MOSES Energy Security Ratings for Georgia

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The aim of this paper is to provide a starting point for quantitative assessment of national energy security in Georgia for policy implications. After an extensive literature review of different energy security approaches, we selected the International Energy Agency (IEA) approach, MOSES (Model of Short-Term Energy Security), for its relative simplicity and potential for initiating the dialogue on a wide spectrum of energy security issues requiring policy intervention. With this paper we intend to pave the way to a more comprehensive and detailed analysis of Georgia's energy security for policymakers. The outcomes will also show where the country stands in comparison with other countries where in the MOSES analysis.

MOSES uses a total of 35 indicators to assess the domestic and external risk, as well as the resilience of each system. Each indicator is classified as high, medium and low by color-coding; green color reflects a favorable outcome, meaning high resilience or low risk, whereas red reflects the opposite situation, and yellow is the mid point between them. Once the individual indicators are analyzed they are assessed according to their color and importance in order to obtain a letter classification (A to E, or A to C) for each energy or fuel.[1] The method allows for specific recommendations regarding each type of energy or fuel.

The indicators were measured for data mostly from 2015 energy balance of Georgia[2]. Other sources include: Georgian Oil and Gas Corporation, Supsa Oil Terminal, Georgian Industrial Group, and personal communication with experts and the National Statistics Office of Georgia.

Below we present the energy security ranking for Georgia by each MOSES category.

Crude oil

Georgia is a transit country for crude oil transportation from Caspian region to the world markets. In spite of significant amounts of crude passing through the country by pipelines and railway, Georgia practically does not use this resource for own needs. Limited own production of crude oil is mainly exported. There is only one operating refinery with minor production capacity and diversity of process and almost all Georgia's demand for oil products is satisfied by imports. The storage facilities for crude oil serve for transportation purposes rather than for country's internal use. Nevertheless formally applied MOSES methodology giver the following indicator ranges for Georgia.

Table 1. Crude oil indicators for Georgia

Dimension	Indicator	Unit / Range	Value
External risk	Import dependency	%	-1.34

[1] Jewell, J. (2011), "The IEA Model of Short-Term Energy Security (MOSES): Primary Energy Sources and Secondary Fuels", *IEA Energy Papers*, No. 2011/17, OECD Publishing, Paris. http://dx.doi.org/10.1787/5k9h0wd2ghlv-en

[2] http://geostat.ge/?action=page&&p_id=2288&lang=eng

	Political stability of suppliers		- / 0-7	5.65
Domestic risk	Volatility of production		%	4.07
	Share of offshore production		%	0
External resilience	Diversity of suppliers		- / 0.1-1.0	0.626
	Import infrastructure (entry points)*	Ports	Quantity	3
		Pipelines	Quantity	2
Domestic resilience	Storage levels**		Days	70

*5 classifications instead of the usual 3. Ports classification = "medium-high".
**Due to unavailable information, the average level of crude oil storage was replaced by maximum storage capacity.

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Overall Georgia falls into crude oil classification: GROUP A. Only 5 out of analyzed developed countries are in the same classification

Figure 1. Crude oil MOSES ranking for Georgia

Group	Countries that:	No. of countries
A	**Export crude oil** or **import ≤15%** of their crude oil consumption.	5

Source: Jewell, J. (2011). MOSES: Primary Energy Sources and Secondary Fuels.

Other indicators show fairly positive outcomes with the exception of weighted political stability of suppliers[3] and the number of import pipelines, but this should not be a factor for concern as the country is not dependent on imports for domestic supply. The domestic resilience is high, although this indicator was estimated based on available storage capacity rather than average stock levels, this also does not account for the fact that storage is used for transit rather than stock for internal consumption, which can result on overestimation resilience.

In summary, MOSES methodology places Georgia in the **Group A** with 5 OECD countries; However, this can be misleading for policy conclusions, as this is rather unique situation indicating the absence of operating refineries rather than oil richness of the country. Luxembourg is the only OECD country that does not use the crude oil like Georgia. The main conclusion is that MOSES methodology on crude oil is not fully adequate to Georgia situation, however it indicates a fairly unique situation when the country does not use the crude oil as its important source of primary energy, in spite of big amounts of this resource transited through its territory.

Oil products

Georgia imports nearly all of its oil products from more than 6 different countries. The market for oil products is fully liberalized and competitive. it is dominated by several big

[3] Country Risk Classifications of the Participants to the Arrangement on Officially Supported Export Credits. June 2017. OECD http://www.oecd.org/trade/xcred/cre-crc-current-english.pdf

players including SOCAR, Lukoil, Gulf, Wissol and Rompetrol who import and retail the oil products. Country does not keep the strategic storage of oil products and relies mostly on these oil companies for storage.

Table 2. Oil product Indicators for Georgia[4]

Dimension	Indicator			Unit / Range	Value
External risk	Deficit	Gasoline		%	100
		Middle distillates		%	96.6
		Other oil products		%	87.4
Domestic risk	Crude oil security profile			Classification letter	A
	Number of operating refineries			Number	1
External resilience	Diversity of suppliers			- / 0.1-1.0	0.174
	Import infrastructure (entry points)		Ports	Number	3
			Rivers (Other)	Number	1
			Pipelines	Number	0
Domestic resilience	Flexibility of refining infrastructure (Nelson complexity index)			Quantity	<6.0
	Average stock levels (2010)*	Gasoline		Weeks	6
		Middle distillates		Weeks	4
		Other oil products		Weeks	2

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*4 classifications instead of the usual 3. Middle distillates and other oil products = "lowest" (below low).

The **diversity of suppliers** is calculated using the Herfindahl-Hirschman index with suppliers' - proportion (source: OEC)[5]. **Flexibility of the refining infrastructure** (*i.e.* the ability of refineries to deal with different kinds of crude oil is calculated using the Nelson complexity index[6] According to expert information, there are few process occurring at the refinery and therefore, the complexity index is in the lower classification

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Despite having a high diversity of suppliers, all oil products present a deficit greater than 87 % and their average stock levels are classified from low to lowest. Therefore, as these two are the main indicators in the assessment of oil products, the letter classification for Georgian oil products is letter D in each case. Other indicators also present high risk and low resilience such as the low number on refineries, their low flexibility on infrastructure (Nelson complexity index), and the lack of import infrastructure. Georgia could increase its energy security for oil products by increasing their average stock

[4] According to the MOSES, oil products are classified as: **Gasoline** – motor gasoline; **Middle distillates** – kerosene type jet fuel, kerosene, road diesel, heating and other gas oil; **Other oil products** – fuel oil, liquid petroleum gases, lubricants, bitumen, paraffin waxes, non-specified.

[5] The observatory of economic complexity (OEC). http://atlas.media.mit.edu/en/visualize/tree_map/hs92/import/geo/all/show/2015/

[6] http://www.ril.com/downloads/pdf/business_petroleum_refiningmktg_lc_ncf.pdf .

levels.

Figure 2. Oil product security profile for Georgia

Group	Countries that:	No of countries
Gasoline **D**	**Import >45%** of their gasoline consumption and have • 3-6 weeks of gasoline stocks, one oil product pipeline, and low supplier diversity.	**1**
Middle distillates **D**	**Import >45%** of their middle distillates consumption with moderate supplier diversity and 3-6 weeks of middle distillates stocks.	**2**
Other oil products **D**	**Import ≤45%** of their other oil products consumption and are • in Crude oil groups D or E with either • a highly flexible refining portfolio and <3 weeks of other oil products stocks or **Import >45%** of their other oil products consumption with moderate supplier diversity and <3 weeks of other oil products stocks.	**6**

The Figure 2 indicates that the high external dependence on gasoline and middle distillates is unusual for developed countries and only 1 or 2 fall in the same category D. While the high external dependence on other oil products is more frequent.

This ranking indicates towards the same problem as highlighted above, own oil refining facilities might significantly improve the short term oil product security of the country.

Natural gas

Natural gas supply in Georgia is almost 100% from external sources. There is no gas storage facility and winter peak demand is solely dependent on importers and importing infrastructure resilience.

Table 3. Indicators results and their classification

Dimension	Indicator		Unit / Range	Value
External risk	Import dependency		%	99.5
	Political stability of suppliers		- / 0-7	5.14
Domestic risk	Share of offshore production		%	0
External resilience	Diversity of suppliers		- / 0.1-1.0	0.76
	Entry points	Ports	Quantity	0
		Pipelines	Quantity	3
Domestic resilience	Send-out capacity		%	0
	Natural gas intensity, cm/$1000 USD*		-	176

Natural gas intensity is used as an indicator of domestic resilience. This is calculated by dividing a country's gas consumption by the GDP and is a sign of a country's economic exposure to gas disruptions. MOSES classification gives three rankings for gas intensity, the medium ranking being 20-60 cm/kUSD. Georgia exceeds this threshold almost

three times, which indicates a highly unproductive use of natural gas.

it says like the country's economy is super resilient to gas disruptions, although this is an average of the whole year, maybe related to HPP in summer, therefore not that much dependent on gas (talking about the economy).

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Natural gas classification: GROUP E (see Figure 5). Georgia can be found in the group of countries with the highest risk and low resilience, for both, domestic and external factors, when it comes to natural gas. The main reason is that the country is almost 100 % dependent on imports for natural gas, which happens to be the main indicator for the assessment of this primary energy. The results for political stability and diversity of suppliers show high risk and low resilience respectively, suggesting that Georgia is highly susceptibility in the case of a physical interruption of supply. This is also exacerbated by the fact that there is no LNG port in the country. Domestic risk for natural gas is measured by the percentage of offshore production, which in the case of Georgia is cero. Given that the country has no production of natural gas, neither offshore nor onshore, this indicator should not be taken as a positive result.
Georgia would significantly benefit of diversifying its natural gas suppliers, building storage capacity, and an LNG port in order to take advantage of natural gas spot market. This port would also help build resilience in case of pipeline damage.

Figure 5. Natural gas: security profiles

Group	Countries that:	No. of countries
E	**Import ≥70%** of their natural gas supply and have • 3-4 pipelines and/or 1-2 LNG ports with low supplier diversity and maximum send-out capacity <50% of peak-daily demand.	3

Georgia falls under the same these countries have their own means of assuring the energy security. E.g. Sweden's electricity depends on nuclear and hydropower;

COAL

Georgia has a significant reserve of brown coal and a number of coal mines constructed in Soviet period. However up to now coal has failed to contribute significantly to energy security of Georgia. Discussions and studies of coal fired power generation or coal gasification have not resulted in industrial scale projects (except minor 13MW coal power plant with poor reliability track record).

The coal indicators of energy security classification by MOSES are given table 4 below:

Table 4. Coal security indicators for Georgia

Dimension	Indicator	Unit / Range	Value
External risk	Import dependency	%	55.7
Domestic risk	Share of underground mining*	%	100

External resilience	Diversity of suppliers		- / 0.1-1.0	0.82
	Import infrastructure (entry points)	Sea or river ports	Quantity	2
		Railways	Quantity	1

*There is no high category for this indicator because the MOSES approach, which was created for OECD countries, says that no country has more than 60% of their domestic coal production from underground sources.

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By coal classification, Georgia falls into group B (see Figure 6).

Figure 6. Coal: summary of findings on security of supply

Group	Countries that:	No. of countries
B	**Import 30%-60%** of coal with • the share of underground mining >40%.	2

The two main indicators for the assessment of coal in the country are the import dependency and the underground mining. The first indicator puts the country in group A or B, but the amount of underground mining is the determinant factor for the final classification. It is important to take into consideration the fact that this classification is for countries with shares of underground mining up to 60 %. Georgia underground mining goes up to 100 %, which implies a higher risk that is not taken into consideration in this approach.

Biomass and waste

Table 5. Indicators results and their classification

Dimension	Indicator	Unit / Range	Value
External risk	Import dependency	%	-0.15
Domestic resilience	Source diversity*	0.3-1.0	0.99

*According to Georgia Energy Balance 2016, there are only 4 types of biomass, being wood fuel the most used.

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Biomass and waste classification: GROUP C (see Figure 7). Despite having no import dependency on this energy source, Georgia is classified into group C because it gets almost all of its biomass from one source, and this happens to be the most important indicator for this source of energy. Currently, almost 100 % of the country's biomass comes from fuel wood, which is creating serious deforestations problems with the consequent loss of biodiversity. Thus, it is highly important for Georgia to diversify the source of biomass by increasing the proportion of pellets, briquettes, and other solid fuels, together with vegetal materials and residuals amounts used to generate energy. Furthermore, increasing the efficiency of the use of wood will reduce its demand.

Figure 7. Biomass and waste: summary of findings on security of supply

Group	Countries that have:	No. of Countries
C	**Low diversity of sources** (with high concentration of sources >0.5 which means at least 75% of their biomass and waste comes from a single source) and **low import dependency** (16%-24%).	3

Hydropower

Hydropower is a backbone of Georgia's power sector, providing 70-75% of total supply. In absence of significant fossil reserves, it is considered as a main factor of Georgia's energy Security and main direction of Georgia's energy policy.

MOSES assesses the risk of hydropower by its supply volatility due to hydrology variations. In our case we used the hydropower annual output historic data as a proxy for assessing this volatility.

Indicator: Variability of hydropower production.
Measures both risk and resilience aspects of hydropower production. No data available for full load hours, therefore this indicator was calculated using the electric supply of hydropower plants.

Volatility of hydropower production for Georgia (09/2006 – 06/2017): 13.8 %

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Georgia falls into hydropower security GROUP A (see Figure 8).

The volatility of hydropower production for Georgia represents in terms of risk a moderate variability in the weather, and in terms of resilience, a moderate resilience capacity of the hydropower system, for instance not enough hydro reservoirs (stocks) compared with annual production. This approach is very simplistic when it comes to assess hydropower; other indicators such as spare capacity, geographic spread of hydropower plants and water storage reservoirs should be consider as well in order to obtain a comprehensive and accurate assessment of this type of primary energy source.

Figure 8. Hydropower security profile for Georgia

Group	Countries with:	No. of countries
A	Volatility of hydropower production ≤11%.	**12**

However this analysis does not account for profound seasonality of hydrology regimes and seasonality of demand. A more rigorous analysis
Export opportunities might be an interesting factor as well.

SUMMARY and Conclusions

Georgia's MOSES energy security profile is be summarized in a table below.

Primary energy source or fuel	Security Profile for Georgia
Crude oil	**A**

Oil products	
Gasoline	**D**
Middle distillates	**D**
Other oil products	**D**
Natural gas	**E**
Coal	**B**
Biomass and waste	**C**
Hydropower	**A**

It shows moderately positive rankings in all oil products except oil products and natural gas which however have the major share in Georgia's energy balance. Although not in MOSES methodology, we decided to compile a summary rating for Georgia by weighing different ratings according to their share in energy balance. If we assign A-E equivalent numbers of 1-5, we arrive at Georgia's overall energy security rating at **3.7** I.e. slightly better than **D** (4).

- Unlike other countries, Georgia does not use crude oil as a primary energy source and an important factor of energy security.
- Resilience to disruption in oil products is low compared to developed countries and requires increase in reserves;
- The lowest security ranking is related to natural gas and requires both reduction of supply risks and increase in domestic resilience by providing gas storage and increasing the efficiency of use.
- Due to unsustainable use biomass is not a stable energy source and requires new solutions
- Hydropower has low annual variability compared to non-hydro-dominated countries and can be considered a relatively reliable energy source

Although MOSES methodology does not fully capture the specifics of Georgia's energy security, it provides a useful platform for discussions on this issue. There is a need for further research and its closer relation to country's practical energy security policy.