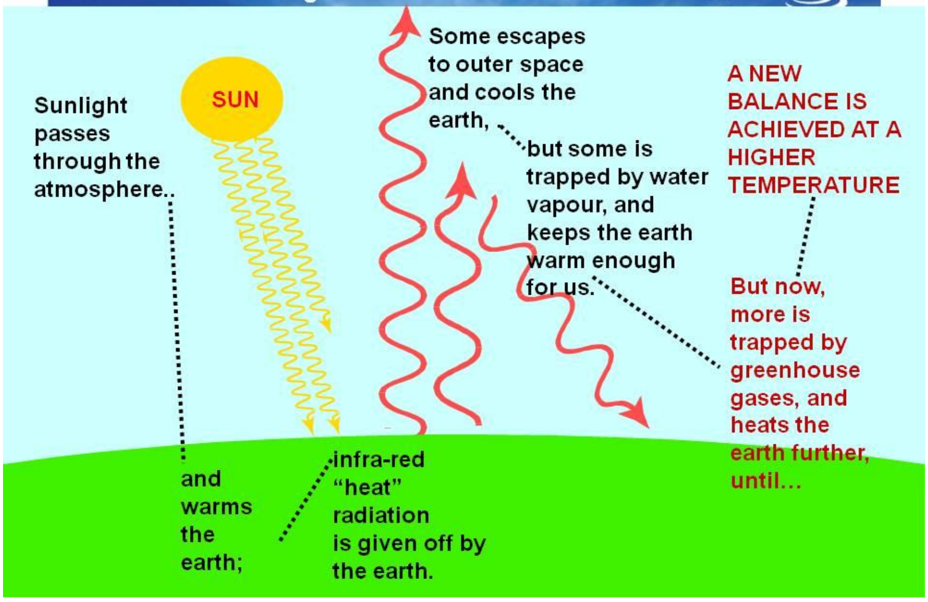

Carbon dioxide levels are rising fast

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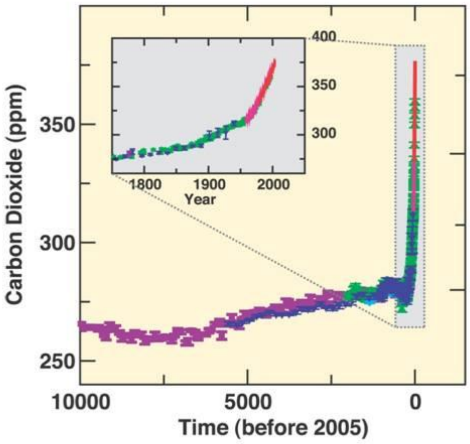
- Carbon dioxide concentrations – higher now than for 650,000 years
- Man-made emissions have increased [CO_2] by 1/3
- By 2050, concentrations expected to be 2x pre-industrial levels



[Source: IPCC]

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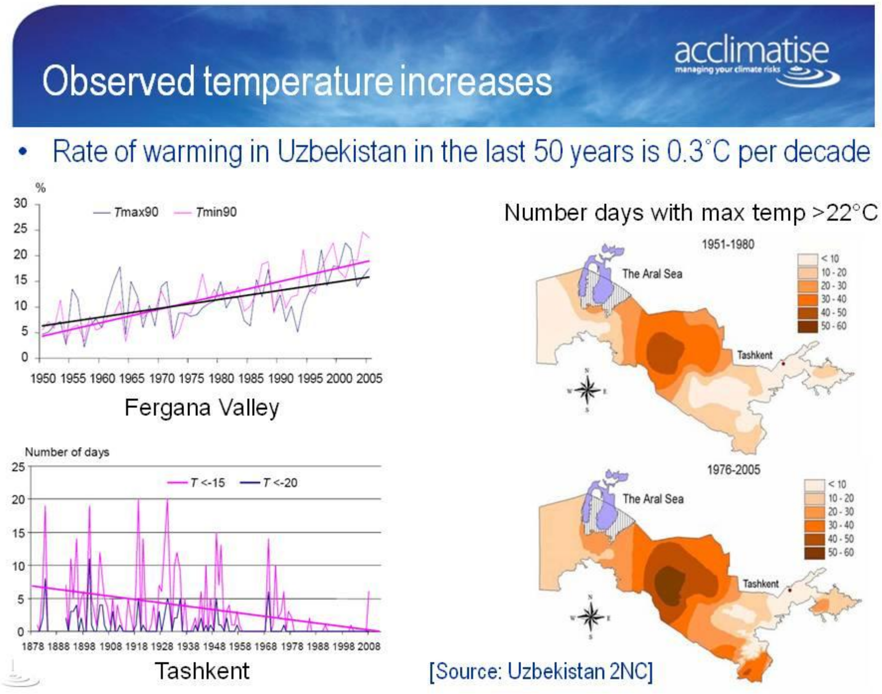
Observed temperature increases
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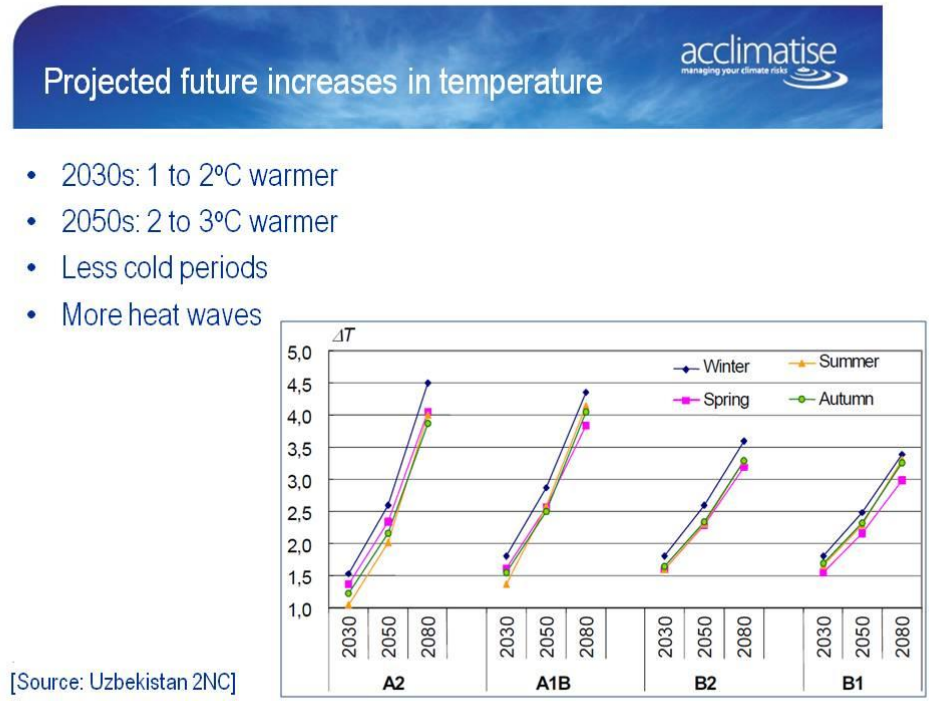
• Rate of warming in Uzbekistan in the last 50 years is 0.3˚C per decade
%
Tmax90
Tmin90
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005
Fergana Valley
Number of days
T <-15
T <-20
1878 1888 1898 1908 1918 1928 1938 1948 1958 1968 1978 1988 1998 2008
Tashkent
Number days with max temp >22°C
1951-1980
The Aral Sea
Tashkent
< 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
1976-2005
The Aral Sea
Tashkent
[Source: Uzbekistan 2NC]


Projected future increases in temperature
acclimatise
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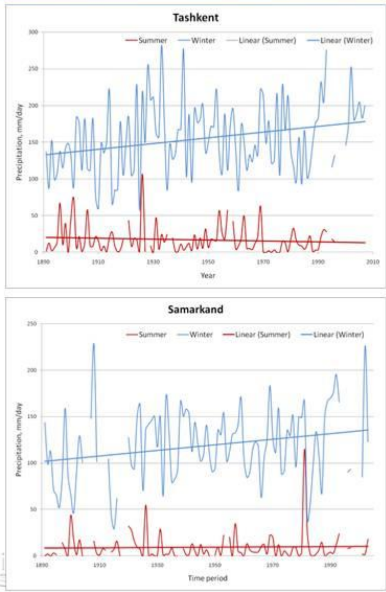
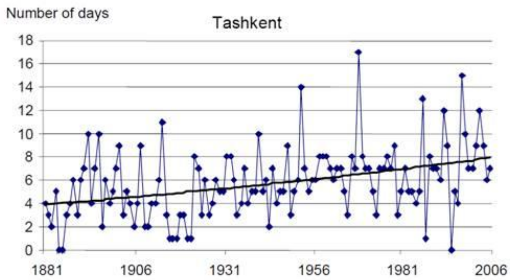
• 2030s: 1 to 2ºC warmer
• 2050s: 2 to 3ºC warmer
• Less cold periods
• More heat waves
ΔT
Winter
Summer
Spring
Autumn
2030 2050 2080
A2
A1B
B2
B1
[Source: Uzbekistan 2NC]

Observed changes in precipitation



- Increased winter precipitation
- Decreased summer precipitation
- Increased precipitation intensity

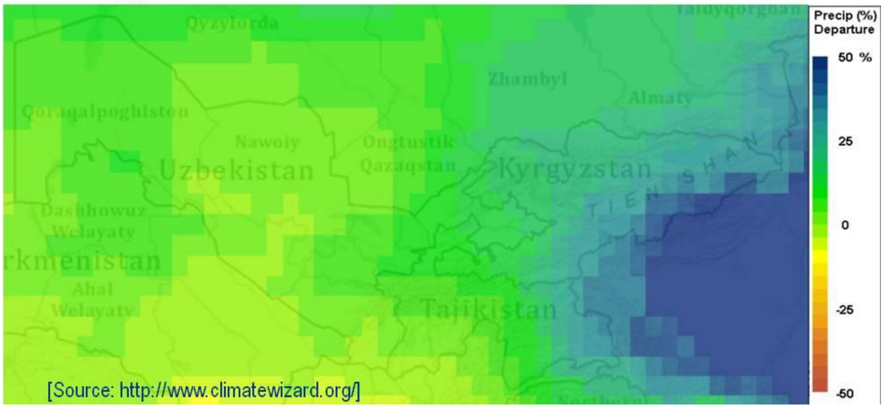


Number of days with precipitation >15mm

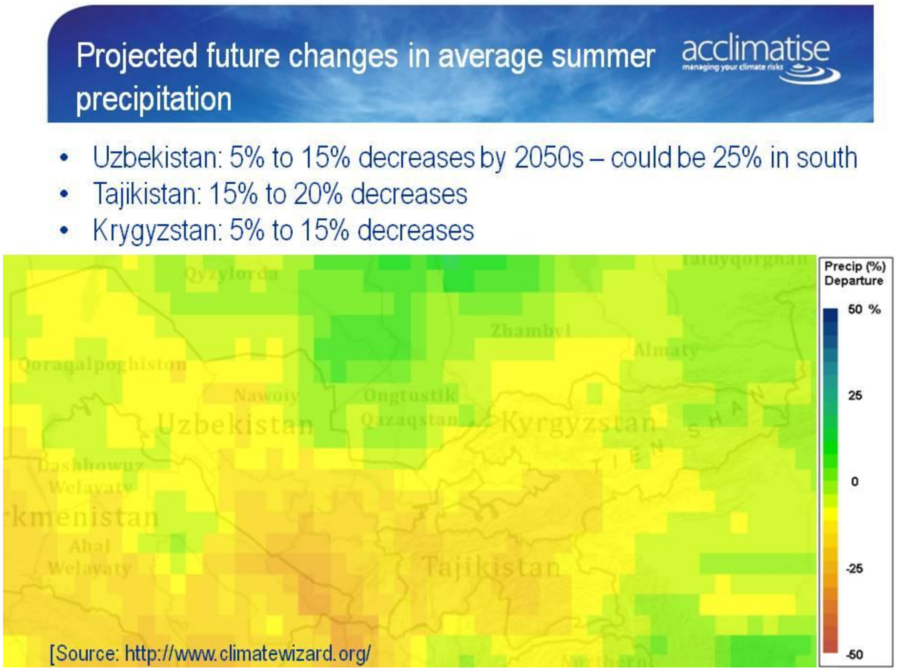
[Source: KNMI & Uzbekistan 2NC]

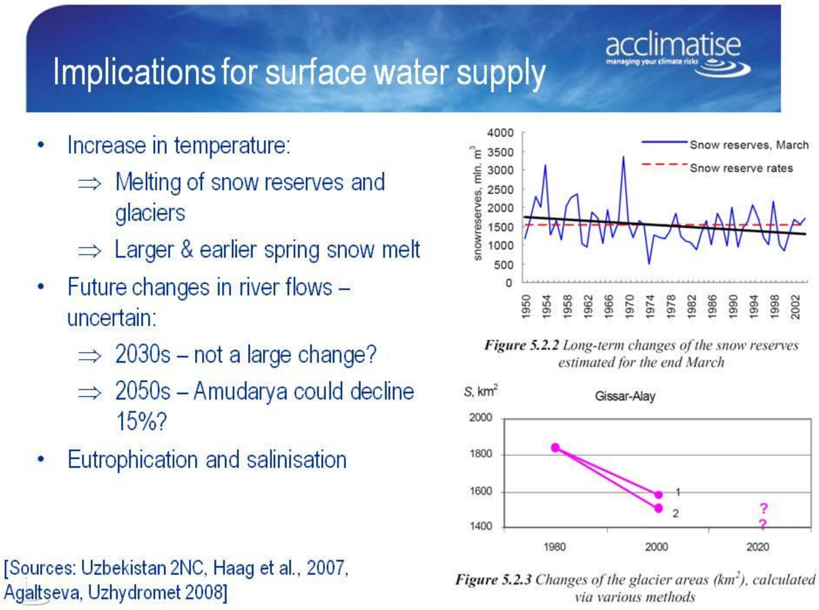
Projected future changes in average winter precipitation

- Uzbekistan: 5% to 10% increases by 2050s
- Tajikistan: 20% to 40% increases
- Krygyzstan: 25% to 50% increases



[Source: http://www.climatewizard.org/]


Projected future changes in average summer precipitation
acclimatise
managing your climate risks
• Uzbekistan: 5% to 15% decreases by 2050s – could be 25% in south
• Tajikistan: 15% to 20% decreases
• Krygyzstan: 5% to 15% decreases
Qyzylorda
Zhambyl
Almaty
Qoraqalpoghiston
Nawoiy
Ongtustik Qazaqstan
Uzbekistan
Kyrgyzstan
Dashhowuz Welayaty
kmenistan
Ahal Welayaty
Tajikistan
Precip (%) Departure
50 %
25
0
-25
-50
[Source: http://www.climatewizard.org/


Implications for surface water supply
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• Increase in temperature:
⇒ Melting of snow reserves and glaciers
⇒ Larger & earlier spring snow melt
• Future changes in river flows – uncertain:
⇒ 2030s – not a large change?
⇒ 2050s – Amudarya could decline 15%?
• Eutrophication and salinisation
Snow reserves, March
Snow reserve rates
Figure 5.2.2 Long-term changes of the snow reserves estimated for the end March
S, km²
Gissar-Alay
Figure 5.2.3 Changes of the glacier areas (km²), calculated via various methods
[Sources: Uzbekistan 2NC, Haag et al., 2007, Agaltseva, Uzhydromet 2008]

Implications for water demand

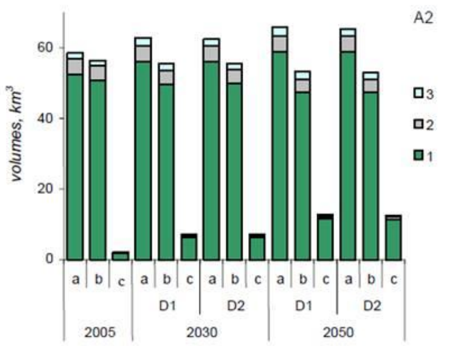


Figure 5.2.13 Dynamics of change of the total water withdrawals and water deficiency in line with scenarios:
a) required water withdrawals;
b) secured water withdrawals;
c) water deficiency.
1 – for irrigation;
2 – for non-irrigation water supply;
3 – for the potable water supply.

[Source: Uzbekistan 2NC]

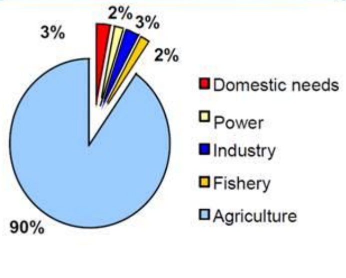


***Figure 1.4** Surface water use*

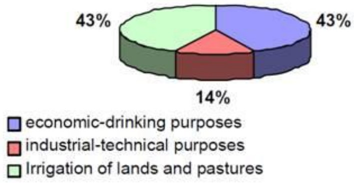
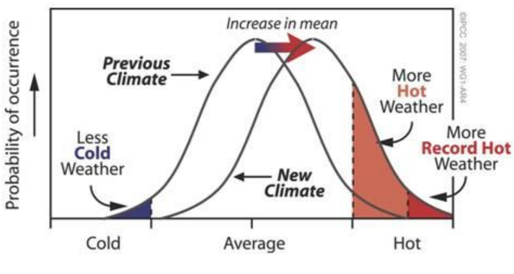


***Figure 1.5** Use of underground water for different purposes*

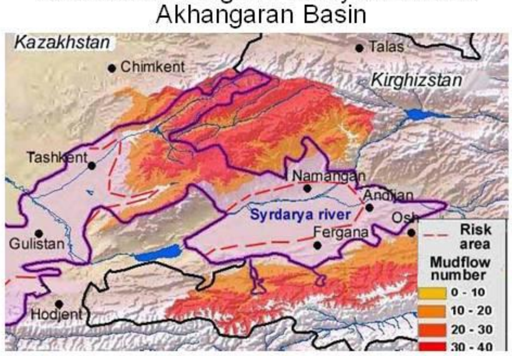
Probabilities of extreme events are changing

- More heat waves
- Less cold weather
- More summer droughts
- Heavier rains or rapid snowmelt – lake outbursts, floods and mudflows
- Reduction in avalanche hazard



[Source: Uzbekistan 2NC]

Mudflow number per century & mudflow risk areas in Fergana Valley & Chirchik-Akhangaran Basin



Implications for energy sector (1)

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- Water for oil, gas coal production
- Cooling water for thermal power plants
- Water for hydropower plants
- Competition with other water users?
- How will agriculture respond?

[Source: Uzbekistan 2NC]

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Implications for energy sector (2)

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- Changes in efficiency as temperatures increase
  - Oil and gas production
  - Thermal power plants
  - Electricity transmission & distribution
- Which assets and activities are vulnerable to changes in extreme events?
  - Gas pipelines?
  - Electricity transmission & distribution?
  - Risks of environmental contamination from energy sector activities?

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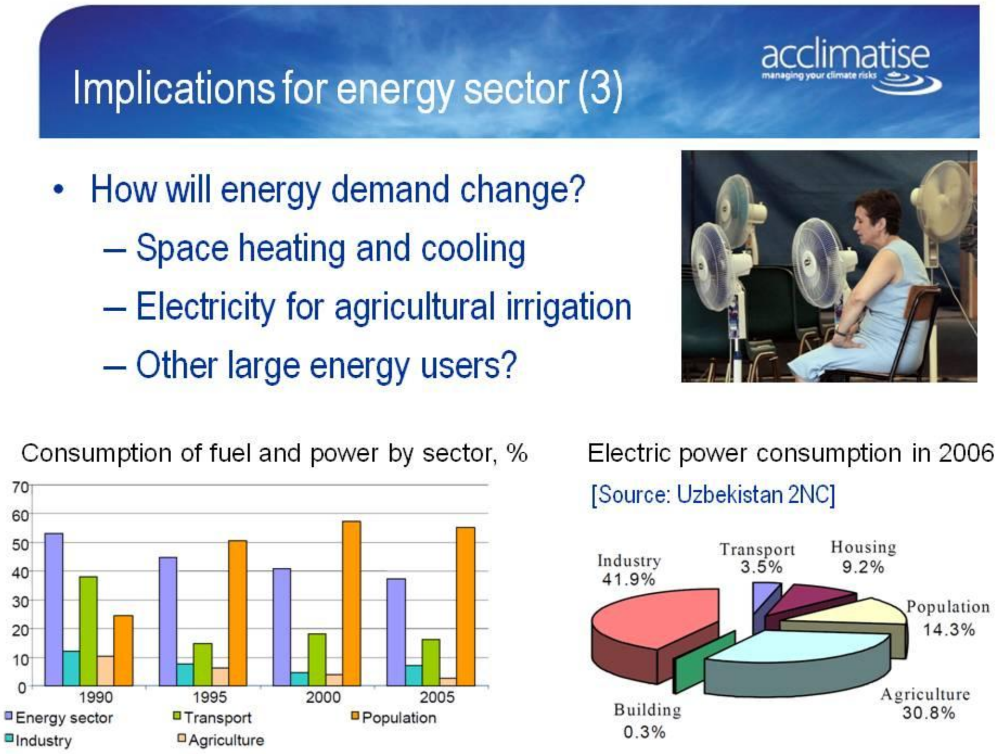
Implications for energy sector (3)
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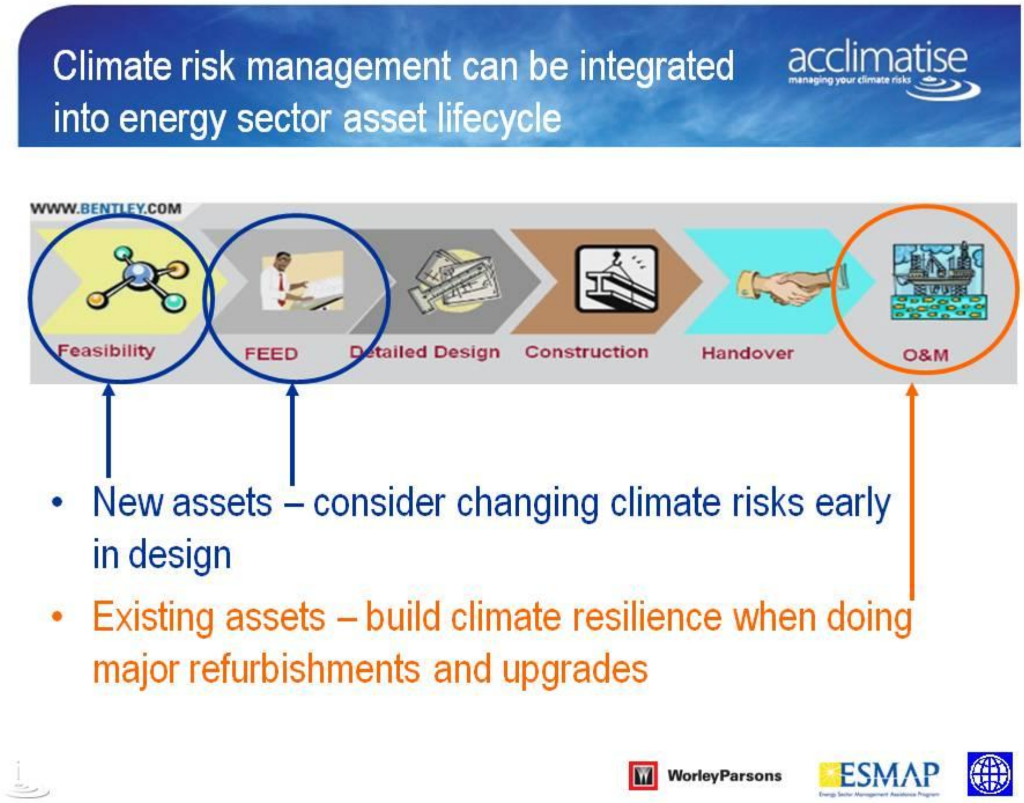
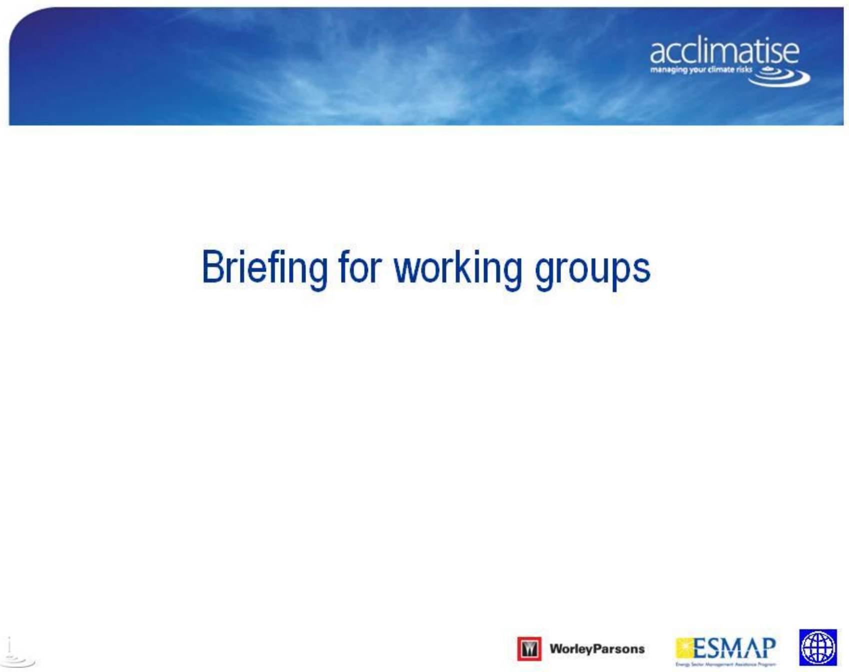
• How will energy demand change?
– Space heating and cooling
– Electricity for agricultural irrigation
– Other large energy users?
Consumption of fuel and power by sector, %
70
60
50
40
30
20
10
0
1990
1995
2000
2005
Energy sector
Industry
Transport
Agriculture
Population
Electric power consumption in 2006
[Source: Uzbekistan 2NC]
Industry 41.9%
Transport 3.5%
Housing 9.2%
Population 14.3%
Agriculture 30.8%
Building 0.3%


Climate risk management can be integrated into energy sector asset lifecycle
acclimatise
managing your climate risks
WWW.BENTLEY.COM
Feasibility
FEED
Detailed Design
Construction
Handover
O&M
• New assets – consider changing climate risks early in design
• Existing assets – build climate resilience when doing major refurbishments and upgrades
WorleyParsons
ESMAP


Stakeholders are concerned about climate change and adaptation
acclimatise
managing your climate risks
"The World Bank Group will give considerable attention to strengthening resilience of economies and communities to increasing climate risks and adaptation… Adaptation will require more resilient infrastructure, broader disaster relief and preparedness measures, and new agricultural technologies and practices to counter increased climate risks."
Banks
WORLD BANK
ADB
IFC
Investors
Insurers
WorleyParsons
ESMAP


acclimatise
managing your climate risks
Briefing for working groups
WorleyParsons
ESMAP

Four working groups

A. Oil, gas, coal production & transmission / transportation – Stuart Arch

B. Thermal power plants, electricity transmission & distribution – Ivaylo Mirchev

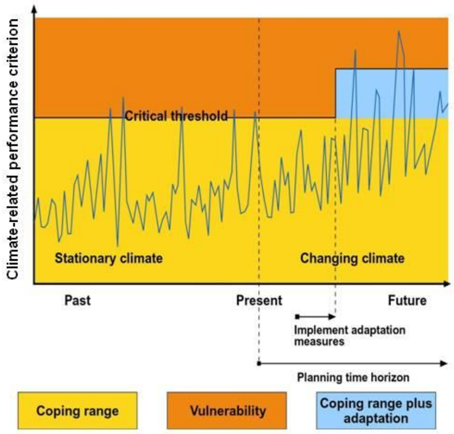
C. Renewable energy generation – hydropower, wind, solar, etc – Richenda Connell

D. Energy demand – Simon Croxton

Discussions in working groups (1)

1. Overall context, objectives and strategies for the energy sector – existing and planned energy assets
2. Energy sector climatic vulnerabilities, sensitivities and critical performance thresholds

- **Lunch break**



The relationship between coping range, critical threshold, vulnerability, and a climate-related performance criterion


Discussions in working groups (2)
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managing your climate risks
After lunch:
3. Risks & opportunities from climate change
4. Vote on highest risks & opportunities
5. Bring 1 flipchart back to final plenary session
• "Top 3" risks or opportunities
• Maximum 5 minutes feedback
WorleyParsons
ESMAP