Bridging continents: The role of green energy corridors in the CAREC region and beyond in the process of integration of energy systems and power markets'

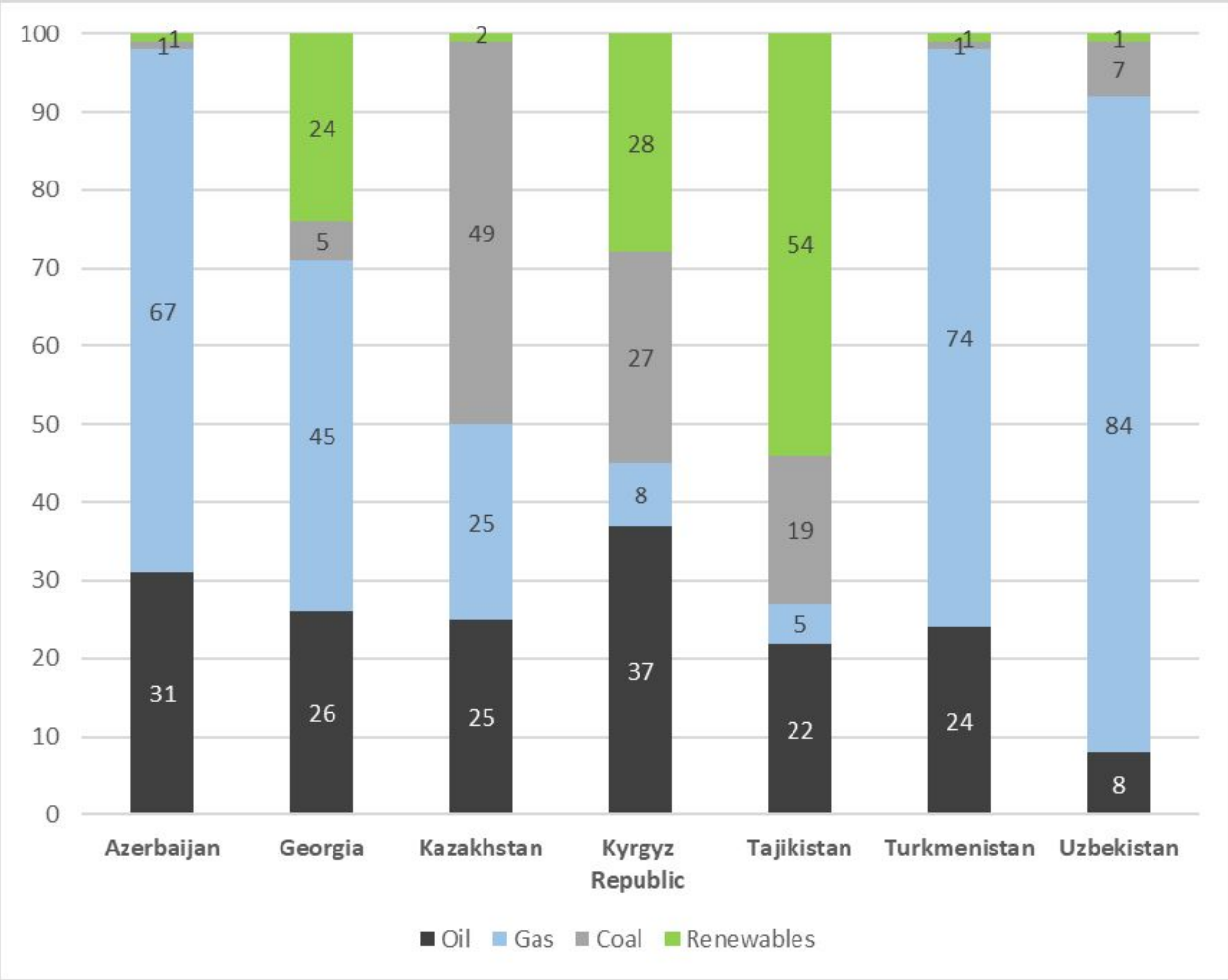
Dr. Vladislav Zavadskiy

Senior Energy Expert

Vladislav.Zavadskiy@gmail.com

WeChat/WA: +7 777 231 79 59

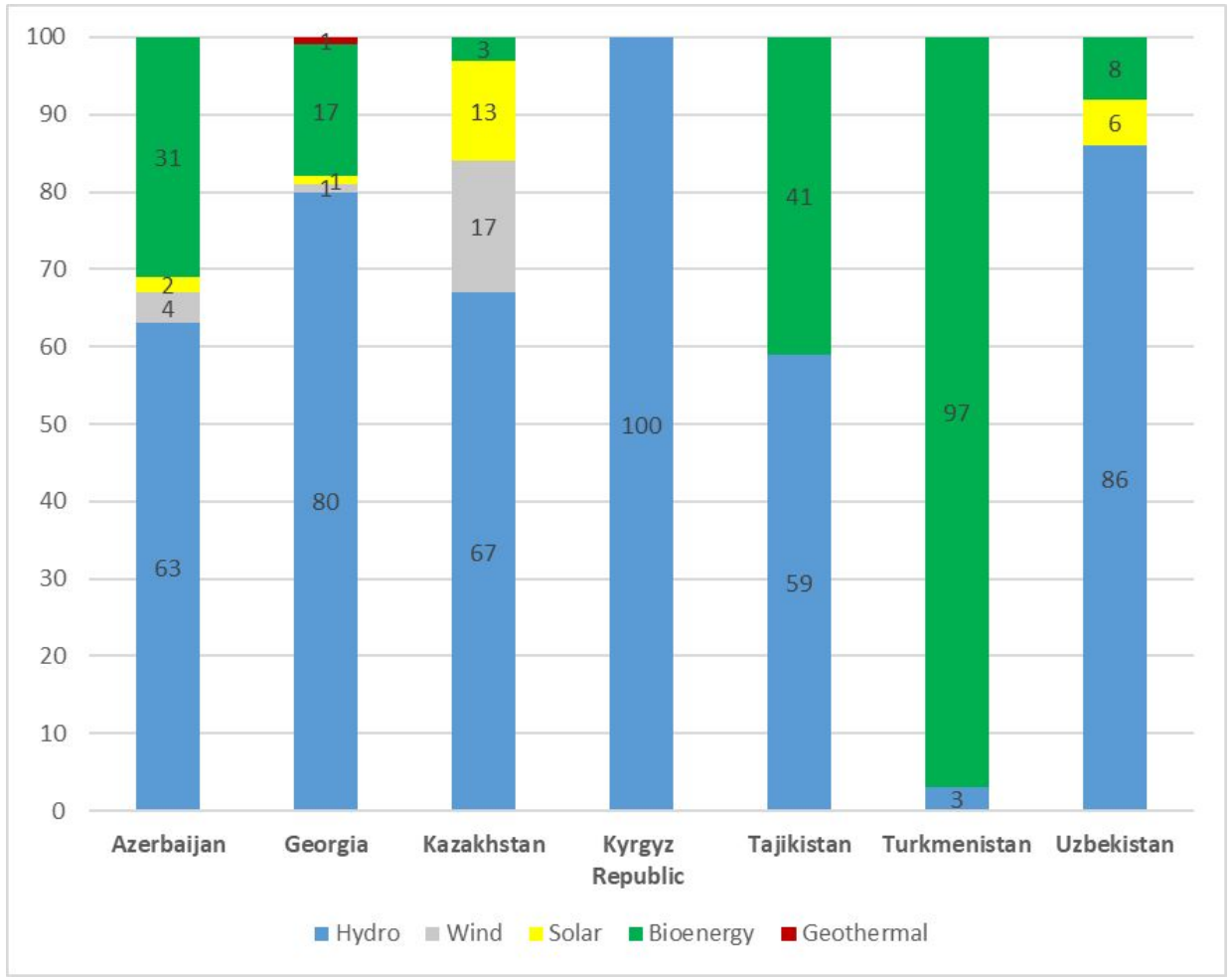
CCA7 current energy landscape overview



Total Energy Supply in CCA7 (2021), (%)

Source: IRENA https://www.irena.org/Data/Energy-Profiles

CCA7 current energy landscape overview



Renewable Energy Supply in CCA7, 2021, (%)

Source: IRENA https://www.irena.org/Data/Energy-Profiles

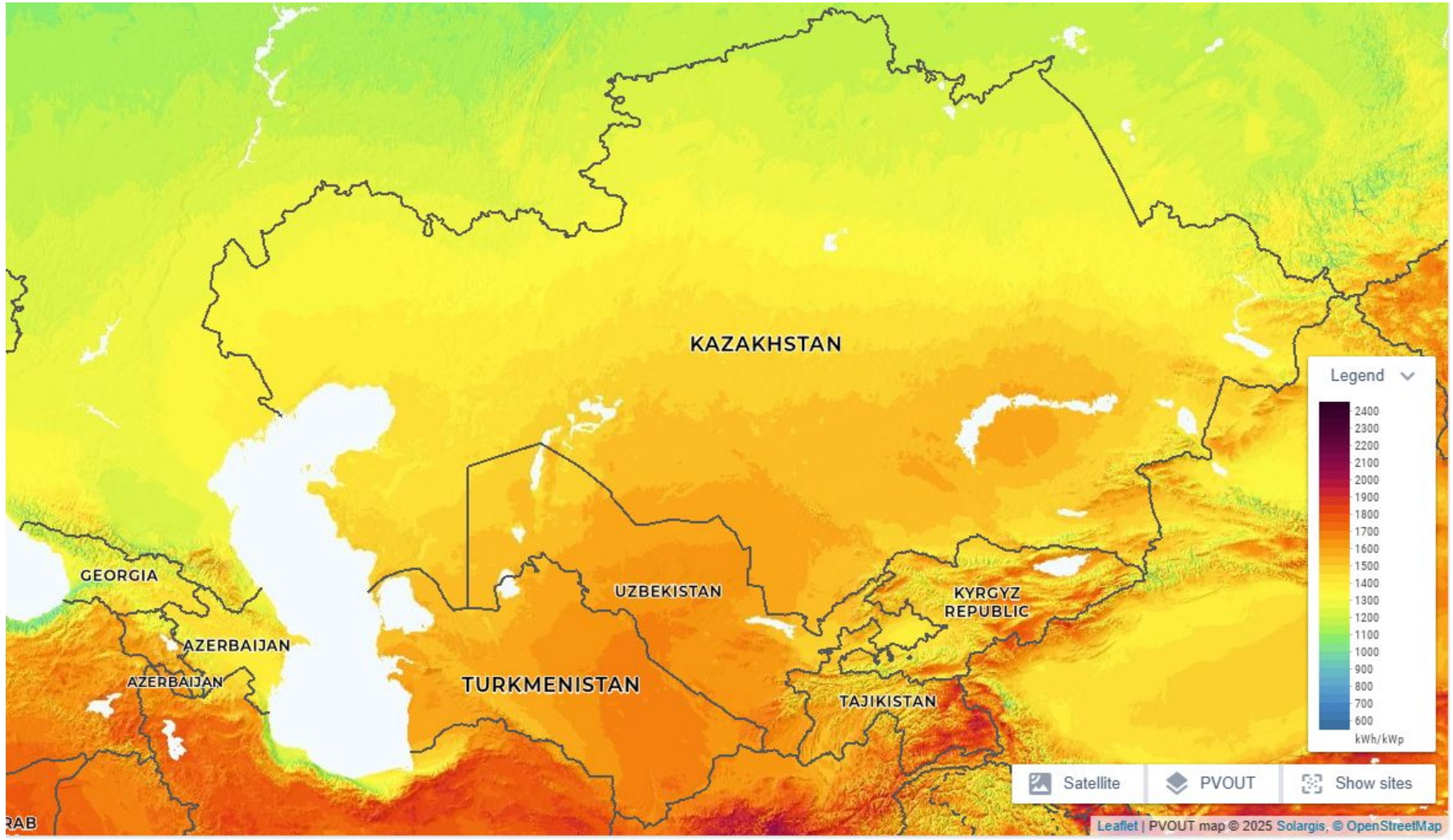
The Need for a Green Energy Transition

- Global Context: Reference global climate agreements such as the Paris Agreement and the urgency of meeting international climate goals;
- Local Benefits: Emphasize the benefits of transitioning to green energy:
  - Economic diversification away from fossil fuels;
  - Job creation in new energy sectors;
  - Improved public health outcomes through reduced pollution;
  - Enhanced energy security and independence.

Prospects for the Development of the Renewable Energy in the CAREC Countries

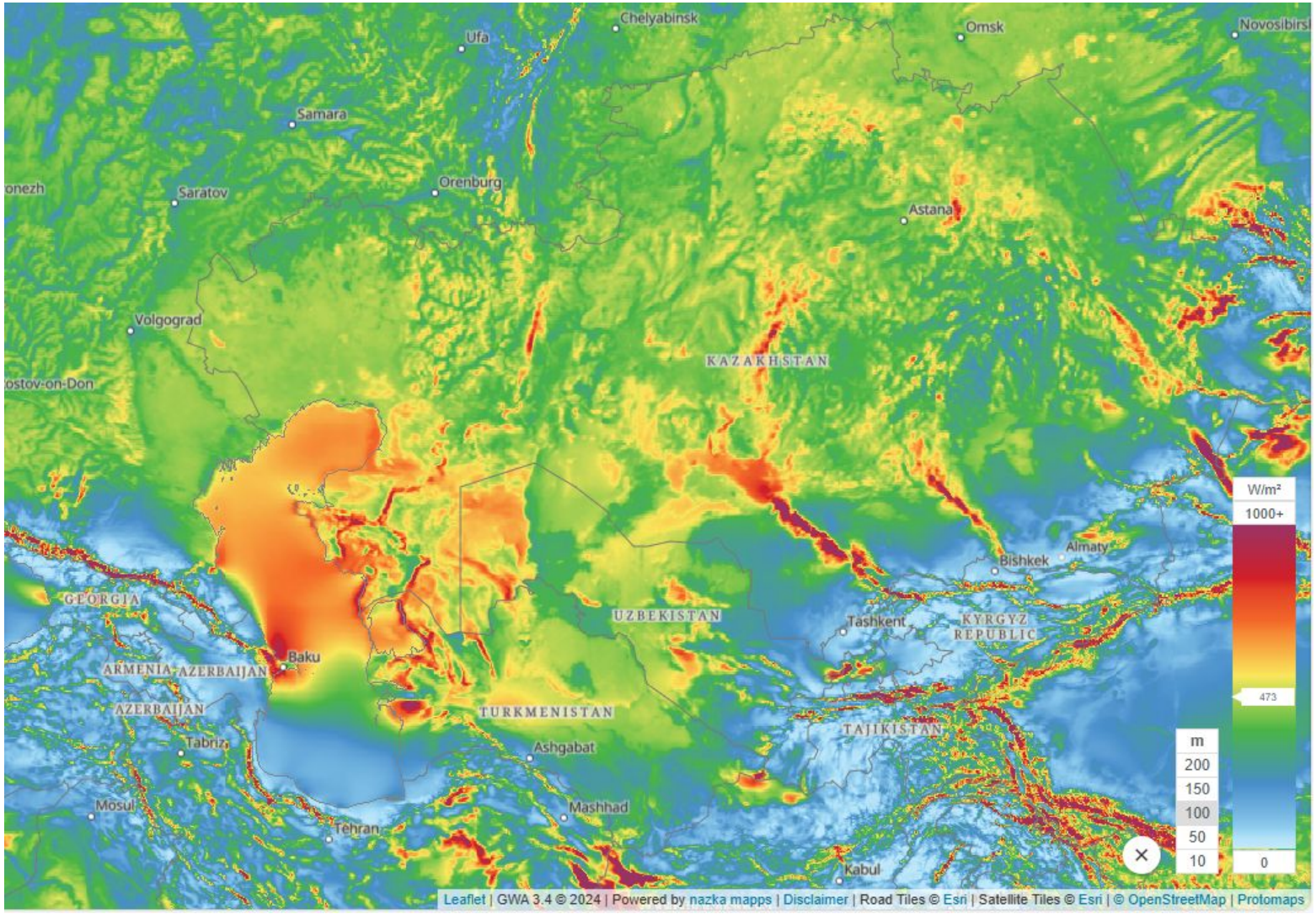
- Azerbaijan: 30% by 2030;
- China: 25% by 2030, carbon neutrality by 2060;
- Kazakhstan: 6% by 2025, 15% by 2030, 50% alternative and renewable energy by 2050, 80% alternative and renewable energy by 2060;
- Kyrgyzstan: 10% by 2040;
- Tajikistan: 10% by 2030 (implies diversification, including renewable energy sources);
- Turkmenistan: zero growth in greenhouse gas emissions by 2030;
- Uzbekistan: 25% by 2026.

Source: Caliber.az; People's Daily Online.cn; USAID Energy in Central Asia, 2021; TESC 2024, Turkmenistan, 2024



Solar energy potential in CCA7, (kWh/m2)

Source: Global Solar Atlas



Wind energy potential in CCA7, (W/m2 (100 m))

Source: Global Wind Atlas

Ongoing Renewable Energy Development Support Activities in the CAREC Countries

- Support at the governmental level, development of renewable energy development programs;
- Renewable energy auctions;
- Direct subsidies;
- Tariff policy;
- Attraction of foreign capital and technologies;
- COP29;
- Green energy corridors.

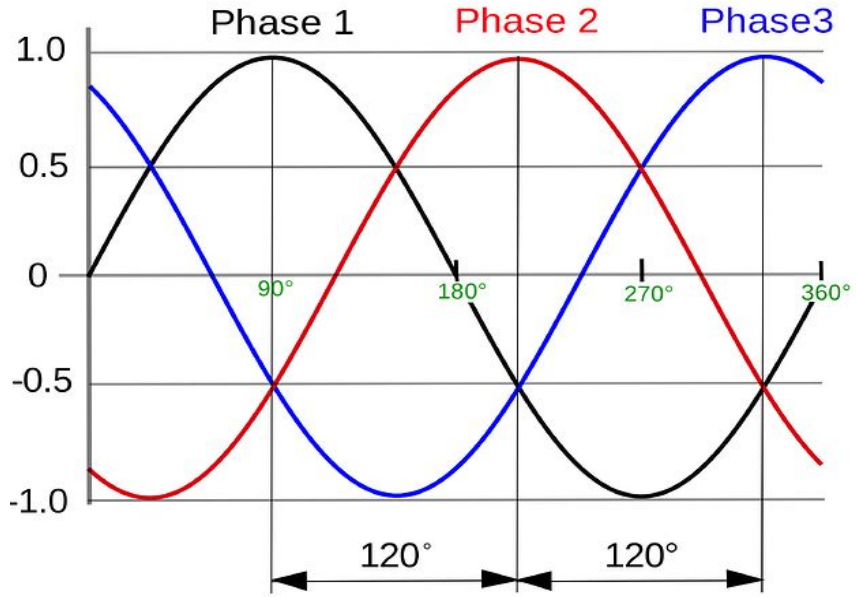
Renewable energy

Is it good or not?

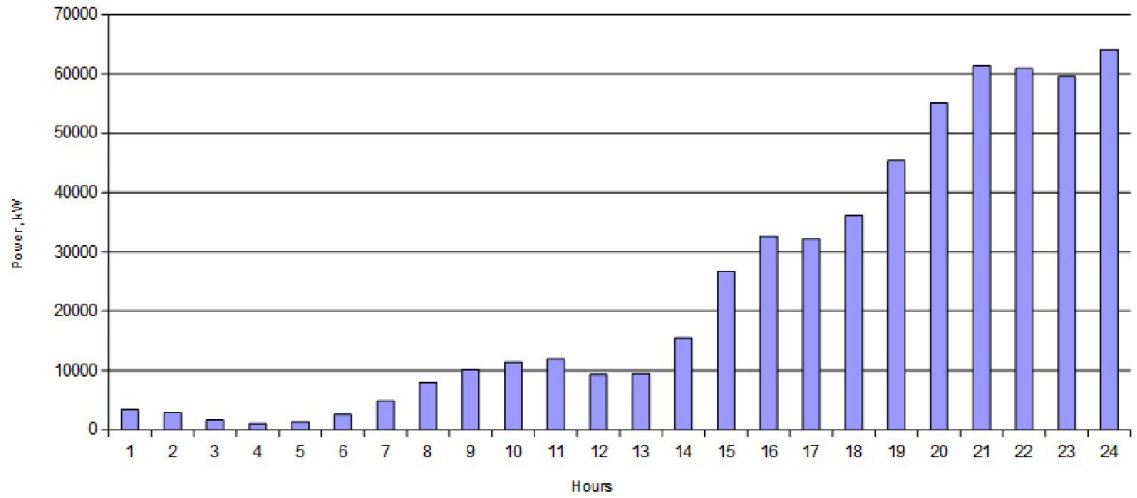
Power quality

An ideal situation is:

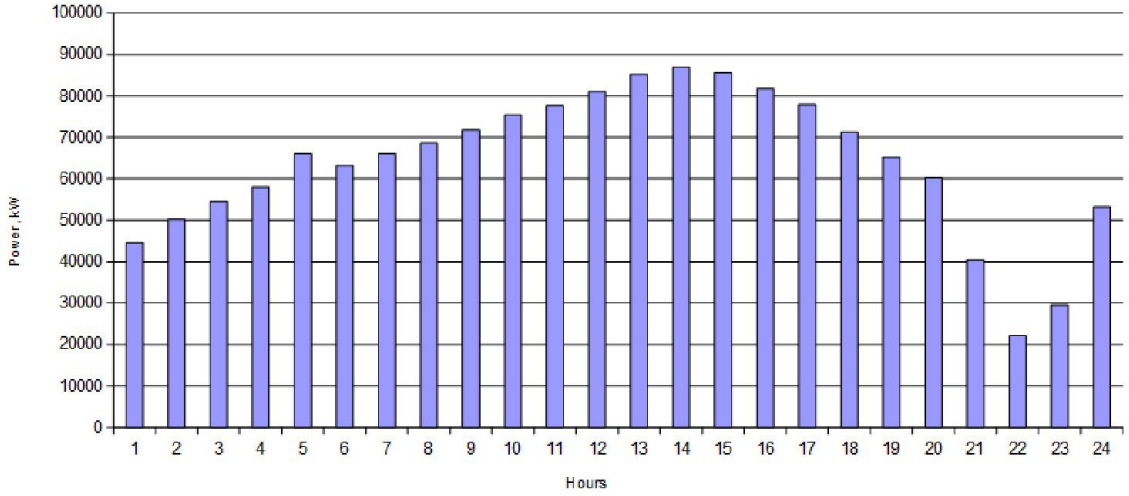
Production=Consumption



Source:
https://wiki.testguy.net/t/power-quality-analysis-basic-theory-and-applications-explained/70

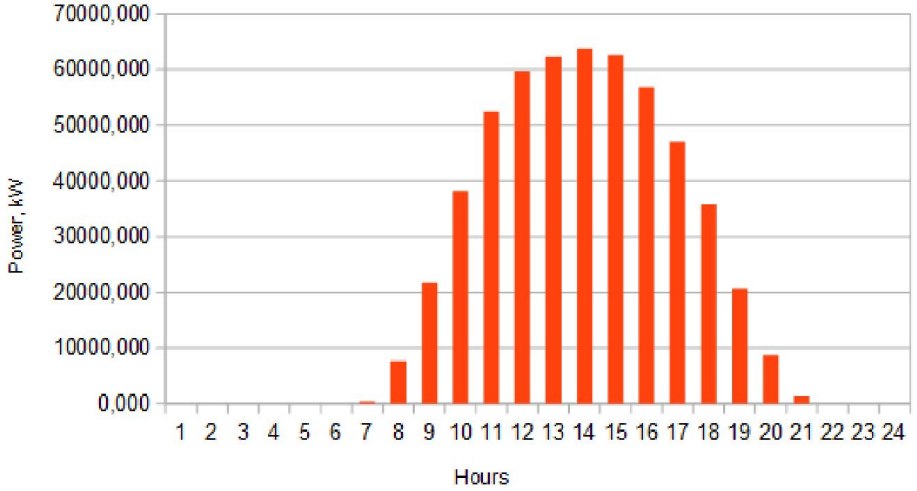


Renewables.ninja 100 MW wind farm power output profile simulation on 22.06.2014

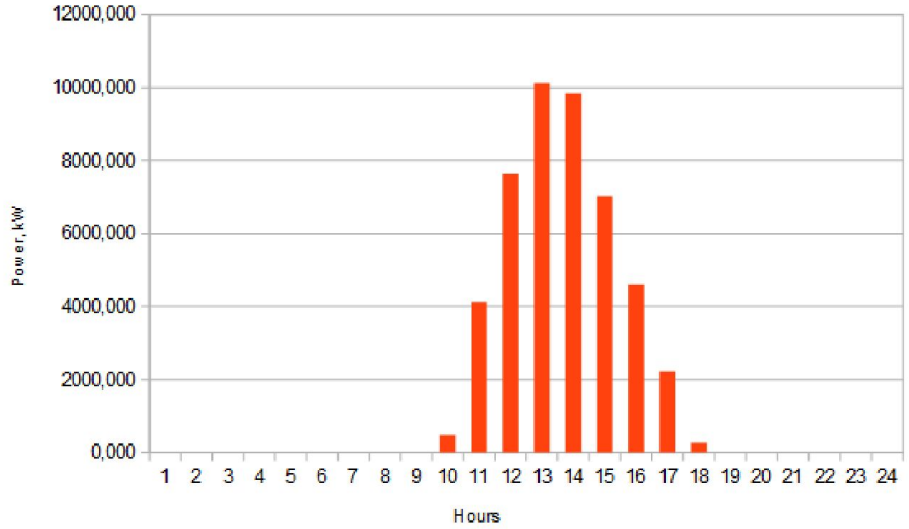


Renewables.ninja 100 MW wind farm power output profile simulation on 22.12.2014

Source: Renewables.ninja RES power output forecasting tool.
https://www.renewa bles.ninja/

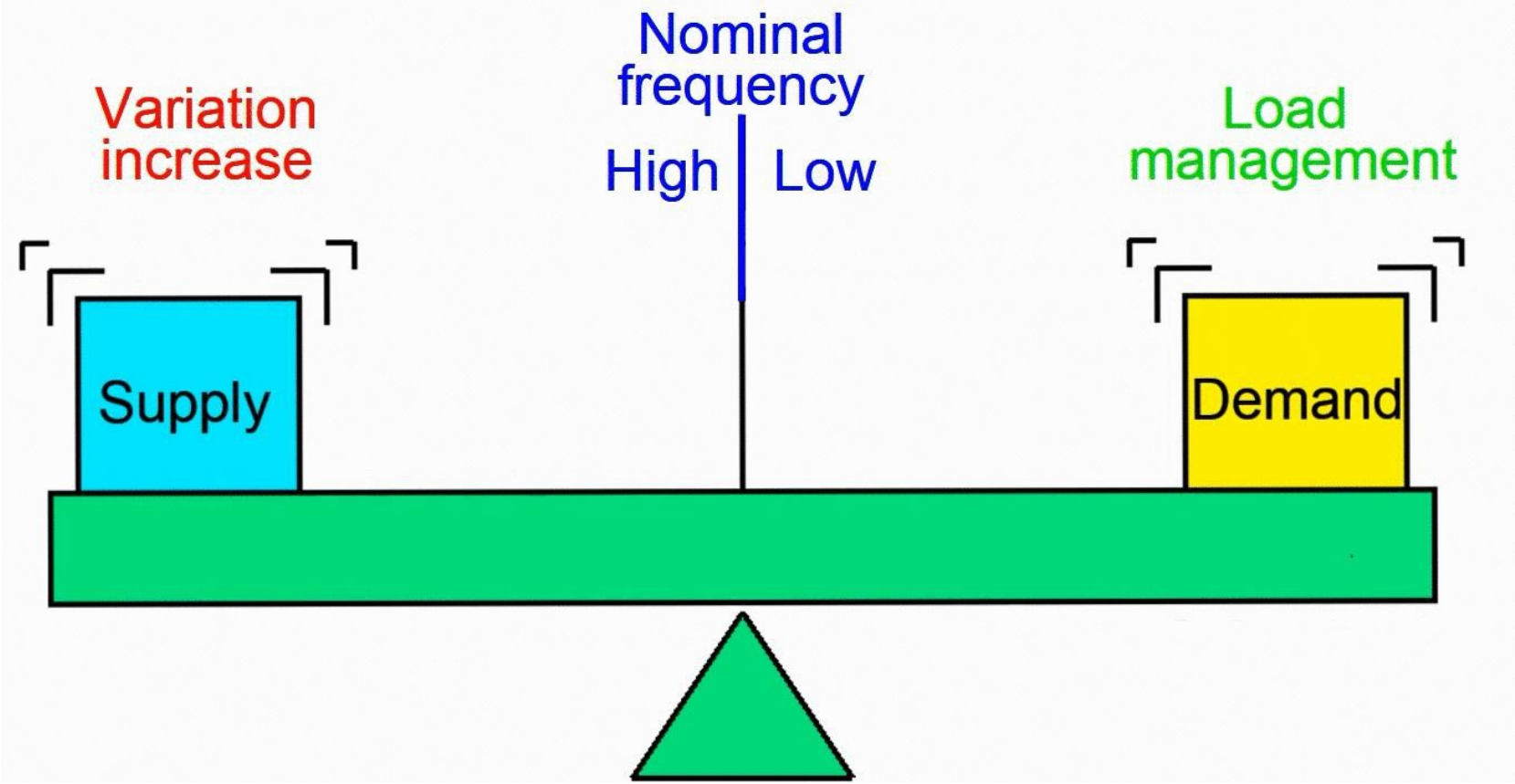


Renewables.ninja 100 MW PV solar plant power output profile simulation on 22.06.2014



Renewables.ninja 100 MW PV solar plant power output profile simulation on 22.12.2014

Source: Renewables.ninja RES power output forecasting tool.
https://www.renewa bles.ninja/



Relationship between demand/supply balance and frequency in a power system

Source: Kondoh Laboratory, Department of Electrical Engineering, Faculty of Science and Technology, Tokyo University of Science

Blackouts…

29 April 2025

‘15 gigawatts of energy suddenly dropped from Spain’s supply’…

> ‘A cross-border power blackout on Monday paralysed the Iberian Peninsula for most of the day, disrupting millions of lives across Spain and Portugal’…

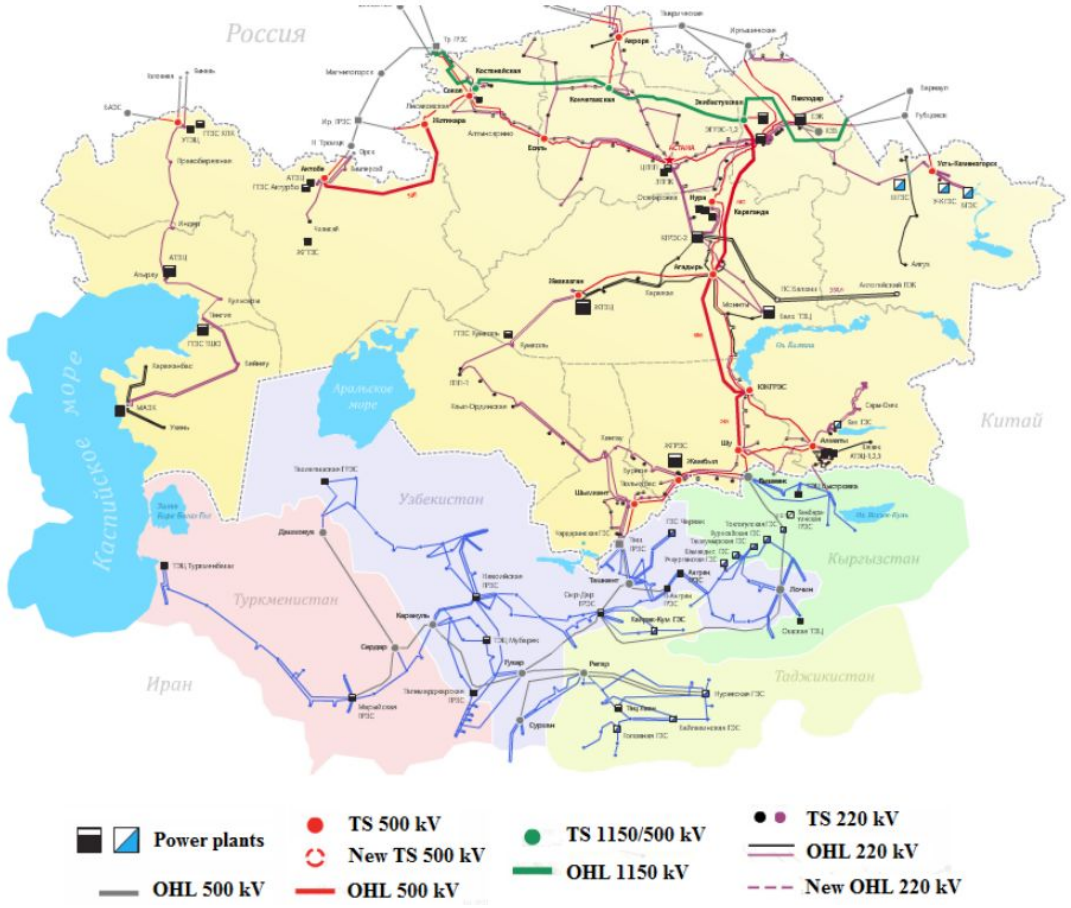
Still no clear reason…

2 May 2025

‘Bali has been plunged into darkness as a total power outage has hit the province’…

Source: CNN, France 24, The Bali Sun

There is a solution – large electrical network can smooth the fluctuations



CA countries electrical networks

Source: Vladislav Zavadskiy, Unit Commitment in a dispersed power system involving renewable energy. LAP LAMBERT Academic Publishing, ISBN-13:978-3-659-82615-3; ISBN-10:3659826154; EAN:9783659826153, 2018

Strengthening the power system interconnections is a key success factors for the renewable energy development in the CAREC region!

Caspian Green energy corridor

- Part of the CA – AZ – EU power link;
- Laying of a power cable along the bottom of the Caspian Sea;
- On 2 May 2024, the governments of Azerbaijan, Kazakhstan, and Uzbekistan signed an MOU launching the Caspian Green Energy Corridor initiative;
- On 13 November 2024, during the World Leaders Climate Action Summit, held alongside the 2024 United Nations Climate Change Conference (COP29) in Baku, President Kassym-Jomart Tokayev of Kazakhstan, President Ilham Aliyev of Azerbaijan, and President Shavkat Mirziyoyev of Uzbekistan formalized a strategic partnership agreement focused on the production and transfer of green energy;
- On 4 April 2025, ADB, AIIB, and the energy ministries of Azerbaijan, Kazakhstan, and Uzbekistan signed an MOU to support the initial Feasibility Study for the Caspian Green Energy Corridor Project;

Source: ADB. 58386-001: Central Asia Regional Economic Cooperation (CAREC) Program: The Caspian Sea Green Energy Corridor Project; S. Sakenova. 2024. Kazakhstan, Azerbaijan, and Uzbekistan Sign Agreement on Energy System Integration. The Astana Times. 13 November.

Caspian Green energy corridor

- Kazakhstan plans to export 7 GW of capacity, Uzbekistan - up to 5 GW of capacity;
- Project will increase strengthening of electrical systems interconnections;
- Strengthening regional cooperation within the CAREC region;
- The Caspian Green Corridor can drive significant economic growth and create jobs in participating countries by attracting investments in renewable energy infrastructure and fostering technological innovation;
- The corridor will also enable Central Asia's renewable energy producers to access European electricity markets;
- Climate resilience.

Source: ADB. 58386-001: Central Asia Regional Economic Cooperation (CAREC) Program: The Caspian Sea Green Energy Corridor Project

Bridging continents: The role of green energy corridors in the CAREC region

- Variable generation from renewable energy sources as an objective limiting factor for their large-scale implementation;
- Electricity storage along with the strengthening of intersystem connections as a leveling factor for variable generation;
- Huge hydropower project such as Rogun, Kambarata-1 can force green energy transition and balance power system;
- Green energy corridors in the CAREC region and beyond can drive significant economic growth and create jobs in participating countries by attracting investments in renewable energy infrastructure and fostering technological innovation;
- Caspian Green Energy corridor (phase I, II), link to EU and South-East Asia;
- Development of models to support the electricity system interconnection to attract private and foreign investment;
- Power markets integration and development;
- The significant role of think tank organizations such in research and multilateral banks supporting green energy transition, energy storage development, strengthening intersystem connections and regional cooperation;
- Transfer of best practices, technologies within the framework of regional cooperation and integration.

Thank you!