Case Study on EECCAs: Technological Pathway toward the Amended Gothenburg Protocol Ratification

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Kazakhstan: air quality situation

- In 201910 cities of Kazakhstan had high air pollution levels: Aktobe, Almaty, Atyrau, Balkhash, Karaganda, Nur-Sultan, Shymkent, Temirtau, Ust-Kamenogorsk, and Zhezkazgan
- The air quality monitoring data showed that concentrations of key air pollutants in the ambient air consistently exceeded the limit values (LVs) of both Kazakhstan and the European Union (EU), especially in the winter. In some cases, the average annual concentrations were two or three times higher than the EU annual concentration LVs
- Air quality management (AQM) in Kazakhstan is regulated through the Environmental Code
- Maximum Allowed Concentration (MAC) are established for 683 air quality pollutants (2015 Order of the Minister of National Economy No. 168): short-term maxima and daily averages

Pollutant	MACs in Kazakhstan		LVs in EU		
	One-time (µg/m^3)	24-hour (µg/m^3)	Concentration (µg/m^3)	Averaging period	Number of permitted exceedances per year
$PM_{2.5}$	160	35	25	1 year	n.a.
PM_{10}	300	60	50	24 hours	35
			40	1 year	n.a.
NO_2	200	40	200	1 hour	18
			40	1 year	n.a.
SO_2	500	50	350	1 hour	24
			125	24 hours	3

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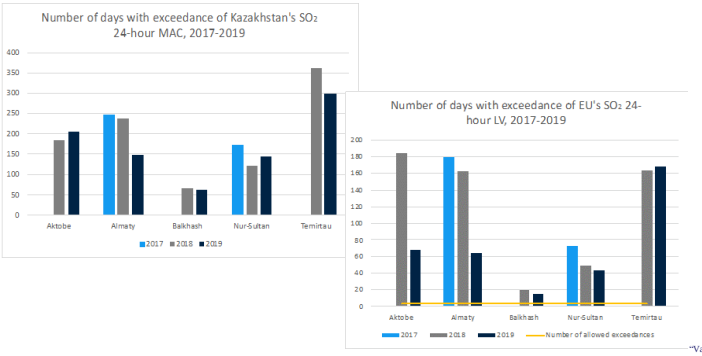
Kazakhstan: air quality situation

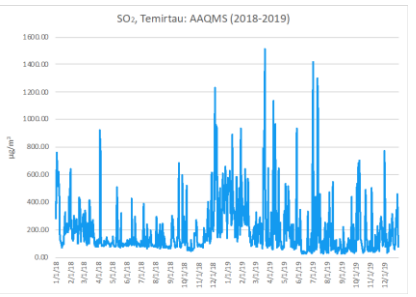
In terms of SO_2: exceedances of limit values in several cities:

- In 2017–19, both Kazakhstan's and the EU's 24-hour LV for SO_2 were exceeded in: Aktobe, Almaty, Balkhash, Nur-Sultan, and Temirtau.

Highest number of days with exceedance of Kazakhstan's 24-hour MAC (left) and EU's 24-hour LV (right) for SO_2, 2017-2019



24-hour SO_2 concentrations in Temirtau, 2018-2019



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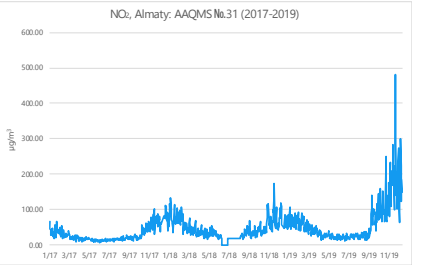
Kazakhstan: air quality situation

In terms of NO_2: exceedances of limit values in some cities:

- Almaty, Shymkent, and Temirtau had the highest NO_2 concentrations, which also exceeded the average annual NO_2 LV in the EU in 2017-2019
- Average annual concentrations at 7 out of 10 AAQMSs in Almaty were higher than the EU LV in at least one year in 2017-2019
- The highest annual average NO_2 concentration in 2017-2019 was recorded in Temirtau



Highest calculated annual average concentrations of NO_2 in selected cities, in 2017-2019

City	Highest calculated annual average (µg/m³)	Year	Maximum 24-hour average concentration (µg/m³)	Date of maximum 24-hour average concentration
Almaty	63.5	2019	480.8	December 10, 2019
Shymkent	63.4	2018	311.8	December 8, 2019
Temirtau	131.0	2019	1,355.2	March 13, 2019

Source: Original calculations for this publication.

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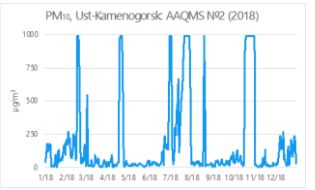
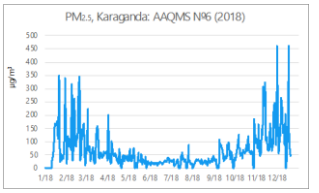
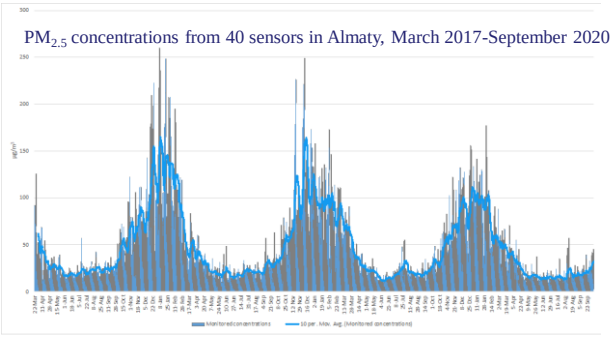
Kazakhstan: air quality situation

In terms of PM_{10} and $PM_{2.5}$: exceedances of limit values in several cities

- In 2018, the highest annual average PM_{10} concentration was for Ust-Kamenogorsk, while the highest annual average $PM_{2.5}$ concentration was for Karaganda
- It is important to consider PM exposure in Almaty- Kazakhstan's largest city







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Kazakhstan: main sources of emissions

- In 2019 electricity and heat generation are major source of SO_2 and NOx emissions, with 32% and 29% share, respectively, followed by petroleum refining and iron and steel plants
- Residential heating is responsible for 33% of $PM_{2.5}$ and for 20% of NMVOC emissions while the iron and steel production contributes for 25% of $PM_{2.5}$
- Coal fired LCPs are the largest sources of SO_2, NOx, and PM.

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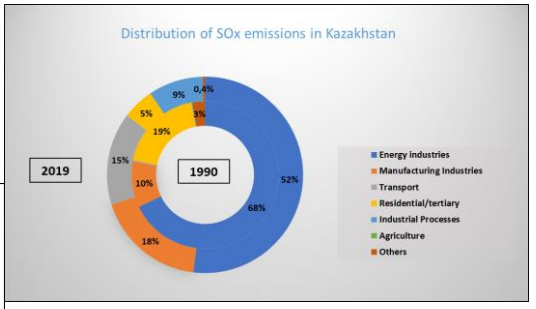
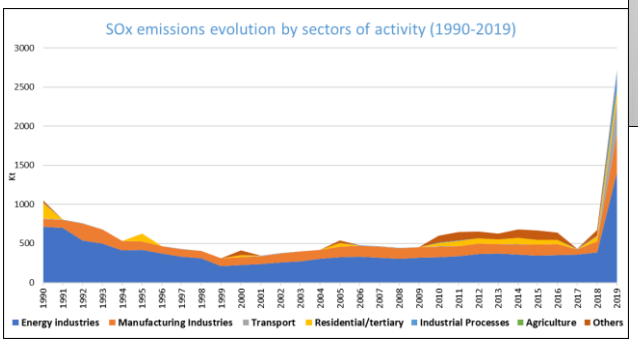
Kazakhstan: main sources of SO_2





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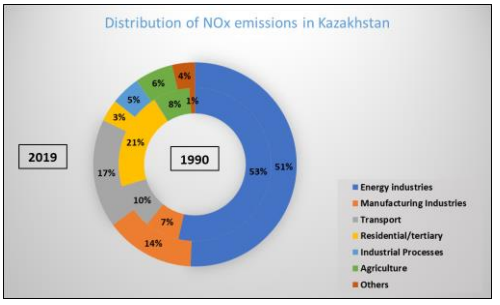
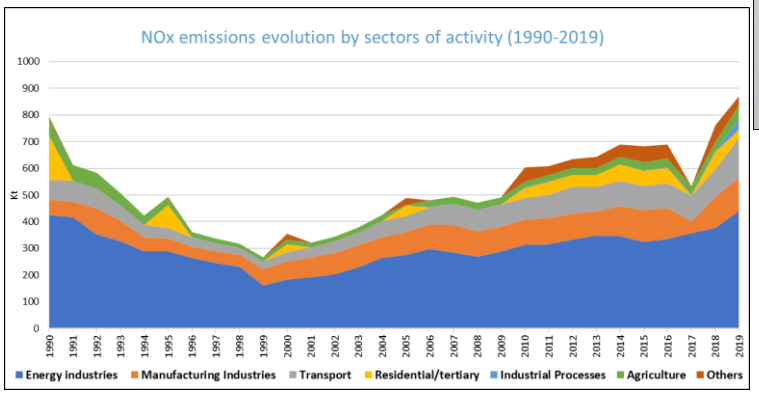
Kazakhstan: main sources of NOx





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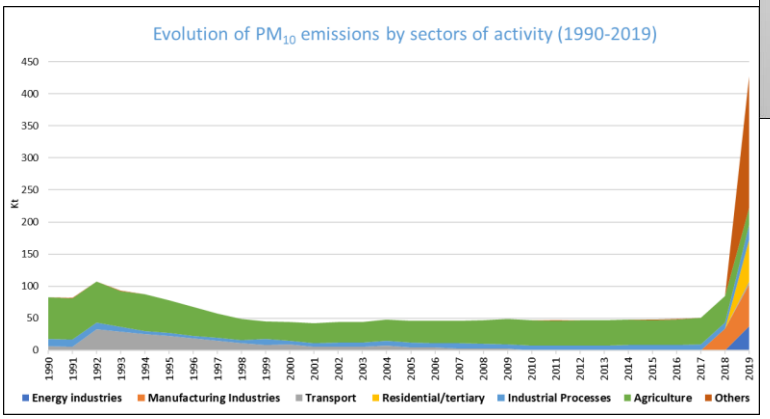
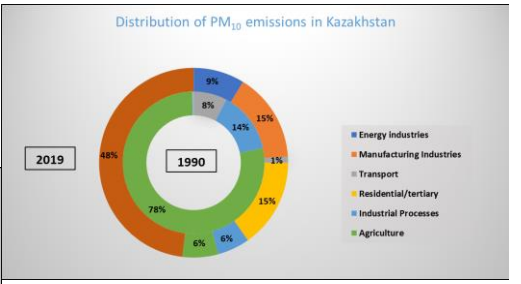
Kazakhstan: main sources of PM_{10}





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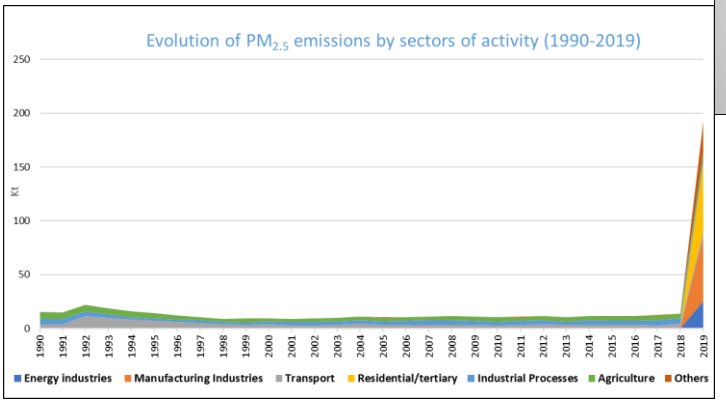
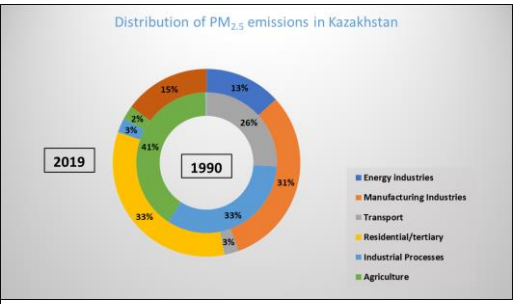
Kazakhstan: main sources of PM2.5





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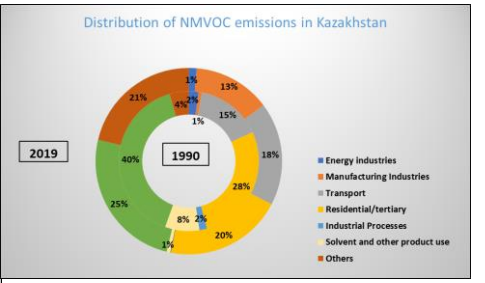
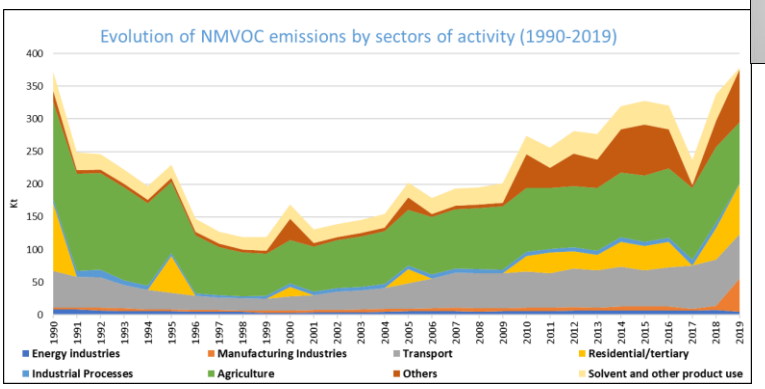
Kazakhstan: main sources of VOC





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Kazakhstan: Current emission regulations

- Kazakhstan developed the road map and the National Action Plan for the ratification of three latest CLRTAP Protocols, although not yet approved by the competent authority
- Kazakhstan started the process to partially align, the national policies with EU IED, via the new 2021 Environmental Code. Such Code introduces integrated environmental permits based on BAT, starting from 2025, with country specific BAT reference documents being elaborated
- Currently, Kazakhstan has no emission limit values (ELVs) for stationary sources similar to the LVs in force in several countries (for example, China, the EU, and the US).
- For large point sources, Kazakhstan has not yet established generally applicable ELVs, but rather a maximum annual emission limit is specified for each large industrial installation.

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Kazakhstan: Current emission regulations

Environmental code (01/2021)

- The largest sources of industrial pollution in Kazakhstan, namely Category I enterprises, are required to obtain an IEP based on BAT starting in 2025
- ELVs under the previous emission permitting system were based on historical emission levels and did not require implementation of cleaner technologies, whereas the IEP system is based on sector-specific BATs
- Category I enterprises are required to conduct automatic emission monitoring, which improves transparency of emissions reporting and are subject to mandatory EIA
- Category II enterprises are screened to determine whether an EIA is needed
- Category III enterprises are required to submit environmental impact declarations (ex. warehouses, furniture workshops, concrete mortar units)
- Category IV enterprises are exempt from EIA regulation or environmental impact declarations as their environmental impact is deemed to be minimal (car washes, service stations, public catering facilities, or micro and small business facilities with low-power boiler installations for meeting their own energy needs)

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Kazakhstan: Regulation improvement

Environmental code (01/2021)

- Transition to the implementation of BAT principles involves development by July 1, 2023, of BAT Reference Books (BREFs) for the 50 most polluting enterprises in Category I.
- The BREFs will provide the competent authorities with a technical basis for establishing permit conditions for industrial facilities considering such facilities' technical characteristics, geographical location, and local environmental conditions.
- Five BREFs are being developed and discussed in 2021, covering the following sectors:
  - Fuel combustion at large energy-producing installations
  - Oil and gas processing
  - Production of inorganic chemicals
  - Cement and lime production
  - Energy efficiency

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Kazakhstan: Current emission regulations

Emission limit values for **solid** fuel combustion in draft BREF LCP of Kazakhstan and AGP

Type of combustion plant/ Total rated thermal power, MW of thermal energy	Substance	**Draft BREF LCP of Kazakhstan**		**AGP**	
		New installation mg/m^3	Existing installation, mg/m^3	New installation mg/m3	Existing installation, mg/m3
< 100	NOx	155-200	330-450	300 (coal, lignite and other solid fuels) 450 (pulverized lignite) 250 (biomass, peat)	300 (coal, lignite and other solid fuels) 450 (pulverized lignite) 300 (biomass, peat)
100 - 300		80-130	200-210	200 (coal, lignite and other solid fuels) 200 (biomass, peat)	200 (coal, lignite and other solid fuels) 250 (biomass, peat)
≥ 300		80-125	200-210 (excluding pulverized coal)	150 (coal, lignite and other solid fuels) (general) 150 (biomass, peat) 200 (pulverized lignite)	200 (coal, lignite and other solid fuels) 200 (biomass, peat)
< 100	SOx	170-220	400	400 (coal, lignite and other solid fuels) 300 (peat) 200 (biomass)	
100 - 300		135-200	220-250	200 (coal, lignite and other solid fuels) 300 (peat) 200 (biomass)	250 (coal, lignite and other solid fuels) 300 (peat) 200 (biomass)
≥ 300		25-110 (pulverized coal plant and fluidized bed boiler)	165-200 (excluding fluidized bed boiler)	150 (coal, lignite and other solid fuels) (FBC: 200) 150 (peat) (FBC: 200) 150 (biomass)	200 (coal, lignite and other solid fuels) 200 (peat) 200 (biomass)
< 100	Dust	**35-60**	**70-200**	20 (coal, lignite and other solid fuels) 20 (biomass, peat)	30 (coal, lignite and other solid fuels) 30 (biomass, peat)
100 - 300		**35-60**	**70-200**	20 (coal, lignite and other solid fuels) 20 (biomass, peat)	25 (coal, lignite and other solid fuels) 20 (biomass, peat)
300 - 1000		**35-60**	**70-200**	10 (coal, lignite and other solid fuels)	20 (coal, lignite and other solid fuels)
≥ 1000		**35-70**	**70-200**	20 (biomass, peat)	20 (biomass, peat)

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Kazakhstan: Current emission regulations

Emission limit values for **liquid** fuel combustion in draft BREF LCP of Kazakhstan and AGP

Type of incineration plant/ Total rated thermal power, MW of thermal energy	Substance	**Draft BREF LCP of Kazakhstan**		**AGP**	
		New installation mg/m^3	Existing installation, mg/m^3	New installation mg/m3	Existing installation, mg/m3
< 100	NOx	100-215 (in boilers)	450-500	300	450
100 - 300		85-100 (in boilers)	450-500	150 50 (light and medium distillates)	200 (general) Existing plants within refineries and chemical installations: 450 (for firing of distillation and conversion residues from crude oil refining for own consumption in combustion plants and for firing liquid production residue as non-commercial fuel) 90 (general for light and medium distillates) 200 (plants operating less than 1,500 hours a year)
≥ 300				100	150 (general) Existing plants within refineries and chemical installations: 450 (for firing of distillation and conversion residues from crude oil refining for own consumption in combustion plants and for firing liquid production residue as non-commercial fuel (< 500 MWth))
< 100	SOx	100-250 85-100 (in boilers)	**750-1400**	350	
100 - 300				200	250
≥ 300		75-200 85-100 (in boilers)	**600-950**	150	200
< 100	Dust	7-18	7-25	20	30 (in general) 50 (for the firing of distillation and conversion residues within refineries from the refining of crude oil for own consumption in combustion plants)
100 - 300				20	25 (in general) 50 (for the firing of distillation and conversion residues within refineries from the refining of crude oil for own consumption in combustion plants)
≥ 300		7-10	7-15	10	20 (in general) 50 (for the firing of distillation and conversion residues within refineries from the refining of crude oil for own consumption in combustion plants)

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Kazakhstan: Current emission regulations

Emission limit values for **gaseous** fuels combustion in draft BREF LCP of Kazakhstan and AGP

Type of incineration plant/ Total rated thermal power, MW of thermal energy	Substance	**Draft BREF LCP of Kazakhstan**		**AGP**	
		New installation mg/m3	Current installation, mg/m3	New installation mg/m3	Current installation, mg/m3
Open-cycle gas turbines (GTP)					
≥ 50	NOx	25-50	**100-150**	100 (natural gas)	100 (natural gas)
Combined cycle gas turbines (CCGT)					
50–600	NOx	15-40	75-120	50 (general for natural gas)	50 (general for natural gas), 150 (plants working on natural gas and operating less than 1,500 hours per year) 120 (general for other gases) 200 (for other gases, for plants operating less than 1,500 hours a year)
>600		15-40	50-100		
Natural gas combustion in boilers and engines					
Boiler <100	NOx	50-100	**100-200**	100 (natural gas)	100 (natural gas)
Boiler ≥100-300		50-100	**100-200**		
Boiler ≥ 300		50-100	**100-200**		
Engine		55-85	**100-175**		

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Kazakhstan: The strategy ‘Kazakhstan 2050: A New Political Course of the Established State’

- The strategy ‘Kazakhstan 2050: A New Political Course of the Established State’ adopted in 2012 sets ambitious goals for sustainable development and the country’s transition to a low-carbon economy. The Kazakhstan 2050 strategy provides that:
  - By 2050, alternative and RES should account for at least 50 % of the total energy consumption
  - By 2050, Kazakhstan should fully upgrade its production facilities and assets in line with the latest technological standards
  - In addition, all mining companies should practice environmentally responsible production and
  - By 2025, the local market should provide transport fuels according to the latest environmental standards

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Kazakhstan: Concept for Transition of the Republic of Kazakhstan to Green Economy

- In 2013, the Concept for Transition of the Republic of Kazakhstan to Green Economy was adopted
- Concept outlined areas of interventions, such as energy efficiency and cleaning of industrial processes
- It estimates that the largest improvement in energy efficiency can be achieved in the residential sector through insulation of homes, among other things
- The second important sector for energy efficiency improvements and emission reduction is replacing old boilers in thermal power plants (TPPs) and CHP plants with new, more efficient ones
- A key measure to reduce air pollution is the installation of dedusting and desulfurization equipment at coal power plants, as well as converting CHPs in large cities from coal to gas
- One of the target of the concept is "Reduction of SOx and NOx emissions by 2030 to European levels of emissions
- In general, the Concept envisions developing and implementing emission standards and control mechanisms similar to the ones in the EU

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Kazakhstan: 'Strategic Plan for Development until 2025'

- The latest strategic document is the 2018 'Strategic Plan for Development until 2025' features green economy and environmental protection as specific policies
- It also lists the achievement of Kazakhstan's commitments under the Paris Agreement, continuing work on decarbonizing the economy and promoting investment in green technologies and RES development, among specific tasks
- Despite the outlined specific tasks, the plan includes only two indicators related to the environment—GDP energy intensity and share of RESs

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Kazakhstan: Policies in the Residential Sector

- The main legal instrument that addresses energy issues in the residential sector is the 2012 Law on Energy Saving and Energy Efficiency Improvements.
- The law provides for mandatory energy efficiency assessments for new buildings and, in the case of expansion, existing buildings
- As for existing buildings, the law provides for support to dwelling owners to implement energy efficiency measures in their homes
- The law introduces heat meters so that payments for heat energy can be based on actual consumption
- Payment per use is an important step toward incentives to save energy and invest in thermal rehabilitation of buildings and more efficient appliances

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Kazakhstan: Policies in the Residential Sector

- Reduction of losses in the energy and heat networks is one of the objectives of the program 'Energy Saving 2020'
- The 2014 Concept for Development of the Energy and Heat Sector until 2030 envisions the modernization of energy-generating capacities
- Moreover, the Concept for Transition of the Republic of Kazakhstan to Green Economy places a high importance on switching from coal to gas in urban TPPs and CHPs

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Kazakhstan: Technological Pathway to comply with the AGP technical provisions

SOx Annex IV:

Large combustion plants - the key sector for action and industry

The following secondary measures can be used

- boiler sorbent injection
- dry sorbent injection (DSI)
- spray dry absorber (SDA)
- wet flue-gas desulphurisation (FGD)

associated with the use of low Sulphur content solid or liquid fuels

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Kazakhstan: Technological Pathway to comply with the AGP technical provisions

NOx Annex V

Large combustion plants - the key sector for action and industry

A combination of primary and secondary measures

- combustion optimisation
- combination of primary techniques for NOx reduction such as air or fuel staging, flue-gas recirculation, low-NOx burners (LNB)
- selective non-catalytic reduction (SNCR)
- selective catalytic reduction (SCR)

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Kazakhstan: Technological Pathway to comply with the AGP technical provisions

PM (Annex X)

In all industrial sectors covered:

Fabric filters and electrostatic precipitators are the techniques recommended to able compliance with limit values implemented by the Annex

- Fabric filters
- Electrostatic precipitators

When desulphurisation is also conducted, the following techniques are also available:

- wet flue-gas, desulphurisation (FGD),
- dry or semi-dry FGD system.

The proper sizing of the equipment is essential.

A key sector in Kazakhstan for which only recommended limit values are proposed is **domestic heating** with solid fuels.

- Development of the use of efficient appliances, based on the Code of good practices developed by UNECE

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Kazakhstan: Technological Pathway to comply with the AGP technical provisions

VOC (Annex VI)

Depending on activities using solvents, primary measures and end of pipe techniques such as adsorption, oxidation

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Kazakhstan: Main conclusions

- Air quality: PM, SO_2, and NOx concentrations too high in many cities and main concern in term of air quality
- Emissions: large impact of LCP for SO_2 and NOx emissions followed by petroleum refining and iron and steel plants. For PM, domestic heating and iron and steel production is the largest source of emissions. For NMVOCs emissions, domestic heating has dominant contribution. Coal fired LCPs are the largest sources of SO_2, NOx, and PM
- The implementation of the new Environmental Code and the definition of BAT, would allow Kazakhstan to be in compliance with some of the requirements of AGP Technical Annexes IV, V and X, for the industrial sources covered, however, only if the BAT AELs implemented will be the same as in the AGP Technical Annexes
- A technological pathway quite common for industrial plants covered by the technical annexes
- For small domestic appliances, the techniques are also known and could be used

By the implementation of the provisions of key EU Directives, the Republic of Kazakhstan would be in the condition to comply with some of the requirements of the four AGP technical annexes IV, V, VI and X, in particular their ELVs, tentatively around 2032-35

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Thank you very much for your attention!

Questions?

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