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Armenian Energy System Development: The Prospects of EAEU Single Energy Market

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ABSTRACT

Armenia today is a country with significant energy and economic issues. The country has come over a difficult period of military conflict, it's highly dependent on imports of energy resources, the national energy system is out-of-date. The energy issues require significant financial investments, which can't be provided in the current conditions. This defines the theoretical and practical significance of the research, especially in the context of the need for reforms in energy sector and in economy in general. In addition to that Armenia is isolated from EAEU single energy market, which proves to be a problem for the country. The authors focused on the analysis of weak and strong points of the Armenian energy industry, revealing and proving, that the current situation harms economic development of the country. The key strong points revealed are the willingness of cooperation with Russia, readiness for the green transformation, access to the international financial market, readiness of the legal framework. Based on these findings and on the econometric model, that proves that natural gas, oil and hydroenergy are the most significant energy resources for the GDP of the country, contributing to its growth, the authors have developed recommendations for the development of the Armenian energy industry, taking into account the poor situation with financial resources in the country in general and the dependency of Armenian energy system on the Russian energy sector companies.

Keywords: Armenia, Energy Sector, EAEU, Energy Market, Renewable Energy, Conventional Sources of Energy

JEL Classifications: Q40; Q47; P18

1. INTRODUCTION

Armenia today is a country with faltering economy, difficulties in political sphere and social unrest (Voskanyan, 2020; Friedrich Ebert Stiftung, 2017). The overall situation in the country is difficult and far from ideal, while the poor energy prospects add up issues of high importance and high costs. In this regard, the overview and the analysis of the possibilities for the energy system development of the country is highly important.

Armenia is one of the key Russian allies in the Caucasus region, although tensions in the relations between two countries exist (Branch, 2018; Congressional Research Service, 2021). The incorporation of Armenia in the zone of Russian geopolitical

interests and geoeconomics influence is one of the important regional tasks for Russia, just as the task of the smoothening of relations between Armenia and Azerbaijan. The recent conflict on Nagorno Karabakh district finished with the loss of Armenia (Congressional Research Service, 2021) led to the unrest in the country and high political instability. In this regard, any relations between the two conflicting countries in the sphere of energy are impossible. Russia sees its role in easing the conflict and supplying Armenia with energy resources, but the energy system in Armenia lacks capabilities for the distribution and generation of energy.

This poor situation and lack of financial resources leads to the incapability of Armenia to maintain its energy system and the need to reform it. The article aims at pointing out the weak and strong

points in energy sphere of Armenia and compiling them in a single strategy or a number of recommendations for the better economic and energy performance of the country energy industry. In order to reach this goal, the authors analyze all the energy segments of Armenia and give recommendations on all of them, focusing on the potential source of financial resources for the realization of suggested projects.

The main results of the study include: pinpointing the weak and strong points of the Armenian energy sector, developing an approach to the selection of the energy sources through econometric modelling, finding the possible sources for financing energy sphere development in Armenia and development of the complex of measures for boosting energy sector development in the country.

2. LITERATURE REVIEW

The energy sector of Armenia hasn't been widely discussed in scientific literature. The discourse focused on the Caucasus region in general. The most relevant works on theme of Armenian energy system are the following. First of all, it's necessary to point at (Rodionova et al., 2020), where the authors compare EAEU countries and figure out the major dilemma – the need for modernization and lack of financial resources in Armenia. The second interesting work also refers to the wider region (Gibadullin and Pulyaeva, 2019), it proves the difficulties with connecting Armenia to the EAEU infrastructure and grounds the idea, that the country needs to develop an isolated (to a higher or lower degree) energy system. Armenian current situation of full dependency from the Russian suppliers is depicted in (Vavilov and Trofimov, 2016), moreover, the authors demonstrate such risks of the current situation as the monopolization of markets, extreme power of Gazprom in the researched countries, the exploitation of the national economies by the Russian giant. The other article enforces these ideas (Zhiltsov et al., 2017), pointing on the Russian interests in the region, promoted by energy policy (Kosowska et al., 2018), on the other hand, proves, that this situation doesn't satisfy Armenia and is the source of threats to the country (Touryan et al., 2012), provides analysis of one of the possible solutions for Armenia – green energy, proving that today small hydro stations and small solar plants are the most effective way to increase the Armenian energy generation. Nuclear energy of the country is discussed in (Davtyan, 2018), where the authors give no recommendation, but focus on the state of being of the industry.

Taking into account the scarcity of literature, this paper contributes to the better understanding of the Armenian energy market and has practical significance in the context of Armenian energy industry reformation.

3. METHODOLOGY

The article is structured according to the following logic. Firstly, a brief overview of the situation in the energy industry is given with basic statistical analysis of its development. Secondly, the weak points of the current Armenian energy industry are revealed, based on them the positive sides and the opportunities for growth are stated. Then in order to figure out whether it's financially

possible for the country to realize these possibilities the ways of investment attraction to the country are figured out.

In order to assess the importance of the energy factors in the Armenian GDP, the authors have conducted econometric modelling with GDP and all the energy generation and energy consumption statistics used hereinafter. The model looks the following way:

$$GDP \sim \alpha_1 * Gas + \alpha_2 * Oil + \alpha_3 * Coal + \alpha_4 * Nuclear + \alpha_5 * WindandSolar + \alpha_6 * Hydro + \alpha_7 * Biofuels + \alpha_8 * Energyconsumtion + const$$

Those energy sources, which proved to be relevant in econometric model are considered important for the GDP growth. In case the coefficient is positive, they contribute to the growth of GDP, the opposite is true too. The choice of models with different variables is made by the best value of the criterions of model adequacy (R-squared, adjusted R squared, DW-criterion, Akaike-criterion and by the P-values for the variables).

Based on the results of the previous sections of the article the possible solutions for the pinpointed energy sectors are discussed along with the possibilities for the Armenian green energy sector.

4. OVERVIEW OF THE ARMENIAN ENERGY INDUSTRY

First of all, let's refer to Figure 1, demonstrating the most important sources of energy in Armenia.

Figure 1 allows to make several important conclusions:

- 1) The major source of energy in the country is natural gas, which, as it follows from common logic, comes from Russia;
- 2) The role of nuclear energy is high, even higher than the role of oil.
- 3) The majority of hydrocarbons in the country are imported (Igityan, 2019), so Armenia is highly dependent on energy imports.

In this regard, it's necessary to pinpoint several important facts on the Armenian energy system in gas sphere. First of all, Armenia is highly limited in the sources of gas. As it was already mentioned, Azerbaijan doesn't cooperate with its neighbor in energy sphere, moreover, the strategic decisions on the Azerbaijani gas pipes is to avoid their construction on territory of Armenia at any costs – Baku – Ceihan, Baku – Erzerum, Baku – Kars, which are one of the most significant gas pipes on shore of the Caspian and Black Sea, have been constructed to isolate Armenia from the gas flows (Caucasus Analytical Digest, 2011). In this regard, partnership with Iran after the sanctions were lifted from the country, was regarded as a new partner and a new opportunity to diversify the Russian gas imports. Still, the strong move from Gazprom was to buy the shares of the joint Russian-Armenian energy venture and to create “Gazprom Armenia” – an affiliated company, which has the rights and owns the Armenian part of the Iran – Armenia gas pipe (Eurasianet, 2015). As a result, the Armenian gas market

is totally controlled by Gazprom, consequently is in dependence from Russian policy and is a strong instrument of the Russian policy in the country.

The overall situation is even worse, when said, that the Armenian market of oil depends on Russian companies too (Minassian, 2008). Armenia is totally dependent on the Russian export of oil and gas, which is a significant risk for the country security and a mighty instrument for the Russian policy. The other important issue is that the Armenian electric energy is generated on oil and gas electric stations – 42% of electricity in the country comes from this source, while hydropower and nuclear power account for 28% respectively. The remaining 2% come from renewable sources or are a part of statistic mistake (calculated, based on (IAEA, 2019).

Figure 2 reflects the current situation and the future of the demand for energy.

The overall situation with energy independency in the country is bad, as, just as it's demonstrated on Figures 1 and 2, the growing demand for energy needs to be satisfied and the country will have to buy more energy from Russia, while the GDP of Armenia is growing too, but after the military crisis the overall growth trend, reflected on Figure 2 will inevitably fall. The other sources of energy in the country are less important and play a significantly lower role in its development. Figure 3 reflects their dynamics.

The data on Figure 3 is also very important, as it reflects those sources of energy, which are used as the substitution for the

Figure 1: Main energy sources in Armenia (created by authors, based on (IEA))

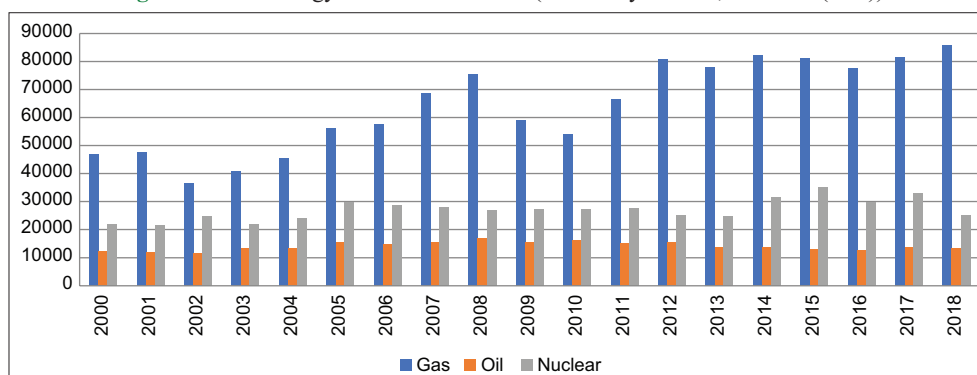


Figure 2: Energy consumption in Armenia (created and forecasted by authors, based on (IEA))

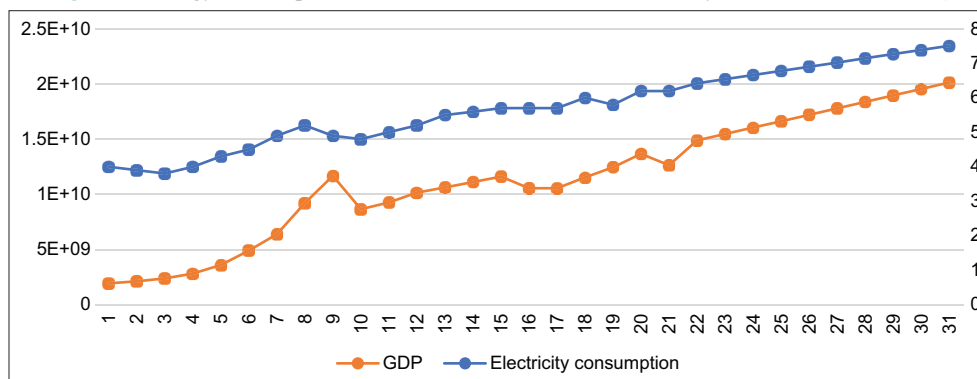
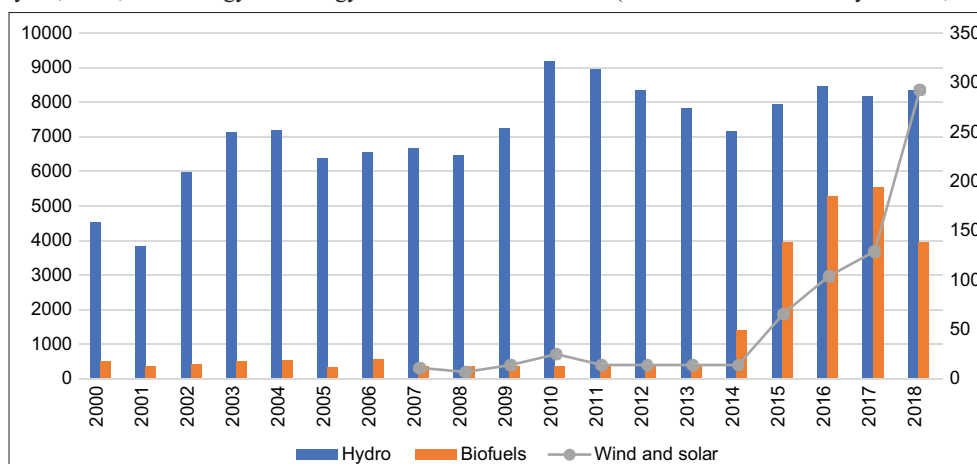


Figure 3: Hydro, wind, solar energy and energy from biofuels in Armenia (created and forecasted by authors, based on (IEA))



traditional ones in Europe and which lie in the basis of the European green energy transition (Hafner and Raimondi, 2020), which according to the position of the European Commission allows the European economies not to fall under pressure of Russian energy weapons (Henderson and Mitrova, 2020).

In Armenia these sources are developed rather badly, taking into account the non-willingness to use biofuels and the costs of wind energy generation in the country. The key issues of this way of energy system development in the country are:

- 1) Unsuccessful joint plan with Iran to build Megrinskaya hydro electric plant (Open Democracy, 2021; Korotyshev and Tyumenkova, 2012), the unsuccessful endeavours to use the rest of the water resources more efficiently;
- 2) The difficult situation around Armenian nuclear electric station. This plant badly needs reconstruction and proliferation of its generation power, while the major and only supplier – “Rosatom” doesn’t fully suit the Armenian Conception of energy security of Armenia (Strategy national safety republic of Armenia, 2020).
- 3) The low financial capabilities of the Armenian population to mount and maintain solar panels, despite it being the most effective source of green energy in the country.
- 4) The non-Armenian ownership of the Armenian electric energy distributor (it’s owned by an affiliate of the Russian Inter-RAO – Tashir Group (Economist intelligence, 2019), and its ineffectiveness in financial field and in the field of energy distribution.

These major shortcomings lead to the significant problems in the potential for the Armenian energy sector modernization, while the most probable ways of its development lie in the cooperation with EAEU and Russia, putting the national energy system in even higher dependency from Russian MNCs.

The positive sides, which provide possibilities for the future development of the Armenian energy system are:

- 1) The high solar energy potential, along with the modern and progressive regulation – the country has the legal framework for energy purchase from private producers (households), these producers are free from taxes, if their generation capacity is under 150kWt (ECRB, 2020).
- 2) The willingness of the Russian side to cooperate with Armenia in energy sphere, the participation of the Russian companies in green energy development – for instance, in Razdanskaja hydroelectric station the 5-th generator is owned by Tashir Group;
- 3) The ability to attract financial resources from the development institutions, such as the World Bank and the Eurasian Development Bank on low costs;
- 4) The inclusion of the households in energy-saving process and in green energy generation, demonstrated by the rapid growth of green energy production since 2014 (Figure 3).

Based on these positive and negative points, it’s necessary to assess the whole specter of relations in the EAEU, namely the relations on the creation of the single energy market in the Union. The current goal is the creation of the single electric energy market

by 2025, which includes joint electric grid, tariffs, the possibility of overflows of energy, the joint approaches to the electric energy trade (Westphal and Pastukhova, 2016; Gibadullin and Pulyaeva, 2019). Armenia, not like any other country of EAEU has no common borders with any of EAEU economies and in this regard the country will have to arrange electric energy flows through South Ossetia and Georgia, which will inevitably lead to higher tariffs and the dependency on the infrastructure of these two regions. In this regard, Armenia has little or no profits from the creation of the single EAEU electric energy market except for the establishment of the same tariffs, which will be more realistic and will lead to the better performance of the “Armenian electric grids”. Still, the affiliation of this company with Russian companies to a certain extent is a positive fact, as the Russian energy giants will be capable of fixing the best transition rates in South Ossetia due to the tight bonds of the region with Russia and will be able to conduct talks with Georgia on a different level, than Armenia.

5. FINANCIAL SOURCES

When we have figured out the major problems and positive sides of the Armenian energy system, let’s reveal the financial sources, available for the country in order to develop its energy system.

First of all, it’s necessary to say, that the development of energy system in Armenia should be based on the comparison of price efficiency of every energy source. IRENA reports the falling costs of renewables, for instance, the price of solar energy is stated as 0,07 USD/KWh, the price of wind energy as 0.04 USD/KWh, if speaking of onshore wind (IRENA, 2020), while the price of electricity from natural gas according to the same agency, equals about 0,3 USD/KWh. At the same time, it’s quite clear that none of the modern economies can rely totally on renewables because of the issues with electricity storage and instability of electricity generation. The reservation of fossil fuel plants for the needs of backup in case of peak demands and bad weather is needed. Moreover, the IRENA calculations don’t take into account the costs of building green energy generators, which leads to the misunderstanding – the win in energy generation costs don’t cover the losses in the construction costs of the facilities, generating energy.

Secondly, Armenian energy system needs to comply with the out-of-date electricity grid, left from the USSR, which requires a certain overkill in energy generation. Taking into account these two criterions, the best option for the energy system development financing lies beyond the credits of international institutions, promoting green energy.

The first possible option is to refer to the EADB mechanisms. The Bank can issue a credit for Gazprom Armenia or enlarge the current credit of \$17 million to Armenian energy grid in order to stimulate the development of the energy system of the country (Eurasian Development Bank, 2021). The Asian Infrastructure Investment Bank, on the other hand can attract investments in the solar energy system of Armenia with respect to the high influence of the Chinese interests in AIIB and the Chinese leadership in the

production of solar panels (González, 2015). At the same time, it's necessary to pay the major attention to the development of the Armenian energy grid.

As it was already said, the Armenian energy grid belongs to Inter-RAO via its affiliate Tashir Group. The obvious barrier for the development of the Armenian energy grid is the need to transport electricity via the Georgian territory and the need to modernize the energy grid in whole in the country. The only source of financial resources for the stimulation of this process is the state budget of Armenia, which today is deficit (Statista, 2021). One of the options for Armenia is to issue small amount of government bonds with high interest rates, hoping to attract speculative capital. The second option is to address Inter-RAO and ask for investments in return for the energy facilities on territory of the country (the company transferred its assets to Tashir Group as they brought losses). The second measure doesn't correlate with the energy security of the country, but this measure is necessary, as the low developed energy grid in the country prevents the development of the energy system as a whole.

The development of nuclear energy in Armenia has always been financed from abroad. The possible options include the attraction of the portfolio investments, as it was already done with the first nuclear energy station in the country, the attraction of financial resources from the countries, standing for nuclear energy proliferation as a green energy source in Europe – the most powerful of them are France and Great Britain and from Russia, which will provide its services. The intergovernmental credit in exchange for the tighter integration in EAEU and the resolution of the several trade barriers, existing today on initiative of Armenia will help solve the issue (Bank of Russia, 2019).

At the same time, cooperation with Iran is highly limited, but not closed for commercial actors. The affiliates of the Armenian companies can establish closer ties with Iran and trade oil and gas in small quantities.

The further rise of taxation in the country or restrictive measures of monetary character won't lead to the growth of the state budget revenues, as the economy of the country is functioning badly and the fall in economic activity can lead to the further fall in economic growth.

The next step of the analysis is to figure out which sources contribute most to the GDP changes and how. In order to do that, let's refer to Table 1, demonstrating the results of econometric modelling of the Armenian GDP.

As we can conclude from Table 1, the most important factors for the Armenian GDP are gas, oil and hydroenergy, hence, the majority of the economy functions due to these sources of power. In this regard, the interesting finding is that these sources contribute to the growth of GDP, while gas in the Concept for energy security of Armenia is considered a significant threat for the economic development of the country. The negative value of the constant on the other hand depicts the negative impact of gas imports on GDP along with such quality factor as the bad quality of energy grid. Potentially it can reflect even the costs of nuclear energy production and the costs of the growing energy demand in the situation of the remaining energy supply and overuse of current energy facilities.

The conducted analysis gives a field for discussion on the further use of gas and oil from Russia in Armenia and on the non-relevance of the green energy sources in the country.

6. DISCUSSION

As we have stated in the previous section, the country, according to the econometric model, will develop better in case it continues to use the same energy model, as it's using now. The empiric analysis of these factors allows to offer several possible solutions for the cheaper imports of gas in the country.

The first obvious solution is to pursue the idea of the Iran-Armenia gas pipeline. It will be built and financed by Gazprom Armenia its current operator and the final price of gas on the Armenian market will be more marketlike. Still, this option doesn't suit the situation when the demand for gas is growing, just as the costs of it, especially taking into account the growth of gas prices (Bruegel, 2021). In order to secure the current prices a long-term contract with the Russian gas supplier (Gazprom) is a good option, especially taking into account the willingness of the Russian side to form long-term contracts (Locatelli, 2014).

The second solution is to store gas and bring forth the idea of Armenia as a regional gas hub – Georgia doesn't use its potential

Table 1: The results of econometric model for Armenian GDP in Gretl: Time series: 2000-2018 (T=19), Dependent variable: GDP (created by authors)

	Coefficient	SE	t-ratio	P-value
Const	-1,41147e+10	2,05268e+09	-6,876	<0,0001***
Gas	178114	15717,5	11,33	<0,0001***
Hydro	678461	188572	3,598	0,0026***
Oil	410111	153208	2,677	0,0172**
Mean dep. Var.	7,97e+09		SD of dependent var.	3,79e+09
Sum squared resid.	1,21e+19		SE of the model	8,98e+08
R-squared	0,953222		Adjusted R square	0,943866
F (3, 15)	101,8880		P-value (F)	3,36e-10
Log.likelihood	-416,4065		Akaike criterion	840,8131
Schwarz criterion	844,5908		Hannan-Quinn criterion	841,4524
Rho	0,248517		DW criterion	1,488066

fully (Energy Charter Secretariat, 2014), so Azerbaijan is the major competitor. In order to do that, Armenia needs to invest in gas storages and gradually develop its gas pipeline infrastructure. This proposal is a long-term one, but can suit the situation in the country.

Nationalization and further buy-out of the national energy distributor, better, buying out a share of it is another step for the country energy independence, moreover, it will allow to directly invest in the national electric grid reconstruction. This can be done only from the country budget, so the financial support of IMF and the World Bank will be needed.

The situation in oil sphere is somewhat different. Armenia uses only a small part of imported oil for energy generation, the bigger part is refined and used in transport. In this regard the planned joint venture in oil refinery with Iran looked good until the reimposition of sanctions (The impact of renewed sanctions on Iran, 2019). The key issue with this project is the absence of infrastructure for transportation of oil products. This sphere of energy development has no prospects for development and the only recommendation given is to create a financial stabilization mechanism. This mechanism can look like the one on Figure 4.

The development of the hydro energy in Armenia has far better prospects. Armenia has more than 300 rivers, which are longer than 10 km. (Water action hub). The generation of energy by the hydroenergy stations of significant size in the country is limited by the natural possibilities. At the same time, the development of the small hydrostations by the model of Norway (Magnusson and Palm, 2019) looks like a prospective idea, moreover it contributes to the greener energy sphere. The only issue, which the country will inevitably face is the lack of capacity of the electric grid. The possible solution is to build up the hydro energy capacity close to the small towns and villages, while redirecting the freed energy from the central grid to the capital and big cities. This model isn't a long-lasting solution, but for the first time it will fulfill its functions of stimulating the local energy production.

The proposed steps for the better energy sphere development in the country encompass the types of energy, revealed in the econometric

model. At the same time, Armenia has a vast solar potential, just as the potential to use wind power (Renewable Energy in Armenia, 2017). In addition to that, the country can benefit from the use of energy from waste, contributing to the cleaner landscape and to the tourist attractiveness (Atoyan, 2016). Missing out green energy sources in econometric model can be explained by the recent character of their growth, so the implications for the faster growth of green energy are important.

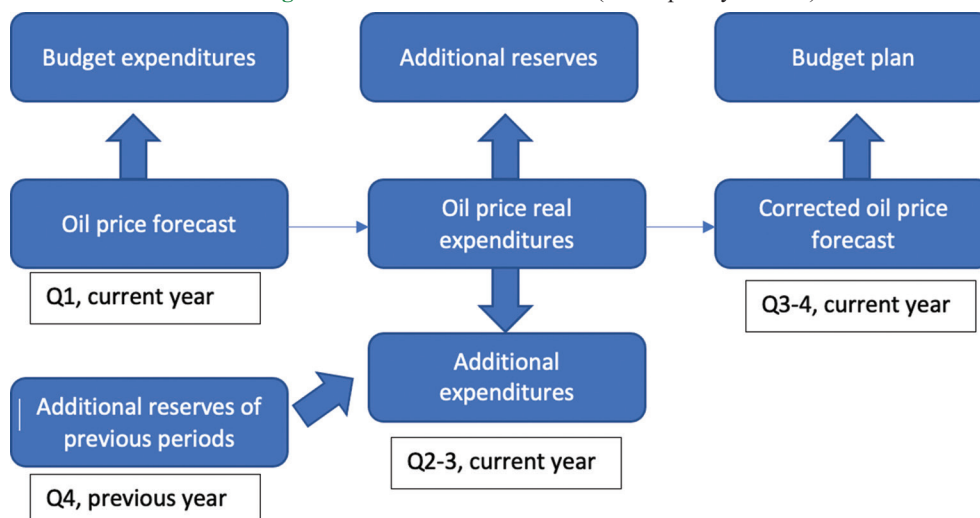
First and foremost, today, when Armenia imports energy, the electricity, generated by households from solar panels should be used in the country – redistributed, used by the households themselves. Still, when the balance between production and consumption is reached, it can be exported, so the national budget gets additional revenues.

Secondly, Armenia can introduce “green certificates”, just as it's today in Sweden (Johannes, 2017). It will limit the monopoly of the big energy producers and give way to the greener energy. At the same time, the formation of the stock exchange for these certificates can be transformed into the state-regulated auction, which will contribute to the state budget. The idea of the “green certificate” is the following: a company, generating energy from green sources receives certificates for a certain volume of energy. It can exchange or trade them with companies, generating energy from conventional sources, while all the companies of energy sphere will have to own a certain amount of “green certificates”, depending on the volume of energy generated.

The measures, aimed at stimulation of the solar energy in the country are adequate and do bring results, while the introduction of the same measures for energy from waste (except for the limit of 150 kWt generation) may serve as a boosting point for the solution of the waste disposal problem in the country.

The introduction of the proposed measures for the stimulation of green energy will cost nearly to nothing for the state budget, while the growth of energy production in Armenia will be higher. The authors suggest to use both tracks of measures for the stimulation of the energy sphere development, as the second track (green) will

Figure 4: Reservation mechanism (developed by authors)



add up to the budget revenues in long run, while in short run can boost the economic activity in the country.

7. CONCLUSION

The Armenian energy sector today is overcoming serious issues, such as lack of financing, high share of foreign participation, high vulnerability to crises, lack of technical development, isolation from the global gas market, low quality of infrastructure.

The named complex of issues brings forward serious barriers for the energy sector development, but the strong sides, such as long-run partnership with Russia, the ability to attract financial resources from international organizations, high solar potential, the willingness of households to participate in the green energy development make it possible to figure out the major solutions.

The most important spheres of energy development in Armenia are gas, oil and hydroenergy, while nuclear energy and green sources of energy are missed out for now.

The country can attract financial resources from various sources, but it's quite risky and expensive, at the same time, there is no other way to avoid economic stagnation from lack of energy.

The cooperation with Iran, Russia and the promotion of the national vision of energy security lie in the basis of the better energy sphere development. The creation of the reserve mechanism in the sphere of oil, the transition of Norwegian institutes in small hydrostations, the transition of the Swedish institutes and their reimagination in the sphere of "green certificates" will contribute to the higher share of green energy in energy balance, to the higher budget revenues.

The complex development of energy sphere by both directions – conventional sources of energy and green sources of energy is the key to a more sustainable energy sector in Armenia.

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