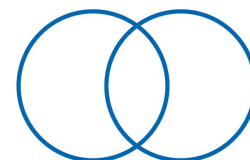


Vaca Muerta, Argentina

Narrative Report

Andres Knobel, November 2016

OpenOil



Context

In 2013 the U.S. Energy Information Agency (EIA) reported that Argentina held the 2nd and 4th top shale gas and oil reserves in the world. A large portion of these are in the Vaca Muerta basin in the province of Neuquen (southwest of Argentina), an area that has had oil and gas production for many decades. In August of that year, the main oil company of the country, YPF (51% state-owned), signed a joint venture with Chevron to exploit the Loma Campana area, within the Vaca Muerta basin.

The companies agreed to run a one-year USD-1.2 billion pilot project to prove feasibility. The pilot was successful and thus both companies moved to stage 2 of the project, where up to a total of USD 16 billion would be invested to produce shale gas and oil.

This project is especially important for Argentina. After several years of price distortions, after local prices were decoupled from international prices, Argentina went from being an oil exporter to a net oil and gas importer. This had a huge impact on national accounts, the Central Bank's foreign currency reserves and on inflation (25-35% annually).

Expectations were high that the development of Vaca Muerta might allow Argentina to return to energy self-sufficiency, and obtain revenue from oil and gas exports – emulating the transformative success achieved in the United States.

Assumptions

There is very little public information on the details of the Vaca Muerta-Loma Campana project. While both YPF and Chevron are listed companies, they only have brief references to this project but no disaggregated data on costs or investment.

While YPF reports some details on its operations across the entire Vaca Muerta, it does not provide any information specifically on the Loma Campana concession.

Executive Summary

The Vaca Muerta-Loma Campana project is an unconventional oil & gas development located in the southwest of Argentina. It started operations in 2013.

With current low prices the project is not viable without billions of US dollars of subsidies from government (for gas) and Argentinian consumers (for oil).

If cost savings exceeding 25% can be realized (versus 2013 predictions) the project may be viable without subsidies.

Government should not entertain fiscal regime concessions unless it is clear these are necessary to make an otherwise unviable project stay in business.

Vaca Muerta-Loma Campana, Argentina

Narrative Report

This model is primarily based on a single 2013 corporate presentation prepared by YPF on the agreement with Chevron.¹ It details the company's forecast for the whole duration of the project (35 years - being the duration of the Loma Campana concession).

Our approach has been to first establish what YPF/Chevron's outlook for the project was at the time of the investment decision in 2013. Then we evaluate how changes in production, cost and particularly price outlook will impact project economics.

Production: YPF estimated an oil peak rate of 50,000 bpd and a gas peak rate of 3 million cubic meters per day, and total life of project production of 750 million barrels of oil equivalent (BOE). To approximate this we assumed production would reach this "plateau" in 2017, remain there for 20 years – assuming drilling continues throughout this period – and thereafter decline by 10% per year until the end of the concession in 2048. This would produce 725 million BOE, with 71/29 oil versus gas.

However, while actual gas production is now close to 3 million cubic meters per day actual oil production is around half the 50,000 bpd. We therefore explore below an alternative "shorter plateau" scenario where gas reaches a higher peak of 4 million cubic meters per day and oil 50,000 bpd in 2023, plateau is maintained for 12 years, then declines at 10% thereafter. This produces 722 million BOE through 2048, with 65/35 oil to gas ratio – meaning slightly more gas versus oil.

The model allows the user to change the gas production peak rate, start year and duration. It also allows to choose whether oil peak will be reached or not versus maintaining the lower ratio observed in actual production to date.

Price: the gas price is assumed at USD 7.5/MBTU (the current subsidized price guaranteed by Argentina). In the 2013 case we inferred that YPF was assuming USD120/bbl, based on their stated estimated total BOE production target and accompanying forecast for total royalties to be paid of USD 8,500 million.² Obviously this oil price is no longer realistic, therefore we evaluate below an alternative scenario, closer to the situation in year 2016, with an international price of USD 50/bbl and a fixed domestic price of USD 65/bbl. Further, at the time of writing, (November 21, 2016) news sources are saying that the Argentinian government is taking steps to reduce the oil price so that in time it will align with the

¹ YPF Corporate presentation, slide 11, available at:
<http://www.ypf.com/inversoresaccionistas/Lists/HechosRelevantes/29-08-2013%20Presentaci%C3%B3n%20YPF.pdf>

² We assume these figures were quoted in \$2013 constant real terms

Vaca Muerta-Loma Campana, Argentina

Narrative Report

international price. We show below what that would do to Loma Campana economics.³

The model allows the user to choose - separately for both gas and oil – between constant subsidized prices, constant non-subsidized prices or the latest forecasts by the U.S. EIA Annual Energy Outlook (reference, low and high cases).

Exploration Costs: based on the YPF presentation and description of initial payments by Chevron for YPF past investments, exploration costs are assumed at USD 300 million.

Development costs: total lifetime development costs were estimated in 2013 at USD 15,700 million (the total 16 billion investment minus exploration costs). YPF has disclosed that an initial pilot investment of USD 1.2 billion was spent by 2014. Based on an YPF press release, 60% of the investment was expected to have been spent by 2019. We have set this up in the model as the “original” development cost schedule. However, to align development costs with our revised Shorter plateau scenario we assume the 60% is spent between 2015 and when plateau is reached in 2023, with the remaining investment assumed equally distributed over the 10 years after 2024. This is the “revised” development cost phasing scenario.

Operating costs: based on research on unconventional operating costs in the U.S. and elsewhere, we have assumed operating costs at USD 0.09 per cubic meter of gas, and USD 10/bbl, in order to reach a similar total operating cost as estimated by the company in 2013 (USD 9 billion, 2013 real terms).

Discount rate: the required rate of return for such a project in Argentina is debatable. We have assumed 10% nominal, however, a recent report by Wood Mackenzie suggested 12.5% for an Argentinian oil project in the area. Perceived Argentinian political risk is likely an important consideration for investors.

Fiscal regime: Royalties 12% flat (for oil charged on gross revenues, for gas on revenues excluding subsidy), turnover tax 3%, stamp tax 1.2% of revenues and corporate income tax 35%. Income tax depreciation 10 years straight line. Turnover tax and stamp tax are charged on the same gross revenue base, therefore we model them together as 4.2% “Stamp and Turnover tax”.

³ <http://www.cronista.com/economiapolitica/Aseguran-que-el-Gobierno-eliminará-el-subsidio-al-barril-de-petroleo-20161118-0093.html>

Vaca Muerta-Loma Campana, Argentina

Narrative Report

Other taxes have been excluded either because they are not material, or for lack of information. For instance, dividend withholding tax was repealed in 2016. As for presumed minimum income tax (1% of assets), it will be repealed in 2019 and it works as a credit against corporate income tax. A “signature bonus” of USD20 million was not included.

Findings

The base scenario of 2013 shows a viable project, with a pre-tax full-cycle IRR of 33% and a post-tax IRR of 17%. Recall that this is our inference of YPF/Chevron forecast at that time. Sticking with the 2013 case, but considering only 2017 “point forward” cashflows, the post-tax NPV10 would be USD 8.0Bn – had things gone as expected in 2013 this project would now be a very valuable asset indeed for the companies.⁴

However, many things have, or may change. To explore these we have set up a number of scenarios in the model, in which we define alternative sets of parameters. In the chart below (reproduced in the SCENARIO sheet in the model) we show the investor point-forward NPV under each of our alternative scenarios. We focus on point-forward results as that is what investors will use when making decisions. Past investments are “sunk”, and cannot be recovered, and it is only cashflows from 2017 forward that matter. For information, we show in a table below the full-cycle IRR for each of the scenarios we describe below.

Scenario 1: The results from the original 2013 base case with \$120Bbl oil. The project is very profitable.

Scenario 2: Scenario 1, plus imposing a capped oil price of \$65 Bbl (the current domestic price including the consumer’s subsidy). The project becomes very marginal – a point forward NPV10 of zero in theory would mean the investors would not want to continue the project.

Scenario 3: Scenario 2 plus changing to our revised production scenario with of 4 million cubic meters per day, reached in 2023 and maintained for 12 years. Oil still gets to 50,000 BOPD when gas plateau is reached. Development cost timing is revised accordingly. The reduction in NPV from delayed production and reduced proportion of oil is somewhat offset by benefit of delaying development costs, however NPV reduces overall.

Scenario 4: Scenario 3, but the oil subsidy is removed, and the oil price stays at \$50 Bbl constant real terms. The NPV has reduced by USD 1.8Bn to negative \$1.1Bn.

Scenario 5: Scenario 4 plus the gas price subsidy is also removed so the project receives \$4.50MMBtu rather than the subsidized \$7.50. The project NPV reduces by a further USD 1.2 Bn to negative USD 2.3Bn.

⁴ This is very sensitive to the discount rate. The 2017 point forward NPV12.5 for the 2013 base case would be USD 6.2 bn versus USD 8.0 bn with a 10% discount rate

Vaca Muerta-Loma Campana, Argentina

Narrative Report

With revised production, the original cost structure and current oil and gas prices, the project is unviable without both the oil and gas subsidies.

Scenario 6: Scenario 5 plus we assume development costs are reduced by 25%, recognizing the significant cost reductions and efficiency improvements being achieved in unconventional gas and oil production (particularly in the United States) since the oil price crash.

Scenario 7: Scenario 6 plus operating costs also reduced by 25%. The project is almost break-even point forward with negative NPV10 of USD 100 million.

Note that Argentinian sources have informally suggested that cost reductions of up to 40% might be achievable. In scenario 13 we illustrate the effect this would have.

Scenario 8: Scenario 7 but the discount rate is increased to 12.5%, reflecting higher perceived Argentinian political risk⁵. The project (just) remains viable.

If cost savings of at least 25% can be achieved, the project could be viable point forward without subsidy at current oil and gas prices.

Scenario 9: Scenario 8 (no oil or gas subsidy, 12.5% discount rate), but now we assume Reference case oil and gas prices from the EIA Annual Energy Outlook. See chart below - these show a steady increase from current low prices up to around \$140Bbl (real terms 2016) by 2040 for oil and from around \$3.00 MMBtu today to around \$5.00 per MMBtu by 2024 for gas. If these prices eventuate, with the reduced cost structure, the project will be strongly profitable.

Scenario 10: Scenario 8, but EIA LOW case prices, meaning oil prices materially below \$50 Bbl for most of the project's life. The project would be unviable with NPV12.5 of negative 400 million.

With 25% cost savings, without subsidy the project remains unviable at the EIA low case forecast.

5

http://www.rigzone.com/news/oil_gas/a/146243/Tight_Gas_Helping_Argentina_Operators_Reverse_Producti_on_Decline

Vaca Muerta-Loma Campana, Argentina

Narrative Report

Box: What is the right discount rate?

We started our analysis with 10% nominal, which has been for some time a default industry rule of thumb for doing NPV calculations. A good source for Weighted Average Costs of Capital (WACC – the basis for a discount rate) for various industry sectors is [New York University](#), which quotes a WACC for Integrated Oil & Gas (the big guys) of 10.2% and Oil & Gas E&P companies (smaller players) of 8.37%.¹ So 10% seems about right.

However, the “true” discount rate – in the sense of the minimum return that investors would require before committing capital to a particular project, is specific to each company and to a significant extent depends on their – often subjective - perception of project and political risks.

Wood Mackenzie suggest a 12.5% WACC for Argentinian projects, which includes a country-specific risk premium². If we accept that 12.5% is the right rate, then - in theory - as long as the NPV12.5 point forward is equal to or greater than zero the investors should be willing to proceed with the project. However it is of course not that simple in practice. Investors will choose to put their money into their highest return opportunity, and would ideally like to earn more than their minimum cost of capital and therefore earn some positive NPV. Another way of achieving that is to set a higher “hurdle” discount rate before approving a project – 15% is often quoted.

The debate around this quickly gets rather technical (and to some extent theological), but in our view with an existing project already underway, with (we infer) relatively low technical risk, where investment can be scaled up or down depending on results and so losses minimized, but with moderate to high political risk, 12.5% arguably already includes some margin above an absolute minimum acceptable rate of return. Indeed, if it came to the crunch (and as we show below it may well do...), we expect YPF and Chevron would be willing to accept a lower return than 12.5% for this project, particularly given the strategic context in which this positions them as key players in a potentially very important producing basin.

Scenario 11: Scenario 10 but with royalty reduced from 12 to 8%. Investors may argue that Argentina should become more “competitive”⁶ by reducing the “government take”. This would reduce the NPV loss by USD 300 million and leave the project still unviable at a 12.5% discount rate. A royalty reduction would make a meaningful but relatively modest difference relative to the price and cost uncertainties faced by the project. Royalty reductions

⁶ We personally disagree that lowering taxes is a wise, let alone legitimate, way of “competition”.

Vaca Muerta-Loma Campana, Argentina

Narrative Report

are unlikely to make the difference between the project going ahead or not, however answering this definitively depends on a realistic view of production, prices and costs – and a realistic view of the minimum require rate of return.

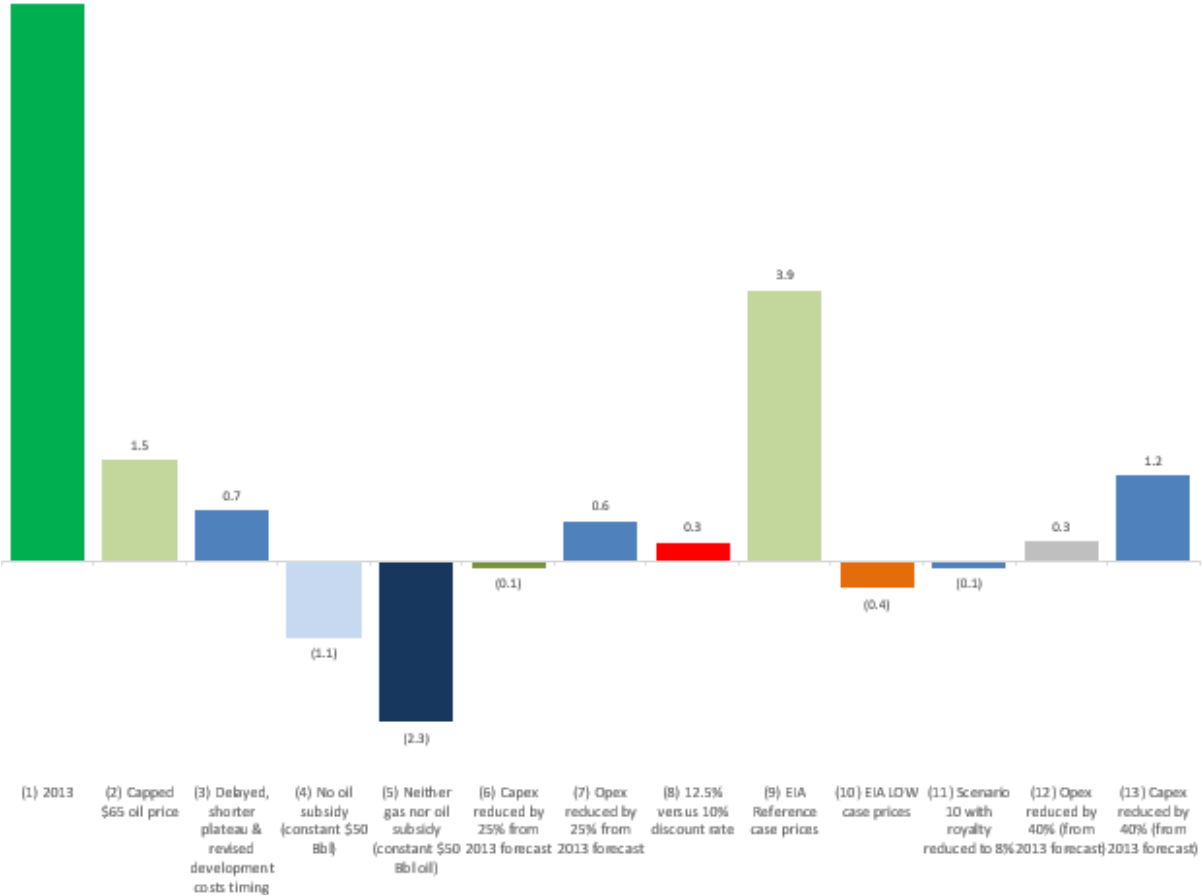
Changing the royalty rate has a relatively marginal effect. Production, cost structure and oil & gas prices are more important factors than the fiscal regime. The government should not entertain fiscal regime reductions unless careful analysis shows that this is needed to make an unviable project into a viable one.

Scenario 12 & 13: starting from Scenario 11 (low case EIA prices), further reducing opex and capex so that these are 40% lower than the 2013 forecast. The capex reduction has a much bigger effect and the project would be viable 2016 point forward.

If cost savings of 40% are achievable, the project does not need fiscal regime concessions to be viable, point forward.

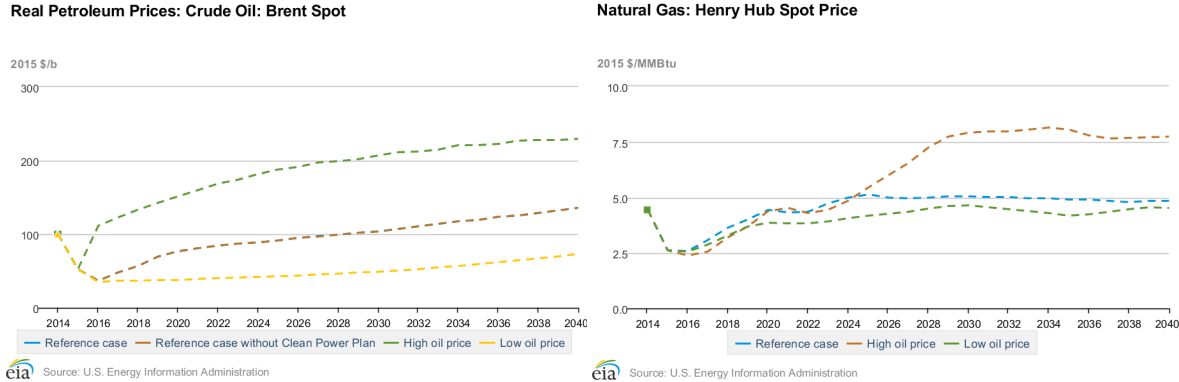
Charts

Chart 1: Scenario results: Contractor net cash flows 2017 point forward NPV

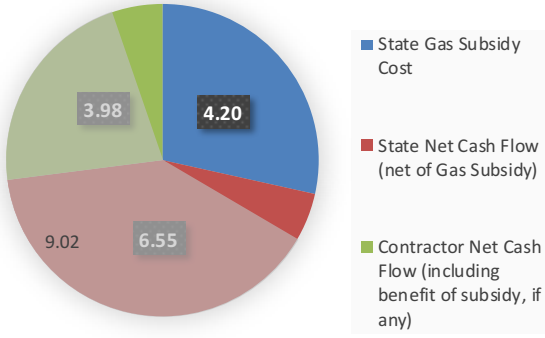


Vaca Muerta-Loma Campana, Argentina Narrative Report

Chart 2: EIA Price forecasts from Annual Energy Outlook 2016 ⁷



Net Cash Flow Sharing/Cost (USD Bn)



Light gray area shows oil subsidy contribution

This chart shows full-cycle undiscounted net cashflow results for scenario 3 – where the international oil price stays \$50 Bbl (real terms), but the project benefits from both the gas and oil price subsidy.

The “real” size of the pie representing the project’s true net cashflows of USD 10.45 Bn should only be the green and red areas, representing Argentina’s and the company’s net cash flows, totaling USD 10.5 Bn. The blue section (USD 4.2 billion) is the gas subsidy given by Argentina to “enlarge” the pie (the net cash flows) and make the project more appealing to investors.

However, out of this USD 10.5 Bn the majority - USD 9 Bn illustrated by the gray wedge - is the subsidy paid by Argentinian consumers in the form of higher oil prices (the difference between the \$65 regulated and \$50 Bbl international price).

⁷ <http://www.eia.gov/forecasts/aeo/>

Vaca Muerta-Loma Campana, Argentina

Narrative Report

In other words, in a low price environment the subsidies being paid both by the State (gas subsidy) and by consumers (oil subsidy) significantly exceed the government's fiscal revenues.

Information Gap Analysis

Given the lack of detailed information, many of the model inputs are assumptions based on the 2013 corporate presentation of the project and its total production, costs and royalties.

The model could be improved after confirming the following details.

Production: What production profile is expected for gas and oil, in terms of path/time to plateau, plateau production rates, plateau duration and decline thereafter.

Given actual performance to date is it realistic that oil will get to 50,000 Barrels per day?

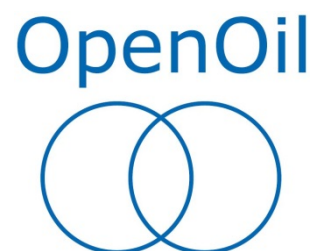
Price: What were initial agreements or expectations on subsidies, and what are government plans now⁸? On the one hand, the oil sector is asking for higher subsidies at least for some time, while the government wants to link domestic prices back to international ones. What will happen and when?

Costs: What is a realistic current view of future development costs and timing? Likewise for operating costs.

Discount rate: what is the company's minimum acceptable rate of return (discount rate) for this project? Does the government agree with it?

Fiscal regime: how are well drilling costs classified under Argentina's tax rules, and how are they depreciated? Is there any other fiscal concession? Does VAT materially impact the investors net cashflows?

OpenOil is a Berlin-based consultancy and publishing house specialised in developing open data information systems, software solutions and intelligence around the oil and gas industries. We work with governments, media, civil society and companies around the globe.
Learn more at www.openoil.net



⁸ According to media reports, the government is planning to eliminate oil subsidies:
<http://www.cronista.com/economiapolitica/Aseguran-que-el-Gobierno-eliminara-el-subsidio-al-barril-de-petroleo-20161118-0093.html>

Appendix: Full-cycle results for scenarios

	(1) 2013	(2) Capped \$65 oil price	(3) Delayed, shorter plateau & revised development costs timing	(4) No oil subsidy (constant \$50 Bbl)	(5) Neither gas nor oil subsidy (constant \$50 Bbl oil)	(6) Capex reduced by 25% from 2013 forecast	(7) Opex reduced by 25% from 2013 forecast	(8) 12.5% versus 10% discount rate	(9) EIA Reference case prices	(10) EIA LOW case prices	(11) Scenario 10 with royalty reduced to 8%	(12) Opex reduced by 40% (from 2013 forecast)	(13) Capex reduced by 40% (from 2013 forecast)
IRR before fiscal Full-cycle	33%	12%	15%	7%	2%	11%	14%	14%	26%	10%	10%	12%	17%
Contractor IRR after fiscal Full-cycle	17%	5%	5%	-9%	n.a.	n.a.	4%	4%	15%	4%	5%	6%	9%

Our main focus in the body of the report is on point-forward NPV, as this is the main metric that investors should use for making decisions about whether and how to progress the project, standing at the end of 2016. Everything that has happened before is irrelevant, except to the extent it might impact future tax calculations.

However, it is interesting to see what each scenario would result in measured across the whole of the project lifecycle. Note that scenario 1 showed very positive results with post-tax IRR of 17% (these are all nominal IRR). The only other scenario that gives investors a full-cycle IRR above 10% is scenario 9 – with 25% cost reduction and higher EIA reference case prices.

What this means is that though we would argue scenario 13 (with 40% cost savings & low EIA prices) is viable for the investor point-forward even at the EIA low case, if an identical new project was being evaluated to start tomorrow, and the investor wanted to make sure they had an

Vaca Muerta-Loma Campana, Argentina

Narrative Report

acceptable return even at low prices, the project would be considered marginal, and investors might conclude it is not worth doing if they perceive a material chance of prices as low as the EIA low case.

If so, and this project is representative of other potential projects in Argentina, this result may have implications for the design of Argentina's fiscal regime for future projects: recall scenario 13 has a reduced royalty of 8%. With the existing royalty of 12% the post-tax IRR would be 1% lower at 8%.

However, this raises the interesting question of what oil/gas price forecast would be the basis for such investor decision making? (see Box)