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Different Scenarios of Investments in Georgia's Energy Sector

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Abstract

Various types of recent research point out the fact that Georgia's energy sector (and in particular hydro energy sector) is one of the most attractive ones when it comes to investment opportunities. Hydro power remains the cheapest and the most "ecofriendly" source of power for Georgia. An essential part of Georgia's hydro energy potential is still untapped (in fact, the current electricity generation represents just about 40% of Georgia's estimated annual hydropower output potential). Currently, Ministry of Energy of Georgia has more than 60 HPP projects available for investment. For every potential investor, it is of vital importance to have general knowledge about what to expect from the desired sector, what the risks that could hurt the success of the investment are and if the expected rate of return equals or exceeds his or her required rate of return. This article is based on our previous article and develops three different scenarios for investment opportunities in Georgia's Hydro Energy sector. For all three scenarios expectations are evaluated and sensitivity analysis is provided.

Keywords: energy sector, investment, hydro energy

JEL: G17

Introduction

The total installed capacity of power plants in Georgia is 3,724 MW, where the share of HPPs is 75% (2,799 MW). Currently, 67 hydroelectric power stations operate in the country. The main part of them is located in western Georgia (on the rivers Enguri and Rioni basins). Nearly half of annual processing of the country produces 7 regulated HPPs, with the total installed capacity of 1,991 MW and the annual production exceeds 5 billion kWh. The total installed capacity of the existing 12 seasonal stations is 646 MW while 48 small deregulated HPPs (up to 13 MW with the total installed capacity - 162 MW) provide only 5% of the country's annual processing. The total volume of water reservoirs is 2,259 mln. m3 (useful volume - 1,425 mln m^3). Most of the existing HPPs are outdated and require reconstruction/modernization to increase efficiency. Since 2010, 18 HPPs have been gradually put into operation, with total installed capacity - 174 MW.

Hypothetical HPP for Investment

The articles published earlier (Gagnidze & Gvazava, 2018) explain how we determined the "Hypothetical HPP" using data of about 39 potential HPP projects defined by the Ministry of Energy of Georgia. Finally, our research revealed that the "Hypothetical HPP" has the following 5 main indicators:

- Installed Capacity - 7.62 MW
- Average Annual Generation - 35.99 GW/hs
- Capacity Factor - 54%
- Cost of Construction- 13.19 mln. USD
- Time of Construction – 2 years.

During the year, the expected generated electricity by months is graphically shown below (Figure 1):

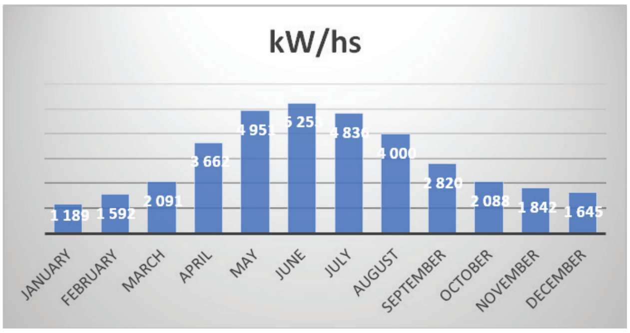

Figure1: Generation Dynamics

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CAPM model and Basic Results for the "Hypothetical HPP"

In our earlier article (Gagnidze & Gvazava, 2018) the suitable CAPM model for the Georgia's Energy sector was determined. After all the required calculations, the following results are derived for the investments on the "Hypothetical HPP":

Table 1. Basic Indicators Calculation Results for "Hypothetical HPP"

Debt Finance Part	39.63%
Equity Finance Part	60.37%
Debt Finance Amount	5,225,777
Equity Finance Amount	7,960,056
Cost of Debt	8.64%
Debt Maturity (Years)	15
Cost of Equity	17.96%
Weighted Average Cost of Capital	14.27%

Georgia's Electricity Market

According to the 2016 report of the Georgian National Energy and Water Supply Commission (GNERC) and Tokhadze, N. (2014), the current model of the Georgian Electricity Market may be defined as a direct contracts market, where market participants fulfill the obligations on a monthly basis. Besides the direct contracts market, the balance market is operating, which allows participants of the power market to balance the monthly quantity of electricity specified in the contracts and buy/sell too much demanded/generated electricity.

Electricity market of Georgia can be divided into wholesale and retail markets and includes electricity manufacturers, direct consumers, exporters, importers and distribution licensees (in the supply part), as well as service providers - transmitter system operator, market operator, transmission and distribution licensees. The main subjects of retail marketing are electricity distribution license holders. Power supply in the retail market can also be provided by small HPPs. Whatever the end-consumption segment, retail consumption is represented by household and non-household consumers.

According to the Georgian National Energy and Water Supply Commission (GNERC), the main subjects of service to wholesale markets are:

Buying and Selling Electricity

- **Electricity Producers**

In 2016 there were 77 producers of electricity, including, 5 thermal power plants (and the coal-based Tkibuli thermal power plant), 2 regulated, 15 partially deregulated, 4 deregulated and 51 small deregulated power plants. In 2016, five hydroelectric power plants (Dariali HPP, Saguramo HPP, Shakshakheti HPP, Maxanaia HPP and Kazreti HPP - 116.7 MW), 1 Thermal Power Plant (13.2 MW) and 1 wind power plant (Kartli wind power plant - 20.7 MW).

- **Direct Consumers**

In 2016 the number of direct consumers (registered as a qualified enterprise) still amounts to 4. Their total consumption is slightly lower (1%) compared to the previous year.

- **Electricity Importers**

In 2016, 12 companies were registered in the wholesale market for import of electricity. Imports of 478.9 mln. kW/hs electricity were carried out, which is 31.5% less than in 2015.

- **Electricity Exporters**

In 2016, 29 companies were registered in the wholesale market as an exporter of electricity. Exports of 559 mln. kW/hs were made, which is 15.3% less than in 2015.

- **Electricity System Commercial Operator (ESCO)**

ESCO is authorized to sell and/or sell the imported and/or exported electricity through direct agreements as well as the Standard Terms of Direct Electricity Agreement.

- **Power Purchasers**

JSC "Energo-Pro Georgia", JSC "Telasi" and JSC "Kakheti Energy Distribution" are registered as a qualified enterprise in the part of electricity purchase. Abkhazia region was provided with 1,926 mln. kW/hs electricity. Accordingly, growth increased by 7.2% compared to the previous year.

- **Transmission and Dispatch Licensees**

In the purchase of electricity for the purpose of covering losses for ensuring electricity (capacity) transit. In 2016, 849 mln. kW/hs electricity transit was carried out from Azerbaijan to Turkey and Russia in the direction of Armenia.

Network, System, Accounting and Administrative-Commercial Service Part:

- **Transmission System Operator (TSO)**

Dispatch Licensee. By the end of 2014, the dispatch licensee was nominated as a transmitter operator, who signed agreements with Transmission Network Assets Owners (Transmission Licensees) in 2015 to transfer the power to operate and develop the transmission network. The "IE" system mainly manages the SCADA (supervisory control and data collection system) and uses the automated system of top level power and power control and accounting.

- **Market Operator**

Electricity System Commercial Operator (ESCO), which buys buy and sells balancing power and organizes a guaranteed capacity trading, as well as registers the registration of enterprises in wholesale trading, changes in registration data Entry and registration cancellation. The market opera-

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tor owns and operates the automated commercial accounting system (KAA), which generates the uniform purchase and sale of electricity and automatically receives data from the EASA systems. Its purpose is to obtain, check, collect, group and summarize data for the wholesale trade of electricity.

- **Transmission Licensees**

Transmission service is carried out on three Georgian electricity transmission licenses on the Georgian Electricity Market. In 2016, the prolonged license of JSC "Energo-Pro Georgia" was passed in 2017 by 2017 to 2020. The prolongation was made to the MoU between the JSC "Energo-Pro Georgia" and the Government of Georgia in the Memorandum of Understanding on "Construction of the Electricity Line Connecting to the Republic of Turkey and the Proper Infrastructure Construction".

- **Guaranteed Capacity Sources**

In the reporting year, 4 thermal power plant was functioning on the Georgian electric power market. Their total output in 2016 was 2,235 million kWh. (Issue - on the satellite - 2,134 million kWh).

- **Distribution Licensees**

Part of the service - networking services, as well as using the networks owned by third parties. Distribution licensees provide the following network services: retail customers, together with delivery services; Retail customers buying electricity from direct contract with Small HPPSs; Direct consumers connected to the distribution network; "Distributed Generation". However, unlike the above-mentioned case, distribution of networking services by distributed generation is not provided by the applicable legislation.

Market Rules

Article 36[19] of the Electricity (Capacity) Market Rules, approved by the Decree No. 77 of the Minister of Energy of Georgia of August 30, 2006, reads:

- If the electricity generated by the newly built HPP is not sold (wholly or in part) under direct agreement with the Electricity System Commercial Operator (including, the owner of the power plant and the commercial operator of the applicable laws and / or the Government in accordance with the legal act Irdapiri contract), the newly built HPP is considered as a seller of electricity to the Electricity System Commercial Operator by direct agreement made under standard conditions.
- Within the framework of the Direct Contract drawn up by Standard Conditions, the Electricity System Commercial Operator carries out settlement when purchasing balance electricity from the newly constructed HPPs: A) From September 1 to May 1 of each calendar year the upper limit of the tariff of the hydro power plant which was given the highest tariff by the Commission, but not more than the price indicated in the agreement under Article 23 (4) of the Law of Georgia on Electricity and Natural Gas; B) From May 1 to September 1 of each calendar year, the lower limit of the regulated HPP which was given the lowest tariff by the Commission.

Research Methodology
Different Scenarios

Based on ideas developed by Fernandez, Cunha, & Fereira (2011), and by Lee, S.-C. (2014) (and using Damodoran (2018) tables), the following three different scenarios have been considered:

Scenario 1: it is assumed that the total power generation generated by HPP will be sold to the Electricity System Commercial Operator (ESCO). Tariffs are taken in accordance with the actual tariffs of 2017, with the tariffs "ESCO" purchased electricity from small hydro power plants.

Scenario 2: it is assumed that every year from September to May, HPP will sell the generated electricity to the Electricity Market Commercial Operator according to the above mentioned article 3620 of "Electricity (Capacity) Market Rules".

Scenario 3: it is assumed that HPP will be able to sign direct purchase agreement with Electricity System Commercial Operator at 7 USD cents which is quite an optimistic assumption because direct purchase agreements are opposed by both European Union and International Finance Corporation.

The information and assumptions used for **Scenario 1** are presented in the Tables 2a,b,c below:

Table 2a. Factual Information and Assumptions (Scenario 1)

Debt Finance Part	39.63%
Equity Finance Part	60.37%
Debt Finance Amount	5,225,777
Equity Finance Amount	7,960,056
Cost of Debt	8.64%
Debt Maturity (Years)	15
Cost of Equity	17.96%
Weighted Average Cost of Capital	14.27%
Technical Losses and Own Consumption	3%
Operating Costs (as a % of Revenue)	10%
Corporate Income Tax	15%
Property Tax	1%
Tariff Growth Rate	4%
Summer Tariff (Export) ($)	6.00
Summer Tariff (Local Market) ($)	0.65
Winter Tariff (Local Market) ($)	7.00
Reinvestment Rate (as a % of Net Profit)	10%
Exchange Rate $/₾	2.3
Cost of Construction (1 MW of Installed Capacity) ($)	1,727,049
Depreciation Period (Years)	50

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Taken into consideration the assumptions from Table 2a, the relevant Income Statement and Free Cash Flow to Firm for the Company for the next 10 years is the following:

Table 2b. Factual Information and Assumptions (Scenario 1)

Period/ In Thousand USD	1	2	3	4	5	6	7	8	9	10
Revenue	0	0	1270	1320	1373	1428	1485	1545	1606	1671
Operating Costs	-119	-123	-127	-132	-137	-143	-149	-154	-161	-167
Operating Profit	-119	-123	1143	1188	1236	1285	1337	1390	1446	1504
Depreciation & Amortization	0	-185	-264	-264	-264	-264	-264	-264	-264	-264
Profit Before Interest and Tax	-119	-308	879	925	972	1022	1073	1126	1182	1240
Interest Expenses	-635	-635	-635	-635	-635	-635	-635	-635	-635	-635
Profit Before Tax	-754	-942	244	290	338	387	438	492	547	605
Tax Expense/Benefit	113	141	-37	-43	-51	-58	-66	-74	-82	-91
Net Profit	-641	-801	208	246	287	329	373	418	465	514

Table 2c. Factual Information and Assumptions (Scenario 1)

Period/ In Thousand USD	1	2	3	4	5	6	7	8	9	10
Profit Before Interest and Tax	-119	-308	879	925	972	1022	1073	1126	1182	1240
Tax Expense/Benefit	113	141	-37	-43	-51	-58	-66	-74	-82	-91
Tax Shield on Interest	95	95	95	95	95	95	95	95	95	95
Depreciation & Amortization	0	185	264	264	264	264	264	264	264	264
Capital Expenditures	-3956	-9230	0	0	0	0	0	0	0	0
Free Cash Flow to Firm	-3867	-9117	1201	1240	1280	1322	1366	1412	1459	1508
Terminal Value (10 years)	11480									

Project IRR = 8.12% **Project NPV = - 2,698**

The information and assumptions used for **Scenario 2** are presented in the Tables 3a,b,c below:

Table 3a. Factual Information and Assumptions (Scenario 2)

Debt Finance Part	39.63%
Equity Finance Part	60.37%
Debt Finance Amount	5,225,777
Equity Finance Amount	7,960,056
Cost of Debt	8.64%
Debt Maturity (Years)	15
Cost of Equity	17.96%
Weighted Average Cost of Capital	14.27%
Technical Losses and Own Consumption	3%
Operating Costs (as a % of Revenue)	10%
Corporate Income Tax	15%
Property Tax	1%
Tariff Growth Rate	2%
Summer Tariff (Export) ($)	6.00
Summer Tariff (Local Market) ($)	0.65
Winter Tariff (Local Market) ($)	7.00
Reinvestment Rate (as a % of Net Profit)	10%
Exchange Rate $/₾	2.3
Cost of Construction (1 MW of Installed Capacity) ($)	1,727,049
Depreciation Period (Years)	50

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Taken into consideration the assumptions from Table 3a, the relevant Income Statement and Free Cash Flow to Firm for the Company for the next 10 years is as follows:

Table 3b. Factual Information and Assumptions (Scenario 2)

Period/ In Thousand USD	1	2	3	4	5	6	7	8	9	10
Revenue	0	0	2258	2303	2349	2396	2444	2493	2542	2593
Operating Costs	-212	-219	-226	-230	-235	-240	-244	-249	-254	-259
Operating Profit	-212	-219	2032	2072	2114	2156	2199	2243	2288	2334
Depreciation & Amortization	0	-308	-264	-264	-264	-264	-264	-264	-264	-264
Profit Before Interest and Tax	-212	-527	1768	1809	1850	1893	1936	1980	2024	2070
Interest Expenses	-635	-635	-635	-635	-635	-635	-635	-635	-635	-635
Profit Before Tax	-847	-1161	1134	1174	1216	1258	1301	1345	1390	1436
Tax Expense/Benefit	127	174	-170	-176	-182	-189	-195	-202	-208	-215
Net Profit	-720	-987	964	998	1033	1069	1106	1143	1181	1220

Table 3c. Factual Information and Assumptions (Scenario 2)

Period/ In Thousand USD	1	2	3	4	5	6	7	8	9	10
Profit Before Interest and Tax	-212	-527	1768	1809	1850	1893	1936	1980	2024	2070
Tax Expense/Benefit	127	174	-170	-176	-182	-189	-195	-202	-208	-215
Tax Shield on Interest	95	95	95	95	95	95	95	95	95	95
Depreciation & Amortization	0	308	264	264	264	264	264	264	264	264
Capital Expenditures	-3956	-9230	0	0	0	0	0	0	0	0
Free Cash Flow to Firm	-3946	-9180	1957	1992	2027	2063	2099	2137	2175	2214
Terminal Value (10 years)	16853									

Project IRR = 15.42% **Project NPV = 1,202**

The information and assumptions used for Scenario 3 are presented in the Tables 4a, b, c below;

Table 4a. Factual Information and Assumptions (Scenario 3)

Debt Finance Part	39.63%
Equity Finance Part	60.37%
Debt Finance Amount	5,218,435
Equity Finance Amount	7,948,872
Cost of Debt	8.64%
Debt Maturity (Years)	15
Cost of Equity	17.96%
Weighted Average Cost of Capital	14.27%
Technical Losses and Own Consumption	3%
Operating Costs (as a % of Revenue)	10%
Corporate Income Tax	15%
Property Tax	1%
Tariff Growth Rate	2%
Summer Tariff (Export) ($)	6.00
Summer Tariff (Local Market) ($)	0.65
Winter Tariff (Local Market) ($)	7.00
Reinvestment Rate (as a % of Net Profit)	10%
Exchange Rate $/₾	2.3
Cost of Construction (1 MW of Installed Capacity) ($)	1,727,049
Depreciation Period (Years)	50

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Taken into consideration the assumptions from Table 4a, the relevant Income Statement and Free Cash Flow to Firm for the Company for the next 10 years is the following:

Table 4b. Factual Information and Assumptions (Scenario 3)

Period/ In Thousand USD	1	2	3	4	5	6	7	8	9	10
Revenue	0	0	2442	2491	2541	2592	2644	2696	2750	2805
Operating Costs	-230	-237	-244	-249	-254	-259	-264	-270	-275	-281
Operating Profit	-230	-237	2198	2242	2287	2333	2379	2427	2475	2525
Depreciation & Amortization	0	-185	-264	-264	-264	-264	-264	-264	-264	-264
Profit Before Interest and Tax	-230	-422	1934	1978	2023	2069	2116	2163	2212	2261
Interest Expenses	-634	-634	-634	-634	-634	-634	-634	-634	-634	-634
Profit Before Tax	-863	-1055	1301	1345	1389	1435	1482	1529	1578	1627
Tax Expense/Benefit	130	158	-195	-202	-208	-215	-222	-229	-237	-244
Net Profit	-734	-897	1106	1143	1181	1220	1260	1300	1341	1383

Table 4c. Factual Information and Assumptions (Scenario 3)

Period/ In Thousand USD	1	2	3	4	5	6	7	8	9	10
Profit Before Interest and Tax	-230	-422	1934	1978	2023	2069	2116	2163	2212	2261
Tax Expense/Benefit	130	158	-195	-202	-208	-215	-222	-229	-237	-244
Tax Shield on Interest	95	95	95	95	95	95	95	95	95	95
Depreciation & Amortization	0	185	264	264	264	264	264	264	264	264
Capital Expenditures	-3956	-9230	0	0	0	0	0	0	0	0
Free Cash Flow to Firm	-3961	-9214	2098	2135	2174	2212	2252	2292	2334	2376
Terminal Value (10 years)	18087									

Project IRR = 16.74% **Project NPV = 2,014**

Obviously, if **Scenario 1** assumptions are close to reality, a small HPP investment will be unprofitable and the current value of this project is negative. Consequently, the percentage of IRR is unacceptable because it is much lower than the Weighted Average Cost of Capital. **Scenario 2** is comparatively better for the investor as it offers a better picture/option but it is quite difficult to definitely know that from May to September (i.e. when the HPP generation reaches its peak) the company will be able to export electricity at 6 cents per kW/h. The only country that might be willing to purchase electricity at this price is Turkey. However, for the past two years the price of electricity has dropped in Turkey due to high volatility and devaluation of Turkish Lira and is around 5.2 cent currently – is reported at the current rate of 5.2 percent. **Scenario 3** is an ideal situation for investing in small HPPs, but it is quite optimistic that the newly constructed HPP will be able to sign a direct purchase agreement with ESCO at 7 cents per kW/h.

Sensitivity Analysis

Using Sensitivity Analysis, it can be observed which variables project NPV and IRR is most sensitive to and, thus, the change of which is the most risky. Table 5 below shows the sensitivity of the project NPV based on Tariff per kW/h and Construction Cost of 1 MW Installed Capacity.

Table 5. Sensitivity A

Tariff (cents) /Construction Cost of 1 MW Installed Capacity (USD)	1,250,000	1,750,000	2,250,000
4.00	(132,331)	(2,782,339)	(5,432,347)
5.00	1,430,880	(1,219,128)	(3,869,137)
6.00	2,994,091	344,082	(2,305,926)
7.00	4,557,301	1,907,293	(742,715)
8.00	6,120,512	3,470,504	820,495
9.00	7,683,723	5,033,714	2,383,706

It is evident from the table that the project is quite sensitive both for tariff change and construction cost change. If it is assumed that on average the company will be able to sell electricity for 6 cents per kW/h, it will have to monitor construction costs very rigorously in order to make the project remain beneficial.

Table 6 below demonstrates sensitivity of the project IRR based on Tariff per kW/h and Construction Cost of 1 MW Installed Capacity.

Table 6. Sensitivity B

Tariff (cents) /Construction Cost of 1 MW Installed Capacity (USD)	1,250,000	1,750,000	2,250,000
4.00	13.02%	7.94%	4.58%
5.00	16.69%	11.12%	7.44%
6.00	19.96%	13.95%	10.00%
7.00	22.96%	16.53%	12.32%
8.00	25.73%	18.91%	14.45%
9.00	28.33%	21.14%	16.44%

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Table7 below shows sensitivity of the project NPV based on Tariff per kW/h and Operating Expenses as a percentage of Revenue.

Table 7. Sensitivity C

Tariff (cents) /Operating Expenses (% of Revenue)	10%	20%	30%
4.00	(2,660,697)	(3,561,908)	(4,463,120)
5.00	(1,097,486)	(2,224,000)	(3,350,515)
6.00	465,725	(886,093)	(2,237,910)
7.00	2,028,935	451,815	(1,125,305)
8.00	3,592,146	1,789,723	(12,700)
9.00	5,155,357	3,127,631	1,099,905

Tight control of Operating Expenses will be of vital importance in this project. As shown in Sensitivity Analysis if Operating Expenses reaches 20% of Revenue, even with 6 cents per kW/h, project NPV will be still negative.

Table 8 shown below shows the sensitivity of the project NPV based on Tariff per kW/h and Operating Expenses as a percentage of Revenue:

Table 8. Sensitivity D

Tariff (cents) /Operating Expenses (% of Revenue)	10%	20%	30%
4.00	8.12%	6.24%	4.28%
5.00	11.32%	9.18%	6.95%
6.00	14.17%	11.78%	9.31%
7.00	16.77%	14.12%	11.42%
8.00	19.16%	16.27%	13.33%
9.00	21.40%	18.25%	15.09%

Expected NPV Criteria for Decision Making

In this case, expected NPV criteria are used in order to derive the optimal decision. The main question to be answered is whether there are any probabilities of Scenario 1, Scenario 2 and Scenario 3. Obviously, Scenario 3 is extremely optimistic and less likely and it is thought that the probability for this Scenario is low. Let use 0.2 (we can change this number later and discuss possible changes in decision). Scenario 1 and Scenario 2 are more realistic and for the beginning it is initially assumed that both have probability 0.4. Using QM for Windows program and Decision Making Methods described by Render (2012) and Evans (2016) the following result the following Decision Trees (Figures 2,3 and 4) have been obtained

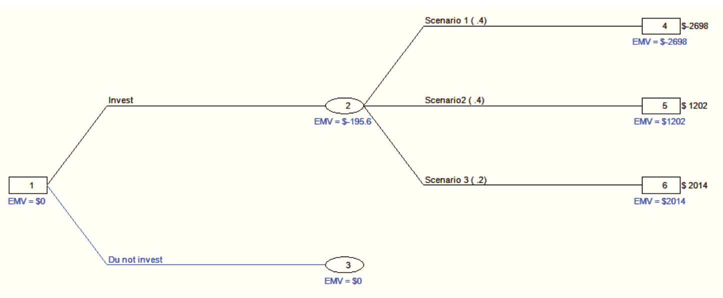

Figure 2. Decision Tree

As it is obvious from the table, the suggested decision is **"Do Not Invest".** If the expected probabilities are changed and the probability of Scenario 1 is 0.3 is considered, the probability of Scenario 2 is 0.4 and the probability of Scenario 3 is 0.3. Then the following outcome is observed:

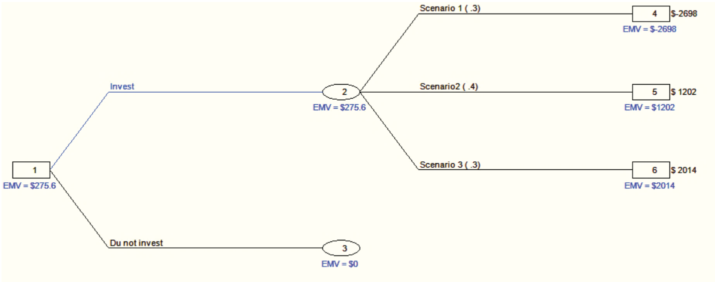

Figure 3. Decision Tree

As the diagram illustrates, the suggested decision is **"Invest".** If the probability of Scenario 1 is 0.2, that of Scenario 2 and Scenario 3 are 0.6 and 0.2, respectively, the following result is obtained:

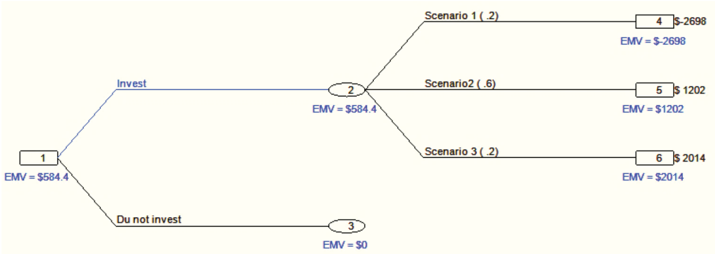

Figure 4. Decision Tree

As we see the suggested decision again is **"Invest"**.

In general, it can be seen, that if the probability of Scenario 1 is relatively large (like 0.4), then the decision is "Do Not Invest". If the probability of the Scenario 1 is relatively small (say no more than 0.3) then the decision is to "Invest". In any case, if the probability of Scenario 1 is no more than 0.308 (even the probability of Scenario 3, the "most optimistic", is 0), the suggested decision is to "Invest". This means that before making the decision the potential investor has to estimate the corresponding probabilities.

Conclusion

According to the above calculation and analysis, it is obvious that despite great potential, currently, it is quite risky to make investment in small HPPs in Georgia. If current prices remain unchanged, the project NPV will be negative and the investor will lose money. Undoubtedly, the Turkish electricity market plays a vital role in success of small HPP in Georgia. Turkey and Georgia have an inverse trend when it comes to electricity demand. In summer Turkey experiences shortage of electricity while surplus is observed in Georgia and vice versa. Using this factor will be beneficial if Turkey's electricity prices are higher than the prices offered by the Electricity Market Commercial Operator to small HPPs in Georgia.

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In our opinion, the potential investor should spend some time on making additional estimations and observe the market dynamics in the whole region. Sensitivity Analysis has also shown that the huge risk is not only related to the volatility of prices but also construction cost and potential amount of operating expenses. All these three factors require extensive attention from the investor.

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