Transition Pathways for Central Asian Energy Infrastructure

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Unlocking Private Investments in Sustainable Infrastructure in Asia: Lessons from Central Asia

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Main Messages

1. The CAREC region's conventional energy economy faces many challenges on both the demand and supply sides
2. New renewable energy technologies present golden opportunity for transition in this sector
3. With the right combination of public and private sector commitments, today's fossil fuel income can finance the infrastructure needed to deliver tomorrow's renewable energy future
4. This future promises a new generation of more sustainable and inclusive regional economic growth

Background

- Energy is one of the most important strategic resources of the Central Asian region.
- Energy services secure livelihoods in all CAREC member countries, directly and indirectly
- In the past, primary energy resources have offered potent development stimulus to the region's exporters and by an ever-expanding web of regional infrastructure, to their neighbors.

The Past: Central Asian Energy Trade

Table 1. Net Energy Exports for the Five Largest CAREC Exporters by Energy Source, 2017

Country	Coal	Oil	Natural Gas	Electricity	Total
Azerbaijan	0	1,406	237	4	**1,643**
Kazakhstan	511	3,058	404	16	**3,973**
Mongolia	808	-11	0	-6	**797**
Uzbekistan	-13	6	713	2	**706**
Turkmenistan	0	180	1850	12	**2,030**
Total	**1,306**	**4,639**	**3,204**	**28**	**9,149**

Note: Energy exports are in petajoules (PJ); one million tons oil equivalent (Mtoe) is approximately equal to 42 PJ.

- In 2017, the region's main energy exporters accounted for **6%** of global oil trade and **14%** of global natural gas trade in.
- In energy terms, oil and gas accounted for more than **85%** of the region's energy trade.

CAREC energy development is at a crossroads

- The region's primary sources of energy demand are beginning a determined transition away from fossil fuel-based energy.
- Despite this risk, CAREC's legacy energy exporters and most of the other countries in the region have the potential for a bright energy future.
- This potential can be fulfilled with a fundamental shift from unevenly distributed carbon fuels to more widely available renewables, primarily wind and solar energy.
- Building out such capacity would require massive investments, but these can largely be financed with conventional export earnings and Public Private investment Partnerships (PPP),
- Including FDI from larger trading partners that have historically relied on CAREC for conventional energy.

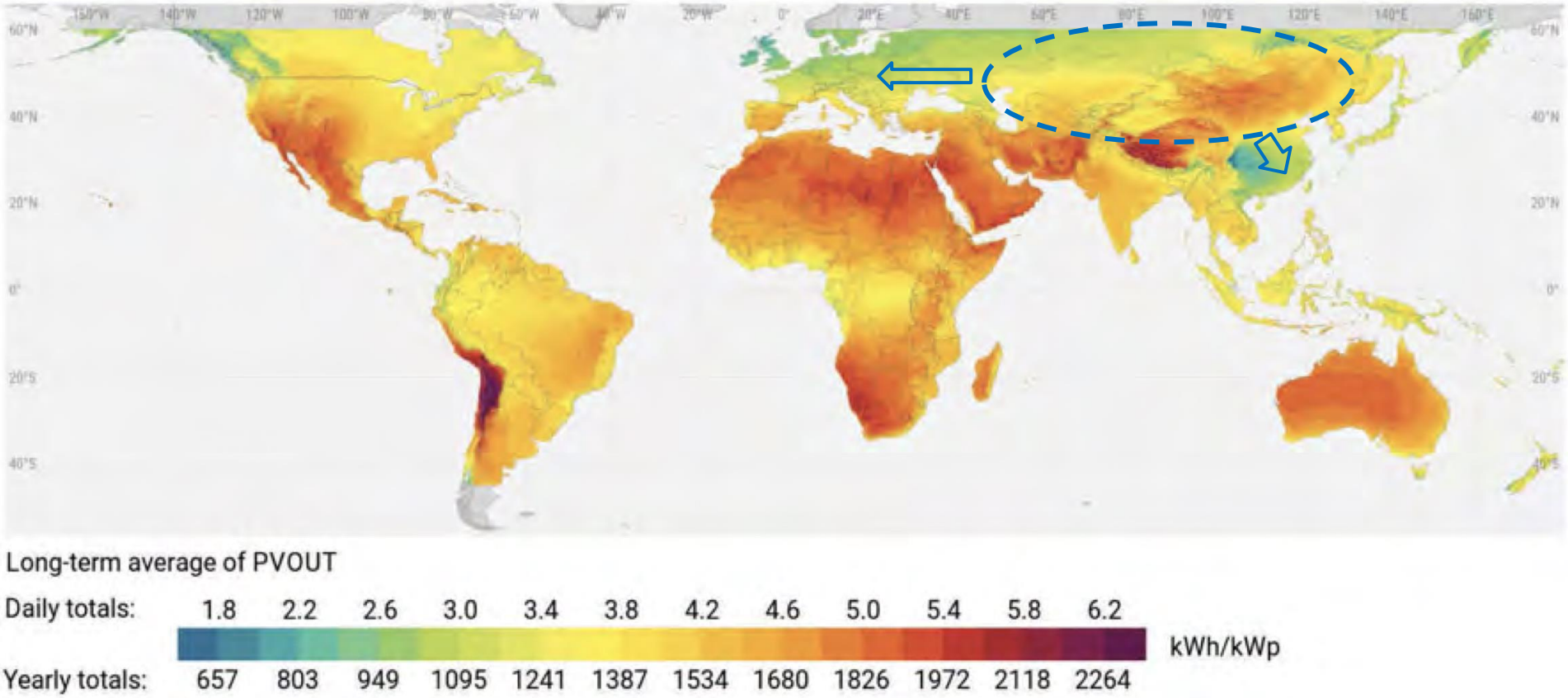
The Future: Wind Resources

CAREC Countries	Mean wind speed (m/s)	Neighboring Countries	Mean wind speed (m/s)
Afghanistan	9.5	Bulgaria	6.7
Azerbaijan	7.8	Germany	8.5
China	8.9	Greece	8.5
Georgia	8.2	Hungary	6.7
Kazakhstan	8.5	India	6.6
Kyrgyz Republic	9.1	Italy	7.1
Mongolia	8.8	Poland	7.8
Pakistan	7.8	Romania	6.8
Tajikistan	9.5	Russia	8.5
Turkmenistan	8.5	Turkey	7.3
Uzbekistan	8.7	Ukraine	7.5

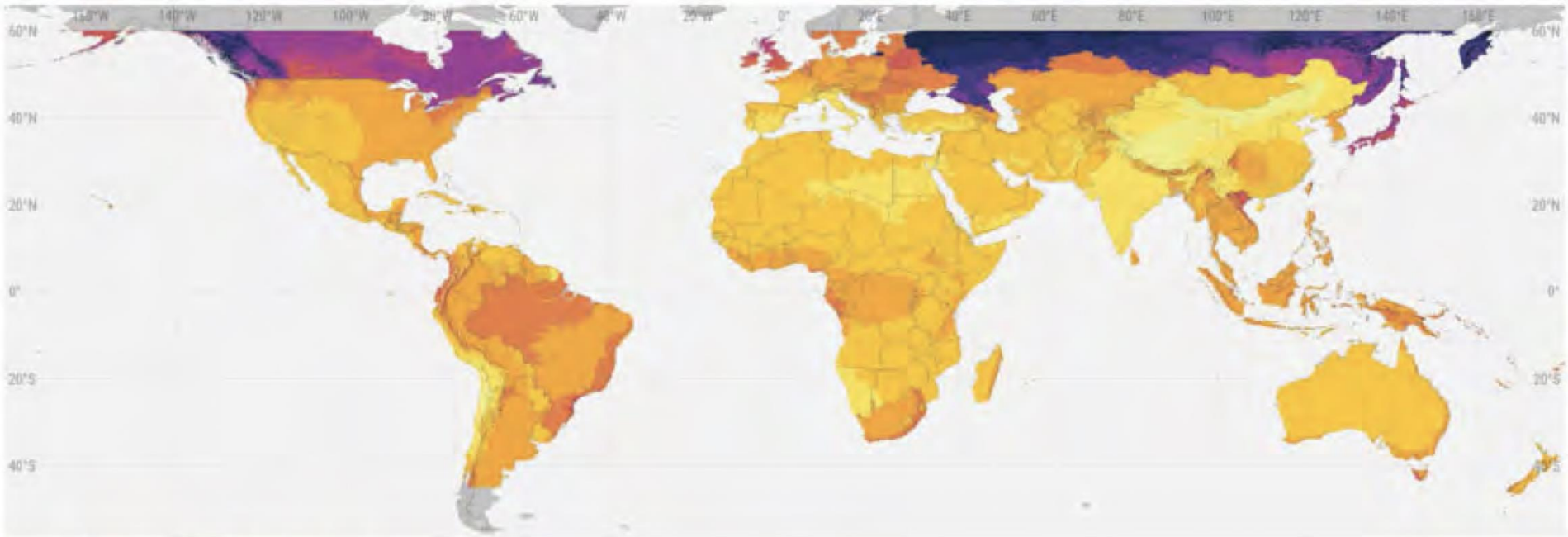
High
Medium
Low

Source: Data are from the Global Wind Atlas, https://globalwindatlas.info

The Future: Long Term Yearly Average Solar Power Potential

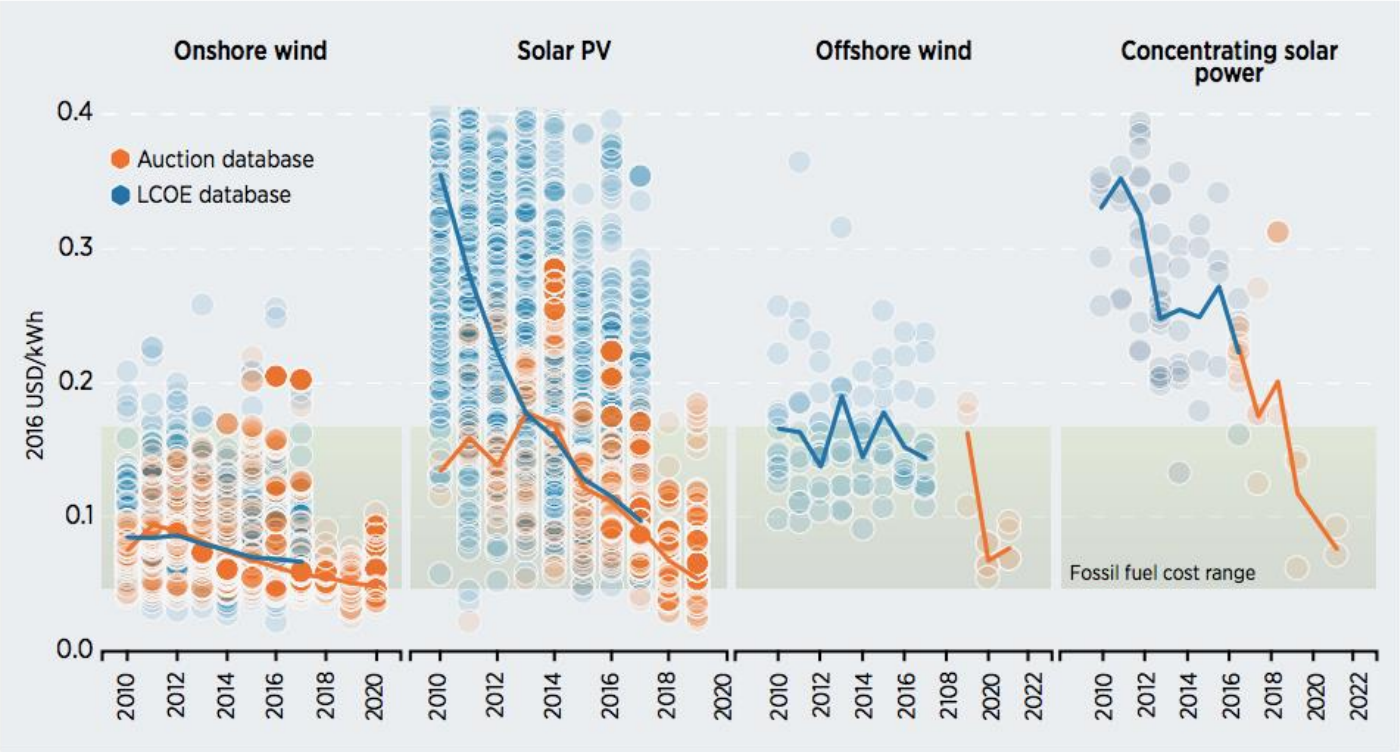


Cost of Ground Mounted PV Solar Electricity



The Present: Renewables are Already Competitive

Levelized cost of electricity for projects and global weighted average values of Solar and Wind

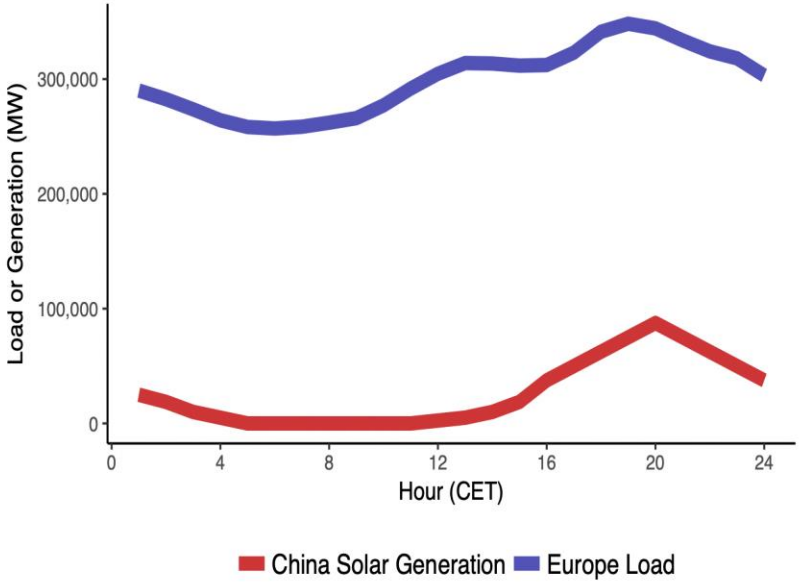


Source: IRENA Renewable Cost Database and Auctions Database.

Note: Each circle represents an individual project or an auction result where there was a single clearing price at auction. The centre of the circle is the value for the cost of each project on the Y axis. The thick lines are the global weighted average LCOE, or auction values, by year. For the LCOE data, the real WACC is 7.5% for OECD countries and China, and 10% for the rest of the world. The band represents the fossil fuel-fired power generation cost range.

Temporal Arbitrage: China's Solar Energy Generation Matches Europe's Load Profile

- Solar generation resources offer the opportunity for arbitrage across both time zones and latitude, taking advantage of temporal and seasonal variation in local insolation and electricity loads across long distances.
- The figure illustrates how China's average daily solar generation curve closely tracks Europe's load curve for a typical winter day.
- This occurs because demand for electricity in Europe peaks in their evening, as people return home from work. At that point, it is mid-day in China, when solar generation capacity is greatest.
- China's current solar generation alone could meet almost one third of Europe's peak demand.
- Central Asia has more than enough potential to fill in the rest



Hourly load data is pulled from ENTSO-E, the European Network of Transmission System Operators, for a randomly selected winter day (January 1, 2018), and aggregated from the country level to the entire European region.[9] The Chinese solar generation profile is estimated by multiplying the total solar installed capacity in 2018 by hourly capacity factors.[10] The Chinese and European data is then matched by hour.

Source: Roland-Holst and Springer, https://blogs.berkeley.edu/2020/06/20/how-to-globalize-clean-energy/

Recommended Regional Energy Transition

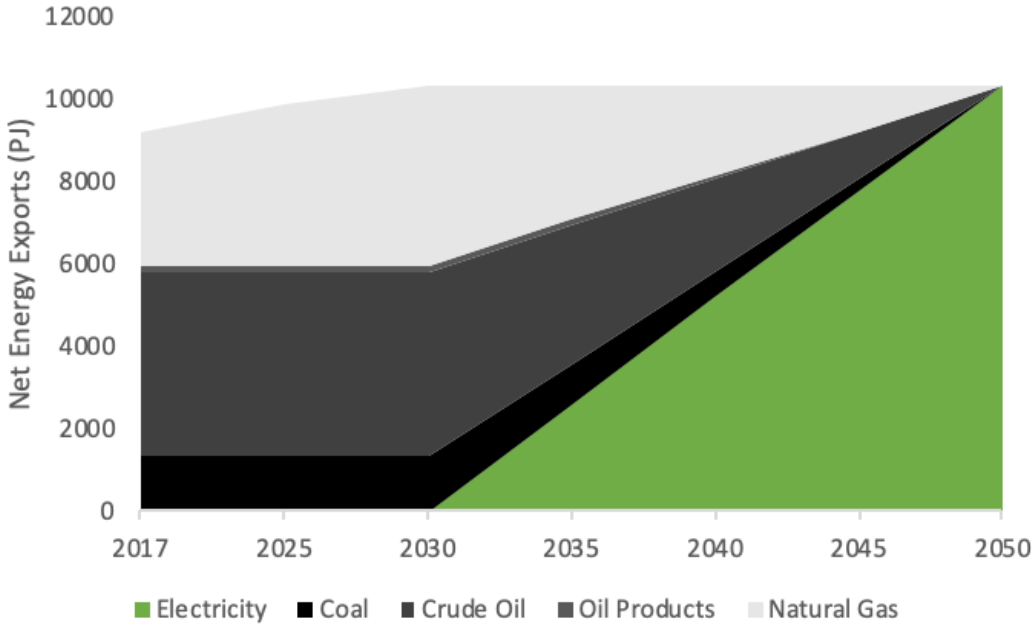
Three stages:

1. High-carbon (2020) primary carbon fuel exports, financing growth and transition to
2. Mid-carbon (by 2030) (natural gas and gas-fired electricity/hydrogen exports), financing new capacity for
3. Low-carbon (2040-50) renewable(solar and wind) electricity exports

Illustrative Energy Transition

Table 3. Scenario Assumptions

Assumption	Scenario 1 Electricity	Scenario 2 Hydrogen
Share of electricity in net energy exports	100%	0%
Share of hydrogen in net energy exports	0%	100%
Wind share of primary energy	50%	50%
Solar share of primary energy	50%	50%



Renewables for Regional Economic Convergence

- This strategy is noteworthy because endowments of renewable capacity (esp. wind and solar) are much more equally distributed across the region than carbon fuel resources.
- Thus, phases 2 and 3 of transition would open opportunities for more inclusive regional energy infrastructure investment.
- Grid investments needed for more extensive supply development could also dramatically improve energy access within the region.
- In this way, energy can play the same role that manufacturing did in the dynamic East Asian economies, with export opportunities driving infrastructure investments that ultimately facilitate intra-regional connectivity, efficiency, and long-term, more inclusive growth.

Metrics for Progress

- Historically, energy sector development has been driven by private or public profit seeking.
- This goal recognizes the importance of generating public funds, as well as incentives for PPP, but it does not take account of wider development priorities.
- For this reason, we recommend that regional energy sector transition be informed by the UN Sustainable Development Goals.
- To advance policy dialog in this direction we propose adapting the SDGs with the following Energy Development Indicators (EDIs).
- Two examples are presented here for the first two SDGs.

SDG 1: No Poverty – Livelihoods and Energy

EDI 1: Eliminate Energy Poverty in across CAREC by 2030

Indicators:

- EDI 1.1 - Energy Poverty – Headcount percent of Energy Poor People (EPP) – people without electricity, and/or biomass dependent for heating
- EDI 1.2 - EPP population living below the national poverty line
- EDI 1.3 - Poverty gap ratio (incidence x depth of energy poverty)
- EDI 1.4 - Share of energy poorest quintile in national consumption

SDG 2: No Hunger - Agrifood Production and Food Security

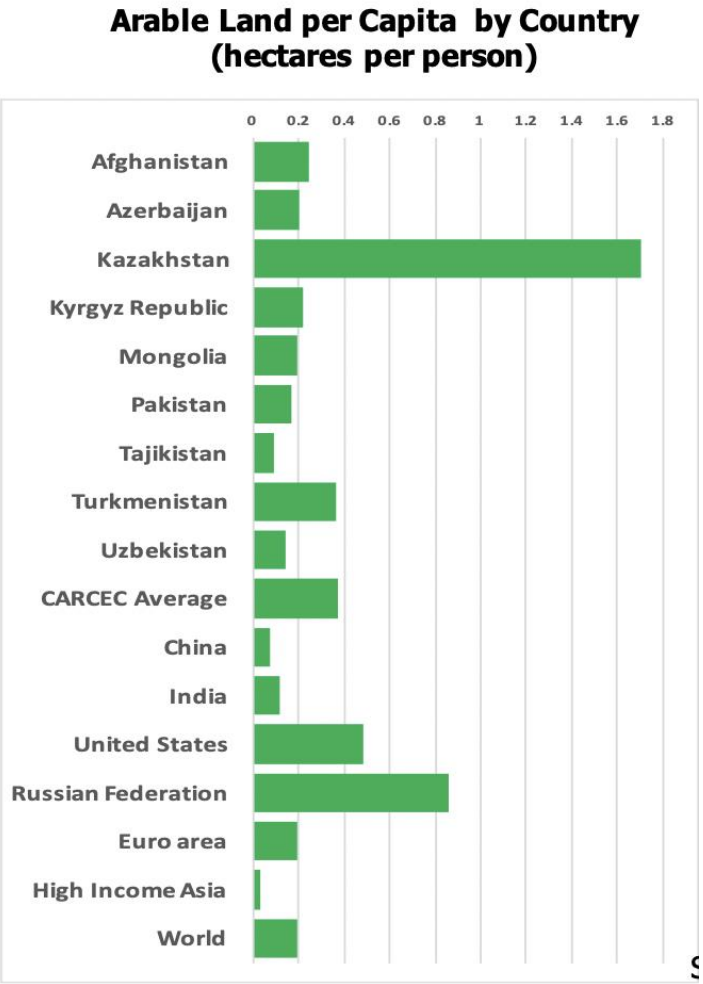
EDI 2: By 2030, raise the nutritional status of all EPP above the SDG minimum for dietary sufficiency.

Indicators:

- EDI 2.1 - Proportion of EPP population below minimum level of dietary energy consumption
- EDI 2.2 - Prevalence of underweight in EP children (under five years of age)

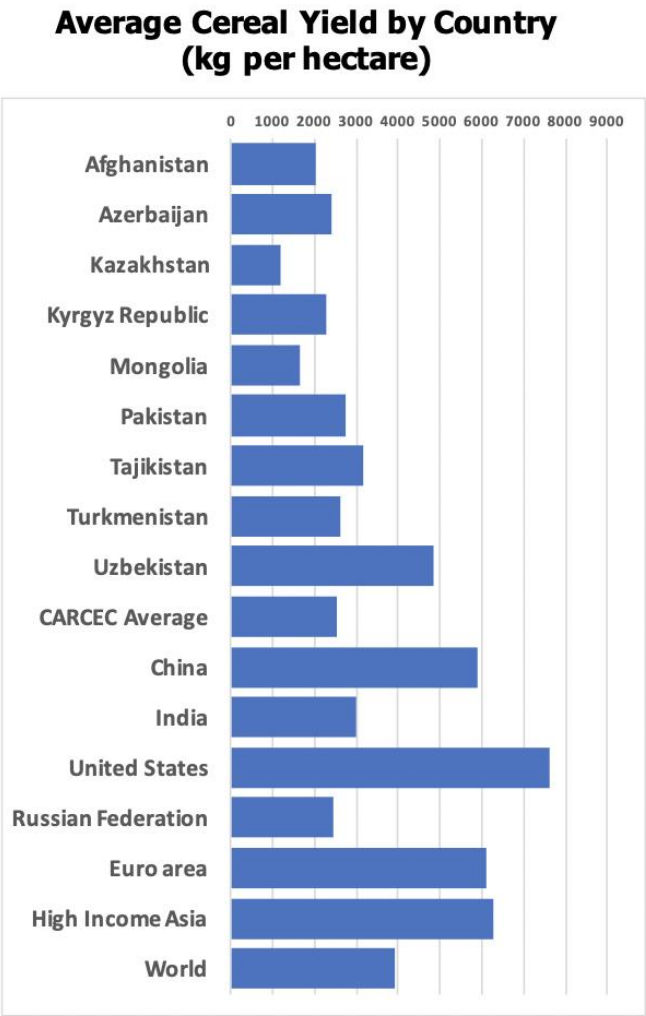
CAREC Land is Relatively Abundant

- CAREC agrifood potential is enormous
- Lower cost, more accessible energy can be a potent catalyst for sector development
- On the demand side, China is the world's most dynamic food economy, and the world's largest importer



but Productivity is Low

- As CAREC shifts to renewable energy, natural gas resources can be directed to large-scale fertilizer production and
- Lower cost electricity can accelerate agricultural mechanization, food processing, and cold chain logistics to serve more distant, higher income markets



Thank you!

- Follow-up questions:

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