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Written Testimony

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Hearing on Automation and Economic Disparity

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Chairman Himes, Ranking Member Steil, and Members of the Committee,

Thank you for inviting me to testify today on this important subject.

US labor market inequality has surged since 1980. This has not just taken the form of incomes at the top growing faster than the bottom. It has also been associated with workers, and especially men, with high-school education or less experiencing significant declines in their real earnings. Figure 1 summarizes these changes by depicting the evolution of real wages for 10 demographic groups, differentiated by education and gender.[1] For example, it reveals that men with less than high-school degree have seen their real earnings fall by more than 15% over the last four decades. Even men with a college degree have seen only limited gains in their real earnings, while men and women with post-graduate degrees experienced rapid wage growth. In the meantime, racial inequities have widened, and regional disparities have multiplied. These sweeping changes in the wage structure have many causes, ranging from globalization to the transformation of US labor market institutions, including the erosion of the real value of the minimum wage and the diminished role of collective bargaining.

[1] See Acemoglu, Daron and David Autor (2011) "Skills, tasks and technologies: Implications for employment and earnings," *Handbook of Labor Economics*, 4: 1043-1171, and Autor, David (2019) "Work of the Past, Work of the Future," *American Economic Association Papers and Proceedings*, 109: 1-32.

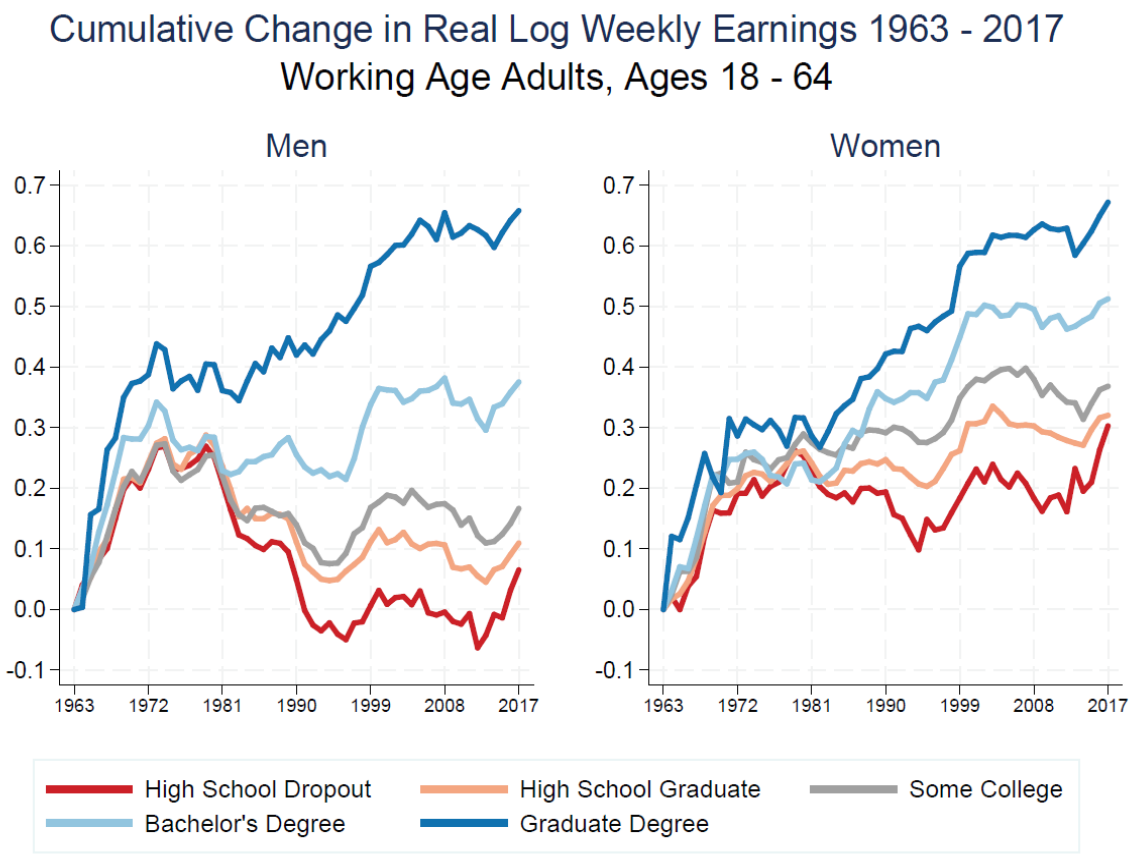

Figure 1: Evolution of real wages by ten demographic groups, 1963-2017. From Autor (2019).

My research, however, indicates that the most important factor in these trends has been automation — that is, the substitution of machines and algorithms for tasks previously performed by workers. Automation is not a recent phenomenon. The beginning of the British Industrial Revolution was marked by rapid advances in automation technologies in the textile industry, and automation played a major role in American industrialization during the 19th century. The rapid mechanization of agriculture starting in the middle of the 19th century is another example of automation. The more recent wave of automation has been dominated by numerically-controlled machinery and then robotics in manufacturing and software-based automation in clerical and office jobs.

Two types of evidence illustrate the effects of automation technologies on inequality. First, in local labor markets (commuting zones) where there has been faster adoption of industrial robots, we see not just lower employment and wages, but also greater inequality between high-education and low-education workers and a bigger gap between those at the top and bottom of the income distribution.[2] Second, and more directly, Figure 2 depicts the relationship between task displacement (the amount of automation) experienced by a demographic group and its real wage change between 1980 and 2016. These demographic groups are distinguished by education, gender, age, race and native/immigrant status. Worker groups suffering larger task displacement — the ones employed in routine tasks that can automated in industries undergoing rapid automation — have almost uniformly experienced large declines in their real wages.[3] These groups include all demographic categories with less than a college degree. In contrast, groups that have not experienced much direct automation, including those with post-graduate degrees and women with college degrees, have seen their earnings increase rapidly over the last 40 years. In summary, Figure 2 indicates that more than half, and perhaps as much as three quarters, of the surge in wage inequality in the US is related to automation.

Automation is not the only phenomenon that has led to task displacement. Workers may also lose the tasks they used to specialize in to offshoring and foreign competition. These trends have also contributed to rising economic disparities, but comparatively, they have been less important than automation. For example, the direct effects of offshoring account for about 5-7% of changes in wage structure, compared to 50-70% by automation.

[2] Acemoglu, Daron and Pascual Restrepo (2020) "Robots and Jobs: Evidence from US Labor Markets," *Journal of Political Economy*, 128(6): 2188-2244

[3] Acemoglu, Daron and Pascual Restrepo (2021) "Automation, Tasks and the Rise in US Wage Inequality" NBER Working Paper No. 28290.

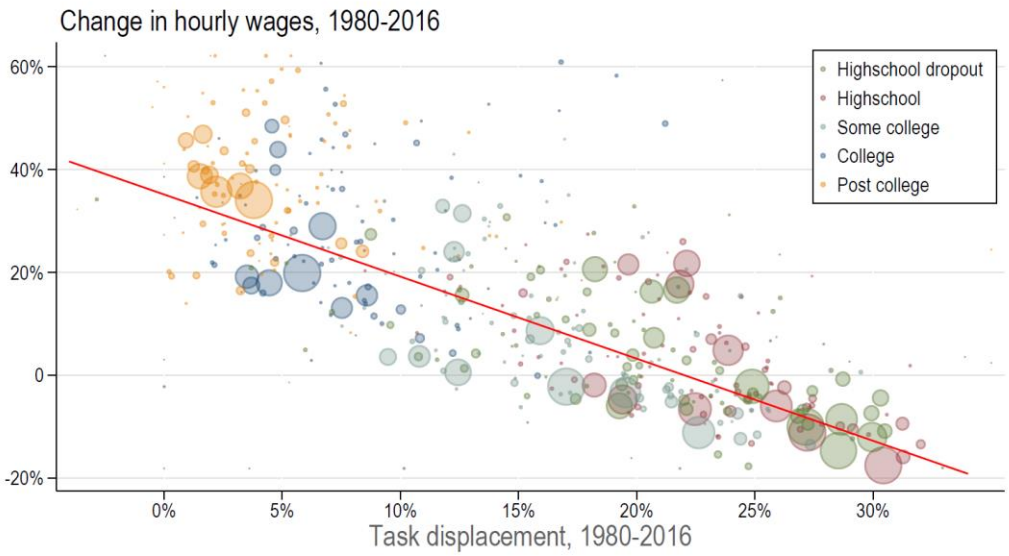

Figure 2: Task displacement (the amount of automation) experienced by a demographic group and change in that demographic group's real wage from 1980 to 2016. Demographic groups are defined by education, age, gender, race and native/immigrant status. From Acemoglu and Restrepo (2021).

While the main impact of automation over the last four decades has been on wages, workers most affected by automation have also seen their labor force participation and employment rates decline. The evidence does not support the most alarmist views that robots or AI are going to create a completely jobless future, but we should be worried about the ability of the US economy to create jobs, especially good jobs with high pay and career-building opportunities for workers with a high-school degree or less.

Automation has contributed to specific dimensions of economic disparities as well. Automation accounts for 80% of the sizable increase in the college wage premium (the earnings of college-educated workers relative to those with just a high-school degree). It has also widened the gap between Black and White Americans. Without automation, we estimate that the racial wage gap (after taking out differences in education, age and gender) would have closed by 2 percentage points between 1980 and 2017, but because of automation, it has widened by 3.5

percentage points. Automation, together with globalization, has also been a major driver of regional disparities. Some of the industries most affected by both globalization and industrial robotics were heavily concentrated in specific areas, such as Detroit or Raleigh Durham, and as they reduced their hiring, these local economies have been pushed into decline and stagnation.[4]

One dimension of disparities that has been helped by automation is the gender wage gap. Although several occupations in which women are overrepresented have also been automated, on the whole it has been male-dominated occupations that have undergone faster automation. As a result, automation has helped close the gender wage gap and is responsible for about 17% of the narrowing of this gap since 1980.[5]

But what about the benefits of automation? During the mechanization of agriculture or in the three decades following World War II, automation was also rapid, and the US economy created millions of jobs and achieved broadly-shared prosperity, which can also be seen from Figure 1 above — real wages for all ten demographic groups depicted there grew in tandem, at a rate exceeding 2% per annum in real terms, on average. So what is different today?

Two major factors should be emphasized. First, automation technologies in the first half of the 20th century and in the 1950s and 1960s went hand-in-hand with other technological advances, which increased worker productivity in a diverse set of industries and created myriad opportunities for them. Chief among those advances is the introduction of new labor-intensive tasks, such as clerical tasks both in manufacturing and non-manufacturing, technical occupations,

[4] On the effects of imports from China, see Autor, David, David Dorn, and Gordon Hanson (2013) "The China Syndrome: Local Labor Market Effects of Import Competition in the United States" *American Economic Review* 103(6): 2121-68. On the effects of industrial robots, see Acemoglu, Daron and Pascual Restrepo (2020) "Robots and Jobs: Evidence from US Labor Markets," *Journal of Political Economy*, 128(6): 2188-2244.

[5] Acemoglu, Daron and Pascual Restrepo (2021) "Automation, Tasks and the Rise in US Wage Inequality," NBER Working Paper No. 28290.

design tasks and precision work in manufacturing. What we have experienced since the mid-1980s is an acceleration in automation and a very sharp deceleration in the introduction of new tasks. Put simply, the technological portfolio of the American economy has become much less balanced, and in a way that is highly detrimental to workers and especially low-education workers.[6]

Second, not all automation technologies are created equal. Those that reduce costs and boost productivity generate a set of compensating changes, for example, expanding employment in non-automated tasks. On the other hand, if automation is "so-so" — meaning that it generates only minor productivity improvements — then it creates all the displacement effects but little of the compensating benefits. As the US economy shifted more and more into automation, it may have also gone into less beneficial types of automation (compare, for instance, the benefits of mechanization of agriculture to those of automated customer service).

This discussion underscores another important problem. In some popular discussions, technology-based explanations for the rise in US wage inequality are pitted against those that emphasize the decline of unions or the erosion of the real value of the minimum wage, with the implication that the latter causes are more controllable. This is a false dichotomy in two ways. *All* those causes have contributed to the current situation, and technology *is* a factor that humans can control. Technology is very much what we create with our collective knowledge, and the technological choices we make can have huge distributional consequences, and sometimes few aggregate benefits.

[6] Acemoglu, Daron and Pascual Restrepo (2019) "Automation and New Tasks: How Technology Changes Labor Demand," *Journal of Economic Perspectives*, 33(2): 3-30.

The technologies that are developed depends on society's institutions, including those that govern how the labor market functions and who has social and political power. My reading of the evidence is that a number of factors have pushed US businesses towards automating the production process excessively, and as a result greatly contributed to inequality, but without generating significant aggregate benefits.[7]

The first factor that has led to excessive automation is the transformation in the corporate strategies of leading companies. American and world technology is shaped by the decisions of a handful of very large and very successful tech companies, with tiny workforces and a business model built on automation.[8] Big tech companies have had a defining impact on the direction of digital technologies in general, and are today dominating the path of artificial intelligence (AI). Available data suggest that US and Chinese tech giants are responsible for more than two out of every three dollars spent globally on AI.[9] There is of course nothing wrong with successful companies pursuing technological advances consistent with their business model. The problem is that these companies have become so dominant both in their sector and in terms of their impact on US society's priorities that their approach has become the only game in town. Past technological successes have more often than not been fueled by a diversity of perspectives and approaches, and if we lose that diversity, it can have disastrous consequences, including on economic disparities.

The dominance of the paradigm of a handful of companies has been exacerbated by declining government support for fundamental research, as government spending on research has

[7] Acemoglu, Daron (2021) *Redesigning AI: Work, Democracy, and Justice in the Age of Automation*, Boston Review Forum.
[8] Acemoglu, Daron, and Pascual Restrepo (2020) "The Wrong Kind Of AI? Artificial Intelligence and The Future Of Labour Demand." *Cambridge Journal of Regions, Economy and Society* 13.1: 25-35.
[9] Artificial Intelligence: The Next Digital Frontier? McKinsey & Company.

fallen as a fraction of GDP and its composition has shifted towards tax credits and support for corporations. [10] The transformative technologies of the 20th century, such as antibiotics, sensors, modern engines, and the Internet, have the fingerprints of the government all over them.[11] The government funded and purchased these technologies and often set the research agenda. This is much less true today.

US businesses have also invested heavily in automation in response to globalization trends. First with the rapid increase in imports from Japan in the 1980s and then the surge of imports from China, they became much more focused on cost-cutting, and automation provided one easy way of reducing labor costs.

Finally, government policy is encouraging automation excessively, especially through the tax code. The US tax system has always treated capital more favorably than labor, encouraging firms to substitute machines for workers, even when workers may be more productive. As Figure 3 shows, over the last 40 years, via payroll and federal income taxes, labor pays an effective tax rate of over 25%. Even twenty years ago, capital was taxed more lightly, with equipment and software facing tax rates around 15%. This differential has widened even more with tax cuts on high incomes, the shift of many businesses to S-Corporation status making them exempt from corporate income taxes, and very generous depreciation allowances. As a result of these changes, software and equipment are taxed close to zero now and in some cases, corporations can get a net subsidy when they invest in capital. This generates a powerful motive for excessive automation: Companies can save money when they install machinery to do the same jobs as workers and lay

[10] Gruber, Johnson, and Simon Johnson. *Jump-Starting America*: *How Breakthrough Science Can Revive Economic Growth and the American Dream*. Public Affairs, New York, NY, 2019.
[11] Lerner, Josh. *Boulevard of Broken Dreams: Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed and What to Do about It.* Princeton University Press, New York, 2009, and Mazzucato, Mariana. *The Entrepreneurial State: Debunking Public Versus Private Sector Myths*. Public Affairs, New York, 2015.

off their employees, because the government subsidizes their investments and taxes what they pay in wages.

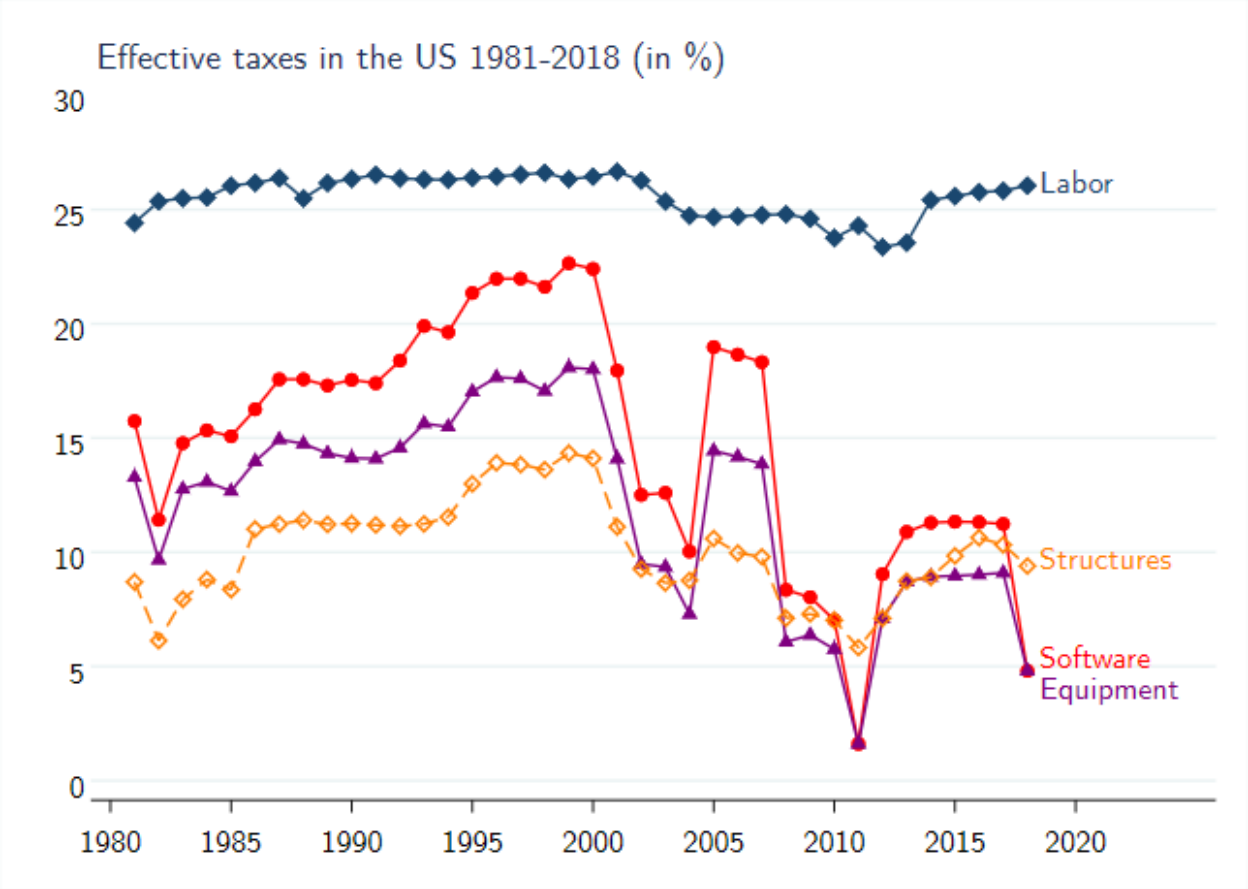

Figure 3: Evolution of effective taxes in the U.S. From Acemoglu, Daron, Andrea Manera and Pascual Restrepo (2020) "Does the US Tax Code Favor Automation," *Brookings Papers on Economic Activity*.

If economic disparities in the US have been at least partly fueled by technological choices, then it should be clear that redirecting our technological energy and ingenuity must play a leading role in redressing these disparities.

Popular accounts and tech entrepreneurs often imply that the future of technology is largely preordained or, alternately, the most promising directions are being explored already. This is not necessarily the case. There are many different feasible paths for future technology,

and we are not choosing the ones that are best for social good, as current choices in the industry are excessively automating work. There are many applications of AI that instead augment human capabilities and create new tasks in education, health care, and even in manufacturing. For example, rather than using AI for automated grading, homework help, and increasingly for substitution of algorithms for teachers, the industry can invest in using AI for developing more individualized, student-centric teaching methods that are calibrated to the specific strengths and weaknesses of different groups of pupils. Such technologies would lead to the employment of more teachers, as well as increasing the demand for new teacher skills — thus exactly going in the direction of creating new jobs centered on new tasks. Similar possibilities abound in health care, for example, in improving care quality by empowering nurses. The problem, however, is that without a push for redirection of technological change, the tech industry is currently much more focused on using AI and digital technologies for automation, rather than producing opportunities for workers.

Some policymakers might be tempted to tackle economic disparities directly, for example, by increasing the minimum wage. The evidence supports the view that moderate increases in minimum wages can help low-pay workers without generating large adverse consequences on employment. However, the minimum wage and other direct interventions in the labor market by themselves cannot be the main solution to rising inequality, especially when automation is playing such an important role. If the minimum wage is raised significantly, this will be another trigger for companies to automate work. Indeed, the pandemic has demonstrated how modest wage pressure and labor shortages have led to much faster automation in consumer-facing industries, such as fast food and groceries.

What can be done to redirect technological change in a more worker-friendly direction? A first and easy step is to correct the differential taxation of capital and labor. This would go a long way but is not sufficient by itself. This need not take the form of punitive taxes on capital. A large part of the gap between the taxation of capital and labor comes from very generous depreciation allowances that started being introduced in 2000, and were supposed to be temporary. They can be eliminated, as they were meant to be temporary. In addition, US tax revenues are unduly hurt because the base for capital taxes is very narrow, as many businesses do not pay any corporate income taxes. Closing tax evasion loopholes and applying corporate income taxes to previously exempt businesses, such as S-corporations, would go a long way as well. Finally, corporate income taxes can be increased in coordination with other advanced economies. Recent policy proposals on the global minimum corporate tax go some way towards redressing these problems, but much more effort is necessary to broaden the capital tax base and to create a level playing field between capital and labor.

A second and more ambitious step should be to reevaluate the role of large tech companies. Big Tech has a particular approach to business and technology, centered on the use of algorithms for replacing humans. It is no coincidence that companies such as Google are employing less than one tenth of the number of workers that large businesses, such as General Motors, used to do in the past. This is a consequence of Big Tech's business model, which is based not on creating jobs but automating them. There is increasing recognition that these large companies are having huge effects on our society that need to be regulated (for example, when it comes to Facebook's role in polarization and the spread of misinformation). Their effects on technology, and especially on economic opportunities for low-skill Americans, may be even more consequential, and have not become a policy focus so far. This should change, and

policymakers should think about ways in which the considerable technological know-how and capabilities of our economy can be used for creating opportunities for Americans of all backgrounds and skills. These issues go beyond debates about automation, as they relate to the issue of limiting the size and the dominance of big tech companies, and are also entangled with questions of market power and anti-trust. Nevertheless, existing policy proposals, including anti-trust, are no direct remedy for encouraging a more diverse approach to new technologies. Such an approach would require greater social diversity among executives and researchers, including among large tech firms, and ways of lessening the dominance of Big Tech so that new companies can enter and build technologies that generate new tasks and opportunities for both low-education and high-education Americans.

Measures aimed at removing the distortions that encourage excessive automation can be strengthened with government R&D policies specifically targeting technologies that help human productivity and increase labor demand. Research policies that target specific classes of technologies are controversial and difficult. They may be particularly challenging in the context of choosing between automation and human-friendly technologies, since identifying these may be nontrivial. Nevertheless, I would like to end my comments by emphasizing that there have been successful instances of technological redirection in the past.

Two decades ago renewable energy was prohibitively expensive and the basic know-how for large-scale energy production from green technologies was lacking. Today renewables already make up 19% of energy consumption in Europe and 11% in the US, and have costs in the same ballpark as fossil-fuel based energy.[12] This has been achieved thanks to a redirection of

[12] Renewable Power Generation Costs in 2018, International Renewable Energy Agency; Global renewable energy consumption, Our World in Data. See also https://www.lazard.com/perspective/lcoe2019/;

technological change away from a singular focus on fossil fuels towards greater efforts for advances in renewables. In the US, the primary driver of this redirection has been government subsidies to green technologies and state-level regulations, as well as the changing norms of consumers in society, which have pushed many companies towards reducing their emissions.

The experience in the energy sector shows that it is feasible to redirect technological change. The same can be done for the balance between automation and human-friendly technologies, but as in the case of combating global warming, change must start with a broader recognition within society and among policymakers that our technology choices have become highly unbalanced, with myriad adverse social consequences, including on economic disparities.

https://irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019;
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