# Chapter 12

## Low-carbon Green Recovery from the Pandemic in the United States

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## 1. Setting the Scene: From Pandemic Crisis to Systems Change

### 1.1. Pandemic situation

The United States (US) declared COVID-19 to be a public health emergency on 31 January 2020 (HHS Press Office, 2020). As of 31 December 2021, the country has had nearly 55 million cases, over 450,000 of which were recorded within the preceding 7 days (US CDC, 2022). Roughly 823,000 people have died, with some models estimating that domestic fatalities will surpass 900,000 in early 2022 (US CDC, 2022; Institute for Health Metrics and Evaluation, 2022).

To date, containment measures have varied by state and even by county. In March and April 2020, many places in the country implemented 'stay-at-home' orders, heavily restricting both business and travel activity. However, these orders have subsequently been rolled back and many (but not all) state- and local-level governments have instead turned to more targeted interventions. Such interventions include limiting the size of public gatherings, restricting the operations of certain entities (e.g. restaurants, gyms, and schools), and requiring the use of masks in various situations; the restrictiveness of these interventions is then fine-tuned based on factors such as local outbreak and hospitalisation trends. Although the US Centers for Disease Control and Prevention (US CDC) has offered guidance on how to operationalise these and other related interventions, no nationwide order has been mandated.

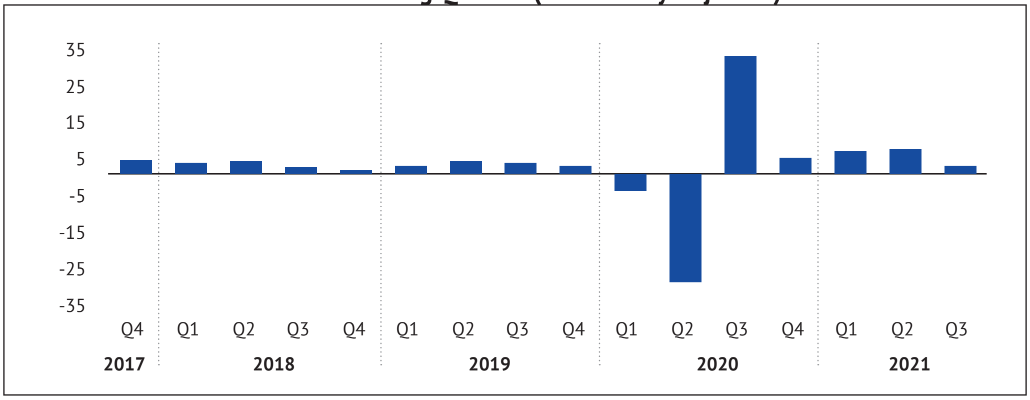
Breakthroughs in the viability and availability of several vaccines have also provided communities with additional tools for combatting the virus' spread. However, vaccination rates continue to vary widely across the country, as does adherence to certain practices, such as social distancing and the use of masks. When coupled with continued (and in some cases, growing) strains on healthcare infrastructure, this suggests that for the US, the pandemic remains a crisis that is both ongoing and likely to result in additional longer-term societal impacts. An essential first-order task for the US thus remains getting the outbreak under control; anything short of this will further exacerbate human suffering and undermine efforts to promote economic recovery.

### 1.2. Economic situation

COVID-19 has had a profound impact on the US economy. As shown in Figure 12.1, US gross domestic product (GDP) fell at an annualised rate of 31.4% between April and July 2020, in what some analysts have characterised as the 'biggest blow [to the economy] since the Great Depression' (US BEA, 2020a; Mutikani, 2020). Broken down by industry, GDP from private goods-producing industries fell 34.4%, led by decreases in durable goods manufacturing. Contributions from private services-producing industries also fell, by 33.1%, with steep declines in several areas (including accommodation and food services; transportation and warehousing; and entertainment), which were offset somewhat by increases in finance and insurance (US BEA, 2020a).

However, as early as mid-2020, signs of at least a partial economic recovery were already apparent.

**Figure 12.1** **Real Gross Domestic Product: Percentage Change from Proceeding Quarter (Seasonably Adjusted)**




Source: US BEA (2020a).

With the easing of stay-at-home orders, some business activities that had been postponed or restricted began to resume (US BEA, 2020b); the initial COVID-19 stimulus also began to reach impacted businesses and individuals during this period.[1] Subsequently, the US saw a sizeable rebound in its GDP growth in Q3 and higher-than-typical growth rates in each of the next 3 quarters. A return to a pre-pandemic level of real GDP is now anticipated to have occurred in mid-2021 (Wolfram, 2021).

Even so, the US' economic recovery has been uneven and is arguably still incomplete; key evidence here is the state of employment. Roughly 6.5 million people were recorded as unemployed in December 2021 – significantly less than peak unemployment in April 2020 yet still above the levels recorded in February 2020 (US BLS, 2021). As highlighted in Figure 12.2, employment in fields such as leisure and hospitality, government, and even education and health services all remain well-below February 2020 levels – to the extent that despite seeing job growth in some areas (e.g. transportation and warehousing), US nonfarm employment is still down 2.87 million jobs overall since the onset of the pandemic (US BLS, 2022).[2] Meanwhile, although teleworking continues to enable new patterns in and opportunities for work, several studies have cautioned that this trend alone is unlikely to support a full rebound in employment. Amongst other reasons, this is due to modelling suggesting that only one-third of the kinds of jobs typically available within the US can be done remotely (Dingel and Nieman, 2020; Guyot and Sawhill, 2020).

Looking to the energy sector, in particular, disruptions in travel, supply chains, and regular business

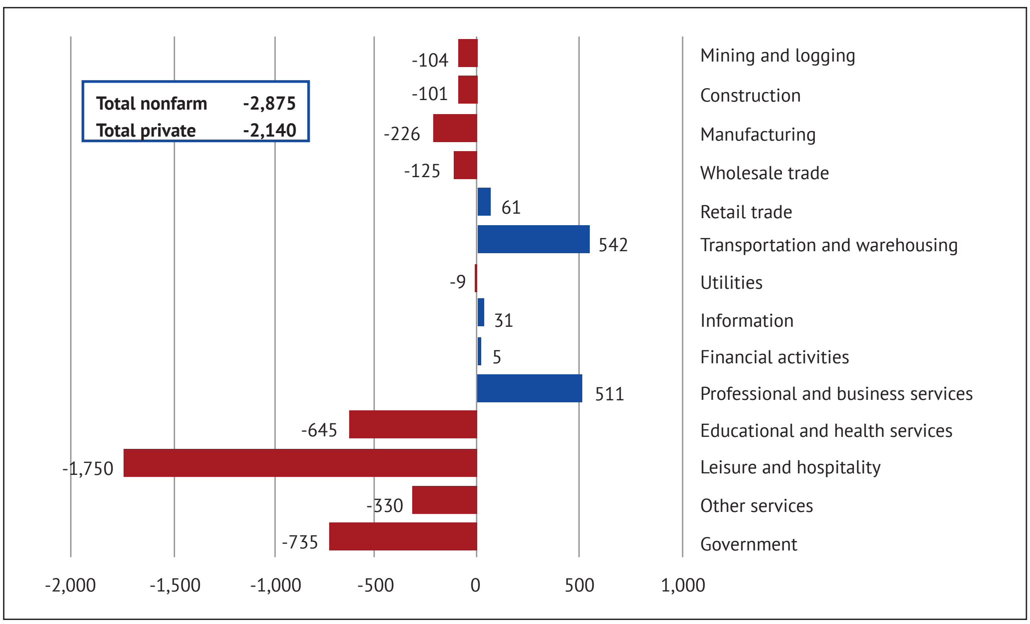
[1] More on US COVID-19 relief is explored in Section 3 of this chapter.

[2] Some of this shortfall likely reflects challenges in filling otherwise available positions (e.g. nursing and elder care have seen an increase in people quitting their jobs to then exit these sub-fields). Even so, given that unemployment overall remains elevated, this suggests a potential mismatch in the labour market that will need to be addressed.

patterns have had a pronounced impact on its employment situation. Prior to the pandemic, this sector was one of the US' fastest growing job markets. Yet, the US Department of Energy (US DOE) estimates that the sector shed roughly 1.4 million jobs in the first half of 2020; even with a notable recovery in the second half of the year, sector employment remained 840,000 jobs below its pre-pandemic peak as of year-end 2020. Of these losses, energy efficiency jobs made up the largest volume (271,700 jobs), followed by those tied to motor vehicles (231,200 jobs) and fuels (211,200 jobs). A similar study for 2021 has yet to be finalised but is expected to show that a full recovery in sector employment remains elusive (US DOE, 2021).

These energy sector trends have important implications for the shape of the US' wider economic recovery. More precisely, studies have argued that 'building back better' from the crisis continues to require policy attention on both improving the resiliency of currently struggling firms and promoting expansion into areas that show strong potential for growth (Baily, 2020). How these considerations apply when thinking about US energy outlooks is thus explored in the next section.

**Figure 12.2 Changes in US Nonfarm Employment Between February 2020 and January 2022 (Seasonally Adjusted, in Thousands)**




Source: US BLS (2022).

## 2. Low-carbon Green Growth During the Pandemic

### 2.1 Energy consumption and CO2 outlooks

Going into 2020, the US Energy Information Administration (US EIA) had projected that US carbon dioxide (CO2) emissions would decline slightly over the course of the year, even as the country's overall energy consumption increased (US EIA, 2020a).[3] Yet as might be expected, since the onset of the pandemic, US energy demand patterns have undergone a series of dramatic changes; some of which may ultimately prove to be purely near-term phenomena.

Amongst these shifts, the US EIA notes that energy consumption in the transportation sector fell by 15% in 2020 as travel restrictions and avoidance severely curtailed demand. Dampened business activities and the shift towards remote work also drove decreased energy consumption in the commercial and industrial sectors, by 7% and 5%, respectively. Meanwhile, whilst stay-at-home orders led to more people spending more time at home, a relatively warm year encouraged less use of home heating. Residential consumption thus also fell, though by a relatively modest 1% (US EIA, 2021f).

The collective impact of these shifts was that between 2019 and 2020, total US energy consumption fell from 100 to 93 quadrillion British thermal units ('quads'), the largest recorded decrease in the US EIA's 60-year history (US EIA, 2021f). As part of this, consumption of all fossil fuels declined, with especially steep year-on-year declines in petroleum (-13%) and coal (-19%) (US EIA, 2020f).[4] Notably, analysis by the US EIA has suggested that for coal, this level of decline was due to not only a decrease in overall US electricity consumption but also an increase in the rate of switching within the power sector (US EIA, 2021d). Indeed, a key departure from otherwise downward consumption trends in 2020 can be seen in US demand for cleaner power, with both wind and solar consumption ultimately seeing a net increase during this period (US EIA, n.d.).

Correspondingly, US CO2 emissions decreased in 2020 by 570 million metric tonnes (a roughly 11% year-on-year decrease) (US EIA, 2021h). However, this level of emission reduction is anticipated to be short-lived. To this point, the US EIA estimates that US CO2 emissions rose by roughly 300 million metric tonnes (or 7%) in 2021 as economic activity continued to recover (US EIA, 2021c). This is not to say that COVID-19 has had no longer-term impact on US energy consumption patterns – indeed, decarbonisation of the power sector appears to have sped up as gains by wind and solar continue to prove resilient. Rather, this level of emissions rebound highlights that in the near term, some sectors (e.g. transportation and industry) have more limited means by which they can pursue

[3] A key assumption here was the role of continued fuel switching in the power sector, based on increasingly favourable economics for wind and solar, as well as the sustained competitiveness of natural gas.

[4] U.S. BEA. Gross Domestic Product, Third Quarter 2020 (Advance Estimate). U.S. Bureau of Economic Analysis (BEA). October 29, 2020. https://www.bea.gov/data/gdp/gross-domestic-product (accessed on November 1, 2020).

radical decarbonisation amidst rising energy demand.

Longer-term, US EIA modelling suggests that under a business-as-usual scenario, US emissions will decline through 2035 but then climb again through 2050. Key to this picture is that as trade and economic activity continue to increase, so will demand for transportation-related uses of energy. Although both efficiency improvements and the greater adoption of electric vehicles are anticipated to play a role in dampening energy demand and $CO_2$ emission growth, current trends here are assumed to be insufficient to peak oil demand before 2050 (US EIA, 2021a).

## 2.2. Production trends

US energy production was at an all-time high prior to the onset of the pandemic, reaching 101.4 quads in 2019 (US EIA, 2020d). Oil and natural gas accounted for roughly two-thirds of this total, representing a high degree of overall exposure to the industry in US production patterns. Even so, it is worth noting that production linked to renewable energy also recorded new highs in 2019 (US EIA, 2020a).

Both domestic and international markets are important destinations for US energy supplies. Thus, when global energy demand underwent an unprecedented drop in Q2 2020, many producers felt this shock both immediately and painfully. A particularly steep decline in transportation-linked demand, for example, led to escalating price-driven shut-ins of US oil production over the course of the year, with crude oil production falling 'from a peak of nearly 13 million barrels per day (b/d) in November 2019 to [an] average [of] 11.3 million b/d in 2020 and 11 million b/d in the first 10 months of 2021' (Cahill, 2021). Natural gas production likewise declined in response to market shifts and remains below 2019 levels. Coal production – already expected to decline during this period – also dropped off more than previously anticipated (US EIA, 2021b; US EIA, 2021a).

In contrast with the above, US renewable energy production has continued to hit new highs during the pandemic. Wind and solar have been the primary drivers of this increase, as domestic demand for both sources remained resilient and important new capacity installations came online in 2020 (including 15 GW of new capacity in offshore wind) (US EIA 2021a; IEA, 2021b). In turn, these positive gains meant that some areas of the clean energy sector even added new jobs in 2020, further bolstering outlooks for increasing clean energy production (US DOE, 2021).

Looking ahead, the US EIA anticipates that the current pace of recovery in US and global energy demand will enable US oil and natural gas production to return to their respective 2019 levels by 2023. After this point, production of both fuels is then expected to continue to hit record highs through mid-century. Key to this picture are expectations about robust demand growth in some foreign markets – particularly in parts of Asia – boosting oil and natural gas prices and making a case for increasing US exports (US EIA, 2021a).

Even so, it should be noted that US oil and natural gas players have had to adapt to weather the interim market shock, with 2020 seeing a rash of industry restructuring as a means of reducing operational costs (Cahill, 2021). This suggests that even as oil and natural gas production levels continue to recover, lost jobs in this sub-sector are unlikely to return at a matching pace.

Returning energy demand is also anticipated to support the case for increasing energy production from renewable sources. However, several caveats apply here as well when thinking about US industry futures. Amongst these is that 2020 was an important cut-off for several renewable energy tax credits – and, as such, some developers raced to complete relevant projects during this window (with the pace of new project completions expected to then slow in subsequent years). This suggests that the kinds of growth observed in US renewable energy production during this period may not be fully replicable absent new financial incentives or improvements in market conditions.

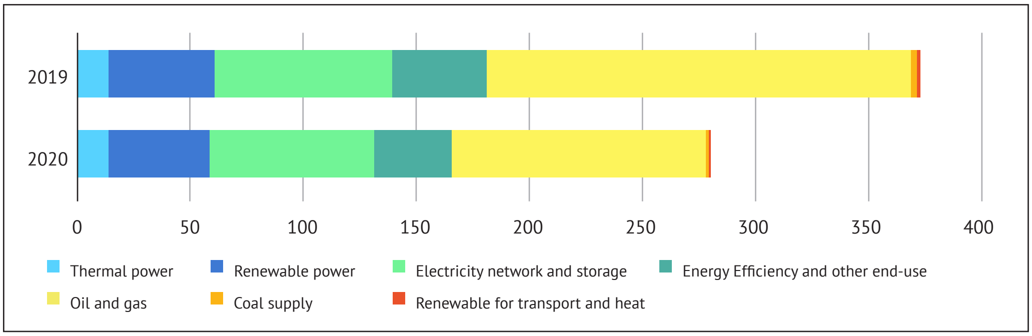
### 2.3. Investment trends

The International Energy Agency (IEA) estimates that US energy investment declined by 25% in 2020, primarily driven by the US' exposure to the oil and natural gas sector (IEA, 2020a). Investments by US shale companies, for example, underwent a particularly pronounced decline – 45% – driven by supply shut-ins as well as a 50% increase in shale financing costs; two factors which, even with restructuring efforts, still led to a surge of bankruptcies in the industry (IEA, 2020b). Meanwhile, clean energy investment also fell across the board. Energy efficiency investments, for example, declined from US$42 billion in 2019 to US$34 billion 2020, whilst investment in renewable power declined from US$46 billion in 2019 to US$44 billion in 2020 (IEA, 2020c). (See Figure 12.3 for more on US energy investment by sector.)

As of 31 December 2021, US energy investment has yet to return to pre-pandemic levels. However, investment has continued to rebound over the course of the past year as global energy demand outlooks improve and some paused US projects have been able to restart (IEA, 2021b). Encouragingly, some of the fastest recovery appears to be tied to renewable energy investment: solar PV investment, for example, is anticipated to have grown by over 10% in 2021 (IEA, 2021b). Meanwhile, in May 2021 the federal government also greenlit the construction and operation of the 800 MW Vineyard Wind project – the country's first such large-scale offshore wind project – sending a positive signal to investors about the future of offshore wind in the US (IEA, 2021b).

Even so, two concerns stand out when thinking longer term. First, both the US and the wider Asia-Pacific continue to struggle with underinvestment in basic energy infrastructure. If not addressed, this could limit the technical viability of greater utilisation of wind and solar energy – and have knock-on effects for how well US projects focused on new capacity installations at home and abroad are able to sustain their investment momentum. Second, the slower rebound in US oil and natural gas investment does not necessarily mean that US energy investment patterns are becoming

**Figure 12.3** US Energy Investment by Sector (US$ billion)




Source: IEA (2020c).

'greener'. Tight operating margins here might ultimately mean, for example, reduced industry spending on researching and deploying clean consumption tools – narrowing the otherwise expected pathways for reaching net-zero emissions by mid-century and raising challenging questions about what recovery really means.

## 3. Composition of Recovery and Stimulus Packages

### 3.1 Overview

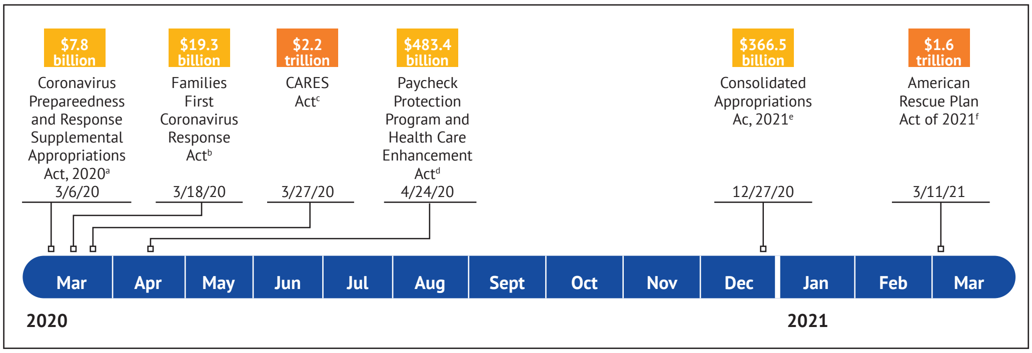
Figure 12.4 shows a timeline of US COVID-19 relief legislation to date. As of 31 August 2021, the US Government Accountability Office estimates that the US Congress had appropriated roughly US$4.8 trillion to COVID-19 relief, of which US$3.9 trillion had been obligated (US GAO, 2021b). Roughly 39% of these obligated funds are tied to unemployment insurance and individual cash payments, whilst business loan programmes operated by the Small Business Administration account for an additional 21%. (See Table 12.2 for a further breakdown of spending.) Although the US Congress is continuing to debate the merits of passing additional recovery legislation – including a proposed Build Back Better Act – the likelihood and specific composition of any next-round stimulus is unclear as of 31 December 2021.

Additional federal action to stimulate economic activity or provide relief has taken several forms. Select actions have included pausing student loan repayments, lowering federal interest rates (to 'support the easier flow of credit'), and approving targeted and blanket regulatory rollbacks (to 'boost the competitiveness of US industry') (IMF, 2020). Numerous state and local governments have also established their own supplemental initiatives, including establishing emergency grants and utility bill forgiveness programmes.

### 3.2. Energy sector-related COVID-19 relief

Initial rounds of US COVID-19 relief largely touched on energy sector concerns in only a broad sense, via making business loans, tax credits, and other relief available to struggling US firms generally.

**Figure 12.4 Timeline of Federal COVID-19 Relief**




Source: IEA (2020c).

To that end, several independent assessments have suggested that this approach enabled US oil, natural gas, and coal players to apply for substantial relief at an early date, with just 77 such firms receiving the equivalent of US$8.2 billion in benefits from tax code changes in the CARES Act alone (Butler, Mufson, and MacMillan, 2020; DeConcini Neuberger, 2020; Bailout Watch, 2021). Changes to US federal environmental protection rules (including on methane emissions) also reduced formal regulatory requirements on some domestic producers, although it is unclear whether firms have made noteworthy operational changes on this basis to date.

Clean energy players arguably benefited less from the federal government's initial approach to relief. For example, several notable tax code changes were designed to provide relief to US businesses via allowing them to request refunds on taxes paid in prior years. Such changes enabled sizeable tax credits for some deeply indebted oil and natural gas firms (who had otherwise recorded high profits in recent years) but had more limited relevance to renewable energy and energy efficiency firms (whose revenues saw less-extreme swings) (DeConcini and Neuberger, 2020; Kusnetz, 2021). Meanwhile, in May 2020, the Trump administration announced that it was ending a 2-year rent holiday for wind and solar companies operating on public lands, handing these firms massive retroactive bills (Groom, 2020). As scholars at the World Resources Institute have aptly observed, this occurred during roughly the same period that the federal government approved a dramatic reduction in the royalties required to produce oil and natural gas on public lands, suggesting a lack of parity in early sectoral relief (DeConcini and Neuberger, 2020).

Subsequent federal government efforts have expanded relief available to clean energy projects and firms. The Consolidated Appropriations Act, 2021, for example, provides a 2-year extension of the Solar Investment Tax Credit as well as 'more supportive terms for renewable energy projects to access federal lands' (Runyon, 2021). It also includes targeted stimulus for projects linked to renewable energy – including solar (US$1.5 billion) and wind (US$625 million) – as well as

**Table 12.1 Federal COVID-19 Relief Appropriations, Obligations, and Expenditures as of 31 August 2021**

| Major spending area[a] | Total appropriations[b] ($ in billions) | Total obligations[c] ($ in billions) | Total expenditures[c] ($ in billions) |
|---|---|---|---|
| Unemployment Insurance (Department of Labor) | 858.6 | 660.3 | 650.2 |
| Economic Impact Payments (Department of the Treasury) | 855.3 | 841.6 | 841.6 |
| Business Loan Programs (Small Business Administration) | 838.0 | 829.6 | 827.6[d] |
| Public Health and Social Services Emergeny Fund (Departmenr of Health and Human Services) | 350.1 | 240.0 | 172.1 |
| Coronavirus State and Local Fiscal Recovery Funds (Department of the Treasury) | 350.0 | 239.8 | 239.8 |
| Education Stabilization Funds (Department of Education) | 278.6 | 257.0 | 51.7 |
| Coronavirus Relief Fund (Department of the Treasury) | 150.0 | 149.9 | 149.9 |
| Disaster Relief Fund (Department of Homeland Security)[e] | 97.0 | 63.8 | 9.9 |
| Suplemental Nutrition Assistance Programs (Department of the Agriculture) | 91.7 | 66.1 | 64.6 |
| Other areas[f] | 881.6 | 532.4 | 391.9 |
| **Total[g]** | **4,750.9** | **3,880.1** | **3,399.3** |

Source: US GAO (2021a).

other technologies that enable cleaner energy consumption, such as advanced transportation (US$2.6 billion) and energy-grid projects (US$3.44 billion) (Consolidated Appropriations Act, 2021; Shieber, 2020). Even so, this act and other legislation have also continued to provide new support to fossil fuel players and have done so without requiring that recipients subsequently heighten their commitments to cleaner production.

### 3.3. Implications for a low-carbon growth trajectory, Paris commitments, and the 2030 Agenda

In its original Intended Nationally Determined Contribution (INDC) submission, the US pledged to reduce net greenhouse gas (GHG) emissions by 26%–28% from their 2005 levels by 2025. Although the Trump administration announced that it intended to formally withdraw from the Paris Climate Accord in November 2020, this decision was ultimately reversed by a then-incoming Biden administration.

Subsequently, the US has submitted a revised INDC, committing to reduce its GHG emission levels by 50%-52% from their 2005 levels by 2030, with a further goal of 100% carbon-pollution free power generation by 2035 (since updated to 2030). Meanwhile, an executive order announced in August 2021 sets an additional goal that '50% of all new passenger cars and light trucks sold in 2030 be zero-emission vehicles' (Executive Office of the President of the United States, 2021).

Several studies have found that despite this high degree of policy volatility, the US has made encouraging progress towards realising its Paris commitments. This includes substantial progress over the past decade in accelerating switching to cleaner energy sources in the power sector and in promoting energy efficiency generally (US EIA, 2021a; IEA, 2021a); progress that, as Section 2 noted, has been largely sustained (and in some areas enhanced) during the pandemic. However, modelling efforts by this author and others have nonetheless suggested that more robust action is likely necessary to fully achieve the country's 2025 and 2030 targets (Gillispie and Endo, 2021; Climate Action Tracker, 2021; IEA, 2021a). For example, realising entirely carbon-pollution free power generation in the US is expected to require notable upgrades to existing grid infrastructure and management systems, as alluded to earlier. Recent stimulus packages are expected to have reduced but not eliminated gaps in investment here (American Society of Civil Engineers, 2022).

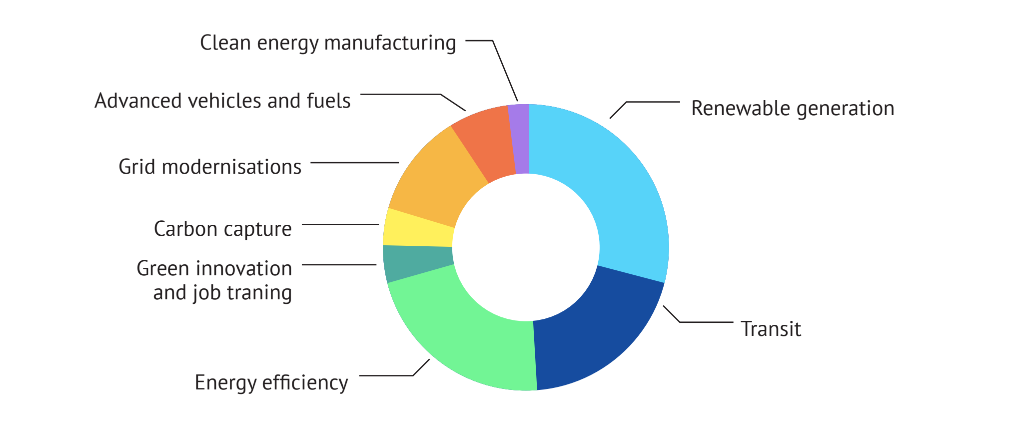
Finally, it should also be noted that some regulatory rollbacks appear to have had a decidedly mixed impact on 'boosting the competitiveness' of the US energy industry. This includes in natural gas, as at least one major export deal appears to have been scuttled based on growing concerns about US shale's level of methane emissions (White and DiSavino, 2020). At a minimum, this suggests that rollbacks are not challenging perceptions in some overseas markets that US firms might be unable or unwilling to meet high standards for environmental protection. If more economies were to adopt this view, the US could find it harder to make a case for the relative merits of its energy exports – much less encourage others to heighten their own climate action.

### 3.4. Comparisons of the 'green stimulus' to the 2008–2009 global financial crisis

In deciding how to move forward, the US might first consider looking back: reviewing the approach it took to stimulus during the 2008–2009 global financial crisis. Indeed, several assessments have found that the federal government's approach to this earlier crisis produced notable benefits. This includes creating roughly 900,000 jobs in clean energy fields and supporting the leveraging of US$150 billion beyond direct stimulus funds into the US economy (US Council of Economic Advisors, 2016; Varro, Beyer, Journeay-Kaler, and Gaffney, 2020).

The main stimulus measure of the US during this earlier crisis was the American Recovery and Reinvestment Act of 2009 (ARRA). Under this act, the equivalent of around US$90 billion in federal funding was allocated to the clean energy sector via measures such as direct spending and tax code changes (Varro, Beyer, Journeay-Kaler, and Gaffney, 2020). As Figure 12.5 highlights, the majority of these funds were directed to renewable energy and energy efficiency projects, whilst a sizeable share was also directed to advanced vehicles and transit. Resources were also designed to be spent over the course of the subsequent decade (2009–2019) to support a near-term infusion of capital into the sector as well the ramping up of longer-term projects (e.g. infrastructure and technological

**Figure 12.5 Clean Energy Budget by Sector in the American Recovery and Reinvestment Act**




Source: Varro, Beyer, Journeay-Kaler, and Gaffney (2020).

research and development) (Congressional Budget Office, 2015; Jaeger, Westphal, and Park, 2020). Related to this design aspect, the IEA has noted that the ARRA also helped to enhance the market case for investing in US energy infrastructure projects by guaranteeing a 'long-term, stable, regulated rate of return' on such investments (Varro, Beyer, Journeay-Kaler, and Gaffney, 2020).

Such an approach has several notable divergences from the US approach to the COVID-19 crisis to date. The first – and perhaps most glaring – is the ARRA's greater overall commitment to stimulus that explicitly targeted clean energy projects. In real dollar terms, the White House Council of Economic Advisors estimates that roughly one-eighth of the ARRA's total funds were ultimately directed to clean energy projects (US Council of Economic Advisors, 2016; Office of the Press Secretary, 2016). To put this in perspective: if clean energy projects had received a similar share of US COVID-19 relief spending to date, this amount would exceed US$600 billion.

Less apparent, though no less relevant, is the extent to which the ARRA's stimulus also represented a bold vision for systemic change. For example, whilst both the ARRA and US COVID-19 relief packages have directed support to ongoing national initiatives, the ARRA incorporated more ambitious objectives for supporting new public- and private-sector undertakings that might disrupt energy demand and pricing patterns.

This included projects linked to not-yet-commercially-viable technologies, perhaps most notably several for decarbonising the power sector (Jaeger, Westphal, and Park, 2020). Arguably, the gap between the technologies we need for decarbonising the power sector and the technologies that we already have is significantly smaller than it was in 2008, suggesting that reduced spending on this specific push in COVID-19 relief may simply reflect smaller expected returns-on-investment.

However, the US' COVID-19 response has also yet to incorporate a comparable push focused on a different, still carbon-intensive end-use – raising questions about potential missed opportunities to position the US as a global leader in innovation.

Indeed, when thinking about the way forward, it is worth noting that several key low-carbon technologies – including solar PV and lithium batteries – have seen both their relative capacities and prices improve markedly over the past decade. This suggests that at least some of the conditions necessary for unlocking new energy consumption and production patterns are even more favourable now than they were in 2009, as are opportunities for jumpstarting the rise of new industries (Jaeger, Westphal, and Park, 2020).

Thus, an enhanced US commitment to green growth in the current recovery might yield new – and even surprising – benefits for the US economy, including in job creation. In the context of once again rising global energy demand, such a commitment might also prove critical to helping the country sustain and grow its role as an important energy partner.

## 4. Recommendations

As the COVID-19 pandemic enters its third year, the US continues to grapple with the need for new and greater policy attention on managing the crisis on several fronts. Perhaps most pressing is the task of getting the domestic outbreak under control. Yet alongside this, decision makers must also confront growing questions about how to address the country's uneven and as-of-yet incomplete economic recovery. This includes questions about the potential merits – and risks – of approving any next-round stimulus.

Sections 2 and 3 noted several ways in which clean energy transitions benefit US recovery from the COVID-19 pandemic. To that end, additional policy support for accelerating such transitions could be a good investment, not just a new expense – if it has the right design. This section makes three recommendations as to what this should look like.

First, policy 'support' does not necessarily mean new spending; it can also mean addressing conditions that undermine the competitiveness of otherwise desired goods and services. US demand for cleaner energy sources has shown remarkable resilience during the pandemic, whilst investment in relevant new domestic capacity – especially wind and solar – appears to be picking up steam. This suggests that, to an extent, the task at hand for the US government is to not undercut already-encouraging sector growth trends. Yet as Sections 2 and 3 suggested, some regulatory changes from the 2020–2021 period risk doing exactly that by favouring 'brown' development strategies. The relatively 'low-hanging fruit' here is restoring earlier US environmental protection rules, strengthening market signals about the advantages of switching to low-carbon technologies.

To take this idea further, the Biden administration should also consider enhancing ongoing energy market and policy reform dialogues with counterparts in Asia. A more explicit focus on identifying regional best practices in accelerating low-carbon transitions, for example, could help all countries involved to adopter smarter – not just more extensive – regulations around goals such as reducing GHG emissions. In turn, this could also help with growing US-Asia clean energy trade by reducing the prospect that ill-suited or overly byzantine regulations act as barriers to green development.

Second, spending on infrastructure should be regarded as a force multiplier. Current trends in the growth of the US clean energy sector are encouraging but still not enough to deliver on existing US – much less global – decarbonisation plans. 'Building back better' is thus likely to require an additional catalyst, where (as suggested earlier) available infrastructure can shape what is possible.

A targeted push to upgrade power grids and other energy infrastructure would enable fuel inputs to be used more efficiently, address barriers to using wind and solar, and support larger aims for electrifying the economy – outcomes that could help speed up decarbonisation and heighten interests in additional clean consumption tools. Such a push could also create some jobs immediately and generate more new jobs over the long term. Proposed resources for infrastructure projects in pending Congressional legislation could thus have a transformative impact on the US and should be approved in full. Meanwhile, this need for new and more modern infrastructure is not uniquely American. US-backed initiatives, such as Clean EDGE Asia, and organisations, such as USAID and USTDA, are already working with partners in Asia on how to address their own infrastructure gaps; enhanced support here could be invaluable to unlocking new consumption patterns, and in turn, opportunities for increasing US exports to the world's fastest growing region.

Third, a well-placed bet on emerging technologies could yield significant returns. Several sectors of the US economy could benefit from increased support for their cutting-edge projects and tools. Yet, one that seems particularly ripe is transportation, given the twin considerations of robust US and Asian demand growth and several promising technologies for radically decarbonising the sector. Standing in the way of this 'match made in heaven' though are questions about needs for select additional breakthroughs. This includes ongoing challenges in improving battery capacities, as well as making relevant technologies more affordable in general.[5]

Whoever tackles these challenges first could have a golden opportunity to corner a growing market. To that end, the Biden administration should consider making a strategic push to boost relevant US industrial capacities, including via resourcing new public-private partnerships with the expressed aim of advancing breakthroughs in hydrogen and other energy storage technologies.

[5] Establishing the appropriate enabling infrastructure (e.g. charging stations) is of course an additional task here but is not re-raised here to avoid repetition with the preceding point.

Here, closer cooperation with partners in Asia could also prove especially meaningful, as countries such as Australia, the Republic of Korea, and Japan have demonstrated innovative strengths in these fields.

All three of these recommendations envision a high return on investment and are designed to build on both current opportunities and insights from the response to the 2008–2009 financial crisis. Yet, in returning to the example of this past, it also should be kept in mind that not all projects tied to the ARRA ultimately bore fruit. As observed by scholars at the World Resources Institute, the legislation's bet on concentrated solar power projects, for example, was 'not as successful as hoped', whilst US$1.3 billion of the US$3.4 billion that was allocated to carbon capture and storage projects was ultimately returned when projects were unable to meet benchmarks (Jaeger, Westphal, and Park, 2020). Thus, an additional takeaway from the 2008–2009 response for the current crisis is that whilst industrial policy can yield significant net benefits, its specific outcomes are by no means guaranteed. This is something that should encourage decision makers to regularly review key stimulus programmes and adjust focuses as needed – but not necessarily discourage them from betting big on innovation.

# REFERENCES

Agrawala, S., D. Dussaux, and N. Monti (2020), What Policies for Greening the Crisis Response and Economic Recovery? Lessons Learned from Past Green Stimulus Measures and Implications for the COVID-19 Crisis, 27 May. Organisation for Economic Co-operation and Development. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/WKP(2020)11&docLanguage=En (accessed 31 December 2021).

Baily, M.N. (2020), How to Boost Long-run Growth After COVID-19, 16 December. Brookings Institution. https://www.brookings.edu/research/how-to-boost-long-run-growth-after-covid-19/ (accessed 31 December 2021).

Bailout Watch (2021), Fossil Fuel Firms Slashed Nearly 60,000 Jobs In 2020 While Pocketing $8.2 Billion Tax Bailout, 2 April. Bailout Watch. https://bailoutwatch.org/analysis/fossil-fuel-firmsslashed-nearly-60000-jobs-in-2020 (accessed 31 December 2021).

Butler, D., S. Mufson, and D. MacMillan (2020), How the Cares Act Gave Millions to Energy Companies with No Strings Attached, 6 October 2020. Washington Post. https://www.washingtonpost.com/climate-environment/2020/10/06/cares-act-money-companies/

Cahill, B. (2022), What to Expect from Shale This Year, 6 January. Center for Strategic and International Studies. https://www.csis.org/analysis/what-expect-shale-year#:~:text=Crude%20oil%20production%20in%20the,more%20disciplined%20and%20resilient%20industry (accessed 9 January 2022).

Climate Action Tracker (2021), USA: Country Summary, 4 November. New Climate Institute and Climate Analytics. https://climateactiontracker.org/countries/usa/ (accessed 9 January 2022).

Congress (2020), Consolidated Appropriations Act, 2021, H.R.133, 117th Congress. https://www.congress.gov/bill/116th-congress/house-bill/133/text (accessed 31 December 2021).

Congressional Budget Office (2015), Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output in 2014. Congressional Budget Office. February 2015. https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/49958-ARRA.pdf (accessed 31 December 2021).

DeConcini, C. and J. Neuberger (2020), Oil & Gas Win, Clean Energy Loses in U.S. COVID-19 Response, 10 June. World Resources Institute. https://www.wri.org/blog/2020/06/coronavirus-stimulus-packages-clean-energy (accessed 30 October 2020).

Dingel, J.I. and B. Neiman (2020), How Many Jobs Can be Done at Home? June 2020. National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w26948/w26948.pdf (accessed 31 January 2021).

Executive Office of the President (2021), 'Executive Order No. 14037: Strengthening American Leadership in Clean Cars and Trucks,' F*ederal Register* 86(151), 5 August. https://www.federalregister.gov/documents/2021/08/10/2021-17121/strengthening-american-leadership-in-clean-cars-and-trucks (accessed 31 December 2021).

Groom, N. (2020), Trump Admin Slaps Solar, Wind Operators with Retroactive Rent Bills, 17 May 2020. Reuters. https://www.reuters.com/article/us-usa-interior-renewables/trump-admin-slaps-solar-wind-operators-with-retroactive-rent-bills-idUSKBN22U0FW (accessed 31 December 2021).

Gillispie, C. and S. Endo (2021). 'United States Country Report', in S. Kimura and H. Phoumin (eds.), Energy Outlook and Energy Savings Potential in East Asia. Jakarta: Economic Research Institute for ASEAN and East Asia. https://www.eria.org/uploads/media/Books/2021-Energy-Outlook-and-Saving-Potential-East-Asia-2020/Energy-Outlook-and-Saving-Potential-East-Asia-2020-1504.pdf (accessed 9 January 2022).

Guyot, K. and I.V. Sawhill (2020), Telecommuting Will Likely Continue Long After the Pandemic, 6 April. Brookings. https://www.brookings.edu/blog/up-front/2020/04/06/telecommuting-will-likely-continue-long-after-the-pandemic/ (accessed 30 October 2020).

HHS Press Office (2020), Secretary Azar Declares Public Health Emergency for United States for 2019 Novel Coronavirus, 31 January. US Department of Health and Human Services. https://www.hhs.gov/about/news/2020/01/31/secretary-azar-declares-public-health-emergency-us-2019-novel-coronavirus.html (accessed 30 October 2020).

Institute for Health Metrics and Evaluation (2022), Covid-19 Projections: United States, 8 January. University of Washington. https://covid19.healthdata.org/united-states-of-america (accessed 8 January 2022).

International Energy Agency (IEA) (2020a), World Energy Investment 2020: Key Findings. Paris: IEA. https://www.iea.org/reports/world-energy-investment-2020/key-findings (accessed 30 October 2020).

IEA (2020b), Investment Estimates for 2020 Continue to Point to a Record Slump in Spending, 23 October. Paris: IEA. https://www.iea.org/articles/investment-estimates-for-2020-continue-to-point-to-a-record-slump-in-spending (accessed 30 October 2020).

IEA (2020c), Energy Investment by Sector in Select Markets, 2019 and 2020. Paris: IEA. https://www.iea.org/data-and-statistics/charts/energy-investment-by-sector-in-select-markets-2019-and-2020 (accessed 30 October 2020).

IEA (2021a), Sustainable Recovery Tracker: Key Findings. October 2021. Paris: IEA. https://www.iea.org/reports/sustainable-recovery-tracker/key-findings

IEA (2021b), World Energy Investment 2021. June. Paris: IEA. https://iea.blob.core.windows.net/assets/5e6b3821-bb8f-4df4-a88b-e891cd8251e3/WorldEnergyInvestment2021.pdf (accessed 9 January 2021).

IEA (2021c), World Energy Outlook 2021. October. Paris: IEA. https://iea.blob.core.windows.net/assets/4ed140c1-c3f3-4fd9-acae-789a4e14a23c/WorldEnergyOutlook2021.pdf (accessed 9 January 2021)

International Monetary Fund (IMF) (2020), Policy Responses to COVID-19. 24 October. Washington, DC: IMF. https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19 (accessed 30 October 2020).

Jaeger, J., M.I. Westphal, and C. Park (2020), Lessons Learned on Green Stimulus: Case Studies from the Global Financial Crisis, November 2020. World Resources Institute. https://files.wri.org/s3fs-public/lessons-learned-on-green-stimulus-case-studies-from-the-global-financial-crisis.pdf?5gDebandVTpi8eM8XtXwLE7jjZem2DPI (accessed 31 December 2021).

Kusnetz, N. (2021). Fossil Fuel Companies Took Billions in U.S. Coronavirus Relief Funds but Still Cut Nearly 60,000 Jobs, 2 April 2021. Inside Climate News. https://insideclimatenews.org/news/02042021/fossil-fuel-companies-took-billions-in-u-s-coronavirus-relief-funds-but-still-cut-nearly-60000-jobs/ (accessed 31 December 2021).

McCormick, M. (2020), US Energy Industry Loses Jobs While Other Sectors Gain, 3 July. Financial Times. https://www.ft.com/content/e08129d2-a4df-446a-9480-0cbeee29022d (accessed 1 November 2020).

Mutikani, L. (2020), What to Know About the Report on America's COVID-hit GDP, 31 July. World Economic Forum. https://www.weforum.org/agenda/2020/07/covid-19-coronavirus-usa-united-states-econamy-gdp-decline/ (accessed 30 October 2020).

Office of the Press Secretary (2016), Fact Sheet: The Recovery Act Made The Largest Single Investment In Clean Energy In History, Driving The Deployment Of Clean Energy, Promoting Energy Efficiency, And Supporting Manufacturing, 25 February. White House. https://obamawhitehouse.archives.gov/the-press-office/2016/02/25/fact-sheet-recovery-act-made-largest-single-investment-clean-energy (accessed 9 January 2022).

Reuters Staff (2020), U.S. Clean Energy Sector Loses 18% of Jobs During Pandemic - Report, 16 June. Thomson Reuters. https://www.reuters.com/article/usa-clean-energy-jobs-idUSL1N2DS18M (accessed 1 November 2020).

Runyon, J. (2021), Last-Minute Stimulus Deal in US Extends Clean Energy Tax Credits, 4 January 2021. Renewable Energy World. https://www.renewableenergyworld.com/solar/last-minute-stimulus-deal-in-us-extends-clean-energy-tax-credits/#gref

Shieber, J. (2020), New Stimulus Bill Includes $35.2 billion for New Energy Initiatives, 21 December. Tech Crunch. https://techcrunch.com/2020/12/21/new-stimulus-bill-includes-35-2-billion-for-new-energy-initiatives (accessed 31 December 2021).

US BEA (2020a), Gross Domestic Product (Third Estimate), Corporate Profits (Revised), and GDP by Industry, Second Quarter 2020, 30 September. US BEA. https://www.bea.gov/news/2020/gross-domestic-product-third-estimate-corporate-profits-revised-and-gdp-industry-annual (accessed 1 November 2020).

US BEA (2020b), Gross Domestic Product (Third Estimate), Corporate Profits (Revised), and GDP by Industry, Third Quarter 2020, 22 December. US BEA. https://www.bea.gov/news/2020/gross-domestic-product-third-estimate-corporate-profits-revised-and-gdp-industry-third (accessed 31 December 2021).

US BEA (2021), Gross Domestic Product (Third Estimate), Corporate Profits (Revised Estimate), and GDP by Industry, Third Quarter 2021, 22 December. US BEA. https://www.bea.gov/news/2021/gross-domestic-product-third-estimate-gdp-industry-and-corporate-profits-revised-3rd (accessed 9 January 2022).

United States Bureau of Labor Statistics (US BLS) (2021), The Employment Situation – December 2020, 8 January 2021. US Department of Labor. https://www.bls.gov/news.release/archives/empsit_01082021.pdf (accessed 9 January 2022).

US BLS (2022), Current Employment Statistics Highlights, 4 February 2022. US Department of Labor. https://www.bls.gov/web/empsit/ceshighlights.pdf (accessed 5 February 2022).

United States Centers for Disease Control and Prevention (US CDC) (2022), United States COVID-19 Cases and Deaths by State: Reported to the CDC since January 21, 2020. US CDC. https://covid.cdc.gov/covid-data-tracker/#cases_casesinlast7days (accessed 9 January 2022).

US Council of Economic Advisors (2016), A Retrospective Analysis of Clean Energy Investments in the Recovery Act, 25 February. Executive Office of the President of the United States. https://obamawhitehouse.archives.gov/sites/default/files/ page/files/20160225_cea_final_clean_energy_report.pdf (accessed 9 January 2022).

United States Department of Energy (US DOE) (2021), United States Energy & Employment Report 2021. US DOE. https://www.energy.gov/sites/default/files/2021-07/USEER%202021%20Main%20Body.pdf (accessed 31 December 2021).

United States Energy Information Administration (US EIA) (n.d.), Primary Energy Consumption by Source, 1949-2020. US EIA. https://www.eia.gov/totalenergy/data/browser/index.php?tbl=T01.03#/?f=A&start=1949&end=2020&charted=1 (accessed 9 January 2022).

US EIA (2020a), Annual Energy Outlook 2020, January 2020. US EIA. https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Full%20Report.pdf (accessed 9 January 2022).

US EIA (2020b), Short-Term Energy and Winter Fuels Outlook, 6 October. US EIA. https://www.eia.gov/outlooks/steo/special/winter/2020_Winter_Fuels.pdf (accessed 1 November 2020).

US EIA (2020c), October 2020 Short-Term Energy Outlook. US EIA. https://www.eia.gov/outlooks/steo/pdf/steo_full.pdf (accessed 1 November 2020).

US EIA (2020d), U.S. Energy Facts Explained. US EIA. https://www.eia.gov/energyexplained/us-energy-facts/#:~:text=After%20record%20high%20energy%20production,primary%20energy%20production%20in%202019 (accessed 30 October 2020).

US EIA (2021a), Annual Energy Outlook 2021, February 2021. US EIA. https://www.eia.gov/outlooks/aeo/pdf/AEO_Narrative_2021.pdf (accessed 9 January 2022).

US EIA (2021b), Annual U.S. Coal Exports Drop 26% Between 2019 and 2020, 11 March. US EIA. https://www.eia.gov/todayinenergy/detail.php?id=50620 (accessed 31 December 2021).

US EIA (2021c), In 2020, the United States Produced the Least CO2 Emissions from Energy in Nearly 40 Years, 30 December. US EIA. https://www.eia.gov/todayinenergy/detail.php?id=50626 (accessed 31 December 2021).

US EIA (2021d), Renewables Became the Second-Most Prevalent U.S. Electricity Source in 2020, 23 December. US EIA. https://www.eia.gov/todayinenergy/detail.php?id=50622 (accessed 31 December 2021).

US EIA (2021e), The United States Installed More Wind Turbine Capacity in 2020 than in Any Other Year, 28 December. US EIA. https://www.eia.gov/todayinenergy/detail.php?id=50624 (accessed 31 December 2021).

US EIA (2021f), U.S. Energy Consumption Fell by a Record 7% in 2020, 5 April. US EIA. https://www.eia.gov/todayinenergy/detail.php?id=47397 (accessed 9 January 2022).

US EIA (2021g), U.S. Fossil Fuel Consumption Fell by 9% in 2020, the Lowest Level in Nearly 30 Years, 6 July. US EIA. https://www.eia.gov/todayinenergy/detail.php?id=48596 (accessed 9 January 2021).

US EIA (2021h), U.S. Energy-Related Carbon Dioxide Emissions, 2020, 22 December. US EIA. https://www.eia.gov/environment/emissions/carbon/ (accessed 9 January 2022).

US EIA (2021x), In 2020, U.S. coal production fell to its lowest level since 1965, 14 July. US EIA. https://www.eia.gov/todayinenergy/detail.php?id=48696 (accessed 9 January 2022).

US EIA (2021y), Annual U.S. Natural Gas Production Decreased by 1% in 2020, 2 March. US EIA. https://www.eia.gov/todayinenergy/detail.php?id=46956 (accessed 9 January 2022).

United States Government Accountability Office (US GAO) (2021a), Covid-19: Additional Actions Needed to Improve Accountability and Program Effectiveness of Federal Response, October. US GAO. https://www.gao.gov/assets/gao-22-105051.pdf (accessed 9 January 2021).

US GAO (2021b), GAO's Work on the Federal Response to the Covid-19 Pandemic, 16 August. US GAO. https://www.gao.gov/assets/2021-08/2021-08-16-AICPA_Final.pdf (accessed 9 January 2021).

Varro, L., S. Beyer, S. Journeay-Kaler, and K. Gaffney (2020). Green Stimulu After the 2008 Crisis: Learning from Successes and Failures, 29 June. International Energy Agency. https://www.iea.org/articles/green-stimulus-after-the-2008-crisis (accessed 31 December 2021).

White, S. and S. DiSavino (2020), France Halts Engie's U.S. LNG Deal amid Trade, Environment Disputes, 22 October. Reuters. https://www.reuters.com/article/engie-lng-france-unitedstates/france-halts-engies-u-s-lng-deal-amid-trade-environment-disputes-idUSKBN27808G (accessed 9 January 2022).

Wolfram, C. (2021), Economy Statement by Catherine Wolfram, Acting Assistant Secretary for Economy Policy, for the Treasury Borrowing Advisory Committee November 1, 2021, 1 November. U.S. Department of the Treasury. https://home.treasury.gov/news/press-releases/jy0453 (accessed 9 January 2022).