A Guide to the Application of Energy Data for Intelligence Analysis

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The purpose of this article is to provide analysts in intelligence or other government agencies a guide to understanding how energy data can be applied to the analysis of a range of issues in countries around the world.

US government agencies and many foreign governments track energy data from around the world for a variety of reasons, some obvious, some less so. The numbers provide material to forecast energy trends, including energy demand and supply, prices, and energy trade flows. Less obviously, intelligence agencies apply energy data to political and economic forecasts, such as estimates of the impact of energy revenue trends on the stability and foreign policies of energy-producing states. Such data is especially important in forecasting political and economic outcomes in major oil and natural gas exporting states, most importantly in the Middle East, where study of energy data trends can contribute to predictions of broad economic trends and assessments of the likelihood and timing of anti-government activity.

The purpose of this article is to provide analysts in intelligence or other government agencies a guide to understanding how energy data can be applied to the analysis of a range of issues in countries around the world. It can be used to help train new analysts or to serve as a checklist for analysts and diplomats responsible for monitoring and reporting on developments in foreign countries. The principles in this article can also be applied to academic, commercial, and other entities assessing political and economic developments and political risk.

This guide is a result of my interactions with analysts at government research units in various countries and during NATO-sponsored courses on energy security, which revealed that NATO members and associated countries vary significantly in how they collect, analyze, and apply energy data to their analysis.

In this article, I will walk readers through the following applications of energy data:

- the use of energy data to improve broad understanding of nations and regions
- specific indicators in energy data useful for political and economic forecasting
- issues related to electricity supply
- the importance of the resource depletion rate
- the integration of data showing the gap between energy export revenue and revenue necessary for a balanced budget together with the level of wealth reserves in energy producers
- the implications of subsidies policies

Energy's input into understanding foreign states

Expansion beyond the typical range of energy data studied and the integration of expanded data sets into country or regional assessments can improve the understanding of political dynamics in countries and the accuracy of estimates of the futures of countries. The most important data sets that should be integrated into general area and country studies include:

- a. fuel mix composition (total energy supply and electricity fuel mix)
- b. level of electrification and average price of electricity and the percentage of households for which this price is accessible
- c. energy intensity rate (which is important also for assessing future economic trends)
- d. energy trading partners
- e. details of refining capacity
- f. the state of energy security
- g. the composition and interrelationship of the ownership of the energy infrastructure.

a. Total Primary Energy Supply, Fuel Mix, and Electricity Fuel Mix

Study of the relative mix of fuels used in a country's total primary energy supply (TPES) and electricity generation yields valuable information and is readily available.[a] Yet, many intelligence organizations compile data on fuel production and consumption trends in absolute terms of weight and mass (tons of oil produced, volumes of natural gas consumed, etc.) and in comparison to other states (e.g. 19th largest producer of coal), not analyzing their relative weight in a country.[1]

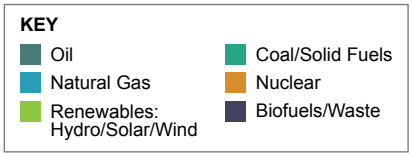
For example, different fuel mixes point to potential energy supply challenges and trade patterns and partners. In addition, a state's total primary energy supply fuel mix reflects the prioritization of different public interests. For instance, if the share of natural gas and renewables is high, this can reflect a strong interest in environmentally friendly policies. A large portion of coal in the fuel mix can reflect a higher priority on energy security of supply, by basing energy consumption on a fuel source that is easy to import, store, or, in some cases, produce locally. A state's fuel mix composition can also indicate the level of pollution in a state. For instance, a fuel mix in which coal comprises a large portion will tend to have high air pollution and likely have high levels of water pollution.

The charts on the right illustrate, through the examples of Bulgaria, China, Iran, and Japan, the vast diversity in the fuel mixes of states. The diagrams of the fuel sources of Poland and Vietnam also show the great diversity of electricity fuel mixes, which lead to different foreign-trade, foreign-relations, economic, public-health, and environmental effects. In addition, they pose different security challenges.

b. Electrification and price

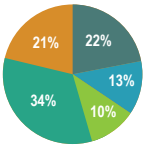
A state's household electrification rate is an important indicator of

Total Primary Energy Supply: Four Samples



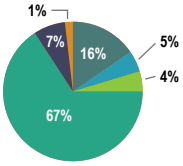
Total Primary Energy Supply (TPES)

Source: European Commission, Energy Statistical Pocketbook (August 2017 data)



Total Primary Energy Supply (TPES)

Source: IEA Energy Statistics (retrieved: March 2016)



Total Primary Energy Supply (TPES)

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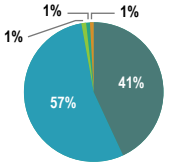

Total Primary Energy Supply (TPES)

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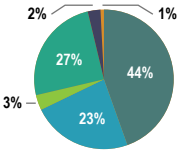
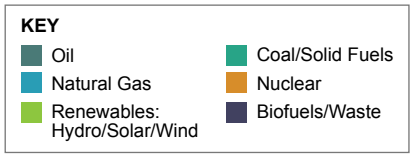


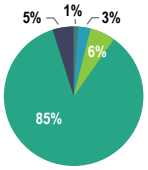
Energy Fuel Sources: Two Samples



POLAND

Electricity Generation by Fuel

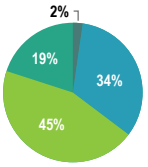
Source: IEA Energy Statistics (retrieved: March 2016)



VIETNAM

Electricity Generation by Fuel

Source: IEA Energy Statistics (retrieved: March 2016)



a. The International Energy Agency (IEA), for instance, publishes the fuel mix of its members and other states. For European Union member states, the data is easily accessible through the European Commission's Eurostat.

economic and human development trends. Accordingly, many major intelligence services routinely include this information in basic reports on a state. Capacity to provide accessible and affordable electricity is an indicator of state strength and can influence the popularity and legitimacy of a ruling government. However, in many states that have the infrastructure to provide electricity, large swaths of their populations cannot afford it. Thus, adding information on electricity prices and the percentage of households for which electricity is affordable provides an additional variable in political circumstances.

c. Energy intensity rate

Energy intensity refers to the amount of energy used per unit of gross domestic product (GDP). Energy intensity rates reflect levels of economic efficiency and thus sustainability. High energy intensity rates are a liability that can hurt future economic growth and leave an economy highly vulnerable to the ebbs and flows of global energy prices. Economies with high energy intensity rates that are experiencing economic growth may be relying on government subsidized energy supplies, a policy that may not be sustainable over time or continue to enable growth in the future.

Energy intensity rates also can point to the dominant sector of an economy (for instance service-based economies tend to have lower energy intensity rates than those based on manufacturing). As a result, significant changes in energy intensity rates can reflect economies transitioning from agricultural to industrial or service-based.

Relevant data can also point to energy security challenges, many of which are or can become national security challenges.

d. Energy trading partners and potential partners

For insight into key trading relationships, analysts may turn to the ratio of imported versus locally produced fuel sources. Among the imported (or exported) energy volumes, a breakdown of where the energy is imported from (and/or exported to) provides useful information on a country's foreign trade relations and, by extension, political strengths and vulnerabilities. Data on gas trade should be broken down between pipeline trade and liquefied natural gas (LNG).

In assessing the potential political importance of energy trading partners, it is important to focus on trade in natural gas, and less on oil and coal. Oil and coal are traded on global markets, with little direct connection between the supplier and the consumer. In addition, oil and coal trading is conducted primarily on spot markets with few long-term contracts binding suppliers and consumers.

In contrast, international natural gas trade occurs primarily via permanent infrastructure and long-term contracts between suppliers and consumers. Even LNG is traded primarily via long-term contracts between suppliers and consumers. Due to the physical connection and the long-term nature of gas trade today, there is much more room for political and foreign policy considerations, than in oil and coal trade.[2]

e. Detailed refining capacity

The specifics of a state's oil refining capacity are useful in analyzing its energy trade relations. Refineries vary in the types (and thus origins) of the oil they can process. Understanding the specific refining capacity of a state indicates its potential oil sources. Similarly, for oil producing states, the grade of their oil indicates to which countries they can export.

f. Energy security challenges

Relevant data can also point to energy security challenges, many of which are or can become national security challenges. Knowledge of this data can point to the greatest threats to stability and economic growth and the most serious points of potential vulnerability to external influence.

In looking at energy security challenges, it is important to identify which fuels are used for which sectors in order to identify supply vulnerabilities. While supplies to most sectors, such as industry, are interruptible without major crises, large disruptions to power supplies can severely affect the functioning of states. In addition, electricity can be used to supplant other disrupted supplies (such as heat).

Identification of sectors that consume imported energy is vital to understanding vulnerabilities to disruption of supplies. For example, many observers have attempted to assess how vulnerable European states are to interruption of Russian energy supplies by focusing on the percentage of a state's gas that Russia supplies.[3] Poland is often cited as a highly vulnerable state, since more than 90 percent of its gas comes from Russia. However, these commentators fail to point out that Poland uses

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very little gas as part of its overall fuel consumption (under 5 percent) and that almost none of that gas is used for power generation. So, Russian disruptions of supplies to Poland likely would have little impact on Warsaw's ability to continue basic functions.[4]

In examining a country's energy security situation, it is important to look at the capacity to supply energy when there are disruptions of regular supplies (due to weather, technical breakdowns, acts of nature, terrorism, intentional disruptions by suppliers etc.). Particularly relevant in this case is assessing the energy storage capacity (especially of natural gas) of states. Thus the collection of energy storage data on states should be done routinely.[5]

g. Power brokers are often power brokers

Identifying the owners or major stakeholders in energy infrastructure in states often lead to identification of the important members of political and economic elites. This group includes owners of power generation facilities, natural gas and electricity grids, refineries, and energy storage sites. In addition, it is useful to identify individuals or companies that hold contracts for the import and/or export of major energy sources.

As part of this analysis, it is important to map out the political affiliations of the players in the energy sector as well as ties they have within their families and other commercial interests. In the case of foreign investors, it is useful to map out their identities and their ties to local political and commercial elites. Local energy companies may also maintain special relationships with foreign entities (governments and/or companies) worthy of analysis.

In major energy exporting states, the centers of political power are usually different from those in other types of states. In states of this type, supervision of the energy production and export sectors are usually in the hands of groups and individuals that are closely linked and loyal to the political leadership. Thus, when mapping out the centers of power in a major energy exporting state, a focus on the power brokers in the energy sector often helps identify the power centers in a state.

It is useful to look at the extent of concentration of ownership or control of energy infrastructure and distribution in a state. Do certain individual and/or companies own various parts of an energy or electricity supply chain? Do entities own multiple pieces of energy infrastructure in a certain state? Study of these power brokers can advance understanding of the functioning of the energy market in a state. For example, do a large number of players have access to the market or is it concentrated in the hands of a small number of individuals or entities.

Political economies of major oil and natural gas producers

States that are major exporters of oil and natural gas possess distinctive economic and political characteristics and propensities that affect their economic performance, regime type, and regime stability, and many other political and economic outcomes. It is therefore important to integrate energy data trends into political and economic analysis of the Middle East where a majority of the states are either major oil and gas producers or possess economies that are highly influenced by the economic trends in oil and gas producing neighbor states.

The International Monetary Fund (IMF) defines a "major energy exporter" as a country in which the average share of oil and/or natural gas exports comprise at least 40 percent of total exports. In 2016, 32 states were classified as "major energy exporters."[a] Most of the major oil and natural gas exporters have "rentier" economies: First, this means that income derived from the state's natural resources is the most significant input into the economy; second, the majority of this revenue comes from abroad; third, only a small part of the population is engaged in generating the rent; last, the state is the primary recipient of economic revenue.[6]

Rentier states also possess emblematic economic and political development patterns, often manifesting as the "resource curse."[7] The major characteristics of rentier states are: economic underperformance, lack of transition to democratic regimes, and a high propensity for involvement in conflicts. A factor in the economic underperformance is the volatility of oil and other natural resource com-

a. Algeria, Angola, Azerbaijan, Bahrain, Bolivia, Brunei, Cameroon, Chad, Columbia, The Republic of the Congo, Ecuador, Equatorial Guinea, Gabon, Iran, Iraq, Kazakhstan, Kuwait, Libya, Nigeria, Norway, Oman, Qatar, Russia, Saudi Arabia, South Sudan, Sudan, Syria, Trinidad and Tobago, Turkmenistan, United Arab Emirates, Venezuela, and Yemen.

modity prices, leading to recurring cycles of boom and bust.[8]

During times of high-energy prices and large state revenues, energy and natural resource exporters tend to undertake large-scale state spending. When the price of the exported commodity falls, the states are left with expensive spending commitments and a substantially reduced ability to meet them. Thus, states with boom and bust economies are not effective in developing infrastructure and public goods over time. These states operate in an environment of constant uncertainty, which creates a built-in challenge to budgets on every level of government. This uncertainty leads to unstable state investments and thus often produces inadequately maintained infrastructure, such as roads and electricity grids.[9] This cycle can also contribute to the emergence of political radicalism.

Due to the emblematic characteristics of major energy exporters, the policy options available to states of this type differ from that of non-major energy exporters. It is important for policy analysts to recognize this difference and reflect it in policy recommendations. For instance, due to the concentration of political and economic power in most major energy exporters, US- and European-sponsored projects aimed at strengthening the power of nongovernmental organizations as a means to bringing democratic transition, have not yielded significant results. Additionally, while all major international economic institutions recommend economic diversification to resource dependent economies, no major energy producers have succeeded in significantly diversifying their economies prior to the beginning of their depletion of the sources of their wealth.

The inability of a state to maintain stable supplies of electricity is an indicator of the state's poor capacity, more broadly, to deliver public goods, and it is a precursor of domestic unrest.

Part II. Specific indicators that yield forecast value

The indicators with specific forecast value are:

- a. electricity supply disruptions
- b. electricity demand
- c. resource depletion of major oil and natural gas producers
- d. the gap between energy export revenue and revenue needed for a balanced budget together with currency reserves
- e. policies on subsidies

a. Electricity supply disruptions

The inability of a state to maintain stable supplies of electricity is an indicator of the state's poor capacity, more broadly, to deliver public goods, and it is a precursor of domestic unrest. Disruption of electricity supply disturbs citizens' ability to carry out routine tasks, heightens their exposure to crime, harms appliances, machinery and food stocks. Water supplies are generally threatened, as water supply systems are typically dependent on electricity for their operation. In agricultural areas, disruption of electricity supplies can cause the shutdown of water pumps and lead to loss of crops. Unable to work or engage in other activity, people become more likely to be drawn to protests.

Many major energy exporters, despite their vast energy resources, have been unsuccessful in delivering stable electricity to their populations.[10] When electricity supplies are disrupted in oil and gas producers, the public often is angered by the sense that "their" resource is being sold abroad, while they do not get basic energy provision at home. Lack of capacity to provide electricity is often viewed by publics as a symptom of the weakness of a ruling regime and can encourage demonstrations and demands for regime change.

In recent years in the Middle East, extended power outages have been associated with public mass demonstrations and even regime overthrows. In Egypt, the falls from power of both Presidents Hosni Mubarak and Mohammed Morsi were proceeded by extensive power outages in Cairo and other major Egyptian cities. In August 2015, insufficient electricity supplies triggered mass demonstrations in Baghdad.[11] Power cuts triggered large demonstrations in the Gaza Strip[12] in September 2015, and Nigeria's unstable electricity supplies were a major issue of contention in that country's March 2015 presidential elections.

b. Electricity demand trends

Electricity consumption trends often dovetail with economic growth trends: when the economy is expanding, demand for electricity typically increases and vice-versa,[a] with paral-

a. An exception to this connection is when energy efficiency mechanisms are also

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lel shifts in employment. For example, change in the electricity consumption rate in China led analysts to correctly assess the 2015 downward trend in Chinese economic growth, even before Chinese authorities and international financial institutions recognized the change.[13]

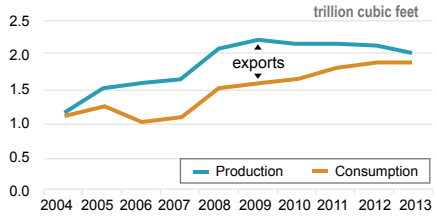
c. Energy production rate and resource depletion rate

In non-democratic energy-exporting states, government revenues from energy exports are critical for maintaining patronage networks and funding security services that underpin the regime's stability. Analysis of energy resource production rates and resource depletion rates contribute to the ability to forecast regime instability in those states. For instance, energy production rates declined steeply in Syria and Egypt in the decade preceding the outbreak of large anti-regime activity, making an additional dramatic decline prior to the outbreak of mass protests. During the year the protests began, Egypt transitioned from being an oil exporter to an oil importer. At the same time, the gap between Egypt's gas production and domestic consumption narrowed, leaving less gas available for export. That meant dwindling revenue as well as shortages for the domestic market. The data on Egypt and Syria's production rates was readily available and openly published on the US Department of Energy's Energy Information Agency (EIA) website in 2010. There was no need for any special or covert intelligence gathering; instead, analysts needed only to analyze data the US government was routinely collecting and publishing:

Despite clear evidence that energy export revenue to the regimes in Syria and Egypt was rapidly declining, few analysts in academe published assessments that the governments in Syria and Egypt were vulnerable to instability because energy export revenues were their main sources of income. Furthermore, representatives of some intelligence services publicly admitted that they did not anticipate instability in Egypt.[14]

DRY NATURAL GAS

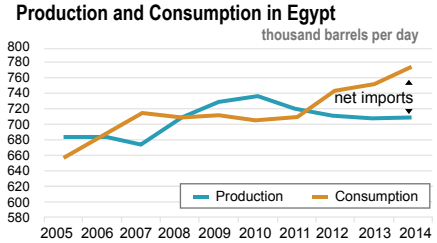
Production and Consumption in Egypt



Source: U.S. Energy Information Administration

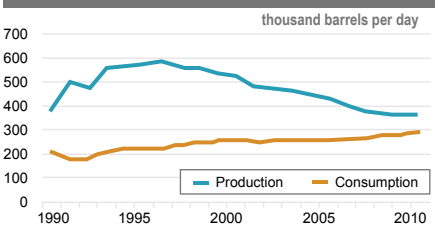
PETROLEUM AND OTHER LIQUIDS

Production and Consumption in Egypt



Source: U.S. Energy Information Administration

SYRIAN TOTAL PETROLEUM BALANCE



Source: U.S. Energy Information Administration

d. Balanced budgets and currency reserves

It is useful to calculate the relationship between a state's balanced budget requirements and energy export revenue (based on trends in prices of oil, natural gas, or coal). Many intelligence services, academics and political risk companies regularly analyze the gap between a state's total revenue needs and energy-based revenue.[15] However, the relevance of this information is improved when combined with analysis of a state's currency reserves. The reserves can be used to preserve public spending levels at times when there is a significant gap between revenue from energy export and the balanced budget. Combining the two indicators produces a far more accurate picture of potential challenges to regime stability, one that is based on numbers that point to a regime's ability to maintain levels of spending rather than looking only at the gap between a balanced budget and revenue from energy export.

Following the recent steep decline in the global oil price (beginning in 2014), many journalists, academics, and policymakers foresaw instability in oil exporters, a judgment based on the exporters' ability in the low price environment to balance their budgets without major budgetary cuts.[16] Many perceived that Russia, for instance, would experience severe economic challenges and thus potentially experience challenges to its domestic stability and maintenance of its military forces. These assessments did not pan out for a variety of reasons,

being implemented during a period of economic growth. In this case, there can be economic growth without a corresponding growth in energy demand. This has taken place in the United States in the past decade, for instance.

including the capacity of Russia to fall back on its immense currency reserves. The factor of the access to currency reserves was overlooked in most published assessments.

e. Energy subsidy policies

Significant changes in energy subsidy policies can trigger public protests and affect regime stability. Most major oil and gas producers and many developing countries subsidize energy supplies to domestic consumers. The subsidized energy can include gasoline, electricity, natural gas, fuel oil, and propane. Subsidies of fuel to the domestic market (through loss of revenue from lack of export, direct costs of imported goods sold at a lower cost to the domestic market or externality costs due to the higher consumption of energy), usually form one of the largest items in the government budgets in oil and gas exporting states, often close to a quarter of the state's annual budget.

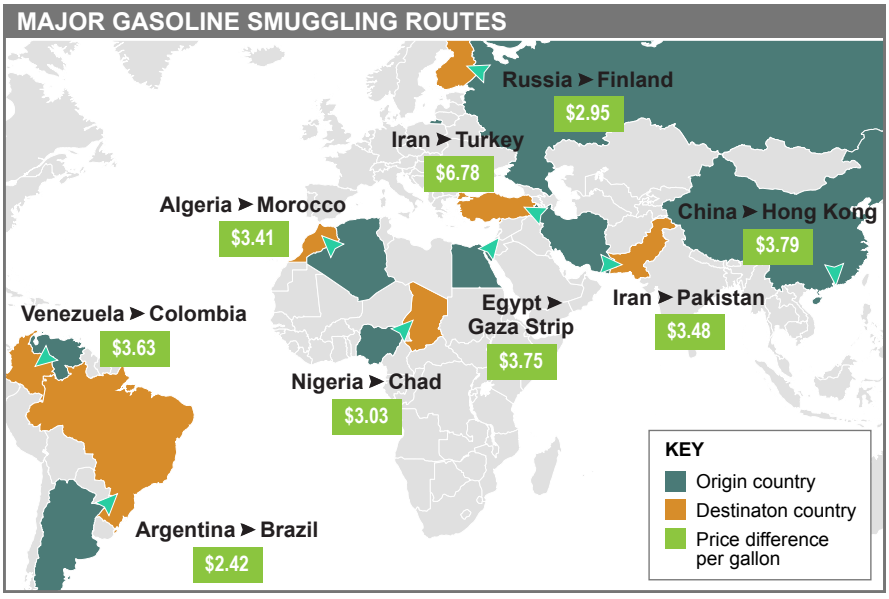
Countries have diverse goals in providing subsidized energy to their citizens. In developing countries, the subsidized products are supposedly intended to help the poor move up the development ladder. In energy exporters, low energy prices are often viewed as an entitlement to the public to receive direct benefit from the country's energy riches. However most of the subsidies of energy do not promote public good and, in the end, tend to benefit the country's rich more than its poor. There is a broad consensus among economists, especially in international financial institutions, that subsidized energy leads to low energy efficiency, and high externality costs (such as from higher pollution, and thus subsequent increased public health costs).[17]

Subsidized gasoline and other liquid fuels are often smuggled to neighboring states.

Low energy costs encourage high and often wasteful consumption and thus increased resource depletion rates, often turning energy exporters into importers within a short period of time. Energy subsidies tend to benefit the rich, who consume much more energy than the poor. Subsidized gasoline and other liquid fuels are often smuggled to neighboring states (when there is a gap in price—see graphic below) often leading to shortages of fuel at home in the oil producing state and essentially to the government subsidizing energy consumption in some neighboring countries.

Despite the wide consensus that energy subsidies rarely promote public interest,[18] the subsidized energy goods are often highly popular and governments that attempt to remove them often encounter serious opposition. Citizens may doubt, or not be informed, that saved funds would be used for an alternative public good, such as lower education and health costs, but they do notice the "price at the pump" or a change in their monthly electricity bill. Political opposition groups often criticize ruling governments and mobilize populist opposition when they try to remove subsidies. Thus, states that subsidize energy products frequently face the same dilemma: the need to cut subsidies in order to improve economic prospects and prevent resource depletion while at the same time addressing the potential of public unrest and instability cuts could unleash. In recent years, in many cases increases in fuel prices in oil and gas exporting states triggered violent protests as they did in Iran (June 2007),[19] Nigeria (January 2012),[20] Jordan (November 2012),[21] Sudan (September 2013),[22] and Mexico (January 2017).[23]

The converse is true, as well: increases in subsidies can help regimes weather challenges. This is illustrated by the responses of various governments in the Middle East to the "Arab Spring" in 2010. A major trigger of the protests was the rise in



fuel and food costs that had occurred over the year preceding the outburst of demonstrations. In response to these demonstrations, Middle East major energy exporting states, such as Saudi Arabia and Kuwait, dramatically increased their public subsidies, blunting the impact of the rise in costs to the population.

In contrast, their resource-poor counterparts did not possess this capacity. States that have gone from being energy exporters to energy importers, such as Egypt, and states with dwindling oil production rates, such as Syria, were not able to mitigate the effects of rising costs through increasing subsidies, since they no longer had extensive revenues from energy exports. In the case of Egypt, the state did not have access to sufficient domestically produced energy resources as well. Thus, we see that except for Libya, which was a target of external intervention, all the ruling regimes that fell during the "Arab Spring" were not major energy exporters. In contrast, the oil and gas rich countries in the region survived the challenge, supported by raising subsidies of energy and other goods.

In sum, changes in policies on subsidies should be regularly monitored, Successful reduction or elimination of energy subsidies can indicate that a ruling government is strong and also possesses capacity for economic reform.

In Sum

Having provided a framework for the use of energy data in intelligence assessments on a broad range of intelligence issues, I trust this article will encourage analysts and managers of analysts to more aggressively apply energy data to their analysis. I also hope, having pointed to some of the most accessible sources of data, analysts will monitor those sources for meaningful shifts in energy-related trends in their areas of responsibility. A fuller list of the most potentially useful sources for such data are shown in the table below.

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Open sources of Energy Data:

International Energy Agency (IEA): Publications and Statistics - https://www.iea.org/

U.S. Energy Information Administration: Country Analysis Reports - https://www.eia.gov/beta/international/analysis.cfm

BP Statistical Review of World Energy - https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html

European Union Statistics Database (Eurostat): Energy - http://ec.europa.eu/eurostat/web/energy/overview

World Bank Databank: World Development Indicators - http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators

International Monetary Fund (IMF): Primary Commodity Prices - http://www.imf.org/external/np/res/commod/index.aspx

Organization of the Petroleum Exporting Countries (OPEC): Publications - http://www.opec.org/opec_web/en/21.htm

Congressional Research Service (CRS) reports - https://fas.org/sgp/crs/

European Commission: Energy News - https://ec.europa.eu/energy/en/news

Wall Street Journal: "Energy Journal" - https://www.wsj.com/news/business/energy-oil-gas

Politico Europe: Energy and Environment - https://www.politico.eu/section/energy/

Central Intelligence Agency: The World Factbook - https://www.cia.gov/library/publications/resources/the-world-factbook/

Endnotes

1. See for example: "Country Comparison: Crude Oil - Production," The World Factbook 2017 (Central Intelligence Agency, 2017). Retrieved from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2241rank.html.
2. For more on the differences in foreign policy implications between natural gas and oil and coal trade, see Brenda Shaffer, "Natural gas Supply Stability and Foreign Policy," Energy Policy, Vol. 56 (2013): 114–25.
3. See for example: "European Energy Security: Conscious Uncoupling," Economist (3 April 2014); Paul Belkin, Jim Nichol, and Steven Woehrel, "Europe's Energy Security: Options and Challenges to Natural Gas Supply Diversification," Congressional Research Service 7-5700 (2013); Ralf Dickel, Elham Hassanzadeh, James Henderson, Anouk Honoré, Laura El-Katiri, Simon Pirani, Howard Rogers, Jonathan Stern and Katja Yafimava, "Reducing European Dependence on Russian Gas: Distinguishing Natural Gas Security from Geopolitics." Oxford Institute for Energy Studies Paper: NG 92 (2014); Zeyno Baran, "EU Energy Security: Time to End Russian Leverage," The Washington Quarterly, Vol. 30(4) (2007): 131–44.
4. For more on how to assess sectors utilizing natural gas and their impact on energy security, see Brenda Shaffer, "Europe's Natural Gas Security of Supply: Policy Tools for Single-Supplied States," Energy Law Journal, Vol. 36 (2015): 179–201.
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