



Resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

I. SUMMARY

Industrialization has been a key focus for North and Central Asian countries since independence. In recent years, countries have sought to modernize and upgrade their existing infrastructure and facilitate infrastructure connectivity and compatibility to better serve socioeconomic purposes. Innovation plays a key role in both industrialization and infrastructure retrofitting as the subregion looks to connect to and become more competitive in global markets. To achieve

Sustainable Development Goal (SDG) 9 by 2030, countries in North and Central Asia must take actions as follows: (1) Enhance regional cooperation for sustainable and resilient infrastructure; (2) Promote green infrastructure and industries; (3) Improve local expertise and human capacities; (4) Ensure sustainable and inclusive digital transformation; (5) Nurture local/subregional innovation landscape.

II. CURRENT STATUS & TRENDS

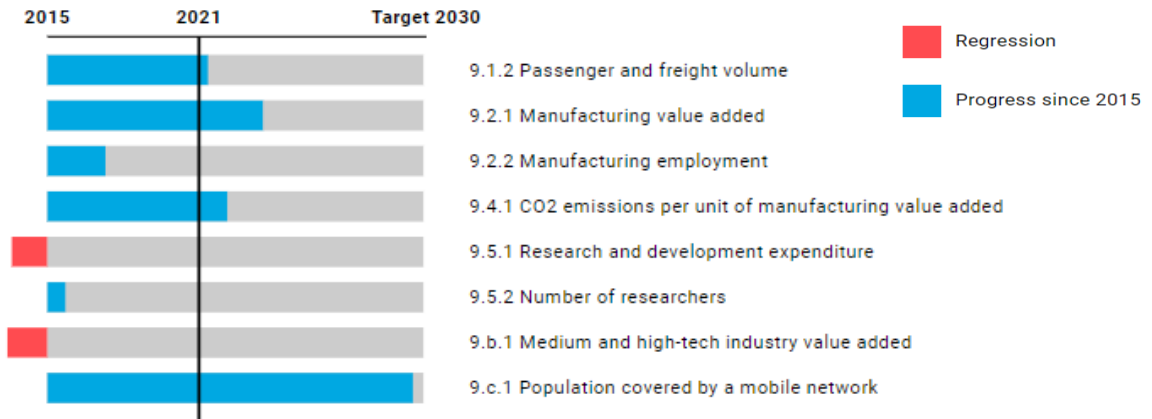
The subregion has progressed on a number of aspects of SDG 9 (as shown in Figure 1): (1) Each North and Central Asian economy has seen an increase in the proportion of manufacturing value added in gross domestic product (GDP) since 2018; (2) Industrial employment, as a share of total employment, has increased in most countries in the subregion between 2011 and 2019. The number of employees in manufacturing industries has also increased; (3) There is a decreasing trend in carbon dioxide (CO₂) emission intensity¹ in most

countries in the subregion since 2011; (4) Most countries in the subregion have witnessed an increase in mobile cellular subscriptions since 2011. However, there are some areas requiring attention and key challenges that need to be resolved: (1) Sustainability and compatibility of subregional infrastructure; (2) Low level of economic diversification and small number of medium and high-tech industries; (3) limited resources for the sustainable development of SMEs; (4) underdeveloped digital & innovation spheres.

¹ Carbon dioxide emissions intensity is defined as carbon

dioxide emissions per GDP.

Figure 1: The status of Sustainable Development Goal 9 in North and Central Asia

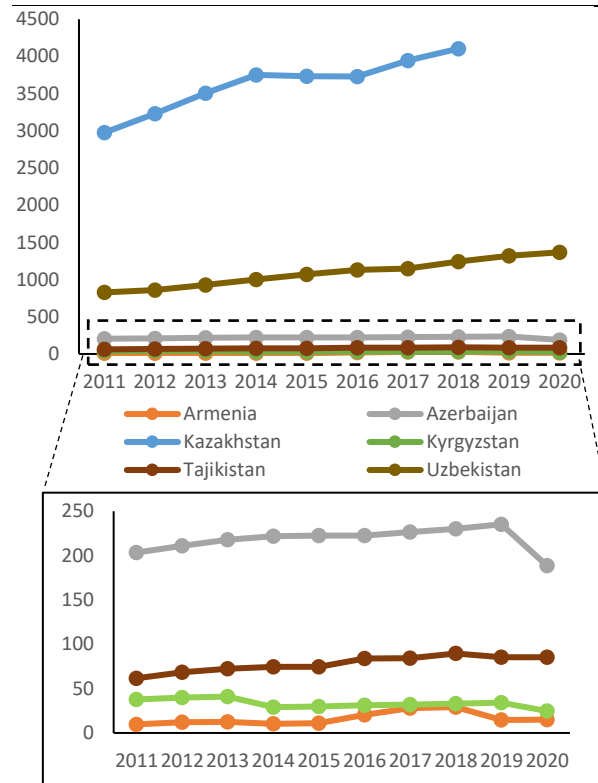


Source: Asia Pacific SDG Gateway, UN ESCAP

Target 9.1 Develop quality, reliable, sustainable and resilient infrastructure.

Due to the geographic position and landlocked status, many countries in North and Central Asia heavily rely on land transport. Road and rail are dominant modes of freight transportation in the subregion. Road transport accounted for 93.4% of freight movement in Kyrgyzstan and 78% of cargo transported in the Russian Federation, according to 2017 estimates. It should be noted, however, that when the distance of cargo movements is taken into consideration, measured in ton-kilometres, rail is the dominant mode of freight transport in North and Central Asia. Between 2019 and 2020, Azerbaijan, Kyrgyzstan and Tajikistan had witnessed a decline in the total amount of freight transported, and most countries in the subregion had also witnessed a decline in the number of passengers transferred, mainly due to the negative impact of COVID-19. Currently, North and Central Asia countries are putting notable efforts to improve their transport connectivity and logistics performance. All countries are actively striving to facilitate railway transit and strengthen their position as a Euro-Asian land bridge, with many transport and transit infrastructure projects being initiated in the subregion.

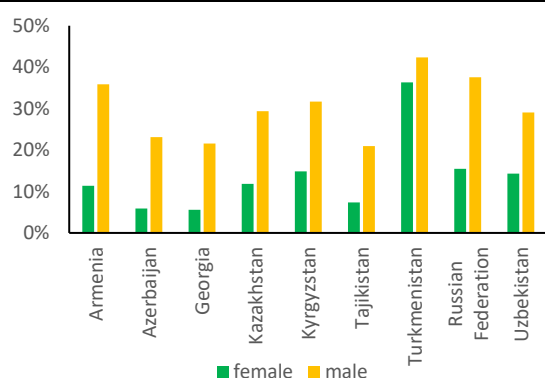
Figure 2: Freight transported (million tons), 2011-2020



Source: World Development Indicators, World Bank
 Notes: All data from Turkmenistan, the Russian Federation and Georgia as well as 2019-2020 data from Kazakhstan cannot be found.

Target 9.2 Promote inclusive and sustainable industrialization. Since 2018, the proportion of manufacturing value added in the GDP in each North and Central Asian economy has been increasing. However, in all countries in the subregion except for Armenia and Uzbekistan, there has been a decline in the proportion of medium and high-tech manufacturing as an overall part of manufacturing value added since 2017. Between 2011 and 2019, with the exception of the Russian Federation, the share of industrial employment in total employment has increased in most countries of the subregion. During this period, the figure in Turkmenistan remained the highest level, followed by the Russian Federation, while Georgia remained the lowest. In 2019, all the countries in the subregion recorded a higher proportion of male employment in industrial sectors compared to female employment in industrial sectors. Large gender gaps for employment in industrial sectors were recorded in Azerbaijan, Georgia and Armenia (as shown in Figure 3). A similar gender gap exists in the manufacturing industries of all countries in the subregion, with huge gaps in Azerbaijan, Kazakhstan, Kyrgyzstan and Uzbekistan where there are twice as many men employed than there are women.

Figure 3: Female/male employment in industry (% of female/male employment), 2019

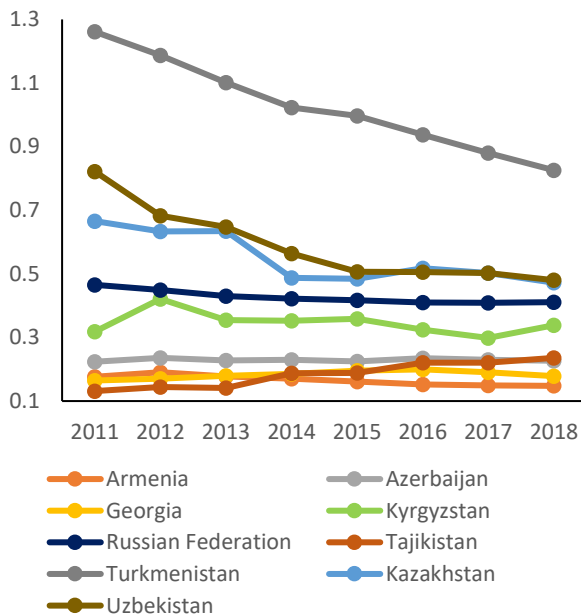


Source: World Development Indicators, World Bank

Target 9.3 Increase access of small-scale industrial enterprises to financial services. Since all the economies in the subregion remains largely driven by wholly or partly state-owned entities, small and medium-sized enterprises (SMEs) tend to operate informally on the fringes of the formal economy (OECD, 2018a). SMEs in Kazakhstan face competition from the informal sector, which accounts for almost one-fifth of total employment. SME innovation rates remain low, despite a steady increase in Kazakhstan in the past decade. According to the OECD (2018a), only “19% of SMEs in Kazakhstan held a bank loan or a credit line in 2014, down from around one-third in 2008–2009, a drop that in part reflects the troubles the financial sector has experienced in recent years”. This may indicate a lack of access to finance due to insufficient credit scores of SMEs, a lack of awareness of existing financing options and/or low financial literacy. In order to reverse the situation, many countries in the subregion have initiated targeted measures to support SMEs, including targeted transfers, simplifying procedures for business registration, providing training programmes and financial literacy support.

Target 9.4 Upgrade infrastructure and retrofit industries to make them sustainable. The CO₂ emission intensity in Kyrgyzstan, the Russian Federation and Tajikistan in 2018 was higher than that in 2011 (as shown in Figure 4). In 2018, CO₂ emission intensity in Turkmenistan remained the highest level at 0.83 kilograms per one unit of economic output produced, followed by Uzbekistan and Kazakhstan at 0.48 and 0.47 kilograms per one unit of economic output produced respectively, while Armenia had the lowest level at 0.15 kilograms per one unit of economic output produced. The average subregional energy intensity stood at 0.37 kilograms per one unit of economic output produced, higher than the world average of 0.3 kilograms per one unit of economic output produced.

Figure 4: CO2 emissions (kg per 2017 PPP \$ of GDP), 2011-2018

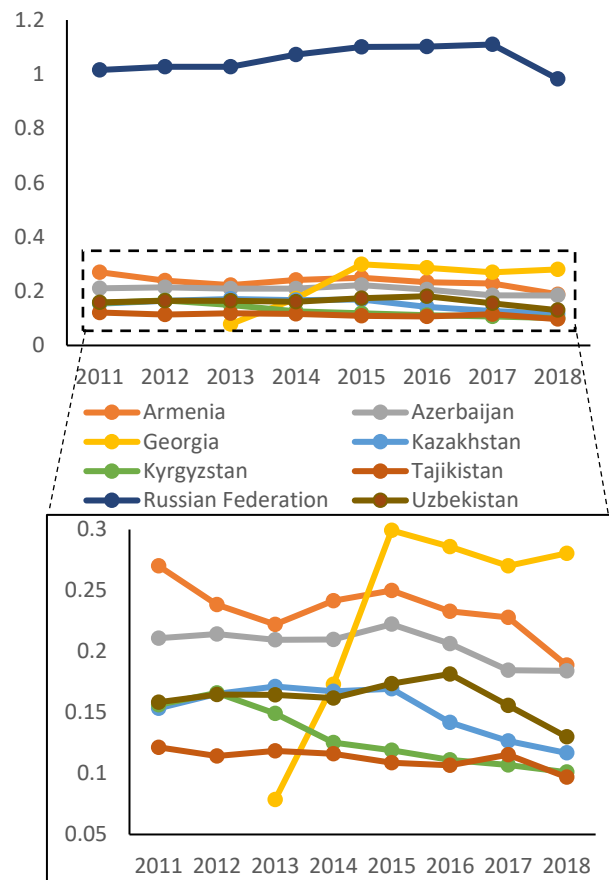


Source: World Development Indicators, World Bank

Target 9.5 Enhance scientific research, upgrade technological capabilities and encourage innovation. Between 2017 and 2018, the proportion of research and development expenditure in GDP has decreased to varying degrees in all countries in the subregion except for Georgia (as shown in Figure 5). The total number of researchers in research and development (number in full-time equivalent) has also decreased in the Russian Federation, Azerbaijan, Kazakhstan and Armenia since 2015, of which the Russian Federation has the largest decline, although it still ranks first in the subregion over the past years. Patenting activity remained low in Kazakhstan,

Uzbekistan and Kyrgyzstan and non-existent elsewhere, a reflection of the difficult business climate (UNESCO, 2021). Between 2019 and 2020, the number of mobile cellular subscribers in the subregion has declined, except for Tajikistan. However, it is still higher than the world average in most of the countries in the subregion.

Figure 5: Research & development expenditure (% of GDP), 2011-2018



Source: World Development Indicators, World Bank

III. AREAS REQUIRING ATTENTION & KEY CHALLENGES

Sustainability and compatibility of subregional infrastructure. The subregion's transit potential is poorly realized due to underdeveloped infrastructure, as well as customs and technical restrictions. Road transit capacity also remains an open issue in the region¹. Additionally, the infrastructure network in some countries in North and Central Asia require significant repairs and upgrading. For example, 60% of the roads in Kyrgyzstan, 54% in Kazakhstan and 48% in Tajikistan do not have asphalt or concrete cover (Levina, 2018). The heavy dependence on road transport in freight transport operations is also a problem, which has proved to be much more vulnerable to the threats of the pandemic than other modes of land transport and subject to numerous restrictions. However, it opened new perspectives for rail and it is important to ensure compatibility of rail infrastructure and systems to facilitate smooth transport and transit of goods through the subregion.

Limited resources for SMEs' sustainable development. SMEs are vulnerable and have been adversely affected by the pandemic, since they tend to have fewer resources and less capacity to cope with abrupt economic shocks. Three main obstacles restrain the sustainable development of SMEs: 1) the lack of effective access to financial resources; 2) the absence of targeted programmes for supporting the development of SMEs, aggravated by general institutional problems, such as poor implementation of legislation, lack of regulation and a proper legal basis for the development of investment projects, ineffective institutional structure for the attraction and promotion of investment, a high level of perceived corruption in regulatory authorities, and vulnerability of rights of ownership of entrepreneurs; 3) problems with access to quality infrastructure, including transport and logistic corridors, lack of quality standards and certification facilities.

Low level of industrialization and diversification. Economies in the subregion heavily depend on natural resource revenues and there is a lack of diversification. Factors such as well-functioning infrastructure, limited administrative red tape, transparency of government operations, and labor with appropriate skills determine whether a country can gain a foothold in manufacturing global value chains. Due attention should be given to the quality of a country's "service links" (ports, roads, customs administration) (Golub et al., 2007). The manufacturing industries have not achieved economies of scale (fragmented, small- and medium-sized and operating informally) and lacks financial support for production, which result in a negative effect on the overall performance of the industry. High- and medium-tech industries are largely underdeveloped.

Limited development in digital & innovation sphere. Although the pandemic has spurred on the adoption of digital technologies in many spheres of daily life and government, digitalization efforts should still be given due attention. Among the areas where digitalization could be a driver for change include cross-border transport and trade operations. The average implementation of a common set of 31 trade facilitation and paperless trade measures by North and Central Asian countries stands at 65.6%. The least implemented paperless trade measure in the subregion is *Paperless collection of payment from a documentary letter of credit*, which has not been implemented at all. The under-investment in research and development in North and Central Asia has spawned a range of systemic challenges that are holding back research and innovation. What is worse, most countries witnessed big drops in recent years. The cultural divide between the business and scientific communities as well as inadequate protection for intellectual property also pose challenges.

IV. GENDER & HUMAN RIGHTS CONSIDERATIONS

There are gender disparities in the implementation of SDG 9, especially in women's employment and pay in certain industries such as research and medium and high-tech industries. Even in countries like Armenia and Kyrgyzstan where the proportion of female tertiary students is higher than male in 2019, barriers remain for employment. The proportion of women in the labour force is lower than men in almost all the countries in the subregion. In Kyrgyzstan, 54.6% of graduates were women, yet they accounted for just 38.7% of the labour force in 2019. While women researchers' participation rate was higher than men in some countries like Azerbaijan, Armenia, Kazakhstan and Kyrgyzstan in 2019, this advantage fails to translate into women's economic empowerment. The gender pay gap in monthly earnings was at 42, 34.7, 32.2 and 23 per cent in the above countries – to the detriment of women – resulting in a higher risk of poverty for women than men. Occupational segregation persists with women concentrated in low-paying informal sectors without social insurance and is perpetuated through educational choices based on gendered stereotypes about types of work "suitable" for women and men.

Digitalization also needs to consider the differentiated impacts for different stakeholders. There were estimated 5.1 million children living

with disabilities in Eastern and Central Europe and Central Asia (UNICEF, 2019). The main digital access barriers of disabled people are affordability of services and devices, limited digital skills and content not available in an accessible format. Digital technologies should enable persons with disabilities to receive information and content in the suitable format for them to access. Digital inclusion should increasingly enable persons with disabilities to get access to education, financial services, skills development and employment. In terms of employment, the digital sphere is currently male dominated. A substantial divide in access to internet and access to services persists between women and men labour forces and between rural and urban residents. Except for Armenia, the proportion of women from 16 to 74 years old using the Internet and computer was relatively lower than men in the subregion in 2020, undermining their chances to obtain skills necessary for labour market transformation in the "Fourth Industrial Revolution". Female entrepreneurship is low due to limited access to assets, financial services, as well as information and markets (ITU, 2020). The difference between urban and rural residents is even worse, with biggest gaps in Azerbaijan and Georgia where rural residents had 22 and 21 per cent less access to Internet compared to urban residents.

V. PRIORITIES FOR ACTION

Priority 1: Enhance regional cooperation for sustainable and resilient infrastructure.

Bottlenecks and operational restrictions, along with additional costs could be offset not only by higher usage of other modes of transport, such as rail, but through greater synergy in combining different transport modes into a transport chain that is efficient, environmentally sound, safe and reliable. The largest potential lies with the development of intermodal linkages through dry

ports as a vehicle to revitalizing railways. Rail transport may become one of the most important and effective drivers of subsequent sustainable development and growth, especially for landlocked countries. Transport infrastructures require expansion, repairs and construction of missing links to increase the resilience of transport sectors to external shocks. North and Central Asian countries can also benefit from co-deployment of transport, energy and ICT infrastructure promoted

by ESCAP, which reduces the overall costs of infrastructure development and enhances its resilience. Appropriate agreements and paperless trade should be leveraged to improve cooperation in the subregion.

Priority 2: Promote green infrastructure and industries. As North and Central Asian countries aim to fulfil their commitments under the Paris Agreement and learned the lessons from COVID-19 policy responses, there is a need to embed sustainability and inclusive measures in existing and future infrastructure and industries. Green infrastructure needs to be prioritized to improve the efficient use of resources – especially energy and water – to ensure the sustainable management of resources. Existing infrastructure needs to be provided with incentives and assistance to be retrofitted. There should be a movement towards mitigating the impact of impermeable urban infrastructure materials such as concrete by including permeable pedestrian paths, bio-swales, street planting, green roofs, green walls, rejuvenated wetlands, urban forests, parklands and other vegetative systems into the urban fabric. Countries should also incentivize the growth and development of sustainability-based industries and encourage diversification away from a resource-based economy.

Priority 3: Improve local expertise and human capacities. Aligning national industrialization targets with a low- or zero-carbon future will require fundamental changes and investments in national and human capacities. To deal with this, government administration and offices must be adapted, strengthened, or created. In terms of intellectual property, shortened and transparent patent application review processes, clearly defined ownership of intellectual property as well as effective identification and punishment of intellectual property theft and other related offenses should be used to strengthen the protection of intellectual property and encourage innovation. Local institutions need to be equipped with knowledge and personnel that can facilitate

sustainable economic transformation. Aside from upskilling existing institutions and personnel, relevant courses and curriculum need to be introduced to ensure the next generation of the workforce has appropriate skillsets and strengthen the links between education, science, and industry. The creation of a local knowledge base is essential to effectively administer this process. Investments in institutional and human capacity can be leveraged to build robust and climate-resilient economies, technological capacity and jobs that can deal with a transition to inclusive and sustainable industries. This in turn will introduce a shift from dependence of low-tech companies to the sustainability of national high-tech industries and expertise.

Priority 4: Ensure sustainable and inclusive digital transformation. North and Central Asia lags behind East and North-East Asia and South-East Asia in the adoption of digital technologies and the use of modern data exchange systems to ensure quick and efficient solutions for seamless movement of freight. Support should be given for a shift towards digitizing the processes involved in exchanging information for efficient operational and regulatory transport controls. Countries should also monitor the implementation of their digital transformation vision, strategy, policy and roadmap to promote digital economy development to ensure that the measures are relevant to the needs of the society and the economy. Governments should support ICT infrastructure development, including 5G, 4G, fixed broadband, data centre construction and fibre-optic network pre-deployment by creating a favourable policy environment that encourages ICT investment, including, sector tax reduction, spectrum fee reduction, new generation network subsidy, incentive for innovation and universal service fund. Enhanced bilateral and multilateral cooperation in cross-border connectivity, Internet management, cybersecurity and data flow should be prioritized to bridge the digital divide.

Priority 5: Nurture local/ subregional innovation landscape. Governments should make an effort to improve the status of researchers through measures such as pay rises, competitive research grants, modern research equipment and joint research projects with institutional partners in other countries. In addition to raising research spending, countries can bolster scientific capacity by revising its migration policy to attract scientist, researchers, and expertise from specific sectors to conduct their research in the country and facilitate knowledge transfer. Targeted regulatory mechanisms would help to rationalize limited resources and quota available for these purposes. To determine the optimal number of highly qualified personnel, for instance, a multilevel system can be put in place to monitor and

forecast the need for specialists in various fields. Additionally, the creation of enabling environments and better regulation for technoparks and the innovation and technologies that these technoparks hold can also foster the local and subregional innovation landscape. These technoparks can be an effective testing ground for innovation and technologies through the establishment of regulatory sandboxes². The sandboxes should be supported by cross-functional authorities to be fully relevant to the realities that these innovation and technologies will function in. For example, fintech sandboxes should be supported by national financial regulatory authorities as well as authorities in the digital sphere. A flexible approach is required to keep up with the changing digital technologies and innovation landscape.

REFERENCES

Alaassar, A, Mention AL, Aas TH (2021), “Exploring a new incubation model for FinTechs: Regulatory Sandboxes”, *Technovation* 103: 102237. Available at: <https://doi.org/10.1016/j.technovation.2021.102237>

Bazarbekova M, Assipova Z, Molgazhdarov A and Yessenov M (2018), “Review of transportation modes in Kazakhstan region”, *Cogent Engineering* 5(1): 1450799. Available at: <https://www.tandfonline.com/doi/citedby/10.1080/23311916.2018.1450799?scroll=top&needAccess=true>

Boeing (2020), “World air cargo forecast, 2020-2039”. Available at

https://www.boeing.com/resources/boeingdotcom/market/assets/downloads/2020_WACF_PDF_Download.pdf

Buyuk Kelajak (2019), “Development Strategy Framework of the Republic of Uzbekistan by 2035.” Available at <http://uzbekistan2035.uz>

Hasanova S (2019), “Strengthening Competitiveness of Small and Medium-Sized Enterprises and Enhancing Their Integration into Regional and Global Value Chains in Kyrgyzstan”. Available at https://www.unescap.org/sites/default/files/Strenghthening%20competitiveness%20of%20SMES_final_English%20version_Savia.pdf

² Regulatory sandboxes are an “incubation model” (Alaassar et al., 2021) for innovative products, services or business models. Issues dealt by sandboxes can vary from being narrowly focused (e.g. concerning a

particular technology or regulatory gap) or having a broad scope (e.g. tackling innovation in a sector or policy area as a whole).

ITF (2019), “Enhancing Connectivity and Freight in Central Asia”. Available at https://www.itf-oecd.org/sites/default/files/docs/connectivity-freight-central-asia_2.pdf

Levina M (2018), “Central Asia improves ailing road infrastructure”, The Times of Central Asia. Available at <https://www.timesca.com/index.php/news/26-opinion-head/19855-central-asia-improves-ailing-roadinfrastructure>

OECD (2018a), “Reforming Kazakhstan: Progress, Challenges and Opportunities”. Available at <https://www.oecd.org/eurasia/countries/OECD-Eurasia-Reforming-Kazakhstan-EN.pdf>

OECD (2018b), “Monitoring competitiveness reforms in Tajikistan”. Available at https://www.oecd.org/eurasia/competitiveness-programme/central-asia/OECD_Tajikistan_monitoring_report_final.pdf

Rep. Turkmenistan (2019), “Prepared for United Nations High-level Political Forum on Sustainable Development”.

UNCTAD (2020a), “Impact of the COVID-19 pandemic on trade and development: Transitioning to a new normal”. Available at https://unctad.org/system/files/official-document/osg2020d1_en.pdf

UNCTAD (2020b), “Challenges, Policy Options, and the Way Forward”. Available at https://unctad.org/system/files/official-document/aldc2020d1_en.pdf

UNECE (2018), “White Paper on Paperless Trade”. Available at https://unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePapers/WP-PaperlessTrade_Eng.pdf

UNECE (2019), “Innovation for Sustainable Development Review of Kyrgyzstan”. Available at https://unece.org/DAM/ceci/publications/I4SD_Kyrgyzstan/ECI_CECI_25_ENG.pdf

UNESCAP (2019), “Review of Sustainable Transport Connectivity in Asia and the Pacific 2019: Addressing the Challenges for Freight Transport 2019”. Available at https://www.unescap.org/sites/default/d8files/knowledge-products/Review2019_LowRes-17Feb2020.pdf

UNESCAP (2020), “Freight Transport and COVID-19 in North and Central Asia: Changing the Connectivity Paradigm”. Available at https://www.unescap.org/sites/default/d8files/knowledge-products/SONCA_TD_policy%20brief_FINAL.pdf

UNESCO (2015), “UNESCO Science Report: Towards 2030”. Available at <http://uis.unesco.org/sites/default/files/documents/unesco-science-report-towards-2030-part1.pdf>

UNESCO (2021), “The race against time for smarter development”, Chapter 14: CENTRAL ASIA. Available at <https://unesdoc.unesco.org/ark:/48223/pf0000377469/PDF/377469eng.pdf.multi>

UNSDG (2017), “SDGs and Gender Equality: UN Interagency Guidance Note for the Europe and Central Asia Region”. Available at <https://unsdg.un.org/sites/default/files/UNFPA-ECCARO-SDGs-GENDER-WEB.pdf>

UN Women (2021), “Progress on the Sustainable Development Goals—The gender snapshot 2021”. Available at <https://bit.ly/3vhDvVT>

Acknowledgements

The paper was prepared under the overall guidance of Michiko Enomoto, Deputy Head, Subregional Office for North and Central Asia, ESCAP. The paper benefited from inputs and review from Patricia Wong Bi Yi, Dan Ye and Alexander Parkyn-Smith of the Subregional Office for North and Central Asia.

Disclaimer

The views expressed through the paper should not be reported as representing the views of the United Nations, but as views of the author(s). The paper describes background research conducted on specific sustainable development goals and are published to elicit comments for further discussion. They are issued without formal editing. The designations employed and the presentation of material do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The United Nations bears no responsibility for the availability or functioning of URLs. Opinions, figures and estimates set forth in this publication should not necessarily be considered as reflecting the views or carrying the endorsement of the United Nations. Mention of firm names and commercial products does not imply the endorsement of the United Nations.