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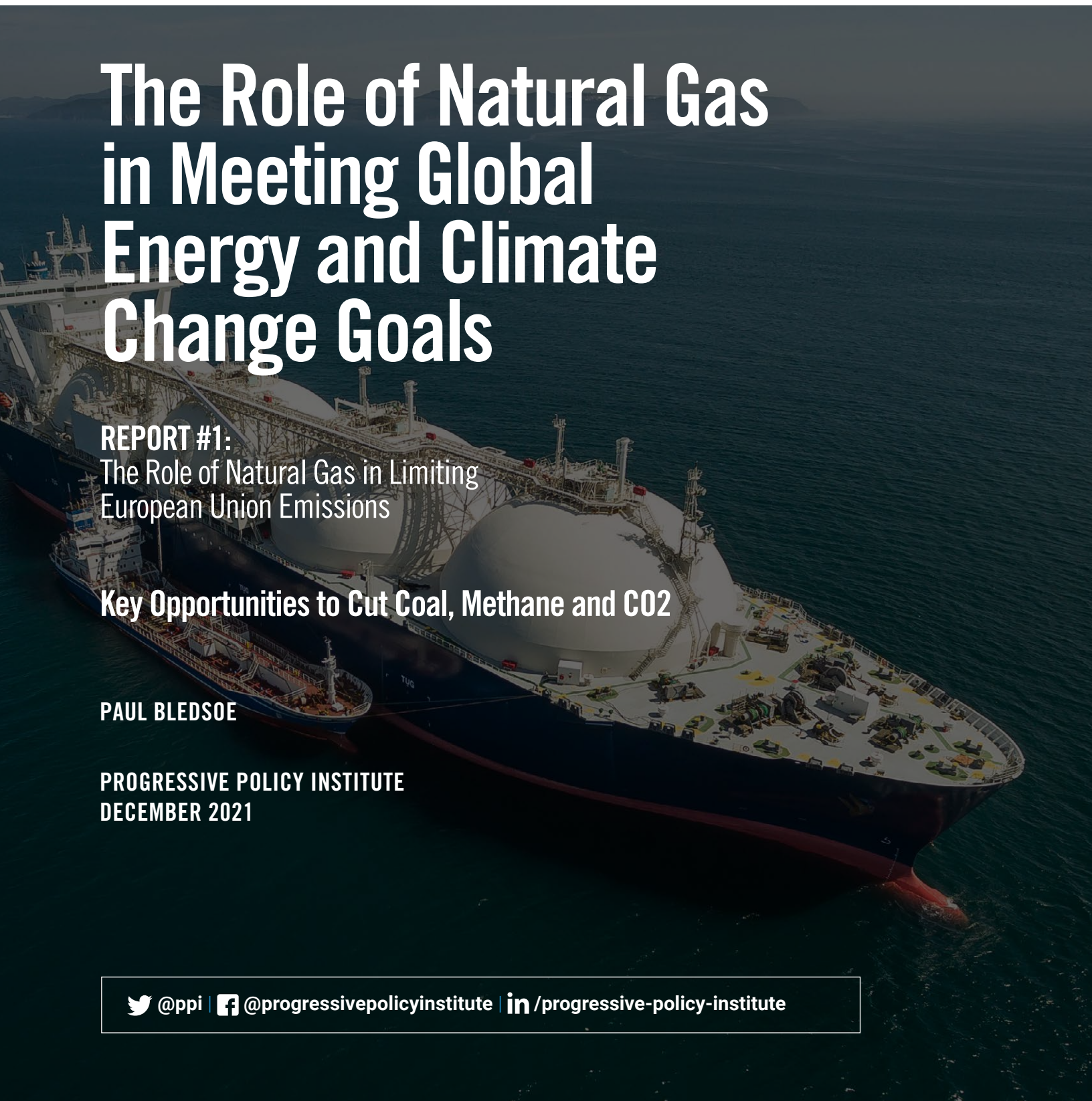
The Role of Natural Gas in Meeting Global Energy and Climate Change Goals



REPORT #1:
The Role of Natural Gas in Limiting European Union Emissions

Key Opportunities to Cut Coal, Methane and CO2

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DECEMBER 2021

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EXECUTIVE SUMMARY

The European Union in recent actions and the United States under President Joe Biden have both offered bold visions for deeply reducing greenhouse gas emissions and asserting leadership in the global fight against climate change. Each is taking important steps to reduce harmful emissions from natural gas, including more aggressive methane controls, emissions reporting, and investments in carbon capture and storage technology.

These initiatives hold great promise in helping Europe lessen its dependence on coal and other dirtier fuel types, as well as ensure that gas imported into the EU is as clean as possible to help Europe meet its climate goals.

For example, on July 14, 2021, the European Union announced sweeping new climate change goals in its "Fit for 55" directive.[1] The extraordinarily ambitious program requires the EU to reduce its greenhouse emissions by 55% below 1990 levels by 2030, relying on the EU carbon trading and pricing market, new Green Deal programs, a wide range of clean energy subsidies, and the beginning of some fossil fuel use restrictions. Most climate experts see the EU proposal as the first-ever attempt by one of the world's three major centers of economic growth and innovation to reduce emissions in keeping with the key Paris agreement goal of reaching net zero emissions globally by 2050 and keeping temperatures from rising more than 1.5 Celsius.

However, today, the EU still gets at least 15% of its electricity from coal, with far higher percentages in Germany, Poland, and other eastern European countries.[2] Analysis by the International Energy Agency and other leading

experts predicts that the EU will use a mix of renewable energy and natural gas to displace coal.[3] Indeed, most studies find that gas use in the EU will grow over the next decade to balance increased intermittent renewable energy on the EU electrical grid as other forms of baseload power (coal and much nuclear power) are phased out.[4]

Yet even as the European Union undertakes these unprecedented steps to reduce emissions, it is increasing its reliance on natural gas from Russia's notoriously leaking, antiquated, and nontransparent gas production and transport system, which has extremely high fugitive emissions of methane, a super-potent greenhouse gas. The EU imports about 40% of its total natural gas from Russia — despite data showing that Russian gas is worse from a climate change perspective than the very coal natural gas is meant to displace.[5] Indeed, new data from the International Energy Agency (IEA) shows that Russia is the world's largest methane emitter, with massive new "super-emitting" methane plumes detected this year, even as studies how Russia has consistently lied about and covered up its emissions for decades.[6]

The EU's importation of high methane emitting Russian gas is a profound flaw in the EU's climate plans which may prevent it from truly reaching its 2030 emissions goals. While huge methane emissions from Russian gas imports may not be technically counted under the EU's greenhouse gas accountancy system, they are nonetheless causing massive greenhouse gas emissions of methane (84 times more potent than CO2) at precisely the time leading experts say cutting methane emissions is the key to keeping temperatures below the Paris targets of 1.5°C and 2°C.

Indeed, in mid-September 2021, the EU recognized the urgent need to cut emissions of methane in an agreement with the United States, the United Kingdom, and other nations to reduce overall methane emissions from all sources within their borders by 30% before 2030. Such admirable efforts to reduce methane, however, will be swamped and rendered ineffectual by global methane emissions from Russian gas and other sources of the EU's gas imports which are outside of this agreement.

In recent months, in fact reducing methane emissions has become a centerpiece of climate protection, as evidenced by the EU, U.S. and over 100 other nations signing a pledge at the recent UN climate negotiations in Glasgow, Scotland, to cut methane by 30% by 2030. However, Russia, Iran, Qatar and other major gas exporters and methane emitters have not signed the pledge.[7]

This report finds that the EU has an array of new options to reduce near-term dependence on Russian gas. These include greater renewable energy use, electricity storage technologies, and imports of lower-emitting U.S. liquified natural gas. Current high natural gas prices are roiling European markets and consumers, spotlighting the increasing need for larger liquified natural gas shipments from the US and other sources, both this winter and for years to come. In fact, specific methane reducing actions by the EU and U.S. can play the key role in forcing all global gas imports to lower their emissions dramatically by creating demand competition for low-emitting gas.

The most important imperative is for the lifecycle of methane emissions from natural gas production to be driven down as close to zero as possible by both major exporters and importers. In the United States, President Joe Biden and Congress are acting to both impose stringent

regulations on methane emissions and take new steps to sharply reduce fugitive emissions and the venting of gas from existing and old unused wells. Such efforts are crucial to limiting near-term temperatures globally as a series of studies have concluded, especially the August 2021 urgent report by the United Nations International Panel on Climate Change.

Moreover, as the IEA noted in its "methane tracker" report released in January 2021, it is in the "strong interest" of natural gas companies to cut methane emissions, since, over time, users will demand, and nations will require, the lower-emitting methane gas sources. "Aside from the environmental gains, oil and gas operations with lower emissions intensities are increasingly likely to enjoy a commercial advantage," the report said.[8]

Nonetheless, government action to limit methane globally is critical. This should include requirements by the EU, the world's largest natural gas importer, that methane emissions from both domestic *and* imported gas be accurately verified and monitored, and then regulated to as close to zero as possible. Such a "global race to near-zero fugitive methane emissions" among natural gas competitors would dramatically cut global emissions, even as gas displaces remaining coal in Europe, Asia, and elsewhere. In this way, super-low-methane gas exports (and also low-CO2 gas with carbon capture and storage) can play a major role in reducing greenhouse gas global emissions even as renewable energy grows.

The IEA and other top analysts believe that the EU will have to use natural gas to displace remaining coal use and balance the EU grid, with gas over the next two decades providing baseload electric power as intermittent renewable energy becomes a higher percentage of the EU's power supply and as the demand for electricity increases due to electrification of transportation and broader growth. Methane from oil and gas is Europe's third largest source of greenhouse gas emissions. Thus, reducing methane emissions from all EU natural gas sources, including imports, is essential to meet the European goal of cutting emissions 55% compared to 1990 levels by 2030.

The EU imports more than 60% of its gas, and total methane emissions from gas-exporting countries like Russia are at least three and eight times the emissions from the domestic EU gas supply chain. If these "imported methane emissions" are calculated by the European Union as it determines its overall emissions profile, they will swamp progress made on other fronts and prevent true reduction of its total emissions. The EU also imports more than 40% of its total natural gas from Russia. Yet data consistently shows that Russian gas is even worse than coal in contributing to greenhouse gas emissions. Russia has deliberately prevented attempts to fully assess its high methane emissions for decades, choosing instead to point the finger at other gas producers and use the echo chamber of its influence operations in Europe to attempt to discredit attempts to hold Moscow to account.

The EU Commission has committed to reducing methane emissions in its domestic energy sector and engaging in a dialogue with its international partners about what carrots and sticks could be used to lower the methane profile of imported gas. But it has not yet promulgated standards to accomplish these goals.

Fortunately, new and more accurate methane detection technologies are increasingly being deployed. They should become standard in the world's major natural gas producing nations. Nations that refuse to have their gas monitored and verified should be denied import status by the EU and other major importers over time.

New sources of gas, including liquefied natural gas (LNG) imports from the United States and other clean sources, can reduce the EU's reliance on methane-heavy Russian gas. But of course, that will require the United States and other exporters to drive down methane and carbon dioxide emissions from the lifecycle as close to zero as possible, and verify their reductions with credible methodologies.

Moreover, the geopolitical costs of Russian gas continue to plague the EU broadly, and Ukraine and other Eastern European nations specifically. EU imports of Russian gas have actually increased since Moscow's illegal annexation of the Crimea in 2015. Over time, limiting Russian gas imports thus could diminish its political leverage over Europe while also helping the EU achieve its climate goals.

Given these realities, European support for the Nord Stream 2 pipeline from Russia to Germany is a massive strategic mistake. Making the pipeline operational would clearly increase Russia's leverage over Ukraine and other Eastern European countries. In addition, allowing Russia to operationalize the pipeline will dramatically reduce the EU's leverage to compel the state-owned Russian monopoly Gazprom to reduce its methane emissions.

The United States has long had better methane and carbon dioxide reporting standards and measurements than other gas exporters, leading the world in both methane science and efforts to reduce methane emissions. More importantly, the Biden Administration, Congress, and the U.S. natural gas industry are beginning to undertake a series of strategic steps to make U.S. gas super-low emitting compared to gas from Russia and other major exporters. This would give U.S. gas a competitive advantage in world markets, boost U.S. LNG sales abroad, and enable European gas importers to make deeper cuts in greenhouse gas emissions as they transition away from burning coal.

Summary of Key Recommendations:

- The EU should put in place rigorous monitoring, reporting and verification rules covering all natural gas, both domestically produced and imported.
- Over the next few years, the EU should require gas exporters to accurately verify lifecycle emissions of methane as a condition for gaining access to the EU market.
- The EU and United States should harmonize their monitoring, reporting, and verification (MRV) regimes of lifecycle emissions from natural gas as a key interim step in this process. This step is crucial in setting a global benchmark for MRV emissions from gas, given the much greater transparency and accuracy of emissions measurements from natural gas produced in the EU and U.S. compared to other gas exporters to the EU.
- The EU should consider adopting stringent methane emissions regulations for domestically produced natural gas immediately, and then extend these requirements to imported gas at the earliest opportunity.

- The EU should seek to diversify and expand its natural gas importation sources both to reduce gas prices to phase out coal and to pressure importers of all types to begin to cut its lifecycle methane and carbon emissions.
- The United States should accelerate its already significant measures to drive down U.S. methane emissions from natural gas production and transportation. In the near-term, the U.S. should aim at making its gas super-low emitting, with fugitive emissions of less than 0.5% of total volume, by far the lowest emitting in the world. In time, U.S. gas should be even lower-emitting, with close to zero methane emissions, and dramatically increase the deployment of carbon capture and storage technologies for CO2 emissions from gas.
- The EU should measure precisely the extent to which Russian gas with high fugitive methane emissions is undermining progress toward both EU and global climate change goals. Specifically, Brussels should study potential emissions from gas transported through the Nord Stream 2 pipeline before allowing the pipeline to become operational.
- Over time, the EU should require all natural gas used in the EU achieve super-low methane and CO2 emissions, as gas will be needed to displace coal in the EU to meet climate goals. Such EU actions during the current decade can help not only meet its own greenhouse gas emissions goals for 2030, but begin the process of bringing natural gas emissions to the lowest possible levels around the world and using it to displace global coal use.
- Increasing low-emitting U.S. liquified natural gas imports to the EU can play a key role in this process, and should be a domestic and international climate change policy priority for both the EU and U.S.
- The EU should prioritize LNG port construction, access, and related infrastructure to spur a competition toward super-low emitting gas, and to displace Russian gas.
- The EU can advance its own energy and security interests, as well as its climate goals, by acting on its stated policy of reducing its dependence on Russia gas, cutting imports by at least half during the current decade.

NOTE: This report does not examine in detail the opportunity for the EU to use its natural gas and pipeline infrastructure to produce hydrogen and biomethane fuel using natural gas, renewable energy, or other energy sources. Topics specific to hydrogen from natural gas and other sources will be examined in an additional Progressive Policy Institute report in 2022.

CHAPTER ONE
HOW CLEANER GAS CAN HELP EUROPE MEET ITS CLIMATE GOALS

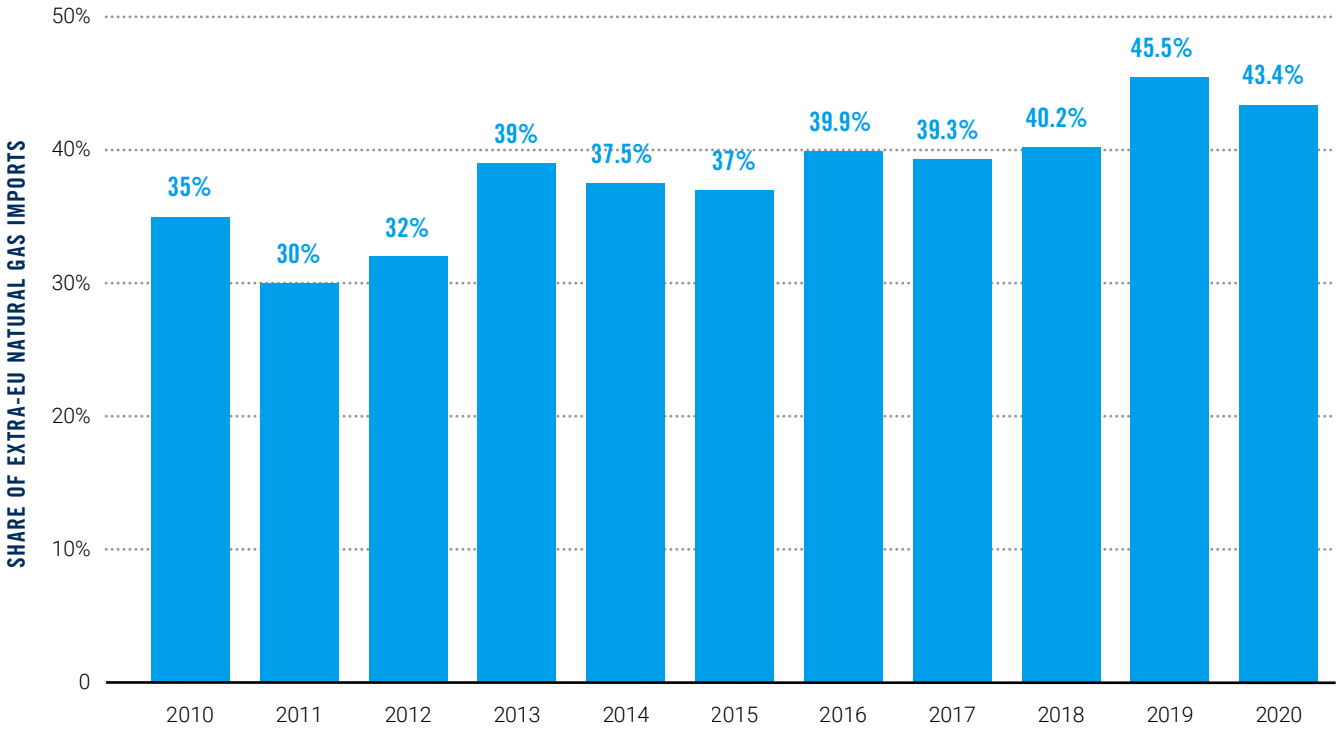
To reduce its greenhouse gas emissions by 55% by 2030 and to net zero by 2050, the European Union will continue to need lower-methane, low-carbon natural gas, to both completely phase out coal this decade and stabilize the EU grid as renewable energy increases. But to gain greatest climate benefit, the EU must also cut lifecycle methane and CO2 emissions from natural gas imports as well as domestic gas.

The growing imperative to reduce greenhouse gas emissions in the European Union and globally is dynamically altering energy geopolitics, policies, and markets on the European continent and around the world. This imperative has spawned a huge emphasis on subsidies for renewable electricity generation in the EU, and a wide range of other policies supporting zero emissions energy throughout Europe's economy.

In particular, the extremely ambitious EU commitment of 55% greenhouse gas emissions reductions over 1990 levels by 2030 will require rapid reduction in emissions from current major sources like coal and high-emissions gas in real time, using existing technologies.[9]

In addition to a welter of national decarbonization policies in every EU nation and the EU Emissions Trading System, which sets a price on carbon emissions, the European Parliament has recently passed a €1 trillion Green Deal clean energy package for the continent as a whole.

SHARE OF EXTRA-EU GAS IMPORTS FROM RUSSIA FROM 2010 TO 2020



Source: Eurostat

Displacing the EU's Large Coal Reliance

The EU is still using coal to meet 15% of its overall electricity needs today, according to International Energy Administration (IEA) data. Coal has at least double the carbon dioxide emissions of natural gas. While closing remaining coal fired power plants is a major priority for the EU and climate advocates, the EU must find baseload power to replace this coal generation.[10]

Germany, for example, is still using coal to provide one-quarter of its electricity, depending on the year. But it has also embraced a goal of eliminating coal by 2038 at the latest, and perhaps as early as 2035.[11] Meanwhile, Germany plans to end its use of nuclear power by as early as next year, 2022.[12]

These combined goals are putting a strain on the German electricity system and will inevitably mean Germany will need more, not less, natural gas in the immediate term. But that gas must be lower-emitting to meet Germany's increasingly stringent greenhouse gas emissions goals.[13]

As this report will show, Germany's current mix of gas has very high methane emissions, especially from Russia, a problem that will be perpetuated, potentially for many decades, should the Nord Stream 2 pipeline become operational and carry large amounts of high-emitting Russian gas.

Poland currently uses coal to provide more than 75% of its electricity, with a goal of lowering that number of 60% by the end of this decade.[14] In this context, it is clear that natural gas will continue to be the key baseline electricity generation fuel for Central and Eastern Europe especially. Indeed, EU data for the last several years show a trend of reduced nuclear and coal, and increased renewable energy and consistent or rising use of natural gas.

Leading EU experts find that a combination of the EU 2030 emissions target and the EU carbon pricing emissions trading system could reduce coal dramatically, replacing it with natural gas. According to analysis[15] conducted by the Institute of Energy Economics[16] (EWI) at the University of Cologne, the planned tightening of the EU climate target for 2030 would significantly increase CO2 prices in European emissions trading and could thereby largely drive coal-fired power out of the market by 2030.

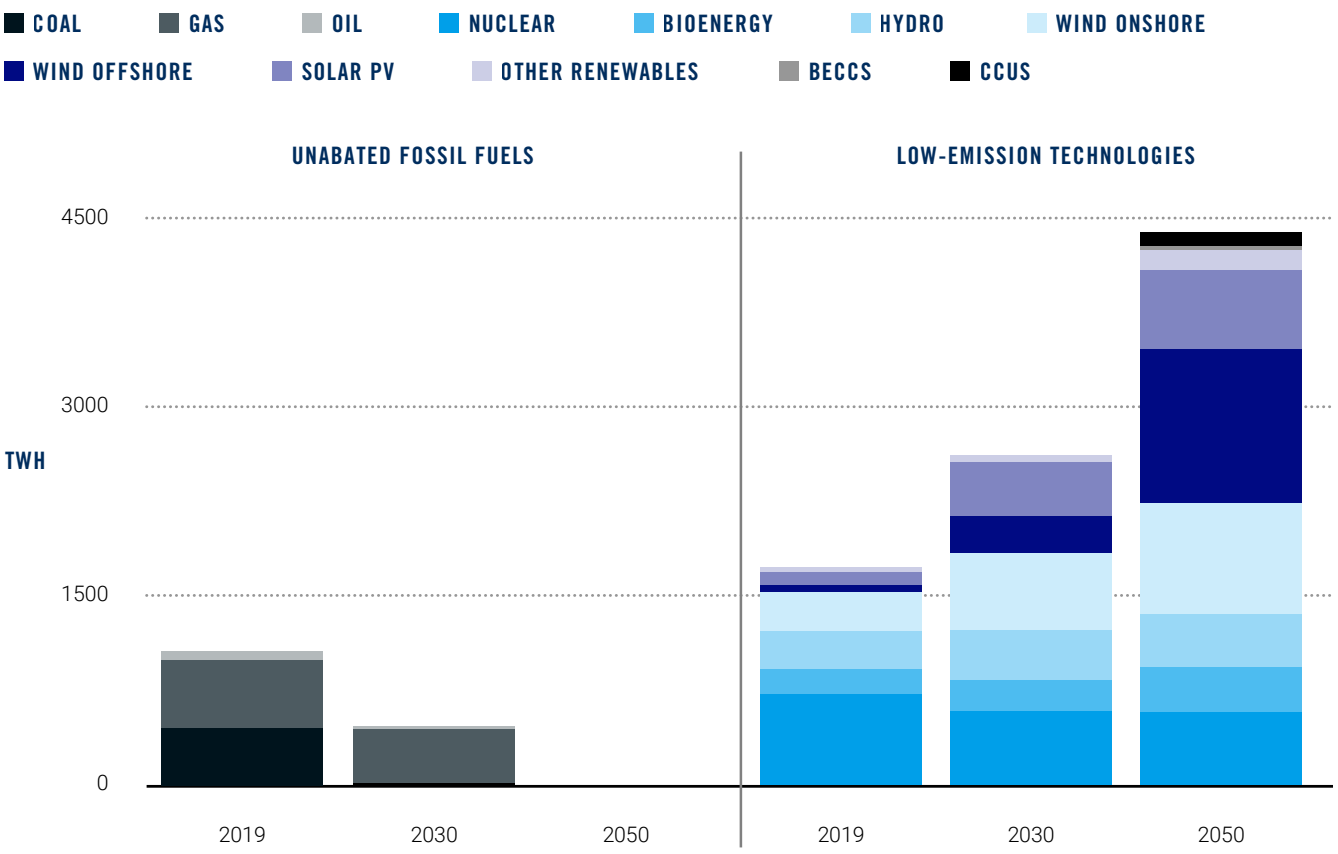
But as the publication in Clean Energy Wire notes, the decrease in coal would be replaced primarily if not completely by natural gas: "the construction of gas-fired power plants would rise significantly in case of a 55 percent [EU] reduction target", EWI writes. "Rising prices for emission certificates increase the competitiveness of gas-fired power plants compared to the remaining coal-fired power plants."[17]

The Growing Role of Natural Gas in EU Energy Mix

In 2018, of the entire EU energy mix including transportation and industrial energy, natural gas was the leading electricity source,[18] ahead of renewable wind and solar, coal and nuclear. In 2019, natural gas was again the largest single source of electricity in the European Union, greater than renewables, nuclear, coal or any other source.[19]

Many climate advocates may wish for an entirely renewable energy-powered EU electricity sector, but recent trends suggest that natural gas will play a major role in EU generation for years to come, since it stabilizes Europe's power grid as increasing amounts of intermittent wind and solar power are used and current baseload power from coal and German nuclear energy is curtailed.

ELECTRICITY GENERATION BY SOURCE IN THE EU, 2019-2050, IEA SUSTAINABLE DEVELOPMENT SCENARIO



Source: Energy Futures Initiative

In 2020, the pandemic caused overall electricity consumption to fall by 5%, yet natural gas still made up a very large percentage of the EU electricity mix. Nuclear fell dramatically by 12%, and coal usage declined significantly by 3% to 15% of overall production. Wind and solar grew significantly. But as the IEA points out: "Most of the additional market space has been captured by gas-fired power plants, which benefited from low gas prices and the sharp recovery in carbon prices, putting them in a more competitive position vis-à-vis coal- and lignite-fired generation."[20]

While overall electricity demand in Europe is expected to rebound at least partially in 2021, it seems increasingly clear that the pandemic further undermined nuclear, and to a lesser extent coal, which is so far, at least, stubbornly at 15% of overall electricity production, as it was in the last year of full pre-pandemic demand. The overall trend mix of sources has been established: the EU is moving toward a combination of higher levels of renewable wind and solar and the same amount or more of natural gas. Indeed, for the first time in 2020,[21] renewable energy (39%) edged out coal and natural gas combined generation.[22]

In June 2021, the Energy Future Initiative led by Ernest Moniz, the former U.S. Energy Secretary under President Barack Obama, issued a report

entitled *The Future of Natural Gas in a Deeply Carbonized World*. In its section on European natural gas reliance, the study found that: "On the demand side, natural gas imports will remain essential although assumptions on demand will determine if imports increase and by how much in the 2020s."[23]

The report suggests a growing, not lessening, role for gas in the near-term, during the current decade, especially:

"The EU has officially endorsed a binding target of at least a 55 percent emissions reduction by 2030 from a 1990 baseline…While natural gas is not favored by many policymakers in the region, it may be useful in the near-term to achieve emissions reductions as coal and oil scale down. … To reach the new EU 2030 emissions targets, coal generation will have to decline in all countries and at a faster pace than initially planned, even in countries that do not plan a total phase out by 2030 (i.e., Eastern Europe). It is uncertain how this coal will be replaced, and by what."[24]

In fact, the Energy Future Initiative authors then suggest that it will be natural gas that replaces coal: "The new 2030 emissions target means that it is likely that gas-fired plants may play a bigger role for both baseload and as an enabler of more rapid integration of renewables into the generation mix over the next decade."

In a September 9, 2021, story, entitled "There's not enough gas," the *Financial Times* noted that gas supplies are tight as demand for natural is gas growing both in the EU and globally: "The simple answer to why gas — after years of relatively low prices — is suddenly pricing at a premium to oil, is because there isn't enough of it."[25] The FT finds growing evidence that the EU and Asia will be bidding over LNG shipments from the U.S. and elsewhere, and coal and potentially fuel oil will be used where gas is not available.[26]

Dominance of Russian Imports in EU Natural Gas Market

The Russian dominance of European gas markets is the dark underbelly of the EU's electricity supply. More than 60% of all EU gas is imported, a figure set to rise higher this decade.

And Russian gas provided a stunning 43% of total EU gas in 2020.

Some industry analysts believe without changes in policy, practices or investment patterns, Russia's share of EU gas could increase in the coming decades, despite newly available and cost competitive LNG from the U.S. and other sources. Russia's market share in Europe is expected to remain above 30%, rising close to 40% by 2040, as domestic European gas production and supplies from Norway dwindle. The share of global LNG supplies in Europe's energy mix is expected to increase to 2040 to partly offset the decline in indigenous output, but still lags Russian deliveries throughout the forecast period.[27]

A recent Platts Analytics study finds that Russian pipeline gas supply to northwest, central and eastern Europe, and Italy would rise between 2020 and 2040: "By 2035 we expect a record Russia market share of 38%," the report stated.[28]

The EU has made a commitment to reduce its use of Russian gas by completing new Liquified Natural Gas (LNG) import facilities and through other sources, but the study finds that the EU's current plans are inadequate to diversify away from Russian gas. LNG imports from sources other than Russia are due to increase during this decade, but currently not enough to prevent

a further rise in Russian gas. There is, in fact, no end in sight for use of gas in Europe, and its use seems likely to increase to meet especially baseload energy demand while displacing coal and reductions in nuclear power generation in Germany and other EU countries.

The real questions are: Will EU gas be cleaner from a climate standpoint — that is, far lower in methane fugitive emissions than current Russian and EU gas — going forward to meet climate objectives? And: Will the EU increase its reliance on Russia, given the high geopolitical and other costs for gas from Russia, or will the EU deliver on its own pledges to cut dependence on Russian gas?

The Moniz report finds the possibility of increasing reliance on Russian gas due to the Nord Stream 2 pipeline from Russian to Germany: "reliance on Russia will substantially increase when the Nord Stream 2 pipeline becomes operational." Yet the study also notes that gas has the potential to be the key fuel to displace coal and meet the stringent EU climate goals:

"While natural gas is not favored by many policymakers in the region, it may be useful in the near-term to achieve emissions reductions as coal and oil scale down."[30]

Cutting Methane Emissions is Key to Climate Protection

New studies of many types are finding that reducing methane emissions is utterly critical to overall climate protection, and indeed presents one of the fastest ways to reduce crucial near-term temperature increases.

Quickly cutting emissions of methane globally could slow the rate of the Earth's warming as much as 30%, new research in 2021 has found.

As *The Washington Post* noted: "The study, published in the journal Environmental Research Letters, calculated that a full-scale push using existing technologies could cut methane emissions in half by 2030. And such reductions could have a crucial impact in the global effort to limit warming below 2 degrees Celsius (3.6 Fahrenheit) compared to preindustrial levels — a central aim of the Paris climate accord." Yet the EU relies most heavily on Russian gas, among the most pervasively-leaking, methane emitting gas in the world.

As Chapter Two of this report will show, increasing the use of Russian gas would be a climate disaster for the EU and the world.

A major June 2020 IEA report, "Methane from Oil and Gas," found that: "Methane emissions are the second-largest cause of global warming today … While methane tends to receive less attention than CO2, reducing methane emissions will be critical to avoid the worst effects of climate change … The largest source of anthropogenic methane emissions is agriculture, responsible for one-quarter of the total, followed closely by the energy sector, which includes emissions from coal, oil, natural gas, and biofuel combustion."[33]

The study noted that "It is necessary to tackle all sources of methane emissions arising from human activity," but: "Analysis shows clear scope to reduce oil- and gas-related methane emissions cost-effectively. Unlike CO2, methane — the main component of natural gas — has commercial value, so that any methane captured can often be monetized, and this is typically easier in oil and gas than elsewhere in the energy sector. This means that emissions reductions could result in economic savings or could be realized at low cost."

The EU itself has acknowledged parts of its

methane problem in a study on methane emission reductions released in 2020: "Methane is the second biggest contributor to climate change, after carbon dioxide. It is also a potent local air pollutant causing serious health problems. Tackling methane emissions is therefore essential to reaching our 2030 climate targets and the 2050 climate neutrality goal, as well as contributing to the Commission's zero-pollution ambition."[34]

As will be investigated later in this chapter, the EU is contemplating by the end of 2021 at least beginning methane emissions monitoring, reporting and verification. But it's true commitment to deep methane regulation in the near-term is less clear. Nor does the EU appear ready to require that the more than 60% of its gas that comes from imports also meet strict methane emissions standards.

Such efforts notwithstanding, the EU is especially in danger of letting high methane gas imports undermine the achievement of its overall climate goals. A 2021 statement by Mark Brownstein, Senior Vice President of the Environmental Defense Fund, a leading climate NGO, is entitled: "*Methane Emissions: Europe's Climate Blind Spot*."[35] As he notes:

"As a major consumer of natural gas, Europe plays a significant role in driving an urgent climate problem: methane emissions. At least one-quarter of today's warming is caused by manmade methane emissions — and the oil and gas industry accounts for about 25% of this. Europe sources much of its gas from Russia, Norway and Algeria and also imports gas from the United States, Qatar and Nigeria. Most of the methane emissions associated with such imports occur before the gas reaches the EU. The 'methane footprint' in producer countries is estimated to be between three and eight times the emissions from the domestic EU gas supply chain. But the European Union has an opportunity to achieve even more by directly addressing emissions associated with EU gas import."

Brownstein also notes that "The single fastest way to slow the rate of warming right now, even as we continue to decarbonize our energy systems, is to cut methane emissions from the oil and gas sector."[36] And most methane emissions reductions can be inexpensive for many in the oil and gas industry to make. Brownstein cites an IEA study finding that: "the oil and gas sector can cut methane emissions by 75% using current technologies — up to two-thirds of that at no net cost."

EU Domestic Methane Emissions

While emissions from Russian gas are by far the biggest methane problem for the EU, domestic gas sources also have significant emissions. A study by the Clean Air Task Force, a top climate research organization, using an infrared camera in a first-of-its-kind project, found that methane is leaking from natural gas infrastructure across the European Union.[37] As the *Washington Examiner* noted: "The nonprofit group found leaks and venting of methane at 123 oil and gas sites in Austria, the Czech Republic, Germany, Hungary, Italy, Poland, and Romania this year."[38] "'Even as one person with an infrared camera, I've been able to find multiple leaks in every country I've visited. It begs the question — why aren't the companies and national regulators doing this already?' said James Turitto, the campaign manager who has been filming the emissions for CATF."[39]

Methane from oil and gas is Europe's third largest source of greenhouse gas emissions. Combating methane would be key to the EU meeting its goal of cutting emissions 55% compared to 1990 levels by 2030.[40] Most striking is that the EU methane emissions, as measured, do not account for the emissions from imported gas from the producing countries.

EU Off Pace to Meet 2030 Climate Goals or Renewable Energy Targets

The EU renewable energy directive requires the EU to fulfil at least 32% of its total energy needs with renewable energy by 2030, as part of its key of cutting emissions 55% below 1990 levels by 2030. But is the EU on track to meet the 2030 climate goal? No, is the answer, as of now, according to many analysts, including a top climate advocacy group, the World Resources Institute: "the EU is not currently on track to meet the 55% target by 2030 … to the latest data from the European Environmental Agency, the EU as a whole is … projected to achieve a 37% emissions reduction by 2030 compared to 1990 through national-level measures in EU countries."[41]

In July 2021, the European Union announced its "Fit for 55" detailed plan for cutting greenhouse gas emissions by the end of the decade.[42] Excellent analysis by Teneo Director Samuel Fluckiger noted the EU goals are tremendously ambitious: "The recently adopted Climate Law … [makes] the bloc legally bound to achieve 55% emissions cuts by 2030 and 'climate neutrality' by 2050. This is no small feat: it requires a doubling of the current rate of annual emissions cuts, across the economy, until the middle of the century."[43] But, crucially, regulations of natural gas and methane however were left uncertain in the plan, to be determined later in 2021.[44]

Germany will end all nuclear power generation by 2022. Yet nuclear power provided more than 11% of Germany's electricity in 2020.[45] The potential entry of the German Green Party in the country's governing coalition in 2021 makes nuclear power phase out, already strongly likely, now all but certain, and of course the Greens favor phasing out coal altogether as soon as possible, much earlier than 2038.[46]

Germany's Green Party has also opposed the Nord Stream 2 natural gas pipeline from Russia to Germany, noting both its climate and geopolitical problems: "The pipeline project Nord Stream 2 is not only a political project because of its climate and energy implications but also because it causes damage on the geopolitical level — especially given the situation in Ukraine — and therefore it should be stopped," its policy papers have noted.[47]

Belgium, Spain, and Switzerland also plan nuclear phase-outs by 2030. The consultancy Timera Energy says that by 2030, regulatory timetables show around 29 GW of nuclear closures in seven European countries (Belgium, Britain, France, Germany, Italy, the Netherlands and Spain). Assuming some plants will get extensions, Timera estimates around 21 GW of that capacity will be taken offline. This will mean that even higher amounts of the EU's baseload power must be replaced, in addition to coal capacity that will have to be substituted for, demonstrating why most analysts believe that the EU will use more gas in the next decade.[48]

While increases in energy efficiency in the EU may reduce electricity demand somewhat over the coming decade, these reductions are more than likely to be overwhelmed by increased electricity demand from the rapidly growing electric vehicle sector. According to

a 2020 IEA report: "In 2030 … global electricity demand from electric vehicles (including two/three-wheelers) reaches 550 TWh, about a six-fold rise from 2019 levels. The share of demand due to electric vehicles in total electricity consumption at a national/regional level grows to as high as 4% in Europe."[49] However, there is an opportunity for millions of electric vehicles to play an increased role and electricity storage capacity in the EU. But this development will likely take time to become proficient and a significant source of demand response electricity storage. (See section on "Role of EU Electricity Storage" in Chapter Three below.)

According to a report by the consultancy McKinsey, demand for electricity in the European Union will grow by 40% between now and 2050, a figure in keeping with other estimates. Part of this increase will be due to the electrification of transport, which all major EU nations have committed to with policies, including banning the sale or usage of oil-burning vehicles by 2040 or earlier.[50]

EU Methane Regulation — Promises and Strategy Proposals

In October 2020, the European Commission adopted a "EU Methane Strategy as Part of the EU Green Deal": "One of the priorities under the strategy is to **improve measurement and reporting** of methane emissions … To **reduce methane emissions in the energy sector**, an obligation to improve detection and repair of leaks in gas infrastructure will be proposed and legislation to prohibit routine flaring and venting practices will be considered."[51] The EU methane strategy also included the following analysis:

"Current policies for non-CO2 emissions are projected to reduce methane emissions in the EU by 29% by 2030 compared to 2005 levels. Nevertheless, the 2030 climate target plan's impact assessment found methane will continue to be the EU's dominant non-CO2 greenhouse. It concluded that stepping up the level of ambition for reductions in greenhouse gas emissions to at least 55% by 2030 compared to 1990 would also require an accelerated effort to tackle methane emissions, with projections indicating a step up needed to 35% to 37% methane emission reductions by 2030 compared to 2005. The EU has reduction targets for 2030 for all greenhouse gases, with anthropogenic methane emissions covered by binding national emission reduction targets under the Effort Sharing Regulation." However, there is currently EU policy dedicated to the reduction of anthropogenic methane emissions.[52]

New Methane Detection Methods

As the 2020 IEA report on *Methane Emissions from Oil and Gas* found: "Early analytical results suggest satellites are a promising method to conduct global scans to detect and estimate emissions levels from large point sources, and could increasingly be used to provide actionable real-time information to operators. There are also more granular aerial surveillance programmes being conducted using lower altitude unmanned aerial vehicles including cube sats, planes, helicopters, and drones combined with infrared and thermal imaging techniques. A number of operator-led aerial surveillance programmes are being conducted by companies including ExxonMobil, Royal Dutch Shell, Chevron, ConocoPhillips and BP. Increased stationary surveillance, complemented with routine aerial monitoring, can provide early and widespread detection for methane leaks."[53]

In the U.S., the state of California is partnering with NASA to develop methane-detecting satellites that may be the most accurate and

impactful globally over time.[54] The leading climate advocacy group EDF has developed its own methane detection technologies called MethaneSat.[55] The geoanalytics firm Kayrros SAS has created additional technologies — termed Methane Watch — for methane detection, that allowed it to discover huge Russian methane leaks in 2021.[56]

Suffice it to say, Russia's massive methane and natural gas industry emissions — which have been purposefully concealed by Moscow for decades — will be increasingly difficult to hide.

If the EU, U.S., and others take appropriate actions, methane detection tech and reporting requirements may exert the effective pressure to use alternatives, including gas that can prove lower methane emissions, to high-fugitive-emitting Russian gas. This may put pressure on Moscow to begin to seriously reduce its own emissions, although this prospect will likely be difficult to accomplish quickly, and its feasibility may remain limited for many years given the opaque and corrupt nature of the Putin regime.

How Quick-starting Gas Plants Expand Renewable Energy

The unique role of quick-starting gas plants in supporting intermittent renewable energy to allow a more flexible electricity grid is in contrast to nuclear and coal, which do not have this ability to support higher amounts of renewable energy. As the 2020 *Progressive Policy Institute* report, "Wind, Solar, and Gas: Managing the Risks of America's Clean Energy Transition," found in the U.S. context: "Natural gas today already supports the expansion of renewable energy by providing an instantly dispatchable source of electricity. The unique flexibility of natural gas power plants to turn on and off within minutes, which coal and nuclear plants cannot offer, means gas quickly matches supply and demand even when the wind isn't blowing and the sun isn't shining."[57]

European coal plants and nuclear facilities face the same problem in taking hours to fully cycle. The EU's modern natural gas plants, like those in the U.S., can however dispatch power within minutes of cycling up. As the 2020 PPI report found regarding the role of gas in U.S. decarbonization: "Most of the challenges associated with overreliance on renewables can be avoided by adopting a generation portfolio with some level of generation capable of fast ramp rates, low capital costs, and high variable costs. In this context, natural gas generators pair especially well with high buildouts of solar and wind. Adding a backstop, for example natural gas, to alleviate the need for a limited quantity of renewables leads to total installed capacity that is much more closely sized to peak loads. This results in a reliable grid that delivers lower electricity prices."[58]

The problems of cost and scale of 100% intermittent wind and solar in the U.S are replicated in the EU:

"But there's a big problem [with 100% renewable grid]: the intermittency of renewables requires overbuilding total installed capacity to produce sufficient energy during periods when available short-term wind or solar output is well below average. One finding from the literature is that total installed renewable capacity should be three to eight times larger than peak demand."[59] The second, more pragmatic path envisions a strategic backstop to wind and solar power by employing dispatchable forms of electricity. For example, a recent comprehensive exercise that models deep carbonization of the United States electrical grid finds that the availability of backstop power, such as natural gas generation

with CCS, reduces electricity costs 10% to 62% compared to scenarios that rely exclusively on variable sources paired with energy storage.

In summation, as the International Energy Agency and other leading analysts have found, the EU has the opportunity to utilize *cleaner lower methane-emitting natural gas* as a way of deploying more renewable energy

in a balanced electrical grid and lowering its overall emissions to meet its 2030 and 2050 climate targets. But as the next chapter will show, to do so it must reduce emissions of high methane-emitting Russian natural gas system. Over time, the EU can also deploy carbon capture technologies at natural gas power plants as needed to drive emissions from gas down near to zero. These technologies are likely to become far cheaper in the next few years as they begin to be deployed in the U.S., China, and elsewhere.

The key point here is clear: the dynamics in the EU are almost precisely the same as in the U.S. Gas can support renewable energy and displace coal, allowing a large drop in overall emissions, but that gas must itself have low methane and CO2 emissions.

CHAPTER TWO
THE HIGH COSTS OF EUROPE'S ADDICTION TO RUSSIAN GAS

Many European leaders and experts have long complained about the high geopolitical costs of Europe's deep reliance on Russian gas. In the first decade of this century, the costs were already chronic and well-understood. As the George C. Marshall European Center for Security Studies noted in 2008: "Europe's dependence on Russia for natural gas already profoundly affects the freedom of action of certain European states and will increasingly erode European sovereignty."[60]

Numerous analysts, like David Buchan, however, have pointed out that Central and especially Eastern European countries who are most deeply dependent and therefore concerned while western Europe has historically shown less consternation.[61]

But the U.K.'s former climate and energy security envoy, Rear Admiral Neil Morisetti observed at the time: "Recent events in Ukraine and the Middle East have served to highlight the vulnerability of our energy supplies and the political straitjacket that results from our over-dependence on fossil fuel imports from these volatile regions."[62] And as *The Guardian* noted during the crisis: "The greater concern in European capitals is that Russia could once again turn off the tap on its gas supplies to Ukraine, as it did in 2006 and 2009. Some analysts say the proportion of European gas demand for heat and power met by Russia has actually risen since then, from 26% of supplies in 2010 to 34% in 2013.

In the aftermath of the Crimea annexation, in 2018, experts pointed out the implicit

compromises toward Russia that dependence on Russian gas inevitably entails for EU nations when Austria invited Putin to Vienna in June of that year: "It is unusual for any European leader to receive President Putin for a state visit in the capital given the current tensions between Russia and Europe,' said Kristine Berzina, senior fellow at The German Marshall Fund of the United States. "But the hostility ends when it comes to energy, as European leaders are well aware that millions of homes would be without heating if Russia turns off the gas taps."[63]

Even mildly pro-Russian analysts acknowledge the costs of EU reliance on Russian gas:

"Gazprom, Russia's state-owned gas monopoly, supplied a total of 200.8 billion cubic meters of gas to European countries, with 81% heading to Western Europe. Russia's hydrocarbon exports generate a substantial amount of revenue for the state, accounting for more than 50% of the consolidated budget. … For the long run, the European Union should aim to diversify its supply routes…Though environmental considerations are a core element behind the EU's new energy strategy, the most immediate goal is to reduce dependency on one external supplier. Indeed, disruptions in the supply of energy from Russia pose a serious threat to Europe, given the needs of modern economies."[64]

But perhaps the single most damning and dramatic evidence of extraordinary geopolitical costs of the European Union's reliance on Russian natural gas is this:

EU gas imports are higher today than before Russia's illegal annexation of Crimea in 2014.

The EU natural gas import share from Russia for the decade 2010-2020 held steady at more than 39%, and Russia provided 39% of natural gas imports into the European Union in the first six months of 2020. And in 2019, Russia provided 43% of the EU's gas.[65]

As *The Economist* magazine recently noted: "[T]he EU remains Russia's biggest customer and Russia the EU's biggest supplier, accounting for 30% of the bloc's crude-oil imports and 40% of its natural gas."[66]

Despite Russia's incursions into Ukraine and illegal annexation of Crimea more than six year ago,[67] the European Union remains as dependent on Russian gas as it was a decade ago. Indeed, leading industry analysts believe Russia's share of EU gas will only increase in the coming decades, despite newly available and cost competitive LNG from the U.S. and other sources: "Russia's market share in Europe is expected to remain above 30%, rising close to 40% by 2040."[68] This continuing dependency is even more surprising given the fact that opportunities for diversification of natural gas imports using liquefied natural gas have increased dramatically in recent years.

A study commissioned by the European Parliament itself — "Energy as a Tool of Foreign Policy of Authoritarian States, in particular Russia" — found deeply disturbing consequences of continuing EU reliance on Russia for both oil and especially natural gas:

"Most energy-rich authoritarian states use their energy wealth to ensure regime survival. But, more than others, Russia uses its energy wealth as well to protect and promote its interests in its 'near abroad' and to make its geopolitical influence felt further afield, including in Europe. It uses gas supplies to punish and to reward, affecting both transit states and end-consumers. This study explores how supply disruptions, price discounts or hikes, and alternative transit routes such as Nord Stream 2 and Turkish Stream, are used by Russia to further its foreign policy ambitions, feeding suspicions about its geopolitical motives. The lack of transparency about Russia's energy policy decisions contributes to this."[69]

The study also analyzed extraordinary reliance of Moscow on the European market representing by far Russia's largest single source of funding for its autocratic government:

"One-third of Russia's natural gas production, roughly 190 bcm is exported. Almost all of which, some 87% in 2016, goes to Europe. In addition, Russia shipped 266.7 million tons of crude oil and oil products to Europe in 2016. Europe is Russia's most important market, and Russia is Europe's primary energy source."

There is a growing sense of cognitive dissonance as the EU, on the one hand, rightly condemns

Russian human rights abuses while, on the other hand, pursuing a long-term energy strategy that locks Europe into being perhaps the largest single foreign source of funding for the Kremlin's autocratic conduct.

As one might imagine, Eastern European nations who have long suffered from Russian intervention are outraged at the state of affairs. Eastern European leaders, including Polish President Mateusz Morawiecki, have expressed deep concerns about Russian gas addiction generally, and that Nord Stream 2 will benefit Russia, but not Europe.[70]

For EU security officials concerned about the long-range vulnerabilities of the EU to Russia's cyber, military, and other incursions, a *Foreign Affairs* May/June 2021 article on Putin's future in Russia after more than two decades in power noted that, "A future spike in energy prices that increased rent streams to the elite and delivered prosperity to the broader public would offer Putin some respite," making Putin's autocratic domination of Russia that much harder to wind down.[71] In other words, the EU's growing reliance on methane-emissions-heavy gas is not only bad for the global climate, it is perpetuating Vladimir Putin's regime.

A long series of major new cyberattacks by gangs operating in Russia with impunity have further dramatized the security and geopolitical risks of continuing to fund the Russian regime through gas imports. Read more about the growing number of Russian cyberattacks on the EU and its allies in **Appendix A**.

High-Methane Russian Gas Undercuts EU Climate Goals

Not all natural gas is created equal regarding greenhouse gas emissions generally, and especially methane emissions — far from it. The current mix of EU gas imports is highly problematic, since gas from Russia and its state-own company Gazprom has extremely high methane emissions and climate change costs.

The International Energy Agency (IEA) reported in January 2021 that Russia is the world's largest methane emitter.[72] Last year the country produced 13,953 kt of methane emissions, almost 20% of the 70 Mt of methane released into the atmosphere worldwide last year. Yet even these

numbers are almost certainly artificially low, since Russia does not allow independent or trusted assessment of its methane emissions.

Russian President Putin recently asserted, yet again, without providing any evidence whatsoever, that Russian natural gas exports are low-emitting.[73]

In fact, all of the evidence suggests Russia operates a leaky, antiquated, unregulated system with extremely high fugitive methane emissions of at least five to seven percent of total gas volume.[74]

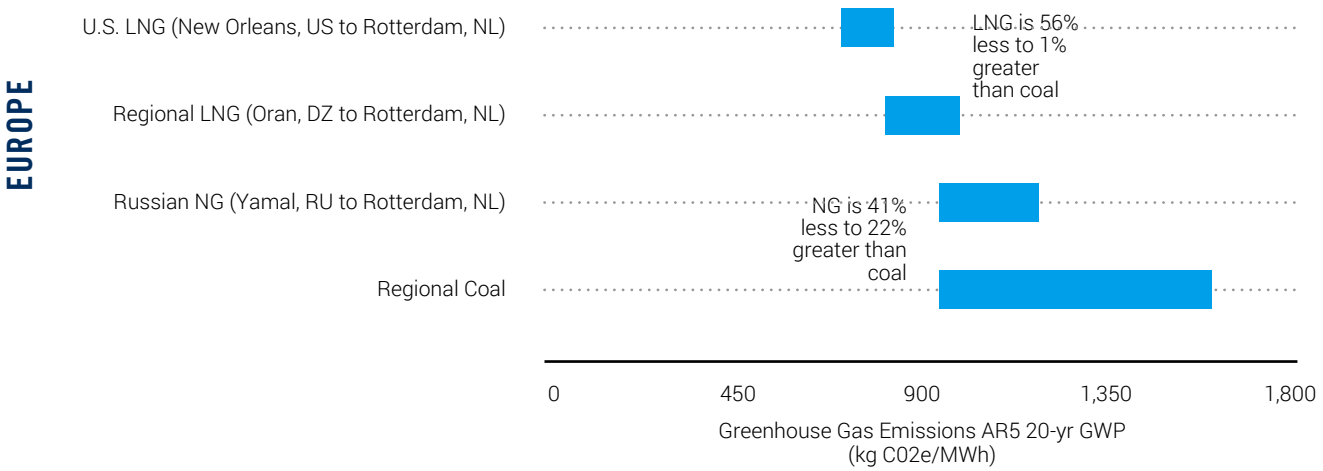
But analysis shows that if natural gas has fugitive emissions of more than 3.5%, it is worse than coal in producing warming. So natural gas, like that from Russia, with very large leaks or fugitive emissions during production and transport, is worse than coal from a climate perspective.[75] This matters greatly since methane has 85 times the warming potency of carbon dioxide over the first two decades after its emitted, and is especially important to mitigating near-term temperature increases.[76]

Just as the European Union undertakes herculean emissions cutting efforts in other sectors it is deliberately pursuing the policy of using natural gas that is worse from a climate change perspective than the coal power gas is meant to replace.

The EU as whole has been very slow to admit this conundrum.

A major 2019 study by the U.S. National Energy Technology Laboratory finds Russian gas piped to Europe has up to 22% more greenhouse gas emissions than European coal.[77] U.S. liquified natural gas (LNG) delivered to the EU, in contrast, has up to 56% fewer total emissions than EU coal, the report shows.

20YR GWP COMPARISON OF COAL AND NATURAL GAS POWER IN EUROPE AND ASIA



Source: National Energy Technology Laboratory

A major investigative series by *The Washington Post* found that "Russia claims that it emitted 4 million metric tons of methane from the oil and gas sector in 2019, the most recent year reported. But six studies and scientific emissions data sets reviewed by The Post, using various methods, found much higher annual numbers in recent years, in some cases two to three times as large."[78]

Indeed, all the evidence suggests, as Joe Biden's Energy Secretary Jennifer Granholm recently noted, that Russian gas is the "dirtiest form of natural gas on Earth."[79]

But Russia has consistently lied about and attempted to cover-up it's methane emissions for many years and even decades. The Washington Post investigation found "Russia has repeatedly revised its methods for calculating emissions, not only shrinking current figures but also rolling back past estimates. The year 2010 shows how Russia's calculations have fluctuated wildly. In a succession of annual reports to the United Nations, Russia has changed its estimate for oil and gas methane emissions for that year from 15.4 million tons, to 31.5 million tons, to 24.7 million tons, to 23.6 million tons, to 6.5 million tons, and — most recently — 5.1 million tons." In short, Russia's methane emissions claims are pure fabrications, and can never be trusted without independent verification.

Yet there's also a sense that the EU nations and others are gaming the accountancy rules of greenhouse gas emissions across borders. While it is true that Russian methane and other gas emissions from the production and transport of gas within Russia don't technically count against the EU emissions totals in the UN accountancy framework, the result is the same for the global climate and overall emissions.

The sourcing of super high-emitting gas from abroad is simply the ultimate climate change shell game not taking responsibility for emissions which in fact EU imports do cause.

As this report will show, creating global standards of accurate accounting and verification of natural gas production and transportation emissions is a crucial step in lowering EU and global emissions and using gas to displace coal in Europe and globally.

NEW SATELLITE DETECTION OF METHANE SHOWING MASSIVE RUSSIAN EMISSIONS

New satellite methane detection technologies have just begun to expose some of Russia's enormous methane emissions. Geoanalytics firm Kayrros SAS reports that methane emissions from Russia's gas infrastructure increased by at least 40% in 2020 even though gas exports to the EU temporarily dropped by nearly 15% over the same period due to the pandemic.[80]

In June 2021, a massive methane plume was detected over Russia in satellite data by Kayrros. Gazprom admitted that it was responsible for the huge methane leak, saying pipeline repairs on June 4 released 2.7 million cubic meters (1,830 metric tons) of methane. According to the Environmental Defense Fund, a leading environmental advocacy organization that specializes in methane issues, the Russia gas leak will have roughly the same short-term planet-warming impact of 40,000 internal-combustion cars in the U.S. driving for a year.[81]

Yet even such an enormous leak was equal to just 0.1% of Gazprom's total pollution in 2019, according to analysts at Moscow-based VTB Capital. As *Bloomberg News* reports: "The leak this month from Gazprom's pipeline in Tatarstan isn't the only major methane release traced to the Russian company. Kayrros detected another giant methane plume on May 24 with an estimated emissions rate of 214 metric tons an hour. Gazprom said this leak resulted from two days from pipeline in Russia's Bashkortostan region with emissions amounting to about 900,000 cubic meters."

Bloomberg continues: "Russia's largest gas company is under pressure to do more to lower the methane emissions caused by its operations as countries in Europe — its biggest market — more closely scrutinize the climate impact of the fuel used to heat their homes and power their grids. The large amounts of methane caused by Russian gas come as the European Union seeks to meet a target of net-zero emissions by mid-century. Gazprom also confirmed it was responsible for three more methane releases that have been spotted in Russia this month."[82]

Russia has Taken No Real Action to Cut Methane or Overall Greenhouse Emissions

Russia is the fourth largest greenhouse gas emitter globally and has done essentially nothing to reduce its emissions to prevent climate change disaster, according to the highly respected climate change experts at the World Resources Institute.[83] Russia climate proposals are "allowing emissions to creep upwards through 2030 and not drop to net-zero until as late as 80 years from now," WRI finds. Crucially, the WRI analysis only looks at Russia's domestic emissions, not it's even greater export of emissions.

Russia emits almost 5% of total global greenhouse gases, and given its dependence on oil and gas, has no serious plans for reductions. This data does not include its oil and gas exports which are among the largest in the world. And as noted the Russian government has systematically prevented and lied about measurements of emissions from its oil and

gas sector for many decades, so actual Russian percentage of global greenhouse gas emissions is far higher than the 5%. Along with high methane exports, also concerning are Putin's plans to establish a vast new oil and natural gas empire in the Arctic, where the melting of sea-ice due to methane emissions, increased shipping, and other largely Russian activities are already threatening to disrupt global climate stability, according to leading experts.

The EU natural gas import share from Russia for the decade 2010-2020 began at more than 38%, and Russia provided 39% of natural gas imports into the European Union in the first six months of 2020.[84] Indeed, EU natural gas import share from Russia actually increased over the decade 2010-2020,[85] despite Russia's incursions into Ukraine and Georgia, and illegal annexation of Crimea more than six year ago, among other geopolitical outrages.[86] In 2019, Russia provided nearly 45% of the EU's gas.

Meanwhile, the EU has only marginally diversified its gas imports by including much larger shares of lower emitting natural gas from the United States. Yet, natural gas production in the United States has fugitive emissions of 1.4% of total gas volume, according to analysis from the Environmental Protection Agency done during the Obama administration.[87]

In a recent survey by Reuters on global methane emissions from gas: "The governments of Russia, Saudi Arabia, and China — which round out the top five world oil-and-gas producers – did not respond to Reuters' requests for comment on their abandoned wells and have not published reports on the wells' methane leakage."[88] This follows a long-standing pattern of Russia and (other major suppliers of EU natural gas like Qatar and Iraq) refusing to report in any way the extent of the greenhouse gas emissions involved in their natural gas production. In essence, the EU is abetting this deliberate covering up by Russia and others of extremely high emissions by not requiring its imports to report the full level of their emissions.

As IEA has found in 2018, flaring and other methane emissions must drop globally as a key element in meeting sustainable development goals.[89] But the U.S. is essentially alone in adopting this agenda, as the Chapter Three below will show. IEA notes: "Russia, Iraq, Iran, Algeria and the United States were responsible for more than half of global flaring. Several field trials have demonstrated viable technologies to reduce flaring, but at root the issue of flaring is also a question of business models. If there is inadequate provision for productive use of the gas at the project planning stage, including the necessary gas infrastructure, then finding a technology fix later on is much more difficult."

This is precisely the business model issue the U.S. is changing but where this is no evidence Russia and Gazprom will. And as IEA notes, cutting methane flaring is crucial to meeting overall climate goals: There is an increasing number of voluntary government and industry commitments to eliminate flaring by 2030. The [UN Sustainable Develop Scenario goals] relies on a rapid reduction in flaring, with government policies and industry commitment all but eliminating it by 2025.[90]

The World Bank has proposed a "Zero Routine Flaring by 2030" Initiative that the U.S. alone appears on track to meet.[91] As the Bank proposal notes, "Much of this gas is utilized or conserved because governments and oil companies have made substantial investments to capture it." But indeed, almost all of these government actions

and private sector investments are being made in the U.S. and none in Russia.

The U.S. is now in position to meet these Zero Flaring Goals far ahead of other nations, making U.S. gas far-lower emitting.

This is especially the case after the EU and US announced in late September 2021 that each would commit to reducing total methane emissions by 30% by the end of this decade.

Russia, with no history of emissions reporting, tracking, regulations, reductions or any similar investments, and no credibility on the topic, and no experience. The likelihood Russia could meet such a standard quickly is nil.

Many have expressed dismay over Russia's Nord Stream 2 pipeline, and the associated risks for Europe. The completion of the pipeline could lock in EU reliance on high methane Russian gas for decades. Read more in **Appendix B**.

Merkel and U.S. "Deal" on Nord Stream 2 — Climate and Geopolitical Retreat

When German Chancellor Angela Merkel visited American president Joe Biden on July 16, 2021, it was clear U.S. officials were still deeply uncomfortable with her position:

Biden also raised at least one thorny issue: U.S. objections to a major natural gas pipeline connecting Germany and Russia. U.S. officials are concerned that the Nord Stream 2 pipeline, which is nearly 90 percent complete, will give Russia potential leverage over Germany while harming Ukraine by weakening its status as a conduit for Russian natural gas.[92]

"Good friends can disagree," Biden said. "While I reiterated my concerns about Nord Stream to Chancellor Merkel, we are absolutely united in our conviction that Russia must not be allowed to use energy as a weapon to coerce or threaten its neighbors."[93]

As they try to paper over their spat around the Nord Stream 2 pipeline that will deliver Russian gas to Germany, Biden and German Chancellor Angela Merkel announced a U.S.-German energy and climate partnership Thursday. The plan is vague, but it includes U.S. climate envoy John Kerry, Energy Secretary Jennifer Granholm, German Minister for Economic Affairs and Energy Peter Altmaier, and German Minister for the Environment, Nature Conservation and Nuclear Safety Svenja Schulze.

Yet how such a new "partnership" could possibly elide the key climate and geopolitical issues in Germany and Europe is very unclear. According to the White House fact sheet on the agreement:

The partnership will support sustainable energy transformations in developing regions (including Ukraine, which was vehemently opposed to the Nord Stream 2 pipeline), concoct policy roadmaps to nullify emissions and share energy technology — and also calls for "preventing the use of energy as a coercive tool." "We share the goals of leading the world to develop the innovative tools urgently needed to accelerate global climate action and achieve net-zero greenhouse gas emissions in their economies by 2050 at the latest," the White House wrote in a partnership fact sheet.[94]

As the *Associated Press* reported, Merkel and Biden "announced a $1 billion fund for Ukraine to diversify its energy sources, of which Germany will provide an initial $175 million grant. And, Germany guaranteed that it would reimburse Ukraine for gas transit fees it will lose from being bypassed by Nord Stream 2 until 2024, with a possible 10-year extension."[95]

Fortunately, many other German leaders, including a few who may succeed Merkel, are more skeptical of the value of the Russian pipeline.

The narrow results from German national elections in late September left the fate of Nord Stream 2 in doubt, with Merkel's Christian Democrats, now led by Armin Laschet, failing to gain a plurality and posting their lowest level of support since the parties founding in 1945. The center-left Social Democrats gained a small plurality of the vote, and along with the Green Party have questioned the value of NS2. As Germany struggles to form a coalition government, it should reject the pipeline's huge geopolitical and climate costs, as a vestige of previous era of politics, and embrace a new long-term strategy that demands low-emitting natural gas emissions imports and rejects Russian attempts to manipulate EU geopolitics.

When Ukraine president Volodymyr Zelensky visited the White House in early September 2021, President Biden reiterated his determination to oppose "Russian aggression" in Ukraine and offered an "ironclad" commitment to Ukrainian sovereignty. Biden announced a $60 million security assistant package for Ukraine but did not suggest the U.S. would reimpose sanctions regarding the Nord Stream 2 pipeline.[96]

Germany Temporarily Suspends Nord Stream 2 Certification

In mid-November 2021, Germany's energy regulator "temporarily suspended" certification of Nord Stream 2 on a technicality noting that Russia's Gazprom and other NS 2 owners have created a German subsidiary that was not yet been legally established. As gas prices have increases in recent months, many analysts have suggested that Gazprom has been purposely restricted gas exports to Europe to force to Germany approve the NS2 project.[97]

Meanwhile, in the same week, U.K. Prime Minister Boris Johnson stated that Europe must make a "choice" between "sticking up for Ukraine" and its national sovereignty or approving Nord Stream 2 as concerns that Russia may be contemplating an invasion of Ukraine have grown.[98]

On November 24, 2021, Olaf Scholz appeared set to succeed Angela Merkel as German chancellor, as Scholz's center-left Social Democrats presented an agreement with the Greens and the pro-business Free Democrats. As *Bloomberg* noted, "Germany could also quickly take a different tone on the global stage. Annalena Baerbock is in line to become Germany's first female foreign minister. The Greens' former chancellor candidate has called for the country to take a more assertive role, has repeatedly criticized China for human rights violations and opposes Russia's Nord Stream 2 gas pipeline."[99]

Russia's Weak Climate Commitment

Russia is the fourth largest emitter of greenhouse gases but also the nation that has taken the least serious action to move its economy away from high admitting fossil fuels. As this report documents, Russia's antiquated oil and gas system is one of the highest emitting in the world with fugitive emissions of methane from leaks, venting, and flaring making its exports especially greenhouse gas heavy.

And yet as documented by leading climate experts earlier Russia has taken no serious action whatsoever to reduce its emissions or diversify its economy and government funding away from reliance on oil, coal, and natural gas.

The international climate and security communities have been woefully negligent in not calling out Russia climate malfeasance more clearly and far earlier.

Finally, just in mid-July of 2021, U.S. climate envoy John Kerry met with Russian foreign Minister Sergei Lavrov in Moscow to discuss climate issues.

As the *Financial Times* reported:

"Lavrov said Kerry's visit to Russia was "an important positive sign in terms of developing bilateral relations, lifting tension, and arranging professional, substantive work in areas where common ground can be found". Russia is "hoping for close co-operation with the United States … in order to secure a successful meeting in Glasgow this coming fall," he added. The talks in Moscow follow a brief meeting between Kerry and Lavrov in New Delhi in April, and a telephone call between the two men in February."[100]

And yet it is hard to see what major progress the U.S. and EU can gain from Russia that would be comparable to compelling the cleanup of the notoriously leaky, super-methane-emitting Russian oil and especially natural gas infrastructure. This effort should be a primary focus of President Biden's climate and foreign-policy agenda with Russia.

The *Financial Times* noted that Russia itself is suffering from widespread and costly climate change impacts. In the past, Putin has denied that man-made causality of climate change, but only recently he seemed to acknowledge the human role that all major scientists agree on:

"Rapidly rising temperatures in Siberia and regular instances of flooding and forest fires have made climate an increasingly important topic for the Kremlin. Putin, who four years ago blamed rising global temperatures on volcanoes and 'cosmic changes,' last month said man-made climate change was a 'tragedy' and that humans 'must minimise the impact we have.'"[101]

The EU has a vital role to play in this process. By requiring EU natural gas and then imports to meet strict greenhouse gas and methane reporting verification and monitoring standards, the EU can compel the cleanup of the Russian natural gas system overtime by forcing the Russians to reduce their gas production emissions or lose lucrative European gas markets. This emphasis on cleaning up Russian natural gas should be a key component of any climate bilateral work between the U.S. and Russia as well as between the EU and Russia. The U.S. is already undertaking remarkable and quick reductions in their own methane emissions to help compel all other natural gas exporters to cut their emissions or be forced out of the market on climate change grounds.

These fundamental market and climate change emissions dynamics are likely to be far more powerful in forcing Russia to clean up its super-leaky system than mere jawboning by diplomats.

The huge push by the Biden administration to dramatically reduce methane emissions from U.S. natural gas exports in the form of liquefied natural gas has the opportunity to increasingly provide Germany and all of Europe super low emitting gas to displace coal and high-emitting Russian gas, helping the EU meet its 2030 climate goals and limit near-term climate impacts.

Deep reductions in U.S. methane are beginning to be undertaken by the Biden administration, Congress, and most surprisingly, by the U.S. gas industry. It is increasingly clear that the U.S. realizes that it can deeply reduce emissions

from methane at relatively low cost, and achieve the goal of making American natural gas by far the cleanest and most climate friendly in the world. This, it turns out, can have a huge positive benefit in terms of reducing methane and other emissions from Europe's natural gas imports.

But there is also strong hope that combined EU and U.S. actions will force global actions, as nations, regulators, and consumers begin to choose lower emitting U.S. gas over much higher emitting Russian, Qatari, Australian, and other sources. Indeed, there is every reason to believe that overtime this dynamic will force these higher emitting other natural gas exporters to finally reduce emissions in their own systems or be excluded from lucrative markets in Europe and eventually Asia.[102]

CHAPTER THREE
CLEANER ALTERNATIVES TO RUSSIAN GAS

In just the last decade, a series of significant clean energy supply options have become available in Europe to displace both the EU's reliance on coal and super-high emitting methane-heavy Russian gas. These include of course renewable energy, especially wind and solar, which the EU "Fit for 55" plan is prioritizing, counting on a dramatic increase in EU renewables production to fully 40% of total energy.

Yet many EU nations have developed important new liquefied natural gas ports to diversify gas imports away from over reliance on Russia. With progress on new lower-methane-emitting liquefied natural gas from the United States as a result the efforts of the Biden Administration and the U.S. industry, there is a new opportunity for the EU to lower its overall greenhouse gas emissions by displacing all of its coal use, as well as much of its high-emitting Russian imported gas. This cleaner LNG can help stabilize the EU electricity grid as greater amounts of intermittent renewable energy are used, along with important new electricity storage technologies. Taken together, renewable energy, cleaner LNG, and new electricity storage technologies can help drive down the EU's emissions to meet its 2030 goal and longer-term climate goals.

Meeting EU 40% Renewable Energy Goal

As part of its "Fit for 55" climate and emissions reductions goals, the EU in July 2021 announced an increase in its renewable energy target from an already ambitious 32% to a dramatically higher 40% by 2030.[103]

In 2019, the last year of pre-pandemic data, the EU got a bit more than 20% of its electricity from renewable sources. While it's true that during the pandemic in 2020 the share of renewable electricity only grew to 38%, this was in part because of a significant but temporary drop in demand of about 6%. While the prices of renewable energy have fallen in many parts of the EU, its ability to meet this goal is highly questionable. As noted earlier, analysts do not believe the EU is on track to currently meeting its climate goals: "Germany, the largest-emitting EU country, would not have met its 2020 climate target without the COVID-19 induced emissions drop. … According to the latest data from the European Environmental Agency, the EU as a whole is set to meet its 2020 target of a 20% greenhouse gas (GHG) emission reduction and projected to achieve a 37% emissions reduction by 2030 compared to 1990 through national-level measures in EU countries."[104]

While the costs and probability of the EU meeting its 40% renewables goal has not yet been subject to rigorous analysis, even

advocates of wind power, the EU's largest renewable source, expressed concerns about meeting the goals given current permitting and other hurdles. According to a Platts report: "The most ambitious renewable energy targets remain academic if we don't solve permitting," WindEurope's communications officer Christoph Zipf said. EU wind energy capacity would need to be 433-452 GW by 2030 to meet a 38%-40% renewable energy target, WindEurope said in a position paper submitted to the EC's consultation process…That is almost a threefold increase on the 179 GW currently installed."[105]

A September 2021 report by one of Europe's largest electric utilities, Enel, found that the EU is not on pace to meet its 2030 climate goals or its renewable energy targets. Enel Chief Executive Francesco Starace said at the current pace Europe would not reach its 2030 target of raising the share of renewable energy to 40% of final consumption until 2043. This sobering analysis suggests that the EU will be dependent on natural gas to produce electricity for decades to come, underscoring the imperative of cutting emissions from gas. It also means the EU must invest in greater efforts to increase its renewable energy share.[106]

Leading studies in both the EU and U.S. suggest that improvements in large-scale battery storage capacity will increase the amount of renewable energy that can be delivered to the grids in America and in Europe. Yet huge innovations and reductions in price and capacity will be needed to more rapidly expand grid scale electricity storage. According to Utility Dive, a top U.S. publication: "A March study published in Nature Energy found that the energy capacity cost of long-duration storage technology must fall below $20/kWh in order to reduce total carbon-free electricity system costs by at least 10%. Capacity costs would have to drop even lower to displace nuclear and natural gas plants, the study found."[107]

In the U.S., large-scale battery storage capacity grew by 35% in 2020 and has tripled in the last five years, according to the U.S. Energy Information Administration. Utilities have reported plans to install over 10,000 MW of additional large-scale battery power capacity in the U.S. over the next three years — 10 times the capacity in 2019. Yet this still only represents a small portion of overall U.S. electricity demand and production. Small nuclear reactors may in time more inexpensively and safely provide additional zero emissions energy in the EU and the U.S. But the commercialization timeline for this technology is still unclear.

Role of Carbon Capture in Reducing Emissions from Natural Gas

Market forces and regulations in the U.S. and EU can help push methane emissions to far lower levels. But natural gas producers and end users like electric utilities will also be compelled to reduce their CO2 emissions to meet net-zero emissions goals. Carbon Capture Utilization and Storage (CCUS) technology is likely to play a role. In the U.S. directed tax incentives to bolster technological advances in CCUS appear likely to lead to at least modest initial commercial application within the next few years. These two reductions of methane for more effective near-term temperature mitigation, and cutting CO2 for longer-term global warming reduction, are critical for gas to play a full role as clean, inexpensive base load generation fuel that also enables the deployment of utility scale renewable energy.

As PPI noted in its 2020 report, "Wind, Solar, and Gas: Managing the Risks of America's Clean Energy Transition": "Ultimately, natural gas

generators with CCS must be deployed at scale to achieve an effective zero-carbon backstop for renewables. The policy and technical inertia surrounding CCS development must be expedited to ensure that CCS technologies develop quickly enough to be applied successfully to a natural gas generator as soon as possible. Therefore, the federal and state policies that have spurred new CCS projects should be strengthened."[108]

It is notable that increased tax incentives for CCUS were included in the bipartisan infrastructure legislation passed by the U.S. Senate in August of 2021, and expected to be approved by the full Congress later in 2021. Commercially viable CCUS technology is one key to achieving carbon neutrality quickly. This pragmatic approach to deploying renewable energy quickly, cheaply, and on a large scale was outlined in the PPI report: "There's no doubt that renewable energy can and should form the backbone of our zero-carbon electricity grid. But natural gas power plants with CCS technology would enable more rapid and strategic development of renewable energy by serving as an emissions-free backstop that secures lower electricity prices and ensures grid reliability."[109]

The implications for the EU are significant, in that the large amount of Russian gas imported into Europe will have no significant carbon mitigation. Coupled with the methane leakage in Russia, it is inconceivable that the EU will legitimately meet its true climate targets while relying on Russian gas without both far greater methane mitigation and over time some form of carbon dioxide mitigation like CCUS. Moreover, scientific and technological advances in using CO2 to create new products like lower emissions cement manufacturing have strong potential to create new industries in the U.S., EU and globally. In addition, pipeline infrastructure now used exclusively for gas may be converted over time to transport and store CO2 as well as hydrogen. Such add-on economic and climate benefits as part of the natural gas transition should not be discounted.

Growth in EU Liquified Natural Gas Import Facilities

EU LNG import terminals have grown dramatically in recent years, providing a huge opportunity for diversification away from the climate and geopolitical problems of Russian gas.[110] The European Union Commission (the EU's executive body) sees the import of LNG as essential in achieving its objective of diversifying sources of energy supply to its member states, and as an important part of the EU's future energy mix, and has commenced implementation of a strategy to make sure all EU Member States have access to LNG.[111]

A pre-pandemic EU-U.S. Joint Statement from March 8, 2019, noted that LNG imports from the U.S. were up by 181%, since July 25, 2018, when the EU and U.S. agreed to strengthen EU-U.S. strategic cooperation including in the area of energy: "With a share of 12.6% of EU-LNG imports in 2019 so far, the U.S. is Europe's third biggest supplier of LNG. The European Union is ready to facilitate more imports of liquefied natural gas from the U.S., if the market conditions are right and prices competitive. This will allow U.S. exporters to further diversify their European markets whilst contributing to the EU's objectives of security of supply and diversification. … The International Energy Agency expects liquefied natural gas imports to Europe to increase by almost 20% by 2040 compared to 2016 levels. … The EU has well developed liquefied natural gas import capacities. … At the same time, given their

strategic importance for diversification, current capacities are being expanded and new capacities are being developed in the Adriatic Sea, in the Baltic Sea, notably in Poland, and in the Mediterranean Sea in Greece. This would allow for a significant increase of liquefied natural gas imports to the EU."[112]

This growth in EU importation of U.S. LNG continued during the COVID pandemic even amid depressed EU energy demand in 2020 and early 2021, according to a February 2021 S&P Platts study on "Reasons for EU LNG Growth": "Europe's LNG import terminal capacity has historically been underutilized … However, by the end of 2019, the average daily send outs had risen to … more than double the average seen in the decade prior."[113]

Importantly, this analysis suggests that LNG is lowering the price of gas for the EU in many instances, and in fact forcing Russia and other competitors to cut their prices: "The price impact of Europe's emergence as the global LNG market's destination of last resort is clearest when looking at the landed price of LNG into Europe. With Europe becoming the destination for a seemingly endless glut of LNG, the landed market price for delivered cargoes into the continent began to" fall "with sellers increasingly lowering offer prices in order to incentivize buyers into the market."[114]

Indeed, the study finds that EU LNG imports can have a large impact on long-term price and supply: "In the coming decade these market access issues will be becoming increasingly important as Europe transforms from just a balancer and into an LNG demand centre in its own right."[115] Thus the report finds imported LNG will be just as important to the EU as piped Russian gas, even without looking at greenhouse gas disparities between different sources of gas imports: "Today, when talking about the future of European gas supply, LNG is firmly viewed as a core part of the supply stack; critical to meeting long term demand alongside Russian pipeline supplies … This expectation for both a growth in Europe's need for LNG, combined with the region's perennial ability to absorb market oversupply, is further catalyzing interest in European regasification capacity..."[116]

In fact, one study finds that the EU's LNG import capacity could grow by 40% in this decade alone, providing huge new opportunity for competition to lower both gas prices and greenhouse gas emissions, and move away from geopolitically fraught over-reliance on Russia:

"LNG import terminals under construction in Croatia and Cyprus will make those countries first-time LNG importers, while pre-construction activity in Estonia, Germany, Ireland, Latvia and Romania would swell the ranks by another five countries. Overall, there are 24 LNG import terminals proposed or under construction in EU member states."[117] And, in fact, major U.S. LNG suppliers have been increasing exports to the EU in 2021.[118]

On the other hand, some pro-Russian analysts are proposing strategies and a Russian roadmap to continued high exports and emissions, in which Russia will try to maintain its current gas share in the European market.[119] Yet even this analysis admits that United States LNG is in an increasingly strong position to displace Russian imports: "The "silent revolution" of shale gas in the United States has caused the change in export–import routes, and, more significantly, has placed the United States in the position of a net exporter. As a result, competition among natural gas exporters has significantly increased,

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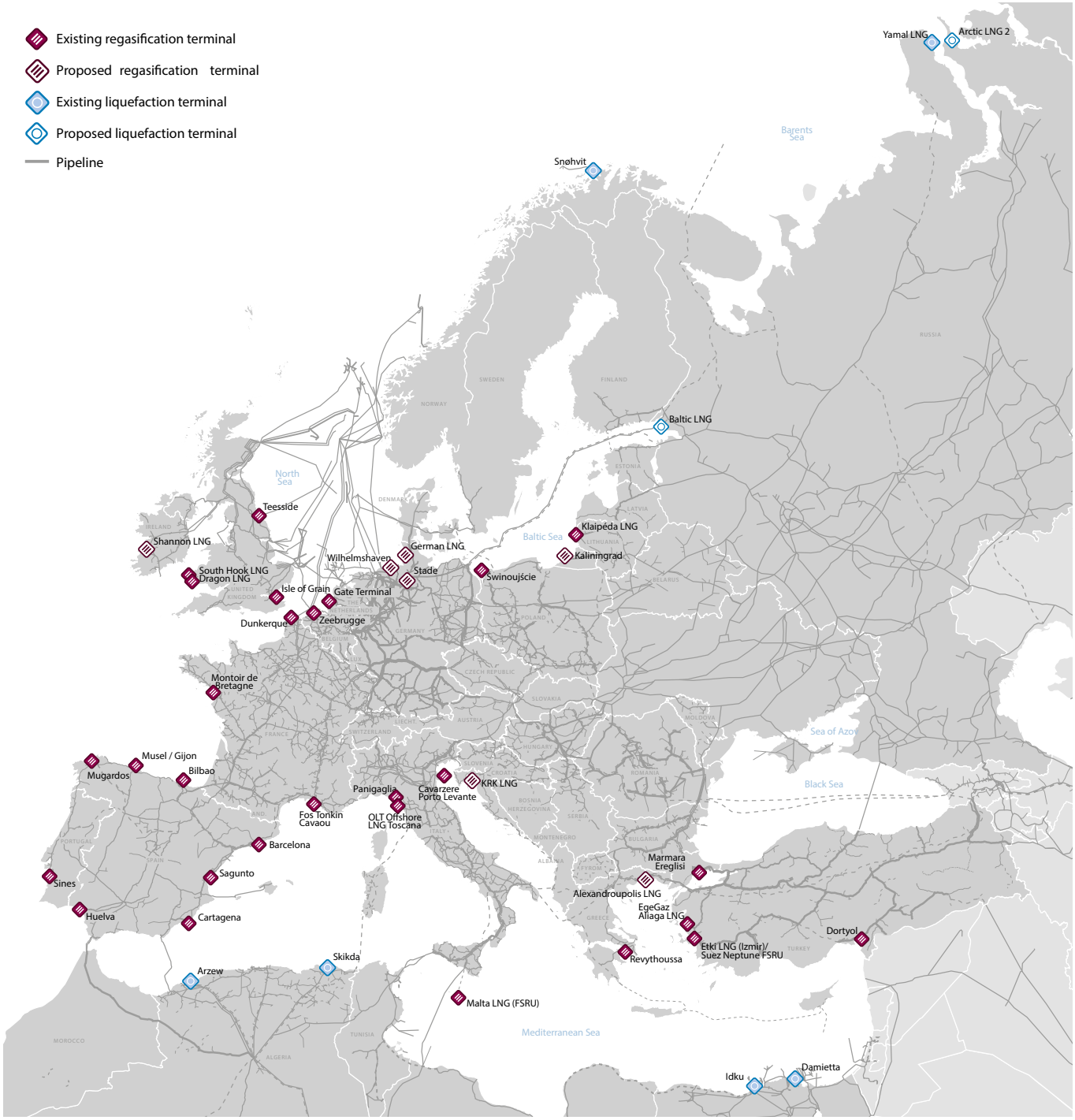


Source: S&P Global Platts

causing a decline in natural gas prices, and even price wars, specifically in the European natural gas market. The shale gas revolution in the United States has also caused re-orientation of natural gas import–export routes, as well as significant expansion of liquefied natural gas (LNG) trade, causing gas-to-gas competition."[120]

Comparative Greenhouse Gas Emissions from EU Global Import Sources

Accurately assessing the relative greenhouse gas emissions from each of the major sources of EU natural gas, both domestic and imported, must be a crucial element in determining overall European Union policies given its climate change and emissions reductions imperatives. Today, only natural gas from the United States can be said to have any certainty regarding emissions of methane and overall greenhouse gas emissions as a whole. Yet, as Chapter Two of this report shows, it is already clear that methane emissions from Russia's antiquated and a leaky gas system are enormous and almost certainly several times larger than those from the U.S. There are strong reasons to believe the same is true of methane and greenhouse gas emissions from other major EU suppliers including Qatar, Iraq, and Iran, according to analysis by the International Energy Agency.[121]

In an October 2020 communication from the EU Commission to the European Parliament on an "EU strategy to reduce methane emissions" highlighted the fact that the EU currently lacks the capability to monitor emissions from natural gas production and transportation either domestically or from imports. Indeed, the report notes that outside of countries like the United States there is no reporting mechanism globally for missions from natural gas, but that may be changing in the few years as the EU aims to set up its own system: "Currently, there exists no independent, international body which collects and verifies methane emissions data. In partnership with the United Nations Environmental Programme (UNEP), the Climate and Clean Air Coalition (CCAC) 31 and the International Energy Agency, the Commission will support the establishment of an independent international methane emissions observatory, tasked with collecting, reconciling, verifying and publishing anthropogenic methane emissions data at a global level. The observatory would be anchored in a United Nations framework."[122]

An Oxford Institute for Energy Studies report found that certain types of gas development are especially problematic in emissions since they have higher methane emissions including a major natural gas development in Qatar: "LNG projects — such as Qatar's North Field expansion — have "significantly higher emissions" than pipeline gas projects, a 2019 Oxford Institute for Energy Studies report says."[123] Regarding Qatari emissions, as analyst Sebastian Castelier has noted in April 2021: While global methane emissions increased by 20% between 1990 and 2012, in Qatar, it jumped 835% over the same time frame, figures published by the World Bank show. This ranked Qatar as the world's second-fastest-growing methane emitter. Qatar Petroleum did not respond to a request for comment.[124]

The EU pledges to establish rules in 2021 for the monitoring and verification of methane emissions, read more in **Appendix C**.

According to a major report by the United Nations International Panel on Climate Change, cutting methane is a key element in limiting global average temperatures below 2°C, the main Paris agreement climate goal. Read more about the report's findings in **Appendix D**.

New U.S. Actions are Substantially Lowering Methane and GHG Emissions

No studies have yet accounted for the recent actions by the U.S. government regarding methane regulations and emissions lowering efforts by the U.S. gas industry, including LNG exporters. Updated with this information, U.S. LNG imports could increasingly have the ability to outcompete gas from other sources based on both price and especially lower greenhouse gas emissions.

The Progressive Policy Institute report, "Wind, Solar, and Gas: Managing the Risks of America's Clean Energy Transition," from December 2020 urged that the U.S. "policy makers and the natural gas industry should join forces to: (1) invest more heavily in carbon, capture, and storage (CCS) technologies to quickly move gas-fired plants toward zero carbon emissions; and, (2) adopt and enforce ambitious goals for dramatically reducing methane emissions — which are many times more injurious to the climate than carbon dioxide emissions — from the natural gas lifecycle. This includes methane originating from abandoned wells that are no longer in use and have not been properly decommissioned."[125]

In fact, these actions to reduce U.S. methane and carbon dioxide emissions from natural gas are now being undertaken by the Biden Administration and by the U.S. Congress. The new Democratic Congress and Biden administration have begun the most aggressive methane regulation regimes anywhere in the world. As the 2020 PPI report found, the U.S. natural gas industry and individual states have shown a remarkable capacity to reduce methane and emissions dramatically and quickly once attempted. Despite Donald Trump's rollback Barack Obama's methane regulations: "Several states have stepped into the leadership vacuum. Led by former Governor and now U.S. Senator John Hickenlooper, Colorado imposed several types of regulations, most notably a leak detection and repair program that began in early 2010s … the number of estimated leaks in Colorado has fallen by 75 percent since these rules went into effect. California, Massachusetts, and New Mexico have followed Colorado's lead with their own forms of regulation, but by and large methane emissions remain largely underregulated by state governments."[126]

In its first 100 days in office, the Biden administration proposed a crash program of spending $16 billion to plug unused or abandoned old oil and gas wells and mines in an effort to reduce emissions of methane and carbon dioxide. The initiative has strong support in Congress and has now been included in the bipartisan infrastructure funding package that gained the support of 67 U.S. senators in late July and is due to become law in this fall. The package includes a $16 billion for cleaning up abandoned mines and orphaned wells, oil and gas wells that are no longer producing. Plugging and reclaiming orphans has been a popular provision on both sides of the aisle, and a particular area of interest for the White House, which views it as both a job creator for oil workers and a climate action due to the methane leaking from orphaned wells.

As the *Associated Press* notes, President Joe Biden himself extolled the methane plugging provisions in late July, telling a crowd in Pennsylvania as he touted the bipartisan plan that many of the abandoned wells are leaking methane, a climate pollutant. "And guess what?" Biden said. "The same union guys that dug those wells, they can make the same union wage capping those wells."[127]

The Biden budget request also includes a request for a nearly 8% increase in funding for the Pipeline and Hazardous Materials Safety Administration (PHMSA), to $310 million: "PHMSA regulates 2.8 million miles of pipelines in the country, which it says transport 65% of the energy consumed in the United States...The agency has already been adding new jobs in preparation for pursuing its newly added mission — clamping down on methane leaks."[128]

U.S. Congress Targets Methane

On June 25, 2021, the U.S. House of Representatives passed legislation reimposing Obama era methane regulations that had been rolled back by former president Donald Trump. Having already passed the Senate, the measure will reinstate a mandate for oil and gas companies to monitor and repair equipment leaking methane. As news reports noted: "The move is a win for Biden, too, because it clears the way for his EPA to more quickly set stricter methane standards for both new and existing oil and gas operations, which Biden has directed the agency to propose by September."

Leading U.S. climate advocates and major gas producers alike hailed the action, as news outlets reported: "Congress just delivered its first bipartisan win for the climate," said Fred Krupp, president of the Environmental Defense Fund, who said the passage of the resolutions should send a signal to the Environmental Protection Agency that its upcoming methane regulations should be more stringent.[129] Mary Streett, senior vice president of BP said, "Regulating methane helps ensure all companies prioritize reducing methane emissions in their operations. Keeping methane in the pipes is good for the planet and for business. It means that we can sell it as a cleaner fuel source rather than losing it," she said.[130]

On June 30, 2021, President Biden signed a bill reimposing methane regulations on the oil and gas industries. As CNN reported, "The President described the bill as an "important first step" to cut methane pollution and said it "reflects a return to common sense and commitment to the common good."[131] Yet as Biden noted, this is just the beginning of even more extensive U.S. efforts to cut methane emissions and make U.S. gas by far the lowest emitting in the world. The Environmental Protection Agency under the Biden administration is planning to propose far deeper cuts in methane emissions, with EPA saying that it will release an even more aggressive plan to cut methane more deeply later this year.[132] Under the law, oil and gas companies will have to check every six months for methane leaks from pipelines, storage tanks and other equipment installed after 2015 — and plug any leak within 30 days after it is detected. Biden also championed funding in the bipartisan infrastructure deal pending in the U.S. Congress that would help cap "millions of abandoned leaking oil and gas wells."

Indeed, climate advocates have voiced an opportunity for the U.S. to show other natural gas producers around the world just how deeply methane emissions can be reduced. "We celebrate Congress clearing a path for the EPA to swiftly move forward with stronger rules to reduce methane pollution across the oil and gas supply chain," said Sarah Smith, a program director at Clean Air Task Force. A recent analysis from the group found the U.S. could reduce methane emissions from the oil and gas sector by 65% by 2025 using existing technology.[133]

President Biden Announces Strict New U.S. Methane Regulations at Glasgow

On November 2, 2021, the Biden administration announced a sweeping set of new policies to cut methane emissions from the U.S. oil and gas sector. Proposed regulations from the U.S. Environmental Protection Agency would set standards for new and existing oil and gas wells, require more frequent and stricter leakage monitoring and require the capture of natural gas produced from oil production. Taken together the new regulations will comprehensively reduce fugitive emissions of methane from American oil and gas production and infrastructure.[134]

The U.S. EPA estimates that the regulations once finalized we'll cut more than 40,000,000 tons of methane omissions from 2023 to 2035, the equivalent of nearly a billion metric tons of carbon dioxide, and more than the total CO2 emitted from all U.S. passenger cars and commercial aircraft in 2019. In addition to the EPA regulations, the U.S. Department of Transportation proposed a rule to reduce methane leaks from natural gas pipelines as well.[135]

Leading climate change activists praised the U.S. methane measures and global methane pledge together as among the most important actions ever taken to reduce global warming. "The pledge to cut methane is the single biggest and fastest bite out of today's warming," Durwood Zaelke, president of the Institute for Governance and Sustainable Development.[136]

Most top U.S. oil and gas producers indicated support for the measures. Karen Harbert, president of the American Gas Association, which represents many of the largest U.S. gas utilities, said her group supported the new U.S. federal regulations, noting that methane emissions from natural gas had declined 73% since 1990. "We recognize we need to button up and get to that last percentage" calling the regulations "the best possible approach" to creating standards across the industry.[137]

The seriousness of methane mitigation efforts in the U.S. is underscored by new proposals from some Democrats in Congress to establish a large fee on domestic methane emissions from domestic U.S. oil and gas companies. While details are still in flux as of this writing, including whether the measure becomes law at all, current Senate proposals would tax methane on a basin-wide standard based on the amount of oil and gas produced by each company in that region. Some in the U.S. oil and gas industry, many of whom support additional regulation,[138] suggest that this would be counterproductive since it might disproportionately fall on larger producers who are generally mitigating methane more, and elide smaller oil and gas companies that are generally not reducing methane as stringently. The industry has also suggested that the fee would simply be passed on to consumers in higher prices impacting lower income households most.

Advocates for the tax have suggested it will be needed to drive methane emissions to ultra-low levels, according to the *Financial Times*.[139]

Studies on Methane Emissions from the U.S. Gas Sector

A series of major studies by the U.S. Environmental Protection Agency, a U.S. National Energy Laboratory, leading environmental groups like EDF, and the U.S. National Academy of Sciences have been conducted in recent years to assess methane emissions from the U.S. oil and gas sector. These studies have consistently found fugitive emissions from the U.S. system of

about 1% or less, and on rare occasion of about 2%. This verifiable U.S. data from a wide range of respected sources stands in stark contrast to almost certainly undercounting estimates of Russian fugitive methane emissions of at least 5% to 7%.

Overall, natural gas production in the United States has fugitive emissions of 1.4% of total gas volume, according to analysis from the Environmental Protection Agency done during the Obama administration.[140]

The U.S. National Energy Technology Laboratory (NETL) in 2020 collaborated with Our Nation's Energy Future, made up of 26 natural gas companies, to calculate the greenhouse gas (GHG) emission profile and methane emission rates across the group's complete natural gas value chain. The report, "Industry Partnerships & Their Role In Reducing Natural Gas Supply Chain Greenhouse Gas Emissions — Phase 2": "We found that the average life cycle methane emission rate for all of ONE Future's [natural gas companies] activity is 0.76%,' Tim Skone, coauthor of the report and NETL LCA expert, said. 'Whereas the U.S. average scenario has an expected life cycle methane emission rate of 1.06%. So, on average, they [major US natural gas companies] are significantly reducing methane emissions, but we still found opportunities to get that number even lower.'"[141]

As noted, the NETL in 2019 concluded that on an average the U.S. methane leakage rate was approximately 1.08%, and like other studies found significant variation in methane intensities between various basins and found that conventional basins such as San Juan having much higher emissions rate than shale development in the Appalachian basin. In 2020 NETL published a study that estimated a methane leakage rate of 0.67% (with a 95% confidence interval ranging from 0.45% to 0.94%) for the ONE Future group of companies.[142]

A major 2019 study by the U.S. National Energy Technology Laboratory finds Russian gas piped to Europe has up to 22% more greenhouse gas emissions than European coal. U.S. liquified natural gas (LNG) delivered to the EU, in contrast, has up to 56% fewer total emissions than EU coal, the report shows.[143]

The National Academies of Sciences published a report titled *Improving Characterization of Anthropogenic Methane Emissions in the United States* that reviewed the quantification, measurement, monitoring of methane inventories from various methane sources, including oil and gas. The report provided multiple recommendations to improve the current estimation methods, including mechanistic understanding of high-emitting sources and coordinated measurements between operators and scientific community, and incorporation of unaccounted emission sources.[144]

The remit of the NAS report was not to recreate a national methane inventory, but to advise how to improve efforts to limit methane emissions and provide a window into emissions trends. For example, the study defined super-emitting areas and producers and also the cause of them (i.e., the need to have a mechanistic understanding of production techniques and need for operator support). This is crucial as some flawed methane emissions studies have used worst case numbers for all areas and companies, and also assumed such emissions exist constantly — 24 hours a day, seven days a week, 365 days a year rather than periodically. This flawed methodology accounts for an outlier report finding far higher emissions.

Another key area of dispute and misunderstanding surrounds contrasting methane measurement methodologies that often exists between what have been perceived as lower bottom-up measurements on the ground and higher top-down measurements findings conducted from the air. Two recent reports suggest that while both methodologies have legitimacy, higher methane measurements from the air appear to be caused by issues related to the timing of measurements and other factors.

Garvin Heath, an expert at the National Renewable Energy Laboratory, wrote a paper entitled "Basin Methane Reconciliation Study": "This study spatially and temporally aligns top-down and bottom-up methane emission estimates for a natural gas production basin, using multiscale emission measurements and detailed activity data reporting. We show that episodic venting from manual liquid unloadings, which occur at a small fraction of natural gas well pads, drives a factor-of-two temporal variation in the basin-scale emission rate of a U.S. dry shale gas play. The midafternoon peak emission rate aligns with the sampling time of all regional aircraft emission studies, which target well-mixed boundary layer conditions present in the afternoon. A mechanistic understanding of emission estimates derived from various methods is critical for unbiased emission verification and effective greenhouse gas emission mitigation. Our results demonstrate that direct comparison of emission estimates from methods covering widely different timescales can be misleading."[145]

A report from Colorado State University notes that when both types of methodologies the same timing and geographical analysis, the seemingly contrasting bottom-up and top-down approaches yield general on methane emissions finding: "While both top-down and bottom-up measurements are equally valid approaches to estimate methane emissions on a regional scale, this study illustrates that the measurements must be carefully aligned in both time and space to be compared … As such, this study showed excellent agreement between these two approaches to methane emission quantification, without requiring guesswork or statistical assumptions that have been used to close the gap in prior research."[146]

A leading climate change and methane expert organization, The Environmental Defense Fund (EDF), has conducted a series of studies on U.S. industry methane emissions over the last decade. A study in the journal *Science* that provides a synthesis of past EDF studies and recent methane studies in the United States. For calendar year 2016, the study found that the total oil and gas supply chain methane emissions were 2.3% of gross production or about 63% higher than the U.S. EPA estimates. In the supplemental materials (S1.3) of the same study, the authors present *alternative methane emissions estimates* employing site-level measurement data from EDF-industry funded studies. This alternative "source-based" calculation by EDF employing EDF sponsored studies amounts to 1.4% of gross production (1.3-1.5%).[147]

Flawed Studies Show Need for Better Methane Monitoring

Some studies, often based on older information or flawed methodologies, have found methane emissions from the U.S. oil and gas industry are often higher than what independent labs and the government reports, despite the U.S. having the most accurate measurements globally. For some EU audiences, these studies seem to have clouded the opportunity that U.S. methane

action represents to drive down emissions from domestic U.S. LNG exports. The Science-published research study conducted in 2015 for EDF of methane releases from the U.S. oil and gas industry suggested that methane emissions were about 60% higher than Environmental Protection Agency estimates.[148]

Another study from a single researcher released in August 2019 but based on data as far back as a decade ago contends that shale gas emissions are far higher than previously reported and undermines the climate value of gas. However, at the same time the study admits that there are large opportunities for reducing emissions[149] from shale gas production: "While methane emissions are often referred to as 'leaks,' some of the emissions include purposeful venting … This suggests large opportunities for reducing emissions." The concerning findings from this study suggest core accurate data from shale gas emissions is urgently needed. But it is important to note that this single study is an outlier, not in keeping with any other major government, environmental group or other reporting. Moreover, none of these studies in any way account for new regulations and government actions by the Biden administration, as well as those newly proposed by industry.

More broadly, unlike the rest of major gas producers and exporters, the U.S. has a uniquely open reporting and monitoring system that has been in place for decades. Russia by contrast, has been a black box on methane, purposely hiding its huge methane emissions. Nor do any of the other major natural gas exporters — Qatar, Iraq, Iran — have anything like the U.S. level of monitoring and verification of the emissions, let alone regulations.

One cannot help but arrive at the conclusion that the U.S. emissions have been overstated relative to the rest of the world simply because the U.S. is the only country with detailed monitoring and verification of emissions as well as regulations.

As stringent Biden methane regulations take effect, and the U.S. natural gas industry itself cuts emissions, it is clearly time for a uniform reassessment of emissions from the rest of the world as well as the U.S.

An additional report from August 2021 report from an environmental group, Earthworks, contends that oil wells in West Texas are leaking methane into the atmosphere are doing so without a permit and in many cases, without the company operating the well even tracking the amount released. The study highlights the need for the oil industry to reduce emissions of methane associated with oil production, by capturing the gas and using it productively, and for better government detection. A U.S. Department of Energy study finds that half of all U.S. methane emissions from oil and gas production come from Texas. As *Politico* noted, "Major oil companies like Shell disputed the report. Shell noted that "since 2017 it has reduced flaring by more than 80 percent even as it has more than doubled increasing production of its operated assets."[150] This means the U.S. federal government must put in place more stringent methane emissions regulations for oil production as well as gas production to cut overall emissions deeply.

New U.S. pipelines Cutting Methane Emissions from Permian Basin

New major pipelines from the Permian Basin in Texas and New Mexico have recently been built and are operational to help gas reach market

with far lower emissions. These pipelines will dramatically reduce the amount of flaring that occurs in the region, and markedly reduce fugitive emissions from this new infrastructure.[151]

As BP has found, flaring in the Permian can be rapidly and hugely reduced: "Since acquiring the assets, BP's flaring intensity has decreased dramatically. As recently as the fourth quarter of 2019, flaring in the Permian Basin was around 16%. Today, it's less than 2% and dropping. BP's new, state-of-the-art Grand Slam facility near Orla, Texas marks a significant step for the company's aims to reduce emissions and enhance production while improving reliability of BP's Permian assets."[152]

U.S. Energy Secretary Jennifer Granholm has also noted that the Biden Administration intends to reduce emissions specifically from LNG export facilities. But Granholm pointed out that U.S. LNG shipments are often bound for "countries that would otherwise be using very carbon-intensive fuels," and that U.S. LNG exports do "have the impact of reducing internationally carbon emissions.[153] Granholm added: "However, I will say there is an opportunity here, as well, to really start to deploy some [carbon capture, use and storage] technologies with respect to natural gas in the Gulf [of Mexico] and other places that we are siting these facilities."

In fact, it is clear that the U.S. will both dramatically decrease the methane and other emissions from its natural gas exports while increasing its overall LNG shipments. As E&E news reports: "U.S. LNG exports are expected to more than double between 2020 and 2029, according to projections in the U.S. Energy Information Administration's most recent annual energy outlook. Exports could increase even more with 'higher oil prices or lower U.S. natural gas domestic prices,' the report said. As of September 2020, there are seven LNG export terminals in the United States, according to FERC, and nearly two dozen that are approved."

Similar to Granholm, U.S. Deputy Energy Secretary David Turk endorsed LNG as an important export and noted U.S. emissions transparency versus Russian secrecy regarding emissions from gas: "We're a democracy; we're the leader of the free world. I think it's a much better outcome for Japan or others to get their energy supplies from the U.S. than to get it from Russia or other countries," Turk said amid Republican questioning at his confirmation hearing before the Senate Energy and Natural Resources Committee. Still, Turk said, the United States needs to do a "better job" of capping methane emissions of natural gas, a chief criticism of LNG opponents.[154]

IEA Suggests Low Methane Gas will have Commercial Advantage

In its methane tracker report released in January 2021, the International Energy Agency noted that it was in the "strong interest" of natural gas companies to cut methane and emissions since over time users would demand the lowest emitting sources. "Aside from the environmental gains, oil and gas operations with lower emissions intensities are increasingly likely to enjoy a commercial advantage," the report said. And as the *Financial Times* suggested in reporting from April 2021: "The debate in the industry is about what needs to be done to ensure that gas remains financeable,' says Massimo Di Odoardo, vice-president of gas and LNG research at Wood Mackenzie, a consultancy. 'Reducing scope one and two emissions [from direct operations and purchased power] is one thing players in the industry can do. That competition has really just started.' Right now, analysts believe the most

pressing issue for companies in the sector is controlling the high emissions of methane from wells, pipelines and other parts of the natural gas chain."[156]

U.S. Industry Actions to Cut Methane Emissions

Pressure has been growing on the U.S. natural gas industry to cut emissions especially from methane. As the *New York Times* recently reported: "…a number of major U.S. gas producers have pledged to reduce methane and other greenhouse gas emissions from its exploration and production operations over the next four years. Exxon Mobil, considered the least progressive oil and gas major, has said it would reduce emissions by 15 to 20 percent by 2025 compared with 2016 levels. More significantly, the company said it would eliminate 'routine' flaring by 2030 in an effort to reduce the carbon dioxide emissions generated when companies burn unwanted natural gas that is released during oil production."

Many in the American oil and gas industry believe that routine flaring can be eliminated in the United States long before the end of this decade. Climate advocates will certainly push for a much quicker timeline. In terms of U.S. methane emitters, it now appears that smaller oil and gas companies account for the lion share of emissions.[157] Yet, increasingly, even industry-wide efforts in the U.S. are under way. The American Petroleum Institute unveiled a new template so individual natural gas and oil companies can more consistently and uniformly report and track greenhouse gas emissions indicator by standardizing the names of indicators, units of measure, and the detailed definitions for reporting boundaries to prompt comparable reporting from one company to another.[158]

Many American companies are also taking voluntary actions to reduce emissions; e.g., the ONE Future Coalition is a voluntary initiative of 41 U.S. natural gas companies to achieve an average rate of methane emissions across company facilities of 1% or less by 2025. Yet, it is clear that the natural gas industry as a whole in the U.S. must do much more. While many larger companies are restricting methane emissions rapidly, "a recent survey from the Dallas Fed showed that those ambitions are far from widespread across the Permian [shale gas basin], which includes scores of mom-and-pop companies alongside big global oil groups. Only half of larger companies, and 30 percent of smaller ones, said they had a plan to reduce their methane emissions."[159]

U.S. LNG Exporters Move to Reduce Emissions

Meanwhile American liquefied natural gas exporters are undertaking a series of measures to reduce methane and other emissions, apparently both to comply with domestic anticipated regulations but to attempt to make U.S. LNG far lower emitting than competitors.[160] As a major article by Argus Media found in June 2021: "U.S. LNG developers are promising that a second wave of proposed projects will have a far smaller carbon footprint, as they compete for business with climate-conscious customers and reposition under President Joe Biden. Project developers are looking into building carbon capture and storage (CCS) facilities to handle emissions from the energy-intensive liquefaction process for facilities proposed on the U.S. Gulf coast. Some are exploring the idea of requiring suppliers to certify that feedgas is 'responsibly sourced' in order to control methane emissions, as they try to assuage concerns from prospective customers that signing long-term contracts to take U.S. LNG could make it harder,

not easier, to reach climate goals … The sector is keen to avoid a repeat of last year, when French gas and power firm Engie ended talks on a long-term supply deal with U.S. firm NextDecade because of concerns over the emissions profile of U.S. gas. "That image cannot be changed by public relations campaigns or similar means," industry group LNG Allies chief executive Fred Hutchison says. 'What is required and what the industry is doing is reducing its greenhouse gas footprint measurably and transparently.'"[161]

Apart from meeting government regulations, major U.S. LNG exporters have begun to take specific actions to account for and reduce the greenhouse gas emissions in their shipments. Cheniere Energy, the largest producer of liquefied natural gas in the U.S., plans to begin providing its LNG customers with greenhouse gas emissions data associated with each LNG cargo produced at its Sabine Pass and Corpus Christi liquefaction plants. The cargo emissions tags quantifying the estimated emissions of LNG cargoes from wellhead to cargo delivery. The company expects to provide data to customers beginning in 2022, with the ultimate goal of providing "dynamic" emissions data on its products in real time. The company also announced a collaboration with five natural gas producers and several leading academic institutions to implement quantification, monitoring, reporting and verification of greenhouse gas emissions performance at natural gas production sites intended to improve the overall understanding of upstream emissions and further the deployment of advanced monitoring technologies.[162]

As *Politico* reported in August 2021: "Cheniere Energy is promoting a peer-reviewed study tracking the greenhouse gas emissions from its own natural gas suppliers through the shipping of LNG to its destination. The study in *American Chemical Society Sustainable Chemistry & Engineering Journal* finds that the greenhouse gas intensity for one metric ton of the gas Cheniere ships to China is as much as 43% below that found in studies that focused on the generic LNG industry. "Expect to see more LNG companies coming out with similar studies," says Charlie Riedl, head of the industry trade association Center for Liquefied Natural Gas.[163] In May 2021, Cheniere and Shell together created and delivered a greenhouse gas neutral LNG shipment to Europe. They accomplished this by offsetting "the full lifecycle greenhouse gas (GHG) emissions associated with the LNG cargo by retiring nature-based offsets to account for the estimated CO_2e emissions produced through the entire value chain, from production through use by the final consumer.[164]

As the *Wall Street Journal* noted in August 2021, U.S. LNG exporters are increasingly investing in proving to customers and importing nations that they are reducing their emissions, especially of methane: "The American gas industry faces growing pressure from investors and customers to prove that its fuel has a lower-carbon provenance to sell it around the world. That has led the top U.S. gas producer, EQT Corp, and the top exporter, Cheniere Energy Inc., to team up and track the emissions from wells that feed major shipping terminals.

"The companies are trying to collect reliable data on releases of methane — a potent greenhouse gas increasingly attracting scrutiny for its contributions to climate change — and demonstrate they can reduce these emissions over time...The tricky part, they said, is proving to skeptics they are actually doing so."[165]

U.S. LNG firm Venture Global, which will likely begin LNG exports by the end of 2021, said in late May that it plans to develop CCS facilities to capture 500,000 tons per year (t/yr) of CO2 from its 10mn t/yr Calcasieu Pass LNG export project and its proposed 20mn t/yr Plaquemines LNG export project.[166] As *Reuters* reported:

"U.S. liquefied natural gas company Venture Global LNG said Thursday it plans to capture and sequester carbon at its Calcasieu Pass and Plaquemines export plants in Louisiana. This is part of a growing trend among energy firms to reduce greenhouse gas emissions to meet increased customer and government demand for cleaner energy to reduce damage caused by global warming. Venture Global said in a release it was launching a carbon capture and sequestration (CCS) project that would compress carbon dioxide (CO2) at its sites and transport the gas to be permanently stored in subsurface saline aquifers. That 1 million tons of carbon per year is the equivalent of removing nearly 200,000 cars from the road each year for 20 years…CCS at Calcasieu would be the first of its kind for an existing U.S. LNG facility."[167]

As the *Financial Times* reported in April 2021: "NextDecade, a U.S. LNG developer, revealed plans in March to capture and store carbon emitted by its proposed Rio Grande LNG plant on the U.S. Gulf coast should that project go forward. This would be the first LNG plant in the U.S. with CCS capability, which the company said would slash its emissions by more than 90 percent. A U.S. federal tax credit for new CCS projects will help offset the added cost, the company says. 'There's no question our customers are increasingly focused on buying low carbon or net-zero LNG cargoes,' says Matt Schatzman, chief executive of NextDecade, who hopes to give final approval to the project this year."[168]

Some of these actions may be in response to efforts by some importing EU nations to reject U.S. gas. Recently natural gas buyers in France and Ireland have acted to reduce U.S. imports: "European Union countries took delivery of 36 percent of overall U.S. liquefied natural gas cargoes in 2019, but buyers there are taking a closer look at how the industry addresses those leaks. France and Ireland have both taken recent steps to limit imports of U.S. natural gas."[169]

This focus on U.S. emissions is deeply ironic for the EU as a whole, given its huge reliance on far higher emitting Russian gas.

In any event, U.S. imports to the EU are growing rapidly in central and Eastern Europe in part because U.S. gas is increasingly beating Russian and Qatari gas on price. Indeed, many analysts, like those with Platts publications, believe that US companies are racing ahead of regulations to cut methane emissions: "Biden's push to start regulating methane could cut the emissions intensity of U.S. LNG in the coming years. But developers are looking for faster ways to offer assurances to customers. NextDecade says it will acquire feed gas for Rio Grande that is certified on its low-emissions profile. U.S. LNG company Cheniere plans to offer emissions data for cargoes from next year. 'There is pressure on LNG providers to do something about the total emissions,' gas certification firm Responsible Energy Solutions founder Roy Hartstein says."[170]

And in late August 2021, experts at Platts and others have begun to echo concerns from U.S. secretary of energy Jennifer Granholm that the U.S. is racing to reduce methane emissions from its gas while Russia does nothing: "But the Biden administration views [U.S. LNG] as a better alternative to European allies increasing their dependence on imported gas from Russia

by completing the Nord Stream 2 pipeline. U.S. energy secretary Jennifer Granholm told lawmakers last month that the pipeline would carry 'the dirtiest form of natural gas on earth,' partly because of a lack of transparency on upstream methane emissions, as Platts noted."[171]

However, some analysts contend that U.S. natural gas has higher methane emissions because regions like the Permian basin in Texas use hydraulic fracturing technology or fracking also produce oil as well as gas, causing additional methane emissions. This analysis is problematic in several respects.[172] First of all, there is strong evidence that the U.S. will virtually eliminate venting and flaring from oil and gas production under new regulations and programs by the Biden administration and increased industry efforts. The same cannot be said for any other major natural gas exporter.

Secondly, such contentions about high U.S. methane emissions from shale gas are based on older measurements typically going back at least half a decade and often much more. During this period new pipelines regulations and a series of industry investments have reduced fugitive emissions, especially flaring, from shale gas production. More recent and credible major U.S. government, national laboratory and environmental group studies find far lower emissions than less informed critics contend.

The International Energy Agency has emphasized that major natural gas producers must deeply reduce flaring from gas production in order to meet the IEA's Sustainable Development Scenario: "Russia, Iraq, Iran, Algeria and the United States were responsible for more than half of global flaring. Several field trials have demonstrated viable technologies to reduce flaring, but at root the issue of flaring is also a question of business models. If there is inadequate provision for productive use of the gas at the project planning stage, including the necessary gas infrastructure, then finding a technology fix later on is much more difficult. There is an increasing number of voluntary government and industry commitments to eliminate flaring by 2030. The SDS relies on a rapid reduction in flaring, with government policies and industry commitment all but eliminating it by 2025."[173]

In fact, only gas production in the United States, now subject to new regulations, government funding for capping of old oil and gas wells, and renewed committed to industry investment, is likely to be on track to meet the IEA's sustainable development scenario. No other gas exporting nation is taking anything like these steps, as of yet. PPI strongly supports all of these actions as key measures in fighting global climate change and keeping the United States in the vanguard of methane and emissions reductions. In fact, the U.S. is now taking almost every step recommended just earlier this year by leading environmental advocates like those at Columbia University' Climate School. But these actions are still in early stages and must be implemented as quickly as possible to limit emissions and increase the U.S. lower-emissions gas advantage.[174]

Lower-Priced U.S. LNG

U.S. LNG exports are increasingly inexpensive, and can undercut the price of Russian gas, forcing Russia to reduce the cost of its gas deliveries. This is crucial to making gas less costly than coal, providing additional market incentives to eliminate coal use in the EU.

As John Dizard pointed out in the *Financial Times* recently: "[A] faster rise in gas prices than

for carbon allowances has, perversely, created economic support for utilities, in particular German utilities, to increase their use of their remaining coal-fired power plants. That is not how it was supposed to work. … The remaining natural gas or hydro stations are not, collectively, close enough to providing enough constant power to offset the fluctuating generation from wind and solar."[175]

Some U.S. LNG exporters believe lower prices U.S. gas can displace EU and Asian coal:

Michael Sabel, the founder and CEO of Venture Global LNG, has said that inexpensive LNG exports are probably in a position to have the biggest impact on emissions "by reducing adoption of new or development of new coal plants and encouraging conversion from coal to gas" including in the EU. Meanwhile, China "is continuing to ... develop new coal plants, and so the cheaper we can make the gas, the more we can encourage China and other countries to not choose coal," he added.[176]

How Fuel Shifting Helped U.S. Decarbonize

As recently as 2018, leading energy experts encouraged the U.S. to help fund EU LNG import infrastructure, as this Baker Institute for Public Policy paper suggested:

"We envision U.S.-funded investments in strategic gas import infrastructure as a way to help bridge the barriers currently posed by local political-economic structures, friction between national security and commercial priorities, and the EU's lack of authority to effectively and directly impose gas market reforms within the member states. In a fully liberalized gas market environment, private capital would flow towards infrastructure opportunities that ultimately would help reduce Russia's ability to use gas supplies as a coercive tool. But at present —particularly in the parts of Europe most vulnerable to Russian energy coercion — monopoly gas service providers and a lack of market liberalization effectively shuts out private funds. The U.S. government would find it neither financially nor politically sustainable to act as the sole or prime funder of strategic gas infrastructure in Europe. Accordingly, the U.S. financial backing we propose would be intended to facilitate the removal of barriers that currently repel private investment. Such funds would be most accurately thought of as 'jump start money' that can hopefully help crack through walls and be multiplied by follow on private investments."[177]

U.S. coal production totaled 535 million short tons (MMst) in 2020, a 24% decrease from the 706 MMst mined in 2019 and the lowest level of coal production in the United States in any year since 1965.[178]

Recent analysis by the U.S. Energy Information Administration finds that U.S. coal electricity generation has fallen by 61% over the past 12 years. In 2020, natural gas generated 1.6 billion megawatt-hours (MWh) and nuclear power plants generated 790 million MWh, while coal-fired electricity was third with 774 million MWh.[179]

Increased U.S. LNG Export Capacity and Delivery to EU

The U.S. Energy Information Agency reported that in 2020 U.S. LNG exports reached an all-time high. "U.S. natural gas exports increased to a record-high 5.3 Tcf in 2020, up 13% compared with 2019. U.S. exports of natural gas have grown substantially over the past decade, and in 2017, exports surpassed imports of natural gas for the first time since 1957. About 55% of U.S. natural gas exports in 2020 were sent by pipeline to Mexico and Canada. Most of the rest was shipped overseas as liquefied natural gas (LNG)."[180]

Yet as previously mentioned, most objective analysts find that U.S. LNG exports will rise substantially over the coming decade, more than doubling as demand increases not only in the European Union but in Asia as well, especially China.[181] However, these estimates do not take into consideration even greater demand growth for U.S. LNG which is likely as U.S. methane emissions become orders of magnitude lower than other natural gas exporters, and the climate change imperative becomes a crucial consideration in the EU and for other natural gas importers.

A 2019 study by Navigant, "Gas for Climate: The optimal role for gas in a net-zero emissions energy system," found that: "Full [EU] decarbonisation of the energy system requires substantial quantities of renewable electricity. Electricity production will more than double and renewable electricity production from wind and solar-PV will increase ten-fold compared to today. Strong growth in wind and solar PV requires dispatchable electricity production by either solid biomass or gas. Battery seasonal storage is unrealistic even at strongly reduced costs."[182] But the Navigant study largely ignores current methane emissions and the need for near-term greenhouse gas cuts, conveniently focusing instead largely on 2050, as is true of many industry studies.

In summary, the European Union has a range of major options to reduce its dependence on both coal and high methane emitting Russian gas imports.

These include increased renewable energy production, greater energy efficiency, advances in electricity storage, and the use of low methane emitting natural gas from the United States and other producers.

No similar study or serious analysis has done mapping the methane emissions from Russian oil development for the obvious reason that the Russian government prevents any accurate assessment of emissions from its oil and gas industry. Many analysts therefore believe Russian emissions from its gas sector may be far higher than current estimates. While the U.S. is undertaking a globally unprecedented crash program to cut already likely the world's lowest methane emissions, which are also the best measured in the world, Russia continues to hide its emissions at every turn.

CHAPTER FOUR
CONCLUSIONS AND RECOMMENDATIONS

How EU Low-Methane Gas Regulations Can Deliver Crucial Climate and Geopolitical Benefits.

CONCLUSION:

To fight climate change, much of the European Union's focus must be on expanding the production of renewable energy to achieve its goal of net zero emissions before 2050. But analysis by the International Energy Agency and others suggests that the *EU will use a mix of renewable energy and natural gas to displace coal* which still makes up 15% electricity generation today.

Indeed, most experts believe that gas use in the EU will stay constant or grow over the next decade or two to balance increased intermittent renewable energy on the EU electrical grid as other forms of baseload power (coal and much nuclear power) are phased out. Therefore, *to meet its climate goals, the EU must find new ways to reduce greenhouse gas emissions from the natural gas it will inevitably continue to rely on. These reductions must come both from EU-sourced gas, and also from the nearly 70% of natural gas the EU imports. Otherwise, emissions gains made domestically will be made illusory and more than off-set by emissions from the gas the EU obtains from abroad.*

Yet even as the European Union undertakes unprecedented steps to reduce its other greenhouse gas emissions, it is increasing its dependence on high methane-emitting gas, especially from Russia's notoriously leaking, antiquated production and transport system. The EU gets more than 70% of its imports and 40% of its total natural gas from Russia — despite data showing that fugitive emissions in the form of methane from Russian gas make it worse from a climate change perspective than the coal it is meant to displace.

Cutting methane is now recognized as the fastest way to limit near-term temperatures rise globally, which is, according to the August 2021 United Nations International Panel on Climate Change report, likely to be necessary to prevent climatic tipping points in natural systems which will make climate change and rising temperatures that much harder to control. Current dependence on heavily emitting methane gas suppliers will in essence inhibit the effectiveness not only of EU's 2030 climate goals, but of global climate protection.

In the meantime, the Nord Stream 2 pipeline from Russian to Germany, owned by Russia's state-owned Gazprom, could soon be fully operational, with the potential to increase the EU's addiction to Russian gas. The pipeline would also greatly exacerbate the EU's long-running geopolitical and security problems associated with reliance on the Kremlin for a crucial energy source, while making Ukraine and the rest of far Eastern Europe more vulnerable to depredations of Russian aggression.

The EU's importation of high emitting gas is a profound flaw in the EU's decarbonization plans which may prevent it from reaching its ultimate climate goals. But this report finds that the EU has an increasing series of new options to reduce near-term dependence on Russian gas. In fact, over time these new opportunities have the potential to begin to force all global gas imports to lower their emissions dramatically.

The European Union can and must dramatically reduce methane emissions from natural gas by promulgating a set of reporting, monitoring, and

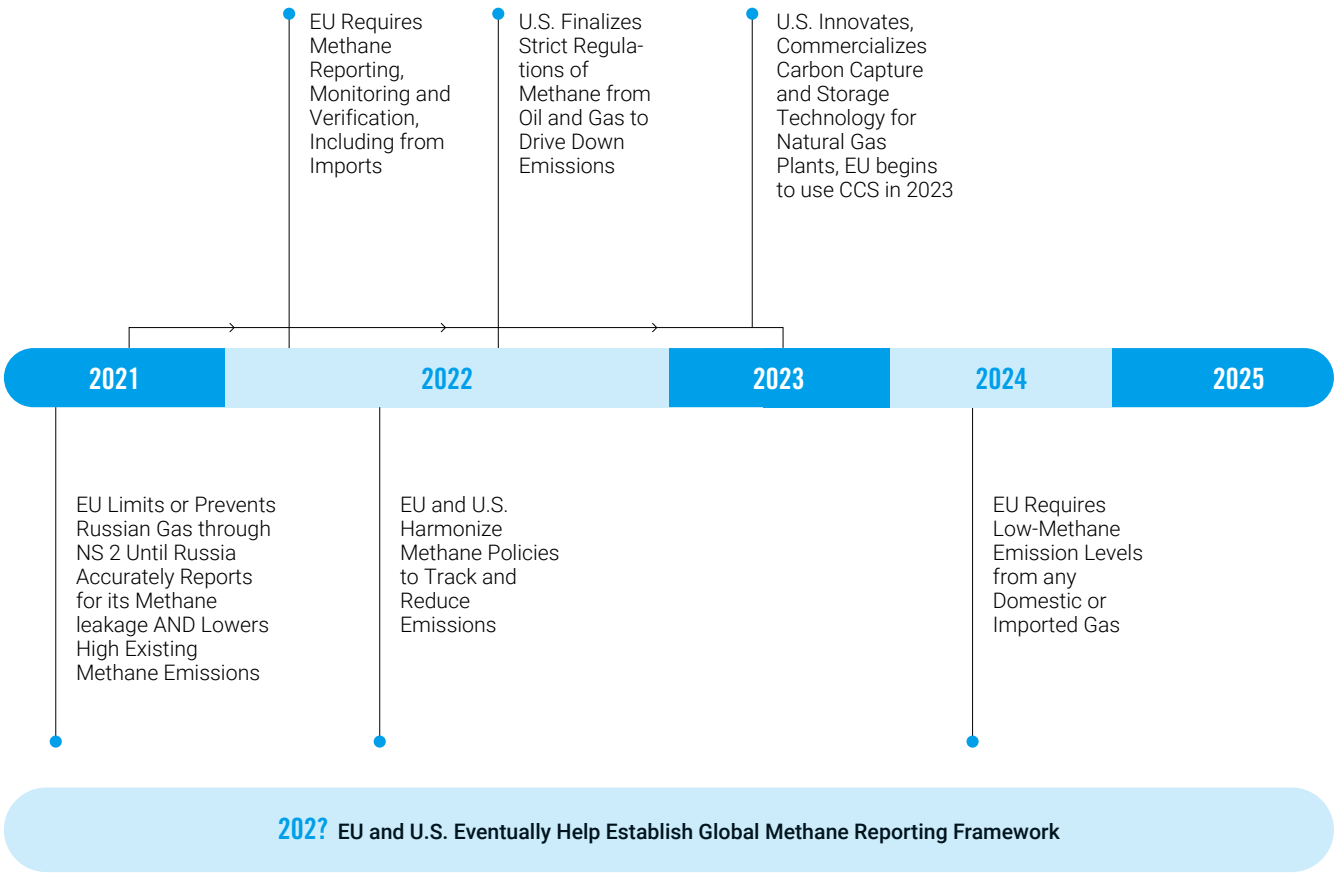
verification regimes for domestic and imported gas. Additionally, in the near future, the EU should impose regulatory requirements and standards requiring low-methane emissions for both domestic and imported gas.

Unlike other natural gas exporters to the EU, the U.S. has a long history of transparency and reporting of greenhouse gas emissions from methane, carbon dioxide and other sources. Now the U.S. is undertaking a series of measures to drive down methane and other emissions from U.S. natural gas production to the lowest levels ever. The U.S. must seize this opportunity to make its gas not only the lowest-emitting in the world, but as close to zero methane as possible. These developments together provide the EU and U.S. a joint opportunity to establish harmonized methane reporting and verification standards immediately.

Such EU and U.S. reporting, monitoring, and verification standards can quickly lead to global standards for accurate methane and carbon dioxide reporting from gas, and accelerate reporting and regulations to drive down methane emissions in the EU, U.S. and globally.

The European Union and United States should take advantage of these opportunities as follows:

RECOMMENDED EU AND U.S. ACTIONS ON METHANE AND NATURAL GAS



Key Report Recommendations:

- The European Union should *undertake a series of reporting and regulatory measures to require that all natural gas, both domestically-produced and imported gas, accurately report all lifecycle greenhouse gas emissions*. These monitoring, reporting and verification regulations should include a *special focus on requiring gas exporters to the EU to accurately verify lifecycle emissions of methane or not have access to the EU market*.

- *The EU and U.S. should harmonize their monitoring, reporting and verification (MRV) regimes* of lifecycle emissions from natural gas as a key interim step in this process. This step is crucial in setting a global benchmark for MRV emissions from gas, given the much greater transparency and accuracy of emissions measurements from natural gas produced in the EU and U.S. compared to other gas exporters to the EU.

- The *EU should consider stringent methane regulations for both domestically produced natural gas immediately, and then extend these requirements to imported gas at the earliest opportunity*.

- The EU should seek to diversify and expand its natural gas importation sources, both to reduce gas prices to phase out coal and to pressure importers of all types to begin to cut their lifecycle methane and carbon emissions.

- The *United States should accelerate its already significant measures to further drive down U.S. methane emissions from natural gas production and transportation*. The explicit goal should be to require that U.S. gas be super-low emitting, with fugitive emissions of less than .5% of total volume, by far the lowest emitting in the world. In time, the U.S. should require the use of carbon capture technologies for CO2 emissions from gas.

- The *EU should examine the role of Russian gas with high fugitive emissions in undermining EU and global climate change goals*. Specifically, the EU should study potential emissions from gas transported through the Nord Stream 2 pipeline before allowing the pipeline to become operational.

- *The EU Parliament and Commission should strongly consider using existing EU law to prevent operation of the Nord Stream 2 pipeline*, including denying any exemption for the Nord Stream 2 under Article 36 of the Gas Directive which can only be granted if the investment increases competition in gas supply and enhances security of supply, which the pipeline demonstrably does not.

- As Germany should reject the NS2 pipeline's huge geopolitical and climate costs as a vestige of previous era of politics, and embrace a new long-term strategy that demands low-emitting natural gas emissions imports and rejects Russian attempts to manipulate EU geopolitics.

- As a matter of improving energy and geopolitical security, and meeting climate goals, the *EU should begin to act on its already stated policies of reducing imports of Russian natural gas, aiming to cut Russian gas imports to the EU by at least half during the current decade*.

- To accelerate the reduction of methane emissions, the *U.S. and EU should require policies and regulations that rely on*

transparent and verifiable data. While the U.S. leads the world in transparent regulatory reporting, technological innovation, and mitigation of methane emissions from the oil and gas sector, it must do even more to verify and lower its emissions.

- The U.S. should support the EU Strategy to Reduce Methane Emissions through the joint Oil & Gas Methane Partnership and through the UN Environment Programs International Methane Emissions Observatory, building upon the existing regulatory equivalency between the U.S. and EU.

- *Alignment between the U.S. and EU efforts on methane can accelerate methane emissions reductions and improve energy security and market access*, as well as support adoption of broader international standards. These developments should be supported by industry to ensure that U.S. industry will not be commercially disadvantaged from implementing measurements and reductions compared to less-transparent non-U.S. suppliers.

- *U.S. should establish global leadership in commercializing Carbon Capture Utilization and Storage technology at industrial and natural gas plants*.

- The European Commission methane strategy should establish a global methane emissions reporting framework as soon as possible, in keeping with the EU pledge to develop legislation to mandate methane monitoring, reporting, and verification.

- *Data collected by the International Methane Emissions Observatory and EU should be used to create a Methane Supply Index to compare the methane footprint of different gas suppliers*. The IMEO would also collect emissions data from other sources to verify emissions reporting, including through satellite and aerial detection technologies.

- Russia and other major natural gas exports to the EU including Iran, Qatar should commit to the Global Methane Pledge, which has already be signed by the U.S., EU and over 100 countries.

- If any suppliers or nations do not transparently report their data, they should be assigned a high default value.

- The EU should establish a Methane Emissions Performance Standard for natural gas sold into the EU market in coming years, with the goal of driving down methane emissions from gas as close to zero as possible.

- As the *U.S. and EU drive down emissions from domestically produced gas, ultra-low emitting gas can both displace EU coal use and help force the decarbonization of all EU natural gas imports*. Increasing low-emitting U.S. liquified natural gas imports to the EU can play a key role in this process, and should be a domestic and international climate change policy priority for both the EU and U.S.

- *Over time, the EU should require all natural gas used in the EU achieve super-low methane and CO2 emissions, as gas will be needed to displace coal in the EU to meet climate goals*. The EU's actions in this decade therefore can help not only meet their own greenhouse gas emissions goals for 2030, but begin the process of bringing natural gas emissions to the lowest possible levels around the world and using it to displace global coal use.

- It is critical to note that while there is already some equivalency between the U.S. and EU, most of Europe's other natural gas suppliers and most natural gas suppliers globally have no such equivalency due to a complete lack of transparent reporting requirements.
- The *U.S. and EU should consider aligning future methane regulations and establishing regulatory equivalence in oil and gas trade between the U.S. and EU*:
  - **Targets:** Establish common 2025 and 2030 methane emissions targets, in terms of methane emissions per unit of gas delivered, for each segment of the value chain.
  - **Accounting:** Facility level accounting through methods consistent with U.S. EPA Greenhouse Gas Emissions Reporting Program or equivalent UNFCCC programs.
  - **Registry:** Common GHG emissions registry system to enable independent verification.
  - **Assurance:** Common assurance protocols for governments to employ for facilities within their boundaries to ensure all firms report consistent with accounting protocols and frameworks, and directives for the IMEO for further verification protocols.
  - Much greater investment in methane monitoring and measurement technologies and research.
  - These principles will ensure regulatory equivalency between the U.S., EU, and other nations.
- *Over time, the EU and then global goal should be requiring all natural gas to achieve super-low methane and CO2 emissions, as gas will be needed to displace coal around the world*. The EU's actions in this decade therefore can help not only meet their own greenhouse gas emissions goals for 2030, but begin the process of bringing natural gas emissions to the lowest possible levels around the world.
- The EU should prioritize LNG port access and pipelines to drive a competition toward super-low emitting gas.
- The EU should begin to actually act on its already stated policies of reducing imports of Russian gas, aiming to cut Russian imports quickly and deeply.

The European Commission, in its 2020 Methane Strategy, has indicated that it intends to take many of these actions soon.[183]

The Commission has pledged improvements in measurement and reporting of methane emissions across all relevant sectors, establishment of an independent international methane emissions observatory anchored in the United Nations framework, and to strengthen satellite-based detection and monitoring of methane emissions. The EU Commission has also maintained it will deliver legislative proposals on compulsory measurement, reporting, and verification and obligations to improve leak detection and repair of leaks on all fossil gas infrastructure, as well eliminating routine venting and flaring in the energy sector covering the full supply chain, helping to close abandoned well sites and coal mines that leak methane.

Yet the Commission has been slow to commit to extending these requirements to imported gas as well as that sourced domestically within the EU.

These programs must be required of all gas exports to the EU, including Russia, subject to strict verification regimes, to become effective climate and security policy.

Non-compliant importers should face loss of market access and other penalties.

The EU leadership position in adopting clear regulatory proposals on methane, and European importers expectations that U.S. LNG exporters will meet these requirements, are both crucial for beginning global efforts to cut methane by both exporters and imports from all nations.

But the EU methane proposals should recognize over time climate imperative for global coordination with fossil fuel buyer countries, including Japan, South Korea, and China. Globally, the majority of other LNG importing countries are less advanced in their focus and prioritization of climate issues and specifically methane than is the EU. To date, concerns over methane emissions of gas imports have been driven primarily by European companies. These recommendations would have a broader impact on the global LNG market and would benefit LNG importing countries that are not yet focused on climate while ensuring a level playing field for all exporters.

Of course, equally, the EU and other importers must require ALL exporting countries to meet new standards, including those like Russia who are historically unable or unwilling to do so.

Skeptics in Europe have expressed legitimate concerns that the aggressive methane and climate policies of the Biden administration and Democrats in Congress could be reversed should Republicans win back the White House and/or congressional control. Indeed, this possibility makes it especially crucial that the EU set up a system that requires not only accurate reporting of the emissions from gas imports but over time lower methane and carbon dioxide levels to qualify for use within the EU. Furthermore, major U.S. natural gas producers and LNG exporters have already begun to see that lower emitting U.S. gas has a competitive advantage against the rest of the world and so will increasingly lobby U.S. conservatives in favor of regulations.

The history of regulatory policy generally shows that once key nations and industries embrace regulations they tend to become first national, then regional based on trade, and eventually global norms.

Some climate advocates claim that the EU and U.S. should somehow immediately end natural gas use. Such magical thinking does nothing to contend with the reality that natural gas is the largest supplier of electricity in both the European Union and the United States. Nor does it grapple with the political reality that dismantling the current natural gas system would be so prohibitively expensive that it would undermine popular support for climate change goals on both sides of the Atlantic. Neither does this view recognize the unique role that gas plays in allowing expansion of renewable energy, as baseload power capable of remarkably quick delivery into the grid when wind and solar power are unavailable, something coal, nuclear and hydropower cannot do nearly so well.

For all these reasons, the EU will need natural gas for years to come. The only questions are:

- Can gas displace all EU coal?
- Can gas emissions — especially of methane, but also in time of CO2 — be driven down to very low levels, first in the EU then globally?

- Can gas be compatible with much larger amounts of renewable energy in the EU grids?
- Can this gas be cheaper than most other EU alternatives?
- Will reduced reliance on Russia improve EU geopolitics help meet global climate goals?
- Can low-emitting gas help meet EU climate goals?

The answer to each of these questions is YES — with the right policies.

Given the imperative to end global coal use, and huge existing investments in natural gas infrastructure that can also be used for other low emissions sources like hydrogen, the fastest way to cut EU and U.S. emissions is to drive down the methane and carbon dioxide emissions from natural gas. Fortunately, we have the technology used to do this quickly and at very low cost.

The U.S. and Biden administration must act decisively to reduce U.S. carbon and methane emissions from the development of American natural gas. Likewise, the American liquefied natural gas exporters must become more efficient in the delivery of low emissions gas to Europe and the rest of the world. But the explicit goal should be to make, and prove, that U.S. and EU gas is the lowest emitting in the world.

EU natural gas policies have the opportunity to create a global race to ultraclean climate friendly natural gas in which major producers attempt to outdo one another in cutting first methane emissions and eventually CO2. In the United States, there is already accurate reporting of methane emissions from natural gas production. Yet similar accurate verification of methane emissions does not exist in Russia, Qatar, Iran and other major gas exporters.

Indeed, it is increasingly obvious that lower-emitting natural gas can play a significant role in helping Europe decarbonize, both by ending its use of coal and by displacing higher-emitting Russian and other forms of gas.

The G7 nations in their 2021 deliberations for example issued a joint communiqué that would require the phasing out a fossil fuel subsidies beginning with the elimination of coal subsidies.[184]

They also agreed to increase support for renewable energy, ensure better measurement and reporting of methane leakage, and accelerate the transition toward decarbonized power in the 2030s. "We stress that international investments in unabated coal must stop now and commit to take concrete steps towards an absolute end to new direct government support for unabated international coal power generation by the end of 2021," the G7 stated.

The broader international climate change mitigation challenge must be kept in mind as the EU, U.S., and the rest of the world address methane and broader emissions. More than three quarters of all global greenhouse gas emissions come from outside the U.S. and EU. As it now stands, major emitting nations like China, Russia, and India, have submitted proposals under the Paris climate agreement that would allow their emissions to grow for the remainder of this decade. Nor have these and other key nations signed the Global Methane Pledge.

Ultimately, only by galvanizing regulatory and commercial pressure on major emitters outside of their borders can the EU and U.S. hope to cut global emissions effectively. It is this global context that dramatizes the EU and U.S. imperatives to curtail unconstrained methane and emissions from Russia and other gas exporters. Equally, as Asia becomes a much larger natural gas importer, and China in particular, there is an opportunity to drive down both coal use and emissions from gas that will act as a temporary substitute.

APPENDIX A

Growing Russian Cyberattacks on EU and its Allies

In recent years and even months, a long series of major new cyberattacks by gangs operating in Russia with impunity have further dramatized the security and geopolitical risks of continuing to fund the Russian regime through gas imports. The widespread nature of these attacks has degraded or threatened almost every industry and western nation on earth. Security experts increasingly name Russian cyberattack as the biggest single immediate threat to western security on a daily basis.

Russian cyberattacks on the German parliament in 2015 including German Chancellor Merkel's own email account in 2020 were tied directly to hackers affiliated with Russian intelligence agencies. Numerous German media report confirmed the involvement and implication of the Russian government, and described the seriousness and outrage over the attack:

"It was an attack the likes of which Germany had never experienced before: In the spring of 2015, hackers broke into the IT system of the German Bundestag and stole more than 16 gigabytes of data — including numerous emails from parliamentarians. Chancellor Angela Merkel's parliamentary office is said to have been the target of the attack. Security officials said the cyberattack was believed to be part of the APT28 espionage campaign, also known as the "Fancy Bear." The Russian secret service is suspected to be behind it.

"According to information from [German media outlets] *WDR*, *NDR* and 'Süddeutscher Zeitung.' German investigators have now succeeded for the first time in identifying a suspect who is said to have been involved in the 'Bundestag hack.' It concerns the 29-year-old Russian Dmitriy Badin, a hacker who is supposed to work for the Russian military intelligence service GRU."[185]

Chancellor Merkel expressed outrage, shock and dismay at the findings, saying had 'hard evidence' that Russia was responsible for an 'outrageous' cyberattack on the German parliament. Answering questions in the Bundestag [in May 2020], the German chancellor said the hacking attack, which occurred in 2015 and also targeted her own parliamentary email account, 'obviously disturbs a trustful cooperation' with Russia."[186] The 2015 Russia cyberattack on Germany[187] was just one of many such incursions into EU democracies in recent years: "Berlin's effort to seek retribution follows years of frustration over Russian hacking as intelligence agencies and cybersecurity firms increasingly tied major attacks to the Kremlin. In February [2020], a group of European countries and members of the 'Five Eyes' intelligence community called out Russia's intelligence service for launching a 'totally unacceptable' cyberattack on networks of Georgia's government, courts, and other organizations.

"That same month, French President Emmanuel Macron told a crowd of security officials in Munich that Russia 'will remain a country that tries to intervene' in European elections, and that EU nations 'need to be quick in our reaction' and 'agree on sanctions.'

"Already in 2018, Western governments criticized Russia over a series of high-profile cyberattacks, including one on Dutch soil against the Organization for the Prohibition of Chemical Weapons, while the U.K. and the U.S. have said that Moscow was 'almost certainly responsible' for the global outbreak of NotPetya ransomware that caused billions of euros in damages."[188]

And as the *New York Times* reported on September 11, 2021, the German government is investigating evidence that the Kremlin is trying to alter the outcome of the German election for Chancellor to succeed Angela Merkel in favor of candidates less opposed to the NS2 pipeline.[189]

The fact that after these attacks on German and EU democracy, the Merkel government still strongly supported the Nord Stream 2 pipeline from Russia to German defies logic.

Famously, and shockingly, the Russian government has also of course directly attempted and in some cases succeeded in undermining the U.S. election process itself. A number of major studies have found that Russian government operatives made major efforts through social media and other sources to influence the 2016, 2018, and 2020 U.S. national elections, spreading demonstrably false narratives regarding a huge range of issues.[190]

Ironically, many of these attacks are focused on U.S. and other energy systems, including the May 2021 attack on the key Colonial pipeline that supplies gasoline to the East Coast of the U.S.[191]

One of the most troubling aspects of the cyberattacks emanating from Russia is that leading experts believe Putin could easily and quickly shut down the attacks but chooses not to. As a leading cyber security and Russian experts noted recently in *The Washington Post*:

"If Putin chose to take the problem seriously, Russian security officials could quickly identify and interdict the attackers and force them to unlock the data to stop the damage to businesses worldwide, including in the United States. …Washington could hit Russia where it hurts by sanctioning its largest gas and oil companies, which are responsible for a significant portion of the Russian government's revenue.[192]

In point of fact, a potentially far more effective way to reduce the Russian government's natural gas revenues would be to displace them with lower-emitting and often less expensive gas from other sources, including U.S. liquified natural gas exports.

APPENDIX B
NORD STREAM 2 PIPELINE: "RUSSIA'S SERIOUS GEOPOLITICAL VICTORY"

Huge Risks for Ukraine and Eastern Europe — Could lock in EU reliance on high methane Russian Gas for decades.

Virtually all objective European analysts have expressed dismay and astonishment at the insistence by outgoing German Chancellor Angela Merkel that the Nord Stream 2 pipeline is in any way in European or German economic, climate, or geopolitical interests.

On July 22, the U.S. and Germany announced a "deal" to attempt to force Russia to pay Ukraine. Many see Germany as having little influence over whether Russia will live up to its side of the deal. Ukraine stands to lose about $3bn (£2.2bn) a year in gas transit fees as Nord Stream 2 would by-pass an already adequate pipeline system in Ukraine. Under the terms of the U.S.-German deal, Ukraine will get $50 million in green energy technology credits and a guarantee of repayment for gas transit fees it will lose by being bypassed by the pipeline through 2024.[193]

As *Politico* notes, "While some influential Germans — notably former chancellor and current Nord Stream 2 chairman of the board Gerhard Schröder — have been instrumental in securing the pipeline's completion, Berlin may have little to no influence over Moscow once construction is done and gas is flowing.

U.S. Senator Jeanne Shaheen, a Democrat on the foreign relations committee who co-authored U.S. sanctions legislation targeting the pipeline, said she was "skeptical" of the deal given that "the key player at the table — Russia — refuses to play by the rules."[194]

Yet the politics in Germany of climate change impacts are changing rapidly in part due to the devastating flooding that afflicted Germany in mid-July of 2021, killing more than 140 Germans and leaving city centers demolished.[195]

Writing in the *Financial Times* in 2019, expert Gordon Sondland, expressed the vast majority view: "Europeans are debating whether to invest billions in Russian-backed gas infrastructure, including the Nord Stream 2 pipeline. They should not. And they do not have to — alternative supplies at affordable prices already exist and more are coming online from the eastern Mediterranean, the Caspian Sea, and the U.S.

The EU has a once-in-a-generation opportunity to loosen Russia's energy chokehold on parts of Europe.

Five years ago, Russia illegally invaded Crimea, raising fears in Europe that the gas supplies it received through Ukraine would be disrupted, as what had happened in 2006 and 2009."

"If Europe allows new Russian gas arteries into the heart of the continent, it will find itself hosting a Trojan horse. If completed, the new pipelines will allow Moscow to make good on its public threats to end gas transit through Ukraine — cutting a vital link between that country and the west. If Gazprom, the state-owned Russian gas company, can bypass Ukraine, it will not only give Moscow significant leverage but also leave the west vulnerable anew to a cut-off in supplies in coming winters.

"The good news is that Europe does not have to make the unwise and unnecessary choice of depending on Russia's president Vladimir Putin to keep the lights on. There are other sufficient, reliable and price-competitive sources of liquefied natural gas free of the true costs of

Russian gas. New discoveries, including one just weeks ago off the shore of Cyprus, underscore the availability of supply from within the EU. The U.S. can be a major and immediate part of the solution. It is now the world's largest producer of crude oil and natural gas. The U.S. energy department projects export capacity reached 50 bn cubic meters in 2018 and will grow to more than 90 bcm by the end of 2019, putting it in line to be the third largest exporter of LNG, after Qatar and Australia. New transmission infrastructure and liquefaction terminals could extend U.S. exports beyond 200 bcm a year, equal to about 40% of Europe's annual gas demand."[196]

It is no coincidence that the Nord Stream 2 pipeline is funded by Gazprom, the state-owned Russian oil and gas monopoly, functionally under control of the Russian government and Vladimir Putin.

"Moscow-based, state-owned Gazprom is the project's sole shareholder and has committed to providing up to 50 percent of the project's financing, with the remaining funds coming from German companies Wintershall and Uniper, Royal Dutch Shell, French ENGIE, and Austrian oil and gas company OMV. According to Nord Stream 2 AG, the overall costs of the project will total around 9.5 billion euros."[197]

Germany has doubled down on importing high-methane Russian gas by building the Nord Stream 2 to pipeline across the Baltic directly into Germany. Ironically, if completed and utilized to its full capacity, the Nord Stream 2 pipeline will simply increase the dependency on super-climate polluting Russian gas for decades to come.

The huge climate change premium that Germany is paying to import Russian gas is being routinely ignored. Shockingly, even the geopolitics of supporting Putin's increasingly repressive regime seem not to be on the agenda of the EU climate advocates. Yet, ironically, the EU needs natural gas as a bridge fuel going forward to provide baseload power and to displace remaining coal. As Inna Sovsun, Ukraine expert at the *Atlantic Council* put it, in July 2021:

"But as most honest observers recognize, Nord Stream 2 is no ordinary business project. On the contrary, it is a geopolitical weapon aimed at the heart of Europe that has been conceived since day one as a tool to isolate Ukraine and strengthen Russia's position in its confrontation with the Western world. With construction of Nord Stream 2 currently nearing completion, Russia is doing little to allay fears that it intends to blackmail Europe with the new pipeline. On the contrary, Moscow's actions indicate that it is growing more confident in its ability to leverage energy supplies for geopolitical gain."[198]

"In recent months, Kremlin-controlled gas giant Gazprom has refused Ukrainian offers of additional pipeline capacity, despite surging European demand for gas due to a range of factors including maintenance on alternative Russian pipelines. Moscow prefers to wait for Nord Stream 2 to be commissioned and wants to send a clear message that it expets Russia's European customers to facilitate this process without delay. Russia's decision not to send additional gas to European markets via Ukraine has resulted in record high prices and plummeting gas stocks. This is raising concerns across Europe ahead of the coming heating season.

"Ukraine's Gas Transmission System Operator is more than capable of meeting any increases in European demand for Russian gas supplies, but

in recent years Moscow has preferred to reduce flows while developing alternative transit routes bypassing Ukraine. Despite this broad downward trend, in both 2019 and 2020, Gazprom did book additional Ukrainian capacity to offset temporary shortfalls due to pipeline maintenance work elsewhere. It is therefore reasonable to conclude that Moscow had no major issue with the practice until the current summer season. Most observers attribute this change in policy to Nord Stream 2 and Russia's desire to underline that the new pipeline is the only way to secure additional gas supplies."[199]

As a commentary piece in *The Interpreter*, published by The Lowy Institute, stated:

"Europe doesn't appear likely to reduce its dependency on Russian energy any time soon. The much-discussed, much-debated construction of the Nord Stream 2 natural gas pipeline, linking Russia with Germany via the Baltic Sea, is now almost completed.

"Once completed, Nord Stream 2 is expected to deprive Ukraine of up to $3 billion in annual revenue by allowing Russia to circumvent the former Soviet republic when transferring gas to Europe. That is one of the reasons why Ukraine's President Volodymyr Zelensky voiced his fears about the U.S. and Russia striking a deal, saying: It would be a loss for the United States, and I believe it would be President Biden's personal loss. It would mark a serious geopolitical victory for the Russian Federation and a new redistribution of spheres of influence.

"Zelensky is aware that Russia, through various lucrative oligarchic business schemes, already holds de facto control over coal production in the Donbass, meaning that after Nord Stream 2 is completed, energy-poor Ukraine could completely lose its role as a regional gas hub. Ukraine is already facing a decrease in the volume of gas transit, even though Gazprom reportedly increased its gas export to Europe.

"Still, close as it is, the Nord Stream 2 pipeline isn't yet complete. The prospect of stopping the realization of the project might be low, but that could be the fallout from a full-scale confrontation between Ukraine and Russia over the Donbass or the death of Kremlin critic Alexey Navalny, who has been imprisoned since January. And from the other end, the Kremlin sees the EU as an unreliable partner, meaning Nord Stream 2 could very well be the last joint project between Europe and Russia, at least in this phase of a "new Cold War."

"That, however, does not mean that the Kremlin and the West will break all economic ties. In 2018, despite anti-Russian sanctions, around 40 percent of natural gas imports to the EU were sourced from Russia, making Moscow the largest supplier of natural gas to the bloc."[200]

An Issue Brief by the *Atlantic Council* think tank found possibly devastating effects should the Nord Stream 2 pipeline be allowed to be completed and ship substantial amounts of gas:

"Europe energy security would be seriously undermined by the pipeline's completion. … Given that Gazprom is notorious for cutting gas supply in the middle of the winter, this is an impermissible energy security risk. As Gazprom has done every so often with former Soviet republics, Russia can use Nord Stream for political or financial extortion. … This concern about excessive concentration in one pipeline system did not exist when only NS1 existed. It is the addition of NS2 that raises the supply risk above the acceptable level. The Geopolitical effect of the completion could be devastating. Russia's obvious intention has been to form

an alliance with Germany and Austria (also with the Netherlands and Belgium) against Eastern and Northern Europe. NS2 is Russia's most daring attempt to break up the EU. The Kremlin has provided all the evidence. In October 2015, Germany's then-Minister of Economy and Energy Sigmar Gabriel met with Russian President Vladimir Putin at his residence Novo-Ogaryovo outside of Moscow. The Kremlin quoted Gabriel as saying: 'Mr. [Alexei] Miller and Mr. Matthias Warnig will continue to pursue the Nord Stream 2 project. This is in our interests… What's most important as far as legal issues are concerned is that we strive to ensure that all this remains under the competence of the German authorities, if possible. So if we can do this, then opportunities for external meddling will be limited. And we are in a good negotiating position on this matter.'"

"These reported remarks, coming just weeks after the announcement of Nord Stream 2 in mid-2015, clarify that this is a geopolitical project. … It is difficult to comprehend how a NATO government could accept any part of this, and it is remarkable that Germany, the otherwise most multilateral of the large EU countries, has acted so unilaterally for so long. Fortunately, Germany is not united around NS2. Apart from Schröder, the only full-fledged support comes from the extreme right, the Alternative for Germany, and the extreme left, Die Linke. The Greens are united against NS2, and the Free Democrats are predominantly negative. Angela Merkel's Christian Democratic Union (CDU) is split … Norbert Röttgen, a CDU member of parliament (MP) and chairman of the Bundestag's Committee for Foreign Affairs, said that the completion of NS2 "would be the ultimate confirmation for Vladimir Putin that he is pursuing exactly the right policy because the West is doing nothing." As the outstanding German journalist Josef Joffe notes: "Merkel has maneuvered Germany into isolation." He adds: "The court of supply and demand may issue this definitive verdict: no need for another pipeline. If so, Nord Stream 2 may just rot away underneath the Baltic — a monument to greed and folly."

"NS2 violates the market-oriented EU energy policy, which requests complete unbundling of pipelines and gas production, because NS2 is fully owned by Gazprom, the gas producer and supplier. Gazprom has all along opposed the EU policy of unbundling and marketization, preferring long-term contracts of take-or-pay over decades, and of course it's monopolization. Gazprom's allies in Europe have been only four governments — those of Austria, Belgium, Germany, and the Netherlands (and, intermittently, France), and five big energy companies — Austrian OMV, German Wintershall and Uniper, Royal Dutch Shell, and French Engie. It is a mystery how Europe can allow a handful of countries and big energy companies to jeopardize its national security, geopolitical objectives, energy policy, and climate policy." [201]

The *Atlantic Council* even points at possible German corruption regarding Nord Stream 2:

"NS2 has had a corrosive impact on governance in Germany, Austria, and the Netherlands, which have all suffered from severe top-level corruption from Gazprom and Russia. In Germany, Schröder stands out. The chief executive officer (CEO) of Nord Stream AG is Putin's old friend, Matthias Warnig, from the East German secret police (Stasi) in Dresden. Schröder and Warnig are Putin's foremost, and presumably best paid, agents in Europe. The completion of NS2 will further enhance Kremlin influence in the German business community. In Austria, a number

of prominent former politicians have started working for Russian state companies after their retirement. Gazprom's way of doing business is so devious and nontransparent that any advance for this company would be damaging for Europe. Both Gazprom and NS2 involve corruption risks that should not be permitted in societies that claim to support the rule of law.

"An egregious example of dubious governance is the establishment by the government of the northern German state of Mecklenburg-Western Pomerania of a state-owned "climate" foundation. This "foundation for climate and environment protection" is supposed to facilitate the completion of NS2. The state will put up €200,000, while Nord Stream 2 AG, which is wholly owned by Gazprom, has provided €20 million. How can this be legal? Germany should have laws against such foreign-government intrusion. The Russian threat to European governance is not limited to NS2. Gazprom is engaged in similar nefarious activities with TurkStream in Bulgaria and Serbia. In Hungary, Prime Minister Viktor Orbán suddenly changed his policy on Russia after he agreed to purchase a new nuclear-power station from Russia after a private meeting with Putin in Moscow in January 2014. Since then, Hungary has declined drastically in Transparency International's Corruption Perception Index." [202]

As *Financial Times* reporter Henry Foy noted: "U.S. and EU opposition to the pipeline has centered on fears that the Kremlin will use increased gas exports as political leverage over European countries, and that its true purpose is to avoid existing pipelines through Ukraine, thus depriving Kyiv of transit revenue. Both Russia and Germany say it is a purely economic project that will ensure future EU gas demand is met." [203]

The strange bifurcation by Germany of an energy policy on one hand and geopolitical and climate considerations on the other is stunningly illogical and destined to backfire to the deep detriment of the EU's climate and geopolitical goals

As one might imagine Eastern European nations who have long suffered from Russian intervention are outraged at the state of affairs. Eastern European leaders including Polish President Mateusz Morawiecki have expressed deep concern that Nord Stream 2 will benefit Russia, but not Europe:

"We are very disappointed, in Poland, about the recent change of the position of the United States in particular because, over the last couple of years, we have worked hand-in-hand with the U.S. administration to stop or to slow down the development of Nord Stream 2," Morawiecki told *Newsweek*.

"And it was only recently where the American administration changed their view on this with false hopes that this will help to repair the relations between the U.S. and the European Union.

"Well, Germany is not the European Union. Germany is Germany, and they have their own interests and it happened that their interests are quite aligned and on the same page with the Russian interests. But this is not aligned with the transatlantic interests. So Germany is on the collision course with the transatlantic strategy, in that view, regarding its own energy interests."

"He added: 'By this, I don't only mean importing American gas. … That's not really the primary significance here. Morawiecki suggested it would be Russia, rather than Germany or Europe, that would benefit most. The primary significance is

that by stopping Nord Stream 2, we were trying to not help the Russians accumulate funds for their military developments and aggressive policy,' he said." [204]

The huge climate change premium that Germany is paying to import Russian gas is being routinely ignored, even the geopolitics of supporting Putin's increasingly repressive regime seem not to be on the agenda of the EU climate advocates.

The Energy Futures Initiative June 2021 report on "The Future of Natural Gas in a Deeply Decarbonized World" found that the EU's "reliance on Russia will substantially increase when the Nord Stream 2 pipeline becomes operational." [205]

The report by former Secretary of Energy Ernest Moniz also notes that "The energy security issue in the CEE and SEE areas is particularly acute as countries in these regions have more fossil-intensive legacy energy mixes than other European countries and remain highly dependent on fossil fuel imports." [206]

In June, Russian President Vladimir Putin crowed that "two and a half hours ago, the laying of the first string of the Nord Stream 2 gas pipeline was successfully completed."

Even more astoundingly, Putin stated that this was just the beginning of energy projects that Russia plans to implement with Europe: "We are ready to continue implementing similar high-tech projects with our European and other partners." [207]

But in fact, only one of two major pipelines has neared completion in the Russian pipeline project (98% according to estimates).

Many leading experts believe there could still be time to prevent Europe from being hustled into decades of reliance on high emitting Russian gas that also funds arguably the most autocratic and dangerous nation on earth.

As EU natural gas expert Alan Riley at the Atlantic Council has noted:

"Physical completion of a pipeline does not mean that the pipeline can immediately be put into operation. New pipelines are subject to a series of national and European laws that mandate who can own the pipeline and how it should be operated. The key legislation is the 2009 EU Gas Directive, which, as a result of amending legislation adopted in May 2019, now also formally applies to import pipelines such as Nord Stream 2.

"Per the 2019 amendment to the Gas Directive, as a new pipeline, Nord Stream 2 must be unbundled, meaning Gazprom cannot both own the pipeline and provide gas through the pipeline, and third-party access must be made available. This means that Gazprom's competitors such as Rosneft and Novatek would be able to sell gas via Nord Stream 2. There must also be tariff price transparency.

"However, Gazprom opposes pipeline unbundling, primarily since it does not want to give its competitors access to its infrastructure. Gazprom will also resist price transparency rules, since pricing information may be used to bring further price review challenges to existing long-term supply contracts with many of its other European customers.

"If Gazprom wishes to avoid these liberalization obligations, it has to apply for an exemption under Article 36 of the Gas Directive. Article 36, however, is clear that an exemption can only be

granted if the investment increases competition in gas supply and enhances security of supply, and the exemption must not be detrimental to competition or the effective functioning of the internal market for natural gas." [208]

In short, there are multiple existing authorities that allow the EU to prevent gas from actually flowing through the Nord Stream 2 to pipeline even if it is technically operational. Moreover, this analysis does not take into account the overwhelming climate imperative to prevent additional emissions-pervasive Russian gas from entering the EU. The EU Parliament and Commission should specifically examine the role of methane-heavy Russian gas from Nord Stream 2 in undermining the EU's climate change goals before they'll allow the pipeline to become operational.

In mid-September 2021, Gazprom claimed that building of the Nord Stream 2 pipeline was complete and that the pipeline might be operational by the end of the year. As the *Financial Times* noted:

"The $11bn pipeline across the Baltic Sea will allow Gazprom to send 55bn cubic metres of gas to Europe per year, bypassing Ukraine. The plan has alarmed Kyiv, which could lose out on billions of dollars in gas transit fees, while U.S. sanctions have delayed construction. Opponents have also raised concerns that the pipeline would make Europe more reliant on Russian gas, which already accounts for more than a third of its demand.

"Gazprom said in a statement that 'the construction of the Nord Stream 2 pipeline has been fully completed.' The pipeline still has to go through technical testing and certification, which normally takes a couple of months, according to industry experts. Gazprom declined to comment on the expected timeframes for the first gas to flow. Last week, chief executive Alexei Miller said Gazprom could send gas via the pipeline "by the end of the year and during this heating season.'"

Together with neighbouring Poland, Ukraine has pledged to challenge the NS2 pipeline's adherence to EU energy market rules, which require separation of production, transit and supply. Such a challenge could force Gazprom to "unbundle" the pipeline, losing its controlling stake in the project. 'We hope . . . as we provide necessary arguments in Berlin and Brussels, that NS2 AG should not be certified as operator of the NS2 [pipeline] under current circumstances,' Yuriy Vitrenko, chief executive of Ukraine's state gas company Naftogaz, told the *Financial Times*.[209]

APPENDIX C

EU pledges to Establish Rules in 2021 for Monitoring and Verification of Methane Emissions

The EU Commission to the European Parliament on "an EU strategy to reduce methane emissions" pledges the EU to take action before the end of 2021 to establish new rules for the monitoring and verification of methane emissions from all sources including natural gas, and other actions to improve detection of methane:

1. The Commission will support improvements in measurement and reporting of methane emissions by companies across all relevant sectors, including through sector-specific initiatives.

2. The Commission will support the establishment of an independent international methane emissions observatory anchored in the United Nations framework, in cooperation with international partners.

3. The Commission will strengthen satellite-based detection and monitoring of methane emissions through the EU's Copernicus programme.

4. In order to deliver on the increased climate ambition of the 2030 climate target plan impact assessment, the Commission will review relevant EU climate and environmental legislation to more effectively address methane-related emissions notably the Industrial Emissions Directive and the European Pollutant Release and Transfer Register. [210]

It also calls for additional specific actions related to the energy sector:

5. The Commission will deliver legislative proposals in 2021 on:

   - Compulsory measurement, reporting, and verification (MRV) for all energy related methane emissions, building on the Oil and Gas Methane Partnership (OGMP 2.0) methodology.

   - Obligation to improve leak detection and repair (LDAR) of leaks on all fossil gas infrastructure, as well as any other infrastructure that produces, transports or uses fossil gas, including as a feedstock.

6. The Commission will consider legislation on eliminating routine venting and flaring in the energy sector covering the full supply chain, up to the point of production.

7. The Commission will work to extend the OGMP framework to more companies in the gas and oil upstream, midstream and downstream as well as to the coal sector and closed as well as abandoned sites.

8. The Commission will promote remedial work under the initiative for Coal Regions in Transition. Best-practice recommendations and/or enabling legislation will be brought forward if necessary.[211]

By all accounts, the EU Commission intends to undertake these rules later this year. However, it does not seem likely that these provisions will immediately apply to the nearly 70% of

European Union gas that is imported. Instead, the report explicitly states that the EU could begin to measure and verify emissions from imports after 2024. In fact, a separate document from March 2020 acknowledges that the lack of measuring methane emissions from natural gas imports is undermining the credibility of the EU use of its natural gas imports and by extension the entire EU emissions reduction and climate change effort: "Methane emissions harm the credibility of gas today as a transition fuel towards a decarbonized energy system and puts in jeopardy the potential of renewable and decarbonised gases in the longer term…" [212]

Indeed, it seems increasingly obvious to many experts that the lack of measuring and verification of emissions from key EU sources like Russia not only undermines EU climate action credibility but may, in the medium term, reduce the value of natural gas shipments that do not certify fully certified and account for their levels of greenhouse gas emissions, especially methane. An Oxford Institute for Energy Studies report from 2019 warned that LNG cargoes without certified emissions are at increasing risk of progressively being "deemed to have a lower commercial value" as buyers will have to "purchase emission offsets" to match their climate targets.[213]

It is notable that the largest U.S. LNG exporter, Cheniere, has announced an extensive program to measure and report the greenhouse gas emissions of each of its LNG shipments — producing "cargo tags of emissions — by 2022. U.S. exporters are working with U.S. natural gas producers to fully understand and report lifecycle emissions of exported gas.[214]

Crucially, independent analysis by the International Energy Agency has found that globally the natural gas industry could cut methane emissions by 40% without additional cost due to the increased efficiency of production by monitoring and repairing methane leaks.[215]

In fact, this process has begun particularly in the United States as major companies there have begun to invest in reducing methane leaks in the Biden administration has begun to develop stringent methane regulations and programs to reduce fugitive emissions of existing or old oil and gas wells.

APPENDIX D

UN IPCC Climate Science Report: Cutting Methane Emissions Key to Rapidly Limiting Global Temperatures

A major report released August 8, 2021, by the United Nations International Panel on Climate Change found that cutting methane is a key element in limiting global average temperatures below 2°C, the main Paris agreement climate goal. As Reuters reported: "Countries must make "strong, rapid and sustained reductions" in methane emissions in addition to slashing CO2 emissions, scientists warn in a landmark report by the U.N. Intergovernmental Panel on Climate Change released Monday.

The report puts "a lot of pressure on the world to step up its game on methane," said IPCC report reviewer Durwood Zaelke, president of the Institute for Governance and Sustainable Development in Washington, D.C. "Cutting methane is the single biggest and fastest strategy for slowing down warming," Zaelke said. These findings mean that cutting methane emissions is even more important in controlling climate change than emissions reductions in other greenhouse gases, suggesting that limiting methane in the EU, U.S. and globally must be a priority in overall climate strategies.

"As the world shifts away from fossil fuels and tackles air pollution, those aerosols will disappear – and temperatures could spike. Quickly reducing methane could "counteract" this effect, while also improving air quality, said IPCC report summary author Maisa Rojas Corradi, an atmospheric scientist at the University of Chile. The report sends a loud signal to countries that produce and consume oil and gas that they need to incorporate "aggressive oil and gas methane reduction plans into their own climate strategies," said Mark Brownstein, senior vice president of energy at Environmental Defense Fund.

"The United States is expected to unveil methane regulations by September that are more stringent than rules issued by the Obama administration, which were then rolled back under former President Donald Trump. … But major economies without strict regulations on oil and gas production or agriculture, such as Brazil and Russia, are also likely to be high methane emitters, said IPCC co-author Paulo Artaxo, an environmental physicist at University of Sao Paulo. "(Methane) leakage from gas and also oil wells is very difficult to quantify," he said. If countries are not looking, they will not find it." [216]

As Durwood Zaelke and his colleague Gabrielle Dreyfus have explained, methane cuts can reduce near-term temperatures uniquely, providing extremely important climate protection that cuts in CO2 alone cannot in the next decade:

"The landmark Global Methane Assessment by the United Nations Environment Programme and Climate and Clean Air Coalition calculates that reducing methane emissions by 45 percent by 2030 will avoid almost 0.3 degrees Celsius of warming globally and 0.5 degrees of warming in the vulnerable Arctic by the 2040s…

"While this UN methane report was published after the January 2021 deadline for inclusion in the [UN IPCC August 8, 2021] AR6 report, AR6 recognizes the importance of 'strong, rapid and sustained reductions in [methane] emissions' to limit warming in the near-term, especially as decarbonization measures, essential for reducing CO2 emissions, will also result in removal of the cooling particles that come with burning coal and diesel, 'unmasking" existing warming and cancelling the cooling benefits of CO2 reductions until around mid-century.'" [217]

Other major publications echoed these findings. A recent *Economist* editorial stated:

"A more palatable approach to offsetting the diminishing effects of sulphate pollution, enthusiastically endorsed by the IPCC, is to redouble efforts to reduce emissions of another climate-changing by-product of human civilisation. Methane is a more powerful greenhouse gas than carbon dioxide, but one which lasts in the atmosphere for only about a decade. Reduce methane emissions and you soon reduce methane levels; reduce methane levels and you reduce global warming.

"Its rising atmospheric concentration shows that today's efforts to abate methane emissions are not up to the job. Happily, there is much more that can be done. Emissions from the energy industry could be more tightly regulated almost everywhere. Because methane is valuable, some would pay for themselves. Reducing emissions from landfill sites is not terribly difficult either. Livestock would burp less with the right feed supplements. Eliminating emissions would be hard; but quite steep reductions are entirely possible.

"Carbon dioxide remains the heart of the climate problem. Exploring the possibilities, practicalities and dangers of solar geoengineering remains a good idea. But it is on methane emissions that progress can be made most quickly. And the world is getting ever hotter. Methane should be given priority on the agenda at the cop26 climate summit this November." [218]

An op-ed in the *New York Times* by Congresswoman Kathy Castor, Chair of the House Select Committee on the Climate Crisis, emphasized U.S. action:

"The new report makes it clear: If we are to keep global temperatures in check, we urgently need to focus on cutting methane pollution. When every fraction of a degree counts, moving quickly to reduce this super pollutant is one of the most immediate and powerful ways to start solving the climate crisis. And because of methane's relatively short life span — it lingers in the atmosphere for around 12 years, while carbon dioxide hangs around for hundreds of years — bringing down our methane emissions will help clear the atmosphere, helping to moderate temperatures and making a real impact on our near-term climate goals.

"Last year, the Democrats on the Select Committee on the Climate Crisis that I lead released a road map to help America reach net zero emissions. In our Climate Crisis Action Plan, we recommended reducing methane pollution from oil and gas extraction by 90 percent by the end of the decade, as well as phasing out the routine flaring of methane.

"Last month, I was disappointed to see only 12 House Republicans join our Democratic majority when we voted in favor of stronger safeguards against methane pollution. This was truly low-hanging fruit: a measure to require oil and gas companies to regularly find and repair methane leaks. The resolution even had support from some of the world's largest oil companies. And yet most of our colleagues across the aisle refused to put the health of American families above the profits of polluters." [219]

As Durwood Zaelke has noted elsewhere, the Arctic is already warming three times as fast as the rest of the planet, and faces tipping points which could quickly lead to its destabilization, making global climate change far harder to prevent.

"One feedback concerns the white shield of Arctic sea ice that reflects solar radiation safely back to space. Half the ice is already gone. The remaining half contains only a few percent of the original strong sea ice that builds up over many years. The rest is fragile new ice that forms each winter. Thin and less reflective, it is also broken up more easily by wind and waves.

"When all the ice vanishes — possibly within a decade or two — the extra heat absorbed by the open seas will cause additional warming equivalent to emitting a trillion tons of carbon dioxide on top of the 2.4 trillion that we've put into the atmosphere since the industrial revolution." [220]

Like other expert sources, another *Economist* editorial, from March 31, on methane cuts strongly advocated that governments require reductions in emissions through improved gas infrastructure and severe limitations on fugitive emissions, and emphasizing that the U.S. leadership already underway is crucial to forcing global reductions:

"A big step would be to stop millions of tons of methane from leaking out of fossil-fuel infrastructure each year, through pipes with holes, leaky valves and carelessness. Natural-gas operators will be able to sell more gas in exchange for a moderate investment in monitoring and repairing leaks. The International Energy Agency, a global forecaster, estimates that 40% of methane emissions from fossil fuels, equivalent to 9% of all human methane emissions, can be eliminated at no net cost for firms. The harder task is to reduce emissions from agriculture, but even here farmers can draw on new ideas, including developing new forms of feed for livestock, and altering how rice is irrigated.

"Politicians and the public tend to worry about carbon-dioxide emissions and neglect the effects of cutting methane. But dealing with the gas would have a large effect rapidly and at relatively low cost. Governments are busy firming up their commitments to cut emissions under the Paris agreement, as they prepare for the cop26 climate summit in November. On April 22nd President Joe Biden will convene his own summit. America is expected to make its targets public around that time, which will almost certainly include a pledge to reduce emissions to net zero by the mid-2000s. It should go further and include a specific target for methane. Then other nations should follow its lead." [221]

Other leading climate experts agree that reducing methane emissions is among the best ways to limit near-term temperature increases, as reported by the BBC: "Drew Shindell … a professor of Earth science at Duke University, agrees CO2 is the number one target in the fight against climate change, but says cutting methane will have a more rapid impact. "So many aspects of climate change are happening faster than expected", he said. "We see more fires, more of the strongest hurricanes, more heatwaves, and methane is the best lever we have to reduce the growth in those over the next 30 years."

Scientists regard a temperature rise of 1.5C above pre-industrial levels as a gateway to "dangerous" warming of the planet. The Paris agreement, signed by nearly 200 countries, aims to keep the increase to within the 1.5C target. The new report says measures available now could reduce [methane] emissions from human activities by as much as 180 million tons a year by 2030 — 45% of the total per year. The main sources of human-related methane are the fossil fuel industry, which accounts for 34% of total emissions, agriculture which contributes another 40% and the waste sector 20%." [222]

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