Gas is not a Bridge Fuel

Why Ireland's Climate Goals Cannot be Met with More Gas

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Oil Change International is a research, communications and advocacy organisation focused on exposing the true costs of fossil fuels and facilitating the transition towards clean energy.

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Executive Summary

The world is not yet on course for achieving the goals of the Paris Agreement on climate change. Those are to keep average warming well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit it to 1.5 degrees.[1]

Nor is Ireland on course[2] for achieving either its short-term commitments within EU legislation, nor its long-term target of reducing greenhouse gas emissions from the energy sector by between 80 and 95 percent by 2050, compared to 1990 levels.[3] The energy sector reductions are especially important to Ireland's contribution to the EU's target of 80-95 percent reductions of all greenhouse gases, given that Ireland has significant agricultural emissions, which are much harder to mitigate.

Put simply, the reason for being off course is an excess of fossil fuels in energy systems. Ireland's targets cannot be achieved without a major reduction in fossil fuel consumption. This report finds that gas is no exception to that rule, and that further development of gas extraction, or import infrastructure, can serve only to undermine the country's progress toward reaching its climate goals.

Even if the gas industry were able to prevent all methane leakage from gas extraction and distribution systems, we find five reasons gas cannot be part of the energy transition:

1. **No Room for New Gas**: Climate goals require the power sector to be decarbonized by mid-century. This means fossil gas use must be phased out, not increased. Even as other sectors may continue some reliance on gas, overall gas use must be reduced significantly.

2. **New Gas is Holding Back Renewable Energy:** Wind and solar are comparable in cost to gas, and all are significantly cheaper than coal, in many regions including Europe. This means new gas capacity competes with new wind and solar rather than coal.

3. **Gas is not Needed in the Clean Energy Transition:** Claims that fossil gas supports renewable energy development do not stand up to scrutiny. The cheapest gas generation technology, Combined Cycle Gas Turbines (CCGT), is designed for base load operation, rather than peaking. While gas "peakers" can do the job, they face increasing competition from battery storage. Most grids are far from renewable energy penetration levels that would require back-up anyway. Renewable energy, storage, demand response and efficiency can and should all be prioritized ahead of more gas capacity.

4. **New Infrastructure Locks in Emissions:** Multibillion-dollar fossil gas infrastructure built today will likely operate for decades to come. The barriers to shutting in existing infrastructure mean that it is critical to stop building infrastructure the full lifetime emissions of which cannot be absorbed into the carbon budget.

5. **Too Much Gas Already:** The coal, oil, and fossil gas in the world's currently producing and under-construction projects, if fully extracted and burned, would take the world far beyond safe climate limits. Opening new fossil gas fields is inconsistent with the Paris climate goals.

In short, not only is new gas inconsistent with agreed climate limits, it will slow down the transition, and is presented as a solution to a problem that does not currently exist, and will likely never exist. The transition must be to zero-carbon, renewable energy, which is both capable of supplying Ireland's needs at a comparable or even lower cost.

Ireland's Climate Goals

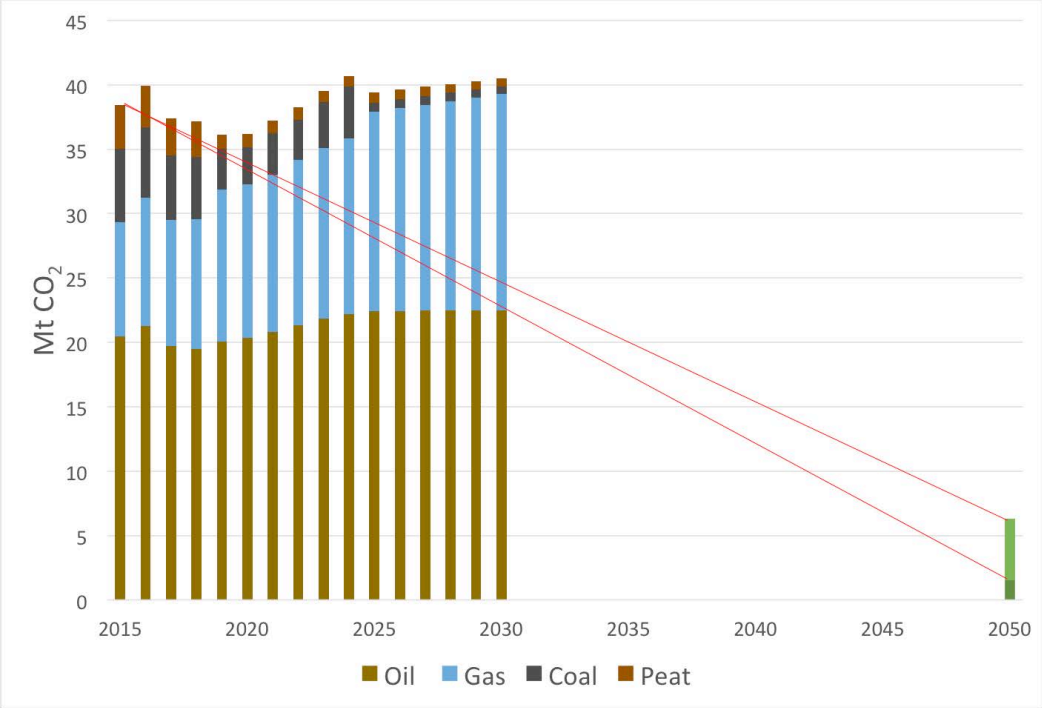
Ireland is a signatory of the Paris Agreement on climate change and has ratified the agreement along with over 175 other countries.[4] The goal of the agreement is to keep average warming well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit it to 1.5 degrees.[5]

By 2020, Ireland is committed under EU legislation to reduce greenhouse gas emissions from sectors outside the Emissions Trading Scheme by 20 percent compared to 2005 levels.[6] Ireland has set a policy target to achieve 40 percent renewable energy in electricity generation by 2020. The EU is yet to allocate legally-binding 2030 obligations to member countries. Ireland's Department of Communications, Climate Action and Environment set out national climate goals in a 2015 White Paper entitled, "Ireland's Transition to a Low Carbon Energy Future 2015 - 2030".[7] These aimed to chart a course toward reducing greenhouse gas emissions from the energy sector by between 80 and 95 percent by 2050, based on 1990 levels.

The Environmental Protection Agency reports that Ireland is not on course for achieving any of those obligations or targets. [8]

As energy projections from the Sustainable Energy Authority of Ireland (SEAI) show, combined with IPCC emissions factors, Ireland's long-term targets cannot be achieved without reducing fossil fuel consumption. [9]

Figure 1: **Emissions from projected Irish fossil fuel consumption** ("With additional measures" scenario), compared to target of 80-95% cuts from 1990 levels by 2050.



Sources: Sustainable Energy Authority of Ireland; IPCC emissions factors

Fossil gas[10] will not be an exception to that rule. Ireland will not be able to achieve its emissions goal by increasing its reliance on gas. The rest of this briefing explains why gas is not part of the solution to climate change.

The Bridge Fuel Idea

Fossil gas is projected by some to be the fastest-growing fossil fuel in coming decades as vast new sources are tapped across the world. The advent of horizontal drilling and hydraulic fracturing (fracking) in North America is significant but only part of this story. As access to ever more sources of fossil gas increases, many in government and industry have become attached to the idea of gas as a transition or bridge fuel toward a zero-carbon energy system, promoting fossil gas as the clean fossil fuel.

While there are benefits for local air pollution from switching from coal or oil to fossil gas, the benefits in terms of achieving climate stability are far less clear. We need a clear understanding of the limits to fuel switching in favour of fossil gas, and the threat to the clean energy transition of increasing production and consumption of fossil gas.

The idea of fossil gas as a transition fuel or "bridge fuel", between coal or oil and renewable energy, is not new. Indeed, the idea became popular with environmental NGOs in the early 2000s when the Worldwatch Institute posited the idea of fossil gas as a bridge to the 'hydrogen economy.'[11] In this incarnation, fossil gas would be used to make hydrogen to replace oil for transportation and would later be replaced by renewable energy deployed for the same purpose.

In 2001, the oil company Royal Dutch Shell published a set of energy scenarios to 2050 in which one of five "common features" included, "the important role of natural gas as a bridge fuel over at least the next two decades."[12] Almost two decades later, the "bridge fuel" idea remains a staple used by proponents of new fossil gas extraction and infrastructure that is designed to deliver increasing quantities of fossil gas for many more decades to come.

The Methane Leakage Controversy

Much of the controversy over whether increased fossil gas production and consumption can be part of a transition to a cleaner energy system has centred around the issue of methane leakage. Methane, the primary hydrocarbon contained in fossil gas, is a highly potent greenhouse gas (GHG) when vented or leaked to the atmosphere.

Studies have found that methane leakage levels can be much higher for gas produced via fracking than for conventionally-produced gas.[13] If elevated levels of methane are leaked in the process of producing and delivering fossil gas to consumers,[14] then its emissions advantage over coal for power generation or other uses is reduced or negated, and the bridge fuel idea is mistaken. Dozens of studies have been conducted to ascertain how much leakage is occurring and what levels of leakage constitute a greater or lesser climate impact for fossil gas compared to the dirtier fuels it supposedly substitutes.[15]

With methane levels in the atmosphere rising fast and climate impacts accelerating, there is no doubt about the importance of reducing methane leakage from existing oil and gas operations and distribution networks.[16] But methane leakage is not the sole determinant of whether fossil gas causes net harm to the climate. In this briefing we review the impacts of gas even in the event that all leakage were stopped.

Five Reasons Fossil Gas Cannot Form a Bridge to a Safe Climate.

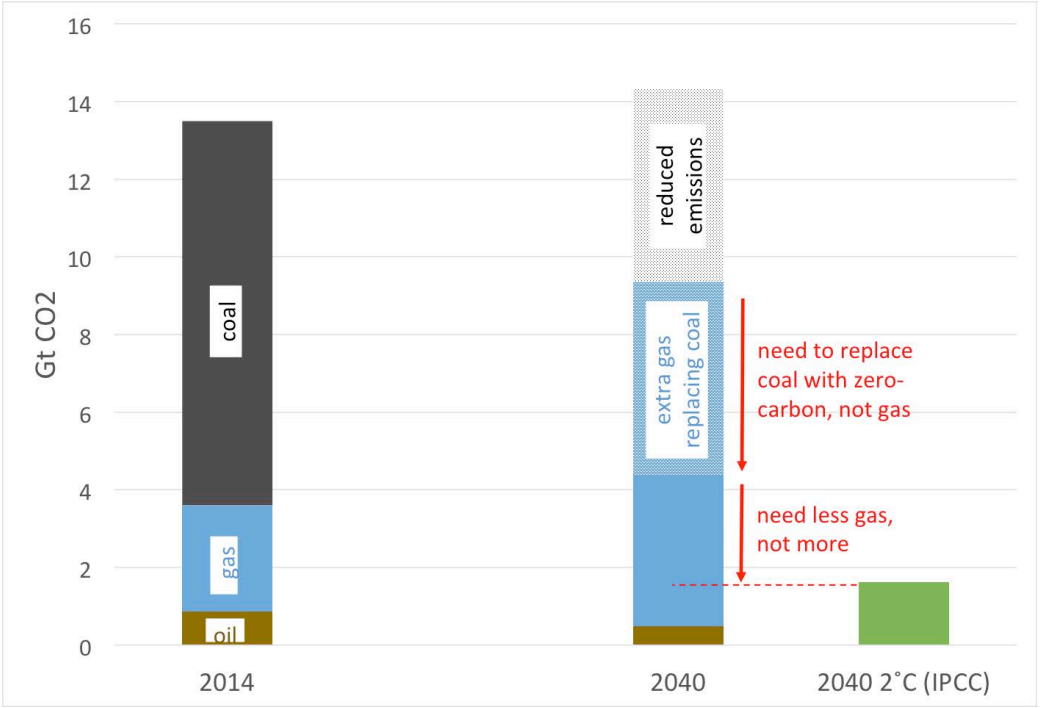
1. No Room for New Fossil Gas (Even to Replace Coal)

Many energy forecasts project an increase in fossil gas consumption, both in direct use and in electricity generation. While growth in electricity demand globally is slowing, particularly in developed countries,[17] "bridge fuel" proponents suggest that coal-fired power plants will be replaced by gas-fired ones, with a potential reduction in emissions of 40 to 60 percent.

The Intergovernmental Panel on Climate Change (IPCC) reports that to stay within the Paris Agreement's long-term temperature goal, the electricity sector must rapidly decarbonize globally and must be carbon-free by roughly mid-century.[18] Shifting reliance from one high-carbon energy source to one that is around half as polluting is not a path to decarbonization.[19] The reductions needed are much greater than a switch from coal to fossil gas would achieve.

Figure 2 shows that, based on the International Energy Agency's (IEA's) projected 2040 power sector inputs, if all of the coal-fired generation[20] is replaced with fossil gas-fired generation, emissions from the power sector would still be more than five times the median of IPCC scenarios for a likely chance of keeping warming below 2 degrees Celsius.[21] Indeed, the figure shows that emissions from oil and gas power alone are too great, meaning that none of the coal can be replaced with fossil gas; it must all be replaced with zero carbon energy sources. And at the same time, the world must reduce fossil gas consumption, not increase it.

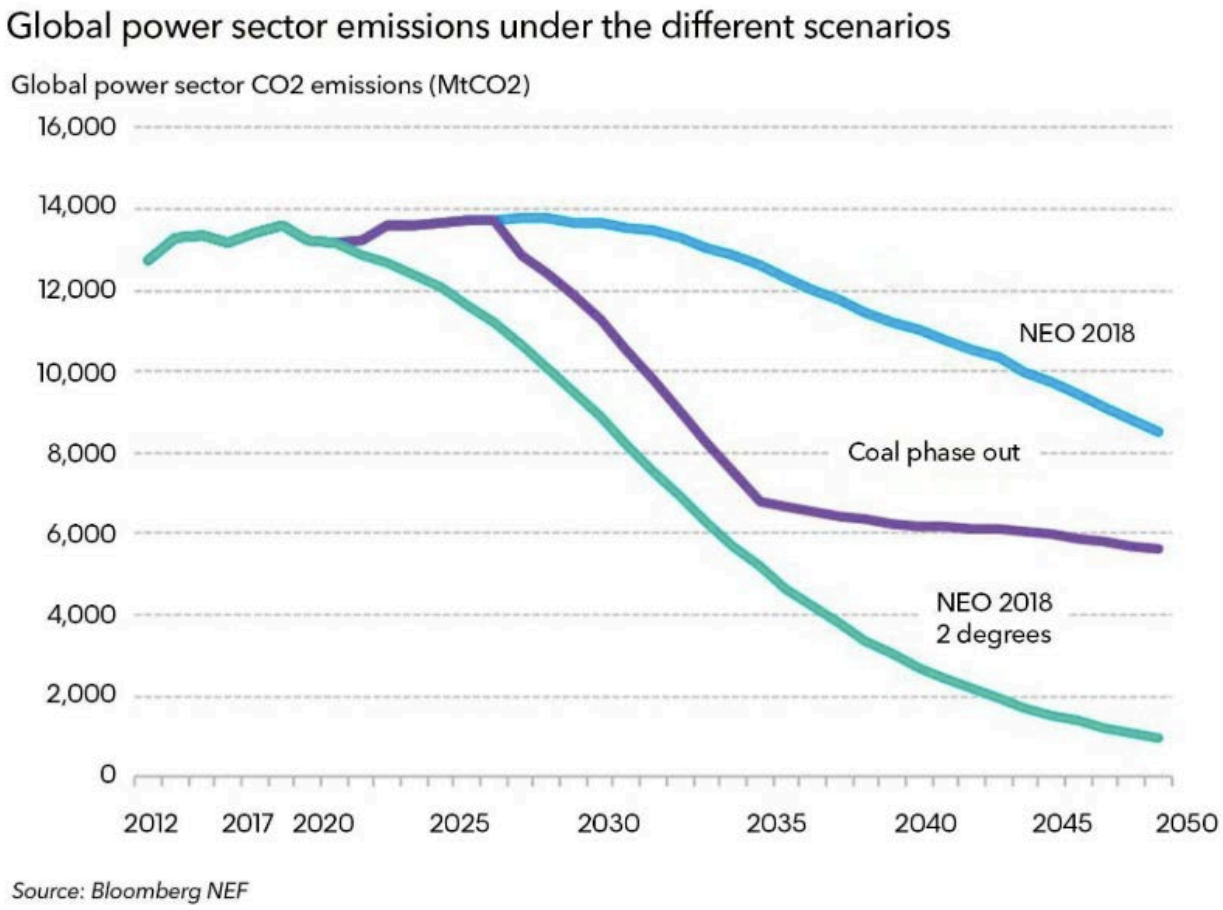
Figure 2: Global Power Sector Emissions – 2014 and Projected 2040 – Compared with Median IPCC 2040 Power Sector Emissions for 2°C (assuming all coal is displaced by gas)



Source: Oil Change International analysis, using data and projections from IEA and IPCC

Bloomberg New Energy Finance (BNEF) came to a similar conclusion in the publication of its New Energy Outlook 2018 (NEO 2018). The NEO 2018 uses a bottom-up, cost-driven model to simulate the ongoing transition in the power sector, based on current policies and available technologies. This projects that globally renewable energy is on course to provide nearly 50 percent of power generation by 2050. However, this is not enough to achieve climate goals. As Figure 3, which is copied from the NEO 2018 shows, the current trajectory is not only inadequate, but replacing all the remaining coal with a combination of gas and renewable energy also leads to emissions exceeding 2-degree pathways.

Figure 3: BNEF Global Power Sector Emissions Scenarios



Source: Bloomberg NEF 2018.[24]

As Matthias Kimmel of BNEF stated, "Even if we decommissioned all the world's coal plants by 2035, the power sector would still be tracking above a climate-safe trajectory, burning too much unabated gas. Getting to two degrees requires a zero-carbon solution." [25]

However, a narrative driven by the fossil gas industry, some governments and multilateral institutions such as the International Energy Agency (IEA)[26] only compares gas with coal, not with the climate limits agreed in Paris. This narrative is driven in part by the newfound abundance of fossil gas, primarily enabled by the development of hydraulic fracturing (fracking) and horizontal drilling. At the same time, the rising urgency of the climate threat has forced some oil companies to belatedly embrace the idea of reducing emissions, which they have done by highlighting the high emissions-intensity of coal (in which they have no stake) and calling for its replacement by gas (one of their two core products).[27] This drive to maximize fossil gas consumption[28] simply does not line up with the emissions goals required to avoid climate disaster.

2. New Gas Is Holding Back Renewable Energy

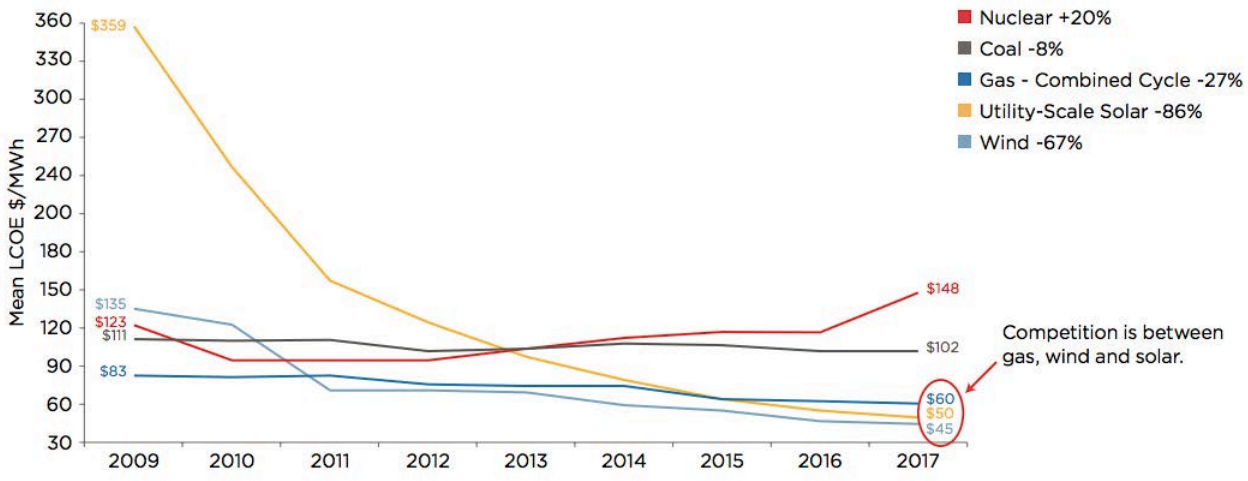
The problem is not just that fossil gas does not go far enough in reducing emissions; it also makes the climate problem worse. Switching from coal to fossil gas might – in theory, with very low methane leakage – reduce emissions from a business-as usual scenario. But this hypothetical situation assumes that new gas displaces dirtier coal. In reality, much of the new gas being developed will displace new renewable energy instead.

The cost of renewable energy has plummeted in recent years, and costs are projected to continue to fall to at least 2040. Bloomberg New Energy Finance (BNEF) found the unsubsidized cost of financing, building, and operating (the Levelized Cost of Energy or LCOE) for utility-scale solar photovoltaics (PV) and onshore wind projects fell 20 percent and 12 percent respectively from early 2017 to early 2018. These energy sources are now the cheapest form of energy generation even in countries with cheap coal-fired generation, such as China and India. BNEF went on to point out that India now has the lowest-cost onshore wind and solar in the world. [29]

While the cost of fossil gas remains near historic lows today, the finite nature of fossil fuels signals that it is unlikely to get cheaper, quite the opposite. But for solar and onshore wind, BNEF projects cost reductions of 62 percent and 48 percent respectively by 2040.According to BNEF, solar and onshore wind will become “the cheapest bulk generation almost everywhere by 2023.”[30] That is just five years away.

Figure 4 shows an LCOE analysis by Lazard from November 2017, showing the global average unsubsidized costs of wind, solar, fossil gas, coal, and nuclear power since 2009. This shows that competition for new generation capacity in the power sector today is between gas and renewable energy, not coal and gas. So new gas will directly discourage the building of new clean energy infrastructure.

Figure 4: Gas Competes with Wind and Solar, not coal



Source: Lazard 2017[31]

Academic studies on this issue lead to a similar conclusion. Several recent studies in the United States have modelled the competition between different fuels, finding that greater supplies of fossil gas will not significantly reduce emissions (absent other regulatory measures on climate), in large part because some of the additional gas displaces zero-carbon energy as well as coal. [32] A global study, using five integrated assessment models, found that increased gas availability or reduced gas cost led to either equivalent or even higher levels of emissions. [33]

3. Gas is Not Needed for the Clean Energy Transition

As renewable energy costs have declined, fossil gas advocates have increased their emphasis on the variability of wind and solar. The sun does not always shine, and the wind does not always blow, and therefore – they argue – more gas-fired generation is needed to balance peaks and troughs in supply and demand. There are several flaws to this argument.

Nobody expects the transition to renewable energy to happen overnight. It is a decades-long process and while climate goals do require the transition to accelerate from today's adoption rates, it will be at least a decade before most mature grids (in developed countries) achieve levels of renewable penetration that would trigger system reliability issues. Ireland's current renewables penetration rate is 27 percent of electricity, mostly derived from wind. [34]

For example, the operator of the electrical grid in northeast Germany says the country's grid can handle up to 70 to 80 percent wind and solar even without additional flexibility options such as storage.[35] Australian grid operator TransGrid goes further, saying that 100 percent renewable energy is both affordable and practical using a combination of existing technology for storage, demand management, and efficiency.[36]

Indeed, where high renewable energy penetration exists today, such as in the U.S. states of Texas and California, gas plant utilization rates have dropped, and gas demand has declined,[37] suggesting that those systems already have more gas generation capacity than they need.[38]

Battery Storage Is Here Now and Cost-Competitive

By the time Ireland approaches those current technical limits, energy storage and grid management technologies will be significantly cheaper than today, and capable of further increasing renewable energy's share. The cost of lithium-ion batteries has declined 79 percent since 2010[39] and 24 percent in 2017 alone.[40] Cost are projected to decline a further 67 percent by 2030.[41] The declining cost of battery storage means that the combination of renewable energy and batteries is already cost-competitive with coal and fossil gas generation.[42] In fact, as BNEF recently stated in the NEO 2018, "(t)he economic case for building new coal and gas capacity is crumbling, as batteries start to encroach on the flexibility and peaking revenues enjoyed by fossil fuel plants." [43]

BNEF's chief editor noted at the beginning of 2018 that energy storage is currently poorly understood by many policymakers. He notes that, "(t)his matters hugely since investing in alternatives (to storage) such as natural gas power plants with a 25-plus year lifetime will either create a long lock-in period that would limit opportunities for other flexible resources such as storage or result in stranded assets further down the line."[44]

This argument for new gas is based on a problem which does not exist today, and is unlikely to exist in the future. It is a solution without a problem.

The Wrong Kind of Gas

Another problem with the claim that fossil gas is an integral partner for renewables, and with the associated emissions claims that are made when comparing coal and gas, is that the cheapest and most efficient gas generation technology, combined cycle gas turbine (CCGT), is not the technology best suited for balancing renewable energy variability.

When many analysts compare the cost and/or emissions of fossil gas with renewable energy or coal, they generally use CCGT for the comparison. But because of the high upfront costs of building CCGT plants, they only make sense as base load plants that are run at high utilization rates. CCGT is not economical for flexible generation, which is the kind of generation needed for gas to partner with renewable energy. Open-cycle gas plants may be cheaper to build than CCGT and can be profitable when run as 'peakers,' which are plants that operate intermittently to handle periods of high demand or constrained supply. But these plants are less efficient and have higher emissions per unit of energy produced than CCGT.[45] These plants are also more expensive to run and in many cases have a higher LCOE than wind and solar partnered with battery storage.[46]

If the goal is to reduce emissions as much and as quickly as possible, then increasing renewable energy and storage capacity is the key. While stability will need to be addressed at different points for different systems, the most cost-effective and least emissions-intensive solution is increasingly something other than a fossil gas plant.

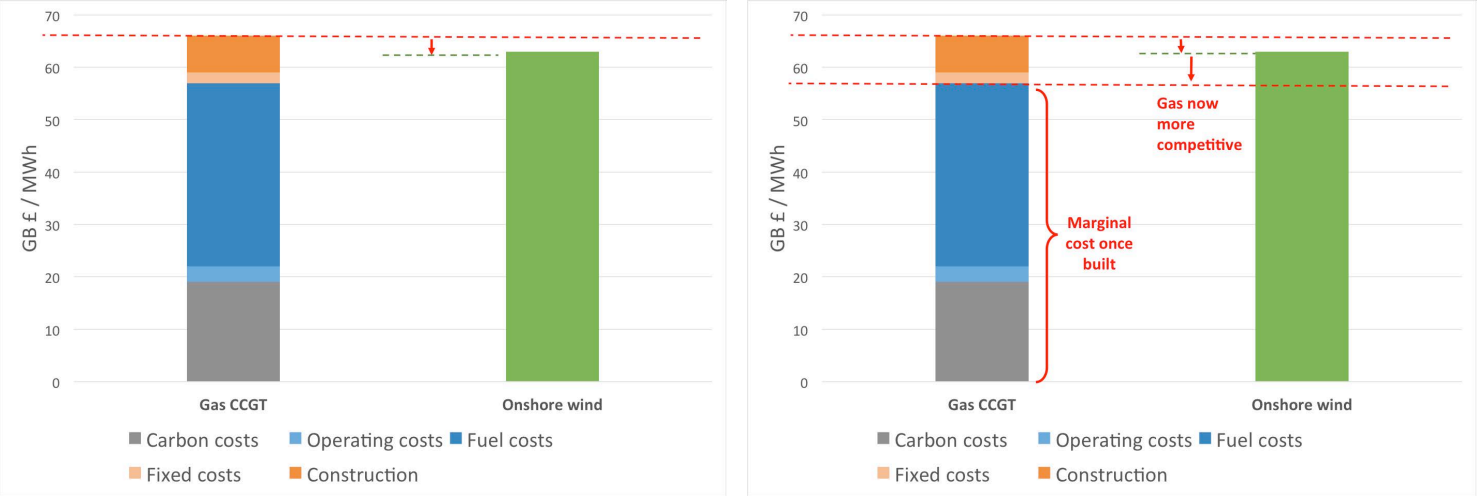
4. New Infrastructure Locks in Emissions

Gas-fired power plants and related infrastructure like pipelines and LNG terminals require large up-front multibillion-dollar investments. Nobody investing today expects to retire the infrastructure earlier than 30 years into its lifetime at minimum, while many power plants and pipelines operate for much longer.[47] This means that gas plants built over the next few years could still be operating beyond 2050, when emissions from the power sector must be nearing zero.

What's more, the problem of lock-in makes it very difficult to shut down a power plant once it is built. Once the capital has been sunk, the operator will likely keep running a plant as long as it can sell power for more than the marginal cost of producing it – even if it incurs a loss on the invested capital. This makes it harder for new generation capacity to compete.

Figure 5 shows data from a UK government estimate of the levelized cost of energy for a CCGT plant compared with onshore wind commissioned in 2020 in the UK. The left-hand chart shows that onshore wind would be cheaper to build and operate than the CCGT plant. The right-hand chart shows that when you take out the cost of construction and other fixed costs, the marginal cost of operating the CCGT plant falls below the cost of new onshore wind capacity. If a lot of new gas capacity is built over the coming decade, as is widely projected, those plants may continue to be operated even as new renewable energy and storage capacity outcompetes on life cycle cost. This may leave it up to governments to impose unpopular costs on gas plants to force them out of the market in order to achieve emissions targets. A more rational approach would be to limit gas capacity today and focus policy on accelerating the transition to clean energy.

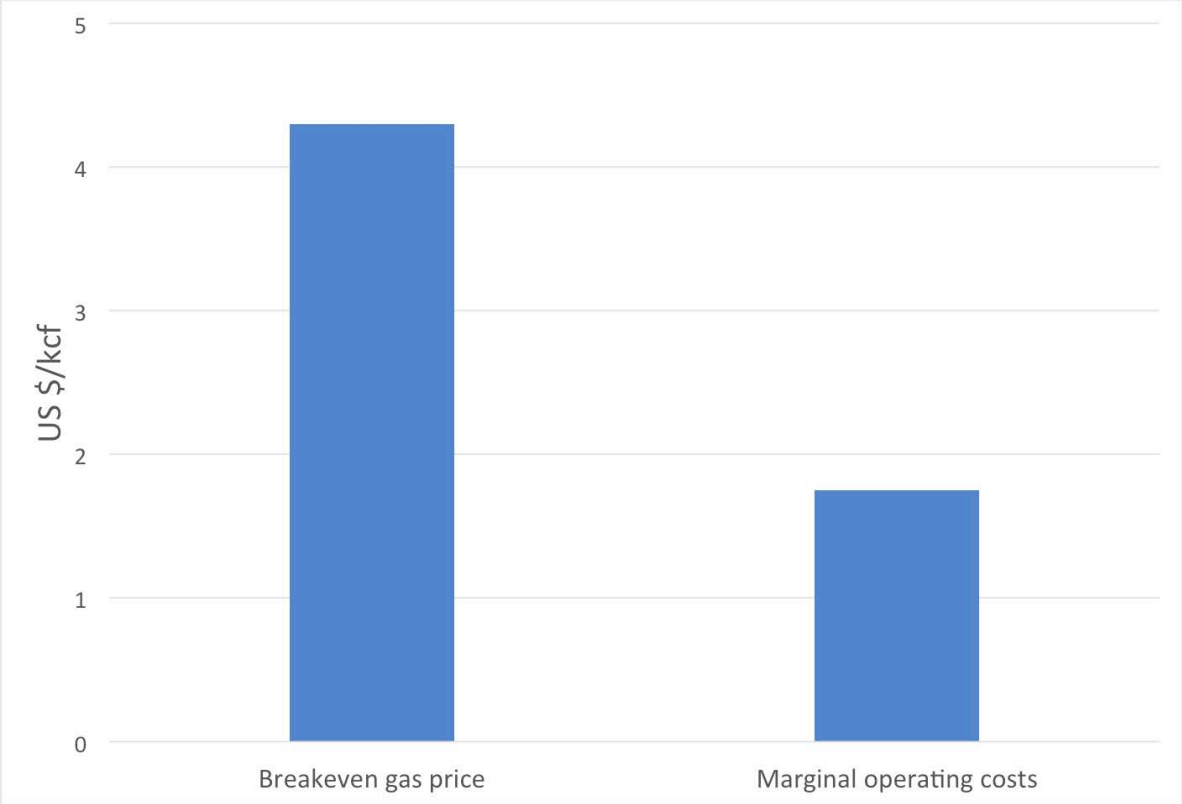
Figure 5: Marginal Cost of Operating a Gas Plant compared to New Build Renewables



Source: Oil Change International using data from UK Department for Business, Energy & Industrial Strategy

The situation is similar for a fossil gas production. Data from the Rystad Energy UCube database shows the estimated breakeven price of gas required for the proposed Spanish Point project off the southwest coast of Ireland is between $4.20 - $4.40 per thousand cubic feet (kcf). This includes the cost of building, installing and operating the platform. However, once those costs have been sunk, the marginal cost of production over the first fifteen years of production is only $1.75 /kcf (see Figure 6).

Figure 6: Breakeven Gas Price versus Marginal Operating Costs for Spanish Point, Ireland.



Source: Rystad Energy AS.

Operator Cairn Energy would need a relatively high gas price to sanction the project. If subsequent climate policy causes the gas price to fall, it creates a lose-lose situation where the gas continues to be produced (with consequent emissions) but while the company makes a loss on capital it has invested, and the government loses revenue.[48]

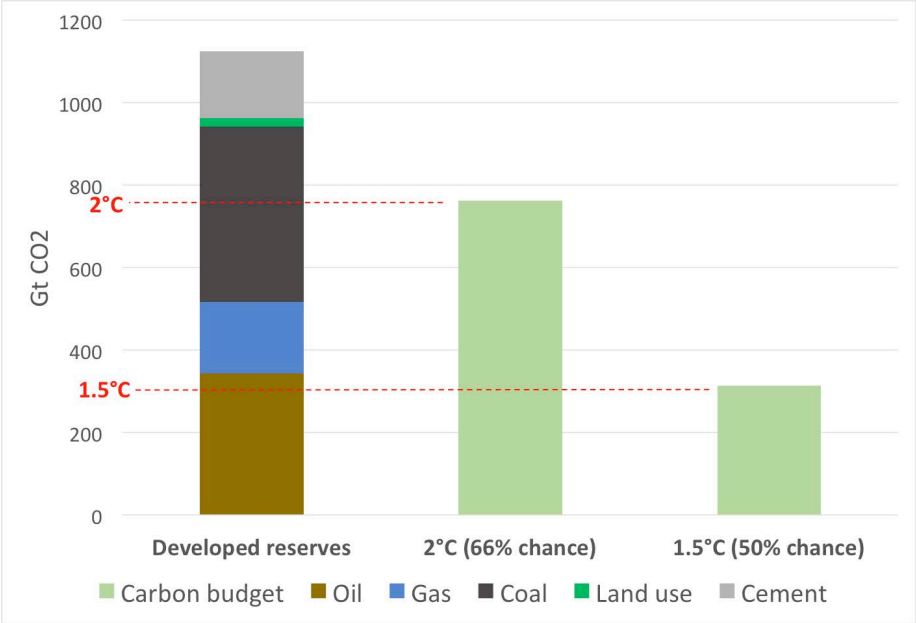
It is clear that the economics of capital intensive energy production supports incumbent infrastructure over new entrants. For the clean energy transition to accelerate it is crucial to cease investment in polluting energy sources and allow zero carbon sources to grow to meet emissions targets. At this late stage in the depletion of carbon budgets, it is necessary to move straight to zero-carbon energy and avoid locking in emissions that we cannot afford.

5. Too Much Gas Already

We can also illustrate the problem of lock-in by comparing emissions from already-operating oil fields, gas fields, and coal mines with how much the world can afford to emit while achieving the Paris Agreement goals: the carbon budgets. [49]

In Figure 7, we can see there is enough fossil gas, coal, and oil in existing fields and mines to take the world beyond the carbon budget for 2 degrees Celsius. And even if all the coal mines were shut overnight, the gas and oil alone would take us beyond the carbon budget for 1.5 degrees Celsius. Even to stay within the upper limit of tolerable warming, 2 degrees Celsius, no new fossil gas fields can be developed unless more than a third of existing coal mines are shut down early. Just like with gas power plants, there is no room for new gas fields – but rather a need to wind down already existing production over the coming decades, while ramping up clean energy to take its place.

Figure 7: No Room for More Gas: Locked-in CO2 Emissions from Existing Fields and Mines Already Exceed Carbon Budgets



Source: Oil Change International analysis; data from Rystad Energy, IEA, IPCC [50]

The fact of a limited remaining Paris-aligned carbon budget for every nation means that very rapid, near-term emission reductions are needed now, especially for nations like Ireland that have high per capita emissions. Delaying substantial and sustained emission reductions reduces energy security by ensuring that even less of Ireland's Paris-aligned carbon quota will be available for a low carbon transition.

Conclusion

While the idea of gas serving as a "bridge fuel" from coal to renewables is not a new one, today it looks increasingly anachronistic. When the climate problem first emerged on the international policy agenda, it might have made some sense to look at ways to use different fuels to reduce emissions compared to a business-as-usual scenario. Now however, the limits of acceptable climate change are clearly agreed, in the Paris goals to keep warming well below 2 degrees Celsius above pre-industrial efforts, and to pursue efforts to limit warming to 1.5 degrees. Climate science interprets these goals into what must happen to energy systems.

We have seen that with very limited remaining atmospheric space, developing new gas production, power stations and infrastructure is not consistent with the Paris goals. To achieve the goals, all new energy development must be zero-carbon.

We have seen also that renewable energy - in Ireland's case, primarily wind power - is available, comparable in price to fossil fuels, and capable of expanding to the majority of energy production. Yet new gas slows the transition, as it competes against renewable generation, and makes it harder to change course later.

The arguments for new gas are based on a situation where climate limits were both less defined and further in the future, and where renewable energy was costly. Those arguments are now outdated, as building of new gas risks pushing the world beyond agreed climate limits.

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