Kazakhstan
Associated Gas Utilization Study

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Thanks to Tom Mitro for his thoughtful review

Columbia Center
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Summary of findings

Slow progress in flaring reduction and APG use

- Since the first anti-flaring regulation in 2006, flaring has slowly reduced and APG projects have started to spring up but more remains to be done

Uncertain and ineffective regulations

- For a long time, uncertain and ineffective regulations, limited gas transport infrastructure whose development got hampered by regional geopolitics have slowed down the progress.

Limited market opportunities hindered by regional geopolitics

- In addition, APG with high levels of poisonous hydrogen sulfide at one of the biggest oil fields have made APG projects costly and difficult to implement.

High levels of hydrogen sulfide

- Growing domestic demand for gas for power generation, clarification and strengthening of anti-flaring / APG use regulation, planned construction of national and regional pipelines could now spur an increase in APG use projects.

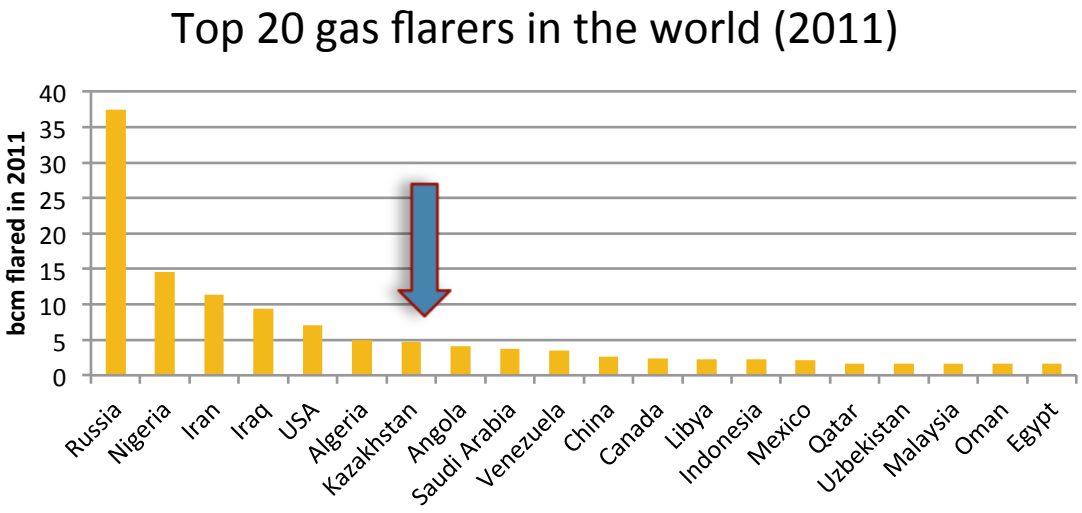
Growing domestic demand, strengthened regulation and planned pipelines

- However, it remains to be seen whether the regional geopolitics will enable the commissioning of the planned pipelines.

The statistics of APG flaring in Kazakhstan

Overview of statistics on APG flaring

On the companies involved



Source: NOAA satellite data

- The country has been an oil producer since 1911, with the second largest oil reserves and second largest oil production among former Soviets after Russia; most of the country's gas reserves are APG.
- The country took on the title of the 7th foremost gas flarer globally as of 2011.

The statistics of APG flaring in Kazakhstan

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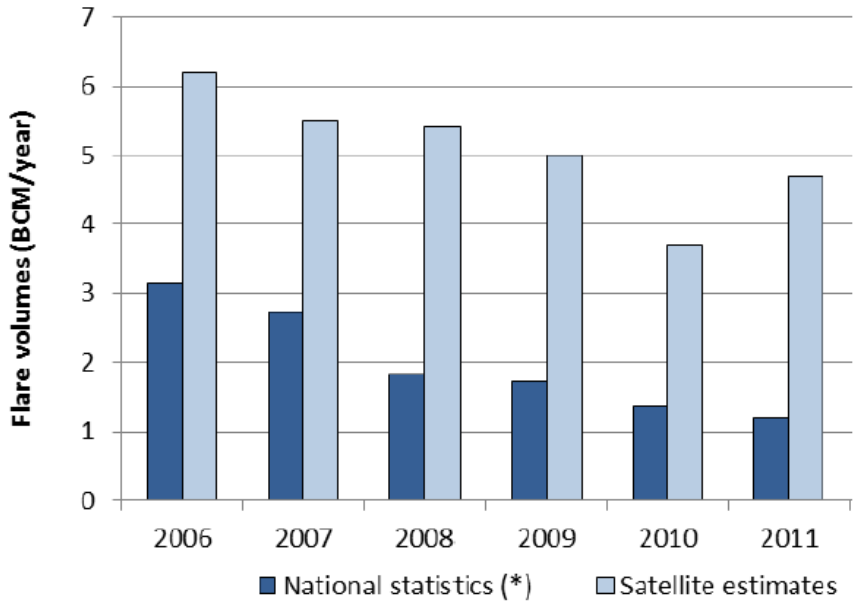
Flare volumes in Kazakhstan according to national statistics and satellite image estimates



Source: National statistics from Ministry of Oil and Gas Kazakhstan, satellite estimates from and NOAA/GGFR

- Although flare volumes have fallen since 2006, flaring remains significant (1 bcm/year in 2013 according to national statistics). Most of the country's gas reserves are APG with 77% of total natural gas reserves situated in four fields: Karachaganak (46%), Tengiz (12%), Imashevskoye (7%), and Kashagan (12%).

The statistics of APG flaring in Kazakhstan: Who is Involved?

Overview of statistics on APG flaring

On the companies involved

- There are many players in Kazakhstan's oil industry, the largest of whom is Chevron.
- The Tengiz field, among others, is run by Tengizchevroil, a consortium consisting of Chevron, Exxon Mobil, KazMunayGas and LukArco

What is the legal and fiscal framework in place to stop flaring and incentivize APG use?

Agencies

Legal framework

Fiscal framework

Government institutions involved in regulation of oil production/flaring	Description
Ministry of Oil and Gas	Regulator of the oil and gas industry; grants the flaring permits Prior to 2010, KazMunaiGas (KMG), the state-owned oil and gas company, was also involved in the regulation of the sector. However, KMG still has equity interests in Karachaganak (10%), Kashagan (16.8%), and Tengiz (20%) and plays a growing role in the sector development since the government provides a majority stake to KMG in all new projects and joint ventures.
Ministry of Environmental Protection	Monitors compliance with environmental regulation
Ministry of Emergency Situations	Monitors compliance with health and safety regulations

What is the legal and fiscal framework in place to stop flaring and incentivize APG use?

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Regulation/Policies on Gas Flaring/APG use	Description
Amendments to Law on Petroleum (2004 and 2005)	Prohibits development of oil and gas fields without utilization of APG; Flaring of APG is prohibited with exception of cases of emergency situations (not applied to agreement signed and approved before 2004) – with initially immediate effect, the law ended up including a transition period and banned flaring of APG as of July 2006 . The initial implementation involved the use of fines and threats to revoke production rights; it then evolved towards more incentive based plans.
Law on Subsoil and Subsoil use (2010)	Adopted in 2010, allowed for technologically unpreventable flaring under specified conditions. Forbids flaring except as authorized by the Ministry of Oil and Gas. Discouraged reinjection (dominant strategy prior) by adding an obligation to process APG so that more gas could be brought into the market (forbade oil and gas field development without APG use) . Operators must get approvals from the Ministry of Oil and Gas for their APG use programs, update them every three years and report annually on their implementation.
Law on Gas and Gas Supply (2012)	As of 2012, adds more clarification to regulatory environment for APG use and commercial framework for supply of gas. Stipulates state preemptive rights to buy raw and commercial gas that are given by government resolution to KazTransGas, the national owner and operator of most of Kazakhstan's gas infrastructure, a subsidiary of KMG. (see next slide).

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Regulation/Policies on Gas Flaring/APG use	Description
KazTransGas: National Owner and Operator by Government Resolution, July 2012	Under the 2012 Law on Gas, subsoil users must make a gas sale offer to KazTransGas based on "i) the recovery cost of the raw gas, ii) the transport cost to the National Operator, iii) the cost of producing commercial gas from the raw gas, and iv) a profitability margin of no more than 10%." (CarbonLimits, 2013) Upon approval by the Ministry of Oil and Gas, KazTransGas may accept or reject the offer. KazTransGaz also has preferential rights to gas supply infrastructure. Those dispositions, in effect, limit other companies' commercial activities related to gas supplies.

What is the legal and fiscal framework in place to stop flaring and incentivize APG use?

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Legal framework

Fiscal framework

Fiscal Framework on Gas Flaring/APG use	Description
Fines and assorted taxes paid on flaring	Penalties related to flaring with fines and threats to revoke production licenses, though this approach has been criticized as not being sufficient to shift oil companies towards APG use

On barriers to APG Use

Power generation

Gas use and reinjection

Liquefied Petroleum Gas (LPG)

- Some of the primary barriers to APG utilization in the sector include:
  - Absence of developed gas transport infrastructure to supply gas to northern, central and southern markets: Gas reserves are in the west and northwest and geographically distant from significant demand areas;
  - Dependence on natural gas supplies from Uzbekistan and Russia – two neighbors that have blocked the development of export-oriented gas pipelines from Kazakhstan to preserve their market share ;
  - No individual capacity for processing Karachaganak field gas
- Legal ambiguity over Caspian sea (is it a 'lake', in common use by all, or a 'sea', subject to UN Convention on the Law of the Sea?) has complicated export infrastructure development and remains a significant source of uncertainty for future export based projects involving APG.
- Tengiz's gas is sour, with high levels of hydrogen sulfide which is lethal when scattered in air, and makes APG use projects relatively costly. Current work is underway to use sour gas injection technology to separate the sour gas from crude and re-inject it at very high pressure in the Tengiz reservoir.

What energy needs could the flared gas satisfy?

Power generation

Gas use and reinjection

Liquefied Petroleum Gas (LPG)

- Forecasted rising domestic demand for gas is driven by demand for power generation in a county where fossil fueled power plants have provided most of the generation capacity so far. The power sector is expected to be the largest contributor to increased primary energy demand as the share of gas-fired power in overall generation rises from 11% in 2008 to an expected 34% in 2035 (also see next slide).
- Additionally, an unofficial target of 95% APG utilization set by the government may be driving increase in APG use in recent years
- Some major planned pipeline projects could open up the export and market options and reduce dependency on Russia and Uzbekistan (see map on slide 13):
  - The 1,475-km Beiney-Shymkent pipeline will enable gas transportation from western to southern Kazakhstan, where there is high demand and also allow a connection to the Turkmenistan-China pipeline. Expected to be commissioned in 2015.
  - The 1,304-km Kazakhstan-China main pipeline allows increased gas transportation from Central Asia to China, gas supply to southern Kazakhstan and the transit of Turkmen gas. Already commissioned.
  - The construction of Kartaly–Tobol–Kokshetau–Astana gas pipeline will provide gas supplies to the northern Kazakhstan (where the capital Astana is).
  - In 2007, Russia and Kazakhstan signed an agreement to construct the Caspian Coastal Pipeline, running from Turkmenistan via Kazakhstan to Russia. Project is however on hold.

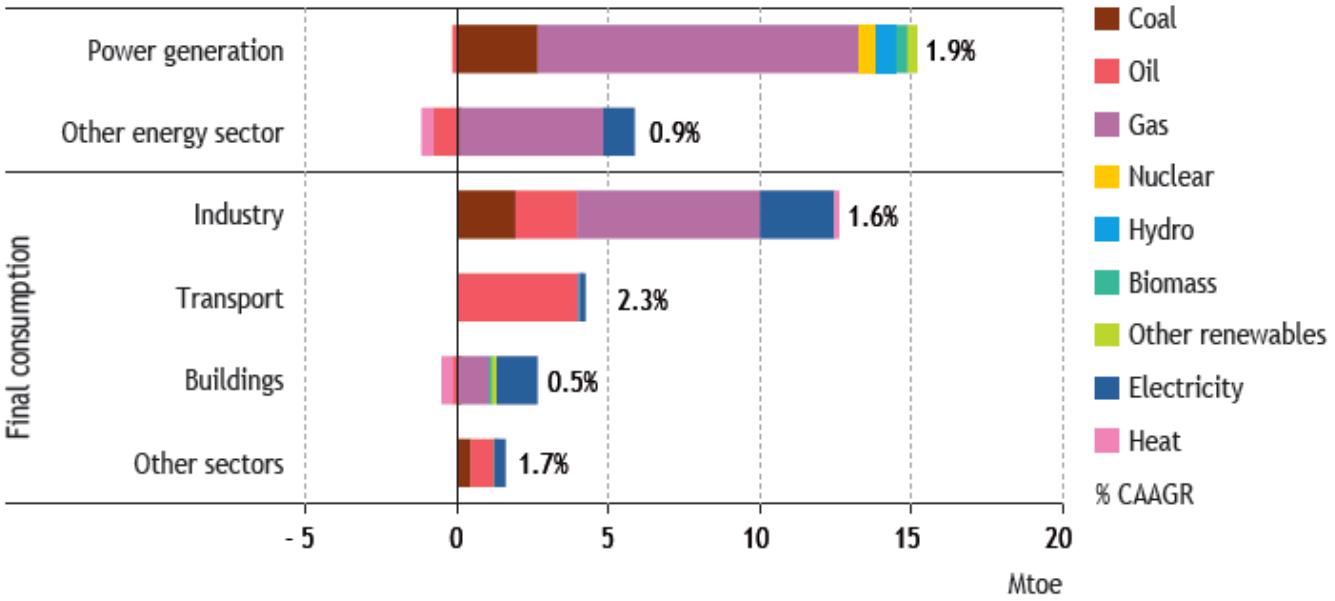
What energy needs could the flared gas satisfy?

Power generation

Gas use and reinjection

Liquefied Petroleum Gas (LPG)

Incremental energy demand in Kazakhstan by sector and fuel - 2008 -2035 under the WEO's "New Policies Scenario"



Source: WEO, 2010

- Under the World Energy Outlook 'New Policies Scenario' (which accounts for Kazakhstan's status as a signatory to the Kyoto Protocol and commitment with the UNFCCC to cutting emissions 15% from 1992 levels by 2020), power generation from gas is expected to constitute a significant part of power generation in the coming years as shown in the figure above.

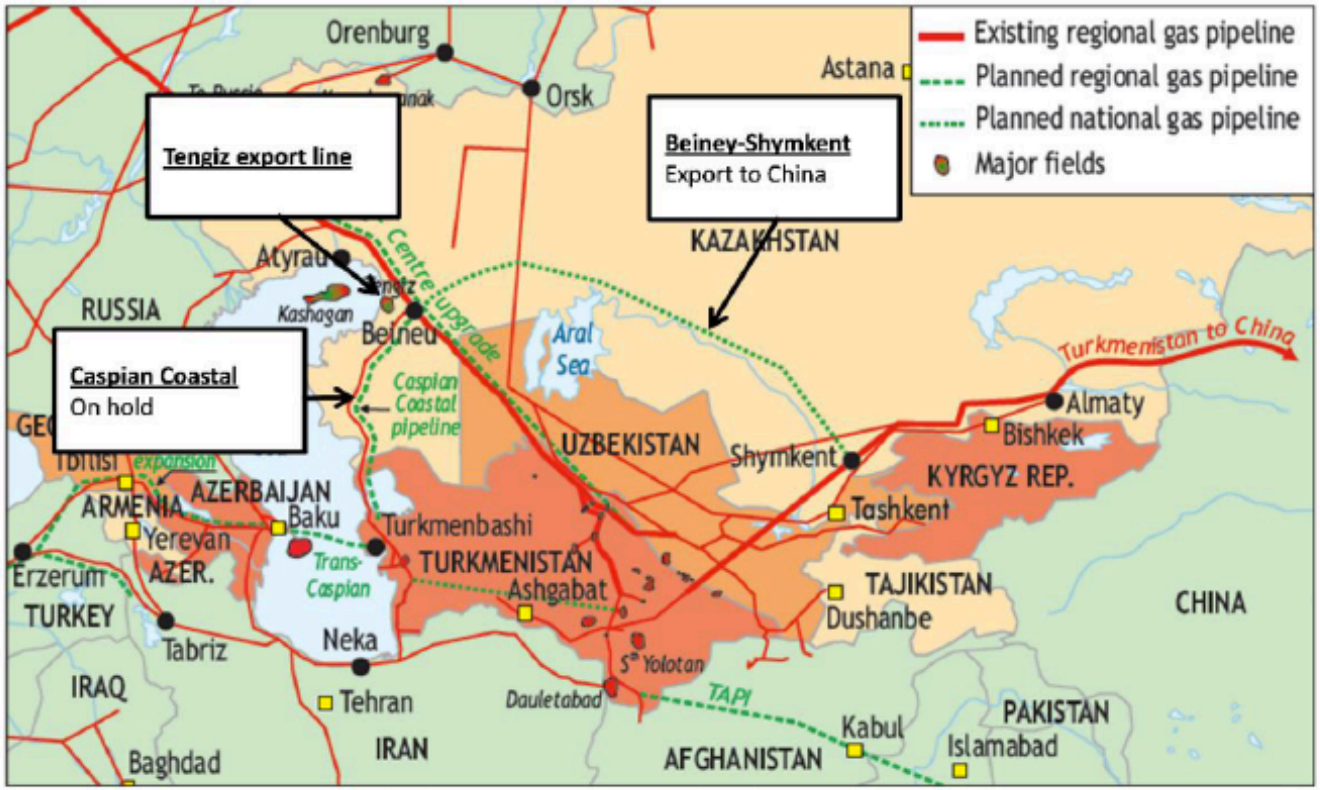
Planned gas pipeline projects

Power generation

Gas use and reinjection

Liquefied Petroleum Gas (LPG)

Main national and regional pipelines



the boundaries and names shown and the designations used on the maps included in this publication do not imply official endorsement by the IEA

Source: IEA World Energy Outlook 2010, Carbon Limits analysis

- it remains to be seen whether the regional geopolitics will enable the commissioning of the planned pipelines.

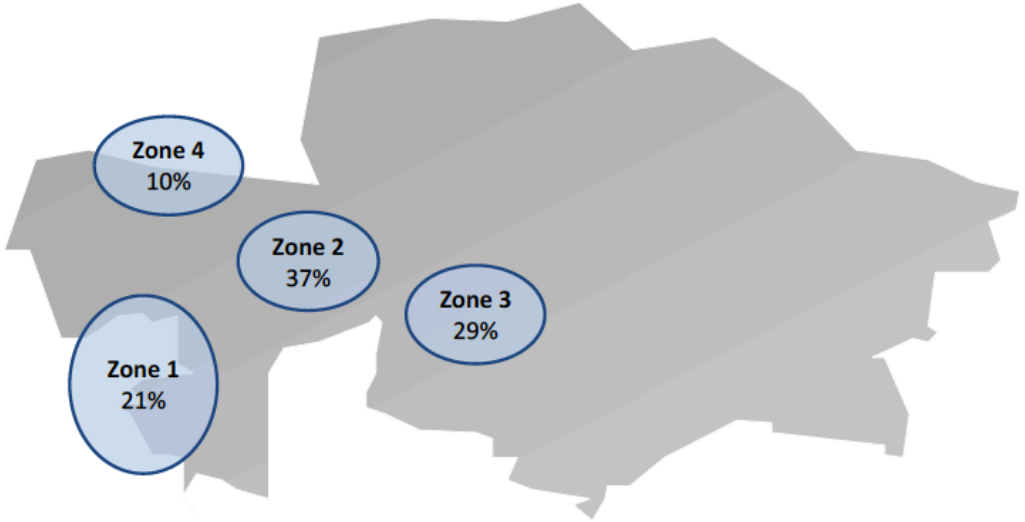
Kazakhstan's major flaring areas account for 95% of all flaring

Power generation

Gas use and reinjection

Liquefied Petroleum Gas (LPG)

Overview of the main flaring areas



Source: Carbon Limits based on NOAA and IHS data

- Approximately 95% of all flaring comes from 4 areas: Caspian Sea and Coast (Zone 1, where Tengiz is located), Aktobe (Zone 2), the Kumkol basin (Zone 3) and Northwest Kazakhstan close to the border of Orenburg (Zone 4).
- In those areas however, a number of APG use projects have sprung up in the last few years; mostly involving reinjection (30% of APG produced), in-house power generation (15%) and commercial purposes (55%) (see next slides).

APG use case study: Kalamkas Power Generation (Zone 1)

Power generation

Gas use and reinjection

Liquefied Petroleum Gas (LPG)

- **Project Participants:**
  - Mangistaumunaigaz JSC, a Kazakh company
- **Project Description and Motivation:**
  - Commissioned in 2011 for in-house electricity for the firm due to energy deficits in the region
  - Power plant has a capacity of 90 MW
- **Project Location:**
  - The Kalamkas field is situated in the Mangistau region of Kazakhstan on the Buzachi Peninsula. Located in Zone 1
- **Associated Gas Use:**
  - Use all associated gas from the company's own field
- **Project Technology:**
  - Power station made up of 2 gas turbines SGT-800 Siemens with 45 MW capacity each

APG use case study:
Tengiz Field Gas Utilization (Zone 1)

Power generation

Gas use and reinjection

Liquefied Petroleum Gas (LPG)

- **Project Participants:**
  - Tengizchevroil (a consortium consisting of Chevron (50%), Exxon Mobil (25%), KazMunaiGaz (20%) and LukArco (5%))
- **Project Description and Motivation:**
  - As of January, 2010, Tengizchevroil finished a 4 - year $258 million gas use project to end routine flaring at Tengiz
  - The formerly flared gas is now used as fuel on site, processed and sold to the market or reinjected for enhanced oil recovery.
  - The Tengiz Gas Processing Plant has a design capacity of 12 BCM/year and when the field attains its max production, the expectation is that about a third of the produced gas will be injected into the reservoir with the rest of the gas processed.
  - The project has reportedly reduced flaring emissions by over 94% since 2000 while raising crude oil production within the same period and has been lauded by the World Bank's GGFR. The Bank reports that previously routinely flared gas (including sour gas) is presently gathered and compressed back into processing facilities for more treatment and subsequent export to consumers. Today just the TCO's purge and pilot flares are authorized to depressurize areas of the plant if necessary for safe operations.
  - "The sour gas is processed into sales gas, natural gas liquids and elementary sulfur which is sold for fertilizer and other products" (Chevron, 2008)
- **Project Location:**
  - Tengiz field is located in Northwestern Kazakhstan near the shores of the Caspian Sea in Zone 1
- **Associated Gas Use:**
  - Use all associated gas from the company's own field

APG use case study: Kenlyk LPG project (Zone 3)

Power generation

Gas use and reinjection

Liquefied Petroleum Gas (LPG)

- **Project Participants:**
  - Funded by the Eurasian Development Bank (EDB) for $25 m over a period of 8 years starting in 2008 under an agreement with the Kazakh company Kazfrac LLP. Aggregate project financing was about $31.4m.
- **Project Description and Motivation:**
  - Facility commissioned in 2010 to collect and process APG at the Kenlyk field.
  - As of 2013, produced about 50,000 tons of LPG from 100 million cubic meters of feedstock gas
- **Project Location:**
  - Kenlyk field in Kyzylorda Oblast, Kazakhstan in Zone 3
- **Associated Gas Use:**
  - APG from the Kenlyk field, about 100 million cubic meters of gas used in 2013 for the production of LPG
  - LPG used as fuel by utility companies and as feedstock by petrochemical and organic synthesis plants

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