Chapter 3
An Opinion About Fracking

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Abstract SE briefly describes the situation regarding the supply of oil and natural gas in the periods leading up to 2004 and shows the role of the state-owned energy companies. A very brief presentation is made of the so-called conventional exploitation techniques for the exploitation of hydrocarbons and then the same is done with the so-called non-conventional techniques (especially fracking), emphasizing especially the large volume of water that these non-conventional techniques require. Then the denomination as "Reserves" of what really are "Resources" of non-conventional hydrocarbons is questioned. In this way, the values mentioned by the International Energy Agency in June 2013 are taken in their true dimension. This opens up a question mark over the reasons why they want to exploit non-conventional hydrocarbons in Argentina through fracking techniques. The main environmental impacts that could be generated by the fracking technique are described. The situation at the end of 2015, in the rest of the world, of the use of fracking is analyzed. Next, a series of recommendations are made and some questions are asked that the application of the fracking technique may generate. As an annex, a critical analysis of the association contract signed between YPF SA and Chevron for the exploitation of hydrocarbon areas, within the Vaca Muerta formation, is included, since this contract started the investigation and exploitation of fracking in Argentina.

Keywords Conventional exploitation of hydrocarbons · The fracking · Unconventional hydrocarbons · Environmental impacts · Vaca Muerta · The YPF-chevron contract

3.1 Some Previous Elements to Better Understand the Topic

Argentina reached its self-sufficiency in petroleum energy and natural gas at the end of the 1970s of the last century due almost exclusively to the work of the state-owned YPF.

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That is to say that the Energy petroleum and natural gas that were consumed in Argentina were produced from Argentina's own deposits.

Exports were very small and so were imports. A small amount of natural gas was imported from Bolivia for geopolitical reasons.

In the state-owned company, it was said that Argentina was a country with oil but not an oil country.

Natural gas was replacing fuel oil in thermal power plants. So did water and nuclear fuels.

The idea was to lower petroleum consumption.

Even at the beginning of the 1980s, when democracy was recovered, alconafta (cane alcohol mixed with naphtha) began to be used, especially in the Northern Zone, NEA and the Center of Argentina.

But in the 1990s, with the Menem-Cavallo government, the energy policy changes completely, especially the petroleum and natural gas.

YPF, Gas del Estado and almost all the Electric Companies are privatized, except the binational ones (Salto Grande and Yacyretá and the nuclear companies Atucha and Embalse and some provincial ones).

It was said that the State was a bad businessman and that with the energy sector in private hands there would be a lot of energy, cheaper and at international prices.

In the matter of petroleum and natural gas the foreign companies, especially the Spanish REPSOL, that had bought very cheap to YPF, launched to increase strongly the production and constructed, even, gas pipelines to export the abundant natural gas to Chile, for example.

Exploration was stopped to replenish reserves and these decreased dramatically from almost 12 years, in the early 1990s to almost 10 years now (with a production almost 30% less) and from almost 20 years to less than 8 years for natural gas.

YPF drilled about 120–150 exploration wells per year, when it was state-owned, and then all the companies dropped to 60–50 and even 30 wells per year.

Without exploration, the reserves would run out and more and more had to be imported.

At the end of the 1990s, almost 40% of the petroleum energy produced and a good part of the natural gas was exported.

Exports amounted to US $22 per barrel of oil and less than US $3 per million BTUs of natural gas.

Today, petroleum (in the form of derivatives) must be imported at almost 120 dollars and Liquefied natural gas at almost 18.

That is 4–5 times more expensive.

This is because companies have dedicated almost all their efforts to exporting large quantities in order to recover as soon as possible what they have spent on buying YPF, to turn profits abroad and to increase dividends to their shareholders. The fact is that the foreign currency obtained by exports did not pass through the Central Bank and the oil was freely available (This situation lasted until 2011).

The local natural gas, at present, is not enough to satisfy the consumption needs of industries, power plants and even, sometimes, of residential users, despite the

fact that more than 40% of the population lacks natural gas. It is that in addition hydroelectric and nuclear plants were stopped.

As it was not invested to expand the capacity of refineries, today gas oil must be imported, partly to replace natural gas in power plants, and sometimes naphtha and fuel oil.

These imports cause an important deficit in the Trade Balance and this added to the great subsidies that are given to the energy sector, essentially to buy LNG, and by the very low levels of the tariffs of GN and EE, contributes, also, to generate a deficit in the national budget creating a very difficult situation to the country that in part is reflected in the difficulties of the Provincial budgets, that sometimes are not even in conditions to pay the salaries of the public employees.

Faced with this situation, that of the fall in reserves and production of petroleum and natural gas, the government decided, rightly and belatedly, to recover the management of YPF by buying 51% of the shares from the Spanish group REPSOL.

ENARSA, which had been created at the beginning of the 2000s, could not contribute to the solution of this problem.

The other problem, the subsidies to the natural gas and electrical energy tariffs, is still delayed. The petroleum derivatives on the contrary gradually increase their price. This generates serious inconveniences to Camessa, the administrator company of the electrical system that buys the EE to the generators with those subsidies of the State since the distributors, that in turn buy the EE to CAMESSA, owe to this every day more money by the freezing of the tariffs.

That is the context.

3.2 Conventional Exploitation of Hydrocarbons

First we will see how petroleum and natural gas are extracted from conventional fields.

Structures containing petroleum and natural gas are in the subsoil at greater depths, generally at 1000 m and more, although in some cases they reach almost 4000 m.

They do not appear as underground petroleum and natural gas layers or rivers, but both are housed in capillaries, small pipes, sometimes not connected to each other, in solid rocks, but which have the property of being porous (i.e., there are spaces occupied by hydrocarbons) and permeable (i.e., hydrocarbons can flow and they can move).

They are deposited in what is called traps (you can imagine the interior part of a shade where the upper part is an impermeable rock that contains them and prevents them from escaping). Natural gas occupies the upper part of the capillaries, petroleum the intermediate part and water the lower part.

To extract them, as they are contained at high pressure (there are almost 1000 or 4000 m of rock layers above), it is necessary to reach the “hat” with a vertical well drilled from the surface. This well is drilled with a special piece called a trepan,

placed at the end of a series of articulated bars. The well starts with a diameter of 50–60 cm and ends, in the trap, with 8–10 cm.

When the drill bit reaches the hydrocarbons, i.e., by piercing the cap, the petroleum comes out through the pipes of the vertical well toward the surface dragged by the natural gas and pushed by the water.

The wells that are drilled are vertical and for about 20 years, in Argentina, also by means of horizontal sections.

This means that the well reaches the area where the hydrocarbons are located vertically and then with a special tool it is made horizontal. In this way, many more hydrocarbons can be extracted than if it were only vertical.

In order to prevent the hole in the well-being drilled from being covered by crushed rock and to cool the drill bit, a fluid called mud is added through the center of the pipe. This mud is formed with water and a special mineral called baryte, which is non-polluting and sometimes contains chemicals, depending on the nature of the ground being drilled. These chemicals can be, for example, gas oil.

The sludge runs in a circuit from the wellhead to the drill hole, in the depths, and from there it returns to the wellhead dragging the bits of crushed rock.

The used sludge is recovered by removing the rock chips and reinjected.

At the end of the drilling, the excess mud is dumped into a pool next to the well.

This sludge usually contains oil and if the pool is not treated and the petroleum is removed, it becomes a contaminated area that ruins the soil and is very harmful to birds.

There are techniques for remediation.

But the history of well drilling in Patagonia has thousands of abandoned, untreated pools that are major environmental liabilities. In Chubut Province, more than 5000 untreated pools are reported.

The fact is that there has been very little control of the oil companies by the State.

A characteristic of the hydrocarbon fields is that their production declines over time. As one of the main forces that allow its extraction is exhausted which is the natural gas that is losing pressure.

For that reason, to extend the useful life, water and gas are usually injected under pressure from the surface.

For example in Argentina, the average production of a petroleum well is about 8–10 m^3 per day when at the beginning of its production can be at 80 or 100 and this decline usually occurs gradually over 10 or 15 years.

For example, the large producing countries in the Middle East produce about 500 m^3 per day per well, which is almost 50 times more than in Argentina.

This low productivity of the wells in Argentina, which produces only 0.2% of the world's petroleum, makes Argentina one of the 5 countries with the highest number of wells drilled.

In other words, what Saudi Arabia produces in one well, in Argentina requires 50 wells.

3.3 The Fracking

Petroleum and natural gas originate from what is called the bedrock. There, in hundreds of years, in beds of ancient seas, buried organic matter decomposed and generated petroleum and natural gas.

That is why it is called bedrock.

But from the bedrock, petroleum and natural gas migrate, moving until they are trapped in special formations that form a barrier of impermeable rock that prevents them from rising to the surface.

There they are housed, forming a deposit.

Today the technology recovers between 30 and 50% of the petroleum originating in the mother rock and the rest remains in the soil. Technical and economic reasons prevent the recovery of more.

In conventional deposits, the rock in which the petroleum is embedded sometimes has unconnected pores and to increase recovery, so-called hydraulic fracturing is performed, which is almost as old as the oil industry.

This technique consists of injecting water from the head of the well, with some chemical substance, under pressure that reaches the rock where the petroleum is located and increases the porosity and allows either to produce petroleum or to increase its production.

In other words, hydraulic fracturing is an old technique.

But where does fracking, which is a multiple fracturing technique, take place today?

Firstly, Fig. 3.1 shows the process and its impacts.

In formations where petroleum and natural gas are hosted in rocks of very low porosity and permeability, or in very compact clays, even in the same bedrock, they are called shale oil or shale gas (oil and natural gas from clays) or tight oil or tight gas (oil and natural gas from compact sands).

Fracking consists of an injection of water, sand and chemicals at high pressure but not in the vertical part but in the horizontal part of the well.

The horizontal section can be 1000 m and the vertical section 2000 or 3000 m long.

The walls of the horizontal section must be perforated by controlled explosions, which produce a series of holes along the horizontal section.

Water with sand and chemicals will pass through these holes at very high pressure causing multiple fractures in the rock area around the horizontal pipe.

This increases the porosity and permeability of these rocks that do not originally have it and this makes it possible for petroleum and natural gas to exit the pipe.

A lot of water is consumed almost 20,000 m^3 per well with the addition of about 400 tons of chemicals diluted in water so that the solution is 2% chemicals and 98% water.

The sand prevents the holes in the horizontal pipe from closing.

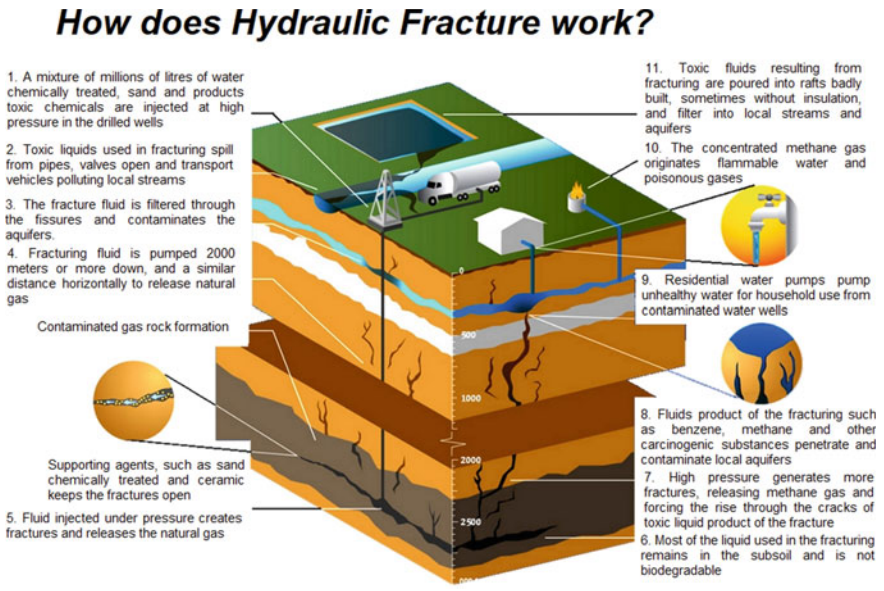

Fig. 3.1 How does hydraulic fracture work? *Source* Hidraulicano.info, May 14th 2012, Cantabria

The operations of this type consist of batteries of wells called platforms (2 or 3 per km^2) and from each one 6–8 wells are drilled, very close together. So the number of wells is enormous.

The production from each well is then collected on the platform. That is, the wells converge on the platform.

About 15 fractures are made in each well, which gives an idea of the amount of water and chemicals to be used.

The composition of the chemical products is not made known by the companies, as they say it is a commercial secret, but it is supposed to be about 500 chemical substances:

17: toxic to aquatic organisms
38: acute toxicants
8: proven carcinogens.

These are generally oxidants, biocides, aromatics, carbon disulfide, pyridines, etc.

In short, a large quantity of water, polluting and toxic chemicals and the expulsion of natural gas into the atmosphere, as not everything is recovered. This expulsion of natural gas increases the greenhouse effect, since the greenhouse effect power of natural gas is 23 times that of the main agent of this type which is carbon dioxide.

A large part of the injected fluid returns to the surface (between 30 and 50%) and this fluid is highly contaminating.

The one that remains in the subsoil can migrate toward water layers and contaminate them.

In Neuquén, the first 500 m of the vertical pipe will be required to be cemented in order to avoid the contamination of the underlying water layers.

However, due to the cracks generated in the rocks by the injections of water, sand and chemicals, the contaminated fluid can ascend to these layers.

Oil and gas wells that lose their structural integrity also leak methane and other pollutants through the liners and release them into the atmosphere and water sources.

Why do so many wells leak? Underground pressures, temperature changes, earth movement from drilling nearby wells, and shrinkage crack and damage the thin layer of cement that is supposed to seal the wells. Keeping the cement in perfect condition while drilling horizontally in the shale is extremely difficult. Once the cement is damaged, repairing it thousands of meters underground is expensive and often unsuccessful. Oil and gas industries have been trying to solve this problem for decades. See: "Shale gas towards a warmer future"; Engineer Anthony R. Ingraffe, researcher and professor at Cornell University, Ithaca, New York State, USA; source: Diario Clarín, Buenos Aires.

For the fluids that come out there are two alternatives:

Treat them in plants at the foot of each platform, but then the separate contaminants where they go, are they moved?

Take them out in trucks and deposit them in other places and then move them again.

In conventional farms, there are almost 5000 contaminated pools in Chubut Province alone.

The useful life of these unconventional wells is very low and the production is exhausted in 5 or 6 years. This then intensifies the drilling.

Once the life of the wells is over, they have to be abandoned and sealed with cement plugs.

The transport of water and materials and supplies causes a huge traffic of trucks, including cisterns, which circulate on rural roads.

In Neuquén, it is estimated that the water would come from Lake Mari Menuco or from the Colorado, Neuquén or Río Negro rivers. The consumption of water from the underground layers would be forbidden and only surface water could be used.

The Neuquén government has even announced that it will build a network of aqueducts in charge of the province to supply the needs of the oil companies.

The problem would not be water consumption but water contamination and the disposal of recycled sludge from the drilled wells.

Anyway, there are working techniques that can save water consumption.

According to the oil service company Schlumberger, the unconventional operations of five operators working in the Neuquén basin demand an annual average of 1,800,000 m^3 of water in an initial stage of exploration or semi-development. Of this figure, some 600,000 m^3 return to the surface (known as flowback water), a volume that must be treated and reinjected, and this is precisely the problem in the treatment and disposal of these waters.

The companies say that instead of 1,800,000 m^3, only 1 million, or perhaps less, could be used. But this would be a considerable technical challenge, requiring the help

of new software. It would have to be taken into account that between 40 and 50% of the fractured wells do not end up producing. Therefore, more detailed analysis should be done at all levels until the operation is completed. And all these variables should be integrated into one platform in order to reduce costs and increase production.

According to business people, it is already totally feasible to model non-conventional fractures (which are irregular and have multiple ramifications) to better predict which points have the greatest production potential. By optimizing the fractures, water consumption can also be reduced.

The technique to be used would be that of fracture with channels, which was created in Argentina and is already being used effectively in many countries, including the USA. Thus, instead of injecting sand continuously during the entire fracture, intermittent pulses of sand and fracture fluids would be made, thus saving this raw material.

In short, the companies claim that it is possible to use up to 60% less water in the shale industry, combining two already proven techniques and taking advantage of the experience and knowledge available in the country. This saving would be achieved, in 20%, through the selection of the fractures, integrating the information and using it to make better decisions and the remaining 40%, by means of the mentioned technique of fracture with channels that besides promoting the hydric saving would have other advantages, among which a greater conductivity would stand out.

In any case, the volume of water used, which is still reduced by almost 60%, must be treated and reinjected, and this is precisely the problem, in the treatment and disposal of this water, known as flowback.

In other words, the main problem is not water consumption, which if reduced will be welcome, but the final disposal of polluted water and this is no longer a problem of quantity but a problem of quality.

3.4 Reserves of Resources? Of "Non-conventional" Hydrocarbons

According to the opinion of the International Energy Agency (IEA) in a document of June 2013, some countries have huge oil and gas reserves that until relatively recently could not be tapped, and it was not even in their plans to do so. Thanks to technological advances, these unconventional hydrocarbons can now be extracted more easily and at sufficiently reasonable prices. Shale oil and shale gas, their names in English (in Spanish they receive others such as bituminous sands, shale oil and gas, shale gas …) may end up revolutionizing the world energy map. According to the latest estimates from the U.S. Department of Energy, the world has deposits containing some 345 billion barrels of unconventional oil, 10% of the world's total crude reserves. And also with almost 7.3 trillion cubic feet of unconventional natural gas, which is 32% of the world's total reserves. These figures already represent a turning point in the conception of the future of fossil energies. They represent an

increase in global reserves of 11% in the case of crude oil and 47% in natural gas and may also fall far short of the actual shale reserves the planet has. The report by the USA. Energy Information Administration (EIA) considers the reserves present in only 42 countries, only contemplates the resources that can be extracted by means of the technologies currently in use and, furthermore, leaves out other potential deposits that would be found under the large oil wells in the Middle East and the Caspian region, and which could be substantially larger than those already known. New hydraulic fracturing (fracking) and horizontal drilling techniques are being used to discover new oil and gas deposits trapped in the rock. But there could be much more. The huge reserves detected may be the gateway to an energy revolution, but it is still to be welcomed with caution that all of them may actually be exploited in the future. "The report shows significant international potential for unconventional oil and gas. But it is not yet clear to what extent technically recoverable resources are also exploitable in economic terms," says Adam Sieminski, director of the EIA. A new world energy map new reserves can drive a shift in the global energy status quo. At present, only the USA and Canada exploit their unconventional gas and oil reserves in truly commercial volumes. And they are called upon to be the protagonists of this new hydrocarbon boom. The USA seems to be the big winner. In fact, a few months ago the International Energy Agency (IEA) painted a new global scenario in which, thanks to its unconventional reserves, the USA would become the world's largest producer of natural gas in 2015 and in 2017 it would also be the leader in oil production. But other countries that are not yet exploiting the full potential of their unconventional fields may also become global giants in this new business. The great power of unconventional crude today is the USA, but Russia greatly surpasses it in shale oil reserves. The Russian giant holds one-fifth of all technically recoverable unconventional crude oil reserves in the world (75 billion barrels), followed by the USA (58 billion) and further behind by China (32 billion), Argentina (27 billion) and Libya (26 billion). These five countries account for more than 60% of all the world's shale oil reserves.

The battle for world leadership of unconventional natural gas will be much tighter. Estimates by the US Energy Information Administration recognize China as the country with the largest shale gas reserves (1.115 trillion cubic feet), followed by Argentina (802) and Algeria (707). The official data of the North American Government contemplates that the American reserves remain in the 665 trillion cubic feet of gas, which would leave it in fourth position. But the magnitudes handled by some consulting firms are pushing the USA's volumes up to the top of the world ranking. The Advanced Resources International group sets the US reserves at 1161 trillion cubic feet, which would surpass China as a major shale gas power.

However, other opinions, especially in Europe, and in some states of the USA and Canada, express well-founded concerns about the negative environmental impacts of the exploitation of these "non-conventional" hydrocarbons.

Finally, except in the USA and Canada, where they are already being produced commercially, in the remaining countries, the figures supplied are more similar to Resources than to Reserves, as there is still much work to be done in exploring and verifying the behavior, under an exploitation regime, of these structures (Fig. 3.2).

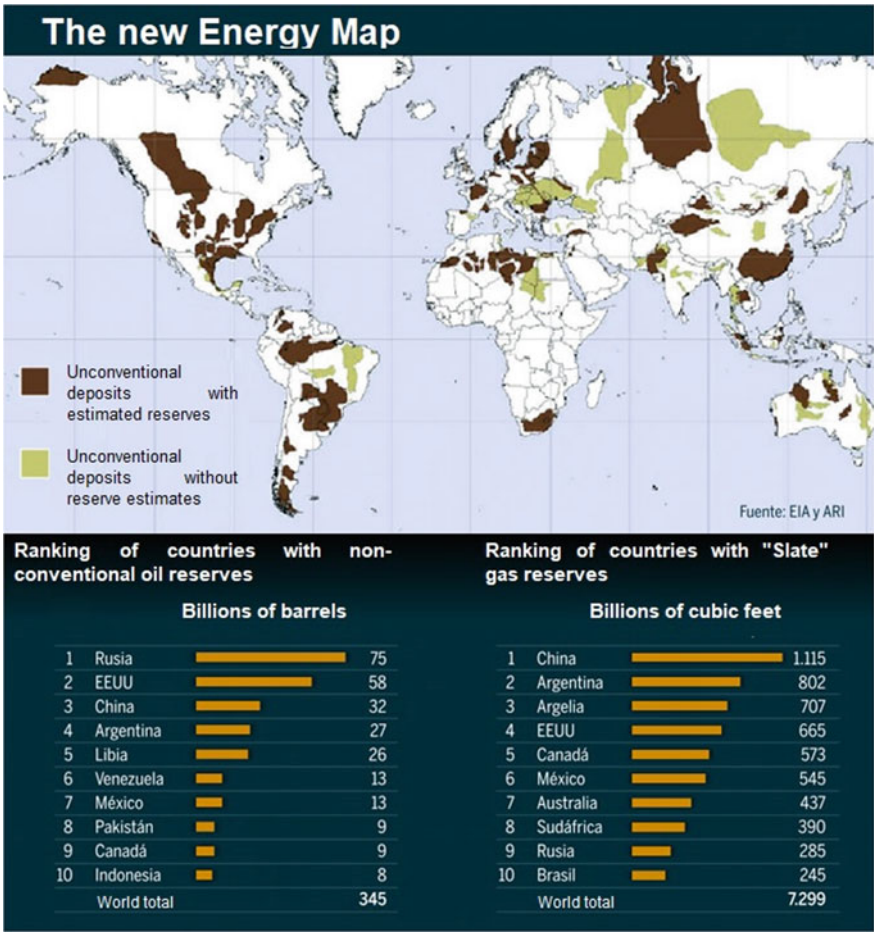

Fig. 3.2 The new energy map. *Source* Fracking a fracture that takes its toll, Aitor Ultrasti and Florent Marcellesi, September 2012, Political Ecology Journal N° 43, 16 September 2012

3.5 Why Fracking in Argentina?

Because more and more oil and natural gas are being imported and this affects the trade balance and there is practically a danger that the mentioned imports will absorb the trade surplus. And then where would the money come from for the imports that the country needs to make, for example, for the functioning of the industrial sector and to pay the foreign debt? Well, the Central Bank's reserves are not infinite and are partly committed.

Because the subsidies to the energy sector (to natural gas and electricity) together with those destined to the transport sector are one of the main causes of the budget deficit and the government inexplicably delays a change in the tariff policy. For

example, if cross-subsidies were applied in the tariff scales, so that the residential users who consume more and the service sector would pay more per unit consumed than the lower-income residential users and the industrial sector, and making this gradually, companies could have an average rate that covers their costs and an adequate expansion of their investments.

Because exploration for conventional oil and natural gas was stopped and a report by the International Energy Agency places Argentina in third place, behind the USA and China as the country with the largest non-conventional natural gas resources. Resources that would be equivalent to almost 70 times the current proven natural gas reserves The resources would be located in: the Neuquén Basin (in the Los Moles and Vaca Muerta formations there are 14 deposits that are being investigated by YPF; Petrobras; Pluspetrol; Pan American Energy; Apache; Exxon; Shell; and the provincial company); in the San Jorge Gulf Basin (Aguada Bandera); in the Magallanic-Austral Basin and in the Chaco Paranaense Basin. Vaca Muerta oilfield is currently being exploited and the Apache Company has produced about 1000 m^3/day of oil, equivalent to 1.4% of the total oil production of the country. In the rest of the structure, Vaca Muerta YPF has placed its greatest hopes and with the production obtained, it estimates that it would reach in 4–6 years self-supply of oil and thus stop importing LNG. One of the most serious drawbacks, from the business point of view (YPF) is the magnitude of investment required to explore (resources must be converted into reserves) and exploit these structures. A well with fracking costs between 12 and 18 million dollars when a conventional exploration well does not exceed, exaggerating, 4 million. That is to say that the investment needs are considerable, mentioning no less than US $7000 million dollars/year for no less than 5 years and currently YPF does not have these figures. As for the availability of technology, without minimizing, although YPF does not have the necessary experience, it can obtain it quickly, since the two essential elements of it, horizontal drilling and hydraulic fracturing, have been handled by YPF for many years.

3.6 Main Environmental Impacts of Fracking

This point is taken verbatim from the Document: “Fracking: a fracture that takes its toll” by Aitor Utresti and Florent Marcellesi of September 2012.

Risks during drilling

As already mentioned, special drilling techniques are required to enable subsequent hydraulic fracturing. For all these reasons, in addition to the usual risks of drilling for hydrocarbons, there are also the specific risks of drilling for diversions. We are therefore talking about risks of explosion, gas leaks, hydrogen sulfide leaks (very toxic in low concentrations), and formation collapses on the pipe. The latter is much more common in the case of diverted boreholes such as those carried out in this case. Let us remember that an average of 6–8 wells are being drilled per platform, and between 1.5 and 3.5 platforms per km^2, so although a priori the risk of an accident

of this type occurring per well is low, as the number of wells to be drilled increases the risk increases alarmingly.

Water pollution

One of the major concerns of hydraulic fracturing is the effect on underground aquifers. By fracturing the subsoil, there is a possibility that one of the induced fractures will reach an aquifer, contaminating the water with the fracturing fluids and with the formation gas itself. In addition to this risk, there is also the possibility that during fracturing it will connect to an old, poorly abandoned well, and hence the gas will communicate well with an aquifer, as it does with the surface. This type of accident has happened before, contaminating an aquifer through an abandoned well in the 1940s.

Chemical risk of additives

As mentioned above, about 400 tons of chemicals, most of which are highly polluting, are required in each drilling operation. When diluted to 2% in water, their level of toxicity is greatly reduced. However, these chemicals reach the platform unmixed. The risk of accident during transport must be taken into account. The number of truck transfers to be made for the density of wells to be drilled is high (which in turn leads to noise pollution and road safety). For each platform, the minimum movement of trucks is estimated to be 4000, a large number of them for the transfer of chemical products. Again, although the risk of an accident involving a chemical spill is low, the large number of operations to be carried out makes it a major risk.

Air pollution

Throughout the drilling and fracturing process, a large number of additives are used, many of which are volatile compounds. The same is true later in the production stage, where the extracted gas needs to be conditioned for injection into the pipeline. All these compounds pass to a greater or lesser degree into the atmosphere, and can generate ozone, or BTX (Benzene, Toluene, Xylene) among others.

Earthquakes

In those areas where the development of fracking is more advanced, an increase in seismicity has been observed, coinciding with periods of hydraulic fracturing. It must be taken into account that during fracking operations the subsoil is pressurized more than 100 times. This overstressing can be sufficient to cause displacement of underground faults, and therefore earthquakes, as has happened in Lancashire in the UK where the company Cuadrilla Resources has recognized that its drilling was the cause of two local earthquakes.

Greenhouse effect

Unconventional gas, because of the conditions in which it is found, is usually made up almost entirely of methane. This is a much more powerful greenhouse gas than CO_2 itself, specifically 23 times more powerful. This means that any leakage of it

during drilling, fracturing, and production is much more harmful than the gases that are generated later during its combustion.

The added problem of fracking techniques with respect to gas leaks is the fracking water in its return. Having been in contact with the gas underground, it absorbs a quantity of gas, which on returning to the surface is emitted into the atmosphere. It has been estimated that in a well in which hydraulic fracturing has taken place, the increase in methane emissions is 2%. A report from Cornell University therefore estimates that shale gas results in an increase in greenhouse gas emissions of between 30 and 100% compared to coal.

Land occupancy

An added problem is the high land occupation of this type of exploitation. As mentioned above, a large number of wells need to be made in order to make good use of the resources. Usually, 1.5–3.5 platforms are drilled per km^2, with an occupation of 2 ha each. The visual impact of this accumulation of wells is very great.

3.7 What About the Rest of the World?

This point is based on the Document: "Fracking: a fracture that takes its toll" by Aitor Utresti and Florent Marcellesi of September 2012.

Unconventional gas fields are distributed throughout the planet with a novel character: they abound in countries historically poorer in hydrocarbons. While in the geopolitics of conventional gas—and energy (in)dependence—Russia, Iran, Qatar and Saudi Arabia concentrate more than 50% of world reserves, in the geopolitics of unconventional gas the list is headed by China, the USA, Argentina, Mexico, South Africa, Australia, India and Europe (central and eastern Europe, France, UK, etc.) and North Africa play an important role. Meanwhile, in South America, besides Argentina, it is Brazil, Chile, Paraguay and even Bolivia, who are far ahead of the traditional hydrocarbon giant, Venezuela. Given that on the one hand the exploitation of non-conventional hydrocarbons is a potentially very profitable business with a central geopolitical character, and that on the other hand it entails serious environmental and health problems, it is not surprising that more and more socio-ecological conflicts are arising at all the extraction points where this technique of hydraulic fracturing is applied.

USA, the guinea pig of fracking

The first alerts have come for years from the USA where, according to data from the US Energy Agency, non-conventional gas production has risen from 1.4% of total US gas supply in 1990 to 14.3% in 2009, and may reach 24% by 2035. This previous experience allows us to have more perspective when analyzing what has happened, given that the first wells were started in the eighties, with a boom in the 2000s, and there are currently 500,000 wells drilled, and a forecast rate of over 30,000 new wells per year.

It is clear that the anti-fracking movement has made its voice heard: documentaries like Gasland, made by US environmental activist Josh Fox, which can be downloaded from the Internet, or Fracking Hell and organized citizen platforms like "No Fracking" show the political and commercial complex hidden behind the exploitation of unconventional gas and its environmental and health consequences in the USA.

"The Promised Land," an anti-fracking film co-written by Matt Damon and John Krasinskipor, and directed by Gus Van Sant, is in preparation: https://www.huffingtonpost.com/2012/04/06/promised-land-matt-damon-fracking_n_1408501.html (it's pretty bad despite good intentions).

The main conclusions that can be drawn from the American experience are once again reminiscent of the classic patterns of conventional socio-ecological conflicts.

The collusion between political and economic powers: under the Bush Junior administration and after an incessant lobbying by the energy transnationals, it caused the repeal of several of the most important environmental protection laws in the US, among them the Safe Drinking Water Act, so that this law would not be applied to fracking. This provision has come to be called the "loophole" or the "Halliburton amendment," since the multinational Halliburton is one of the pioneers and one of the largest providers of hydraulic fracking services in the US, and whose previous executive director was none other than Dick Cheney, then Vice President of the US when this specific legal exemption was approved.

The economic power of the energy multinationals with checks to buy the land; with promises of new sources of employment around the wells. On the other hand, the very aggressive publicity campaigns, get the approval of both the owners of the land, where the gas is, and the economic, political and legislative actors. They also generate their own expert reports where they self-excuse themselves from any environmental pollution or health effects. In fact, due to the weak role of the federal Environmental Protection Agency, the federal states, with tight budgets, are defenseless to face interests and budgets in the millions, which in turn explains that "21 states out of 30, where there are wells, have no specific regulations and none require companies to report the amount of toxic fluid that remains underground".

Harmful effects on the environment and health: in addition to the environmental risks mentioned above, there have been cases of cancer, respiratory problems, brain damage, neurological disorders, hypersensitivity to chemicals, mainly due to water and air pollution. As stated by Grandoso, Duke University has carried out a study that shows that the drinking water wells near the extraction sites have a very high concentration of methane.

A study showed that drinking water wells near extraction sites have very high concentrations of methane, "an indoor asphyxiant and a fire and explosion hazard," while in the Texas town of Dish surrounded by wells, 61% of the recorded illnesses were associated with the contaminants used by the fracking. In November 2010, a study by the Environmental Protection Agency in Wyoming linked contamination of drinking water wells to fracking.

After fifteen years of trials, struggles and diverse lobbying, confrontations between anti-fracking movements and transnational energy companies have resulted in the temporary suspension of water fracking in New Jersey, New York and Pennsylvania

until the risks of contamination of drinking water are better understood, while 16 municipalities have approved local bans (but without regulatory capacity over the gas and oil industry), and Vermont has become the first federal state to approve the ban in May 2012. In addition, in September 2010, the federal Environmental Protection Agency (EPA) requested information on chemicals used by extractive companies: eight responded, and a subpoena was needed for Halliburton to respond. As a symbol of this struggle—among other less publicized ones—Josh Fox is today on the US government's "Terror Watch List" and, denounced by the American Civil Liberties Union, he was arrested in February 2012 when he attended with his camera a public hearing of a US Congress commission dominated by the Republicans and where the harsh conclusions of the EPA about fracking were analyzed.

A new study reveals the contamination of drinking water wells near shale gas extraction sites in the USA, which could reignite the debate on the environmental impact of this controversial technique.

Researchers from Duke University in North Carolina (east) analyzed water samples from 141 private wells that supply homes in the Marcellus shale gas basin in northeastern Pennsylvania and southern New York State.

Methane concentrations in drinking water from homes within a kilometer of the drilling sites averaged six times higher than water from homes farther away, while ethane concentrations were 23 times higher.

The amount of methane in most of these wells far exceeded 10 mg per liter of water, the maximum level accepted by the US health authorities.

Propane was also detected in 10 water samples from household wells located less than one kilometer from the extraction sites.

"The results on methane, ethane and propane, as well as new indications of traces of hydrocarbon isotopes and helium, lead us to believe that the extraction of shale gas has affected the sources of drinking water in homes," said Robert Jackson, professor of environmental sciences at Duke University and lead author of this paper published in the Proceedings of the U.S. National Academy of Sciences (PNAS) Jun. 24–28.

The data on ethane and propane contamination "are new and difficult to disprove," he insisted.

"There is no biological source of ethane and propane in the region, and the Marcellus shale gas basin is rich in these two gases," said the researcher.

These scientists have considered all the factors that could explain the contamination, including the topography and geological characteristics of the site.

"Our research shows that distance from extraction sites, as well as variations in local and regional geology, are the main factors in determining the possible risk of groundwater contamination that should be considered before drilling," explained Avner Vengosh, professor of geochemistry and water quality, and co-author of the paper.

Previous studies by researchers at the same university had found evidence of methane contamination in water wells located near drilling sites in northeastern Pennsylvania (Source AFP-Terra.com, June 26, 2013).

However, a third study, conducted by scientists from the U.S. National Geophysical Institute, had found no evidence of drinking water contamination from shale gas extraction in Arkansas (center).

None of these investigations have detected contamination from the fluids—a mixture of water and chemicals—that are injected under high pressure to fracture the rock and release the shale gas.

Europe and the rest of the world

After the US trial, fracking has landed in Europe and many other parts of the world where, as in the US, several socio-ecological conflicts have been generated, with the dominant economic and political powers facing up to neighborhood, social and environmental groups that denounce the risks inherent in the exploitation of non-conventional gas.

At the level of the European Union, where the International Energy Agency estimates that Europe's reserves of non-conventional gas are 35 trillion m^3, equivalent to forty years of gas imports by current standards, the legislative complexity is once again apparent. So far, the recommendations of the European Parliament, which indicated in July 2011 that "the environmental risks and burdens [of fracking] are not offset by its corresponding potential benefit," are opposed. It recommends that they be regulated and that the components used in the wells be made public, as well as those of the European Commission, which has the capacity to promote a directive on the subject, and which considers that existing legislation can be applied to both conventional and non-conventional gas. In addition, the battle continues in the European Parliament where, on the initiative of a Polish MEP, a report promoting the expansion of fracking gas in Europe has been discussed in the Committee on the Environment, Public Health and Safety. On the other hand, at the end of April 2012, the European Union's Committee of Petitions studied 8000 signatures on the risks associated with this technique. For its part, the anti-fracking movement, through a coalition of 36 non-governmental organizations specializing in the fields of the environment and health, mainly from Europe but also from the USA, Australia and South Africa, has called on the European Union "to ensure that until these problems are properly addressed through a thorough scientific assessment (…) activities related to the extraction of gas and oil from shale, as well as methane from coal seams, should not be continued." They urge Member States to "suspend all ongoing activities, revoke permits and prohibit all new prospecting and exploitation projects." Finally, in May 2012 the European Green Party, very active in the European Parliament, and the social mobilizations with the MEP and alter globalist José Bové, spoke out for all of Europe against the exploitation of non-conventional gas by means of hydraulic fracturing.

The situation in Europe at country level

Germany

Moratorium in the state of North Rhine-Westphalia from March 2011.

Bulgaria

The Bulgarian Parliament passed a resolution banning water fracturing on its territory in January 2012 and provides for a fine of around 50 million euros and the confiscation of the equipment used by those entities that practice it.

Previously, Bulgaria withdrew Chevron's first license for slate gas extraction in North-Eastern Bulgaria.

Opponents of fracking are calling for the resolution to become law.

Czech Republic

The Minister of the Environment proposes a temporary ban for about two years so that new laws can be drafted to regulate the rules for surveys in which various foreign companies have taken an interest.

France

Exploitation of hydrocarbons by fracking prohibited by law since July 2011 for injecting "extremely aggressive products" and resulting in "destroyed landscapes, contaminated water" and "dubious safety."

There is a "National Coordination of Groups against Slate Gas and Oil."

The new French president, François Hollande, while opposed to the exploitation of unconventional gas, does not oppose research, exploration or the withdrawal of drilling licenses or permits.

Northern Ireland

At the end of 2011, he declared a moratorium until environmental studies are carried out.

The Netherlands

National moratorium until summer 2012 until the effects of the technique are known.

Poland

No specific regulation.

Called "fracking heaven," the Polish field would have a central geopolitical importance in counteracting dependence on Russian gas and Gazprom's interests.

After publicizing an estimate of reserves that placed it as the largest field in all of Europe, the latest news reports a volume of gas 10 times less than predicted.

Seven people, including government officials and businessmen linked to Petrol Invest, have been accused of offering or accepting bribes in the granting of licenses to search for unconventional gas in 2011.

UK

No specific regulation.

Some operation of Cuadrilla Resources in Lancashire has been suspended following the occurrence of seismic movements.

Romania

Despite the support of the Romanian President, the newly elected government is preparing a moratorium on fracking.

After the ban in Bulgaria, Romania represented Chevron's new hope.

Sweden

Sweden would allow small-scale fracking under an appropriate regulatory framework.

Switzerland

In April 2011, the canton of Freiburg suspended all authorizations to search for slate gas on its territory.

Ukraine

No specific regulation.

Although estimates differ, it would potentially have with Poland the most important reserves in Europe.

Auctions have started to grant the first exploration and exploitation permits.

Ukraine wants to reduce its dependence on gas imports from Russia.

Exxon, Chevron, Shell, BP, ENI have made offers for the first lots.

Spain

Due to the great lack of transparency or information on the part of the public authorities, it is not easy to know exactly the reality of non-conventional gas exploitation in Spain and to know which permits or concessions in force or requested are for conventional and non-conventional hydrocarbons. As far as non-conventional gas is concerned, the areas of greatest interest for political and economic interests and of greatest social conflict are currently to be found in the so-called Basque-Cantabrian basin (which includes mainly deposits in Cantabria, Álava, Burgos and to a lesser extent Bizkaia, Navarra, La Rioja) and, with a view to the future, also in Aragon, Seville and Jaén. While in Cantabria there is a permit with several wells under the name Arquetu and in Burgos some 20 research wells are planned, the most important deposit is in Alava in the Gran Enara permit where, according to the Basque Energy Agency (EVE), an estimated 184,500 Mm^3 of reserves are located, which would mean, ignoring the extraction ceiling of the wells, the consumption of the Basque Country of 60 years and of Spain for 5 years.

Therefore, although there is currently no state platform linking the different local struggles against fracking, different anti-fracking movements have been organized in each affected area. Whether in Cantabria, where the first permits were issued and a website was launched with the most information in Spain on fracking, in the Basque Country (mainly in Alava and then in Bizkaia) or in Burgos and Navarre more recently, the social and political struggle has reached a significant degree of conflict, making it difficult on the one hand for the political-economic roller to roll and on the other hand allowing a greater degree of awareness and information for

society. Furthermore, thanks to this work, more than 15 municipalities in Alava have declared themselves free of fracking, while Vitoria-Gasteiz (European green capital 2012!) is demanding an Environmental Impact Study for all the wells or in Cantabria several town halls have appealed for permits in the Arquetu area.

It is also of great interest in the construction of more global alternatives that the anti-fracking struggle once again demonstrates the confluence and unity of action that is increasingly normal and powerful among movements for environmental, social and democratic justice. For example, in the Basque Country, the anti-fracking collective includes ecological associations (Ekologistak Martxan, Eguzki, Gaia, Mendialdetik, etc.), political parties (Bildu, Equo, Izquierda Unida, Aralar), the 15M movement and individuals, or in Cantabria, where they include people affected by the issue and organizations concerned with it, such as the 15M movement, Democracia Real Ya, Ecologistas en acción, ARCA, Asamblea contra el TAV, Agitación Rural or Regüelta (You can see the situation in Spain in the documentary "The Shadow of the Fracking" that can be downloaded from internet https://vimeo.com/46871495#t=4).

In the rest of the world

In the rest of the world, whether in South Africa, Quebec, Australia, for example, citizen mobilizations have achieved moratoriums. In contrast, in China, where due to the lack of opposition, the Chinese government signed an agreement with the USA in 2009 and has already begun to drill with the promise that its reserves will be the most important in the world.

Something else about the USA

The exploitation of "unconventional" hydrocarbons through the technique of fracking (especially Permian) in the USA has changed the world's hydrocarbon landscape.

To demonstrate this, Table 3.1 includes the situation of the main concepts referring to hydrocarbons in the USA, comparing what was happening in 2008 (before the fracking boom) with what happened in 2018.

The growth in all concepts has been remarkable, becoming in 2018 the first world producer of oil and Natural Gas and the third world exporter of LNG after Qatar and Australia.

In 2008, the USA imported the equivalent of 66% of the oil it consumed and in 2018 it will import 48.5%.

In 2008, the USA exported 29% of the oil it produced and in 2018 46.6%.

In this way, the USA has reduced its dependence on imported oil, especially from the Middle East, and has practically limited it to that which it buys from Canada and Mexico.

The OPEC countries and Russia have been the most affected by the appearance of the USA as a competitor in the world hydrocarbon market.

The question is whether this situation can be maintained in the medium and long term, beyond the processes of substitution of fossil fuels that are taking place in the world.

But the boom of fracking in the USA has as its counterweight the enormous investment effort required to contain the natural decline of the productive structures,

Table 3.1 US hydrocarbon data

	Units	2008	2018
Oil proved reserves	Thousand million barrels	28.4	61.2
Oil production	Thousands barrels per day	6783	15,311
Oil consumption	Thousands barrels per day	19,490	20,456
Oil imports	Thousands barrels per day	12,872	9929
Oil exports	Thousands barrels per day	1967	7131
Natural gas proved reserves	Trillion cubic meters	6.8	11.9
Natural gas production	Billon cubic meters	546.1	831.8
Natural gas consumption	Billon cubic meters	628.9	817.1
Liquefied natural gas imports	Billon cubic meters	9.7	2.1
Liquefied natural gas exports	Billon cubic meters	1	28.4

Source BP Statistical Review of World Energy

which at present would seem to be sustained almost entirely by the exploitation of the Permian and which has led to the bankruptcy of numerous small- and medium-sized oil companies. The fact is that international oil prices and LNG prices have not accompanied the growing evolution of production, despite the efforts that companies have made to reduce their costs.

That is why it is pertinent to show the work included below:

Fracking in the U.S. all that remains is the permic and that will always last (taken from HFI Search, Seeking Alpha, February 19, 2020)

Summary: In the coming months, the story that U.S. oil production growth will slow down materially will become the main reality. Using an estimated 11,728 wells to be completed this year, we have U.S. shale oil growth of ~424 k barrels per day (b/d) year over year. So, although the overall figure is still positive, all the growth will come from the Permian.

The declining productivity profile of the wells at Bakken, Eagle Ford, Niobrara and Anadarko, combined with the completion of lower wells in 2020, will result in a decline in extraction. This will be the first annual decline in these basins since 2016.

But to make matters worse, the Permian will not be able to sustain the growth of US oil production much longer either. If we assume ~5500 completed wells in the Permian per year, the growth rate begins to plummet after 2020.

In the coming months, the story that U.S. oil production growth will slow down materially will become the mainstream. We are already seeing this in the real-time data with US oil production. Now falling to ~12.6 mb/d, but this will become more evident in the coming months as the EIA 914 reports double-check the data we see.

Most important, however, is the breakdown of US oil production growth this year (Table 3.2 and Fig. 3.3).

Table 3.2 Shale oil production

Shale Oil Production	Average Production	Growth
2017	5,831,751	516,180
2018	7,383,498	1,551,747
2019	8,599,148	1,215,650
2020e	9,023,224	424,076
Total Growth	**3,191,473**	

Source EIA, HFI Research

Using an estimate of 11,728 wells to be completed this year, we have a growth in US shale oil ~424 kb/d year on year

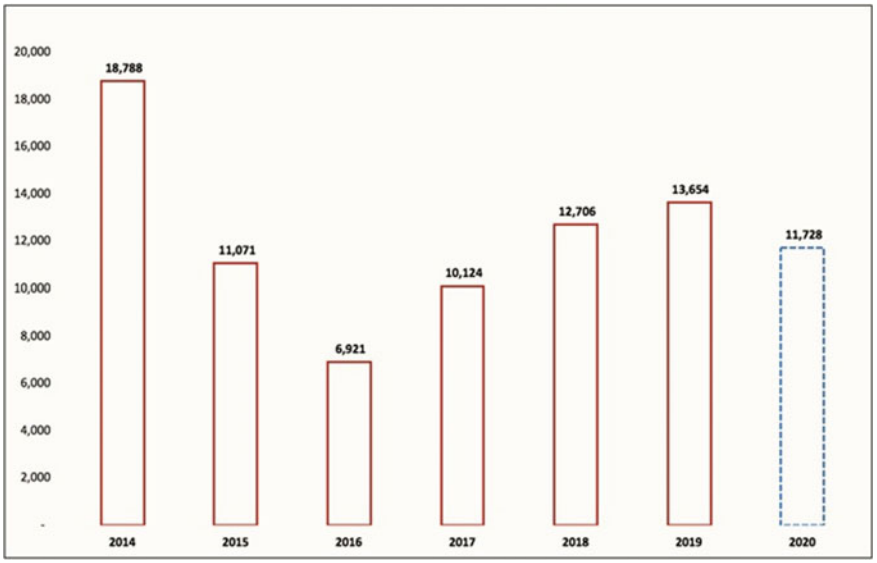

Fig. 3.3 Total wells completed. *Source* EIA, HFI Research

So, although the overall figure is still positive, all the growth will come from the Permian (Fig. 3.4).

The declining productivity profile of the wells at Bakken, Eagle Ford, Niobrara and Anadarko, combined with the completion of lower wells in 2020, will result in decreased production. This will be the first annual decline in these basins since 2016.

But to make matters worse, the Permian will not be able to sustain the growth of US oil production much longer either. If we assume ~5500 completed wells in the Permian per year, the growth rate begins to plummet after 2020 (Figs. 3.5 and 3.6).

This is just the nature of shale. As the base production increases, so does the base rate of decline. The proverbial treadmill increases with pace, so without a corresponding increase in productivity or well completion rates, growth inevitably stops and becomes absolute decline. According to our estimate, the total production gain in the Permian from 2020 to 2025 is only a small ~426 kb/d.

So where does that leave the world's oil supply in the future? (Fig. 3.7).

Goldman estimates that by 2025, OPEC needs to increase oil production by ~5.4 mb/d. But that is under the assumption of +2.3 mb/d of US oil shale. If U.S. shale can only add ~1 to ~1.5 mb/d, the deficit increases to ~6.2 mb/d.

We do not think this scenario is feasible at all with Brent below $60/bbl. One of these will have to give way. Either oil prices will skyrocket to begin destroying demand, or the supply deficit is unavoidable.

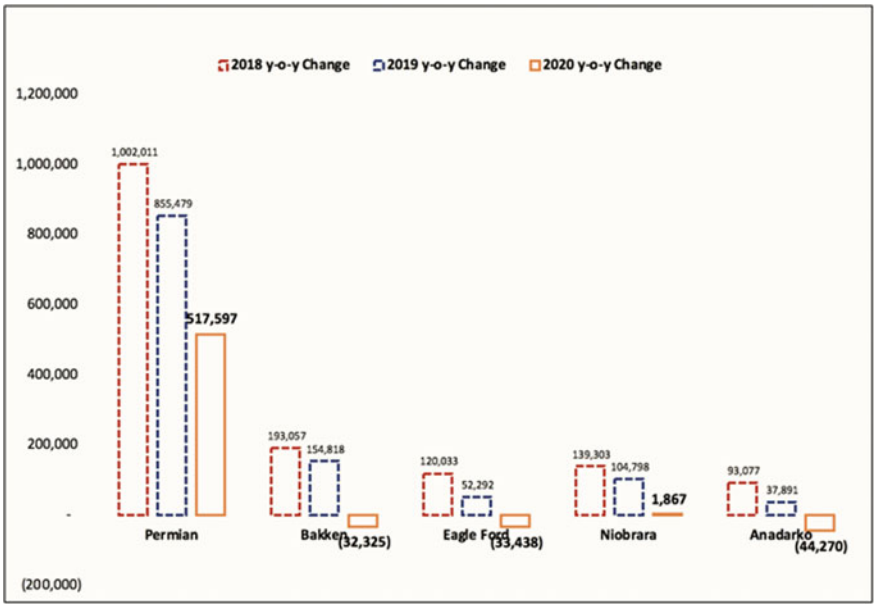

Fig. 3.4 US shale production growth by basin. Fuente: EIA, HFI Research

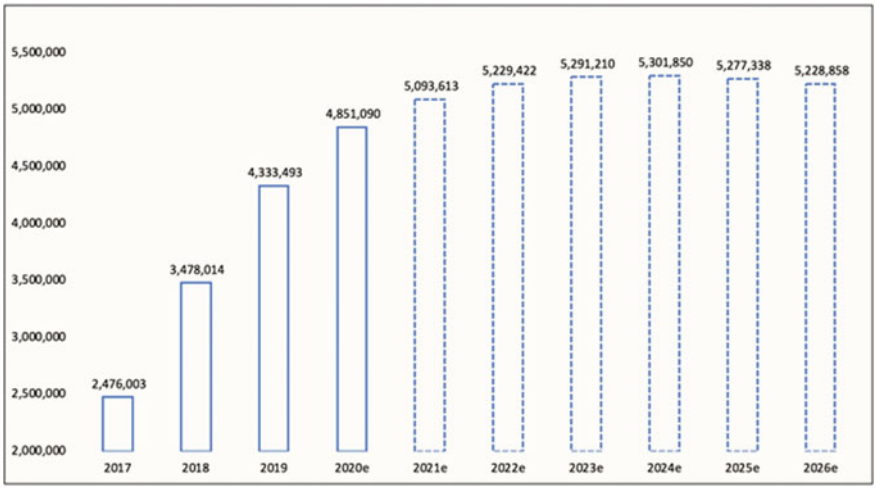

Fig. 3.5 HFI research Permian oil forecast average production. *Source* EIA, HFI Research

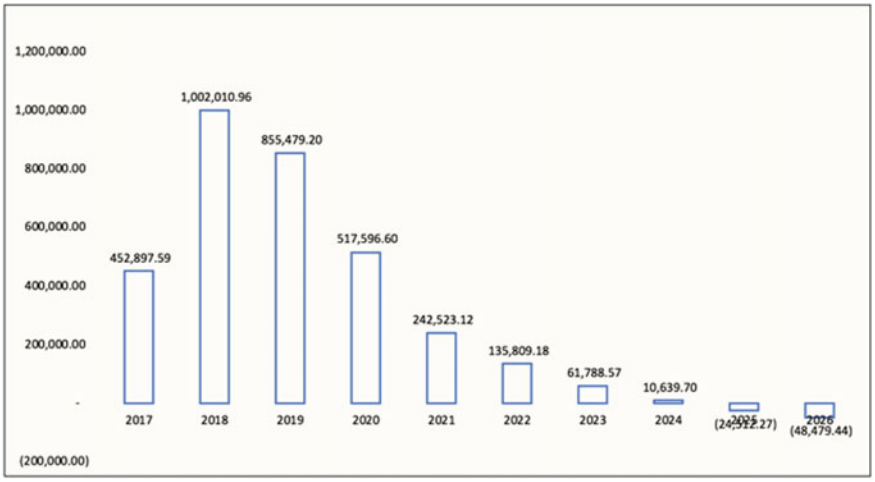

Fig. 3.6 Permian production growth year to year. *Source* EIA, HFI Research

3.8 Conclusions

At the global level, we must reduce the consumption of hydrocarbons by changing the consumption patterns of today's society, using energy savings and gradually replacing these energies with other renewable energies (hydroelectric, solar, wind) and nuclear, in the knowledge that they will not disappear anyway.

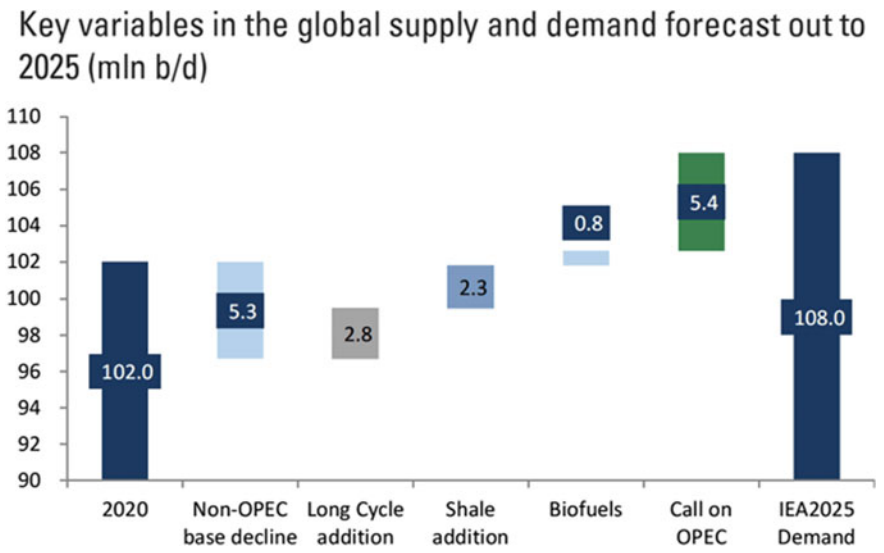

Fig. 3.7 WE estimate a 5.4 mln b/d callus n OPEC between 2020 and 2025 to meet IEA "current policies" demand forecasts *Source* IEA, Goldman Sachs Global Investment Research

For Argentina, in addition to what was expressed in the previous paragraph, it would be necessary to insist on the search for conventional oil and natural gas, since for almost 15 years it has been practically unexplored in the mature basins and in the continental territory or explore the continental shelf whose potential is unknown or increase the production of the mature deposits, the old deposits. One example is the long life of Cerro Dragón in Chubut.

Given the environmental impacts generated by the exploitation of non-conventional hydrocarbons through the use of the fracking technique, declare a moratorium while the corresponding specialists carefully analyze and with the necessary time all the implications that this technology brings with it and then obtain the social license granted by the inhabitants of the affected regions, as well as those who carry out productive activities in them.

Annex: The YPF-Chevron Contract

First of all, it must be said that the content of the agreement is secret so that what is known has actually transcended from authorities and specialists who are supposed to be well informed.

1. Concise content

It is signed between YPF and the international company Chevron.

Chevron is one of the main oil companies in the world, with private capital, of North American origin, and which has behaved poorly in terms of respect for nature and the rights of native peoples (in reality the same could be said of the large international oil companies).

In the case of Argentina, the State YPF, although it was not an example in terms of care for the environment, it was the creator of towns, roads and harbors that continued to exist even with less production of petroleum.

Investments and tasks of the agreement

Amount Chevron	Amount TPF	Period	Area	Wells
10^6 US $	10^6 US $	Years	Km^2	Nº
1240	260	1.5	20	100
4500	4500	5	375	900
8250	8250	33.5	375	1677
13,990	13,010	35	375	2677

10 million dollars per well
Source Private information

A concession is given, that is to say, take a certain area of the Province of Neuquén, 395 km^2, which is given to take out the hydrocarbons for 35 years.

In exchange, Chevron invested 1240 million dollars in 18 months to drill, in 20 km^2, 100 wells, in what they call a "pilot" job.

If things go well, that is, if the wells produce interesting amounts for the companies, the other investments to develop the field in the remaining 375 km^2 would be put in equal parts by YPF and Chevron. In the next 5 years, they would put 4.5 billion dollars each to drill 900 wells, and in the years remaining until completing the 35 years, they would put 8.25 billion dollars each to drill 1677 more wells.

YPF is the one that operates the area, that is to say, it is in charge of the responsibility of the works with the contribution of the technical knowledge of the personnel of Chevron.

The petroleum and natural gas at are taken out are distributed in equal parts.

When the country is able to produce enough so that petroleum and natural gas do not have to be imported, Chevron, after the fifth year of operation, will be able to export the petroleum or natural gas, having the freedom to send abroad up to 20% of the US dollars product of that sale.

If the country continues to import, Chevron can sell this 20% to the country as if it were exporting it and send the corresponding dollars abroad.

For the Agreement to be effective, the owner of the hydrocarbons from Vaca Muerta, which is Neuquén province, must give their approval. The governor agreed to a Decree that must be approved by the provincial Congress. This Decree essentially extends the concession in one of the areas, so that it also expires in 2048. In exchange,

Neuquén seems to receive some special benefits. These are: a canon and something called Responsibility, which add up to 65 million dollars; in addition, the natural gas is removed from the subsidium for a Methanol plant, from which it is will be in charge of the National Government, which will also deliver 1 billion pesos for works in several locations near Vaca Muerta oil field. Additionally, Neuquén will receive 5% of the profits left by the YPF-Chevron association after 2027. To cover itself the provincial Decree includes a reinsurance clause that declares the concession null and void, and the area flies to the Province, if the companies do not comply with their investment plan. That is to say, it receives concrete promises in money if the project, the reason for the Agreement, reaches a successful conclusion.

In order not to think that this agreement was only for the benefit of Chevron, the National Executive issued Decree 929 of July 15, 2013, which provides for similar conditions for companies that invest no less than one billion dollars during the first five years of operation.

2. **Observations and comments**

(i) Firstly, the potential environmental damage implied by the type of operation, the "multiple hydraulic fracture." This technology is highly questioned in North American countries (where it has been most applied), has been banned in some European countries and has merited a negative statement by the European Economic Community's Commission on the Environment. The environmental damages refer, essentially, to the contamination of the water used for the operations (it has some aggregates of chemical products that are dangerous for the health of living beings), more than to the amount of water used. A part of it returns to the surface and it is not defined where it will be deposited and how it will be treated on the surface to be "clean." In addition to possible contamination, water used under high pressure to make hydraulic fractures can escape through cracks in underground rocks into fresh groundwater layers even if these are far away from the place where the fractures were made. Natural gas can also escape to the outside, and it has happened in North America, and this is very harmful to the environment because it raises the temperature of the planet. Of course companies have their answers saying that they can solve these problems.

That is, the main problem is not water consumption, which if reduced will be welcome, but in the final disposal of contaminated water and this is no longer a problem of quantity to become a quality problem.

Productivity of "non-conventional" and "conventional" wells

Oil

Concept	Non-conventional EP	Conventional EP
Initial production	350 Bl/day	350 Bl/day
Production at 5 years	50	205
Additional wells	4 times	

(continued)

(continued)

Concept	Non-conventional EP	Conventional EP
Investment per well	10–12 million US $	1–4 million US $

Source Tecpetrol, Views & Strategies for Long-Term Development of Unconventional Resources in Argentina July 17, 2013

For conventional estimates.

Natural gas

Concept	Non-conventional EP	Conventional EP
Initial production	255,000 m^3/day	255,000 m^3/day
Production at 5 years	11,300 m^3/day	180,000
Additional wells	15 times	

Source Tecpetrol, Views & Strategies for Long-Term Development of Unconventional Resources in Argentina July 17, 2013

For conventional estimates.

(ii) The lack of serious consultation with and information for the people living in the areas where the operations are to be carried out, as indicated by the International Labour Organization (Convention 169 June 1989) and the Argentine Environmental Law (National Law 25,675 November 2002).

(iii) The fact that the Convention is secret and not of public knowledge, at least for the legislators, opens questions as to what clauses it may not contain that are beneficial for the country. They say it is because of the commercial secret.

(iv) The association of State companies with international or national private companies is now common practice in almost all countries (including Venezuela, Ecuador and Bolivia), and everything depends on how these associations are made and how the national interest is protected.

(v) The fact that the companies can keep 20% (in this case, after the fifth year of operation) is better than what happened in the 1990s with decree 1589 of 1989, which allowed the transfer abroad of 70% of the foreign currency obtained and did not respect the condition that before exporting the country was self-sufficient in petroleum.

(vi) If what is wanted is to stop importing by increasing production, it must be taken into account that today YPF does not have all the country's deposits but only produces 36% of the country's petroleum and 24% of the natural gas.

(vii) With this agreement, assuming that the pilot plan on the 20 km^2 area satisfies the companies, in 2048 a quantity of petroleum (10,000 m^3 per day) would be produced that would not be enough to compensate for the normal drop in petroleum production between 2013 and 2048 which would be (being very conservative) of 16,000 or 20,000 m^3 per day. In other words, this investment of almost 28 billion dollars between 2013 and 2048 would not even be enough to cover the natural decline of the current YPF deposits.

(viii) On the other hand, in the "non-conventional" petroleum fields, production decreases year after year (e.g., wells start producing 350 barrels per day and after 5 years they produce 50 and in the natural gas fields they start producing 255,000 M^3/day and after 5 years they produce 1300) and this forces, as it happens in North America, to drill many wells annually and to spend a lot of money. On the other hand, the "conventional" petroleum fields start producing 350 barrels per day and after 5 years they produce 205 and the natural gas fields start producing 255,000 m^3/day and after 5 years they produce 180,000. This requires spending less money and drilling fewer wells.

(ix) This is an agreement fundamentally to produce petroleum and additionally some natural gas, when the fuel that the country needs most is natural gas and that represents, between what is bought from Bolivia by pipeline and what is brought in liquefied by ship, almost 7 out of every 10 dollars spent on importing fuels.

(x) The proposed investment would not be far from the possibilities of the country and YPF, if it were convenient to exploit today Vaca Muerta oil field, because it would involve 620 million dollars a year until 2015; 1800 million per year between 2016 and 2020 and 600 million dollars a year between 2021 and 2048.

(xi) The knowledge to carry out the exploitation today is not available but can be "bought," hiring and paying foreign specialists until ours learn it.

(xii) In my opinion, given the characteristics of this type of exploitation, and this goes beyond the Chevron-YPF Agreement, those who really win are the companies selling equipment and specialized services, all of them foreign.

3. **Why this agreement is made**

(i) **The "ideological" framework**

Throughout history, since the beginning of the twentieth century, in Argentina there have been, roughly speaking, two types of policies with respect to hydrocarbons (petroleum and natural gas). One of national content (governments of Irigoyen, Alvear, Illia; first and third presidency of Perón and partly of Alfonsín's) that thought in the country and in the use of the natural resources for the well-being of the people before the private gain.

Another one of favorable content to the national and foreign private capital that alienated this wealth (all the other governments) and that was unfavorable for the energy companies of the State.

In 2012, it seemed, with the expropriation of 51% of REPSOL shares, that the State YPF would reappear, but many doubts remain and the YPF-Chevron agreement does not contribute to clarify them.

(ii) The production of petroleum and natural gas in Argentina has been falling year after year, while consumption is growing.

The main causes of this situation are:

The reduction of the production capacity of the State YPF first and then the sale at a rather low price of the State YPF to REPSOL, a Spanish company.

This company was dedicated to strongly produce petroleum and natural gas, already discovered by YPF State-owned, to export it and recover as soon as possible the money from the purchase of YPF State-owned.

REPSOL stopped investing, that is, dedicating money to explore, to replace the petroleum that it exported and the country was left without petroleum and natural gas reserves. The petroleum and natural gas were sold abroad at a time when prices were almost four times lower than what it costs today to bring them from abroad.

(iii) As a result, today the country must spend many dollars to import the petroleum and natural gas that are needed for consumption. Fuel imports, mainly natural gas, take 15 out of every 100 dollars that come in for exports and there is less money left to buy outside things that the country needs for industries and the countryside to work.

The other fuels that are imported are the fuel oil and the gas oil that are consumed to produce electricity and for the industrial ones and that before used natural gas.

In addition, in the last 20 years the necessary investments were not made to build new refineries that convert petroleum into naphtha, gas oil and fuel oil, so more and more of the last two must be imported, as there is not enough natural gas to replace them, especially to produce electricity. Neither is the abundant wind used, nor new hydroelectric plants, nor nuclear plants, which would avoid consuming more natural gas.

(iv) The third cause mentioned, to sign the Agreement with Chevron, is that, according to the international experts Argentina has a lot of petroleum and natural gas in deposits called "non conventional" hydrocarbons. They say that the reserves (that is to say what can be extracted from what is in the rocks) can be, and only in the zone of Vaca Muerta oil field; 10 times greater than the reserves of petroleum and 70 times natural gas that the country has today. This is only a hypothesis that has not been verified yet.

(v) But to take out this non-conventional petroleum and natural gas from the rocks underground is very expensive (almost 3 or 4 times more than the petroleum and natural gas that is taken out today from other places in the country) and it is said that YPF does not know how to take it out, it does not have the knowledge to do it, which is called technology.

In other words, it is said, you have neither the money nor the technology to produce this "non-conventional" petroleum and natural gas without the input and knowledge of foreign companies.

(vi) In summary, the reasons given for signing the Convention are: the fall in production, the increase in imports, the lack of money in YPF to invest and the lack of technology to produce in the area of Vaca Muerta oil field.

4. **Possible alternatives**

The energy problem of the country is not only of petroleum and natural gas but of the set of all the forms of energy that can be used (electricity produced by the water, by the nuclear fuels, by the wind, by the sun; and what can be obtained with a good handling of the vegetables). That is to say that we have to see what country we will have in 30 years.

We have to modify the structure of electricity and natural gas rates and increase them little by little for high- and medium-income family consumers and for the commercial sector and to a lesser extent for industries. In this way, we will be able to make gas prices in carafes more similar to natural gas and the amount, today very large, of energy subsidies that in good measure are received by the rich who can pay higher rates will decrease.

Instead of putting almost all the eggs in the basket of petroleum and natural gas from fields like Vaca Muerta oil field, allocate an amount of money, about US $1000 million per year, to make between 200 and 250 exploration wells in areas where they can find petroleum and "conventional" natural gas. The cost of drilling wells in "non-conventional" areas, such as Vaca Muerta oil field, is 3–4 times higher than in conventional areas. Furthermore, in the last 20 years, since the privatization of the state-owned YPF, the exploratory effort is almost nil. If it is not explored it is impossible to discover petroleum and natural gas. But more "conventional" petroleum and natural gas must be found and instead the "non-conventional" ("Vaca Muerta" type) has already been "discovered" and the big question is how much petroleum and natural gas will finally be extracted and at what environmental, social and monetary cost. More information on this will be available after investing US $1240 million dollars in the first stage of Vaca Muerta oil field and verify how much the production of petroleum and natural gas is lowered annually.

Ideally, a group of specialists would have studied the energy, environmental, social and economic aspects of exploiting areas such as Vaca Muerta oil field, before launching a massive drilling plan. The results would then be communicated to the population, especially to the native peoples living in the area, and only then would measures be taken, such as the signing of contracts with private companies or whether the state could do it alone. That is to say, to decree a moratorium for the development of these areas as Vaca Muerta oil field until all the information required to face the exploitations is available.

Bibliography

BP Statistical Review of World Energy, June 2019

"Fracking a Fracture that takes its toll", Aitor Ultrasti and Florent Marcellesi, Political Ecology Journal N°43, September 2012

Fracking in the US All That Remains is the Permic and that will always last, taken from IEA, HFI Search, seeking Alpha, February 10, 2020

IEA, Goldman Sachs Global Investiment Research, 2019

"Reserves or Resources? Of Uncoventional Hidrocarbons" International Energy Agency, June 2013
"Shale gas towards a warmer future"; Engineer Anthoni R. Ingraffe researcher and professor at Cornell University—USA, Clarín Newspaper, Buenos Aires, 2012
Source: Hidraulicano.info, May 14th 2012, Cantabria
Source: "How does Hydraulic fracture work" Hidraulicano.info, May 14th 2012, Cantabria
Tecpetrol, Views and Strategies for long term development of Unconventional Resources in Argentina, July 17, 2013