IHS Markit Energy and Natural Resources

Kazakhstan's National Energy Report 2021

KAZENERGY Eurasian Energy Forum and World Energy Congress

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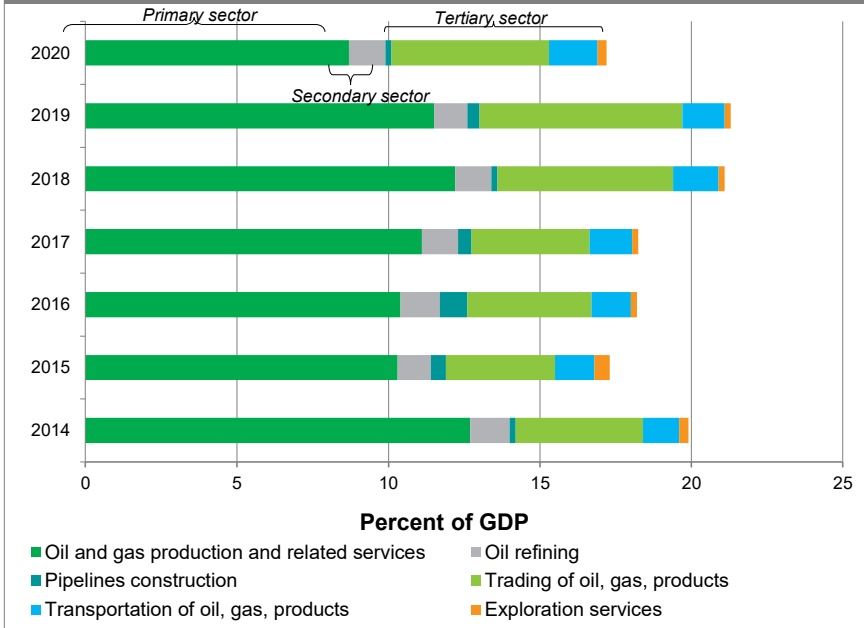
The National Energy Report 2021 (NER 2021): Goals, objectives, audience

- **Provides analytical, internally consistent, and independent overview of major energy sectors in Kazakhstan**
- **NER 2021 analyzes key questions facing Kazakhstan's energy sector, such as:**
  - How is Kazakhstan's energy sector embracing the energy transition? What are the technological, political, and regulatory pathways for decarbonization and achieving carbon neutrality, and how could they potentially be implemented in Kazakhstan?
  - What progress has Kazakhstan made towards achieving its existing Paris Climate Agreement pledges for 2030?
  - What is the outlook for oil and gas production and consumption in Kazakhstan longer term, in the context of the energy transition, COVID-19, and OPEC+ obligations?
  - How is Kazakhstan managing the upcoming energy integration within the Eurasian Economic Union (EAEU)?
- **Update of the main data on Kazakhstan's fuel and energy complex presented in previous National Energy Reports**
- **NER 2021 is intended for Kazakhstan's decision-makers and business leaders, potential investors, thought leaders, and the general public**

Kazakhstan's economy remains heavily dependent on the energy sector: Outbreak of COVID-19 in 2020 brought worst economic contraction (-2.6% decline in GDP) since the early 1990s post-Soviet collapse

After returning to 23% in 2018, the share of the energy sector in national GDP fell to 17% in 2020, driven by lower oil prices and suppressed production

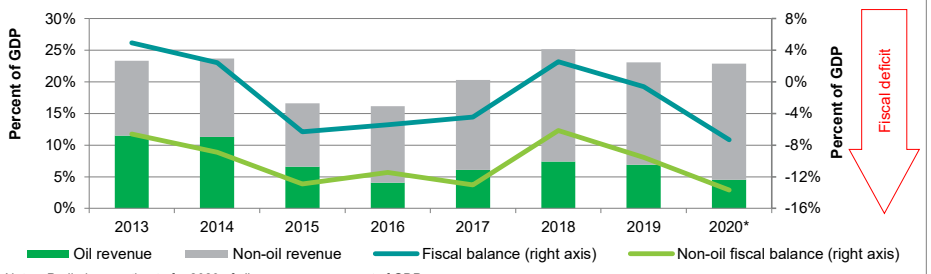
Kazakhstan's oil and gas industry contribution to GDP



Source: IHS Markit, Bureau of National Statistics RK

Lower oil prices in 2020 were key contributors to a growing government budget deficit

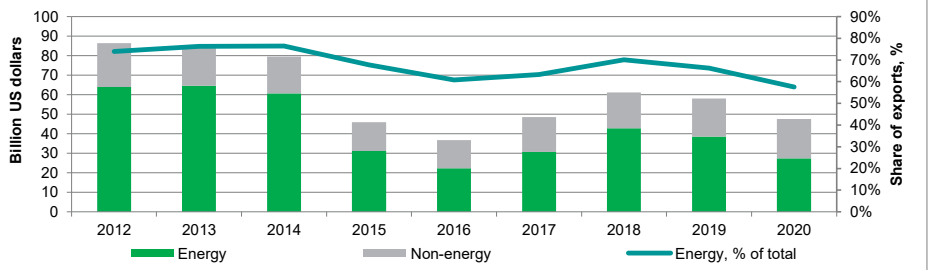
Kazakhstan's government finances, % of GDP



Notes: Preliminary estimate for 2020 of oil revenues as percent of GDP.
Source: IHS Markit, IMF

Energy comprised 58% of country's total export earnings in 2020, down from 66% in 2019

Energy in Kazakshtan's exports*



Notes: *Energy includes all commodities under the Harmonized System Code of 27
Source: IHS Markit, Bureau of National Statistics RK

Contents

Global energy trends and the energy transition

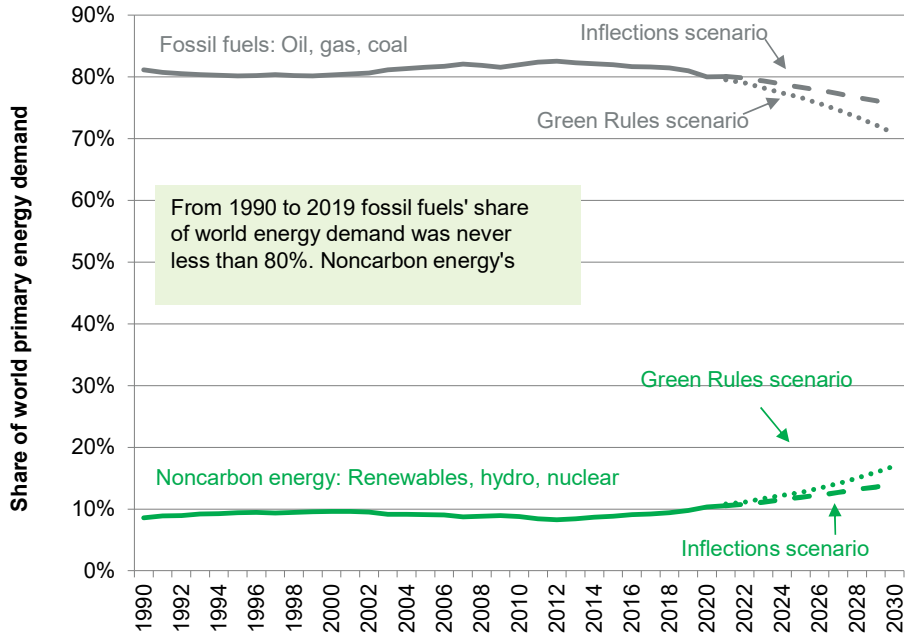
- Energy transition from fossil fuels accelerating globally after 2020.
- Global trend of tightening carbon regulation (such as CBAM in Europe) presents major impetus for broader systemic reforms of energy sector.
- But there is still a sizable role for oil and gas in the global energy balance through 2050.

2020 represents a pivot point for the global energy transition: Moving it beyond slow motion to a faster pace of change

Why was 2020 a pivot point?

- Sharp fall in fossil fuel demand with pandemic
- Government “green” plans: China, EU, Japan, South Korea, Brazil—and Biden’s election in the US
- Money flows: Away from oil, toward renewables
- Approaching “e-day” (when there is no higher cost or premium for “greener” options – e.g., cars, electricity, cement)
- Energy company commitments
- Accumulation of years of policy support and declining costs for wind, solar, and batteries
- Proliferation of net-zero pledges by countries and international movement towards regulating carbon
  - Over two-thirds of global GHG emissions come from countries that have issued net-zero pledges .. and the share continues to rise

Range of shares to 2030 of global energy demand for fossil fuels and noncarbon energy

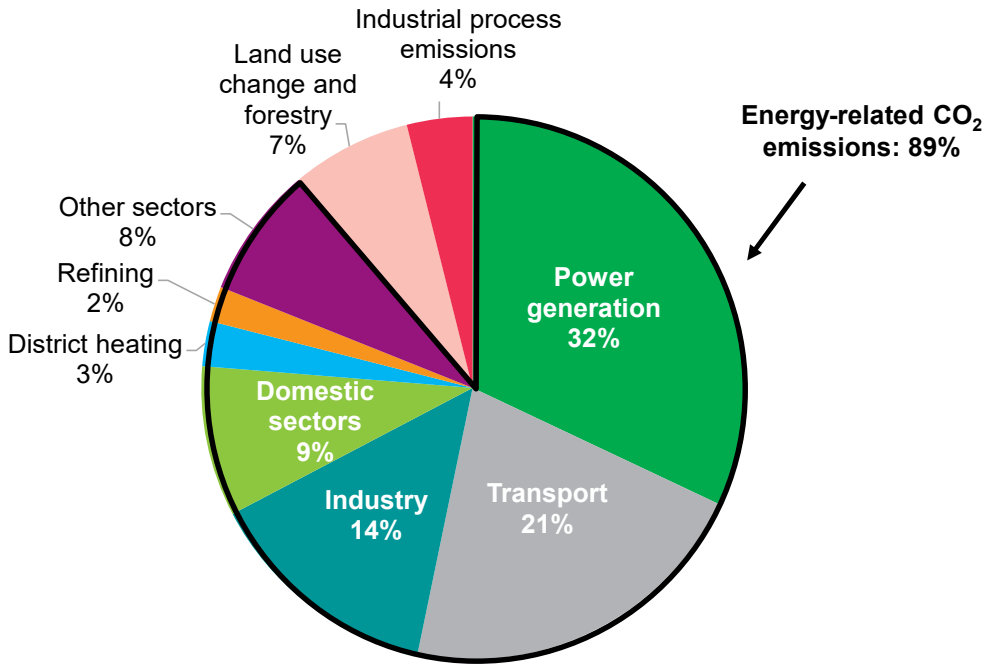


Note: The upper and lower ranges to 2030 are from the IHS Markit Inflections and Green Rules scenarios.
Source: IHS Markit

The Energy Transition is a (likely protracted) process of moving to a lower carbon world to combat global climate change stemming from GHG emissions

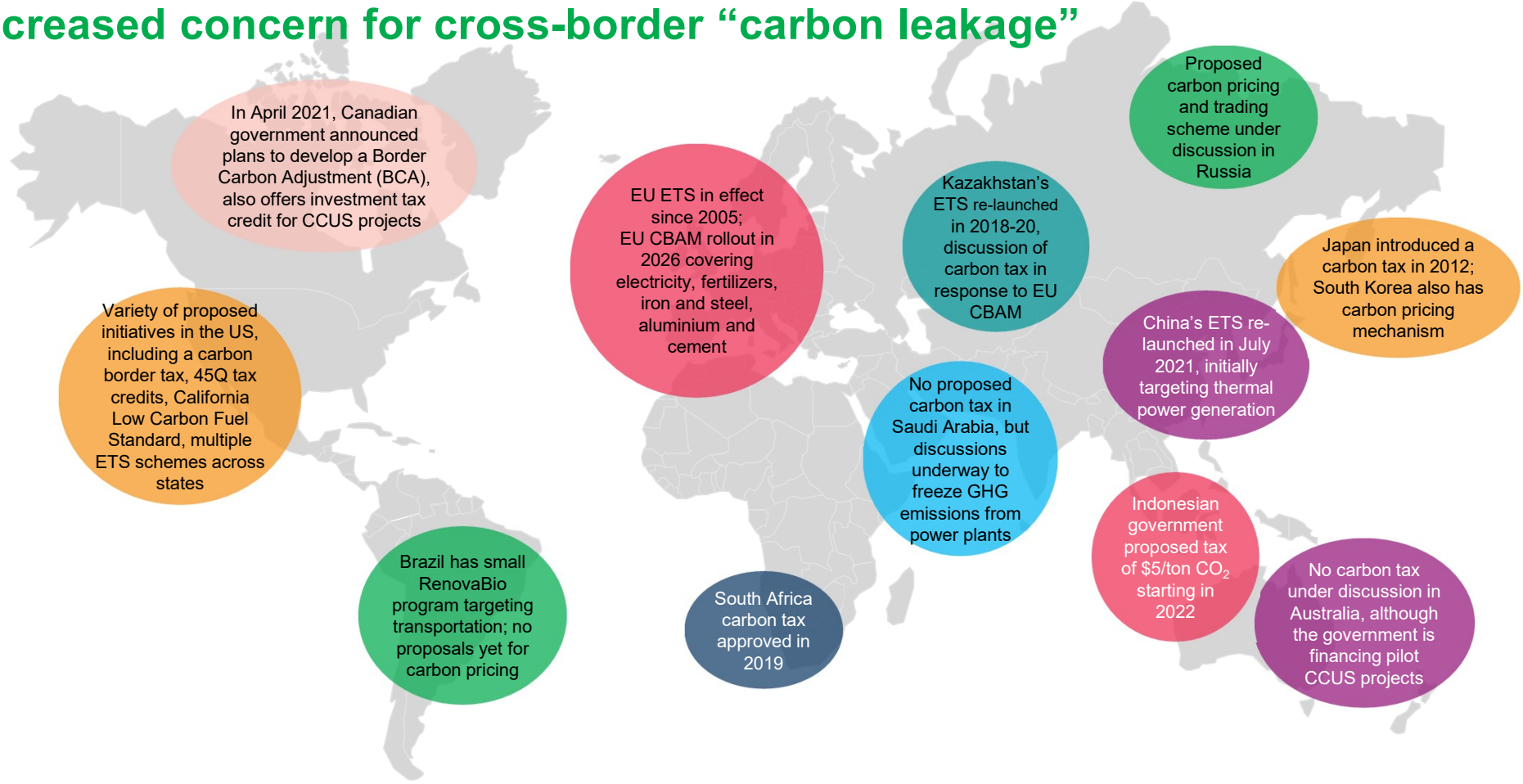
- Energy use accounts for ~90% of CO_2 emissions globally, and the sector is under considerable pressure to ease climate “crisis”
- Moving towards a lower carbon future will impact demand and supply of different fuel types in fundamental ways
- Energy transition is now part of international energy context and lexicon
- Decarbonization of energy use and non-energy contributors is an urgent priority for many stakeholders
- Pace of energy transition will be largely determined by government policies, but pressure from financial institutions, economics, technology advances, and public will also impact its rollout

Global CO_2 emissions by economic sector



Note: Gt = billion metric tons of carbon dioxide equivalent; 2016: about 37.4 Gt.
Source: IHS Markit, International Energy Agency (IEA), WRI

Growing trend for national regulation of carbon emissions, and with it, increased concern for cross-border "carbon leakage"



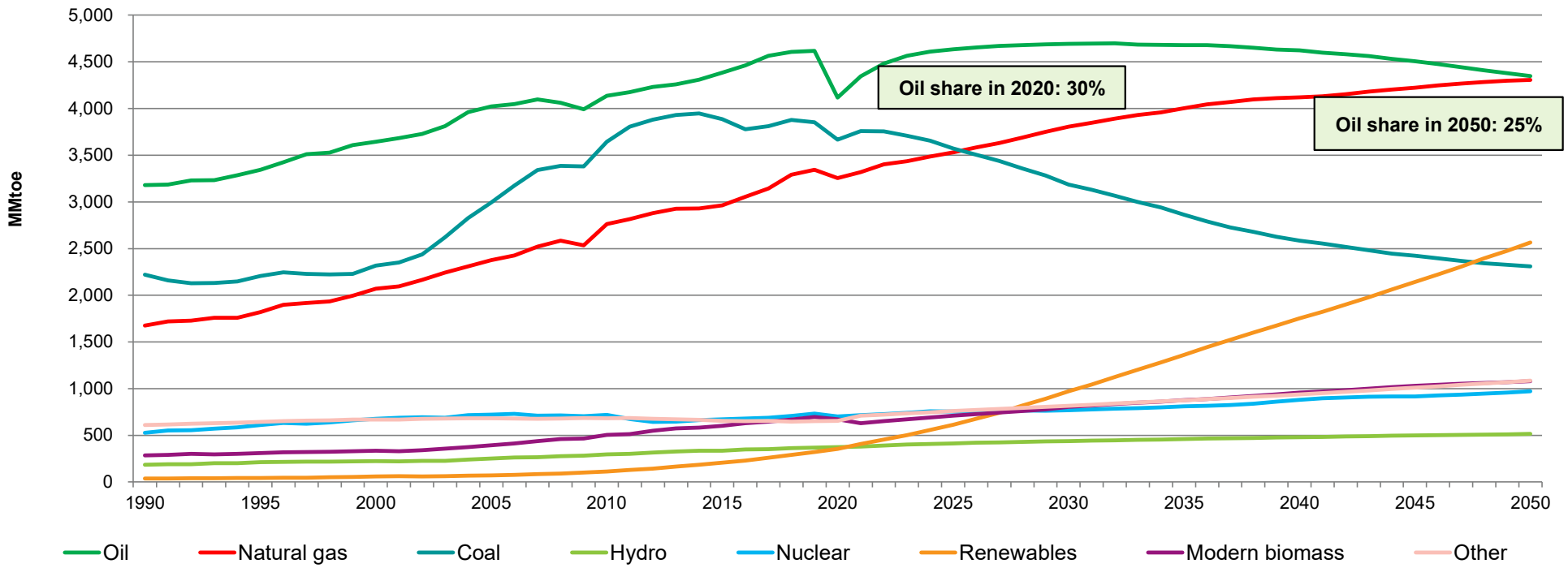
Europe's CBAM proposal threatens mainly Kazakh exports of certain carbon-intensive manufactured goods rather than exports of primary fuels

- **Goals of Carbon Border Adjustment Mechanism (CBAM)**
  - To protect decarbonizing domestic producers from lower-cost, more carbon-intensive imports ("prevent carbon leakage")
  - To use Europe's role as a major trading partner to advance decarbonization agenda in other countries through access to Europe's markets
  - Means to increase EU's "own resources"—funding that is not dependent on direct budget contributions from member states
- **CBAM proposed as an import duty pegged to price of carbon allowances on Europe's carbon market**
  - CBAM coverage limited to a small number of industries currently included in EU's ETS; initial stage includes a very short list of sectors (steel, aluminum, cement, fertilizers, electricity), with coverage planned to be expanded in later phases
  - Mechanism aligned with World Trade Organization (WTO) rules through consistent treatment of domestic and imported goods, with progressive phase-out of free allowances for domestic producers of these goods
  - CBAM still can be applied selectively, depending upon how other countries implement decarbonization programs
- **Fuels (crude oil, natural gas, coal, and refined products) and petrochemicals are <u>not</u> included in the first iteration of CBAM**
  - Covered in ETS at points of consumption; precombustion emissions may be included in a future iteration of CBAM
  - Kazakhstan's exports to Europe of CBAM-listed goods amounted to only ~$193 million in 2019-20, representing a mere 0.3-0.4% of total annual national export earnings

Inflections (base-case) outlook for global primary energy demand: Oil demand plateaus in mid-2030s; gas demand continues to grow through 2050

Oil and gas still account for 50% of global energy demand in 2050; renewables grows to 15%

Inflections: Primary energy demand by fuel, 1990-2050

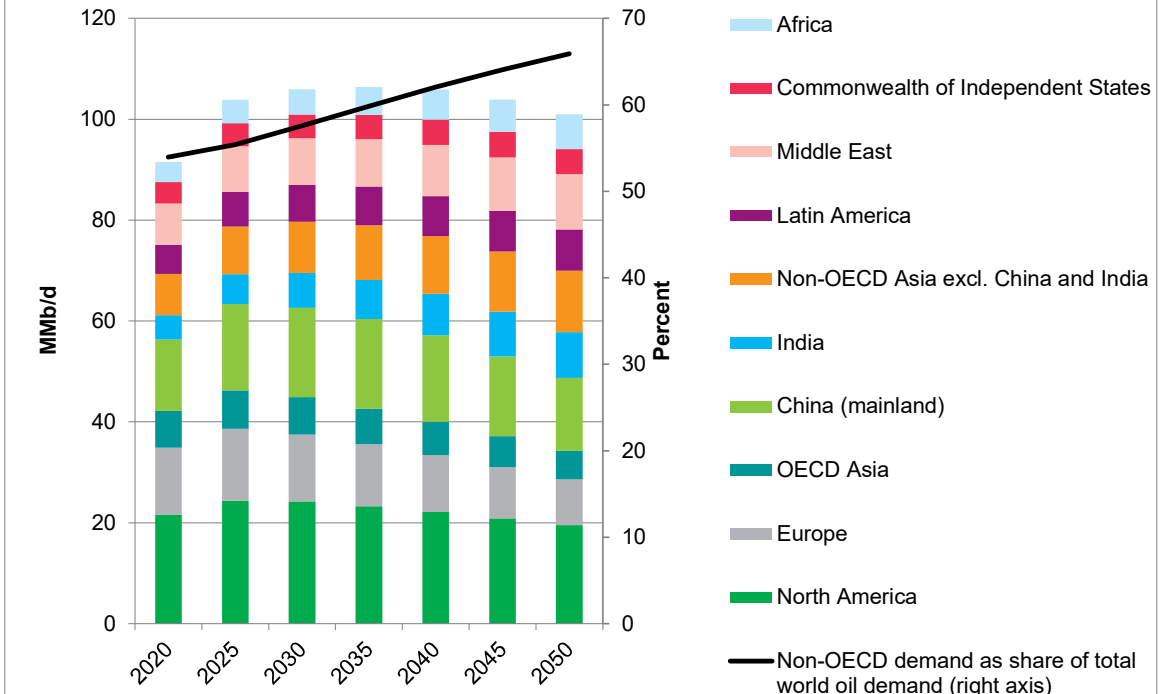


Source: IHS Markit

Despite many contrary views, we believe oil will continue to play key role during the energy transition; total liquids demand expected to grow in non-OECD countries during 2021-50

- Global oil demand increasingly bifurcated between developed and developing economies
- Non-OECD share of global liquids consumption rises from 54% in 2020 to 66% in 2050 in base case
- Asia Pacific market remains chief center of global oil demand growth longer term, supplied increasingly from outside the region
- Europe's indigenous crude oil production falls even more precipitously than liquids consumption, leaving Europe highly dependent on oil imports to meet remaining (albeit declining) demand
- US oil demand also slowly contracts overall from early 2030s; its crude oil and gas condensate production reaches maximum in 2030

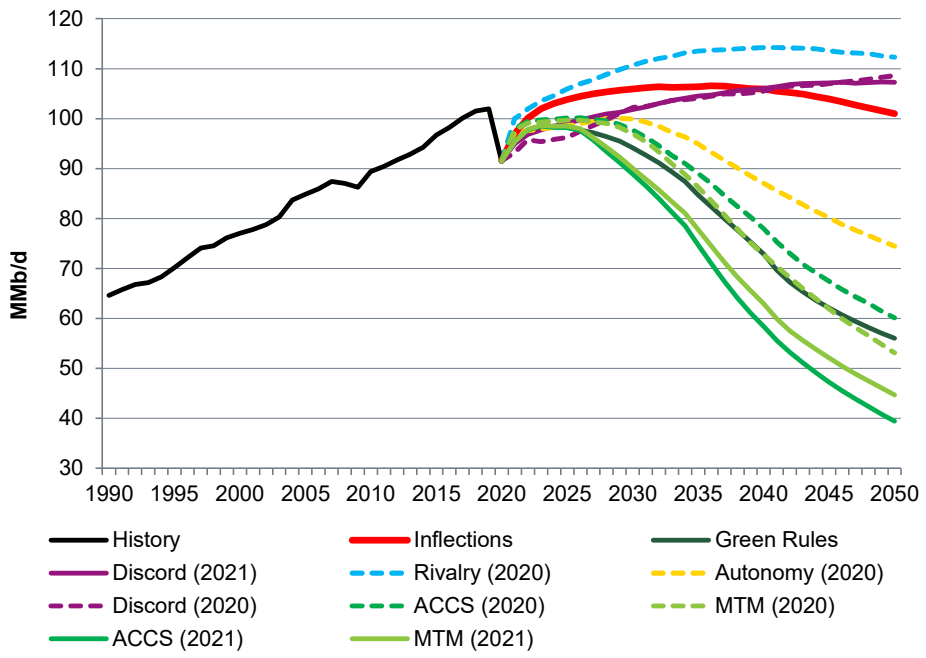
Geographic distribution of global liquids demand to 2050 in the IHS Markit base case (Inflections) scenario



Source: IHS Markit

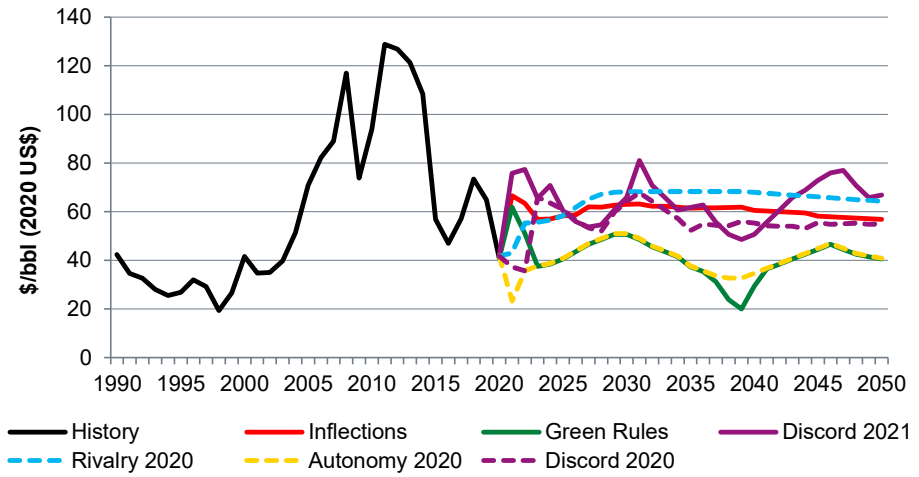
Further drill-down on world oil demand: COVID-19 repercussions and acceleration of energy transition reduce our long-term demand expectations; but in base case (Inflections), world oil demand simply resets to lower level while resuming previous trajectory

Total oil (liquids) demand, 1990–2050



Note: Oil "liquids" demand crude oil as well condensate, biofuels and other liquids (includes GTL (gas to liquids), CTL (coal to liquids), nonrenewable oxygenates, refinery additives and oil shale (kerogen).
ACCS = Accelerated Carbon Capture; MTM = Multitech Mitigation.
Source: IHS Markit

Average annual crude oil prices (real), 1990–2050

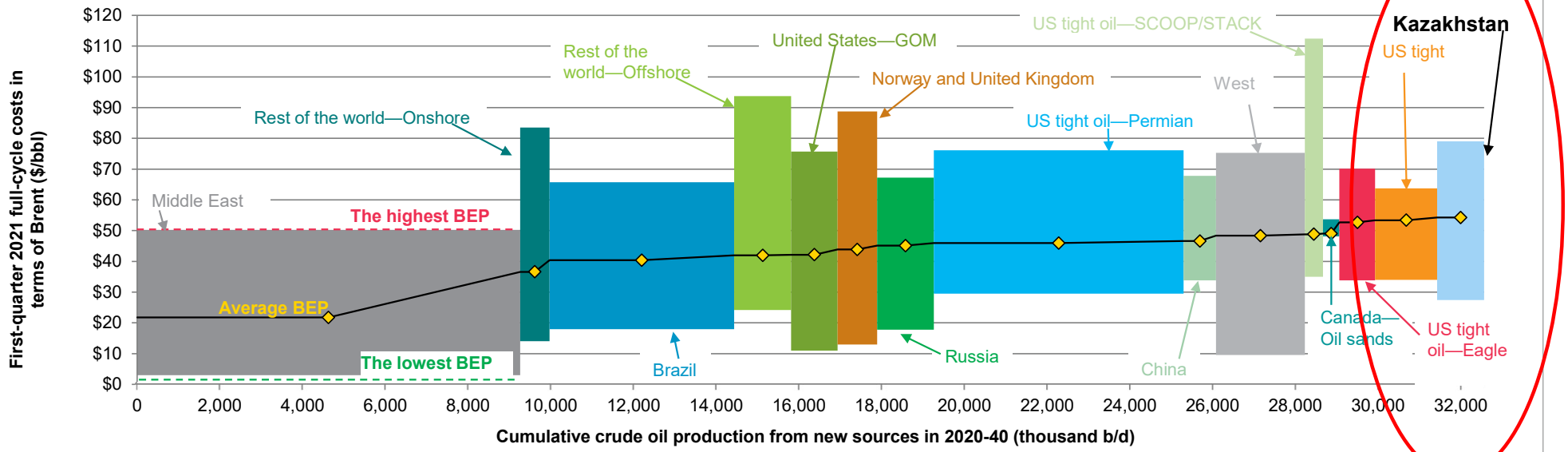


Note: Dated Brent
The crude prices used in the ACCS and MTM outlooks in 2020 were the same as Autonomy. The ACCS and MTM prices in the 2021 outlook are the same as Green Rules.
Source: IHS Markit

Our expectations for average annual oil prices longer term reflect changed supply and demand conditions; we still expect oil price volatility to be a key feature of global oil markets, but price cycles will be of much shorter duration because of the larger share of "short-cycle" (responsive) barrels in overall supply.

Does Kazakhstan have "advantaged" barrels that allow it to garner an increasing share of global oil supply? Most sources of projected incremental global crude oil supply (through 2040) can break even below $50/bbl Brent (in constant 2020 dollars)

Cost curve of new global crude oil supply in select areas in 2040



Note: The cost curve's horizontal axis shows production in 2040 from new projects expected to start production between 2021 and 2040. For a selected country/region/play, the upper side of the bar corresponds to the highest BEP, the lower side of the bar to the lowest BEP, while the width of the bar represents crude oil production from new sources in 2040. New sources of oil equal any volumes from projects that were not producing as of 2020, including sanctioned projects, unsanctioned projects, and assumed discoveries. GOM = Gulf of Mexico. The Middle East includes both offshore and onshore projects in Saudi Arabia, Kuwait, the United Arab Emirates, Iraq, Iran, Oman, Qatar, and Bahrain. West Africa includes both offshore and onshore projects in Angola, the Republic of the Congo, Equatorial Guinea, Ghana, and Nigeria. Rest of the world–Onshore and Rest of the world—Offshore categories include all production from respective projects, not included in other countries or regions. The global supply shown does not include all producing areas (in part so as not to reduce clarity of the supply stack figure) and represents 89% of total global production from new projects.

Source: IHS Markit

Kazakhstan's are not the most expensive barrels in the world to produce, but currently most of its "new" barrels still lie at the high-end of the global cost curve.

Overview of energy transition issues in Kazakhstan

- Kazakhstan's officially reported GHG emissions totaled 364.5 MMt CO_2e in 2019, down 6% from 388 MMt CO_2e in 2018.
- To achieve Kazakhstan's INDC (unconditional) emissions target of 328.4 MMt CO_2e by 2030, this positive downward trend would have to continue: Kazakhstan would need to have total GHG emissions contract by almost 11% relative to 2019. This is certainly possible if:
  - Gasification expands at an accelerated pace, displacing coal consumption
  - Already-sanctioned and already-programmed renewable projects materialize as planned
  - Energy efficiency improvements across the economy continue apace
  - GHG emissions from non-energy sectors—industry, agriculture, LULUCF, and waste —also decline substantially
- Althought certainly not a foregone conclusion, given its current trajectory, Kazakhstan looks unlikely to achieve its INDC conditional emissions target by 2030; national GHG emissions are likely to drift upwards again with economic recovery in 2020s; a more concerted effort is needed to reverse this.
- The more ambitious goal of net-zero emissions by 2060 requires an even broader-based transformation of the entire economy, involving an acceleration of these same pathways as well as other decarbonization initiatives (e.g., electrification of transport and heating, changes in livestock operations); these changes require large investment outlays, so a cogent policy that creates an appropriate pricing framework and an attractive investment climate will be needed.

Several key policy "pathways" for decarbonization of economic activity

No "one-size-fits-all" solution: A multitude of different approaches will be deployed, depending on local conditions

Energy efficiency

- Policies stimulating investment in energy efficiency and modernization
- Policies for households
- Business sector policies

Fossil fuel diversification

- Solar, wind, and other renewables
- Carbon capture, use, and storage (CCUS)
- Nuclear generation
- Fuel switching to gas and retirement of coal-fired capacity
- Biofuels; hydrogen

Electrification

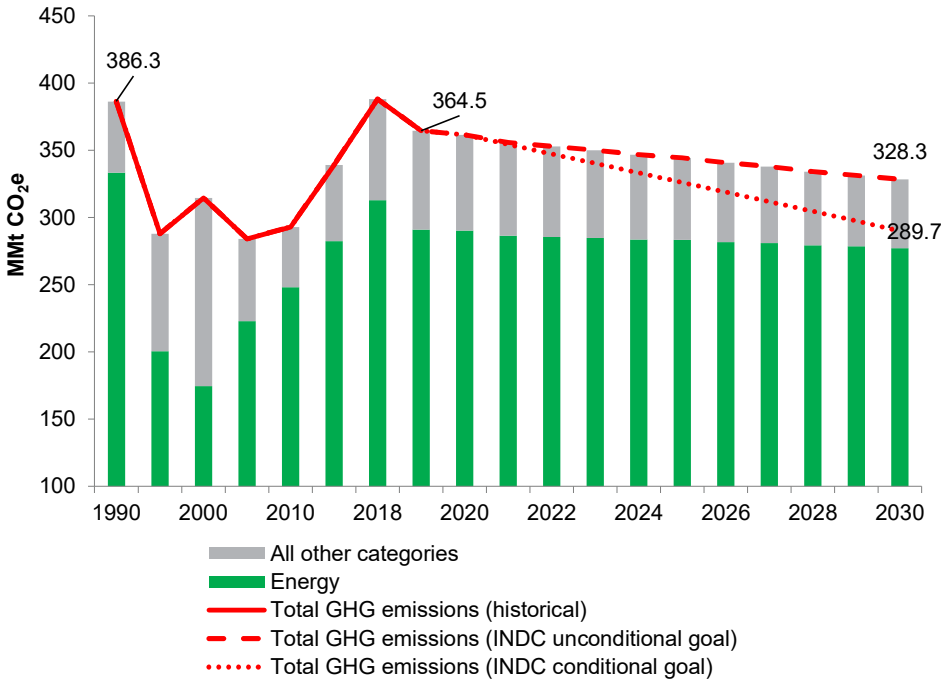
- Electrification of transportation system
- Substituting electrified rail for heavy-duty trucking (goods) and for aviation (people)
- Improved efficiencies
- Hydrogen production from renewables

Carbon offset options

- Voluntary carbon markets
- Compliance-based markets
- Investments in nature-based environmental projects to absorb carbon

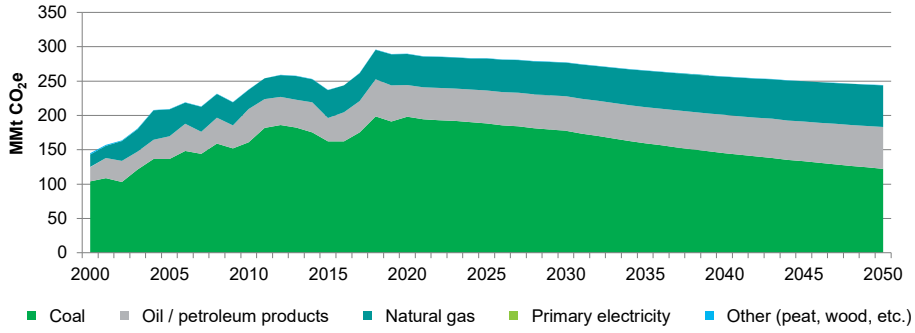
Kazakhstan's total GHG emissions amounted to 364.5 MMt in 2019: Barring expeditious and targeted action, Kazakhstan is unlikely to achieve its (unconditional) Paris Climate Agreement INDC goal for 2030 (of 15% reduction versus 1990)

Kazakhstan's GHG emissions by sector and outlook (INDC compliant)



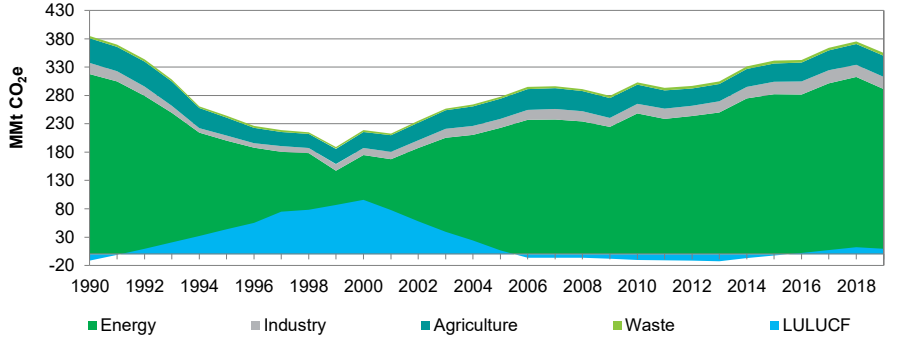
Note: All other categories includes industry, agriculture, LULUCF and waste. GHG emissions in 1990 taken from Kazakhstan's 2021 NIR to the UNFCC.
Source: IHS Markit, Zhasyl Damu

IHS Markit base-case outlook for GHG emissions from energy use in Kazakhstan



Source: IHS Markit

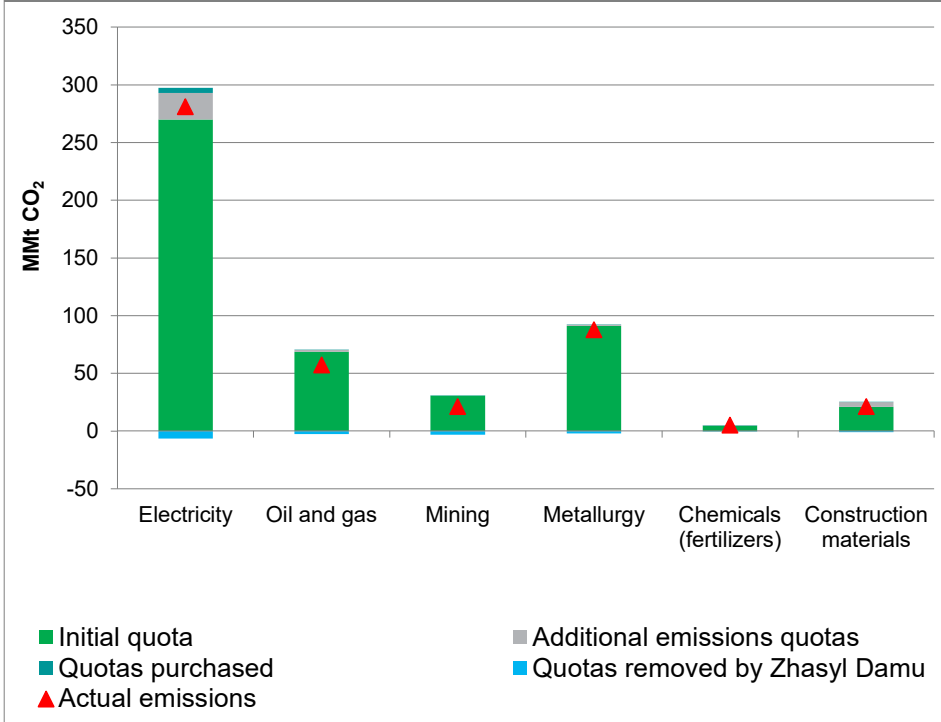
Kazakhstan's historical GHG emissions by sector



Source: IHS Markit, Zhasyl Damu

Kazakhstan's carbon trading system (ETS) for CO_2 emissions relaunched in 2018-20; but lackluster results, especially as an instrument for CO_2 reduction

Aggregated sectoral performance for Kazakhstan's ETS, 2018-20



Source: IHS Markit, Zhasyl Damu

- Kazakhstan's ETS, overseen by Zhasyl Damu, relaunched in 2018-20 covering 130 entities (225 technical installations) across five major sectors; these participating entities accounted for 53% of Kazakhstan's total CO_2 emissions in 2019
- The top 15 emitting companies in the ETS responsible for 38% of total national CO_2 emissions in 2019 (and 36% in 2018)
  - Electricity companies among most actively participants in trading; they most frequently exceeded their initial emissions quotas
  - Most upstream oil and gas operators complied with quotas; midstream operators had lowest compliance (initial quotas set too low?)
  - Mining sector's quotas were probably too generous from outset, as they easily remained within them
- Kazakhstan's ETS requires further fine-timing for improved effectiveness; current operation entirely undermines any notion of a transparent market-based mechanism
  - Few trades and the resulting carbon prices very low without any fluctuations
  - Greater transparency on quota allocation mechanisms needed; companies seemingly able to secure additional quotas rather than actively trade or reduce their emissions
  - Actual emissions of entities not publicly accessible
  - Existing company procurement practices, rules preclude flexible carbon trading

Kazakhstan's oil industry: Accomplishments and challenges

Accomplishments:

- Kazakhstan part of OPEC+ (Vienna Alliance) to rein in oil production and rebalance global markets during 2017–21; the country has benefited from higher prices during periods of world oil demand weakness; aside from mid-2020 when the collapse of demand drove oil producers everywhere to reduce output, Kazakh "mega" project schedules have remained key driver of Kazakhstan's production profile rather than Kazakh OPEC+ commitments.
- Although COVID-19 and the resulting OPEC+ "mega" cut in 2020 ended the ongoing expansion of Kazakh oil production in 2017–19, upstream investment has remained largely intact; the IHS Markit outlook is for a production rebound in the 2020s—led largely by expansion of Tengiz and Kashagan projects.
- Completion of $6 billion refinery modernization program in 2018 at Kazakhstan's three major plants—Atyrau, Pavlodar, and Shymkent—underpinned lightening of average refined product barrel, shifting Kazakhstan to self-sufficiency in motor gasoline and allowing country to become a gasoline exporter.

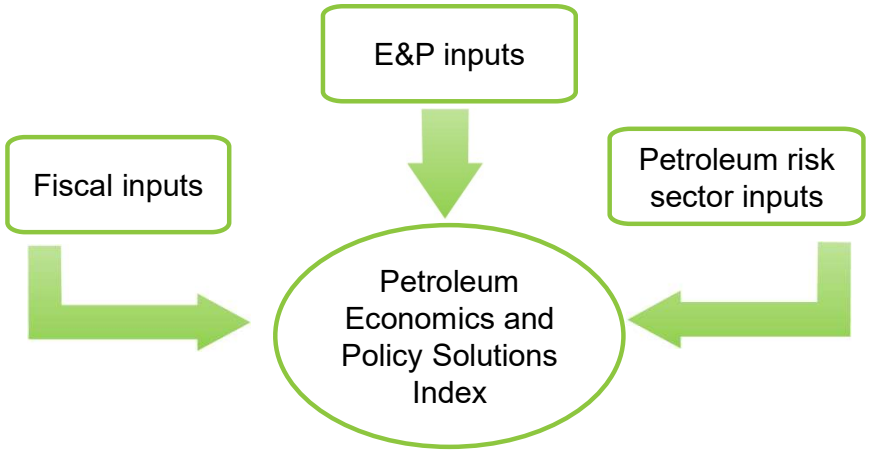
Challenges:

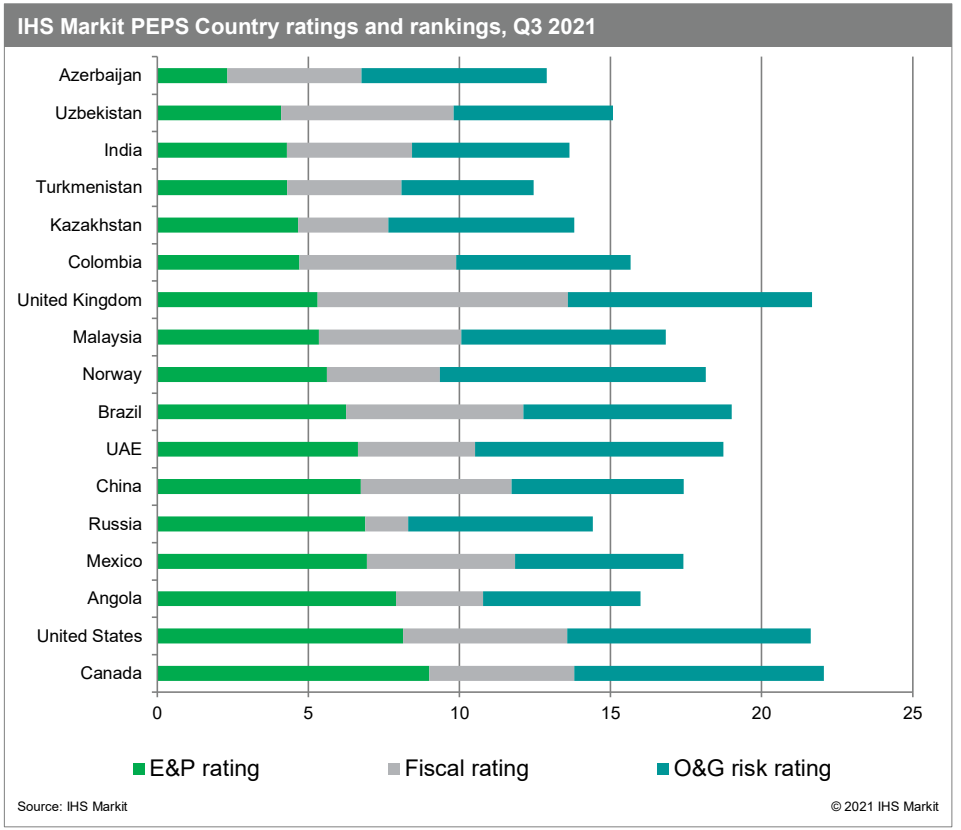
- Relatively high upstream oil production costs, including a high government tax take, render producers vulnerable to low oil prices, and challenge upstream investment longer term.
- Much of Kazakhstan's considerable remaining upstream oil potential may never be developed, given not only high upstream costs but also a more limited upstream investment appetite among companies longer term from the ongoing global energy transition and a less attractive business environment than is found in many other hydrocarbon-producing countries.
- Over-regulation of Kazakhstan's downstream oil sector, reflected in artificially low domestic oil prices, remains a serious impediment to industry development, and an increasing risk for producers as domestic consumption claims a growing share of national oil output.

Overall investment attractiveness is critical for attracting upstream investment globally as companies increasingly seek "advantaged" barrels

Kazakhstan ranked 52 out of 119 markets in IHS Markit PEPS rankings, driven largely by the country's poor fiscal rating

- **Petroleum Economics and Policy Solutions (PEPS) Index** - assesses not only fiscal terms but other factors important for upstream investment, including availability of resources and above-ground risks
- Successive introduction of revised Tax Code, Subsoil Code, and EcoCode in recent years have so far failed to significantly transform Kazakhstan's upstream investment climate
- The planned introduction of the Improved Model Contract (IMC), formed in collaboration with the Foreign Investors Council, could improve Kazakhstan's overall attractiveness

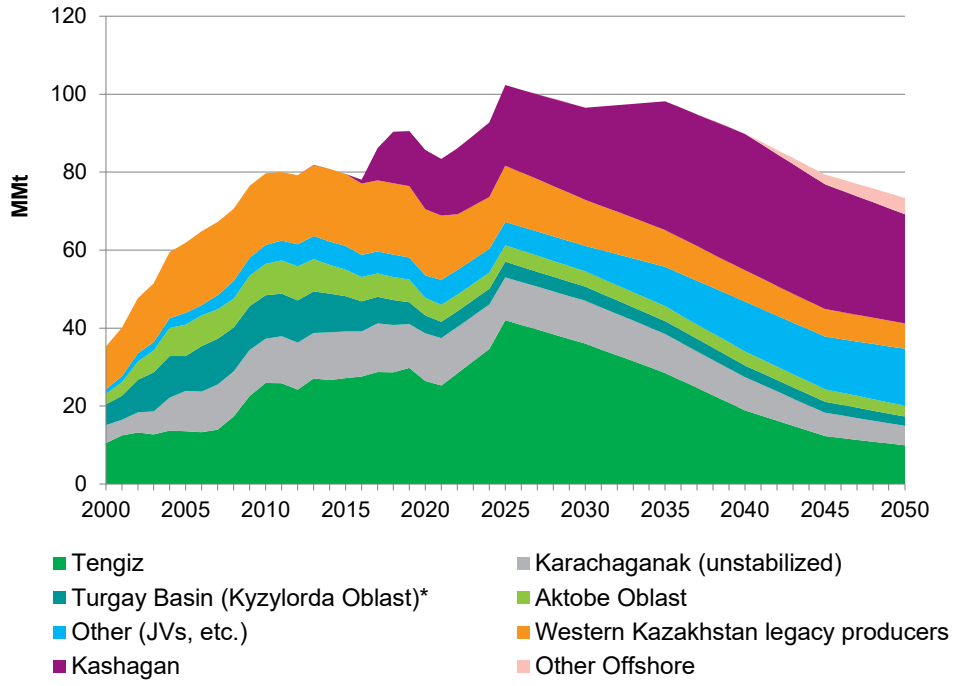




Kazakhstan's oil production expected to return to growth trajectory in medium term, as mega projects expand; but longer term, national production reaches a maximum of only about 102 MMt (2.17 MMb/d) in mid-2020s before slowly contracting, falling to around 73 MMt (1.53 MMb/d) in 2050

- National oil production fell by 5.4% in 2020, but winding down of current OPEC+ deal by end of 2022 sets stage for rebound
- IHS Markit outlook is for expansion of total Kazakh oil production by around 18% during 2021–30, centered primarily at Tengiz and Kashagan, after which aggregate production stagnates and declines
- "Big 3"—accounting for around 63% of national output in 2020—remain key drivers of overall trajectory
  - Tengiz: launch of major Future Growth Project
  - Kashagan: successful ramp-up and debottlenecking, followed eventually by modified Phase 2 development
  - Karachaganak: reached amicable, comprehensive settlement of long-standing issues, facilitating debottlenecking and other projects that maintain oil output near current plateau through 2030s
- KazMunayGaz (KMG) legacy assets expected to experience an attenuated decline longer term with progressive implementation of new technologies for mature fields
- Smaller, independent oil producers clearly could play greater role in Kazakhstan, but realization of this potential depends on greatly improved business conditions for them

Outlook for Kazakhstan's oil production by major project/region to 2050 in the base case

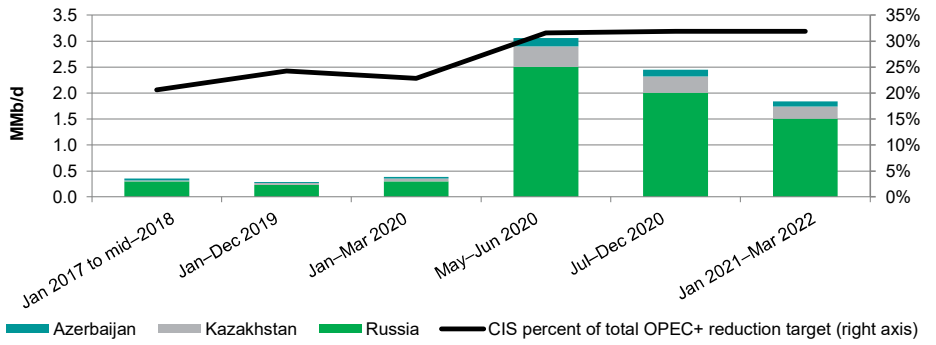


Notes: *Includes Amangeldy in Zhambyl Oblast.
Source: IHS Markit (Eurasian Oil Export Outlook)

Much greater CIS role in OPEC+ 2020 "mega" deal than previous ones; But Kazakh compliance remains challenged despite condensate exemption

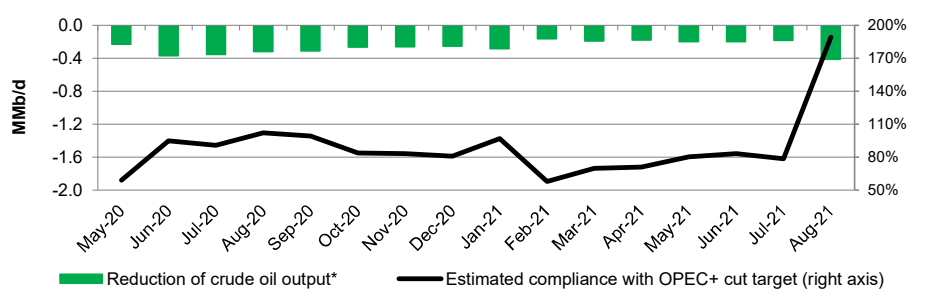
- **CIS member's collective share of OPEC+ cuts targets rose from about 21% in first round of cuts in 2017 to around 32% during initial phase of April 2020 mega deal**
  - The increased CIS role largely reflects Russia's move from being peripheral player in world oil market management to a more central role—putting Russia on par with Saudi Arabia
- **With global oil demand and price rebound in 2021, preservation of OPEC+ unity has become more challenging**
  - During February-April 2021, Russia and Kazakhstan were the only OPEC+ members allowed to increase output (ostensibly to cover domestic demand), reducing net CIS share of cuts, before synchronized quota changes resumed in May 2021
  - Vienna Alliance agreed in July 2021 to extend supply management through end of 2022, with collective increases of 400,000 b/d starting in August 2021
  - Upward adjustment of production baselines from May 2022 for UAE, Russia, Saudi Arabia, Iraq, and Kuwait
- **Overall CIS compliance rate higher compared with previous OPEC+ deals, but with considerable variation**
  - IHS Markit estimates that monthly Russia's compliance through August 2021 ranged between 88% to 103%, while Azerbaijan's was 98% to 134%
  - Kazakhstan's compliance has varied from 59% to 189%; Kazakhstan's average compliance for 2020 was 87%; during January-August 2021 the average compliance rate rose to 91% due to Tengiz maintenance in August (when compliance rose to 189%)

CIS countries' shares of OPEC+ oil output reduction targets (initial plans)



Notes: The Russian cuts programs included both crude and condensate through 2019 and crude only starting in January 2020; the Kazakh and Azeri cuts programs included both crude and condensate through March 2020 and crude only starting in May 2020.
Source: IHS Markit

Kazakhstan's crude oil output cut vs. baseline month, May 2020 onward

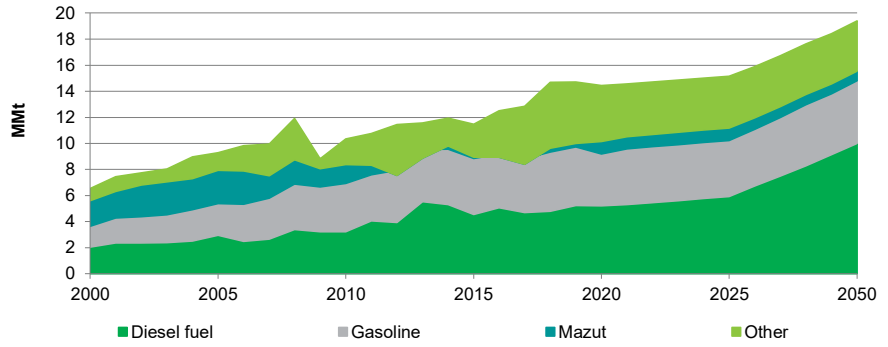


Notes: *Reduction compared with October 2018 production baseline.
Source: IHS Markit

Kazakhstan's domestic market (refineries) set to claim a growing share of national oil output longer term; but domestic oil prices must rise to ensure adequate domestic crude deliveries

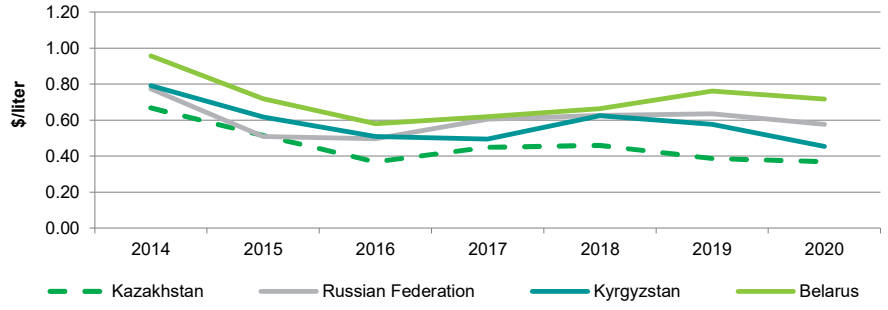
- COVID-19 hit Kazakh refiners' markets hard overall: Kazakh refinery throughput fell by 7.2% to 15.8 MMt in 2020
- Aggregate domestic apparent refined product consumption now rebounding, and expected to reach 2019 level again in 2022; it appears set to grow by around 34% altogether during 2020-50, driven heavily by increased diesel demand (mainly by trucking and agriculture), with gasoline demand growth remaining more muted
- Bulk of Kazakh upstream oil output continues to be directed to export markets, but share of total production directed to domestic markets likely to increase from around 20% in 2020 to 30% in 2050
- Further Kazakh price liberalization critical to ensure domestic markets remain supplied with contraction of KMG's legacy upstream production
  - Kazakh refining sector/domestic refined product markets remain highly administered; margins on domestic market deliveries of crude typically remain much lower than on exports
  - Imperatives of EAEU oil market integration also necessitate higher domestic prices for Kazakhstan to operate as part of genuine common market; Kazakhstan still has lowest retail gasoline and diesel prices of any EAEU member state

Outlook for apparent consumption of refined products in Kazakhstan



Source: IHS Markit

Average retail prices of A-92 gasoline in selected EAEU countries



Source: IHS Markit

Kazakh natural gas industry: Accomplishments and challenges

Accomplishments:

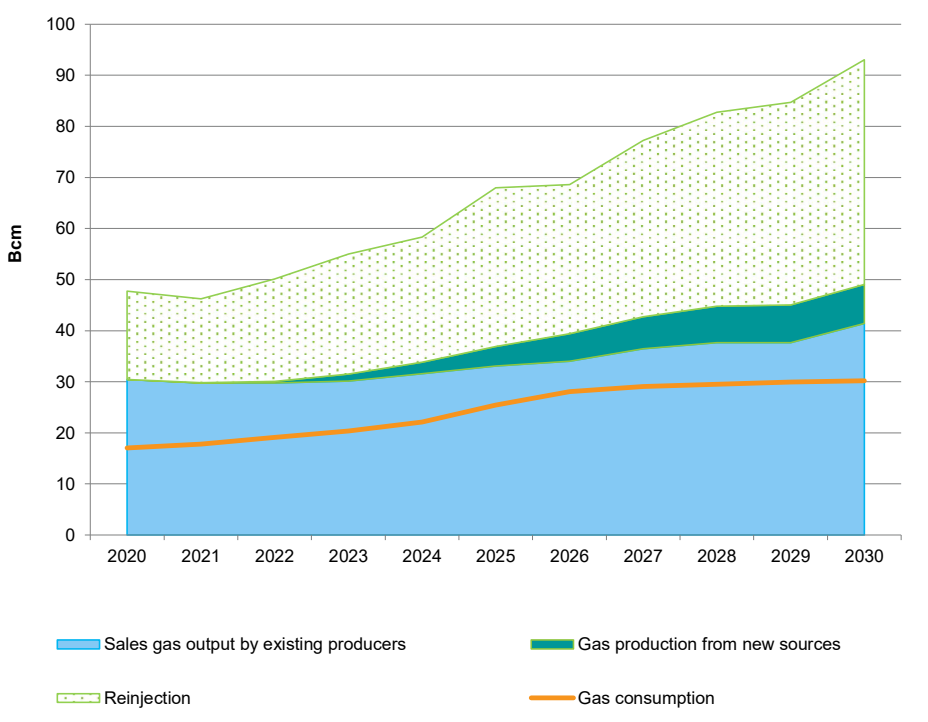
- Natural gas production (gross extraction) had been increasing rather robustly until 2020, boosted mainly by growth in output at Kashagan, while commercial production (gross output minus reinjection) had also been on rise. Because the bulk of Kazakh production is associated gas, output trends are driven mainly by oil developments.
- The gasification of Kazakhstan is a strategic priority for policymakers; by the end of 2020, 53% of Kazakhstan's population had access to piped natural gas. Actual (end-of-pipe) gas consumption nearly doubled over past decade, from 9 Bcm in 2010 to 17 Bcm in 2020.
- Kazakhstan's gas exports to China grew from less than 1 Bcm in 2015, to 7.4 Bcm in 2020; exports to China provide the national gas company KazTransGas (KTG) with a source of revenue sufficient to offset its financial losses on gas sales in the domestic market.

Challenges:

- The combination of low prices for producers of gas and low end-user prices threatens Kazakhstan's gasification goals, by dis-incentivizing production of commercial gas and also discouraging its efficient use by consumers.
- Exports to China are likely to be undermined longer term by rising domestic needs combined with constrained commercial supply; Kazakhstan will have to make hard choices between exports to the lucrative Chinese market or making more gas available in (mainly unprofitable) domestic markets.

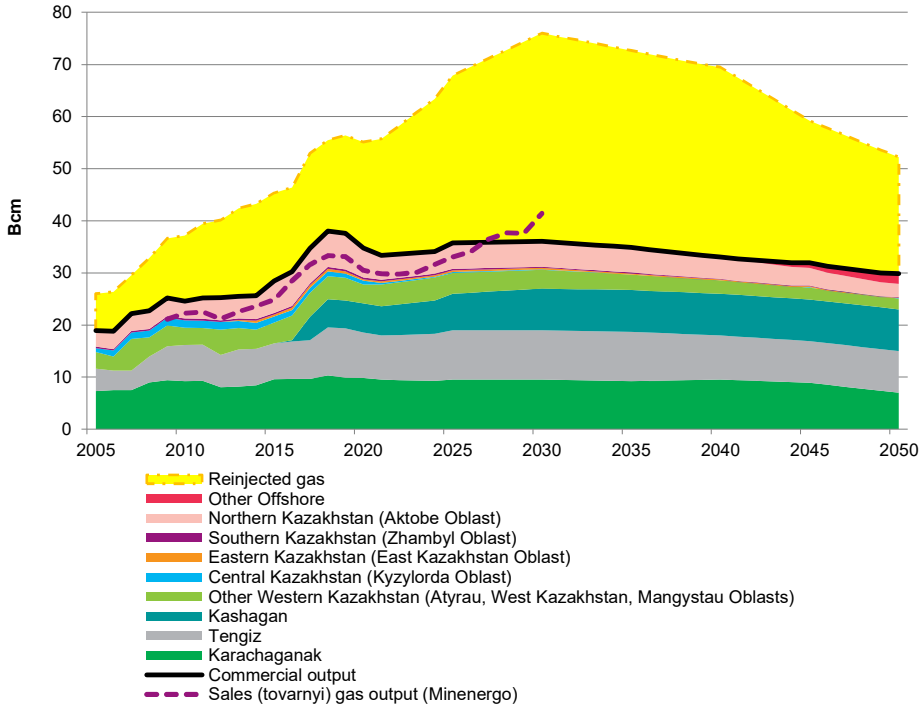
Natural gas is primarily produced as a byproduct of oil production; high reinjection needs and low domestic gas prices limit commercial output

Kazakhstan's Ministry of Energy outlook for natural gas balance to 2030



Source: Ministry of Energy RK, IHS Markit

Kazakhstan's gas production profile to 2050: IHS Markit base-case outlook



Notes: For the purposes of this report, IHS Markit defines commercial gas volumes as gross gas production minus reinjected volumes; therefore, commercial production includes volumes that disappear as other upstream usage and losses. This is not the same as the volume of "sales gas" production (tovarnoye proizvodstvo) reported by the Ministry of Energy RK, which appears to exclude reinjection, impurities, and other upstream usage and losses.

Source: IHS Markit, Ministry of Energy RK

Gasification is a strategic priority for Kazakhstan, with substantial investment in new transmission pipelines and local distribution networks

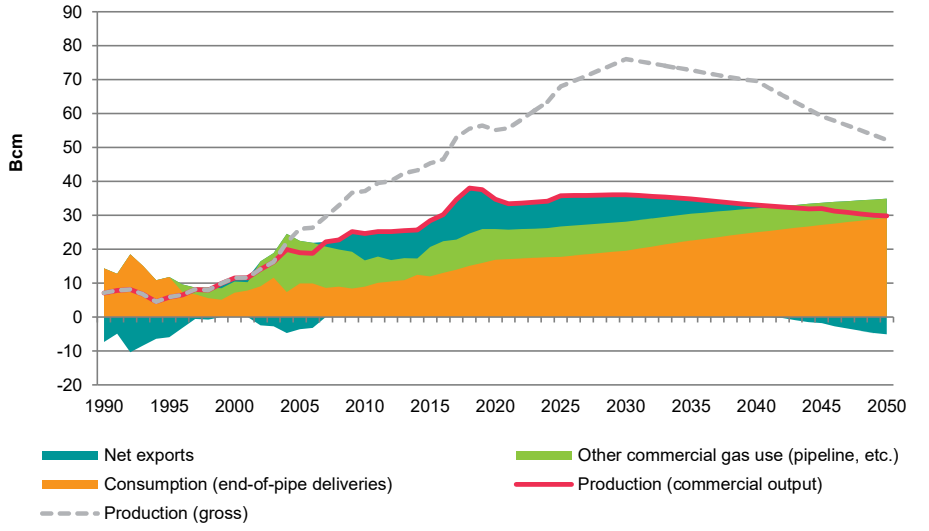
Share of gas in primary energy consumption was 23% in 2020, and expected to reach 29% by 2040

Kazakhstan's domestic gas consumption (end-of-pipe) in 2020 and outlook to 2040 by consumption zone

- Kazakhstan's gasification level rose from 43% in 2014 to 53.1% in 2020. Kazakhstan is on track to achieve the goals of its General Scheme for the Gasification of the Republic of Kazakhstan for 2015–30, which calls for 56% of Kazakhstan's population to have access to piped gas by 2030.
- Prior to completion of Phase 1 of the SaryArka pipeline, only 10 out of Kazakhstan's 14 oblasts and two of three republic-level cities had access to piped gas. By 2030, following the full buildout of SaryArka, at least some areas of all oblasts and the three republic-level cities will have access to piped gas.
- Total government investment in Kazakhstan's gasification was about 121 billion tenge ($317 million) in 2015-19 and another 194 billion tenge ($547 million) is planned for 2020-23.

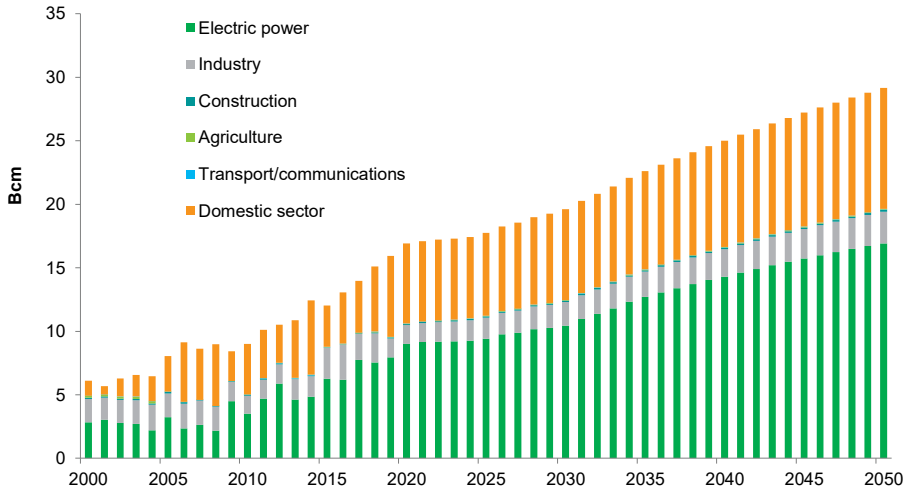
As domestic consumption grows, a tightening gas balance presents a difficult choice between exports and domestic deliveries

Kazakhstan's natural bas balance - base case



Source: IHS Markit

Kazakhstan's natural gas consumption outlook by sector to 2050



Notes: End-of-pipe consumption; transport excludes pipelines; domestic sector is residential-commercial-municipal.
Source: IHS Markit

- IHS Markit expects end-of-pipe gas consumption to exceed 20 Bcm/y by 2025 and reach about 30 Bcm/y by 2050.
- Gas (methane) consumption in petrochemicals is not expected to be a major growth driver; the main consumption drivers are power generation and residential.
- Constrained commercial supply means Kazakhstan must choose between exports to China (contracted deliveries are up to 10 Bcm/y during 2019-23) or making more gas available for domestic use; the IHS Markit base-case scenario does not envisage exports to China exceeding 7 Bcm/y over forecast period out to 2040
- Kazakhstan shifts to become a net gas importer in 2040s (increasingly from Turkmenistan as well as from Russia) due to declining commercial production and growing domestic demand.

Kazakhstan's coal industry: Accomplishments and challenges

Accomplishments:

- In 2020, Kazakhstan ranked eighth in the world in coal (run-of-the-mine) output, producing 109.2 MMt, a 1.4% decrease from 2019.
- Coal mining has introduced a variety of measures to mitigate local environmental damage (e.g., dust, PM air pollution), although there remains much room for improvement through the introduction of BAT.

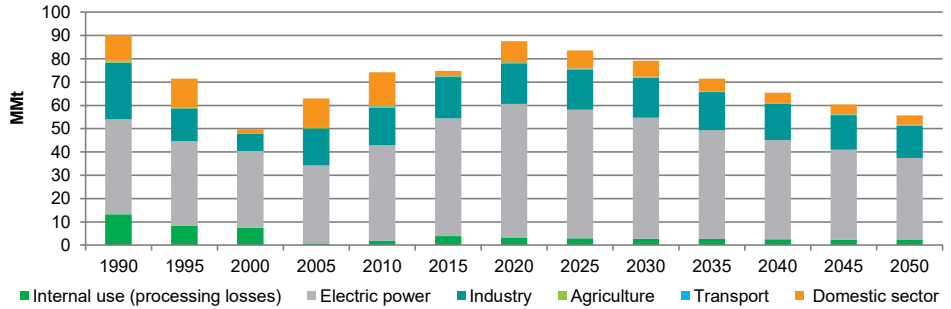
Challenges:

- Coal accounted for 57% of the country's primary energy consumption in 2020. Reducing dependence on coal (particularly in power generation) becomes critical in reducing Kazakhstan's total GHG emissions. Replacing coal with other sources, such as natural gas, renewables, and potentially nuclear, will require broad systemic reforms, massive new investment, and higher end-user electricity prices.
- Longer term, demand for Kazakh coal, both in the domestic economy and by foreign consumers, is projected to decline, albeit slowly, as the energy transition increasingly takes hold. Kazakhstan is seeking to grow exports, but this is challenged not only by overall pressure to reduce coal consumption in key export markets, but also by long distances to market, poor coal quality, and disagreements with transit countries.
- Kazakhstan's government is supportive of the idea to develop value-added coal products and included coal enrichment in the list of activities designated as priority investment projects.

Coal's importance in Kazakhstan's energy balance will diminish over time, from 57% in 2020 to 36% in 2050, as gas-fired power and renewables grow

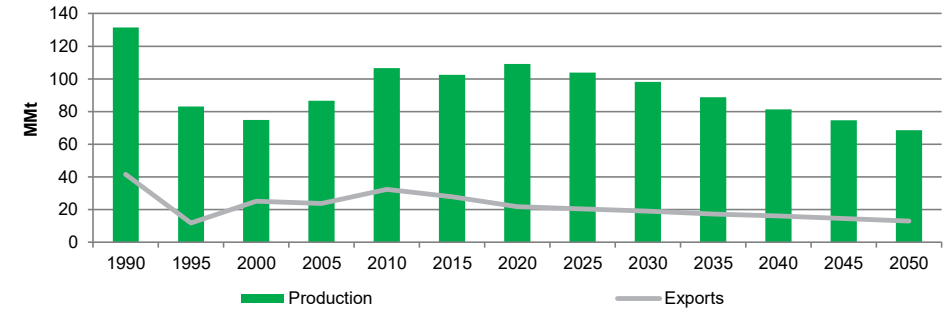
- Coal is expected to remain an important energy source for Kazakhstan, particularly in electricity generation.
  - In the IHS Markit base-case outlook, the share of coal in Kazakhstan's primary energy demand declines from 57% (in 2020) to about 51% in 2030 and 36% in 2050, gradually giving way to natural gas, renewables, and (after the mid-2030s) nuclear generation.
- Fears of a significant drop in coal output due to the COVID-19 pandemic's impact on the overall economy in 2020 did not materialize; gross coal production contracted by only 1.4%; domestic consumption declined slightly (1.4%), and exports declined much less than had been feared, by 3.2% year on year.
- Coal mines have introduced measures to reduce on-site environmental disruption such as dust, PM emissions, and water discharge; such efforts will certainly be intensified as BAT implementation occurs (2025-35).
- Kazakhstan's coal industry's plans to deal with the energy transition are still at a relatively nascent stage; the hope is to reinvigorate development and attract new investment in "value-added" coal-based products.
- A broader plan aimed at phasing out coal as part of the energy transition to reduce GHG emissions has yet to be formulated.

History and outlook for Kazakhstan's apparent coal consumption by sector, 1990-2050



Notes: Apparent consumption is production plus imports minus exports.
Source: IHS Markit

Kazakhstan's coal production and export outlook



Source: IHS Markit, Bureau of National Statistics of RK

Kazakhstan's uranium mining industry: Accomplishments and challenges

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Accomplishments:

- Kazakhstan is the world leader in uranium mine output, producing 19,500 (metric) tons in 2020, accounting for roughly two-fifths of the world total in recent years.
- Kazakhstan possesses 37% of global reasonably assured uranium resources that can be developed at lowest cost (<$40/kg U); mining is carried with the low-cost in-situ leaching (ISL) method, which also has a low environmental impact..

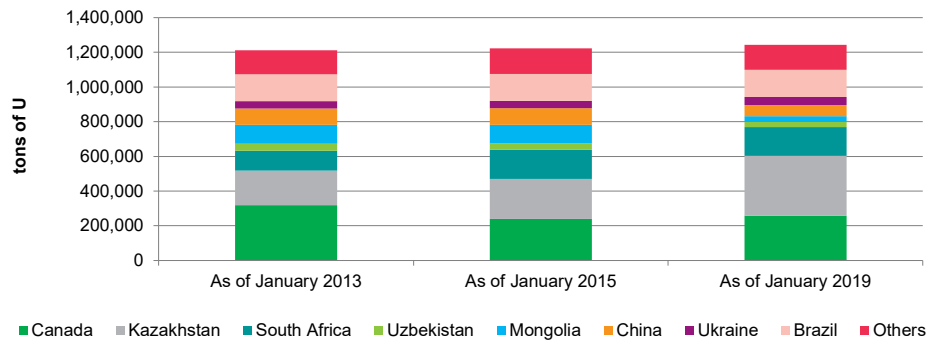
Challenges:

- Recent efforts to expand the uranium value chain in Kazakhstan to elements of the fuel cycle downstream from mining are aimed at diversifying product output and offering greater operational flexibility for Kazatomprom and Kazakhstan's uranium sector more broadly. In 2021, a joint venture with the China General Nuclear Power Group (CGNCP) was concluded to produce fuel assemblies for CGNCP reactors at the Ulba Metallurgical Plant (UMP).
- But these recent initiatives toward product diversification could provide a tangible benefit should Kazakhstan decide to eventually build a nuclear power plant. The country's existing research and development expertise in nuclear research, fuel storage, and waste disposal also provides a supporting base for nuclear generation should the government decide to move the power sector in this direction.

Kazakhstan remains the world's leading producer of uranium, producing it with environmentally friendly techniques at fairly low costs

- Kazakhstan's mine production of uranium fell in 2020 by 15% relative to 2019, in the wake of the COVID-19 pandemic as well as an oversupplied global market following unprecedented growth in 2003–16. In response to poor market conditions, Kazakhstan, along with other major mine producers, deliberately limited output.
- Over four-fifths of Kazakhstan's uranium resources can be developed under the most economically advantageous and least environmentally disruptive method of extraction, in-situ leaching (ISL).
- Kazakhstan's uranium mine output is exported; although other parts of the nuclear fuel value chain are being developed, Kazatomprom remains focused on mining, as it is currently the most attractive segment; Kazakhstan's global comparative advantage lies in its large ore deposits suitable for ISL-based mining.

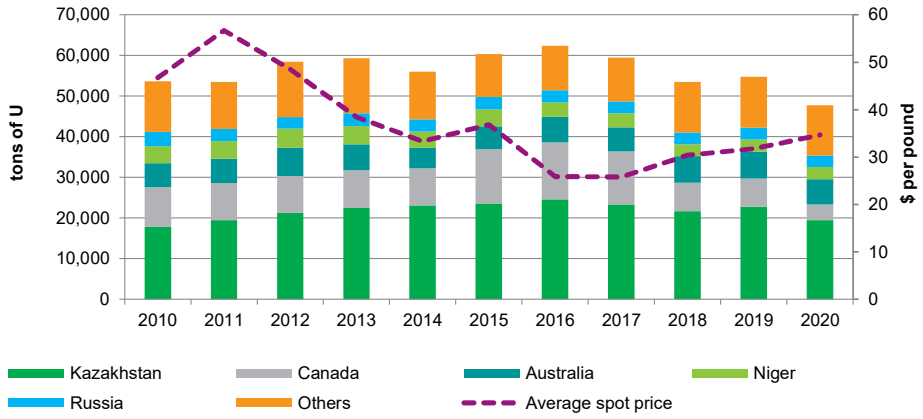
World's reasonably assured reserves with cost of production <$80/kgU



Notes: Totals of 2019 related to cost range <USD 80/kgU should be regarded with some caution since certain countries do not report low-cost resource estimates, mainly for reasons of confidentiality, whereas other countries that have never, or not recently hosted uranium mining, may be underestimating mining costs.

Source: IHS Markit, World Nuclear Association, NEA

Global uranium production by major producer vs. uranium price



Source: IHS Markit, World Nuclear Association, Uranium Miner

Key takeaways for NER 2021

- Although Kazakhstan's GHG emissions declined in 2019 (and probably in 2020), they look likely to drift upwards in 2020s, with economic recovery and rebounding energy consumption.
- To achieve Kazakhstan's INDC (unconditional) emissions target for 2030, Kazakhstan would need to have total GHG emissions contract by almost 11% relative to 2019. While this seems unlikely given current trends, this is certainly possible if cogent policy measures are implemented expeditiously, including:
  - Gasification expands at an accelerated pace, displacing coal consumption in the power sector (and underlying pricing and structural reforms are carried out as part of this).
  - Already-sanctioned and already-programmed renewable projects materialize as planned.
  - Energy efficiency improvements across the economy continue apace.
  - GHG emissions from industry, agriculture, LULUCF, and waste also decline substantially
- To play a greater role in decarbonization, Kazakhstan's ETS must be reformed to create a functional carbon market with greater transparency.
- Kazakhstan should continue to improve the investment climate in upstream hydrocarbons, as oil companies are now pursuing only selected investment opportunities offering "advantaged barrels."
- More broadly, Kazakhstan should work to improve overall investment conditions in the energy sector (especially electricity) to support private-sector investment all across the energy transition.

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