Written testimony
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Prospects for global energy markets, including the role of the United States

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Chairman Murkowski, Ranking Member Manchin and distinguished Members of the Committee, thank you for the opportunity to appear before you today and to present the International Energy Agency's view on global energy trends.

It has been my privilege to serve as the Executive Director of the International Energy Agency (IEA) for over four years. And I am very pleased to share with you our latest views on the prospects for global energy markets, and in particular on the role of the United States.

A brief overview of the IEA

First, I would like to give you a short introduction to the IEA. Since the founding of the IEA almost 45 years ago, the United States has been a crucial pillar for the Agency. US leadership and support has come from across government, including the White House, the Department of State, the Department of Energy and your National Labs. I would like to particularly express my great appreciation for the strong partnership with Secretary Brouillette as well as his predecessor, Secretary Perry. But US engagement with the IEA is by no means limited to the Executive Branch; we are also very much honored by the support from this Committee and from the Congress more broadly. I have been privileged to appear before this Committee each of the past four years and have benefitted from Committee Members' insights, interactions and guidance. Let me thank Chairman Murkowski and Ranking Member Manchin, in particular.

The IEA was founded by United States and 16 other countries in the wake of the 1974 oil crisis to promote energy security, co-operation and stable markets. Since that time, our Agency has evolved, expanding to become the world's leading authority on global energy issues, providing data, analysis and advice to governments and industry on all fuels and all technologies.

Today, the IEA has 30 Member countries. Since the start of 2016, we have welcomed eight IEA Association countries: Brazil, China, India, Indonesia, Morocco, Singapore, South Africa and Thailand. This broader IEA family reflects the global nature of the energy system, accounting for almost 75% of the world's energy consumption compared with less than 40% in 2015.

The coronavirus and global energy markets

Before I begin describing the major trends that are shaping the global energy landscape, I would first like to briefly address the current turmoil resulting from the impact of the novel coronavirus (Covid-19). As we all know, Covid-19 is a major global public health emergency that has brought tragedy to many communities around the world. Its impact is fast evolving and still playing out across the globe.

Any specific short-term forecasts I give you today could be out of date by tomorrow. But it is already clear that Covid-19 is negatively affecting global economic activity. Its impact on oil markets is disproportionately strong because it is stopping huge amounts of people and goods from moving around by car, truck, bus, plane and many other forms of transportation. The IEA is monitoring the situation extremely closely and will provide updates to our member governments as often as needed.

Key global trends

While keeping the unfolding impact of Covid-19 in the back of our minds, I would like to start my main presentation by giving you a broad outline of what the global energy system looks like in 2020. It is an energy world marked by a series of deep disparities. There is the gap between the promise of energy for all and the fact that almost one billion people still do not have access to electricity, mostly in Africa. The gap between the latest scientific evidence highlighting the need for ever-more-rapid cuts in global greenhouse gas emissions and the data showing us that energy-related emissions remain at historic highs. And the gap between expectations of fast, renewables-driven energy transitions and the reality of today's energy systems in which reliance on fossil fuels remains stubbornly high.

As ever, governments' decisions remain critical for the future of energy systems. This is evident in the divergences between the scenarios produced by the IEA that map out different routes the world could follow in the coming decades, depending on the policies, investments, technologies and other choices that decision makers pursue. The scenarios do not provide a forecast of what will happen. Instead, they explore different possible futures to help inform policy and investment decisions today.

The United States remains a cornerstone of global energy security

A fast-moving energy sector highlights the importance of a broad and dynamic approach to energy security. The attacks in Saudi Arabia in September 2019 underlined that traditional energy security risks, centered on **the global supply of oil**, have not gone away. Meanwhile, new or evolving hazards – from cybersecurity to extreme weather – require constant vigilance from governments.

In the IEA's Stated Policies Scenario, which reflects the impact of existing policy frameworks and today's announced policy intentions, shale output from the United States stays higher for longer than previously projected, reshaping global markets, trade flows and security. Annual US oil and gas production growth slows from the breakneck pace seen in recent years, but updated official estimates of underlying resources mean that the United States still accounts for 85% of the increase in global oil production to 2030 and for 30% of the increase in gas. This strengthens its position as the world's largest producer of both fuels. By 2025, total US shale output (oil and gas) overtakes total oil and gas production from Russia.

It is not just the growing volumes of US shale oil that make it a unique contribution to global markets. After a decades-long oil industry shift towards larger projects with longer lead times, US shale offered new supply from projects with short lead times that could be quickly scaled up or down, providing much needed flexibility. Without the response from the US shale industry, the recent supply reductions from Libya, Venezuela and Iran would have delivered painful shocks to the world economy.

Higher US output pushes down the share of OPEC countries and Russia in total oil production. In the Stated Policies Scenario, this share drops to 47% in 2030, from 55% in the mid-2000s, implying that efforts to manage conditions in the oil market could face strong headwinds. Pressures on the

hydrocarbon revenues of some of the world's major producers also underline the importance of their efforts to diversify their economies.

Whatever pathway the global energy system follows, the world is still projected to rely heavily on oil exports from the Middle East for years to come. The region remains by far the largest net exporter of oil to world markets, as well as an important exporter of LNG. This means that one of the world's busiest trade routes, the Strait of Hormuz, retains its position as a crucial artery for the global energy trade, especially for Asian countries such as China, India, Japan and Korea that rely heavily on imported fuel. In the Stated Policies Scenario, 80% of international oil trade ends up in Asia in 2040, propelled in large part by a doubling of India's import needs.

These trends underscore why IEA member countries maintain strategic oil stocks that can be collectively pledged to markets when a disruption occurs. The United States, together with Japan, Korea and Europe are the central pillars of this system. US strategic stocks have proved themselves useful not only during cases of global oil disruptions but also during domestic disruptions, such as during severe impacts from hurricanes, most recently in 2017.

The importance of oil supply security persists even under the strong decarbonization policies included in the IEA's Sustainable Development Scenario – a pathway that indicates what needs to be done differently to fully achieve climate and other sustainable energy goals. Investment in upstream projects is still needed even in rapid transitions, since production from existing fields declines at a rate of roughly 8% per year in the absence of any investment, larger than any plausible fall in global demand. Projects that are low-cost and that have tight control of emissions would naturally be favored in such a scenario. However, the risks of geopolitical disruption may also be heightened in a world where major producers have to cope with significant reductions in hydrocarbon revenues.

Our recent in-depth review of US energy policies, which I presented alongside Secretary Perry here in Washington last September, noted the continued priority the United States places on energy security. The United States remains a cornerstone of global energy security and will play a critical role in any future IEA oil collective responses. In that context, as the shale revolution turns the United States into a net oil exporter, continued careful consideration is required when examining proposals to modernize and sell down the US Strategic Petroleum Reserve.

The US shale revolution has also significantly contributed to global **natural gas security**. Soaring shale gas production in the United States has transformed the global LNG market by diversifying supply and increasing flexibility. This has helped accelerate fuel switching from coal to gas in electricity generation worldwide, which in turn has reduced global carbon dioxide emissions. In Europe in particular, growing imports of LNG from the United States have driven down gas prices, helping European countries cut the amount they pay for gas from Russia by USD 8 billion a year, according to IEA analysis.

The growing importance of electricity security in the United States and beyond

Cost reductions in renewables and advances in digital technologies are opening huge opportunities for energy transitions while creating new energy security challenges. Wind and solar PV provide more than half of the additional **electricity generation** worldwide to 2040 in the Stated Policies Scenario and almost all the growth in the Sustainable Development Scenario. Policy makers and regulators will have to move fast to keep up with the pace of technological change and the rising need for flexible

operation of power systems. Issues such as the market design for storage, the interface between electric vehicles and the grid, and data privacy all have the potential to expose consumers to new risks.

The US power sector is experiencing a significant transition. Renewable electricity has seen rapid growth, driven by reduced costs and policy support. State-level Renewable Portfolio Standards and federal tax credits have helped lower the costs of wind and solar generation and increase the share of renewables in the electricity mix. Today, 15 US states already have a higher share of wind and solar generation than the European average.

As the share of variable renewables such as wind and solar PV increases, the work of smoothly and cost-effectively integrating them into the power system becomes increasingly critical. The United States has shown itself to be a global leader in innovative regulatory approaches for digitalized and flexible electricity market design. Grid operators are incorporating more flexibility resources such as storage, demand response and power market integration in order to safely accommodate larger shares of variable renewables. Further integration of these sources can be fostered by pursuing market regulations that leverage the geographic diversity of resources by expanding transmission capacity. Nevertheless, flexible power generation from gas turbines are set to remain essential for electricity security for decades to come.

The shale gas boom has made natural gas-fired generators more cost-competitive than coal power plants. Natural gas-fired electricity production increased by over 60% in 10 years, and now exceeds coal's share in the power mix. In this context, coordination between the electricity and the natural gas systems takes on special importance when dealing with gas supply disruptions and electricity blackouts as well. A key challenge is to resolve infrastructure bottlenecks that limit the ability of increased shale gas supply to offset the loss of power system flexibility resulting from the retirement of coal-fired and nuclear power plants. These bottlenecks are a particular concern for the Northeastern United States.

At the same time that renewable power is expanding in the United States, the other key source of low-carbon electricity, nuclear power, is facing growing economic pressure, prompting several plants to prematurely shut down. The IEA explored the consequences of this trend for energy transitions and energy security in a major report last May, *Nuclear Power in a Clean Energy System*. Looking ahead, the value of nuclear power as a stable, low-carbon generation source for overall power system resilience should be considered more closely.

It is also vitally important for the United States and other countries around the world to preserve and improve the functioning of their hydropower plants, which remain the world's largest source of renewable electricity generation. Hydropower will play a critical role in providing flexibility to wind and solar PV. The United States is at the forefront of using modern digital tools to exploit hydropower's flexibility potential. I am happy to announce that the next IEA Renewables Market Report, due in October, will have a special focus on hydropower. And I wish to thank the Department of Energy and National Labs for their excellent collaboration with us in this area.

The recent IEA review of US energy policies highlighted the country's continued focus on the protection of its energy infrastructure. It applauded steps taken by the government to update its security frameworks, including by introducing processes to address new trends such as cyber threats. It remains important to conduct regular and comprehensive assessments of risks and vulnerabilities

to foster preparedness and maintain reliability and resilience in the face of new challenges, such as extreme weather events.

I am pleased to say that the IEA will be publishing a major study on electricity security later this year that will help policy makers better manage the integration of variable renewables, guard against new cybersecurity threats and develop resilience to extreme weather events.

The United States is leading the world in reducing emissions

The focus of my presentation today has been on energy security – and one vital aspect of achieving a secure and sustainable energy future is the need to reduce global **greenhouse gas emissions** to mitigate climate change. Doing so is essential to ensure the security of communities, businesses and the energy infrastructure that underpins human economic activity and well-being.

The United States is a world leader in reducing emissions. Last month, the IEA released new data showing that global energy-related carbon dioxide emissions stopped growing in 2019 even as the world economy expanded by 2.9%. This welcome development was primarily due to declining emissions from electricity generation in advanced economies, thanks to the expanding role of renewable sources, fuel switching from coal to natural gas, and higher nuclear power generation.

The United States recorded the largest emissions decline on a country basis, with a fall of 140 million tonnes, or 2.9%. US emissions are now down by almost 1 gigatonne from their peak in 2000 – more than any other country over that period. The powerful combination of technology and supportive policies can continue to strengthen this trend of emissions increasingly decoupling from economic growth, but issues such as the early retirements of nuclear power plants risk undermining progress in other areas. And although the US emissions reductions over the past two decades are impressive and commendable, the country remains the world's second largest emitter after China.

One area of particular concern for global efforts to reduce emissions is the faltering momentum behind **energy efficiency** improvements. This lack of momentum comes against a backdrop of rising needs for heating, cooling, lighting, mobility and other energy services. Improvements in the energy intensity of the global economy (the amount of energy used per unit of economic activity) are slowing: the 1.2% improvement in 2018 was the weakest since 2010 and far below the 3% level that IEA analysis shows is achievable with technologies that are already available today. This worrying slowdown reflects a relative lack of new energy efficiency policies and a lack of efforts to tighten existing measures. Reversing this trend can bring huge economic, social and environmental benefits. Innovative approaches include the use of digital tools to make efficiency easier and more attractive, and to shift electricity demand to cheaper and less emissions-intensive hours of the day.

I am aware of the high priority this Committee gives to energy efficiency, and I commend its deliberations on the subject, including the many strong proposals put forward as legislation. The IEA is devoting considerable efforts to advancing energy efficiency globally. The potential for efficiency improvements to help the world meet its sustainable energy goals is vast, so we have brought together thought leaders from around the globe through the Global Commission for Urgent Action on Energy Efficiency. This is a very important process for identifying the key actions governments can take to make better progress on energy efficiency – and I would like to thank Chairman Murkowski for her invaluable leadership in the Commission's work.

The United States is a pioneer in new energy technologies

Ten years ago, the idea that the United States could become a net exporter of both oil and gas was almost unthinkable. Yet the shale revolution – and over $1 trillion in upstream and midstream investment – is making this a reality. The foundations date back to a publicly funded **research and development** effort that began in the 1970s. This was followed by tax credits, market reforms and partnerships that provided a platform for private initiative, innovation, investment and rapid reductions in cost.

Today, solar PV, wind and some other renewable technologies – mostly in the power sector – are becoming mainstream worldwide. This is also the result of turning initial policy and financial support into large-scale deployment. The United States – the world's largest government investor in energy innovation by a good distance – has played an important role. The progress that has brought down the costs of renewables has been aided by the groundbreaking work of US National Labs.

As I mentioned earlier, the next frontier for expanding renewables like wind and solar PV is to ensure they are reliably and cost-effectively integrated into power systems alongside sufficient flexibility resources such as hydropower, natural gas, demand-side response and storage. In this context, I would like to commend Secretary Brouillette's announcement in January of the Energy Storage Grand Challenge, a comprehensive program that aims to accelerate the development, commercialization and utilization of next-generation energy storage technologies.

The United States has also driven innovation in technologies that can help mitigate climate change by capturing carbon emissions and then storing or using them. Almost 70% of all carbon dioxide captured from carbon capture, utilisation and storage (CCUS) facilities globally happens here in the United States, which has the most attractive investment environment for **carbon capture** of any country in the world. This is largely due to the expanded 45Q tax credits and other complementary policies, such as the Californian Low Carbon Fuel Standard, which are providing a strong incentive for carbon capture investment. A significant number of project announcements have come in the past year, including plans to develop large-scale storage facilities, to expand carbon capture across industrial applications and to scale up new technologies such as direct air capture

We anticipate more investment activity in 2020 following the release of initial IRS guidance last month and with further guidance expected soon. This will cement the leadership of the United States for this critical technology. Research efforts supported by the Department of Energy and US National Labs will also continue to bear fruit in carbon capture – as well as other key areas for energy transitions such as advanced nuclear technologies and system integration of renewables.

Transforming energy systems across the globe will require progress across a much wider range of technologies, including efficiency, CCUS, hydrogen and nuclear among others. It will require action across all sectors, not just electricity. It will also require assembling a broad range of skills, resources and stakeholders. For example, scaling up technologies such as CCUS and hydrogen and bringing down their costs will rely on large-scale engineering and project management capabilities – qualities that are a good match to those of today's oil and gas companies.

The IEA looks forward to working with the United States and all other IEA member countries to help ensure that the transformation of energy systems results in benefits rather than burdens for their

citizens and economies. It also committed to assisting them in spreading energy services, with all the advantages they bring for human well-being, to communities around the world that still live without access to energy, most notably in Africa.

With its boundless human ingenuity, rich resources and track record of successful innovation and commercialization of new technologies, the United States is extremely well placed to continue to lead the world in the development and deployment of energy technologies that can help ensure a secure, affordable and sustainable supply of energy for decades to come.

Chairman Murkowski, Ranking Member Manchin and distinguished Members of the Committee, thank you again for the opportunity to appear before you today. And thank you above all for your continued strong partnership and support for the International Energy Agency.