

## **Hidroituango Hydro: Colombia's biggest infrastructure project at risk**

### **TEACHING CASE<sup>a</sup>**

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Hidroituango Hydropower Station, the biggest dam and most ambitious infrastructure project ever built in Colombia, <sup>[1]</sup> <sup>[2]</sup> faced a major crisis during the second quarter of 2018. <sup>[3]</sup> What started in the morning of April 28<sup>th</sup> as an abnormal but minor water level increase, turned into a significant incident during the first days of May, and later into a major crisis as June approached. During those turbulent days, hundreds of thousands of human lives were exposed to some sort of danger. Thus, every physical or economical effort coming from the developer of the project, Empresas Públicas de Medellín (hereinafter EPM), were focused on making the dam safe and stable since unpredictable events were still occurring. <sup>[4]</sup>

After a vigorous effort that involved not only thousands of people working together day and night on the construction of the dam, but also an investment of millions of dollars, the risk of a considerable incident was heavily reduced in June 18<sup>th</sup>, when the dam reached an elevation of 410 m a.s.l. (1328 f a.s.l.). <sup>[5]</sup> According to Javier Londoño de la Cuesta, EPM's CEO, by November that year, the risk of collapse was reduced to almost 0%. <sup>[6]</sup> <sup>[21]</sup> While the nation held its breath, not only EPM's engineers, workers and contractors, but also its financial team were working hardly facing multiple challenges. With on-field information, EPM's CFO Mr. Jorge Tabares and his team assessed the impact of the contingency for the project and the company. At that time, the main corporate question was not whether the project was likely to be completed safely (according to engineers, it was), but whether to continue with it or not, taking the financial aspects into account.

As the annual board meeting approached, Mr. Tabares was more than compelled to come with an answer. As in many aspects of life, the answer to be delivered to EPM's board had a binary nature (yes/no), but the process of getting to that answer was anything but binary. If Mr. Tabares advised to continue with the project, it had to remain clear that the project still had a positive value (or at least more value than if it

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<sup>a</sup> This case was prepared by Mateo Castaño-Sierra under the supervision of Professor Diego Restrepo-Tobón. The case was developed solely as the basis for class discussion. This case cannot be taken as endorsing or as a source of primary data or illustration of effective or ineffective management by either the authors or Universidad EAFIT.

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were to be cancelled). However, if the answer given to the board was negative, and in Tabares' view the project should be cancelled, it had to be clear enough that it was the best *bad* option. The implications of any of those decisions were very different and Mr. Tabares burdened a huge responsibility.

### ***Hidroituango Hydropower Station: A Brief History***

Hidroituango is an under-construction embankment dam supporting a hydropower station located in the Cauca River, in the northwest of Colombia. The dam is 225 m (738 f) high and has an approximate volume of 20 million cubic meters of water (5,283,441,047 US gallons). The hydropower station was projected to have an installed capacity of 2,400 megawatts (MW) and to provide up to 13,930 gigawatts hours (GWh) yearly, accounting for almost 15% of Colombia's total electricity generation capacity.<sup>[7]</sup> Hidroituango's capital expenses were evaluated in 3.049 BN USD (constant 2009). Construction of the dam and the hydropower station started in 2010, aiming to be finished by 2021.<sup>[8]</sup>

The Hidroituango Project is carried out by EPM, a Colombian multi-utility and second biggest company of the nation, fully owned by the city of Medellín. However, EPM is not the (major) owner of the project; the owner of the project is Hidroituango S.A. This society consists mainly of two shareholders who possess more than 97.1% of the company, and other minority shareholders who own less than 2.9% of the shares. The main shareholders are IDEA, a Colombian second floor bank fully owned by the regional Government of the department of Antioquia (whose capital is Medellín), which possesses 50.74% of the society shares, and EPM, with 46.33% of the shares.<sup>[9]</sup> EPM resulted as a partial owner and the total developer of Hidroituango due to a combination of social, economic and political factors, in which some of the nation's main personalities were involved. Despite that IDEA and EPM are two fully owned State companies, their owners, the regional Government of Antioquia and the city of Medellín, respectively, are not the same institutions. IDEA and EPM respond to different political views, which are not always aligned; for instance, corporate governance in EPM is much stronger than in IDEA.

Initially, in order to catch benefits from market competition, a public bidding process was initiated by Hidroituango S.A., intending to find a suitable developer for the project. Fourteen companies from all over the world showed their intention to participate and pre-qualified to the process; one of those was EPM. This situation bothered some of the other 13 pre-qualified corporations, because they felt, and with some reason, that EPM was judge and jury in the case. Additionally, politics took its place. Given the fact that Hidroituango is located in Antioquia, the main owners were from this department and the engineering studies were done by companies located there, Colombian President Álvaro Uribe (2002-2010), born and raised in Medellín, suggested to ponder if the project could be developed by a company from Antioquia, or at least from Colombia. EPM, which was the only domestic company that showed interest in

developing Hidroituango, was ultimately the biggest winner of this situation once the Society directly gave it the right to develop the project. EPM had beforehand intended to control Hidroituango S.A., but it came short; yet, at the end, the company gained the right to develop the project.<sup>d</sup>

Once EPM was entitled by Hidroituango S.A. to develop the project, the scheme to be used was a BOOMT contract (Build, Operate, Own, Maintain and Transfer). Under this scheme, a third party called the "Developer" (EPM) would finance, build, operate, maintain and own the hydropower station during a finite amount of time (in this case, 50 years), and after that lapse of time it would transfer again the hydropower station to the owners (Hidroituango S.A.).<sup>[8]</sup> A win-win situation was thus configured: the developer gains all the value coming from the operation of Hidroituango and the owner receives annual transfers from the developer's operation. The BOOMT contract stipulated that an initial 50% of the total amount of energy capacity had to be delivered to the markets by December 2018, while the total 100% must be achieved by 2021; construction and operation were constrained to achieve energy delivery goals. After EPM signed the energy contracts in the Colombian markets, more pressure on the deadlines arose: right from the beginning the project ran against time.

EPM intended to develop the project using a subsidiary company called EPM Ituango. This company (fully owned by EPM) was called to operate by means of a project finance figure; this figure is a single-purpose, highly Leverage Company which pays-off the initial investment and the big amortizations and interests by developing very positive net cash flows. To diminish the debt cost, EPM Holding was going to secure some but not all EPM Ituango's debt. Unfortunately, the project finance figure ended being financially ineffective, because EPM Ituango, unlike EPM Holding, wasn't able to gain the right to be exempted from paying part of the Income Tax and VAT. At the end, EPM Holding ended developing Hidroituango as a corporate finance project.<sup>[10]</sup>

As mentioned, Hidroituango's schedule changed during mid-2018 due to the extensive accidents in two of the three river deviation tunnels. By the time of the mishaps, project completion had reached 80%. These accidents impacted several aspects of the project, leading to drastic measures taken by Hidroituango's Project Manager, Luis J. Vélez. The measures taken by him were intended to protect, firstly, human lives at risk and, secondly, to preserve the engineering viability of the hydropower station. Thankfully, both goals were achieved: there were no dead or injured people and the project was believed to be viable from an engineering perspective. Nevertheless, *in extremis* success came with a price, which was calculated by both, the engineering and the financial teams, in over 7,000 BN COP (2.3 BN USD).<sup>[11]</sup> Impacts in CAPEX, other expenses and the projected income changed considerably the financial optics of the project. One

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<sup>d</sup> To better understand the essence of Hidroituango, authors recommend reviewing *Del Sueño a la realidad: Pescadero - Ituango "José Tejada Sáenz", 1969-2011*.<sup>[7]</sup> This book overviews the whole history of the project, from its conception in the 50s until the 2010s, when it was started to be built.

major milestone (to release the first 1,200 MW of capacity) was not achieved in December 2018, because of the already mentioned construction contingencies. Project completion was expected to have a delay of at least three years (until 2024), and the first 1,200 MW of capacity were expected to be launched in 2021. <sup>[12]</sup>

*EPM Group: Colombia's biggest multi-utility company*

EPM Group is a Colombian multinational holding, with operations in more than seven American and European countries and assets valued in more than 52,000 BN COP (16 BN USD approx.). EPM Group business' lines include electric energy, natural gas, water and sewer service, garbage disposal and information and communication technologies. In 2012, the EPM Group established a BHAG (Big Hairy Audacious Goal), which pretended to achieve an EBITDA = 12,500 BN COP by 2025. Given the fact that during 2012 EPM Group generated an EBITDA = 3,750 BN COP, the Holding needed to increase EBITDA by 233% between 2012 and 2025 to achieve the proposed BHAG. In annual terms, EBITDA had to increase at a CAGR of 11.9% during 13 years to reach 12,500 BN COP by 2025. <sup>[13]</sup> It must be noted that EPM is a company which is part of the EPM Group; in fact, EPM develops most of the investments that the EPM Group delivers in Colombia.

***Project Finance vs. Corporate Finance: Leverage and Cost of Capital***

Project finance and corporate finance differ in many ways. Project finance technique typically corresponds to projects with two main characteristics: i) huge leverage comes through a SPV (Special Purpose Vehicle), managed by the developer; ii) financing sources change through times; during the construction phase, short-term debt is issued using banking companies, and when operation takes place, those loans are replaced with long-term bonds.

In project finance, loans are not warranted by assets or holding's FCFF (Free Cash Flow to the Firm) rather than the own project's FCF (Free Cash Flow). Changes in financing sources through time capture how risk changes: initially, without the asset being completed, risk is bigger and, thus, loans are stricter; then, as the asset becomes operative, risk diminishes, making easier to issue long-term debt. Hidroituango was conceived to be leveraged by this sort of financing structure through a subsidiary company called EPM Ituango. However, project finance came to be ineffective as EPM Ituango was not able to have the same tax shield that the EPM Holding had. EPM weighted the pros and cons of the project finance structure; according to internal calculations, using project finance rather than corporate finance would make the investment in Hidroituango 370 million USD more expensive. <sup>[10]</sup> The conclusion was that project finance resulted to be more expensive but less risky than corporate finance. Having into account this information, the decision of the board was to carry on with Hidroituango using corporate finance structure; thus, a clear trade-off between value and risk was settled. But two questions arose once the contingency occurred in 2018:

¿How big was the trade-off between value and risk? ¿How is it going to impact the project now?

**Table 1.** Project Finance vs. Corporate Finance

Project finance	CAPEX + 370 USD M Subordinated debt to the Holding = 70% More cost of capital
Corporate finance	Subordinated debt to the Holding = 100% (the project debt is the Holding's debt) Less cost of capital

Source: author’s elaboration.

The cost of capital of the project was constructed using the Holding’s financial statement, macroeconomic information and benchmark data, as may be seen in Figure 1, Figure 2, Figure 3, Table 2, Table 3 and Table 4.

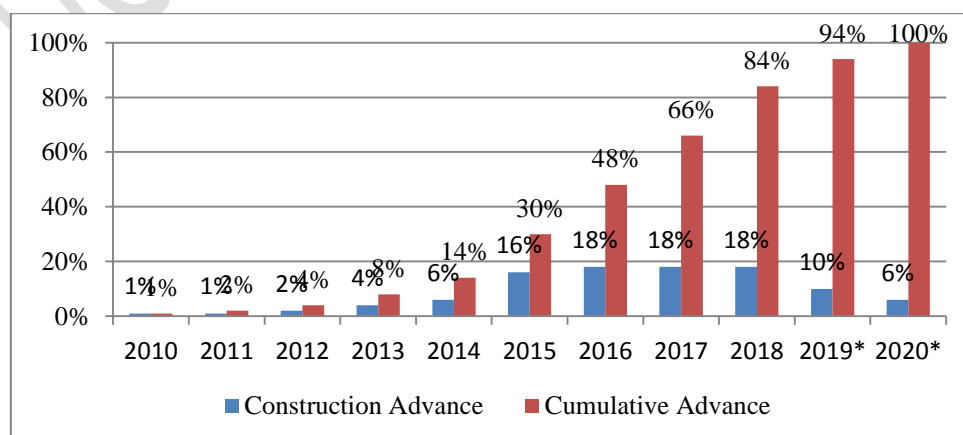
**Base Case Scenario vs. Contingency Case Scenario**

During the contingency, Mr. Tabares and his team established two stages of comparison: Base (or zero) case scenario and Contingency (or 1) case scenario. Base case scenario intended to reflect how the project was before the contingency took place, and Contingency case scenario was intended to show how the project changed due to the contingency. The purpose of this comparison was to quantitatively understand how much the project worsened because of the contingency. The items of comparison were Net Present Value (NPV) in the 2009 and the 2018 terms, Internal Rate of Return (IRR) and Equity Value.

**Capital Expenditures**

Capital expenditures of the project in the Base case scenario were evaluated by EPM in 3,049 USD M in 2009. Construction would start in 2010 and would finish in 2020.

**Figure 1.** Construction progress, Base case scenario

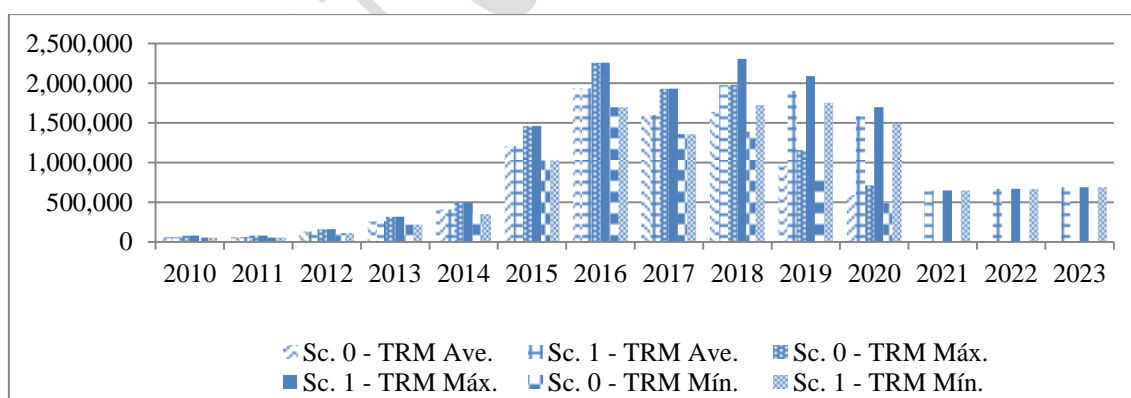


Source: author’s elaboration.

However, Colombia’s currency is the Colombian Peso (COP), and this meant that the COP/USD exchange rate affected CAPEX value in COP terms, the currency in which EPM has most of its income. Additionally, the COP/USD volatility was huge during 2009, denoting there was not much certainty related to know how much was CAPEX value in COP terms. To assess that volatility, EPM created three CAPEX scenarios: one in which the COP/USD exchange rate was the average for the year (2,153 COP/USD), and the two others using maximum (2,596 COP/USD) and minimum (1,825 COP/USD) for the year (see Figure 2).

Additionally, CAPEX value changed not only during 2009 but also from that year forward. Given the fact that it included domestic and imported goods, correction of CAPEX value through time included inflation and devaluation (see Figure 2; also, CAPEX and Depreciation in the three COP/USD schemes of the Base case scenario may be seen in Table 7, Figure 2 and Table 8). In current prices, CAPEX varied from 7,578 COP BN to 10,621 COP BN. <sup>[14]</sup> According to calculations, contingency increased CAPEX in more than 3,000 COP BN (2018) and supposed additional 1,000 COP BN (2018) in other expenses (social and economic issues). <sup>[15]</sup> Besides, construction times increased around three years more, until 2024 (CAPEX and Depreciation in the three COP/USD schemes of the Contingency case scenario may be seen in Table 7, Figure 2 and Table 8). In current prices, CAPEX varied from 11,850 to 14,860 COP BN.

**Figure 2. CAPEX (COP M)**



Source: author’s elaboration.

### *Debt and Construction Loans*

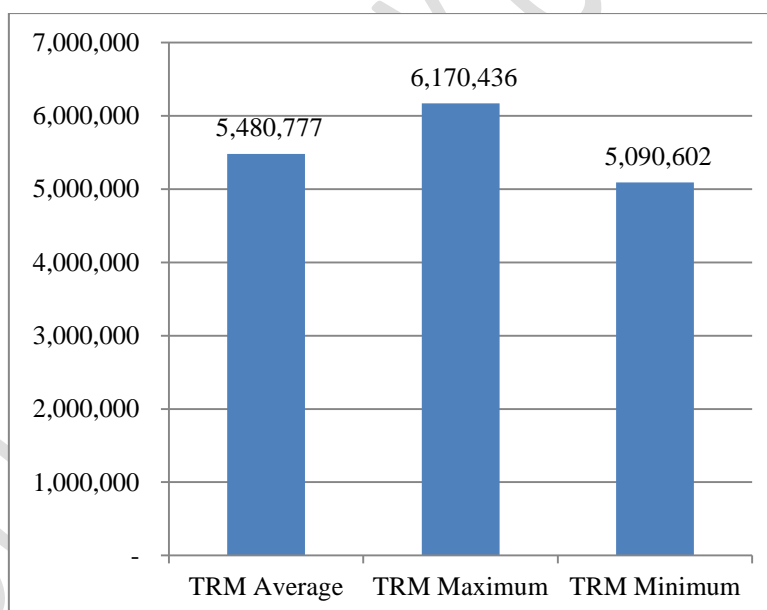
Hidroituango is partially financed by debt issued with international banks. Five loans were contracted until 2016 to raise the capital needed to develop the dam and the hydropower station. <sup>[16] [17] [18] [19] [20]</sup>

**Table 2.** Hidroituango Construction Loans

Issuer	Amount (USD)	To HI (%)	Total to HI (USD)
InterAmerican Investment Corporation (IIC)	550,000,000	100	550,000,000
EDC	300,000,000	45	135,000,000
BNDES	111,400,000	100	111,400,000
Seven Banks Consortium	1,000,000,000	100	1,000,000,000
Total	1,961,400,000	92	1,796,400,000

Source: author's elaboration.

As COP/USD exchange rate changed during 2016, debt in COP terms changed as well. Figure 3 shows these changes using average (3,051 COP/USD), maximum (3,435 COP/USD) and minimum (2834 COP/USD) exchange rate for the year. Debt was not supposed to grow once the contingency took place as long as debt covenants prevented EPM to do so.

**Figure 3.** Hidroituango Project Debt (COP M, 2016)

Source: author's elaboration.

### *Project's Gross Income: First Line in the Income Statement*

Colombia's energy market involves both free-market prices and regulated prices. The latter are established for household internal consumption; in opposition, free market prices are established for the productive sector, including industry, commerce, Government, etc. On top of that, there are special energy contracts called "Reliability Charges". These contracts guarantee to deliver energy to the market at specific periods

of time regardless of any environmental, economic or social conditions. During 2018, spot energy prices reached an average of 288.90 COP/kWh, with a 30% annual volatility.

Long-term energy inflation is expected to reach an average of 3% over the next 30 years. As in CAPEX case, three energy prices schemes or scenarios were configured, given energy price volatility (Table 3).

**Table 3.** Spot Energy Prices 2018 (\$/kWh)

Spot Energy Price 2018 (\$/kwh)	
High prices	375.58
Low prices	202.23
Average prices	288.90

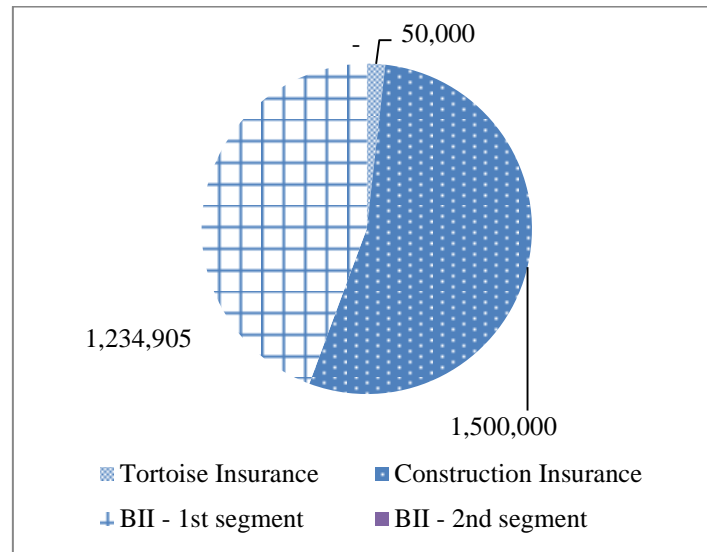
Source: author’s elaboration.

Due to the demand of energy, Hidroituango was not expected to work 24/7. In fact, studies on demanded energy had indicated that Hidroituango was designed to work effectively only around two-thirds of the time during the year.<sup>[7]</sup> In relation to Gross Income, the biggest difference between the Base and the Contingency case scenarios is that in the first, energy started being produced by December 2018 and would be fully operative by 2021, and in the second, it was expected to start to produce energy in 2021 and being fully operative by 2024.

### *Insurances*

Three types of insurances were contracted by EPM once construction started. The first was a small *tortoise* insurance. This tortoise insurance covered only up to 50,000 COP M (around 16 USD M), and was supposed to be used to shield some of the additional expenses caused by the contingency. Additionally, a big 2,500 USD M construction security was hired to prevent losses from events such as those that occurred. This insurance only covered additional capital expenses. EPM’s intentions were, obviously, to use this security, but it remained unclear how much of the additional CAPEX was plausible to be paid by the insurance company; on top of that, that payment, if made, would only be paid until 2021. Finally, a loss of profit or Business Interruption Insurance was paid. This BII, which covered up to 628 USD M, was split in two segments: the first covering up to 380 USD M of loss of profit until 2021, and the second covering up to 248 USD M of loss of profit from 2021 forward<sup>[12] [22]</sup> Given the nature of the contingency, the most plausible outcome was to receive a full payment from the first segment and no payment from the second.

**Figure 4.** Plausible Net Insurances to be received until 2021 (COP M)



Source: author's elaboration.

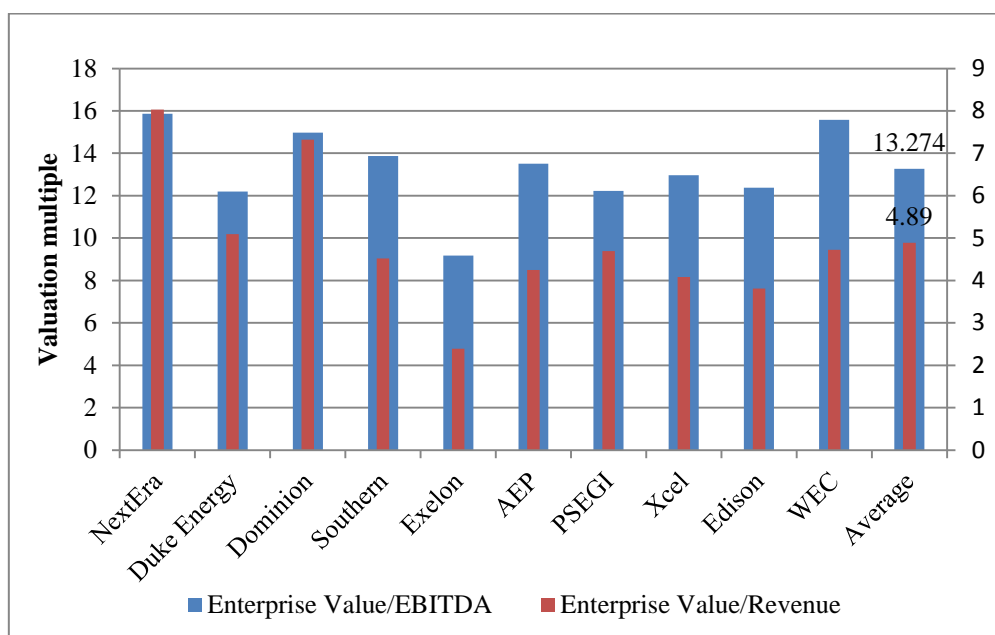
#### *Valuation Multiples: Comparable Utility Companies*

As mentioned, the Hidroituango Project is not itself a separate company; actually, it is an asset inside EPM Holding. Even so, it is relevant to know how much does Hidroituango's Equity value. For this, valuation multiples from comparable utility companies become useful (see Figure 5 and Table 9).

#### *Income Statement and Cash Flow*

Income statement is decisively needed to understand how net profit is gained from the operation of the hydropower. And cash flow allows observing how much cash is generated by the project. Both income and cash flow statements have the clues to value Hidroituango. However, the nature of valuing an asset is better expressed in probabilistic terms rather than in deterministic ones; that explains why three COP/USD scenarios and other three energy prices were projected. It's easier to think a project or an asset possessing a specific value in a specific moment of time; yet, it is more realistic, and somehow harder, to think value in terms of a variable fluctuating in a reasonable range (Table 10 and Table 11 show income and cash flow statements of the project in the Base case scenario when energy prices are high and COP/USD is in average terms). Additional eight scenarios were needed to be constructed in order to come with a project valuation calculated in probabilistic terms. And nine scenarios altogether define the probability matrix that is used to calculate project value. Using Bayesian conditioning, a probability matrix is shown in Table 4. However, different weighted probability matrixes are plausible.

**Figure 5.** Valuation Multiples from Comparable Utility Companies



Source: author’s elaboration.

**Table 4.** Probability Matrix

		Income Scenario (%)		
		Low prices	Average prices	High prices
CAPEX Scenario	TRM Maximum	15	20	15
	TRM Average	10	15	10*
	TRM Minimum	5	5	5%

\*Scenario projected in Table 11 and Table 12.

Source: author’s elaboration.

*Contingency Case Scenario: How do Income and Cash Flow statements change?*

Key financial aspects are redefined in the contingency case scenario: more capital expenditures, income starts to come later, insurance payments, etc. These facts change the income and cash flow statements, thus altering the value of the project. According to Mr. Vélez, due to the contingency, Hidroituango was expected to increase its CAPEX by 3,000 COP BN (almost 1 USD BN), to be invested between 2019 and 2023. Additional social and economic expenses not related with CAPEX accounted for 1,000 COP BN (more than 300 USD M), and were projected to be invested between 2018 and 2020. As CAPEX and other expenses increased, the income was reduced and the insurances were projected to be partially paid; thus, the overview of the project became different from the Base case scenario.

**Conclusions, Questions & Answers**

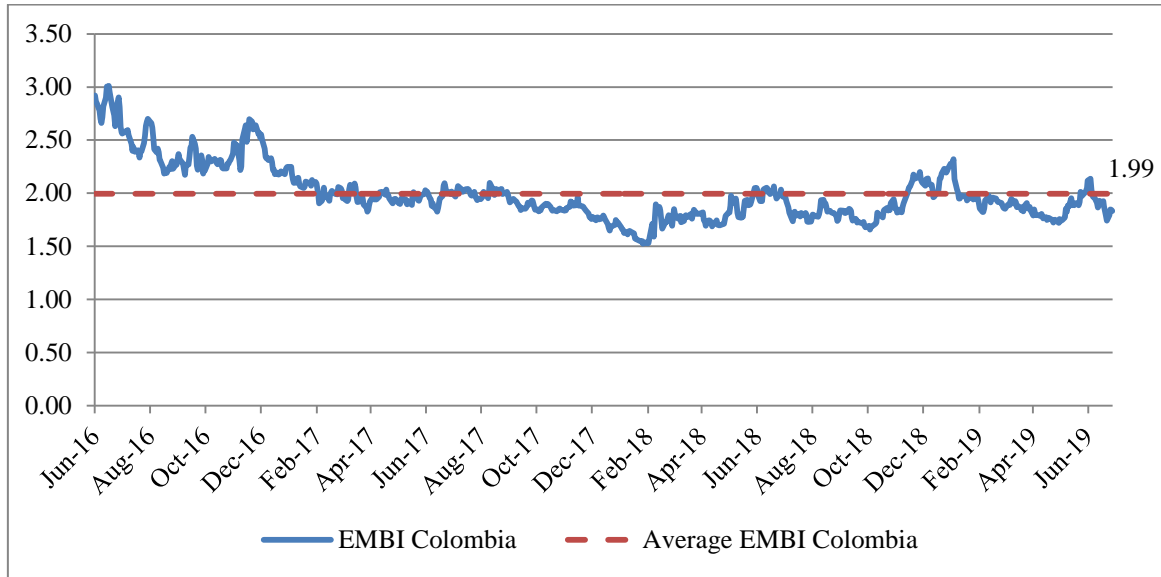
The gap between the initial budgeting and contingency forecasting is the ground where questions and answers lie. At the outset, was the project a good investment? How much

was then its Net Present Value? And its Internal Rate of Return: how did it compared to the WACC? How much did the Equity Value?

And afterwards: how did the projected income statement change after the contingency? How much was then its Net present Value? And it's Internal Rate of Return? Did the WACC change? How much did the Equity Value? Which was the project's probability to have a NPV < 0 in both the Base and the Contingency case scenarios? Was IRR < the WACC? Were there major differences between the Base and the Contingency case scenarios? Should Mr. Tabares had advised to continue with Hidroituango or should he have advised against it? Must be noticed that EPM's board and executive directors, including CEO and CFO, are public servants, and are constrained not only to civil law but also to administrative law. Legal and administrative constraints make decision makers to be more cautious when making a choice related to Hidroituango. At the end of the day is hard to explain to control agencies certain financial issues, particularly difference between value and equity.

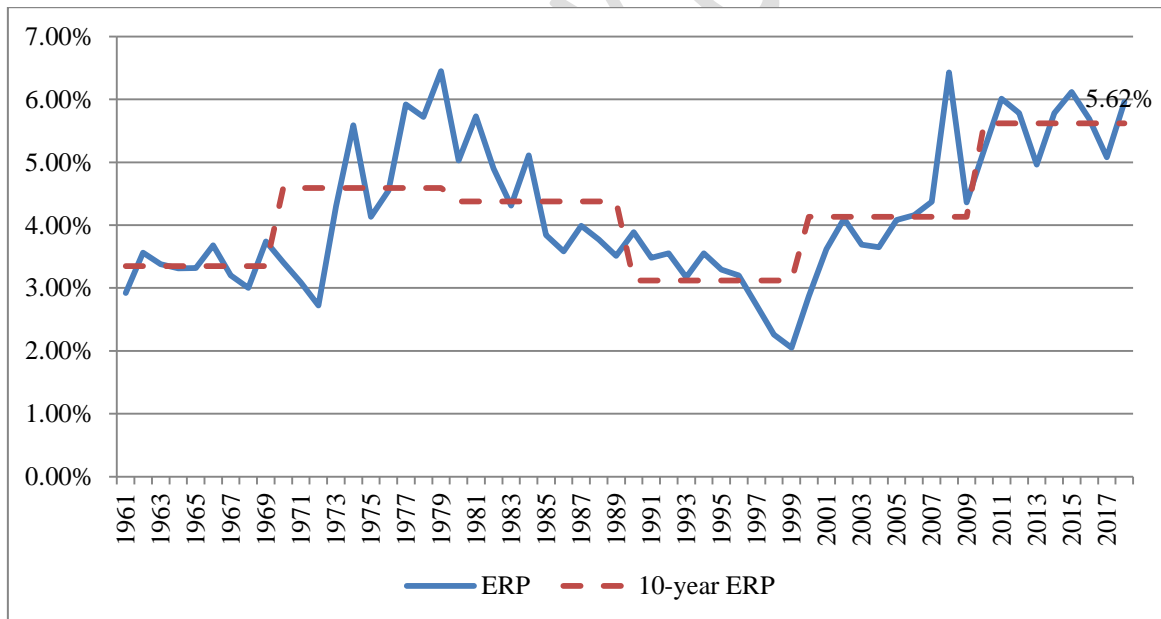
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**Figure 6.** Country Risk Premium (1 pct. equals to 100 basic pts.)



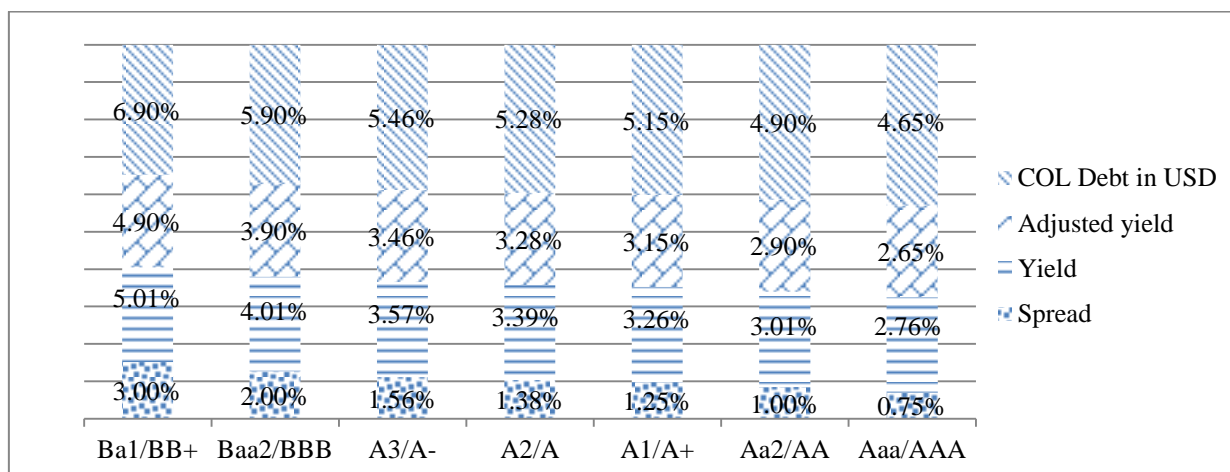
Source: J.P. Morgan.

**Figure 7.** ERP: Equity Risk Premium (1 pct. equals to 100 basic pts.)



Source: Damodaran.

**Figure 8.** Debt Cost for Market Firms with Market Cap > 5 BN USD



Source: Damodaran and Standard & Poors.

**Table 5.** Macro and Microeconomic Data

Long-Term Inflation	
Colombia	3.04%
United States	2.24%
Nominal Long-Term GDP per Capital Growth	
Colombia	4.77%
United States	3.16%
EPM Interest Coverage Ratio	~ 2.7
yield 10-yrs USA	2.01%
$p$ : Default probability	0.18%
$L$ : Debt never paid	60.00%
EPM Debt weight	55.00%
EPM Equity weight	45.00%

Source: author's elaboration.

**Table 6.** Comparable Stocks

Stock	Historial Beta Equity	Market Cap or Equity (USD in Bn)	Debt (USD in Bn)
EIX*	0.41	21.90	19.72
DUK	0.38	64.18	61.78
D*	0.46	62.02	42.96
SO*	0.31	57.52	50.01
EXLLF	0.16	73.52	-3.86
AEP*	0.45	43.43	27.38
PEG	0.55	29.72	15.55
XEL	0.41	30.62	18.91
ED	0.31	28.68	20.86
WEC	0.42	26.30	11.89

\* Electric utilities (central), like Hidroituango

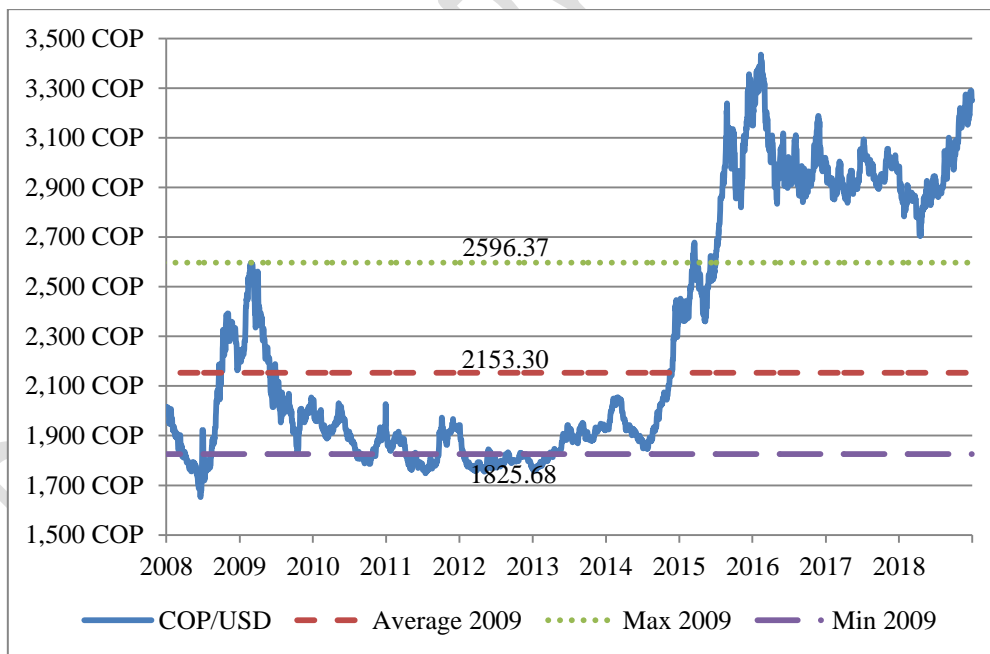
Source: author's elaboration.

**Table 7.** Interest Coverage Ratio and Debt Rating

If Interest Coverage Ratio is		Rating is	
> to	≤ to		
-	100,000	0.20	D2/D
0.20	0.65		C2/C
0.65	0.80		Ca2/CC
0.80	1.25		Caa/CCC
1.25	1.50		B3/B-
1.50	1.75		B2/B
1.75	2.00		B1/B+
2.00	2.25		Ba2/BB
2.25	2.50		Ba1/BB+
2.50	3.00		Baa2/BBB
3.00	4.25		A3/A-
4.25	5.50		A2/A
5.50	6.50		A1/A+
6.50	8.50		Aa2/AA
8.50	100,000		Aaa/AAA

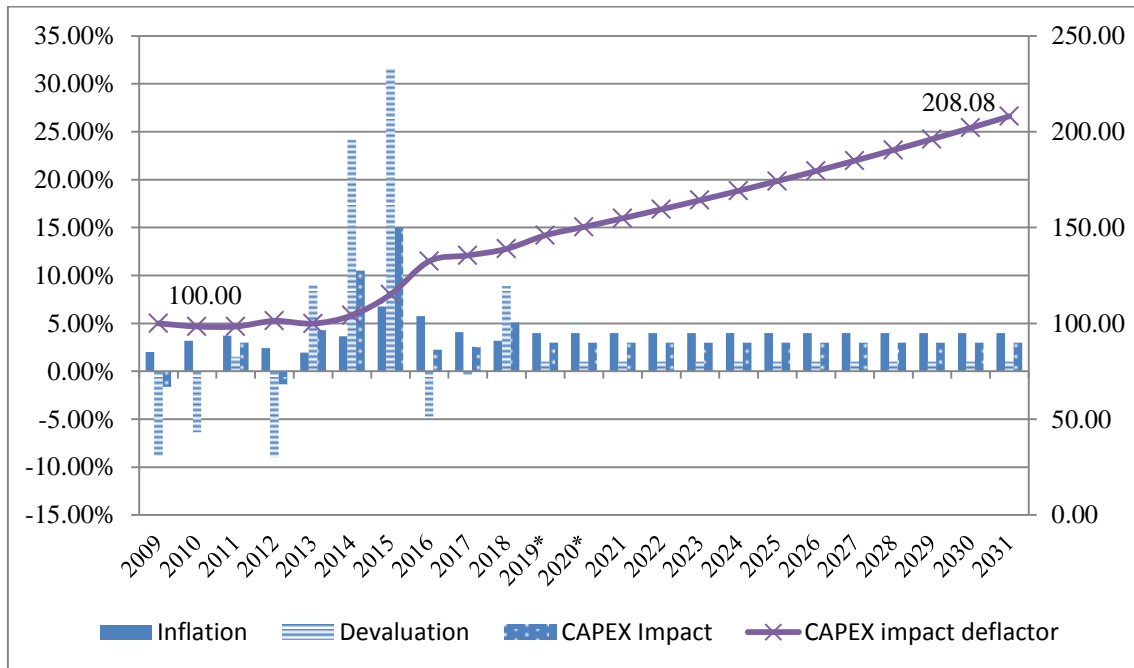
Source: author's elaboration.

**Figure 9.** Exchange Rate COP/USD



Source: author's elaboration.

**Figure 10.** Inflation and Devaluation, real (2009-2018) and projected (2019-2031)



Source: author’s elaboration.

**Table 8.** Valuation Multiples from Comparable Utilities

Public Company	Enterprise Value/EBITDA	Enterprise Value/Revenue
NextEra	15.86	8.03
Duke Energy	12.19	5.09
Dominion	14.98	7.32
Southern	13.87	4.52
Exelon	9.18	2.39
AEP	13.51	4.25
PSEGI	12.23	4.69
Xcel	12.97	4.08
Edison	12.38	3.81
WEC	15.57	4.72
Average	13.274	4.89
Top (90% confidence interval)	16.53	7.60
Min (90% confidence interval)	10.02	2.18

Source: author’s elaboration.

**Table 9. CAPEX/OPEX (COP M)**

	Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
<b>Base Case Scenario</b>	<b>TRM Average</b>	64,586	64,579	133,013	262,381	410,421	1,209,294	1,935,318	1,600,646	1,641,301	958,217	592,176	479,802	494,194	509,019	524,288	540,015	556,214	572,898
	<b>TRM Maximum</b>	77,875	77,868	160,382	316,370	494,871	1,458,124	2,257,405	1,930,003	1,979,022	1,155,384	714,025	574,411	591,641	609,389	627,668	646,497	665,890	685,864
	<b>TRM Minimum</b>	54,759	54,754	112,775	222,461	347,977	1,025,303	1,697,160	1,357,113	1,391,582	812,427	502,078	409,846	422,140	434,803	447,846	461,280	475,117	489,369
<b>Contingency Case Scenario</b>	<b>TRM Minimum</b>	54,759	54,754	112,775	222,461	347,977	1,025,303	1,697,160	1,357,113	1,724,915	1,754,226	1,491,785	649,434	668,915	688,981	640,888	660,113	679,915	700,310
	<b>TRM Average</b>	64,586	64,579	133,013	262,381	410,421	1,209,294	1,935,318	1,600,646	1,974,634	1,900,016	1,581,883	649,434	668,915	688,981	710,844	732,168	754,130	776,752
	<b>TRM Maximum</b>	77,875	77,868	160,382	316,370	494,871	1,458,124	2,257,405	1,930,003	2,304,099	2,088,717	1,694,835	649,434	668,915	688,981	804,068	828,187	853,031	878,619

 OPEX  
 CAPEX

Source: author's elaboration.

**Table 10. Depreciation (COP M)**

	Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
<b>Base Case Scenario</b>	<b>TRM Average</b>	197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154
	<b>TRM Maximum</b>	236,030	236,030	236,030	236,030	236,030	236,030	236,030	236,030	236,030	236,030	236,030	236,030	236,030
	<b>TRM Minimum</b>	168,409	168,409	168,409	168,409	168,409	168,409	168,409	168,409	168,409	168,409	168,409	168,409	168,409
<b>Contingency Case Scenario</b>	<b>TRM Average</b>			292,091	292,091	292,091	292,091	292,091	292,091	292,091	292,091	292,091	292,091	292,091
	<b>TRM Maximum</b>			330,397	330,397	330,397	330,397	330,397	330,397	330,397	330,397	330,397	330,397	330,397
	<b>TRM Minimum</b>			263,346	263,346	263,346	263,346	263,346	263,346	263,346	263,346	263,346	263,346	263,346

Source: author's elaboration.

**Table 11.** Income Statement - Base Case Scenario: High Prices and TRM Average

CAPEX scenario: **TRM Average**

Income scenario: **High Prices**

			2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027		
Spot Price	(\$/kWh)	<i>Changes according to energy prices</i>											386.84	398.45	410.40	422.71	435.39	448.46	461.91	475.77	490.04		
Installed Capacity	MWh												1200	1200	2400	2400	2400	2400	2400	2400	2400	2400	
Effective Capacity	%												67.00%	67.00%	67.00%	67.00%	67.00%	67.00%	67.00%	67.00%	67.00%	67.00%	67.00%
Hours in a year	hr.												8760	8760	8760	8760	8760	8760	8760	8760	8760	8760	8760
Income	M COP												2,724,547	2,806,283	5,780,944	5,954,372	6,133,003	6,316,993	6,506,503	6,701,698	6,902,749		
COGS	\$/kWh	<i>Changes according to energy prices</i>											61.80	63.65	65.56	67.53	69.56	71.64	73.79	76.01	78.29		
COGS	M COP												435,260	448,318	923,534	951,240	979,778	1,009,171	1,039,446	1,070,629	1,102,748		
Gross Profit	M COP												2,289,287	2,357,966	4,857,409	5,003,131	5,153,225	5,307,822	5,467,057	5,631,069	5,800,001		
Gross Margin	%												84.02%	84.02%	84.02%	84.02%	84.02%	84.02%	84.02%	84.02%	84.02%	84.02%	
EBITDA Margin <sup>e</sup>	%	<i>Fixed</i>											50.00%	50.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%	
EBITDA	M COP												1,362,273	1,403,142	3,468,566	3,572,623	3,679,802	3,790,196	3,903,902	4,021,019	4,141,649		
Depreciation	M COP	<i>Changes according to COP/USD exchange rate</i>											197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154	197,154	
EBIT	M COP												1,165,119	1,205,988	3,271,412	3,375,469	3,482,648	3,593,042	3,706,748	3,823,865	3,944,495		

<sup>e</sup> EBITDA Margin = 50%.

Hidroituango Hydro: Colombia's biggest infrastructure project at risk

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
EBIT Margin	%											42.76%	42.97%	56.59%	56.69%	56.79%	56.88%	56.97%	57.06%	57.14%
EBT	M COP											701,715	742,583	2,808,008	2,912,065	3,019,244	3,129,638	3,243,344	3,360,461	3,481,091
EBT Margin	%											25.76%	26.46%	48.57%	48.91%	49.23%	49.54%	49.85%	50.14%	50.43%
Net Profit	M COP											526,286	556,938	2,106,006	2,184,049	2,264,433	2,347,228	2,432,508	2,520,345	2,610,818
Net Profit Margin	%											19.32%	19.85%	36.43%	36.68%	36.92%	37.16%	37.39%	37.61%	37.82%

Source: D. Mercado (2017: 1-5).<sup>[14]</sup>

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**Table 12.** Cash Flow - Base Case Scenario: High Prices and TRM Average

CAPEX scenario: **TRM Average**

Income scenario: **High Prices**

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
CAPEX	M COP	64,586	64,579	133,013	262,381	410,421	1,209,294	1,935,318	1,600,646	1,641,301	958,217	592,176	177,439	182,761	188,244	193,890	199,706	205,697	211,867
New Debt	M COP	54,808	54,808	164,423	274,039	822,116	1,096,155	1,644,233	1,370,194	-	-	-	-	-	-	-	-	-	-
Debt Percentage		1.00%	2.00%	5.00%	10.00%	25.00%	45.00%	75.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Total Debt	M COP	54,808	109,616	274,039	548,078	1,370,194	2,466,349	4,110,582	5,480,777	5,480,777	5,480,777	5,480,777	5,480,777	5,480,777	5,480,777	5,480,777	5,480,777	5,480,777	5,480,777
Interest	M COP																		
CAPEX + Interests	M COP																		
NWOC: Net Working Operating Capital (2010-2018)	M COP																		
Changes in NWO NOPLAT	M COP																		

Cash	% Income	8.00%
Accounts Receivable	Days	90.00
Accounts Payable	Days	60.00
<b>OTHER ASSUMPTIONS</b>		
Debt/CAPEX (project)		51.60%
Taxes		25.00%
g: Long Term Growth		3.00%
EBITDA Margin (first years)		50.00%
Plus EBITDA MARGIN (last years)		10.00%

Source: author's elaboration.

### Endnotes

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