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VAPE STORE: PRODUCE IN HOUSE OR OUTSOURCE?

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Abstract

Vape Store, a French private firm selling electronic cigarettes and derived products is getting prone to online cheaper competition. The company makes most of its revenue through outsourced e-liquids and is wondering if producing them in-house could lower sale prices without lowering its margins. The methodology used to evaluate this project against the outsourcing solution was the Discounted Cash Flow analysis. The Comparable Company Analysis as well as CAPM were used to estimate Vape Store's beta and cost of equity. Results show that producing e-liquids in-house is more profitable than outsourcing and that the company should launch the project.

Keywords:

e-liquid manufacture, inhouse e-liquid production, e-cigarette, e-liquid, vaping, e-liquid price elasticity

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1. INTRODUCTION

Vape Store is the leader in the sales of electronic cigarettes on the French Riviera. Founded in 2013, the company quickly expended, now owning over 9 shops as well as two websites. With the continuously rising prices of tobacco and rising health awareness, people are more and more seeking for tobacco alternatives. However, the company is facing fierce competition from cheaper online websites, arising one question: Should the company start producing its own e-liquids to offer lower prices and cope with competition?

2. THE RESEARCH PROCESS

2.1 The e-liquid market

The business model comes from the razor and blade model, where the company makes money mostly from the sales of consumables (e-liquids) rather than on hardware. The company sells on average 290,000 bottles of e-liquid a year, representing over 55% of its total sales. Vape Store currently outsources all its products from various brands and suppliers. The hardware mostly comes from China whereas 90% of the liquids sold in stores are French with the remaining 10% coming from the European Union or the United States.

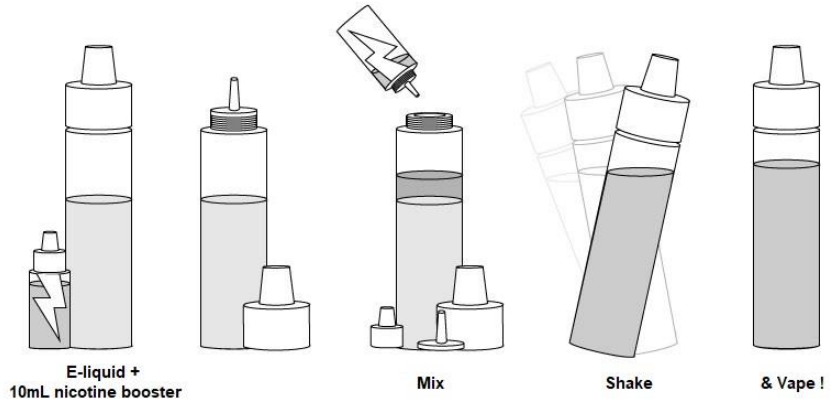
Vape Store's philosophy is to offer good quality products to its customers, especially when it comes to e-liquids. However, it turns out that the company is more and more subject to Asian and online competitors. Clients are more price-sensitive and it is hard to lower sale prices when suppliers are not willing to lower their margins. For example, the average recommended price for a 10mL French e-liquid is around 5.90€. Vape Store buys on average at 1.50€ and resell at around 5.00€. Meanwhile, Asian liquids would sell around 3.00€.

2.2 The legal framework

Regulations for the production of e-liquids containing nicotine are tough and expensive. Liquids are subjects to a lot of controls, and it is hard to get the authorization to enter the market. In France, the maximum authorized concentration in nicotine is 20mg/mL and bottles of e-liquid containing nicotine should not exceed 10mL. In store, 10mL bottles comes in different nicotine concentration:

- 0mg/mL (no nicotine)
- 3mg/mL
- 6mg/mL
- 12mg/mL
- 18mg/mL

A way to overcome those heavy regulations is by producing “mix & vape” liquids. Those do not contain nicotine and come in bigger bottles (usually 60mL). They are filled partially with liquid, leaving space to add a 10mL flavorless nicotine booster. For example, by mixing a 10mL 18mg/mL booster with a 50mL liquid, the customer gets a 60mL 3mg/mL bottle.



Regulations to produce those “mix and vape” liquids in France are softer, they need some paperwork but no laboratory tests. Producers must fill out forms and upload them on the INRS,

(the National Research and Safety Institute for the Prevention of Occupational Accidents and Diseases) website to register all their "recipes". All formulations should also have a Safety Data Sheet available on demand for every customer who might ask. Costs associated to the registration to this online platform are about 150€ per year.

2.3 In-house production, a good alternative?

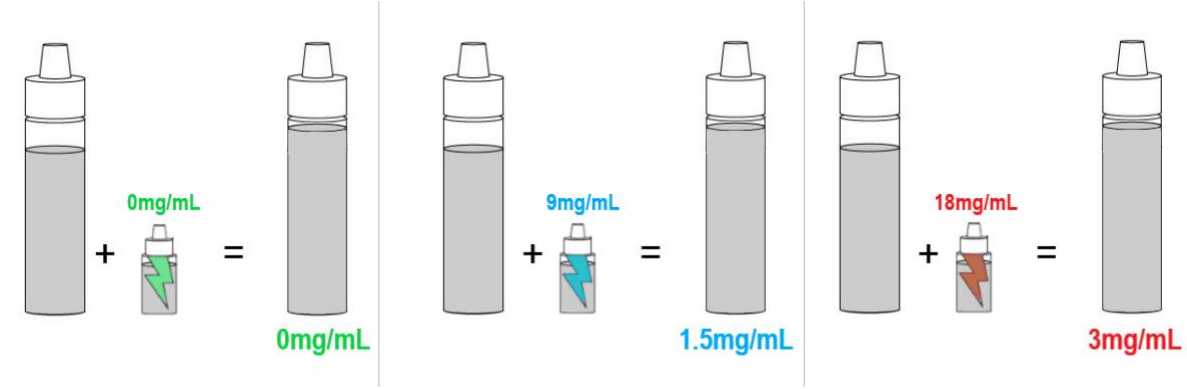
By launching its own brand of e-liquid, Vape Store could differentiate from its competitors by offering unique products that its customer will not find anywhere else. Investing in new projects is also a great way to prove to its clients that the company is strong and keen on building long lasting trust with them, while discouraging competitors from opening new shops in the area. It could also be a way to become autonomous and more flexible, adapting production and new flavors to trends and demand. Finally, it could help reduce waste that the company faces from buying from suppliers. Indeed, suppliers require minimum quantities and as liquids go bad after 2 years, Vape Store currently faces a lot of waste inventories. This topic will be covered in further section *3.5 End of year inventories*.

If this idea looks attractive on paper, it is important to be aware of the uncertainty of it. Not only it is hard to predict how customers will react to those new liquids or how to make them switch but is it really more profitable for the company? Furthermore, launching this project would add up more workload on founder's plate and imply big adjustment in logistics as well.

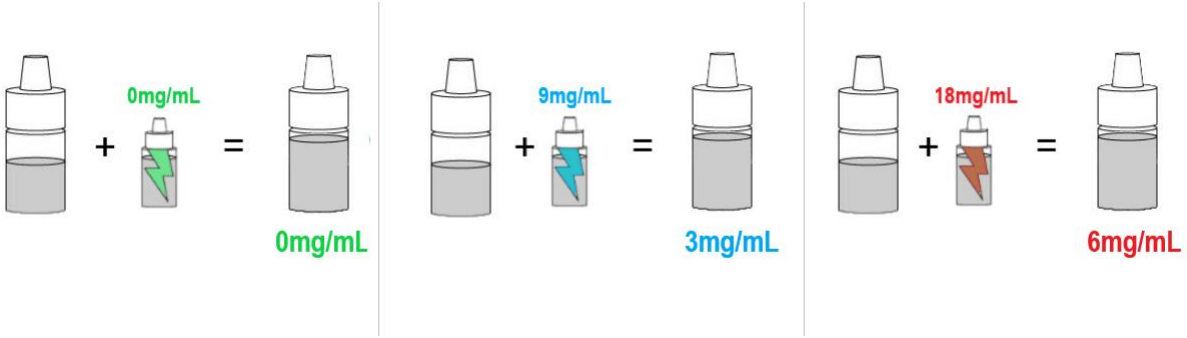
The idea is to launch e-liquids in two formats: 30mL and 60mL bottles. In each bottle, a gap of 10mL must be left free to add the nicotine booster. The company would offer liquids in 0mg/mL, 3mg/mL and 6mg/mL of nicotine. Those three nicotine concentrations combined amounted for 78% of total sales of e-liquid last year. Because the base e-liquids must be overdosed in flavor to deliver a good taste once diluted, even customer vaping 0mg/mL liquids will have to add a neutral booster. The company will therefore offer 3 kinds of nicotine boosters:

0mg/mL, 9mg/mL, 18mg/mL, that way once added in the 20mL or 50mL solutions, it will give the following:

For the 60mL bottles:



For the 30mL bottles:



2.4 Outsourcing, the easy solution

The current strategy has proved effective in the past, being easy, convenient, and used to be very profitable. The founder currently has a couple of exclusivity partnerships with e-liquid producers, making sure that his shops are the only ones selling those brands in the area the firm operates in. Offering a wide range of e-liquid has always been Vape Store's strong suit, making sure that almost all customers entering the shops will find a good fit. But selling top quality products at high prices is not a good strategy anymore and the founder must rethink it if he wants to retain customers.

3. LAUNCHING THE PROJECT

3.1 The initial investment

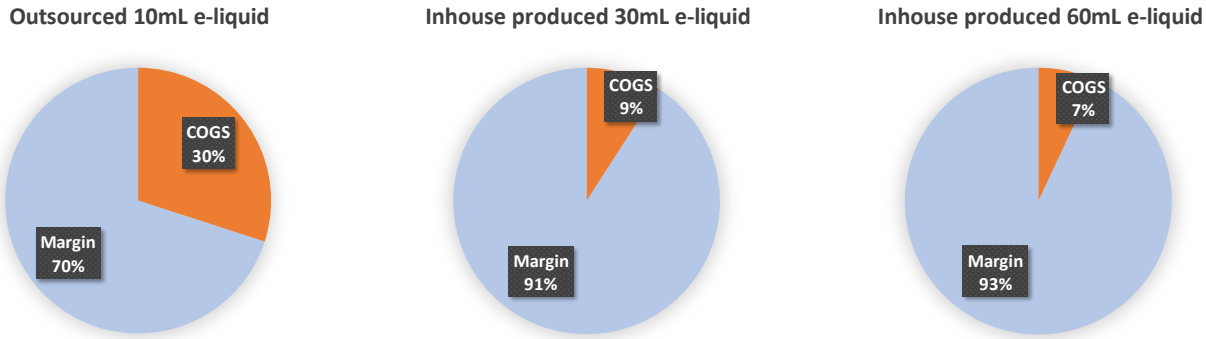
There is a lot involved in producing its own e-liquids. From buying a filling assembly line to getting labels and choosing between bottles and caps. The founder has started to make some calls and talking to other producers of e-liquids.

First, he would need to buy a filling chain of production. There is only one brand making those types of machines in France, and such an equipment would cost around 40,000€. Once it is set up and running, it could fill, put the cap and label around 28 bottles per minute. Preparing the liquid requires various investments as well. The founder would need to acquire a label printer, precision scales, a transfer pump, a magnetic stirer and a couple of glass Erlenmeyer flasks. To make 5 liters of preparations, a worker should need about 20 minutes. On average, it is expected that to make a batch of 250 30mL bottles, the operator would need about 45 minutes to prepare, fill, and clean everything afterwards. To the equipment acquisition, the company would have to acquire an Adobe Photoshop license to design the labels. The *TABLE 1* in the appendixes section shows the various capital expenditures expected to launch the project. All capital expenditures in the initial year are expected to around 50,000€ and to be depreciated in 5 years using a straight-line depreciation, resulting in a depreciation and amortization expense of almost 10,000€ per year.

3.2 The Cost Of Goods Sold

To the initial investment needs to be added all the costs in raw material and packaging for every bottle sold. The *TABLE 2* and *TABLE 3* in the appendix section depict the different components and costs associated for both 30mL and 60mL bottles. The Cost Of Goods Sold (COGS) comprises the total cost of a bottle of e-liquid: the flavor and the propylene glycol/vegetol mix

as well as the packaging and label costs. Finally, the cost of the 10mL outsourced nicotine booster was added. The nicotine boosters would be outsourced to avoid all regulations related to nicotine products. The supplier of flavors that the founder contacted, offered to sell those boosters at very attractive prices (0.40€ per booster). That would result in an estimated average cost of 0.81€ per bottles of 30mL (equivalent to 0.27€/10mL) and 1.04€ per bottles of 60mL (equivalent to 0.17€/10mL). Only looking at the cost of goods sold, producing e-liquids in house would be 5 to 8 times cheaper than outsourcing them. The following pie charts show the margins and the COGS associated with the three alternatives.



3.3 The Research and Development phase

The initial year of the project would be dedicated to the implementation and Research & Development phase. The company would need to decide with which flavor suppliers it would like to work with and try out all the samples it will receive.

The company should be able to launch 50 recipes in the first year. To launch a new liquid, it is important to make some samples, try and compare them. Each recipe would need on average 6 versions before validation. *TABLE 4* in the appendix section shows the detail of the components' costs for each sample. Sample costs for the first year are estimated to approximate 50€, so nearly 1€ per sample. For the subsequent years, the company is expected to launch new e-liquids: 15 new recipes on the first year and 5 new recipes for years 2 to 5 leading to annual

costs of 15€ and 5€ respectively. The price in raw materials per se are cheap and the person who would oversee developing the recipes is the founder so would not add any costs. An additional employee would be needed in the subsequent years if the project is launch, accounting for 20 000 euros per year.

3.4 Pricing strategy and sales projections

The tricky point of this project is to make customers switch from their favorite blend to Vape Store's. Two main types of customers are identified: the ones that constantly like to try new things and the ones who are very loyal to a specific liquid and who are not willing to change. The latter category might be the hardest one to target. For those customers, the only way to make them switch would be to make sure that homemade liquids taste better and/or offer a cheaper alternative with a convincing price to taste ratio. As tastes vary from one customer to another, prices seem to be the main player. A research ran by Stoklosa, Michal & Drope, Jeffrey & Chaloupka and Frank, showed that "based on static models, every 10% increase in e-cigarette prices in Europe is associated with a drop in sales of approximately 8%".

The company thoughts of pricing 3€/10mL or less to cope with competition. The founder suggested charging 8.90€ for the 30mL bottle and 14.90€ for the 60mL bottle. Both prices including the nicotine booster.

In the first year, it is expected to sell 8 bottles of 30mL and 4 of 60mL per day in each of the 9 shops, resulting in sales of 33,480 bottles a year for 364 932,00 €. But the founder should keep in mind the impact of cannibalization on its existing products, that is why, cannibalization in the first year has been estimated to be of 60% resulting in negative revenues for Year 1. But this cannibalization will decrease in the subsequent years because, little by little, the company will stop buying existing brands. This would allow the company to stop outsourcing them. Also, a slight increase in consumption is expected. Indeed, salespersons at Vape Store report that

customers who buy more e-liquids bottles at the time seem to come back more often to the stores than customers who buy one bottle at the time. In other words, it seems that the more customers have e-liquid with them, the more they consume. In this case, customers will carry at all time a bigger bottle of liquid on them, as a consequence, they should fear less running out of it, therefore will not be afraid to consume more throughout the day.

Vape Store is also expecting its sales to grow overtime, the biggest increase in sales should be in Year 2 with clients switching to the house brand. This growth is expected to around 25% and will then slow down, averaging 5% from Years 3 to 5. The following table sums up resulting revenues from the project for Years 1 to 5.

Revenues from sales in euros of in-house produced e-liquids (including cannibalization):

Y0	Y1	Y2	Y3	Y4	Y5
-	(505 068,00)	21 165	261 473	394 172	473 693

3.5 End of year inventories

E-liquids have a lifetime of 2 years. With the outsourcing solution, Vape Store currently wastes large quantities of e-liquids due to the large offer of references and nicotine concentrations that must be in store at all time. Also, suppliers fix minimal quantities to order making it even harder to manage inventories efficiently. Even though the company is trying hard to reduce this waste, it is nearly impossible to cut it completely. This loss is estimated to represent around 3% to 5% of what is bought every year.

By producing in-house, Vape Store expects to lower this waste by matching production to demand. Also, the fact that e-liquids are produced without pre-mixed nicotine makes it even easier to lower waste. Indeed, all shops would have at all time for example 4 or 5 bottles of 30mL and 60mL each that can be mixed with the desired level of nicotine instead of having 5 bottles of each level of nicotine for each flavor that could go to waste. The end of year

inventories in the first year would be quite high since the brand would supposedly launch 50 references. They might not sell everything because it can take time for customers to switch. The table below sums up the end of year inventories and the *TABLE 5* in the appendix section shows the complete computations to get those results.

End of year inventories (in euros):

Y0	Y1	Y2	Y3	Y4	Y5
-	44 636	9 629	11 309	11 019	8 361

4. THE RESULTS

4.1 Discounted Cash Flows

The Discount Cash Flow method was mainly used to evaluate this project.

Taking into consideration all variables stated before, a forecasted 5 years income statement was generated. The project would be entirely equity financed; therefore the cost of capital would be equal to the cost of equity. In order to discount free cash flows and get the Net Present Value of the project, the cost of capital is needed.

Two methods were used to estimate the cost of equity. The first one consists of estimating Vape Store's accounting beta. To do that, annual returns for the past years (2013-2019) were calculated and were regressed against market returns for the same period. Here, CAC40 returns were used to represent the French market. The slope of the regression obtained is the beta of the firm. In this case, because there is no leverage in this company, the beta obtained is the unlevered beta.

The following table sums up the regression outputs:

Beta	R^2	St dev
0,55	66,3%	8%

From this regression, it can be said that 66.3% of the risk faced by the firm is market risk whereas as 32.7% of the risk is firm specific.

Also, with an Unlevered Beta of 0.55, the company is half less sensitive to systematic risk than the market and with a standard deviation of 8%, the returns have relatively low volatility.

From this beta, it was easy to compute the cost of equity using CAPM:

$$(1) \qquad r_e = r_f + \beta_u(r_m - r_f)$$

With r_e being the expected return on equity, r_f the risk-free rate for France (French 10Y treasury bond), β_u the unlevered beta and r_m the market return.

The resulting expected return on equity is 3.16%.

The second method relies on estimating the cost of capital using a comparable publicly traded firm. There is only one publicly traded firm in the e-cigarette business in Europe, *Kumulus Vape* which is French, but it has only been traded since may 2019 so there is not enough history to use it as a comparable firm.

Because of that, Turning Point Brands (TPB), the chosen comparable firm is from the United States. It has been traded publicly since 2016 and operates in the tobacco and the smokeless (e-cigarettes and derivate) businesses, with revenues coming at 96% from domestic operations.

To calculate TPB's beta, the same method as in calculating Vape Store's accounting beta was used: TPB's weekly returns for the past three years were regressed on S&P500 returns for the same period. In this case, TPB has had constant Debt to Equity ratio since 2018 and this ratio is expected to remain constant in the future. The beta obtained through this regression is the levered beta of the company that will be needed to be unlevered to calculate Vape Store's cost of equity.

The regression output is the following:

Beta	R^2	St dev
0,54	3,8%	8%

With a levered (market) beta of 0.54 and a R^2 of 3.8%, the company's risk derives almost completely from firm specific risk (96.2%) making it a relatively less market sensitive than Vape Store.

To get the unlevered beta, the company's debt measure of risk (debt beta) was needed. The interest coverage ratio was calculated from 2016 to Q1-Q3 2020 by dividing the EBIT to the net interest expenses. Those ratios were then compared to Aswath Damodaran's "Ratings, interest coverage ratios and default spread for developed market firms with market cap < $5 billion" (full reference can be found in the reference section). From those default spreads, two methods can be used to estimate the debt beta:

The first one consists of using the CAPM method, calculating the cost of debt by adding the risk-free rate the company's default spread and then plugging the cost of debt on the basic CAPM equation (1) to get the debt beta.

The second method, called synthetic ratings, consists of using the ratings of the investments found with Damodarans table, and uses these ratings to get the debt beta by using the table available in the chapter 12 of the Berks, DeMarzo *Corporate finance* book (full citation can be found in the reference section). The only modification made to this table is that because the debt betas given are across industries, they needed to be scaled to the asset beta of the tobacco industry, that is equal to 1.43 (this beta comes from Damodaran's US beta for all industries table, full reference is available in the reference section). With a constant BB credit rating since 2018, TPB debt beta is 0.35.

To unlever those betas, the Beta formula deriving from Miles/Ezzell Model with a constant D/E ratio is:

$$(2) \quad \beta_L = \beta_u + \frac{D}{E}(\beta_u - \beta_D) \quad <=> \quad (3) \quad \beta_u = \frac{\beta_E + \frac{D}{E}\beta_D}{(1 + \frac{D}{E})}$$

Where β_L stands for levered beta, β_U for unlevered beta, $\frac{D}{E}$ for debt-to-equity ratio and β_D for debt beta.

With this unlevered beta, it was then easy to get the returns on equity using the basic CAPM equation (1).

To calculate Vape Store's returns on equity, there are two possibilities, the first one consists of using US market returns and correct it for regionality by adding to the US Market Risk Premium (MRP), the French Country Risk Premium (CRP=0.73% found on Damodaran's website, full reference available in the reference section). In this case, it is assumed that Vape Store's exposure to risk is proportional to its exposure to all other market risk (reflected in beta). Such that:

$$(4) \quad \underbrace{r_e}_{Vape\ Store} = \underbrace{r_f}_{France} + \beta_u \left(\underbrace{MRP}_{US} + \underbrace{CRP}_{France}\right)$$

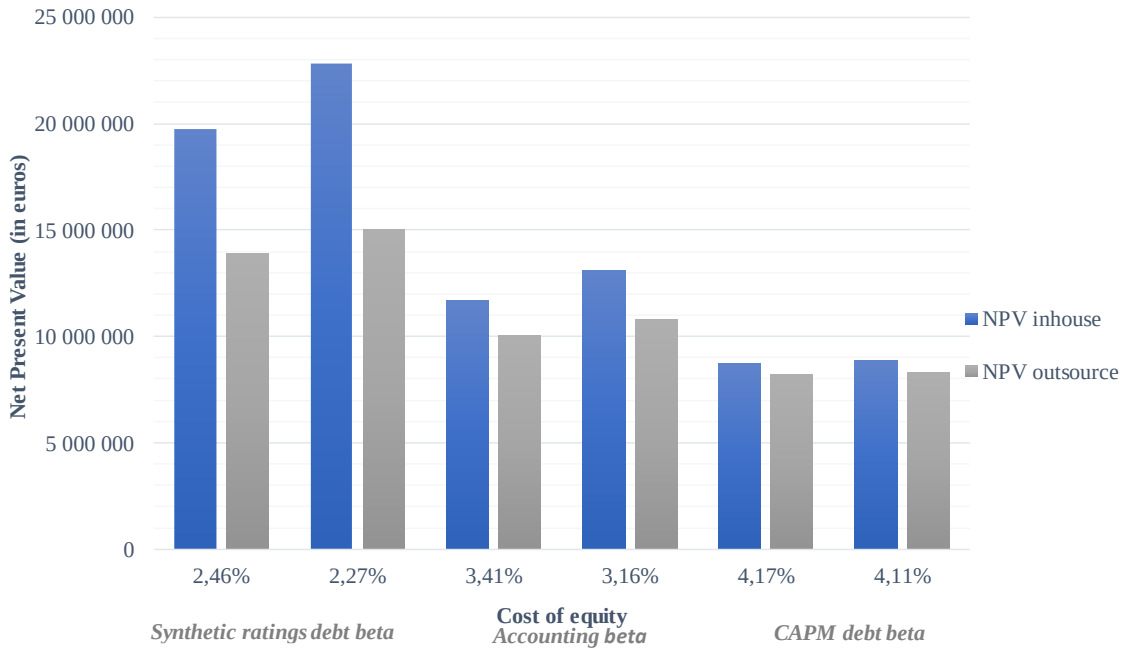
Or, by using French market risk premium such that:

$$(5) \quad \underbrace{r_e}_{Vape\ Store} = \underbrace{r_f}_{France} + \beta_u \left(\underbrace{MRP}_{France}\right)$$

The table below summarizes all combinations:

CAPM FORMULA	BETA DEBT	BETA UNLEVERED	**COST OF EQUITY**
(using US Market Premium)	0,70	0,66	**4,17%**
(using FR Market Premium)	0,75	0,70	**4,11%**
SYNTHETIC RATINGS	BETA DEBT	BETA UNLEVERED	**COST OF EQUITY**
(using US Market Premium)	0,37	0,41	**2,46%**
(using FR Market Premium)	0,37	0,41	**2,27%**
ACCOUNTING BETA	BETA DEBT	BETA UNLEVERED	**COST OF EQUITY**
(using FR Market Premium)		0,55	**3,16%**

The Net Present Values of the projects were calculated using all the cost of equities for comparison purposes, leading to the same result every time: the NPV of producing in house is higher than the NPV of outsourcing. The graph below shows the corresponding NPVs:



For simplicty purposes, only one cost of equity was chosen to carry on calculations. Because Vape Store's accounting beta used to calculate the cost of equity was regressed with few observations (only 7, against 106 for Turning Point Brands) it does not have much power and might be biased. The upside of using Vape Store's accounting beta would have been that it already shows the riskyness of the firm because of its inexistant businesses diversification.

Using a comparable company is the most common way of estimating costs of capital. The data is cleaner are has more observations. The issue with this method is that the adjustements as well as the assumptions made are arbitrary and might lead to biased results. When calculating TPB's unlevered beta through the CAPM method, its unlevered beta is higher than Vape Store's unlevered beta. However, Vape Store should, in reality, have a higher beta compared to TPB because of its size and implied lack of diversification. Therefore, the return of equity chosen was the synthetic rating one, using US market risk premiums. Using US market risk premiums is the best solution to adjust for regionality and therefore risk differences. Indeed, this approach yields reasonable estimates because of the maturity of the US market. French market or European markets may be mature but are dominated by few large public companies, and many privates firms compared to the United States. With a market capitalization to GDP rate of 184.6% for the US compared to 87.8% for France, the US market shows enough history to reasonably estimate the equity risk premium.

From now on, the cost of equity will be equal to 2.46%

The income statement has been forecasted for the next 5 years but is expected to last longer so a continuation value has been calculated using a growing perpetuity at 1%. The following table shows the cash flows resulting from this project as well as the subsequent Net Present Value. The detailed income statement and Net Working Capital calculations and may be found in *TABLE 6* and *TABLE 7* respectively in the appendix section.

Year	**0**	**1**	**2**	**3**	**4**	**5**
Unlevered Net Income	**(14 744,37)**	**(221 751,06)**	**61 710,32**	**188 145,18**	**259 773,40**	**304 418,84**
Plus : D&A	-	9 929,12	9 929,12	9 929,12	9 929,12	9 929,12
Less : Capital expenditures	(49 645,60)	-	-	-	-	-
Less : Increases in NWC	-	(94 635,70)	35 007,14	(1 680,64)	289,81	2 658,27
Free cash flow (Years 0-5)	**34 901,23**	**(117 186,25)**	**36 632,30**	**199 754,94**	**269 412,71**	**311 689,70**
Continuation value (1% market cap)						21 562 095,35
Free cash flow	**34 901,23**	**(117 186,25)**	**36 632,30**	**199 754,94**	**269 412,71**	**21 873 785,05**

NPV (2,46% cost of equity)	**19 756 594,87 €**

The payback period of this project is estimated to be of 1.98 years. If the project was financed using debt, banks typically issue this type of loan for 5 years and expect firms to be profitable after 3 years. Given the fact that the project here is all equity financed, a shorter payback period is better, making this investment less risky for the founder. The profitability of this project is also high, arising almost 400, meaning that for every euro invested, the project is expected to return 400 euros.

Now that this project looks attractive on its own, it is important to compare it to the current alternative which is to keep outsourcing the e-liquids. The same logic has been applied when calculating the NPV of the outsourcing solution. Revenues from sales were calculated as if the same quantity of liquid was to be sold and using current inventory trends. No growth rate has been applied because sales are not expected to increase nor decrease in the following years. The resulting cash flows and NPV are stated in the table below, showing a NPV of 13.9 million euros. All detailed calculations for the outsourcing solution can be found in the appendix in *TABLE 8* to *TABLE 10*.

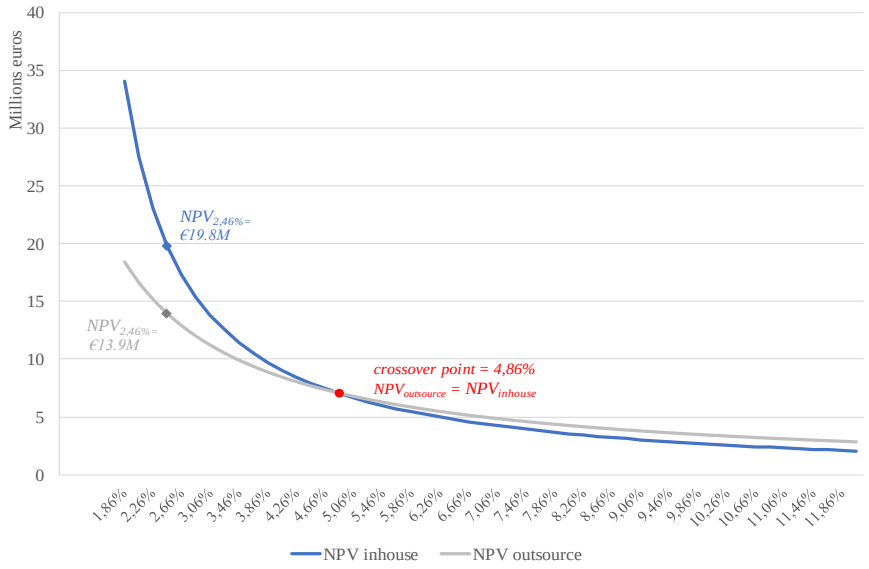
Year	**0**	**1**	**2**	**3**	**4**	**5**
Unlevered Net Income	**-**	**374 976,00**	**374 976,00**	**374 976,00**	**374 976,00**	**374 976,00**
Plus : D&A	-	-	-	-	-	-
Less : Capital expenditures	-					
Less : Increases in NWC			10 420,65	(2 985,27)	58,84	136,44
Free cash flow (Years 0-5)	**-**	**374 976,00**	**364 555,35**	**377 961,27**	**374 917,16**	**374 839,56**
Continuation value (perpetuity)						9 127 508,02
Free cash flow	**-**	**374 976,00**	**364 555,35**	**377 961,27**	**374 917,16**	**9 502 347,58**

NPV (2,46% cost of equity)	**13 896 933,74 €**

Comparing both alternatives, the net present value of producing inhouse is higher than outsourcing by 5.9 million euros. But because this value relies on a lot of assumptions, further analysis will be performed in next sections.

The crossover rate (the rate at which the Net Present Values of both projects are equal), was also calculated, equaling 4.86%. This means that for any cost of equities above 4.86%, the NPV

of producing inhouse would be lower than the NPV of outsourcing. The following graph plots the Net Present Values for each project according relative to different cost of equities.



4.2 Sensitivity analysis

To get a broader look at the margin of error that the company would have, three other sensitivity analysis have been performed.

The first one correlates the price sensitivity of e-liquids, showing the Net Present Value of the project with different combinations of price to quantity sold for the first year. The price elasticity used is the same as stated in section 2.1: 0.8, meaning that for every 10% increase in price, the sales are expected to drop by 8%. The table below sums up the computations. The numbers in blue refer to the assumed price/quantity combinations in the first year with the corresponding NPV and the numbers highlighted in red refer to the combinations that lead to a NPV below the NPV of outsourcing (€13.9M) and that therefore would be not profitable.

The price per unit was combined for simplification purposes: it is expected to sell twice as much 30mL liquids than 60mL ones. Therefore, the average price is 8.90€ * 2/3 + 10.90 * 1/3 = 10.90€. Following the same logic, 8 bottles of 30mL + 4 bottles of 60mL leads to a total of 12 bottles.

Sensitivity analysis with 0.8 price elasticity (for a 10% increase in price, sales drop by 8%)

NPV (in million €)	Sales per day per shop in the first year							
19,75	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
price per unit								
7,95 €	8,86	10,10	11,45	12,92	14,39	15,98	17,69	19,54
8,83 €	10,45	11,83	13,33	14,96	16,60	18,36	20,26	22,32
9,81 €	12,21	13,75	15,42	17,23	19,04	21,00	23,12	25,40
10,90 €	14,17	15,88	17,73	**19,75**	21,76	23,94	26,29	28,83
11,99 €	16,14	18,01	20,05	22,27	24,49	26,88	29,47	32,26
13,19 €	18,29	20,36	22,60	25,04	27,48	30,11	32,96	36,03
14,51 €	20,67	22,94	25,41	28,09	30,77	33,67	36,80	40,18

From this table it can be inferred that there is a moderate margin of error between the expected sales. With the projections of sales and sale prices estimated, it would mean that by the end of year 1, the inhouse produced liquid would represent 45% of sales of e-liquid. But history within the company showed that it would be possible.

In the past, the company made a partnership with a brand, launching a line a tobacco flavored liquids. After 1 year, the shops managed to switch 85% of the tobacco flavored liquid sales to this new line. The main arguments for this switch were price and taste. In the shops, salespersons all agree to say that it is easy to convince a customer to buy a liquid once. If it is better and or cheaper, they will switch to this new liquid very easily.

The next sensitivity analysis performed is correlating the effect of different growth rates in the second year and in the years 3 to 5 to see their effects on the Net Present Value. The following table shows the results.

Sensitivity analysis with different growth rates

NPV (in million €)	Growth rate in Y3-Y5							
19,75	**2%**	**3%**	**4%**	**5%**	**6%**	**7%**	**8%**	**9%**
Growth rate in Y2								
10%	15,37	15,91	16,46	17,01	17,58	18,16	18,75	19,35
15%	16,21	16,77	17,34	17,93	18,52	19,12	19,74	20,37
20%	17,05	17,63	18,23	18,84	19,46	20,09	20,73	21,39
25%	17,89	18,49	19,12	**19,75**	20,39	21,05	21,72	22,41
30%	18,72	19,36	20,00	20,66	21,33	22,02	22,71	23,42
35%	19,56	20,22	20,89	21,57	22,27	22,98	23,70	24,44
40%	20,40	21,08	21,78	22,49	23,21	23,94	24,70	25,46

Looking at the results, it appears that the company can lower its growth rates expectation and still be profitable. Even with a slower growth, the project would still be profitable compared to the current solution and should therefore be accepted.

Finally, the third sensitivity analysis performed correlates the growth rate in year 2 to the discount rate (the cost of equity). The results can be found in the following table.

Sensitivity analysis with growth rate for year 2 and cost of equity

NPV (in million €)		growth rate Y2 (%)							
	19,76	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**	**45%**
cost of equity (%)	**1,79%**	31,91	33,61	35,30	36,99	38,68	40,37	42,06	43,75
	1,99%	25,37	26,71	28,06	29,41	30,76	32,11	33,46	34,80
	2,21%	20,61	21,71	22,81	23,91	25,01	26,11	27,21	28,31
	2,46%	17,02	17,93	18,84	**19,76**	20,67	21,58	22,49	23,40
	2,71%	14,47	15,25	16,02	16,80	17,58	18,36	19,14	19,91
	2,98%	12,39	13,06	13,73	14,40	15,07	15,74	16,41	17,08
	3,27%	10,68	11,26	11,84	12,42	13,00	13,58	14,16	14,74

The results were expected, as the cost of equity increases and the growth rate in year 2 decreases, the Net Present Value falls. Here, an increase of 10% of the cost of equity results in a 15% decrease of the NPV holding the growth rate constant. Similarly, a decrease of 20% in the growth rate results in a decrease of 5% in the NPV holding the cost of equity constant. The Net Present value is far less sensitive to growth rate changes than to cost of equity changes (sensitivity equals 0.25 versus 1.5 respectively). The cost of capital is the most important variable in this estimation process and requires great attention. It is interesting to notice that for every combination in the table, the NPV of producing in-house is never lower than the NPV of outsourcing (for respective costs of equity).

4.3 Monte Carlo Simulation

Finally, a simple Monte Carlo simulation was performed for further analysis. The DCF method is reliable but does not take into consideration that expectations in terms of sales and discount

rate might not be met. The Monte Carlo simulation, by included probabilities, makes a good additional analysis for the project.

The model was built such that the Net Present Value of producing in-house was a function of seven uncertain variables:

1) The number of bottles sold in the first year
2) The sale prices
3) The sale growth in year 2
4) The sales growth in years 3 to 5
5) The cannibalization rate in the first year (that is then expected to decrease by half each year after that)
6) The terminal capitalization rate used to calculate the terminal value of the project
7) And finally, the discount rate, which is in this case the cost of equity

The model was built as an income statement table, very similar to the one used with the DCF method. But all the variables stated a couple of rows before have been assigned a different value for each trial. Using the normal distribution and random probabilities, for each simulation, the uncertain variables where assigned a value based on their estimate and their standard deviation.

Running multiple simulations allows to average the different NPVs calculated to get a more precise estimate on what the founder should really expect.

To get the optimal number of trials needed to run this simulation, several steps were performed:

First, the simulation was run 10 000 times (a number of simulations that is high enough so that the sample standard deviation converges reasonably well) in order to calculate the sample standard deviation. The result was s = 3 485 181.

Secondly, a 95% confidence interval was chosen, leaving a z-statistic equal to 1.96.

Thirdly, a level of precision of 35,000 was set, meaning that the NPV is required to deviate from its mean estimation by 35,000€ maximum. This number can be interpreted as being an acceptable variation of the NPV above or below the average value of all simulations. The lowest the level of precision is, the less volatile the model will be. In this case, lowering this value would result in higher number of simulations. For example, if the level of precision was set to 10 000, about 470 000 simulation should be run. Running such an important number of trials could take several hours and could not be performed on average computers. Here, a level of precision of 35 000 represents 1% of the current standard deviation, improving already the precision of the simulation by 99%.

Using the following equation, it was then easy to determine the optimal sample size:

$$(6) \qquad P\left(-\frac{\emptyset}{s/\sqrt{n}} < \frac{\bar{x}-\mu}{s/\sqrt{n}} < \frac{\emptyset}{s/\sqrt{n}}\right) = confidence\ level$$

Where s is the sample standard deviation, n is the sample size, $\bar{x}$ is the sample mean, μ population mean and $\emptyset$ is the level of precision.

According to the Central Limit Theorem, the distribution of the sample mean is scaled by $\frac{\sqrt{n}}{s}$ so the distribution becomes standard normal. Given the 95% confidence level chosen before, the upper and lower bonds of the equation become -1.96 and 1.96.

To get the number of simulations, one only needs to solve the upper or the lower bound of the equation for n such that:

$$(7) \qquad \frac{\emptyset}{s/\sqrt{n}} = 1.96 \quad or \quad -\frac{\emptyset}{s/\sqrt{n}} = -1.96$$

$$(8) \qquad \frac{35\,000}{3\,485\,181/\sqrt{n}} = 1.96 \qquad <=> \qquad n = 38\,091$$

The optimal number of trials for this Monte Carlo simulation is 38 091. The simulation must therefore be run 38 091 times to achieve the desired level of precision leading to a Net Present Value of 19.4 million euros. What does it mean? Why is it different than the NPV calculated with the DCF method?

This Net Present Value accounts for the uncertainty of the variables. Indeed, it is hard to estimate with certainty sales, growth rates as well as the impact on sales of existing products. This Monte Carlo simulation, by running almost 40 000 trial of combinations, gives a more precise estimate of what the Net Present Value could be. Furthermore, using a normal distribution with mean of 19.4M, standard deviation of 3.5M and a sample of 38 091, with 95% confidence, there is a 95% probability of chance that producing inhouse would be more profitable than outsourcing. The table below sums up all outputs from this simulation:

Monte carlo simulation output	
Mean	19 388 149,43 €
Median	19 208 334,90 €
Minimum	6 637 034,12 €
Maximum	40 987 269,30 €
Standard Deviation	3 498 147,85 €
Chances that NPV inhouse > NPV outsource	95%
Optimum number of trials	38 091

The expected Net Present Value calculated through the Monte Carlo simulation is slightly lower than the one calculated through DCF but remains consistent with previous results. In both cases, producing e-liquids in-house remains cheaper than outsourcing them.

5. CONCLUSION

It goes without saying that producing in-house looks like the best alternative for Vape Store. On the financial side of it, it is expected to generate additional 5.9 million euros in cash flows to the company thanks to higher margins. But launching its own brand does not only have pecuniary advantages, it would also help the company differentiate from its competitors. The company could better adapt to demand and trends by being faster in its decision making. It would also be a way to increase customer loyalty towards the shops. It is nevertheless important to note that this industry is volatile and subject to a lot of controversy and scandals. This project is such an attractive investment because of the risk that it incurs. The final call will be made by the founder who still need to weight the pros and cons of this additional workload.

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APPENDIX

***TABLE 1:** CAPITAL EXPENDITURES IN YEAR 0 AND RESULTING DEPRECIATION PER YEAR FOR YEARS 1 TO 5*

Qty	Item	CAPEX	Years of D&A	Depreciation / Year
1	Transfert pump	1 000,00 €	5	200,00 €
1	Filling chain of production	40 000,00 €	5	8 000,00 €
1	Label Printer	6 021,00 €	5	1 204,20 €
1	Adobe Photoshop licence	99,60 €	5	19,92 €
1	Flash point testing machine	1 000,00 €	5	200,00 €
1	Waterproof precision scale	175,00 €	5	35,00 €
1	Waterproof large precision scale	200,00 €	5	40,00 €
1	Magnetic stirrer	650,00 €	5	130,00 €
10	5 liters Erleinmeyer flasks	300,00 €	5	60,00 €
10	5 meters Silicone tubes	200,00 €	5	40,00 €
	Total	**€ 49 645,60**		**9 929,12 €**

***TABLE 2**: CACULATION OF COGS FOR 30ML BOTTLES*

30 mL bottle is composed of :	
20 mL of preparation :	
- 22,5% flavor	0,09 €
- 77,5% of PG/VG mix	0,07 €
1 x 30mL packaging	0,18 €
1 x 30mL label	0,08 €
1 x 10mL nicotine booster (outsourced)	0,40 €
TOTAL	**0,81 €**
Price / 10mL	0,27 €

***TABLE 3**: CACULATION OF COGS FOR 60ML BOTTLES*

60 mL bottle is composed of :	
50 mL of preparation :	
-18% flavor	0,18 €
- 82% of PG/VG mix	0,17 €
1 x 30mL packaging	0,19 €
1 x 30mL label	0,10 €
1 x 10mL nicotine booster (outsourced)	0,40 €
TOTAL	**1,04 €**
Price / 10mL	0,17 €

TABLE 4: ***CALCULATIONS OF RESEARCH & DEVELOPMENT COSTS***

For each recipe : **6 samples of 10mL**

		Price/kg	Price/sample
- Liquid	15% flavors	19,00 €	0,02 €
	85% PG/VG	4,05 €	0,04 €
- Bottle + cap			0,10 €
	Cost per sample		**0,16 €**
	Total cost per recipe		**0,96 €**

Year 0 :	50 new recipes	**Year 1 :**	15 new recipes	**Years 2-5 :**	5 new recipes
Sample costs =	47,76 €	Sample costs =	14,33 €	Sample costs =	4,78 €
Yearly regulation fees=	150,00 €	Yearly regulation fees=	150,00 €	Yearly regulation fees=	150,00 €
Total R&D costs=	**197,76 €**	**Total R&D costs=**	**164,33 €**	**Total R&D costs=**	**154,78 €**

TABLE 5: ***CALCULATIONS OF END OF YEAR INVENTORIES FOR YEARS 1 TO 5***

Note: E-liquids have a lifetime of 2 years

Year 1	sold from current year prod	produced current year	inventory current year
	40%	100%	60%
30mL	22 320	55 800	33 480
60mL	11 160	27 900	16 740
		Total Y1 inventory value	44 635,70 €

Year 2	sold from Y1 prod	Inventory from Y1	sold from current year prod	produced current year	inventory current year
	80%	20%	**70%**	100%	30%
30mL	26 784	6 696	1 116	1 754	526
60mL	13 392	3 348	558	877	263
				Inventory from Y1	8 927,14 €
				Inventory from Y2	701,42 €
				Total Y2 inventory value	**9 628,56 €**

Year 3	sold from Y1 inventory	go to waste from Y1	sold from Y2 inventory	Remaining inventory from Y2	sold from current year prod	produced current year	inventory current year
	90%	10%	**80%**	20%	**75%**	100%	25%
30mL	6 026	670	421	105	22 848	33 510	8 377
60mL	3 013	335	210	53	11 424	16 755	4 189
						Go to waste Y1	892,71 €
						Inventory Y2	140,28 €
						Inventory Y3	11 168,91 €
						Total Y3 inventory value	**11 309,20 €**

Year 4	sold from Y2 inventory	go to waste from Y2	sold from Y3 inventory	Remaining inventory from Y3	sold from current year prod	produced current year	inventory current year
	90%	10%	**80%**	20%	**80%**	100%	20%
30mL	95	11	6 702	1 675	23 963	32 949	6 590
60mL	47	5	3 351	838	11 982	16 475	3 295
						Go to waste Y2	14,03 €
						Inventory Y3	2 233,78 €
						Inventory Y4	8 785,61 €
						Total Y4 inventory value	**11 019,39 €**

Year 5	sold from Y3 inventory	go to waste from Y3	sold from Y4 inventory	Remaining inventory from Y4	sold from current year prod	produced current year	inventory current year
	90%	10%	**80%**	20%	**85%**	100%	15%
30mL	1 508	168	5 272	1 318	25 518	33 023	4 953
60mL	754	84	2 636	659	12 759	16 512	2 477
						Go to waste Y3	223,38 €
						Inventory Y4	1 757,12 €
						Inventory Y5	6 604,00 €
						Total Y5 inventory value	**8 361,12 €**

TABLE 6: ***PREVISIONAL INCOME STATEMENT FOR YEARS 0 TO 5 (IN EUROS)***

	Year	0	1	2	3	4	5
Incremental earnings forecast							
	Sales without cannibalization effect	-	364 932,00	456 165,00	478 973,25	502 921,91	528 068,01
	COGS without cannibalization	-	(29 757,13)	(37 196,41)	(39 056,23)	(41 009,05)	(43 059,50)
	Cannibalization		(609 000,00)	(304 500,00)	(152 250,00)	(76 125,00)	(38 062,50)
	Gross profit with cannibalization	**-**	**(273 825,13)**	**114 468,59**	**287 667,02**	**385 787,87**	**446 946,01**
	Selling, general and administrative	(20 000,00)	(20 000,00)	(20 000,00)	(20 000,00)	(20 000,00)	(20 000,00)
	Research and Development	(197,76)	(164,33)	(154,78)	(154,78)	(154,78)	(154,78)
	Depreciation & amortisation	-	(9 929,12)	(9 929,12)	(9 929,12)	(9 929,12)	(9 929,12)
	EBIT	(20 197,76)	(303 918,58)	84 384,69	257 583,12	355 703,97	416 862,11
27%	Income tax	5 453,40	82 058,02	(22 783,87)	(69 547,44)	(96 040,07)	(112 552,77)
	Unlevered Net Income	**(14 744,37)**	**(221 860,56)**	**61 600,82**	**188 035,68**	**259 663,90**	**304 309,34**
Free cash flow							
	Plus : Depreciation & amortisation	-	9 929,12	9 929,12	9 929,12	9 929,12	9 929,12
	Less : Capital expenditures	(49 645,60)	-	-	-	-	-
	Less : Increases in NWC	-	(94 635,70)	35 007,14	(1 680,64)	289,81	2 658,27
	Free cash flow (Years 0-5)	**34 901,23**	**(117 295,75)**	**36 522,80**	**199 645,44**	**269 303,21**	**311 580,20**
	Continuation value (1% market cap)						21 554 520,35
	Free cash flow	**34 901,23**	**(117 295,75)**	**36 522,80**	**199 645,44**	**269 303,21**	**21 866 100,55**

TABLE 7: ***NET WORKING CAPITAL CALCULATIONS (IN EUROS)***

Year	0	1	2	3	4	5
Cash		50 000,00	50 000,00	50 000,00	50 000,00	50 000,00
Inventory		44 635,70	9 628,56	11 309,20	11 019,39	8 361,12
Receivables	-	-	-	-	-	-
Payables	-	-	-	-	-	-
Net Working Capital	**-**	**94 635,70**	**59 628,56**	**61 309,20**	**61 019,39**	**58 361,12**
Increase in NWC		94 635,70	(35 007,14)	1 680,64	(289,81)	(2 658,27)

TABLE 8: ***CALCULATIONS OF INVENTORIES FOR YEARS 1 TO 5 IF THE COMPANY CONTINUES OUTSOURCING E-LIQUI***

Note: E-liquids have a lifetime of 2 years, after that they cannot be sold anymore

Year 1	sold from current year inv	bought current year	inventory current year
	80%	100%	20%
10mL	133 920	167 400	33 480

Total Y1 inventory value	50 220,00 €

Year 2	sold from Y1 inventory	Remaining inventory from Y1	sold from current year inventory	bought current year	inventory current year
	70%	30%	**80%**	100%	20%
10mL	23 436	10 044	110 484	151 916	30 383

Inventory from Y1	15 066,00 €
Inventory from Y2	45 574,65 €
Total Y2 inventory value	**60 640,65 €**

Year 3	sold from Y1 inventory	go to waste from Y1	sold from Y2 inventory	Remaining inventory from Y2	sold from current year inv	bought current year	inventory current year
	60%	40%	**70%**	30%	**80%**	100%	20%
10mL	6 026	4 018	21 268	9 115	106 625	146 610	29 322

Go to waste Y1	6 026,40 €
Inventory Y2	13 672,40 €
Inventory Y3	43 982,99 €
Total Y3 inventory value	**57 655,38 €**

Year 4	sold from Y2 inventory	go to waste from Y2	sold from Y3 inventory	Remaining inventory from Y3	sold from current year inv	bought current year	inventory current year
	60%	40%	**70%**	30%	**80%**	100%	20%
10mL	5 469	3 646	20 525	8 797	107 926	148 398	29 680

Go to waste Y2	5 468,96 €
Inventory Y3	13 194,90 €
Inventory Y4	44 519,33 €
Total Y4 inventory value	**57 714,23 €**

Year 5	sold from Y3 inventory	go to waste from Y3	sold from Y4 inventory	Remaining inventory from Y4	sold from current year inv	bought current year	inventory current year
	60%	40%	**70%**	30%	**80%**	100%	20%
10mL	5 278	3 519	20 776	8 904	107 866	148 316	29 663

Go to waste Y3	5 277,96 €
Inventory Y4	13 355,80 €
Inventory Y5	44 494,87 €
Total Y5 inventory value	**57 850,67 €**

TABLE 9: ***PREVISONAL INCOME STATEMENT FOR YEARS 0 TO 5 IF THE COMPANY CONTINUES OUTSOURCING E-LIQUIDS***

Year	0	1	2	3	4	5
Incremental earnings forecast						
Sales	-	669 600,00	669 600,00	669 600,00	669 600,00	669 600,00
Cost of good sold	-	200 880,00	200 880,00	200 880,00	200 880,00	200 880,00
Gross profit	**-**	**468 720,00**	**468 720,00**	**468 720,00**	**468 720,00**	**468 720,00**
Selling, general and administrative	-					
Research and Development	-	-	-	-	-	-
Depreciation & amortisation	-	-	-	-	-	-
EBIT	-	468 720,00	468 720,00	468 720,00	468 720,00	468 720,00
Income tax at 27%	-	(126 554,40)	(126 554,40)	(126 554,40)	(126 554,40)	(126 554,40)
Unlevered Net Income	**-**	**342 165,60**	**342 165,60**	**342 165,60**	**342 165,60**	**342 165,60**
	-					
Free cash flow	-					
Plus : Depreciation & amortisation	-	-	-	-	-	-
Less : Capital expenditures	-					
Less : Increases in NWC			10 420,65	(2 985,27)	58,84	136,44
Free cash flow (Years 0-5)	**-**	**342 165,60**	**331 744,95**	**345 150,87**	**342 106,76**	**342 029,16**
Continuation value						13 903 624,24
Free cash flow	**-**	**342 165,60**	**331 744,95**	**345 150,87**	**342 106,76**	**14 245 653,40**

TABLE 10: ***NET WORKING CAPITAL CALCULATIONS FOR YEARS 0 TO 5 IF THE COMPANY CONTINUES OUTSOURCING E-LIQUIDS***

Year	0	1	2	3	4	5
Cash						
Inventory		50 220,00	60 640,65	57 655,38	57 714,23	57 850,67
Receivables	-	-	-	-	-	
Payables	-	-	-	-	-	
Net Working Capital	**-**	**50 220,00**	**60 640,65**	**57 655,38**	**57 714,23**	**57 850,67**
Increase in NWC			10 420,65	(2 985,27)	58,84	136,44