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Regional Integration as an Energy Security Strategy: Lessons for Central Asia from Europe’s Efforts towards Security of Supply through Regulatory Integration

Richard Wheeler

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During the Soviet era, the Central Asian energy system was regionally integrated. The electricity grid worked as a unified system, and current day problems related to the water-energy nexus were non-existent. This changed after the five countries became independent. Self-reliance in energy became a stated policy goal, and significant investments were made in gas pipelines and electrical connectors to reduce dependency of energy transit on neighboring countries. Countries began to pursue energy export and internal supply policies without considering the synergies possible from working with neighboring countries which possess complementary energy resources. Energy trade in the region became politicized.

Recent improvements in relations between the countries of the Central Asian region currently provide an opportunity to re-integrate the regional energy system in a way which will benefit the countries of the region. However, reintegration in the current twenty-first century context will require much more than simply agreeing to reconnect electricity grids or to resume gas pipeline flows. Bringing significant amounts of renewable sources of energy online – which will be necessary if the region will have any realistic chance of meeting its carbon reduction commitments under the Paris Agreement – will require a greatly increased amount of regional cooperation and coordinated regulatory reform.

This Policy Brief will explore if best practices in the current energy integration processes undertaken by the European Union can be applied in Central Asia with an aim towards improving energy security. Prior to the Third Energy Package in 2009, European energy markets were nationally based and not well integrated. This contribution will begin by offering some definitions of energy security. European regulatory changes since 2009 will be discussed. Attention will also be paid to the implementation of "network codes", and how they assist in energy market integration. Examples from European and North American energy markets show the unique challenges which Central Asia will face if it is decided to pursue renewable sources of energy on a large scale. The role of existing energy-related multilateral organizations, and their potential for cooperation in implementing new energy regulations regionally, will be examined. Finally, a case study will be presented on lessons learned about energy insecurity from the Bishkek thermal power plant incident earlier this year.

Definitions of Energy Security

Before examining how regional integration can play a positive role in ensuring energy security, a logical starting point is to discuss the varying definitions of energy security. It should be noted that there is no universally accepted definition of energy security, and that each organization which deals with energy tends to define energy security in a way which most closely matches its own mandate and constituencies.

For example, one of the broadest approaches towards energy security is used by the OSCE. Given its very broad constituency of 57 participating States, each using its own distinctive energy mix, the OSCE approach of primarily fostering dialogue between producer, transit and consuming countries allows for a broad approach towards energy issues in keeping with its mandate as a security organization possessing several instruments within its conflict cycle toolbox.[1]

It could be claimed that Winston Churchill initiated the discussion about energy security in the early twentieth century by saying that "Safety and certainty in oil lie in variety and variety alone."[2] And nearly a century after Churchill, the energy security debate has continued, with the World Energy Congress using the term "Energy trilemma" to mean that energy supplies should be secure, equitable and environmentally sustainable.[3] It should be noted that consumer countries tend to see energy security in terms of access to energy, or security of supply; this can be seen from the definition used by the International Energy Agency (IEA), namely "the uninterrupted availability of energy sources at an affordable price."[4] On the other hand, energy producers tend to view energy security as unfettered access to markets where they can get the best price for their commodity.

The European Union has no officially agreed definition for security of supply. However, given that the EU is generally an importer of energy products, especially natural gas, it should not be surprising that the EU has placed an emphasis on ensuring security of supply by putting in place a robust market design, bolstered by detailed rules and new regulatory institutions. The Council of European Energy Regulators, in its "Concept Paper on Security of Gas Supply," mentions recommendations for "prevention" and "mitigation".[5] For the EU, security of supply has both short-term and long-term elements. Short-term security is the ability of the energy system to react promptly to sudden changes in the supply-demand balance.[6] For example, the explosion and one-day shut-down resulting from the December 2017 industrial accident in Baumgarten, Austria did not lead to a gas supply crisis in East Central Europe.[7] This incident demonstrated how robust the European gas market has become. Long-term energy security assumes that timely investments are made to supply energy in line with economic developments and environmental needs.[8] Such investments include not only critical infrastructure, such as transmission power lines and gas pipeline interconnectors which

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1 "Thematically, our engagement increasingly involves good governance and transparency in the energy sector, as well as threats to critical energy infrastructure, sustainable energy solutions, awareness-raising, and early warning mechanisms." Remarks delivered by Goran Svilanovic, OSCE Coordinator of Economic and Environmental Activities, at a meeting of the Mediterranean Contact Group in Vienna, 18 May 2012.

2 From https://www.foreignaffairs.com/articles/2006-03-01/ensuring-energy-security, accessed 22 March 2018.

3 World Energy Council official website: http://www.worldenergy.org/wp-content/uploads/2013/09/Trilemma-original.pdf accessed 3 February 2014.

4 IEA official website: http://www.iea.org/topics/energysecurity/ accessed 3 February 2014.

5 https://www.ceer.eu/documents/104400/-/-/42f8b22e-68f7-d205-5b02-73cda850a676; Source: Ilaria Conti, week 11 published lecture materials from course "Introduction to the Regulation of Gas Markets", p. 3, Florence School of Regulation, accessed 2 February 2018.

6 For a detailed discussion about security of supply in electricity markets, please see: Pablo Rodilla and Carlos Batlle, "Security of Generation Supply in Electricity Markets", *Regulation of the Power Sector*, Ignacio J. Perez-Arriaga, ed., Springer-Verlag, London, 2013, pp. 582-3.

7 Kristi Knolle, "Gas supply from Austrian gas hub back to normal after deadly blast," 13 December 2017, https://www.reuters.com/article/us-austria-blast/gas-supply-from-austrian-gas-hub-back-to-normal-after-deadly-blast-idUSKBN1E7242, accessed 16 December 2017.

8 Ilaria Conti, week 9 lecture from course "Introduction to the Regulation of Gas Markets", Florence School of Regulation, accessed 29 January 2018.

physically bind together different national energy markets, but also distribution systems, such as the ones which came under stress in Bishkek earlier this year.

Europe's Regional Energy Integration and Regulatory Institutional Framework

Natural gas and electricity networks, given their special characteristics, require regulatory attention to ensure that energy security will be enhanced through their proper use.[9] [10] It therefore comes as no surprise that the European Union is pursuing the goal of "security of supply", as it informally defines energy security, through market integration and regulatory reforms.

The European journey towards a continent-wide, integrated gas market took its first halting steps in 1996, with the passage of the first energy package. This first package focused on network access for all companies, including new market entrants and incumbents, to gain access to the gas transmission network.[11] If the first energy package dealt with the supply side, the second energy package focused on the demand side, allowing customers freedom of choice in regards to their gas suppliers.[12] These reforms however, were insufficient to create a continental gas market, and so a Third Energy Package was released in 2009. Given that EU Member States tend to jealously guard their national prerogative in energy policy, the Third Energy Package was made possible by the Lisbon Treaty in 2009, which specified that energy policy falls under shared competence.[13] EU Directives 2009/73/EC (for gas)[14] and 2009/72/EC (for electricity)[15] provide the statutory support for the Third Energy Package.

The Third Package mandated the unbundling of upstream assets from transmission assets.[16] In other words, natural gas producers or electricity generators could no longer also own transmission lines. This unbundling created conditions which allow for a competitive wholesale energy market, and a European energy market. New market mechanisms, including entry-exit tariffs and gas capacity auctions were introduced.[17] In order

9 Please see Annex 1 at the end of this Policy Brief for diagrams which illustrate how power and natural gas markets function.

10 By way of illustration of the complexities of managing electricity networks: in accordance with Kirchoff's laws of physics, the flow of electric power within a network cannot be directed through a pre-determined path; although we can know the entry and exit points, the exact pathway taken by an electric flow through a complex network cannot be controlled by the network operators. Source: Damian Laloux and Michel Rivier, "Technology and Operation of Electric Power Systems", *Regulation of the Power Sector,* Ignacio J. Perez-Arriaga, ed., Springer-Verlag, London, 2013, pp. 2-3.

11 Ilaria Conti, week 9 lecture from course "Introduction to the Regulation of Gas Markets", Florence School of Regulation, accessed 29 January 2018.

12 Ibid.

13 Specifically, by Article 194 of the Treaty on the Functioning of the European Union. Source: Aurelie Bos, Tatiana Mitrova, Kirsten Westphal, "German-Russian Gas Relations: A Special Relationship in Troubled Waters", December 2017, German Institute for International and Security Affairs, p. 23.

14 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0094:0136:en:PDF.

15 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0072&from=EN.

16 Ilaria Conti, week 9 lecture from course "Introduction to the Regulation of Gas Markets." Op. cit.

17 Ibid.

to improve resilience in the event of a gas supply crisis, Regulation 994/2010 on the Security of Gas supply was adopted; this regulation put into place emergency plans and empowered a Gas Coordination Group to facilitate joint action and exchange of information. Not less importantly, the Third Energy Package also formed an institutional framework for energy regulation by mandating the creation of ACER (Agency for the Cooperation of Energy Regulators), ENTSOG and ENTSO-E (the European Network for Transmission System Operators for gas and electricity, respectively).[18] A "regulator" is the national authority responsible for energy regulations, while a "transmission system operator" or TSO is responsible for operating the transmission system on a given territory. Although there can be only one national regulator, some large countries such as Germany have divided their gas systems into several TSO regions.

In addition to introducing the building blocks for a competitive wholesale energy market, and an institutional framework for energy regulation, the EU decided to introduce an additional measure meant to harmonize energy regulations across the continent: gas network codes and electricity network codes. The gas network codes were drafted by ENTSOG and were intended to regulate important aspects of how gas markets function across borders, including the allocation of pipeline capacity, congestion management practices, the harmonization of transportation tariffs, of measurement units and other technical details in order to ensure interoperability across neighboring transmission system operators.[19] As for electricity, there are a total of eight network codes: three market codes, three connection codes, and two operation codes.[20] It should be noted that the development of gas codes in the EU is currently more advanced than that of the electricity codes.[21]

Current Challenges in European and North American Energy Markets

European institutions have paid much attention to the role of renewable sources of energy while constructing an increasingly integrated energy market. Specific measures have included the RES Directive in 2009; Energy Efficiency Directive in 2012; the 20/20/20 initiative; and most recently, in November 2016, the Winter Package for a clean energy transition. Concerns in Europe about the environmental effects of climate change has certainly determined much of this attention and led to widespread European support for engaging in the UNFCCC process[22], and ultimately approving voluntary reductions in carbon emissions by approving the Paris Agreement in November 2015. In addition to positive environmental

18 Ibid.

19 Ilaria Conti, week 11 lecture from course "Introduction to the Regulation of Gas Markets", Op. cit.

20 Leonardo Meeus, Tim Schittekatte, "The EU Electricity Network Codes: Technical Report," European University Institute, Florence, October 2017. This publication can provide a very detailed discussion about the subject of power networks and the use of network codes in Europe.

21 Interview by Ilaria Conti, Head of Gas Area, Florence School of Regulation, with Klaus-Dieter Borchardt, Director of DG Energy, European Commission, on 22 January 2018; accessed on 25 January 2018. https://www.youtube.com/watch?v=N7GBa3YyYKY

22 The UN Framework Convention on Climate Change has been the mechanism through which the Kyoto Protocol (1997), Cancun Agreement (2010, agreement on limiting global warming to 2C), and Paris Agreement (2015) were negotiated.

effects, the proper integration of renewable sources of energy can also constructively increase energy security by diversifying a country's or region's energy mix.

However, assimilating renewable energy sources (RES) is not without its technical challenges. The most widely used RES are wind and solar, which are generated on a variable (rather than constant) basis. Current technology does not allow electricity to be stored in substantial amounts for extended periods of time. Moreover, to maintain balance in the power grid, electricity must be consumed by a customer at a network's exit point at precisely the same time and in the same amount that a power generator creates electricity at a network's entry point.[23] This means that renewable sources of energy cannot currently be used as baseload energy.[24] Some visual representations which demonstrate the challenges of adopting variable sources of energy in an electricity grid can be found in Annex 2. One thing which is clear: reconnecting the Central Asian electricity grid and energy systems will require much more than the twentieth century rules which were in place during the Soviet era. Proper attention to twenty-first century technological solutions will be necessary. The countries of Central Asia would be wise to look toward organizations which have proven experience in implementing best practices within a modern context for integrating their energy systems into a regional structure that can benefit all five countries in a synergistic manner. An examination of some multilateral organizations active in the region will follow.

Multilateral Organizations and their Potential for Cooperation

There are several organizations which deal with regional energy issues in Europe and Eurasia.[25] Some are primarily regulatory-related organizations, some emphasize economic-trade issues, and some are mainly security-related organizations. While describing them below, this contribution will mention their roles, either as engines for broad economic integration, sources of best practices for energy-related regulatory issues, or as broad platforms for dialogue. For this discussion, the most relevant multilateral organizations are the Shanghai Cooperation Organization, the Eurasian Economic Union, and the Energy Community.

The Shanghai Cooperation Organization is an example of a platform for dialogue in energy issues. As security-related organization, with a growing membership which has come to include India and Pakistan, in addition to longtime members China, Russia, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, the SCO's main mission is to fight the "three evils" of terrorism, separatism and extremism.[26] That said, cooperation in energy has long been part

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23 Damian Laloux and Michel Rivier, "Technology and Operation of Electric Power Systems", *Regulation of the Power Sector*, Ignacio J. Perez-Arriaga, ed., Springer-Verlag, London, 2013, p. 2.

24 For a detailed discussion about how electricity grids function, see Ibid; and Leonardo Meeus, Tim Schittekatte, "The EU Electricity Network Codes: Technical Report," European University Institute, Florence, 2018.

25 For a more detailed treatment of this topic, please refer to: Wheeler, Richard, "Multilateral Engagement with Central Asia on Energy Issues", *Central Asia in the Era of Sovereignty: The Return of Tamerlane?* Ed. Daniel L. Burghart and Theresa Sabonis-Helf, Lexington Books, 2018, pp. 269-290.

26 Shanghai Cooperation Organization, "About SCO," http://eng.sectsco.org/about_sco/.accessed 14 August 2018.

of the SCO agenda, with talks about forming an "energy club" having started in 2004,[27] with agreement formally reached in 2013.[28] This Energy Club, as a consultative body, is similar in format to the Organization's Business Council; its main aim is to encourage non-binding dialogue between academia, state officials, and the business community of its member countries. The SCO Energy Club is an unusual grouping within the SCO context, as its 2017 Chairmanship was held by non-SCO member Turkey. Other non-SCO countries which actively participate in the SCO Energy Club as members now include Afghanistan, Belarus, Iran, Mongolia and Sri Lanka. Although organizations which function as platforms for non-binding dialogue, such as the OSCE or the SCO Energy Club, often provide opportunities for informal exchanges of best practices, experience has shown that the detailed technical expertise required to guide discussions about the coordination of energy regulations tends to fall outside the scope of such organizations.

The Eurasian Economic Union (EAEU) is an economic trade bloc which has recently become very active in issues related to regional energy integration. Although the EAEU came into existence in its current form in January 2015, it is the successor organization of the Customs Union, which was formed in the late 1990's. Members currently include Russia, Belarus, Armenia, Kazakhstan and Kyrgyzstan; the EAEU has concluded or is currently negotiating free trade agreements with non-members Iran, China, India, Egypt and Vietnam.[29] Between its five members, the EAEU plans to create unified energy markets in electricity (by 2019), common oil market exchange (by 2021), and an integrated natural gas market (by 2025).[30] The foundation of its technical integration, the network codes, is reportedly based upon the rules currently being used by the CIS Free Trade Area.[31] [32] Energy integration within the EAEU is being handled by the Moscow-based Eurasian Economic Commission, which functions in a manner very similar to that of the European Commission. An Energy Department, overseen by a Minister responsible for the energy and infrastructure portfolios, functions within this Eurasian Economic Commission.[33] Although the EAEU, unlike the SCO Energy Club, is actively creating a unified energy market by addressing regulatory and technical issues, it currently only includes two of the five Central Asian countries. Given that Tajikistan, Turkmenistan and Uzbekistan – three countries which are important for integration of the broader Central Asian region – are outside of the EAEU, there exists a real possibility that as

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27 Matusov, Artyom. "Energy Cooperation in the SCO: Club or Gathering?" *China and Eurasia Forum Quarterly 5*, no. 3 (2007): 83–99.

28 "SCO members ink memo on creation of Energy Club," Asia-Plus, December 8, 2013, http://news.tj/en/news/sco-members-ink-memo-creation-energy-club

29 https://www.telesurtv.net/English/news/Iran-Joins-Free-Trade-Zone-with-Eurasian-Economic-Union-20180.424.0033.html, accessed 25 April 2018.

30 Maria Pastukhova and Kirsten Westphal, Eurasian Economic Union Integrates Energy Markets - EU Stands Aside, *SWP Comments 5*, German Institute for International and Security Affairs, January 2018, pp. 1-4.

31 According to a discussion held under Chatham House rules at the Central Asia Energy Security Conference; Almaty, Kazakhstan, 4-6 April 2018, organized by the George C. Marshall European Center for Security Studies.

32 CIS FTA members currently include: Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Uzbekistan. Ukrainian participation in the CIS FTA was unilaterally suspended by Russia, effective on 1 January 2016.

33 Eurasian Economic Commission, "Energy and infrastructure," http://www.eurasiancommission.org/en/act/energetikaiinfr/Pages/default.aspx.

technical and regulatory rules are developed, incompatibilities could arise within the Central Asian region from the creation of a single energy market within the EAEU.

With the aim of avoiding such technical and regulatory barriers to unfettered energy trade within the region, several European multilateral organizations could provide extensive knowledge on current best practices related to encouraging cross-border energy trade. In addition to the above-referenced ACER, ENTSO-E, and ENTSOG – organizations which are "internal" to the European Union, and which have deep experience in integrating regional energy markets and working with regulatory frameworks – the Energy Community has experience in working with countries which are outside of the EU regulatory framework.

The Energy Community is a regional organization based in Vienna which focuses on countries which either aspire to join the European Union or to increase energy trade with Europe. Its mission is to help create an integrated energy market allowing for cross-border energy trade and integration with the EU market by extending EU internal energy policy to non-EU members on the ground of a legally binding framework. Countries with which it works are known as Contracting Parties, and the Energy Community helps its Contracting Parties to develop their national legislative framework in compliance with European legislation and regulatory frameworks in the areas of electricity, gas, environment, renewable energy, energy efficiency, security of supply and competition. Its mission also includes: establishing a stable regulatory and market framework capable of attracting investment in power generation and networks; enhancing the security of supply to ensure stable and continuous energy supply; and improving the environmental situation in relation with energy supply in the region and foster the use of renewable energy and energy efficiency.[34] Although the Energy Community's role as a regional organization is focused on bringing national-level energy related legislation and the practical implementation of energy regulation of its Contracting Parties into line with EU regulations, the proven experience of the Energy Community in facilitating regional integration can serve as a model for the coordination of energy trade in regions such as Central Asia.

The Applicability of European Regulatory Experience for Central Asia

Since independence, energy-related cooperation between Central Asian countries was curtailed, to the detriment of all countries in the region. Several recent bilateral agreements have raised hopes for a more integrated regional approach towards energy trade. With an eye towards this trend, it should be remembered that the regional integration of energy markets involves many complex factors and may be viewed by different observers as primarily driven either by geopolitical, economic or technical considerations. While some observers principally perceive such integration projects as competition in the Central Asian region between different political/economic groupings such as the European Union, China's One Belt One Road initiative and the Eurasian Economic Union, others have encouraged dialogue on a technical level between these entities.[35]

34 https://www.energy-community.org/aboutus/whoweare.html

35 Maria Pastukhova and Kirsten Westphal, Op. cit., pp. 5-7.

On that note, this contribution agrees with the need for technical dialogue between countries and aims towards a consideration of the merits of regional energy integration from a technical, rather than political perspective. Given the advances in energy technology in recent years, it will not be easy to provide for the smooth interoperability of a regional energy system in the modern context of carbon reduction, variable renewable energy and competitive wholesale markets where much of the infrastructure and operational assumptions were developed during the twentieth century. From this perspective, Central Asian countries would greatly benefit from the practical experience gained by European institutions and regulatory bodies from the past decade of energy integration in Europe. Specifically, technical dialogue and cooperation with the Energy Community, ACER, ENTSO-E and ENTSOG would unlock valuable practical expertise in this area. That said, it would be beyond the scope of this contribution to recommend formal membership or official status for Central Asian countries in any of these multilateral organizations, as this is a political issue. Cooperation between recognized platforms for dialogue – such as the Task Force on Regional Electricity Cooperation in Asia (RECA, launched with the cooperation of the Brussels-based Energy Charter),[36] the SCO Energy Club or the OSCE – with these above-referenced specialist technical organizations could also be beneficial for countries of the region as mechanisms for exchanging best practices in this area.

Case Study on Energy Insecurity: the Bishkek thermal power plant incident

The mechanical breakdown of the Bishkek thermal power plant during January - February 2018 serves as an excellent case study of how energy insecurity in one form of fuel in a specific location can have potentially devastating effects for a broad area within the regional energy system. On 26 January, the city central heating system suffered a mechanical breakdown, when six of the eight heating units went offline.[37] In Bishkek, as in most former Soviet urban centers, heating for retail residential and business customers is delivered through an elaborate and centralized system of pipes, which are heated with hot water which is pumped through the system. This district heating system allows customers to use natural gas primarily for cooking, and electricity for lighting and powering household appliances. Residential use of gas or electricity for heating is generally not required (except for limited use of space heaters in single rooms), thus lowering the need for gas and electricity in the city energy system.

The heating system broke down because of a mechanical failure in the water pumps supplying the heating units. Output reduced from 340 to 154 megawatts (MW), but fortunately

[36] https://energycharter.org/what-we-do/trade-and-transit/regional-energy-task-force/ and https://energycharter.org/fileadmin/DocumentsMedia/Events/RECA_Issyk_Kul_2015_Declaration.pdf

[37] Kapushenko, Anna. "Why is Bishkek freezing, and what happened at the thermal power plant?" (Почему Бишкек мерзнет, и что случилось на ТЭЦ?), https//kloop.kg/2018/01/29/pochemu-bishkek-merznet-i-chto-sluchilos-na-tets/, 29 January 2018, accessed 30 January 2018; and Kerimbekov, Chyngyz. Kubat Rakhimov: the accident at the CHP was a result of the decline of the entire power system." (Кубат Рахимов: авария на ТЭЦ была результатом упадка всей энергосистемы), 29 January 2018 http://knews.kg/2018/01/kubat-rahimov-avariya-na-tets-rezultat-upadka-vsej-energosistemy/, accessed 3 February 2018.

stabilized at that level.[38] Repeated attempts to bring the system back to full functionality were unsuccessful over several days, starting on 26 January. Compounding the situation, the system broke down during a severe cold spell in northern Kyrgyzstan; daytime temperatures did not rise above -15C for several days during this crisis, and nighttime temperatures dropped as low as -23C.[39] Although a collapse of the entire city's energy system was deftly avoided, the lack of residential heating for several days did put the local electric and gas distribution systems under severe stress. Residents and news outlets reported lowered gas pressure citywide, and localized electrical blackouts which were concentrated in specific neighborhoods.[40] The severe stress of the gas and electricity distribution systems were a result of customers' attempts to replace the district heat by burning gas in their kitchen stoves (which can be dangerous due to potential carbon monoxide poisoning) and by using electric space heaters. During 27 January in particular, the situation looked dire; the partially functioning heating system had created a realistic possibility of a cascading failure of the gas and electrical distribution system, and the city teetered on the brink of a catastrophic energy failure during the coldest days of the year.

Fortunately, the situation was brought under control, and catastrophic failure was avoided. Some measures taken in advance helped: Anticipating freezing weather, on 25 January, the Kyrgyz electricity grid managers announced a temporary curtailment of electricity exports to Uzbekistan.[41] This decision meant that there was enough electricity during traditionally low-production winter months in the Kyrgyz grid available for dispatch to Bishkek. This situation is also indicative that the above-mentioned localized electrical failures were due to overloaded distribution systems in specific neighborhoods, rather than a lack of electricity supply in the grid. In addition, the heating system only partially lost functionality, meaning that the pipe network did not freeze; the temperature of the pipe system dropped from +82C to +62C (initially) and then to about +50C,[42] while indoor residential room temperatures generally remained in the uncomfortable but not hazardous +10 to 15 C range. Additionally, warmer weather arrived on 1 February, meaning that the truly dangerous phase of this crisis had passed. Full functionality of the district heating system was gradually restored, and aided by the warmer weather, by mid-February the city district heating system was mostly running normally.[43] Although Kyrgyzstan was able to resolve this issue without as-

38 Chudubaeva, Gulzia. "Accident at the Bishkek CHP: simple workers dismissed, top managers get away with reprimands." (Авария на ТЭЦ Бишкека: уволены простые рабочие, топ-менеджеры отделались выговорами), 29 January 2018. http://knews.kg/2018/02/avariya-na-tets-bishkeka-uvoleny-prostye-rabochie-top-menedzhery-otdelalis-vygovorami/, accessed 25 April 2018.

39 https://www.accuweather.com/en/kg/bishkek/222844/month/222844?monyr=1/01/2018.

40 Based on telephone interviews with Bishkek residents conducted between 26 January to 10 February 2018.

41 Iman, Nurul. "Kyrgyzstan stopped provision of electricity to Uzbekistan" (Кыргызстан прекратил подачу электроэнергии в Узбекистан) 26 January 2018, https://golosislama.com/news.php?id=33731, accessed 28 January 2018.

42 Chudubaeva, Gulzia. "Accident at the Bishkek CHP: simple workers dismissed, top managers get away with reprimands." (Авария на ТЭЦ Бишкека: уволены простые рабочие, топ-менеджеры отделались выговорами), 29 January 2018. http://knews.kg/2018/02/avariya-na-tets-bishkeka-uvoleny-prostye-rabochie-top-menedzhery-otdelalis-vygovorami/, accessed 25 April 2018.

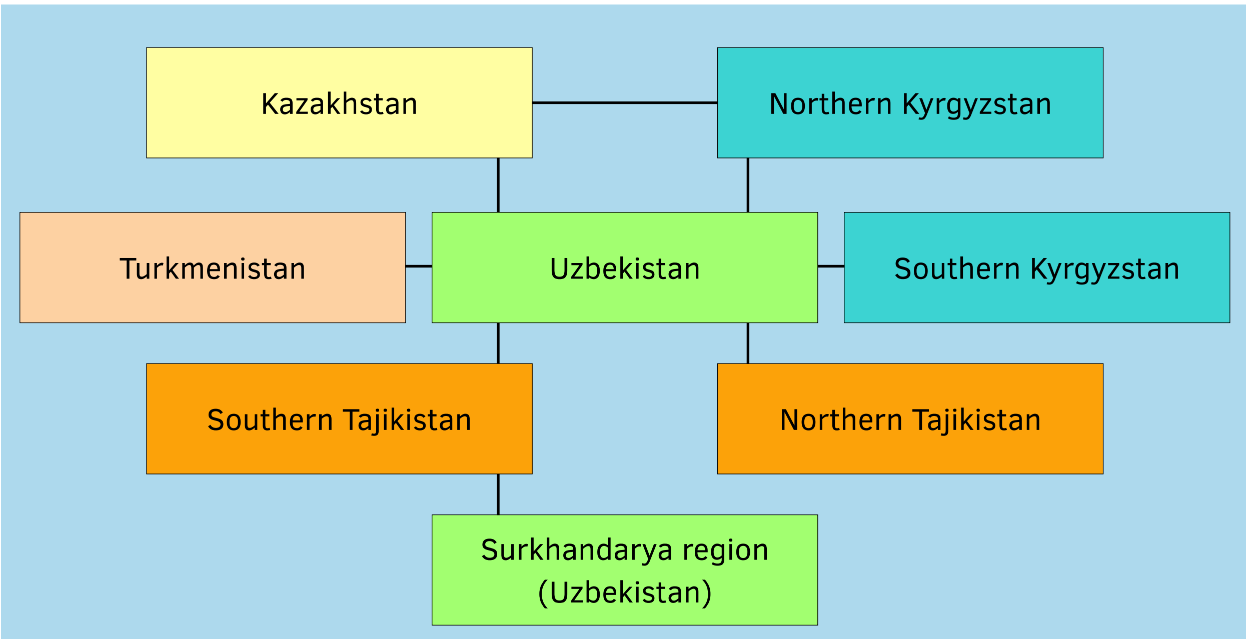
43 "When the Bishkek CHP will work normally, according to Isakov." (Когда ТЭЦ заработает в привычном режиме, сказал Исаков) 31 January 2018, https://ru.sputnik.kg/society/20180131/103.752.5173/kogda-tehc-vernetsya-v-privychnyj-rezhim.html, accessed 2 February 2018.

sistance from its neighbors, this self-reliance was a necessity, because alternative energy supplies were not available during these winter months when hydroelectric supply is historically tight. It is also not helpful that redundancy is not built into the Bishkek heating system, which would have allowed for a quick deployment of alternative resources during an emergency.

Lessons learned from the Bishkek power plant breakdown include the following: (1) energy insecurity in a single form of energy (in this case, district heating) can have a cascading effect on the security of supply of other forms of energy (in this case, natural gas and electricity), within a given consumer market; (2) equipment failure – resulting either from "upstream" problems with the city power plant, or "downstream" problems in the distribution system – results in systemic risk to the broader energy network due to increased demand in parts of the system; (3) increased systemic redundancy (as an infrastructure issue) and more flexible regional supply of alternative fuels (as a market model) would have provided the city with better energy security.

Indeed, the interdependent nature of the energy system in Central Asia, despite several construction projects in recent years to create energy transit which is not dependent upon crossing the territory of neighboring states, which can be seen in the diagram below:

[44]

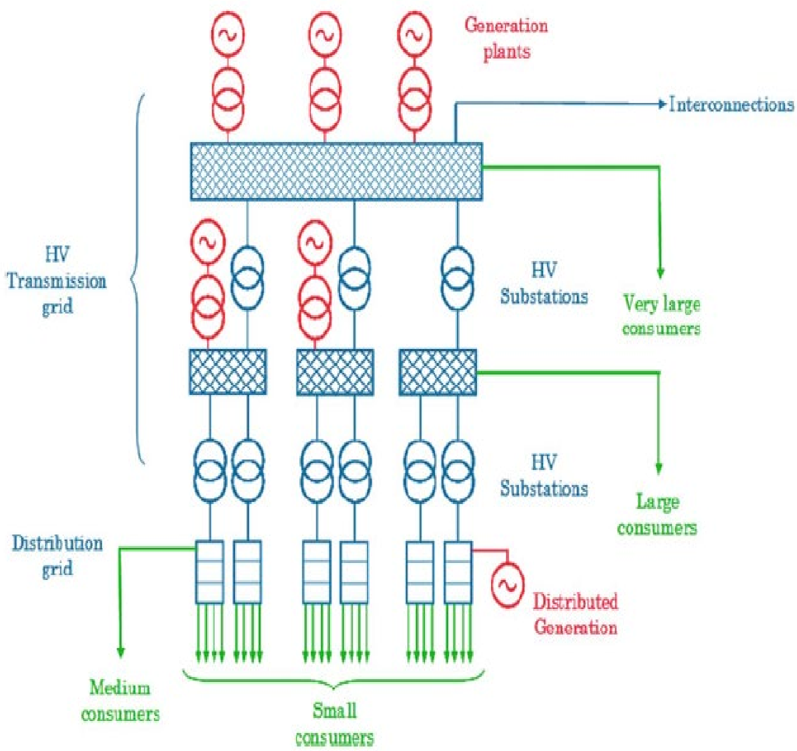


For reference, a more detailed view of the Central Asian electricity grid can be found in Annex 3 of this Policy Brief.

[44] From a presentation delivered by Farkhod Aminjonov at the Central Asia Energy Security Conference; Almaty, Kazakhstan, 4-6 April 2018, organized by the George C. Marshall European Center for Security Studies.

Annex 1

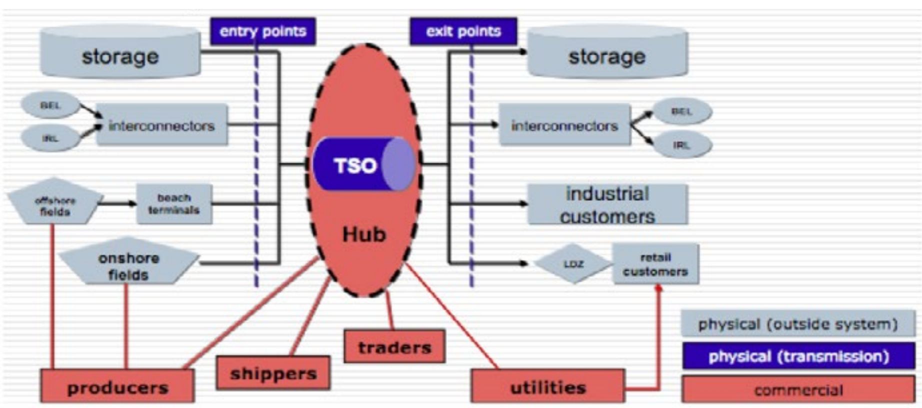
Figure 1. System configuration and structure of a typical electricity grid: [45]



Electric Power system configuration and structure

Figure 2. Illustration of Physical versus Commercial Flows in the Gas Market: [46]

Physical versus Commercial Flows in the Gas Market

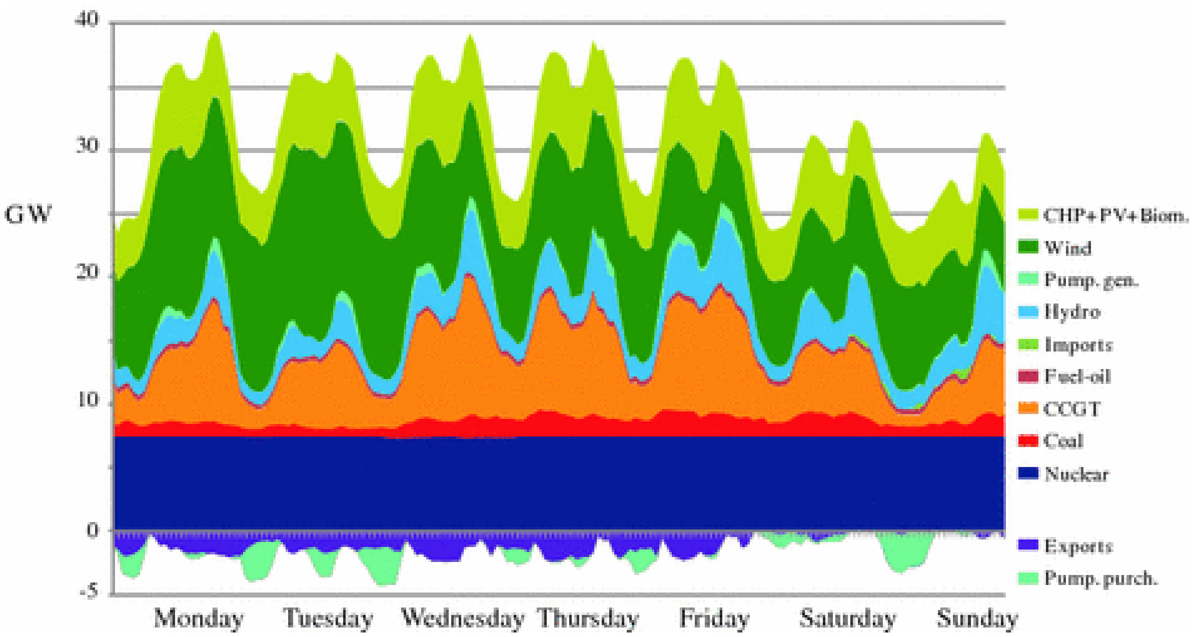


[45] Damian Laloux and Michel Rivier, "Technology and Operation of Electric Power Systems," Ignacio J. Perez-Arriaga, ed., Op. cit., Springer-Verlag, London, 2013, p. 6.

[46] Paolo Natali, Lesson 1 text for online course *Introduction to the Regulation of Gas Markets*, p. 6, Florence School of Regulation, accessed on 9 November 2017.

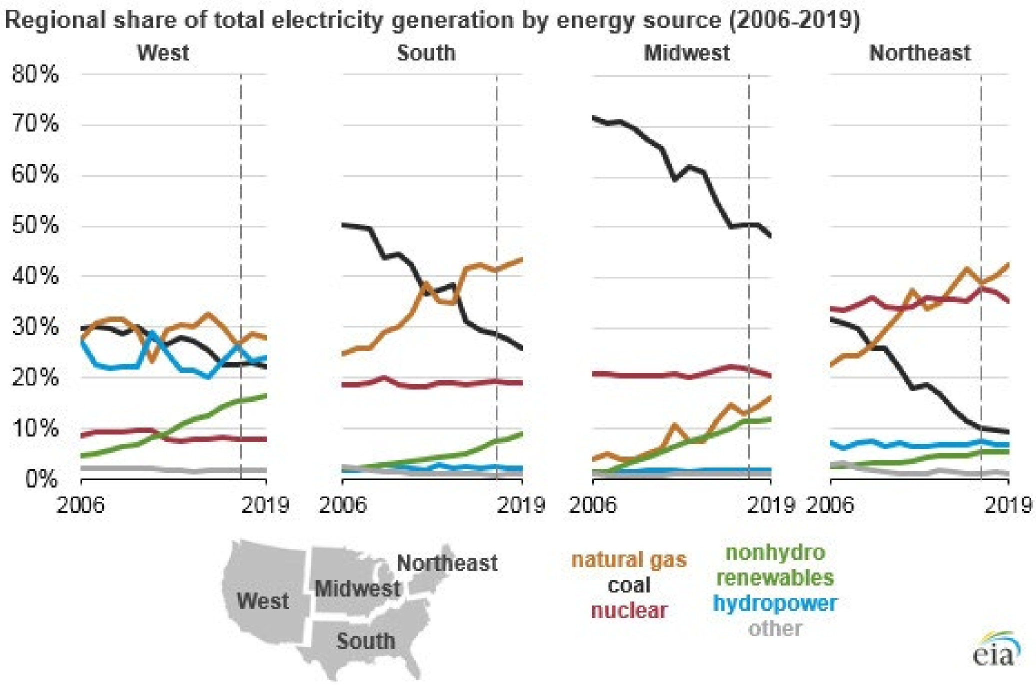
Annex 2

Figure 3. Dynamic of Baseload vs. Variable Electricity supplies during a week (Spain) [47]



Electricity supply in the Spanish system operator's information system (SIOS)
www.esios.ree.es

Figure 4. Change in the energy source of electricity in the US [48]

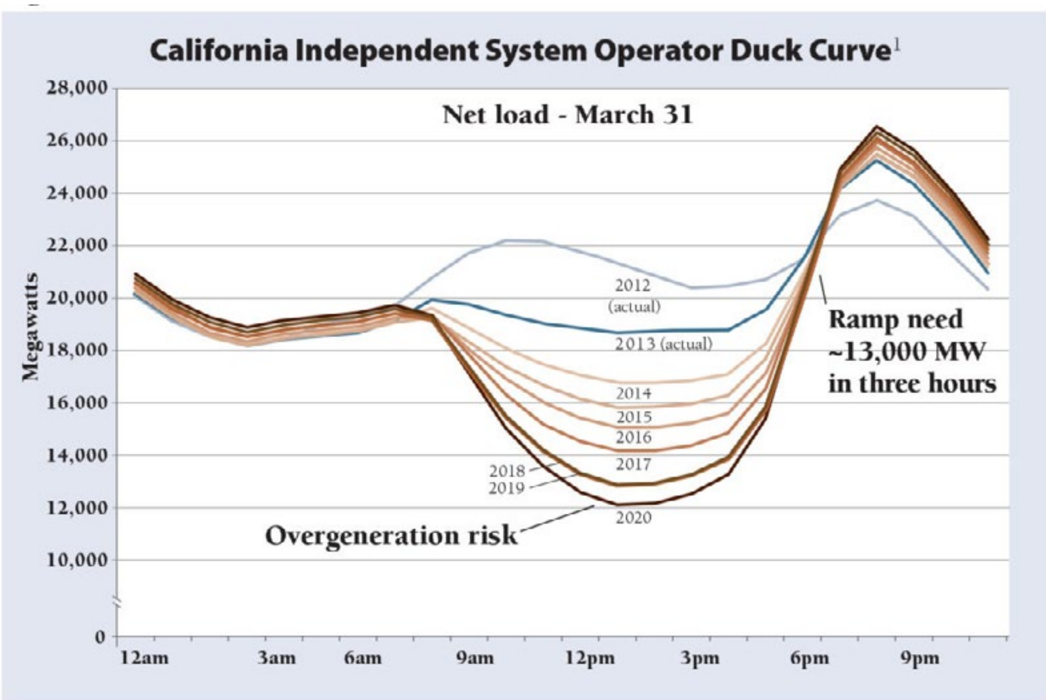


47 Mariano Ventosa, Pedro Linares and Ignacio J. Pérez-Arriaga, "Power System Economics", *Regulation of the Power Sector*, Ignacio J. Perez-Arriaga, ed., Op. cit., Springer-Verlag, London, 2013, p. 57.

48 Source: EIA (US Department of Energy)

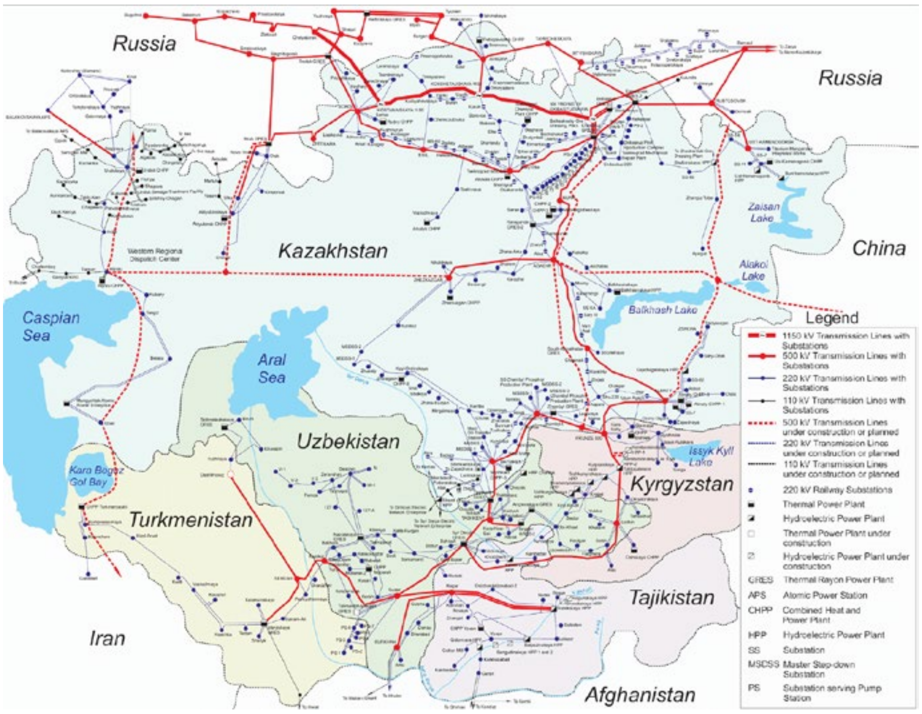
Annex 2 (continued)

Figure 5. … has resulted in a the "duck curve" challenge, as illustrated in California: [49]



Annex 3

Figure 6. The Central Asia energy grid: [50]



49 https://www.sg2b.com/solar-integration-raps-teaching-the-duck-to-fly-strategies/

50 Source: http://www.geni.org/globalenergy/library/national_energy_grid/central-asia/graphics/central-asia-electricity-grid.gif

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