TRADE UNIONS FOR ENERGY DEMOCRACY

Working Paper No. 10

PREPARING A PUBLIC PATHWAY

Confronting the Investment Crisis in Renewable Energy

CUNY The Murphy Institute

ROSA LUXEMBURG STIFTUNG NEW YORK OFFICE

TRADE UNIONS FOR ENERGY DEMOCRACY

Table of Contents

Published by Trade Unions for Energy Democracy (TUED), in cooperation with the Rosa Luxemburg Stiftung—New York Office and the Murphy Institute at the City University of New York, November 2017.

Edited by James Hare.

With support from the German Federal Ministry for Economic Cooperation and Development (BMZ).

Disclaimer: This paper represents the views of its contributing authors. The opinions expressed here may or may not be consistent with the policies and positions of unions participating in TUED. The paper is offered for discussion and debate.

Trade Unions for Energy Democracy (TUED) is a global, multi-sector initiative to advance democratic direction and control of energy in a way that promotes solutions to the climate crisis, energy poverty, the degradation of both land and people, and responds to the attacks on workers' rights and protections.

TRADE UNIONS FOR ENERGY DEMOCRACY

Preparing a Public Pathway

Confronting the Investment Crisis in Renewable Energy

By Sean Sweeney and John Treat

Inadequate levels of investment in renewable energy are a major obstacle standing in the way of the transition to a new, renewables-based energy system.[1] TUED Working Paper 9, *Energy Transition: Are We Winning?* raised this investment deficit in passing and in a very broad context: Fossil-based energy use is rising globally, and renewables have so far failed to seriously alter the overall direction of global energy systems. "Modern renewables" like wind and solar remain on the margins of the global energy system. At the end of 2015, wind and solar PV together generated just 4.6% of global electricity.[2]

By using the term "investment deficit" we aim to draw attention to the discrepancy between the levels of investment in renewable energy that are currently being seen around the world and those levels that are widely considered necessary to meet the science-based emissions targets and temperature thresholds articulated in the 2015 Paris Climate Accord: "well below two degrees Celsius" and "net zero emissions."[3]

It is also necessary to stress at the outset that the investment deficit in renewable energy is part of a much larger investment shortfall in what are often referred to as "low-carbon solutions" or "green technologies" (including, for example, storage and conservation). We touch briefly on this below but focus mainly on generation—principally wind and solar power.

Echoing a string of recent reports, a 2017 study by the International Energy Agency and the International Renewable Energy Agency (IEA-IRENA), *Perspectives for the Energy Transition: Investment Needs for a Low-Carbon Energy System*, estimated that investment in renewable energy needs to be more than double 2016 levels by 2030, reaching roughly $600 billion per year, in order to be consistent with the effort to keep global temperatures below the warming threshold of two degrees Celsius. This means approximately $14 trillion of investment in wind and solar generation, combined, by 2030.[4]

Like many similar studies, however, the IEA-IRENA study fails to explain *why*, in a world awash with "idle capital," the investment deficit in renewables exists at all. The present paper attempts to address this crucial issue. We believe that an honest review of the data and the policy history leave no doubt that the dominant policy paradigm—justified (and perhaps blinded) by a constant insistence on the need to "mobilize private sector investment"—has failed, even on its own terms, either to generate the kind of momentum needed to drive a full-on energy transition or to seriously impede the rise in fossil fuel use. We believe such a review also shows that the prospects for the dominant policy paradigm to produce results consistent with any serious effort to reduce emissions—let alone meet the Paris targets—are extremely poor.

We will attempt to show that any effort to address the investment deficit must deal with its systemic and institutional roots. These roots trace back to the privatization and liberalization of electricity markets that began in the UK in the 1980s, became EU policy in the 1990s, and have since come to define the dominant policy approach in many parts of the world. Even where

energy systems have remained publicly owned, the policy approach to renewables is oriented toward private corporations and investors.

Goals and Structure

This paper seeks to advance two main goals.

The first goal is to indicate the scale of the investment deficit and explain why it exists. We believe an honest assessment of the data leaves no doubt that the currently dominant approach for advancing the transition to renewable energy is failing and that there is no basis on which to believe it can succeed. Globally the growth of renewables under the current approach is inconsistent, unpredictable, costly, and—most importantly—far behind schedule.

The unwavering commitment to a profit-driven "green growth" approach to scaling up renewable energy has prioritized policies designed to "mobilize private sector investment," both in renewables and in other energy transition areas, such as energy storage and conservation. Pointing to the prospects of abundant wealth and profit in investing in the green economy, leading "green growth" advocates like Nicholas Stern, former chief economist of the World Bank, have created what we suggest might be—given the stakes involved—the "greatest policy failure ever." The anticipated levels of investment have failed to materialize, and deployment levels have lagged far behind the technical potential of renewables.

Instead of acknowledging the failure of this approach and seriously considering public alternatives, in recent years the dominant policy has sought to establish "certainties" for private investors by way of "public-private partnerships" (or "P3s," sometimes also called "PPPs"). In reality, such "partnerships" amount to elaborate schemes to use public resources—whether present-day taxes or future fees from users—to enhance private gain. In the process, their widespread adoption has wrought chaos on power generation systems in many countries—not only for renewables, but also for traditional sources, with damaging implications for the development of the technical and institutional infrastructure necessary for any smooth transition to renewable energy in the years ahead.

The second goal of this paper is to further encourage the global trade union movement to advocate more confidently and more forcefully for public renewable power, where public financing is used to expand and enhance social ownership and democratic control, and to advance a "just transition" for workers across the energy sector.

As we describe in some detail below, public money—in one form or another—is already responsible for the bulk of the world's renewable energy deployment. Current trends therefore support the case for such a publicly driven approach and should put an end to the idea that the energy transition we desperately need is dependent on the calculations and proclivities of private investors.

Building on the work of others in and around the international labor movement, we believe that unions can support a planned, coordinated approach to the energy transition within a framework of knowledge sharing and cooperation across regional and national boundaries. This offers a viable alternative to the chaotic and crisis-torn current approach. Unions can and should play a leading role in mapping, developing, and pursuing such an alternative pathway. They increasingly show a willingness to do so.[5]

After providing some background, the paper is divided into five main sections, followed by a conclusion.

The first section shows how current levels of investment in renewables, while generally trend-

ing upwards in recent years, fall far short of the levels needed to achieve the "decarbonization" objectives presented by major institutions and do not even begin to allow us to realize the technical potential of renewable energy resources and technologies. We also show that, although the world's major policy institutions acknowledge the investment deficit and recognize its implications, they are stuck in a policy "echo chamber," in which the same misguided prescriptions are repeated and the same fading hopes reiterated in a classic "group think" pattern.

The second section shows how the main assumptions, policy initiatives, and mechanisms put in place to stimulate investment in renewable energy have turned out to be severely flawed. Here we revisit the main arguments of the *Stern Review*, the landmark 2006 study on the economics of climate change, which asserted the primary role of the private sector, the efficacy of competitive electricity markets and carbon pricing as means to promote renewables, and the need for government policy to "send signals" by way of a "sticks and carrots" approach to escort green business from the economic margins to the mainstream.

The third section shows how governments, both anticipating and responding to the limits of Stern's characterization of mitigation as an "investment opportunity," have used subsidies and "certainties" in the form of P3s and power purchase agreements (PPAs) to attempt to bring renewable energy to levels that can reduce emissions significantly and meet climate goals. By protecting renewables from the market (using "out-of-market" measures) governments have compensated for the failures of the competitive market, leading to a situation where public institutions are committing resources as a means to "leverage" private capital. We show how this story has unfolded in the EU and how such an approach has not solved the underlying problems facing renewables—namely their inability to generate sufficient levels of profit for investors. We also show how this approach has led to a destructive economic and political conflict between various for-profit energy interests.

In the fourth section, we look at the impact these "out-of-market" measures have had on traditional utilities and the entire energy system. This is an area that receives limited attention but, as we attempt to show, is crucially important to any significant energy transition in the years ahead. We also show how problems of "energy market design" are likely to continue to impose pressure on renewables.

In the fifth section, we examine several additional features of the current investment regime that have emerged in recent years: the potential role of institutional investors, the persistence of public-private partnerships (P3s) in energy, the "financialization" of P3s, and the shifting roles of public and private actors. We also look at the reasons behind the very recent emergence of "green bonds" and long-term financing for renewables.

In the concluding section, we briefly summarize union policy at the international level. Here we see a growing confidence in publicly driven alternatives—but also a lingering support for the "green growth," for-profit framework articulated by the likes of the World Bank. We then spell out the main arguments for public financing and public renewable power and the need to challenge the existing approach to investment in renewable energy.

Climate, Carbon, and the Central Role of Renewables

There are multiple reasons why reliance on fossil fuels needs to be dramatically reduced. The devastating impacts of air-born pollution from the use of fossil fuels on human health are well documented,[6] and these impacts on their own would be a strong argument against the contin-

ued use of fossil fuels wherever other options exist. While the health and environmental impacts associated with the boom in hydraulic fracturing (fracking) for oil and gas are hotly disputed by the industry itself, reports from affected people and communities and increasing scrutiny by health experts indicate cause for very serious concern.

But it is fossil fuels' contribution to climate change through warming temperatures that has generated the greatest concern. The prospect of severely disruptive climate change scenarios has led to a dramatic increase in scholarly and political attention to energy systems and how they might undergo a transition to low-carbon forms of generation.

The past decade has seen the publication of various studies highlighting the potential of renewable energy to meet most if not all of the world's energy needs within just a few decades, particularly if these are combined with serious pursuit of efficiency gains and reasonable conservation measures.[7] In the United States, the recent eruption of controversy around the work of Mark Jacobson and colleagues may highlight the fact that while there is still significant technical work to be done regarding transition scenarios, the kind of transition we must carry out will also have much broader social, economic, political, and other implications.[8] It seems beyond dispute that any transition taking seriously both the conclusions of the scientific community and the wishes of the public must rely heavily on renewable energy technologies and in the process must help limit the damage from a warming climate; improve health and quality of life; and create large numbers of useful, productive, and satisfying jobs.

With such an aim in view, it is widely recognized today that the potential of renewables will need to be *fully* realized in order to achieve the targets agreed at COP21 in Paris to keep overall global warming "well below two degrees" and achieve "net zero emissions" by the second half of this century. This potential will need to be *fully* realized in order to protect the health of millions of people suffering the impacts of burning fossil fuels, to provide electrical power for the one-billion or more people who currently have no clean source of energy, and to preserve as far as possible the levels of well-being achieved through the use of once-abundant and—in economic terms—inexpensive fossil fuels. The energy transition cannot, therefore, be partial; neither can it be unhurried. According to a 2017 joint IEA-IRENA study:

> *Limiting the global mean temperature rise to below 2°C with a probability of 66% would require an energy transition of exceptional scope, depth and speed. Energy-related CO2 emissions would need to peak before 2020 and fall by more than 70% from today's levels by 2050.*[9]

That policymakers would wish to focus on reducing greenhouse gasses (GHGs) in power generation in achieving climate commitments is easily explained. The proportion of global GHGs related to energy is larger than those produced by any other sector, by some distance, and power generation, at 25%, is still the largest single contributor.[10] Full decarbonization of power generation also offers a means—perhaps the only realistic means—of decarbonizing transportation and heating systems, provided that enough renewable energy can be generated to meet these additional needs.[11] Since 2000, power sector emissions worldwide—despite the decade-long growth of renewables—have increased by more than 45% while electricity demand has increased by more than 50%.[12] Decarbonization would thus require existing trends to be stopped and then reversed—and quickly.

Mitigation and Markets

Roughly a decade ago, various plans and proposals began to emerge that were designed to help reach consensus on the timetables and

targets needed, in the Intergovernmental Panel on Climate Change's (IPCC) words, to "reduce the sources or enhance the sinks of greenhouse gases."[13] Principal among these "mitigation scenarios" were those presented in the IPCC's Fourth Assessment Report (AR4) released in 2007.[14] Concurring with the International Energy Agency,[15] AR4 asserted that low-carbon technologies—including carbon capture and storage (CCS) and nuclear power—would need to be quickly developed and deployed. The IPCC's scenarios also informed the UN's Sustainable Development Goals for 2030, specifically "Goal 7: Affordable and Clean Energy," to address issues of access, renewable sources, efficiency, research and development, and infrastructure.[16]

What these scenarios have in common is the singularly important role ("mitigation contribution") they attribute to renewable energy as a means of reducing GHGs. Furthermore, wind and solar technologies were already proven, relatively safe, and generally enjoyed public support. Geothermal and tidal power could also play a significant role over the longer term. With prices of renewable energy technologies falling, the economics seemed to point to a massive scale-up of renewables in the decades ahead.

Either way, it was widely accepted that deployment of renewable energy needed to be rapidly stepped up.[17] A decade later, this is still very much the case. A March 2017 assessment from the IEA and IRENA estimated that the share of renewable energy "needs to increase from around 15% of the primary energy supply in 2015 to 65% in 2050." On this scenario, "Energy demand in 2050 would remain around today's level due to extensive energy intensity improvements. Around half of the improvements could be attributed to renewable energy from heating, cooling, transport and electrification based on cost-effective renewable power."[18] These levels of deployment would be the minimum required in order to address rising emissions in the power sector.

"The Private Sector Must Lead"

As we describe below, the major policy institutions drew up a menu of policies to support to decarbonization of power generation. These policies were guided by several core assumptions. Principal among these was the need to price emissions (the "polluter pays" principle). This was intended to discourage investment in carbon-intensive economic activity, promote energy efficiency, and to provide a consistent policy anchor to incentivize the development of a robust renewable energy industry. If the carbon price were high enough to discourage investments or "business as usual" practices in carbon-intensive sectors, few doubted that renewable energy would provide the private sector with attractive returns for decades to come.

At the time, the idea that the private sector could and should take the lead in driving large-scale renewables went largely unchallenged. The role of governments was to "send signals" to the market by establishing clear targets and timetables for emissions reductions via a strong global and science-based climate agreement to succeed the Kyoto Protocols and national commitments that were consistent with an emissions reduction "pathway" (in the case of the more developed economies) or a flattening of "emissions trajectories" (in the case of the major developing countries).

No "Adequate Returns on Investment" on a Dead Planet

More than a decade has passed since these mitigation scenarios and related projections emerged. By now, it is clear that the full potential of renewable energy to reduce emissions and decarbonize power generation is not being realized—not even close. As we showed in *Energy Transition: Are We Winning?*, the deployment of wind and solar power has increased

significantly, and at times quite impressively. However, the deployment is still not happening at anything like the speed or scale required to achieve any of the most significant mitigation scenarios proposed more than a decade ago.

And time, it seems, is running out. In April 2017, former UN climate chief Christiana Figueres headlined the launch of a new global climate initiative under the banner, "Mission 2020." The initiative's new report, *2020: The Climate Turning Point*, drew attention to the fact that, to be consistent with the target of keeping warming "well below two degrees Celsius," adopted in Paris during COP 21, emissions should start to fall after 2020. While renewables and green investments have made huge strides over the past decade, "it is clear from all of the calculations that annual investment in climate action by 2020 needs to be well beyond $ 1 trillion."[19]

Mission 2020 repeats familiar talk of "milestones" that need to be reached. One important milestone, the report claims, is that, by 2020, the financial sector will need to have "rethought how it deploys capital" and will need to be "mobilizing at least $1 trillion a year for climate action," with most coming from the private sector.

But the future of human civilization cannot be allowed to depend on whether the tiny fragment of humanity that comprises the financial sector has sufficiently "rethought how it deploys capital." Since Nicholas Stern himself raised the specter of civilizational crisis more than a decade ago in his flagship report, *The Economics of Climate Change*, investment patterns have barely changed. After a decade of inaction and accumulating danger, ritualistic calls for "more ambition" ring increasingly hollow.

The primary obstacle that stands in the pathway to an energy transition is the political and ideological commitment, on the part of the major institutions and policy think tanks, to package the transition as a large profit-making opportunity. On this logic, there can be no transition without profit. The problem is this: there is currently not enough profit in renewable generation (or in energy conservation, storage, etc.) to generate the level of investment that can deliver the deployment of renewables on a for-profit basis at the speed and scale required. By contrast, a not-for-profit "public goods" approach to the energy transition can radically alter the prospects of renewables and allow us to effectively pursue climate and decarbonization targets.

Part One: Investment Deficit Realities

This section shows how current levels of investment in renewables, while generally trending upwards in recent years, fall far short of the levels needed to achieve the "decarbonization" objectives presented by major institutions and do not even begin to allow us to realize the technical potential of renewable energy resources and technologies. We also show that, although the world's major policy institutions acknowledge the investment deficit and recognize its implications, they are stuck in a policy "echo chamber," in which the same misguided prescriptions are repeated and the same fading hopes reiterated in a classic "group think" pattern.

As noted above, by "investment deficit" we mean the discrepancy between the current levels of investment in renewable energy and the levels of investment that are widely considered necessary to meet the science-based emissions

targets and temperature thresholds articulated in the 2015 Paris Climate Accord: "well below two degrees Celsius" and "net zero emissions."[20]

Major policy institutions like the IEA, the World Bank, and the World Economic Forum all acknowledge that the investment deficit exists. In its *World Energy Investment Outlook* (WEIO) released in 2014, the IEA's concern about the investment deficit is made extremely clear:

> *The investment path traced in the (WEIO) report falls well short of reaching climate stabilisation goals, as today's policies and market signals are not strong enough to switch investment to low-carbon sources and energy efficiency at the necessary scale and speed.*[21]

Two years later, the IEA calculated that investment in renewables had been $286 billion in 2015, and noted that, "Globally, energy investment is not yet consistent with the transition to a low-carbon energy system envisaged in the Paris Climate Agreement."[22] Overall, the annual investment deficit in what the IEA refers to as "clean energy" is estimated to be $600 billion annually, although—as noted above—the investment gap in renewables for power generation is less pronounced.

According to Bloomberg New Energy Finance (BNEF), total global investment in renewable energy was at "worryingly low" levels for 2015—despite the fact that 2015 had been a record year.[23] Reflecting on these trends, the Climate Policy Initiative—a non-profit that advises major institutions and government agencies on energy and land use policies and business practices, with a special focus on finance—reached an alarming conclusion: "The cumulative gap between finance needed and finance delivered is growing, putting globally agreed temperature goals at risk, and increasing the likelihood of costly climate impacts."[24]

According to a 2017 study by IEA-IRENA, investment in renewable energy will need to be more than double 2016 levels by 2030, at around $600 billion per year, in order to be consistent with keeping warming below two degrees Celsius. This adds up to approximately $14 trillion of investment in combined wind and solar generation.[25]

Renewables' Growth Is Real

To some extent, the investment deficit is concealed behind a constant stream of "good news" headlines about renewable energy trends. The deployment of renewables is indeed growing rapidly. Total global wind power stood at 73 GW in 2006. By 2016 it had grown to nearly 487 GW—an almost seven-fold increase.[26] Globally, wind additions totaled 54.6 GW in 2016, lower than the previous year's record of 63.6 GW added, but still a significant addition. During the same ten-year period, solar PV increased from 6.5 GW to 303 GW of installed capacity globally, according to the European Photovoltaic Industry Association. Solar added 50 GW in 2015 alone—a 25% increase over 2014[27]—and another 75 GW in 2016. In 2016, all renewables set another new record, with 161 GW in total new installations.[28]

Investment levels, too, have shown rates of growth that would normally be impressive. When compared to several years ago, financing for renewable energy—currently around $300 billion per year globally—has seen a major expansion. Mainstream bodies like the IEA all agree that renewable energy will continue to make advances in the decades ahead as investment levels trend upward. The dramatic fall in the cost of wind and solar technologies and installation has instilled the belief that modern renewables will soon be able to compete economically with fossil-based generation, thus reducing the need for subsidies and other forms of policy support. In 2016, global investment levels in renewable energy fell 17% from 2015 levels, to roughly $242 billion, and investment levels have fluctuated significantly

since 2011 after several years of uninterrupted expansion. However, with costs continuing to fall, the lower dollar amount in 2016 still produced a 9% increase of installed capacity over the previous year.[29]

Renewables Still on the Margins

As encouraging as the recent growth of renewables appears to be, however, it has to be viewed against the backdrop of overall global energy trends. As we showed in *Energy Transition: Are We Winning?*, the growth of renewable energy, while impressive when viewed in isolation, has done little to displace fossil-based energy in the global economy, or even to begin to challenge its dominance. Citing a range of data sources, the paper showed how the most common explanations for the slow pace of transition—among them a "lack of political will" or "inadequate levels of political ambition"—tell us very little about the dynamics of accumulation that drive the global economy, how those dynamics impact energy production and use, and the overall evolution of energy systems.

Today, "modern renewables" like wind and solar remain very much on the margins of the global energy system. At the end of 2015, wind and solar PV together generated just 4.6% of global electricity. According to the World Economic Forum's (WEF) *Global Energy Architecture Performance Index Report*, the growth of renewables has been impressive but has done little to alter the composition of energy consumption, which "changed very little from 2010 to 2014."[30]

Choosing to "accentuate the positive," Figueres' *Mission 2020* notes, "In 2015, investment levels reached $286 billion worldwide, more than 6 times that in 2004. Over half of that investment, $156 billion, was for projects in developing and emerging economies." But in order to be consistent with the target of keeping warming "well below two degrees Celsius," investment levels need to be *much* higher—especially since investment in other mitigation options (principally carbon capture and storage technologies and nuclear power generation) has also fallen behind the levels proposed by the IPCC and IEA.

Investments in Fossil Fuels Are Higher than Investments in Renewables

Global investments in fossil fuel-based energy stood at around $950 billion in 2013, more than double in real terms the year 2000 figure and more than three times the annual amounts invested in renewables.[31] According to the IEA, total investment in the energy sector reached $1.8 trillion in 2015.[32] In its more comprehensive *World Energy Investment Outlook Report* of the previous year (2014), the IEA had noted that, of the $1.6 trillion invested in energy that year, fully $1.1 trillion "went to extracting fossil fuels, oil refining and building power plants that burn fossil fuels." So while the growth of investment in renewables in recent years is indeed impressive, the majority of energy-related investment continues to be in fossil fuels.[33]

Growing Pressure on Renewables

One frequent point of reference for those committed to the current approach is the fact that, for electricity generation, investment in new, renewables-based generation capacity has exceeded new fossil fuel-based capacity for at least three consecutive years. This difference was largest in 2015 and occurred despite the sharp decline in fossil fuel prices that year.[34]

Despite these gains, investment levels today remain particularly low in certain key areas that will be profoundly important over the longer term. For example, according to the IEA, investment in electricity storage for renewables stood at roughly $10 billion in 2015—a level that is, says the IEA, "nowhere near big enough to allay fears of a shortfall in dispatchable capacity."[35]

Studies by the IEA, IPCC, and others assume that decarbonization of power generation will also require considerably more nuclear power as well as commercial-scale carbon capture and storage (CCS) projects for power generation and industry. Currently, neither CCS nor nuclear power appear likely to attract the levels of investment or subsidies needed to play the role assigned to them on these scenarios. CCS in particular has suffered major setbacks in recent years, with more than forty projects either cancelled or put on hold.[36] According to the IEA, in mid-2017 only seventeen projects were still active globally.[37] And while, globally, roughly sixty nuclear power stations were under construction in 2017, the IEA's "Two Degrees Scenario" (2DS) proposes that nuclear capacity will need to grow from 390 GW (2017 data) to 900 GW by 2050, and nuclear will need to increase its share of power generation from today's eleven percent to sixteen percent.[38]

There are additional challenges that, while beyond the scope of this paper, need to be acknowledged. Particularly significant is the need to electrify large parts of the transport sector, particularly motor vehicles. This will likely require *even more* electricity generation capacity from renewable sources. In the words of IEA-IRENA, "Electrifying road transport at the pace and scale required [to meet the 2°C scenario] is an enormous task: the share of electric cars in passenger car sales would rise from less than 1% today to almost 70% in 2050." According to the IEA-IRENA 2017 report, this transition would require approximately $15 trillion of investment between 2016 and 2050. The report notes, "The electrification of road transport implies significant investment across the whole chain value, from R&D in battery capacity and robustness, to the upgrade of the grid to meet possible local surplus demand and the deployment of charging stations for cars and catenary lines for trucks. Their quantitative assessment would require a further analysis."

The need to power domestic and industrial heating systems on electricity from renewable sources, rather than from gas or oil, will also require additional renewable energy capacity, barring some technological breakthrough. Various technical solutions to this challenge are being actively pursued. The most promising among them involve the substitution of hydrogen-based heating systems for those based on methane, but the underlying technologies for the production of hydrogen at scale are in their infancy, and viable, scalable solutions are likely to be many years away.

Taken together, all of this means that renewables will likely need to play a *much larger* role in reducing emissions from both power generation and other sectors than was anticipated a decade ago, when the IEA's and IPCC's decarbonization scenarios were first proposed. Therefore the investment requirements for renewables in the coming decades are likely to be *even larger* than currently estimated.

Capacity Factors

Discussions of renewable energy often pay insufficient attention to the important question of "capacity factors." For example, for every megawatt of installed wind or solar generation, the level of actual electricity generated only reaches a certain percentage due to the variable nature of wind and sunshine. Finding ways to store this "variable renewable energy" (VRE) will allow a higher percentage of the energy actually generated during windy and sunny periods to be used, but this requires investment in storage technologies. Similarly investment is needed to upgrade electrical grids in order to accommodate VRE from wind and solar PV. According to the IEA, investments in this are also currently inadequate.[39]

The technical challenges posed by VRE are frequently a subject of heated debate over whether or not these challenges can be adequately addressed and overcome. But it is generally accepted that, as long as the contribution from wind and solar to the electricity mix does not exceed a few percentage points, the integration of renewables into existing grid infrastructure poses few technical challenges. The IEA has warned that, as VRE enters its next generation of deployment and begins to constitute a significant proportion of the overall energy mix, "the issue of system and market integration becomes a critical priority for renewables policy and energy policy more broadly."[40] A recent report from REN21 explores changes to electricity systems that may help address these challenges.[41] However they are addressed, overcoming them remains of major importance to a full transition to renewable energy.

As shown below, "system integration" poses one set of challenges, but "market integration" is a challenge that is very much the product of enforced competition between different forms of generation, where what is needed—indeed absolutely essential—is planning and coordination between them.

Waiting for the Miracle to Come?

We noted above that the major institutions and policy think tanks all acknowledge that the investment deficit exists. None, however, seems willing or able to recognize *why* the dominant, market-driven paradigm—which has left an investment deficit that continues to accumulate year-on-year—has failed, or to consider approaches that depart from it.

The International Energy Agency

Noting that the decarbonization of power generation alone would require an *additional* $9 trillion above "business as usual" projections by 2050, the IEA points to the need for an "investment framework aimed at encouraging rapid, large-scale deployment of low-carbon technologies" in order to "steer the transformation of the energy system in a timely way in order to jointly achieve climate and energy security objectives."

In 2015, the IEA expressed hope that the Paris Agreement would create "a different investment landscape," but it did not stipulate what that landscape might look like or how it would differ from the pre-Paris landscape, other than to point to the importance of "removing obstacles" and "policy consistency" as well as "new financing vehicles" that might "make re-

newables more competitive" and thus reduce the need for subsidies.[42]

IEA Executive Director Maria van der Hoeven had warned a year earlier, however, that the needed investment "won't materialise unless there are credible policy frameworks in place as well as stable access to long-term sources of finance [...]. There is a real risk of shortfalls." The Agency's Chief Economist Fatih Birol also warned, "These [financing] goals won't be achieved without mobilising private investors and capital, but if governments change the rules of the game in unpredictable ways, it becomes very difficult for investors to play."[43]

Noting the commitments made in Paris, in March 2017 the IEA and IRENA jointly developed a "sub-2°C Scenario" in order to offer a development pathway that could be compatible with the goals adopted in the Agreement. Achieving this goal "is technically possible," but will require "significant policy reforms, aggressive carbon pricing and additional technological innovation."[44]

In July 2017, the IEA noted that, over the past five years, new wind and solar installations globally had been "almost entirely offset by the slowdown in nuclear and hydropower investment decisions, which declined by over half over the same time frame." In other words, renewables had done almost nothing in terms of displacing the use of fossil fuels in power generation. It added:

> *Investment in new low-carbon generation needs to increase just to keep pace with growth in electricity demand growth [sic], and there is considerable scope for more clean energy innovation spending by governments and, in particular, by the private sector.*[45]

The World Bank

In order to generate more investment in renewables, the World Bank believes it "will ultimately be essential for the bulk of the capital to be provided on commercially sustainable terms from conventional capital markets and financial institutions."[46] The Bank's proposals to address the investment deficit have tended to focus on how governments should ensure that companies tell investors about the potential risks of investing in fossil fuels:

> *One approach is to increase the level of disclosure that firms have to make to investors about their carbon-intensive activities and assets so that investors can assess the materiality of these risks and allocate capital accordingly. This will allow investors to better understand the exposure of firms to emissions* that are not currently priced or to higher carbon prices in the future.[47] (emphasis added)

In other words, the World Bank places crucial reliance for containing carbon emissions and activating investment capital for renewables on *investors' anticipation of future risk associated with hypothetical future costs*.

It is difficult to take seriously the Bank's idea that a significant body of investors might today be influenced by the threat of carbon prices (which have not yet even been imposed), especially when the likelihood of establishing an effective carbon price globally currently appears to be extremely low. Similarly, the Bank does not explain how, if investors turn away from "high-carbon investments," this will translate into an increase in investments in renewable energy—when there are almost certain to be available less risky and more profitable investment opportunities outside the energy sector entirely.

World Economic Forum

Forever upbeat, the World Economic Forum's (WEF) *Global Energy Architecture Performance Index Report* states that the past five years have seen "momentous shifts," adding that "the energy system has started to turn, much akin to

a colossal tanker pointing in a new direction but still very far from its destination." But evidence for this assertion is hard to find, even within the WEF's own account. As noted above, the composition of energy consumption has changed very little from 2010 to 2014, with the share for renewables growing just 1.4%. Speeding things up will therefore require, "Innovative approaches [...] to ensure an attractive investment environment." For the WEF, governments must establish a "long term frame" and stick to it so that investors know that there will be no sudden change of course.[48]

The main point to be drawn from these three cases—the IEA, the World Bank, and the World Economic Forum—is this: the world's major policy institutions acknowledge the investment deficit and its implications, but have remarkably little to offer that can guide policy in addressing it. They take as given that "we need more private investment," but offer essentially nothing beyond vague truisms in their attempts to explain why this investment has not already materialized. Private investors, we are told, will eventually deliver once more "certainties" are in place and more "obstacles" removed.

Part Two: The Greatest Policy Failure Ever?

Given that the need for renewables to play a much larger role in keeping global warming within the two degrees Celsius limit is widely recognized and their technical potential to do so is quite firmly established, it is necessary—indeed urgent—to ask why investment levels remain inadequate.

Privatization + Liberalization = Decarbonization?

In order to begin to answer this question, it is important to remember that policies to promote renewables in OECD countries were introduced *after* considerable privatization of electricity systems and liberalization of those countries' electricity markets. In the EU, the "Internal Market in Energy" directive passed down to EU member states in 1996 made power plants operate as commercial enterprises. Wholesale and retail markets were created to impose competition. Transmission and distribution systems became "unbundled."

Similar measures were introduced in numerous countries beyond the EU.[49] Many of the "structural adjustment programs" imposed on the global South by the IMF and the World Bank from the 1970s to the 1990s contained "conditionalities" on borrowing that required privatization of electrical power and other public services.

The rapid initial growth of renewable energy in the EU under such a policy regime fueled the impression that such an approach was both responsible for this growth and could be expected to continue to produce it, including beyond the EU itself. As a consequence, privatization and liberalization came to be viewed as not only compatible with decarbonization but as necessary conditions for achieving it. In 2007, the European Commission stated, "[A] competitive market will help to fight climate change. Energy efficiency will improve in all parts of the supply-consumption chain. The Emissions Trading Scheme, an important measure for cutting emissions, will only function in a competitive market environment."[50]

On this view, widespread privatization and liberalization of electricity markets offered the only way forward for renewables. In the

Commission's eyes, privatization and liberalization would promote investment that would simultaneously provide the capital to replace aging generation infrastructure and open the market to new players, such as renewable energy companies. According to the Commission, "Boosting investment promotes innovation, in particular in energy efficiency and renewable energy, which are important factors in the fight against climate change."[51]

Building on the Public Services International Research Unit's (PSIRU's) invaluable work in this area, we will now describe how, along with many other negative consequences, a key element of the legacy of privatization and liberalization is that it has proven to be a massive impediment to the development of large-scale renewable power—including within the EU.

The Stern Review: Mitigation Is an Investment

In the mid 2000s, concerns about climate change grew dramatically following the IPCC's *Fourth Assessment Report* (AR4) and the occurrence of extreme weather events, such as the 2003 heat wave in Europe, which claimed 70,000 lives, and Hurricane Katrina's decimation of New Orleans in the United States.

In 2006, responding to the need to quickly develop a coherent and effective policy framework, Nicholas Stern, former Chief Economist of the World Bank, made headlines when he told the world, "The science tells us that greenhouse gas emissions (GHGs) are an externality; in other words, our emissions affect the lives of others. When people do not pay for the consequences of their actions we have market failure. *This is the greatest market failure the world has seen*."[52] To address this market failure, Stern and his co-thinkers produced a landmark 2007 study titled *The Economics of Climate Change*, which became known as the "Stern Review."

Stern saw that, alongside its undisputed "successes," economic growth had also produced some major problems, principal among them the "market failure" of un-priced externalities, such as GHG emissions. GHG levels and climate change, Stern argued, could be addressed by policies that would incentivize "green" investments (which it was believed would be profitable over the longer term) and by "disincentivizing" carbon-intensive economic activity. Therefore, Stern argued, reducing emissions "must be viewed as an investment, a cost incurred now and in the coming few decades to avoid the risks of very severe consequences in the future. If these investments are made wisely, the costs will be manageable, and there will be a wide range of opportunities for growth and development along the way. For this to work well, policy must promote sound market signals, overcome market failures and have equity and risk mitigation at its core."[53]

At the heart of Stern's vision was the need to price carbon. On the model envisaged, this price would rise incrementally over time, allowing investors and markets to adjust.

The carbon price was considered to be the most important policy mechanism, but a more comprehensive "sticks and carrots" approach, Stern believed, would do most of what was otherwise required to bring about a "green growth" transition at the global level. These policies were endorsed and adopted by major institutions like the World Bank, the IMF, the European Commission, and UNEP, and they became—and to a large extent remain—the established wisdom.

Two essential features of Stern's approach bear emphasizing. First, it reflected a firm belief that private investors—and the private sector more generally—would commit sufficient investment to avert the economic damage the climate crisis would unleash. Second, it took for granted that those who thus committed would be rewarded by attractive returns on their investments. Since

the amounts of capital needed to bring about a full-on transition to a low-carbon economy runs into many trillions of dollars, Stern also posited that institutional investors and other private interests have access to the levels of capital required, whereas governments—once the driving force in energy-related investment—were purportedly too broke to develop large-scale renewable power and carry out the other transformations needed across the major economic sectors. There was, in a phrase, "no alternative" but to make investing in renewables and the "green economy" attractive to private investors in order to assist in the development and maturation of new markets and technologies.

An Active Role for Governments

Significantly, Stern's approach departed from what had been one of the core pillars of neoliberal policy: that governments must "get out of the way" and allow markets to determine prices and outcomes. Aware of the threat of climate instability, Stern articulated a more actively "interventionist" role for governments, albeit "at arm's length." Carefully crafted policies could shape economic activity and market responses by sending clear "market signals." There was no need for governments to step in with heavy-handed "command and control" measures but neither could they play the role of passive observers. Stern maintained that the overarching policy goal was to create an environment conducive to private sector investment in low-carbon economic activities in order to foster "green growth" across the economy.

It is also worth remembering that the main thrust of neoliberal policy-making since the early 1980s had been to reduce business costs by driving down wages, removing labor market protections, eliminating regulations of various types, and imposing other cost-reducing measures. Stern recognized that a carbon price, along with incentives and subsidies for renewables, would initially *increase* costs—but he argued that this would ensure growth and profits *over the longer term* while protecting the economy from the massive external threat of climate instability. Once emissions were priced, with the carbon price increasing incrementally over time, Stern predicted an inexorable transition towards a more sustainable, low-carbon world—one driven by investments in renewable energy, energy conservation, and green technologies.

Following Stern's lead, the major policy institutions put in place a "sticks and carrots" approach to developing renewable sources of power. Renewables were needed, but at the time of the Stern Review and the IPCC's *AR4*, they were not yet in a position to compete head-to-head with coal and gas. Consistent policy support from governments, the institutions reasoned, could create a robust renewables market. Costs would fall as a result of economies of scale, further innovations, and "learning by doing." Renewables would then be on course to achieve "grid parity" with coal and gas in terms of price. Subsidies could then be phased out.

It is important to note that the competitive electricity markets introduced in Europe, North America, and more recently, in key developing countries of the South were not expected to impede the penetration of renewables over the longer term. In fact, renewables, having no fuel costs, enjoying political support reflected in deployment targets, and aided by a price on carbon, would not only be able to compete with fossil fuels but would ultimately largely displace them. As David Robinson, Senior Research Fellow at the Oxford Institute for Energy Studies, notes: "In principle, apart from ensuring that the EU's ETS (Emissions Trading Scheme) worked properly and sent adequate price signals, no other intervention would be required to encourage decarbonization of the

electricity sector."[54] Further liberalization and privatization would only improve renewables' prospects in that "incumbent" fossil-dependent generators, with their aging infrastructure, would steadily lose market share. Investors, aware of the facts that the underlying economics were shifting toward renewables and that renewables enjoyed considerable policy support, were expected to flock to wind and solar. The energy transition, it was believed, was indeed "inevitable."

The Carbon Price: Still Missing, After All These Years

More than a decade after the Stern Review, carbon pricing and emissions trading schemes have failed to perform as expected. The European carbon market (the EU ETS) is currently a shambles, with the carbon price far too low to have any measurable impact on emissions levels.[55] One Cambridge University energy economist has described the EU ETS as "a complete disaster," adding, "We have seen the fluctuations in the carbon price which undermine any confidence that banks would have on lending to low-carbon technology."[56]

The World Bank's detailed annual assessment of carbon markets and taxes reported that, in 2016, only 13% of global GHGs were covered (or "scheduled" to be covered) by a price, although World Bank data for 2017—still being compiled—suggests that this figure is currently closer to 15% of global GHGs.[57]

The limited level of coverage should be a major concern, but so should the actual price of emissions under the various schemes. In 75% of cases, the price was below ten dollars per ton of CO_2. Citing both IPCC and IEA sources, the World Bank reminds us that "a global average carbon price of between US$80/tCO$_2$e and US$120/tCO$_2$e in 2030 would be consistent with the goal of limiting the global temperature increase to 2°C."[58] Revising the needed carbon price downwards, the High-Level Commission on Carbon Prices, a project of the World Bank, reported in May 2017 that, in order to be consistent with sub-two degrees Celsius target, the global carbon price needed to reach "$40-$80 per ton of CO2 by 2020 and $50-100 per ton by 2030."[59]

But according to recent estimates from the IEA and the IRENA in their 2017 *Perspectives for the Energy Transition*, "Carbon prices in 2030 will need to rise to US$120/tCO$_2$ in OECD countries and to US$90/tCO$_2$ in emerging economies for energy-related CO_2 emissions."[60] For power generation specifically, it is accepted that the carbon price will need to be higher than the economy-wide average in order "to displace existing assets where capital is sunk compared to the case where competition is between two options for investment in new power generation facilities."[61]

None of this changes the fact that the vast majority of global GHG emissions today—roughly 85%—are still *not* covered by a price, and the price on those that *are* covered is often so low as to be effectively meaningless from a mitigation standpoint. Indeed, the World Bank cannot point to a single instance where carbon trading, in the decade since it was enthusiastically proposed, has had more than a barely measurable impact on emissions levels.[62] The fact that carbon prices are low—and, it seems, unlikely to rise to the levels required—means that carbon pricing probably has little bearing on investment decisions taken today with regard to new generation infrastructure projects that could be operational for decades.

It is, of course, impossible to know whether carbon prices will rise to the levels required within the timeframe thought to be consistent with the Paris targets, but if the experience of the last decade is any guide, serious doubts are more than justified.[63] In any case, one thing is clear: The

failure of carbon pricing to date cannot be reduced (as it often is) to "flaws in carbon market design." The "missing" price on carbon shines light on the clear unwillingness and/or inability of the private sector and the vast majority of private investors to engage in long term "system preservation." Large sections of business accept the need for an effective carbon price in principle but undermine it in practice by demanding free pollution permits or, in the case of energy-intensive manufacturers, by threatening to close operations and relocate to less "carbon constrained" economies.

Tellingly, the *Report of the High Commission on Carbon Prices*, released in May 2017 and co-chaired by Stern and Nobel Laureate Joseph Stiglitz, lists a number of "co-benefits" that can be generated by reducing emissions, among them lower air pollution, improved health, higher energy security, and lower expenditures.[64] Some of these co-benefits can be translated financially (such as savings from reduced fuel use) but "others cannot be directly and consensually assigned a monetary value" since they "are not monetized, quantified, or even identified by decision makers and businesses." In other words, the social benefits of reducing emissions are economically invisible to the very people and entities expected to make the kind of investment and business decisions needed to put the world on the path to a low-carbon and sustainable world.

There are several important lessons to be grasped here. As noted by PSIRU in a 2013 paper titled *Renewable Energy*, in the context of the compulsory internal electricity market, renewables could only flourish if cheaper fossil-based energy (for electricity as well as other uses) was made more expensive. This was the goal of the carbon price. As a "market mechanism" the price was intended to discourage the use of fossil fuels and to make investments in fossil fuels less attractive. As the paper notes, the EU's ETS has been unable to achieve this goal:

> *It is now clear that the climate change policies are incompatible with the market rules [...]. An attempt to provide a market solution by creating a carbon trading scheme, the ETS, failed.*[65]

In a companion PSIRU paper published the same year, *Energy Liberalisation, Privatisation and Public Ownership*, the same authors described how liberalized energy markets in Europe came under "great pressure," leading to a situation in which European governments began to create "mechanisms to develop renewable energy which involve public spending and the public sector."[66]

In the next two sections, we will look in more detail at how various "out-of-market" mechanisms were developed and introduced in the EU context. With the European Union positioning itself as the world leader in renewable energy development and ambitious climate goals, these mechanisms were designed to stimulate investment and thus drive the further advance of renewables across the region. Despite early successes, the progress of renewables in the European Union is currently in serious jeopardy. Developing further the conclusion reached by PSIRU in 2013, the obstacles facing renewables in the EU can be traced back to the impacts of privatization and liberalization. Rather than deal with those problems directly by reforming the power sector *as a whole*, policy makers at the European Commission have tried to protect renewables from market competition as a means to guarantee the revenues and profits of private investors and developers. Despite these efforts, investment levels in renewables have fallen dramatically.

Part Three: The "Out of Market" Experience

In this section we show the role governments have played in the effort to drive renewables forward and how public funds have been used in the hope that they might leverage or mobilize additional private capital. Focusing on the EU as a crucial pattern setting context for such efforts globally, we show how private renewable companies have been protected from market competition in order to provide certainties and guarantee revenues. In essence, public funds have been used to make profitable what would otherwise have been unprofitable.

The EU: Renewables Pioneer

In the discourse on energy policy, the European Union has received accolades for making a solid political commitment to renewable energy. During the ten years leading to 2015, this political commitment provided the platform for the rapid deployment of wind and solar power. In 2015, renewables had reached 25% of installed capacity in the EU, although roughly forty percent of this capacity was provided by established hydroelectric power facilities. Modern renewables like wind and solar nevertheless accounted for roughly fifteen percent of the EU's power generation capacity.[67]

The success of the EU therefore became a point of reference for policy makers, as well as for unions and their allies, in many parts of the world. It is therefore often inferred that the EU—by supporting renewables in this way—has shown the path forward and its policies should be emulated in other regions.

As noted in the previous section, it is often asserted that the EU's success in deploying renewables is a product of the privatization and liberalization policies pursued in the 1990s. It is claimed that EU directives to restructure electricity markets created the regulatory landscape upon which "new actors" (wind and solar companies) could thrive and that liberalization and market competition are pre-requisites for an energy transition to a low-carbon future. Because fossil-based centralized power generation systems were often publicly owned, regulated, and monopolistic, high emissions have often been presented as intrinsically linked to public ownership. The "contestable" market for electricity was considered to be the best environment in which to develop renewable energy.[68]

As we show below, the opposite is true. The EU's success in deploying renewables has little or nothing to do with the so-called "competitive" electricity markets, or with the "unbundling" of key parts of the energy system described above. The EU's success is really a story of public money being used to develop a privately owned renewables sector. In assessing the rise in renewable energy over the past decade, a 2013 paper prepared for the OECD Round Table on Sustainable Development concluded that, "The most effective [policy] instruments [to spur growth in renewables] have been those that provide a predictable return to investors but shift the risk to rate payers or government budgets."[69]

It often seems to be assumed that the financial costs to the public associated with the EU approach are justified, given the urgent need to move away from fossil fuels, the significant number of jobs created, and other social and economic benefits. But this is not the central issue. Rather, the problems that have emerged in the EU—among them the recent collapse in investment levels in renewables (particularly in solar)—highlight serious flaws in the overall approach. These flaws no longer seem merely incidental, but fundamental. If this is indeed the case, then a radically different approach is called for in order to reach the deployment

levels for renewables that the science says are necessary, both in the EU and globally.

Given the wider, pattern-setting influence of the EU's approach to supporting renewable energy, a careful reckoning of the policy history and its impacts is warranted.

Political Support for Renewables

The European Union's Emissions Trading Scheme (EU ETS) was put in place in 2006 but, with the carbon price set relatively low at thirty euros per ton, was not expected to have an immediate impact on investment patterns. The EU nevertheless wanted to show global leadership on climate change and, led by Germany, also to develop its wind and solar industries as global suppliers. To that end, a 2009 EU Directive mandated: a 20% reduction of GHG emissions, a 20% share of energy from renewable sources in gross final energy consumption, and a 20% savings in energy consumption by the year 2020 (based on 2005 levels).[70] Under this "20-20-20" directive, member states were required to develop a "National Renewable Energy Action Plan" that would include information on sectorial targets. The 20-20-20 targets, in tandem with a steadily rising carbon price, were designed to "provide certainty" for private investors and to encourage continuous development of technologies that generate energy from all types of renewable sources.[71]

But in order to reach the 20-20-20 targets, many EU governments initially turned to "out-of-market" measures. Germany had pioneered the feed-in tariff (FiT) model as early as 1991, with its Electricity Feed-in Act (1991). The legislation provided for a fixed twenty-year power purchase agreement (PPA) to new generators engaged in renewables. Deployment was initially disappointing, however, which led to a series of revisions to stimulate interest. This "revised" FiT model was later incorporated in the Renewable Energy Sources Act of 2000—the framework legislation that has governed German renewable power generation in the years since. Importantly, the 2000 act also stipulated that the support to renewable electricity generators would be paid by electricity consumers, rather than by taxpayers. Transmission grid operators were also obliged to integrate the electricity produced by the renewable energy power plants and sell it on the electricity exchange.

Rising Deployment and Investment

In its revised form, the FiT model set in motion a rapid increase in deployment of renewable energy across Europe. Since the early 2000s, roughly 255 GW of renewables capacity (not including hydropower) were added—a truly impressive level.[72] In 2015, EU countries added 22.3 GW of renewables, which corresponds to 77% of the total 29 GW for all new EU power installations that year. In 2017, the EU had about 1000 GW in installed power generation capacity overall, of which around one quarter was renewables.[73]

The EU is particularly advanced in wind power. In terms of cumulative installed capacity, the EU remains the leading region with around 42.5% of the world's cumulative capacity in 2015. The EU is also the first region where offshore wind has been deployed at commercial scale with 11.5 GW of installed capacity by mid-2016, with 92% of global installations.[74]

The levels of energy consumed from renewables—at 16.4% by the end of 2015 for the EU as a whole—has put the EU well on course to meet its target of 20% of energy consumption being generated from renewable sources by 2020.[75]

The impressive growth of renewables was reflected in investment levels. Between 2004 and 2011 clean energy investment in Europe rose 600% in relation to its base value in 2004.

During this period the EU was outperforming the investment levels of China and the United States combined. Throughout 2005 – 2014, Europe had the highest shares of global new investments in renewable energy technologies, being surpassed by China only in 2013.[76] By 2014 EU countries had invested approximately €1.1 trillion in large-scale renewable energy installations.

Not only did the revised FiTs lead to the deployment of large amounts of renewable energy, the social and economic benefits—including jobs—were substantial and have been well documented.[77]

Austerity and After

However, the "out-of-market" measures (primarily FiTs) used to drive renewables brought with them unintended consequences—consequences that eventually led governments to pull back their support. The removal of this support has had a serious impact both on levels of deployment and investment levels in the period after 2012.

By 2012, fueled by the austerity narrative, the costs of supporting renewable energy had become a major political issue. A European Commission report on subsidies for renewables calculated that the FiT payments in the EU28 were €27 billion in 2012, but renewables also enjoyed investment grants (an additional €13 billion) and exemptions from energy taxes (€12 billion).[78] The report noted that, in 2012, "Around €40 billion of the interventions are paid directly by energy consumers in the form of levies." In 2016, Germany spent €25 billion, with €23 billion passed on directly to consumers through electricity bills.[79]

By any objective measure, the direct economic impacts of the FiT were regressive, in the sense that it mostly transferred resources from the vast majority of energy consumers towards investors, private renewables companies, and often to relatively wealthy homeowners and businesses that could afford and accommodate significant solar installations.

A study by the European Trade Union Institute (ETUI) that looked at Italy's support for renewables noted that landowners were set to receive 20,000 euros per hectare over twenty years for letting out fields—a price that was barely a fraction of the earnings from the subsidy itself.[80] According to the study, permits ultimately reached a value of 400,000 euros per megawatt so that "those who had bought permits for a few thousand euros for a 10 MW plant were able to resell [them] for as much as €4 million." By 2012, Italy had installed 16.4 GW of renewable power, but small producers contributed just 2.4 GW of capacity, whereas the larger producers installed 14 GW. In percentage terms, 11.7% of producers gained 85% of incentives, and the very largest producers—just 2.4% of the total—gained 77% of incentives. As the study notes, "the capital behind these investments was, in the vast majority of cases, not Italian, an issue which gave rise to further concerns about the overall progressivity of the incentives system [...]. Finally, the bill was paid by 29 million Italian consumers." Electricity bills rose quite sharply.

In Spain, attractive FiTs led to a 700% increase in solar PV capacity in the years before 2012. The government did not introduce a cap on capacity, estimating that 500 MW of new capacity would come on line; in fact, the FiT led to deployment of 3.5 GW of new capacity. But with that additional capacity, the "tariff debt" thus incurred also grew dramatically.[81]

In both Germany and Spain, tariff payments passed on to consumers raised residential consumers' electricity bills by more than fifteen percent in 2012. In Germany, a 2017 study showed how the FiTs, while raising the share of renew-

able energy to 32% of gross power production in 2015, had reached €21.4 billion annually. Because industrial consumers of electricity pay lower rates (in order to enhance their global competitiveness) the burden of the subsidy has fallen on households and amounted to roughly a quarter of the average household electricity price in Germany in 2014.[82]

The rising cost of subsidies and the regressive nature of "burden sharing" would eventually lead to important modifications in the policy support for renewables, with a gradual but decisive shift away from the original inclusive approach to FiTs towards a "winner-take-all" system of competitive bidding and auctions. This signaled an end to the period where governments extended support for all renewables projects on more or less equal terms. Competitive bidding was introduced to control the rising costs of subsidizing renewables that occurred as a result of the FiT systems' "come one, come all" approach. With the cost of wind and solar technologies falling dramatically, policy makers concluded that the subsidies could be reduced without inflicting serious harm on the industry or jeopardizing the "20% by 2020" renewable energy target.

Ending the Advance: The Case of the UK

The change in EU policy was in some respects triggered by the United Kingdom, which—quite significantly—was the first country in the EU to embark on a massive wave of privatizations in the 1980s and 1990s. How and why the change in renewables policy occurred therefore warrants attention, given what it tells us about the system-wide impacts of renewables driven by out-of-market measures.

In 2008, the UK parliament passed the Climate Change Act, which committed the UK to achieve an 80% reduction in GHG emissions by 2050 (from a 1990 baseline). A government commission set up in 2010 declared, "Urgent action is needed to help raise the scale of investment," and proposed setting up a Green Investment Bank (GIB) to "tackle the barriers and market failures limiting private sector investment in green infrastructure." These "barriers" included "high political and regulatory risk."

Ernst and Young reported the UK's decarbonization commitments under the Climate Change Act would require £450 billion by 2025, but "traditional sources of capital for investment in green infrastructure" (utility companies, project finance, and infrastructure funds) were expected to provide £50 to £80 billion, *leaving a funding gap running to hundreds of billions of pounds*. "With the Government's top priority being to tackle the deficit," the report said, "it is clear that the significant majority of investment to fill this funding gap will have to come from the private sector."[83]

In 2011, expressing concern about rising FiT-related costs, the Office of Gas and Electricity Markets (OFGEM, the national regulator)[84] reported that £1.1 billion in taxpayer subsidies was paid to producers of renewable energy in 2009-10. Of this, about £522 million was for wind power.[85]

The rising cost of subsidies was not the only problem identified by OFGEM. In 2009, the regulator warned that replacing the country's aging generation capacity and meeting the UK's carbon targets would require £100 billion of capital investment over a ten-year period.[86] Both OFGEM and the Government therefore concluded that energy market reform (EMR) was needed, arguing that without reform the UK risked a major capacity crisis over the medium to long term. In other words, there was not enough investment in the energy sector to guarantee that retired capacity would be replaced. Something therefore had to be done to address the investment deficit.

But why was there not enough investment? According to OFGEM, one of the problems was "increased risk" alongside "the uncertainty in future carbon prices" (i.e., the carbon price under the EU ETS had so far failed to change investment patterns) along with the fact that "short-term price signals at times of system stress do not fully reflect the value that customers place on supply security."[87] In other words, the entire power generation sector—from the incumbent fossil-powered and nuclear utilities to the newcomer solar and wind companies—was saturated in risk. Investors would need to be pulled back into the energy sector, and that meant eradicating risk for all suppliers.

UK Energy Policy and Climate Change

Excerpt from "Just Transition and Energy Democracy: A Civil Service Trade Union Perspective," by Public and Commercial Services Union (PCS)[88]

UK climate commitments to the Paris agreement are bound up with the European Union aim of 40% reduction by 2025 on 1990 levels. With the decision to leave the EU, the UK now has to define its own contribution to reduce greenhouse gas emissions. Fortunately for the UK we have the ground breaking Climate Change Act 2008. This sets out a series of actions for government to achieve an 80% cut in greenhouse gas emissions by 2050.

Section 4 of the Act establishes the principle of setting five yearly carbon budgets to meet this end goal. In July 2016, the government accepted the fifth carbon budget set by the Committee on Climate Change covering period 2028-2032. This sets emissions at 1,765 $MtCO_2e$ including emissions from international shipping (but not aviation). However, the government "recognises that current policies are insufficient to meet the requirements of the fourth and fifth carbon budgets."

The Energy Act 2013, is another key piece of legislation providing for electricity market reforms, including a package of measures designed to incentivise up to £110 billion of investment to update the energy infrastructure. This is largely predicated on increasing nuclear power supply, and the introduction of Contracts for Difference (CfDs) which "is a private law contract between a low-carbon electricity generator and the Low Carbon Contracts Company (LCCC), a government owned company."

This guarantees the generator a 'strike price' reflecting the cost of investment and a 'reference' price as a measure of the average market price for electricity in the UK. This is supposed to ensure a stable revenue stream to generators and protect consumers from paying higher costs when electricity prices increase. The reality however is the government has now entered into agreement over the building of Hinkley point C with a strike price that is forecast to be generating the most expensive electricity in the world.

Contracts for Difference and Competitive Bidding

In early 2012, the UK embarked on a process of "Energy Market Reform" (EMR) that led to the passage of the Energy Act of 2013. The EMR sought to sustain the levels of renewable energy deployment consistent with the 2008 Climate Change Act and the EU's climate goals while controlling both the costs of the FiT and

its negative impact on the investment environment for the power sector as a whole.

The 2013 Act introduced a regime of "Contracts for Difference" that gave renewable power developers fifteen-year "power purchase agreements" (PPAs) with "take-or-pay" clauses, where the buyer agrees to a set amount—or "strike price"—for each megawatt hour (MWh) of power produced and agrees either to "take" the power at the pre-agreed price or pay a penalty for refusing it. By locking in both volume and price for sales of new low-carbon generation at non-market prices, for fifteen years, these agreements effectively established a long-term, guaranteed, risk-free, publicly subsidized income stream for producers. CFDs also became the support mechanism for nuclear and CCS. Under a CFD, generators are paid for the electricity they sell ("energy only market"), and they are also paid, by way of a price agreed between the generator and the government, the difference between the value of the electricity sold and the available capacity (a "two-product market").

The most significant feature of this change of policy was that generators would need to bid against each other in an auction in order to win the contracts. The successful bidder would then be guaranteed a price for the electricity generated per MWh. The Energy Act set aside £15 billion in public money over a ten-year period to 2025 in order to cover the difference between the agreed price under the PPAs (the "strike price") and the revenues actually earned by the generator by selling electricity. During the first auction in late 2014, 2.1 GW of capacity had been procured, at a total cost of £315 million.[89] As with the early version FiTs, "CfD contracts would be funded entirely through a levy on consumers' bills rather than through taxation."[90] By providing "certainties" in the form of guaranteed revenues, the CFD system was expected to attract much higher levels of investment in the years ahead.[91]

Capacity Payments and Markets

The Energy Act of 2013 also introduced "capacity payments," in which power station operators would be paid for the electricity they generate and also for the capacity made available.[92] These payments were needed in order to "ensure sufficient reliable capacity is available by providing payments to encourage investment in new capacity or for existing capacity to remain open." The capacity market created by the act was "to provide an insurance policy against the possibility of future blackouts—for example, during periods of low wind and high demand—to ensure that consumers continue to benefit from reliable electricity supplies at an affordable price."[93] The government also agreed to "constraint payments" whereby wind producers would be paid *not* to generate power when the power was not needed in order to guarantee revenue to the company.

Here the UK government was not subsidizing decarbonization but felt it needed to introduce another subsidy (this time for capacity and reliability) in order to address the problems created by an unplanned and incentives-driven approach to renewables.[94]

Although the full impacts of capacity payments on the overall dynamics of renewables investment and deployment are more complex than can be fully addressed here, there is at least some basis for concern that they can hamper investment. According to Wind Europe, "The EU power sector faces an overcapacity of power generation of approximately 13% (160 GW). This puts downward pressure on wholesale power prices and undermines investments in new power generation capacity. The application of poorly designed capacity payments in some countries is making things worse. They give undue compensation to redundant power plants that otherwise would have left the market."[95]

The EU's State Guidelines Endorse Competitive Bidding

In April 2014 the European Commission published its revised *State Aid Guidelines on Environmental Protection and Energy 2014-2020*. The Commission said that the Guidelines were necessary in order to find ways of reaching the 2020 climate targets "in a cost-effective way." The Commission had also grown concerned about the costs associated with supporting renewables and how subsidies for renewables were "over-compensating" power producers and "reducing incentives to efficiency and distorting competition."[96]

The FiTs had, in effect, insulated producers from market price signals and had thus had an adverse impact on electricity markets (discussed in more detail below). The Guidelines were also intended to minimize windfall profits by increasing the competition between renewables companies by way of competitive bidding. The Guidelines instructed governments to phase out FiTs completely by early 2017. The Commission anticipated that renewables would reach full grid competitiveness by 2020, and implied that subsidies would be completely unnecessary by 2030 at the latest.

However, in July 2014 the European Commission endorsed the UK's CFD regime as a means of controlling costs while providing certainties for generators as a means of attracting investment. According the commission, "the UK Contracts for Difference encourage all renewable energy technologies producing electricity to compete against each other for support beyond 2016. It is a fine example of how to promote the decarbonisation of the economy with market-based support mechanisms, at the lowest possible cost for consumers."[97]

Under a competitive bidding system, developers are paid for the support levels they actually require based on their true cost, therefore avoiding publicly subsidized windfall profits. At the auction, interested investors announce the amount of subsidy at which they would consider installing a specific amount of renewable capacity. Since bidders compete against each other over access to compensation entitlements, a more cost-oriented generation portfolio will result. The bidding process is therefore a means to drive cost reductions through competition among rival bidders, but the successful bidders would be rewarded with locked-in profits over a fifteen-year period by way of power purchase agreements (PPAs), structured as a CFD.

Sounding the Retreat

The election in May 2015 of a Conservative-majority government in the UK would lead to yet another important policy shift. That government quickly announced deep cuts to support for solar and wind as well as energy conservation programs.[98] In announcing the removal of support for onshore wind, Energy Secretary Amber Rudd said, "Government support is designed to help technologies stand on their own two feet, not to encourage a permanent reliance on subsidy." In 2014, onshore wind made up around five percent of the UK's electricity generation and, according to Rudd, had been supported by around £800 million of subsidies. The UK had enough onshore wind projects to meet the UK's 2020 renewables commitment, and the government was determined not to increase its contribution beyond twenty percent. "We could," said Rudd, "end up with more onshore wind projects than we can afford." These changes meant that 7.1 GW of onshore wind capacity additions were unlikely to go ahead.[99]

In 2016, the Conservative government also announced the privatization of the UK's Green Investment Bank (GIB). From 2012 to 2016, the GIB invested £2.3 billion of public money into sixty projects with a total value of over £10

billion invested. The bank's role, stated the government, was always intended to stimulate private sector investment—not to provide long-term subsidies.

The UK Conservative Party's removal of support for renewables is important because it gave expression to the view that the renewable energy industry had already been well supported (perhaps *over*-supported) by government subsidies—the cost of which had been shouldered in large part by the general public through their electricity bills. The government had done enough. The competitive market would now determine whether or not renewable energy would thrive or stagnate.

The New Risk Shift

Today (mid-2017), the UK government is the exception, but there are signs that the Trump Administration also intends to terminate support for wind and solar power in the US. Most governments, especially those in the OECD countries, have not yet adopted a "no subsidies needed" policy and have turned to competitive bidding (and therefore PPAs) because it requires renewable energy companies to compete among themselves while rewarding the successful bidder with the kind of "certainties" desired by the companies and required by the investors lending them money. This reasoning has increasingly made competitive bidding the "policy of choice" in other parts the world.

Competitive bidding may have reduced the cost of subsidizing renewables, but it has also created several additional problems. First, it exposes renewables companies to new kinds of risk. Second, it largely shuts out smaller renewables companies and even community-based projects and cooperatives. Third, it significantly changes the role of government, from "signal sender" to "ringmaster"—an issue we discuss in some depth in the next section.

In terms of increasing risk exposure, the bidding process requires that projects must be at a relatively advanced stage of development (to demonstrate serious intent) in order to be eligible, but this means that bidders must commit considerable resources just in order to qualify to bid. For the *successful* bidder, the risks would of course have been worthwhile. Revenues and profits are guaranteed for perhaps fifteen or twenty years—and potentially even longer—under a CFD-type PPA.

But not all bidders are successful. According to one industry source:

> *Since financial investors will typically only commit funds to projects with subsidies already secured, developers will bear these risks. However, developers will price in the risks in their bids, increasing the project's cost and capital requirements.*[100]

Dive Bidding

Understandably, not all renewables companies were happy with the move from FiTs to competitive bidding. Responding to the EU's *State Aid Guidelines*, the European Wind Energy Association (EWEA) warned that competitive bidding would have a chilling impact on investor interest. EWEA drew attention to the fact that there had been instances of "investors bidding too low to ensure they won the tender" but which were then "not able to develop the project as the economics did not guarantee sufficient returns."[101]

PSIRU, too, has noted instances where developers have submitted unrealistically low bids in order to capture market share in the expectation of later renegotiation. "In India," PSIRU notes, "18 out of 28 companies which won bids for solar generation failed to deliver and were fined 20% of the contract value; 5 received further fines of 40% after further delays. Similar fines were applied in Rajasthan against a company whose construction plans were found to be fictitious. The tendering process in Andhra Pradesh

was also vulnerable to various forms of corruption and extortion." Brazil, too, held a series of auctions in late 2012 for 250 MW of wind projects. As PSIRU notes, the winning bids promised to sell at $42 per MWh, implying such low profits that investment analysts have questioned how much of this capacity will in fact be built.[102]

Bidding Farewell to Small Producers?

There are concerns that competitive bidding also threatens to drive many of the small producers from the energy system entirely, including cooperatives and community-based projects that have been a major source of grass roots support for renewable energy across many parts of the EU and beyond.

In the UK, at least one study has concluded the complex auction design favors big or sophisticated players able to navigate the complex process. For this reason, only a few large solar companies submitted bids during the first CFD auction, with many small- to medium-sized companies left on the sidelines. The UK solar industry has suffered a huge decline under the bidding system, not because the power it generates is more expensive, but because solar and onshore wind are categorized as "mature technologies" and thus need to bid at lower prices than offshore wind, which is categorized as a "less mature" industry in need of a higher level of price support. Reflecting the government's political priorities, the categories and budget split were set to favor offshore wind.[103]

The Renewable Energy Association (REA) has complained that the auction process favors large offshore wind generators, effectively blocking onshore wind and solar from the renewables market. Solar industry interests point out that only 5 of the 27 CFDs awarded in the first auction round went to solar projects. The REA also notes that the winner-take-all CFD system has left little or no space for less mature technologies, such as wave and tidal, or energy from waste and anaerobic digestion, all of which are likely to be needed in the future energy mix, but which may not currently be economically competitive.[104]

In Germany, a new renewable energy law was adopted in sixteen states in 2016. The law was designed to both slow down the amount of new renewables capacity coming on line and to replace the old "come one, come all" FiT with a competitive bidding system. The FiT had spurred the development of more than eight-hundred renewable energy cooperatives in Germany; had generated investment from local banks, farmers, and ordinary citizens; and had created thousands of jobs. The turn toward competitive bidding is expected to favor the large energy companies, which had largely opposed renewables from the outset.[105]

But under this competitive bidding approach, the actual *amount* of renewable energy to be deployed is determined by the government. To the extent that "markets" operate at all in this context, they are largely irrelevant in determining the rates or levels of deployment. The government announces the amount of generation capacity it wants, and holds an auction—a process that has been criticized by solar industry interests in particular because it purportedly shackles an industry that has enjoyed dramatic growth. The auction volume from April 2015 to August 2016 was a relatively low 740 MW. But it has also led to a marked decline in the number of citizen investment funds established to start renewable projects. In 2011, 194 of these funds were established, but only 29 were established in 2014.[106]

Investment and Deployment Levels Fall

Crucially, this shift from FiTs toward competitive bidding has been accompanied by a sharp fall in investment and a slowdown in deployment. In

Germany this fall has been precipitous. Investment in renewables fell 46% in 2015 from 2014 levels and then fell another 15% in 2016—the deepest slump recorded by any country during the same period.[107] In 2016, solar installations fell to a fraction of the levels achieved in prior years, and there are fears that the onshore wind market could virtually dry up by 2020.[108] As of this writing, Germany is expected to miss its 2020 emissions reduction goals by a wide margin.[109]

In the EU, investment in renewables stood at $132 billion in 2011—its highest level—but plunged to just $59 billion in 2015.[110] Investment figures for 2017 suggest a further slump. Deployment of new solar capacity in the EU also fell sharply during this period, from around 22 GW in 2012 to just a little over 8 GW in 2015. Investments in utility-scale PV capacity dropped 31% from €6.1 billion in 2014 to €4.2 billion in 2015. Investments in small-scale PV installations, namely residential and commercial PV with capacities below one megawatt, also fell. However, the fall (from €5.9 billion to €5.2 billion) was less precipitous.

In its annual *The State of Renewable Energies in Europe* (2016) EurObserv'ER lamented the decline of solar PV installation levels across the EU:

> *The 2016 installation level could even be at an all-time low, below or close to that of 2008 [...]. Ironically, Europe has installed the vast part of its PV plant fleet at times when costs were still relatively high and retreat [sic] from the market, just when the costs have reached levels competitive with conventional power plants. Still the fame for historically bringing down PV costs by economies of scale and deploying innovative financing schemes can be attributed to the European Union.*[111]

Meanwhile wind deployment levels increased in 2015, driven by Germany. Across the EU, 12.4 GW of new capacity was added—the highest annual installation level since 2012.[112]

However, industry data for 2016 show offshore wind adding just 1.6 GW—a 48% drop on 2015 levels.[113] The European Wind Energy Association is concerned that deployment levels could slow dramatically after 2020, once competitive bidding has been fully phased in across the region.

Will EU Targets Be Reached?

In 2016 the European Commission established new climate and energy targets for 2030. For the power sector, the EU set itself a binding target to reach collectively a share of at least 27% renewables in final energy consumption by 2030. For many environmental NGOs, the 27% target reflected the EU's desire to slow down the advance of renewables.[114] Assuming the target of 20% by 2020 is reached, the 2030 target presents a scenario that brings a modest additional 7% of renewable power generation capacity into the EU's energy mix.

Nevertheless, the Commission estimated that reaching the 2030 energy and climate targets would require the mobilization of "an extra €177 billion from public and private investment sources annually from 2021 to 2030."[115] In December 2016, the European Environment Agency (EEA) asserted that the EU "can achieve its 2030 target on renewables if the current pace across Europe is maintained" but warned that this "will require additional efforts because regulatory changes affect investors' confidence in renewables, while market barriers persist."[116] Speaking for the wind industry, the EWEA expressed concern that, "The lack of visibility on post-2020 project pipelines [...] exacerbate[s] investor uncertainty and put[s] into question the delivery of the 2030 renewables target and the cost-effective transition to a renewables-based economy by 2050."[117]

Even in Germany—hailed globally for its leadership in renewables—the march of wind and solar was already slowing before the most recent

shift towards competitive bidding and lower capacity commitments. As early as 2011, Germany committed itself to expanding renewable energy generation to "a minimum of 80% of gross electricity consumption by 2050." One study noted that, in order to meet the 2050 commitment, "huge investments" are required:

> *In addition to those in renewables, investments will also need to be made in power plants that can be used flexibly, in storage capacities and new storage technologies, in expanding and modernizing the grid infrastructures, and in tapping areas of potential energy savings along the entire consumption chain.*[118]

This level of investment, the report noted, could not be mobilized under prevailing market conditions in the EU, despite the fact that those same conditions were designed to protect renewables from market competition.

Concerns about future investment in renewables were also expressed in a March 2017 European Commission publication, *Assessing the European Clean Energy Finance Landscape*. The paper concluded: "In order to still try and reach the EU's climate and energy goals for 2030 and 2050, all clean energy sectors would need to see significantly increased investment flows." Importantly, the report noted that the challenge of financing "is particularly difficult for the European power sector where a 100% increase of the current annual investment levels is required, as well as the carbon-intensive industry where an even greater 200% increase of current annual investment levels is required." Furthermore, "Current policies and market conditions will not be able to deliver the 2030 targets nor the long-term 2050 objective of 80-95% GHG emission reductions." The slump in investments could be arrested, the report concluded, as a result of increasing carbon prices reflecting a continuously decreasing cap.[119] Given the present state of carbon prices in the EU's ETS (and around the world), the reference to the need for higher carbon prices seems little more than ritualistic.

Global Influence

Absent a change in policy, it seems reasonable to conclude that the investment required to reach the EU's 2030 targets will almost certainly not materialize. This is serious enough, but the problems facing the renewables sector in the EU have broader implications. The EU is still regarded by many as a "success story," and the approaches it has used to develop the renewables sector have been influential on policy debates and adopted in other parts of the world. According to one estimate, "At last count, 48 countries had adopted auction-based approaches to subsidizing renewables, with an additional 27 countries seriously considering the idea."[120]

To the extent that Europe was until recently the global leader in renewables, it is therefore important to be clear about why this growth occurred and why it is has slowed considerably.

Political commitments and targets undoubtedly played a role in the EU's impressive levels of deployment, as did the presence of some of the world's largest renewable energy companies, especially in wind power. But the main reason for the growth of renewables was out-of-market approaches like FiTs. According to the IEA, out-of-market measures "have become, by far, the most important drivers for investment: the share of investment in competitive parts of electricity markets has fallen from about one-third of the global total ten years ago to around 10% today."[121]

This revealing calculation illustrates two important points. First, the assertions of Stern and the European Commission regarding the competitive electricity market's indispensable role in mobilizing private investment have turned out to be completely false. One can only imagine what the accumulated deployment of renewables, currently at more than 255 GW, would look like if the investment had truly been left to private markets without active government intervention. Second, the IEA's calculation reflects

the global investment picture, which confirms that competitive electricity markets have failed to attract the levels of investment required and may actually be impeding it. As we will see in the next section, Europe's problems are not confined to the renewables sector. They extend across the entire energy system. The implications of this will extend beyond Europe.

In terms of Europe losing its leadership role, there are many factors, among them the rise of China, which has used public money to provide low-cost capital to develop its presence in the renewables sector. But Europe's adoption of competitive bidding has made a major contribution to dampening investor interest and exposing renewable energy companies to further risk.

A sobering assessment of the situation in the EU was offered by Vincent Jacques le Seigneur, President of EurObserv'ER, following the release of its 2016 report, T*he State of Renewable Energies in Europe*:

> *Once the European renewable energy data [for 2016] has been digested, it is clear that a number of preconceived notions are effectively riddled with holes and that the data sets the record straight on wishful thinking about the economics of the various sectors.*[122]

Such a statement would have been inconceivable just a few years ago. It is therefore important that we understand how, in the space of a few years, Europe's "success story" became something very different.

South Africa's Adoption of Competitive Bidding and PPAs

South Africa provides a good example of the policy influence of the EU, and the country's approach has won accolades from the World Bank and the "investor community." According to the authors of a 2014 review of South Africa's "Independent Power Producers" procurement program commissioned by the World Bank, the program generated more than $14 billion of new investment. The authors therefore conclude: "[I]t's evident that private sponsors and financiers are more than willing to invest in renewable energy if the procurement process is well designed and transparent, transactions have reasonable levels of profitability, and key risks are mitigated by government."[123]

The "key risks [...] mitigated by the government" in this instance have been shouldered by the Department of Energy (DOE), which enters into a binding power purchase agreement (PPA), normally for a twenty-year period. The national utility, Eskom, has been mandated to purchase the power generated once the installations have been completed, and if Eskom fails or refuses to pay in a timely manner, the DOE is legally bound to do so.

The guarantees offered to the private renewable energy companies have led to the deployment of four gigawatts of renewable capacity in South Africa—a significant amount.[124] But these levels of investment and deployment are not in alignment with climate targets. According to Carbon Tracker, "Currently implemented policies have so far had little effect on the emissions trends compared to [business as usual]," and "the current policy analysis suggests a 172% increase in emissions by 2030 compared to 1990 levels."[125] According to Eskom, the renewables program has meant that South Africa will burn four-million tons of coal less in 2017—as a result of which the country will burn "only" 113 million tons.

Part Four: Slow Motion Calamity?

The previous section documented the shift from the FiT to the competitive bidding system and its impact on renewable energy investment and deployment levels in the EU. In this fourth section, we look at the impact out-of-market measures have had on the traditional utilities. We also explain how problems of energy market design are likely to continue to impose pressure on renewables in the future. Indeed, the current design has created a degree of system stress that, if left unattended, could create serious problems in the years ahead.

By *system stress* we mean the tension that can result when energy policy attempts to encourage changes to the sources of supply and, in doing so, alters the relationships and power dynamics between the various entities using and managing those sources. Such system-wide impacts have emerged as a contentious policy issue in the UK, the EU and, more recently, in the US, Australia, South Africa, the Philippines, and elsewhere. The UK's energy market reform and the EU's State Guidelines were in large part driven by the need to address these concerns and particularly the impact of renewables on the traditional utilities (sometimes called "majors" or "incumbents").

The power generation sector has become the site of political as well as economic conflict in many countries, and is therefore riddled with the kind uncertainties that most investors seek to avoid. Thus we see that investor interest in *both* renewable and non-renewable sources of power has remained tempered by concerns about instability and risk. Any effective approach to addressing the investment deficit in renewables will need to take account of this reality.

Because renewables have made more headway in Europe than in any other region of the world, the crisis facing incumbent energy providers in the region is already quite advanced. This is also true of the US and, to varying degrees, of other OECD countries. By protecting renewables through out-of-market measures, current policy has created a crisis of profitability among the utilities that bears all the signs of a slow-motion calamity. But because these "system concerns" have been used by the political right to advance an anti-renewables agenda, many progressives erroneously dismiss them as groundless or inconsequential.

Falling Market Value

One measure of the crisis facing incumbents is their falling market value. In 2008, the top twenty energy utilities were worth roughly one-trillion euros. By 2014, their value had fallen by more than half. According to *The Economist*, "Since September 2008, utilities have been the worst-performing sector in the Morgan Stanley index of global share prices. In 2008 the top ten European utilities all had credit ratings of A or better. Now only five do." The two percent fall in energy demand between 2010 and 2015 contributed to this decline, but so did the sense that renewables would continue to cut into profit margins.[126] During this period, US utilities also suffered a downward slide in profits, with the "disruptive" effect of solar contributing to the decline.[127]

During the 2000s, following a phase of extensive market liberalization across Europe, large incumbent companies embarked on a wave of mergers and acquisitions. According to the UK's Energy Research Center, roughly forty percent of the European utility market changed hands between 2003 and 2008, and this activity "has seen debt levels increase 10 fold from 2000 to 2010 for the European utilities." Furthermore:

> *[D]ebt reduction has stemmed mainly from sales of assets rather than by diverting internal cash flows from the balance sheet, but this nevertheless has an effect on corporate priorities with respect to new expenditure. They have embarked upon major cost reduction programmes and disposal of assets to reduce their debt levels.*[128]

For many in the environmental movement, the utilities are little more than an impediment to the transition, and undermining them would be cause for celebration. For instance, John Farrell, Director of the US-based Democratic Energy at the Institute for Local Self-Reliance and a leading advocate of distributed energy, has stated, "The root cause of the battle between utilities and their (captive) customers is the utility monopoly. And the best hope for a democratic energy system may be to smash it."[129] This is not only much too simplistic; it also fails to recognize the potentially serious implications of the utilities' difficulties and what this might mean over the longer term.

When viewed through a whole-system lens, it becomes clear that the existing policy approach has turned power generation into a battleground between different sources of energy. It has fomented an economic and policy-based war between incumbent generators and companies involved in promoting renewables-for-profit. This damaging war is also being fought out in the electoral arena in numerous countries—over jobs, over electricity prices, and over questions of energy security and sovereignty. It has divided unions and communities—and even nations and continents—as corporations and sometimes government agencies are pitted against each other in a destructive battle over revenues, profits, and market share.

Even within the renewables sector itself, there are significant tensions between different segments and constituents. Offshore wind interests often clash with those involved in onshore wind, and solar manufacturers and installation companies are often on the wrong side of trade disputes. In terms of securing policy support from governments, those who represent less mature renewables technologies (tidal power, for example) feel that they are being pushed to the sidelines by large wind and solar supply companies. Utility-scale renewable generation projects often find themselves in unhelpful conflict with decentralized, residential initiatives.

Under the system of "contracts for difference" and competitive bidding, small renewable energy interests are being squeezed out by the larger companies. Meanwhile, large wind companies tend to support investor agreements that liberalize global energy markets—provisions that are resisted by other wind industry actors in developing countries seeking to establish a presence in the growing wind market.

Instead of collaborating around solutions conducive to the public good, the entire power generation sector is locked into a short-term struggle for survival.

Battleground Economics: Wholesale and Retail

Lack of space prevents explaining the crisis facing the utilities in detail. What follows is a summary of its main features.

In many parts of the world, the introduction of renewables has led to competition in wholesale electricity markets, which in turn has led to falling prices, narrower profit margins, and declining market shares for the incumbent generators. The pressure on utilities brought about by wholesale market competition has been heightened by generally flat and sometimes lower energy demand growth (in the OECD countries) and an oversupply of generation capacity as a result of more renewables coming on line.[130]

If falling wholesale prices have hurt utilities, rising retail prices for end users have inflicted further harm. As Robinson notes, "the majors

[traditional utilities] will face growing pressure on profitability in their final markets, in spite of the fact that final prices are rising." As final prices rise, more people turn away from centrally generated power towards "distributed" energy resources, "posing serious concerns about recovery of the system's fixed costs."[131]

But why are final prices rising? Higher retail prices "reflect taxes and the cost of a number of public policies; these include financing out-of-market payments to renewables."[132] Put differently, the utilities cover costs by selling electricity in order to generate revenue. If sales fall—due to more renewable energy coming into the system, to efficiency gains, or the decline of energy-intensive industries—then revenues tumble and profit margins shrink. If they *raise* retail prices in order to compensate for the loss of revenues and profits, demand for electricity weakens further, making renewables an even more attractive proposition for households and businesses. Utilities refer to this as the "death spiral."

The seriousness of the death spiral, says Robinson, is reflected in the precipitous collapse of the European utilities' balance sheets noted above. In 2013 alone, this amounted to a €32 billion decline. Importantly, capacity closures have accelerated since 2010, with 71 GW having closed in just five years (2010-2014), and analysts expect additional closures totaling fifty gigawatts or more of coal- and gas-fired generation within the next several years.[133]

An additional headache for utilities is reflected in the fact that the "levelized cost of electricity" (LCOE)—which shows renewables becoming increasingly competitive—do not reveal the costs either of backing up renewables' supply with reserve capacity (to cope with the sometimes dramatic and sudden changes in output from wind and solar facilities) or of integrating renewables into the system. Such costs are typically borne by the incumbents.

Subsidies for All

We have seen how, by introducing "capacity payments," governments have tried to protect the utilities in order to ensure sufficient future capacity and reliability. This means subsidies have become more generalized because the impact of wholesale competition (falling prices) has led to a profit and investment crisis across the entire power generation sector. In the words of an energy analyst from India, "Huge costs are involved in keeping thermal plants idle when the sun shines. Such costs can be absorbed by central government-owned plants that get paid for available capacity even when they don't generate power."[134]

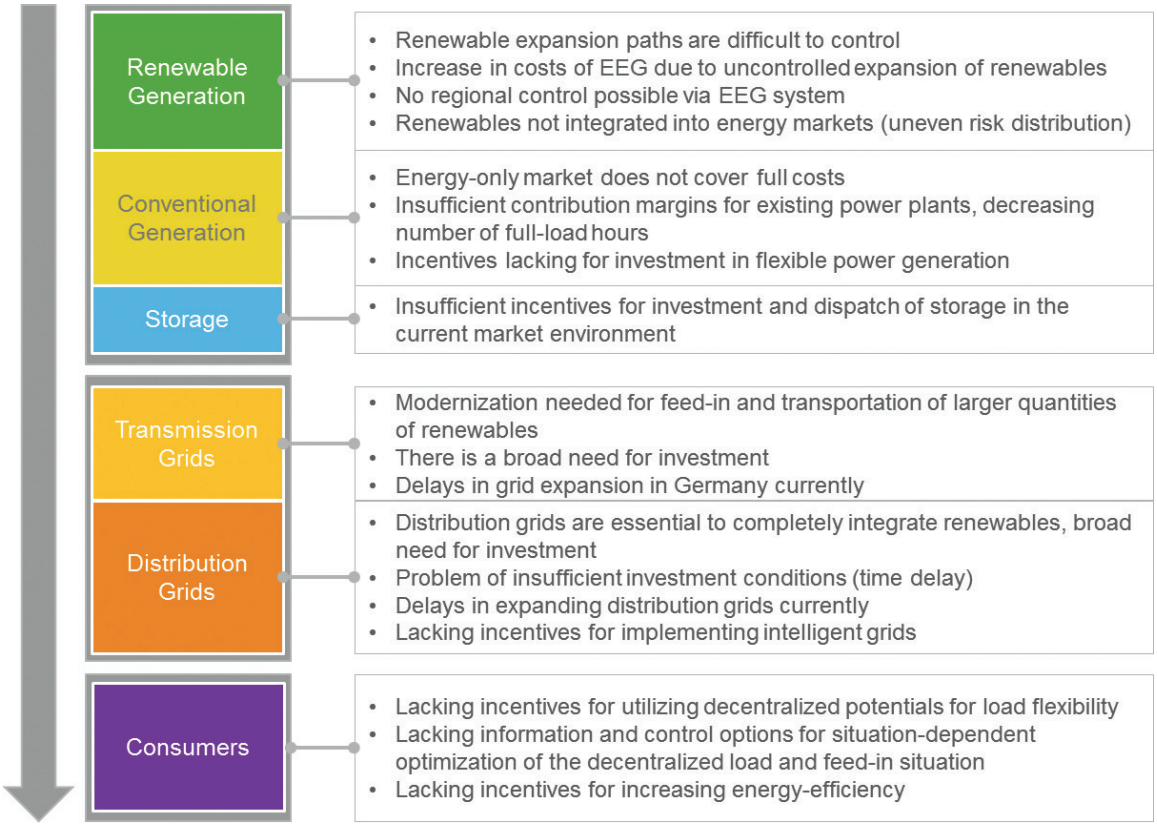
The problem is *not*—as the political right suggests—renewable sources of power; rather, the problem lies in the fact that restructured electricity markets have created a situation where renewables, being unable to compete on a commercial basis, require subsidies that protect them from the market in order to stimulate investor interest. This has compelled governments to intervene in order to help ensure that incumbents generate enough revenue to cover costs, which in turn has simultaneously *slowed down* the deployment of renewables *and* precipitated an investment crisis across the entire power generation sector.

As the German Association of Local Utilities (VkU) notes:

> *In the course of the market liberalization, the current energy market design was developed for an energy system in a steady state. It is therefore primarily based on conventional power generation. Relevant amounts of renewables were not present when the current market design was established. Therefore, the design that has evolved is not suitable for the necessary transformation of the system unless changes are made.*[135]

For the VkU, a complex chart is needed to capture the many problems of the current market design or model created by the intermingling of

protected and unprotected sources of energy. Each of the points highlighted in the chart has its own story, but they all originate from the shift from vertically integrated systems of energy provision to the so-called competitive market and the attempt to superimpose on that market renewable energy generation that plays by a different set of rules.



Not a European Problem

The main story of the EU, therefore, is this: he liberalization of electricity markets in the 1980s and 1990s created competition. This, in turn, encouraged consideration of short-term time horizons—even down to the hourly level—rather than planning for the long term. With competition came a degree of risk for developers and investors that had not existed when electricity generation was performed by vertically integrated—and often publicly owned or regulated—companies, where electricity prices had a direct relationship to actual costs (installation, operation and maintenance, upgrading and repair, etc.).

For the incumbent generators, levels of risk were heightened with the introduction of (market protected) renewables that further disrupted markets and dampened investor interest. In terms of renewables, investors have come to understand that the viability of their investments depended on the policy support received from governments at various levels, whether in the form of the FiTs, CfDs, or other mechanisms designed to provide certainties. Without this support, renewables could not compete with coal and gas fired generation. And with no effective carbon price in place, the risk to renewables was even greater over the longer term. Therefore investing in renewables was also subject to a high level of political risk

because the subsidies could be withdrawn, and the stand-alone market strength of renewables was not sufficient despite the falling costs of renewable energy technologies. Risk therefore dampened investor interest in renewables, which are capital intensive and usually involve considerable upfront costs. Risk also raised the cost of capital, further reducing the number of willing investors.

As noted at the start of the previous section, until quite recently the EU has been the world leader in renewable energy. The policies implemented to drive renewables in the EU have either been emulated—or are being seriously considered—in many other parts of the world. That these policies have today reached an impasse in the EU should trigger alarm bells in policy communities everywhere, and the search for an alternative approach should become an urgent priority. A full and frank assessment of the EU's experience over the last ten or twelve years is today essential, and that means being willing to face the implications of the recent dramatic slowdown in deployment and investment.

Commenting on the energy transition challenge overall, Cambridge University economist David Newbery offered a succinct assessment—one that is applicable beyond the EU:

> *If we are to deliver the low-carbon future in electricity, we need a huge amount of investment. And the main determinant of the cost of that investment will be the cost of capital. And the main determinant of the cost of capital is the cost of risk. The financiers are now really concerned that this [viz., the transition to renewables] will become far more expensive and difficult than they thought.*[136]

Can Renewables Take the Plunge?

Looking to the future, it seems almost certain that the energy market design that locked utilities into a death spiral will also continue to put pressure on renewables. To the extent that renewables still depend on out-of-market subsidies, wind and solar projects will continue to be vulnerable to political changes that may reduce or terminate government support. Investors will continue to factor in political risk, and this will keep the cost of borrowing relatively high.

Renewable energy companies have been consistently on message with regard to the sector's need for government support. They have convinced policy makers that wind and solar are, or soon will be, mature industries and that costs are tumbling. Subsidies, they say, have been essential in order to bring renewables to market but soon will no longer be required. However, as noted above, the policy shift from FiTs to competitive bidding was criticized by renewables companies for exposing them to more risk, forcing them to compete among themselves in order to secure contracts, thus pressing prices downward, eroding potential returns, and cooling investor interest.

The emergence of the practice of dive bidding has added a further policy challenge. What happens when successful bidders cannot deliver power at the agreed price while satisfying the expectations of private investors? Under current conditions, the successful bidder has to deliver within razor-thin margins. In the solar industry, this has been termed "the winners' curse."[137]

Either way, competitive bidding has been a key factor behind the plunge in both wind and solar prices in recent years. Renewable energy companies therefore point to the fact that the subsidies upon which they depended will soon no longer be required. While this has provided a strong political retort to those who want to end those subsidies more or less immediately, it has prompted investors to examine the internal returns on investment of renewable energy companies, with an eye on the longer term.

Sinking Solar? The Case of India

Recent energy auctions in India provide a vivid illustration of the possible implications of falling prices. In early 2017 India made headlines when an auction for renewable energy attracted a successful bid for around four cents per kilowatt-hour. Bids to produce wind power were also low, at around six cents per kilowatt-hour. (In Dubai and Chile, successful auction bids have been even lower.)[138] According to the Indian government, "By introducing competitive bidding, the government has ensured that renewable energy is affordable and attractive for consumers."[139] All over the world, renewable energy advocates greeted the news with enthusiasm, as did major institutions like the World Bank.[140] With renewable energy cheaper than coal for the first time, it was claimed that India's ambitious commitment to install 175 GW of renewable energy by 2022 now looked even more feasible. In 2016 – 17, net capacity additions of renewable energy were higher than for fossil fuels, at around nine gigawatts for each year, although still very far below the 22 GW per year needed to reach the government's target of 175 GW by 2022.[141]

But the plunging price for solar and wind is not all good news, either for renewables companies or for investors seeking to secure good returns on investment. As one industry source in India stated, "Extremely low tariffs don't help anyone. Ultimately people have to raise debt financing, banks have to be brought on board, all of that looks very dicey at these levels." According to another, "Cut-throat competition has driven prices down to unsustainable levels, undermining the booming sector's viability."[142]

And while the scientific and policy consensus insists that the deployment of renewables should be accelerating in India and globally, some industry voices are calling for deployment to slow down. For instance, prominent Indian economics commentator (and Cato Institute Research Fellow) Swaminathan Aiyar has said, "We must invest in solar power. But why shoot up from just 12 GW today to 100 GW by 2022? A more measured pace will give time for thermal plants and banks to adjust, and leave space for cheap, future technologies."[143] According to the author of a recent AFP article on India's solar price slump, "The effect of the falling cost of solar modules, cheaper financing, aggressive competition and a surplus power supply in some states has been to unleash chaos, with companies and state governments clamouring for suppliers to match the new, low prices."[144] In the words of Indian solar entrepreneur Sanjeev Aggarwal, "People are falling over each other to grab a piece of the pie, but the question is if they can ever deliver at these rates."

Unfortunately for India's solar developers, Chinese solar module manufacturers have recently decided to provide clarification that the answer to Aggarwal's question is almost certainly, "no." Taking advantage of the deadlines and penalty structures facing winners of recent Indian solar auctions, Chinese suppliers have begun reneging on contracts and demanding higher prices for contracted equipment before providing it—as much as six cents per watt of capacity. With current prices for solar modules at roughly 37 cents per watt, and solar modules typically accounting for nearly 60% of total costs for solar power projects, this means nearly 10% in additional project costs.[145]

California and the "Folly" of Investing in Solar PV

In California, the deployment of solar PV has accelerated in recent years. As a consequence, prices fell as solar-generated power flooded into the grid during daylight hours, driving prices dramatically lower and thus diminishing rates of return on investments.

An April 2017 BNEF paper warned, "On the basis of wholesale prices, it would be folly to build a new PV plant in California."[146] Despite the fact that decarbonization of the power sector urgently demands a vast and rapid scaling up of renewables capacity, on strictly market terms there is currently "excess capacity" in solar.

Given this discrepancy and the enormity of the stakes, it strains credulity far past the breaking point to suggest that such an approach is in alignment with climate targets. On the contrary, its dominance has proven to be a major impediment to reaching those targets.

Questioning the Market Structure

The problems facing both renewables and incumbent generators have led some policy voices to begin to question the current market construct. According to Albert Cheung at Bloomberg New Energy Finance (BNEF):

> *Over two decades of energy liberalization, this market construct has arguably been able to deliver a competitive and inexpensive power supply. But how relevant is such a construct in a new world where a large portion of plants will have zero variable cost, and cannot be turned on nor turned off?*[147]

The OECD's *Business and Finance Outlook 2016* points to problems with the way markets are structured. Noting that wind and solar had become "increasingly cost-competitive against fossil-fuel-based alternatives in a number of countries," the report's authors sought an answer to the question, "So why is renewable electricity investment not growing faster? There is no shortage of available capital globally." Wholesale electricity markets, the OECD report predicted, would not attract investment in low-carbon technologies unless there was a high CO2 price, periods of very high electricity prices, and even risks of rolling brown-outs (because electricity demand remains fairly inflexible in most countries). However, the report notes:

> *Even if these conditions were to occur, the high risks involved would lead to higher cost of capital which would in itself hinder low-carbon investment, given that most low-carbon generation options have high upfront capital costs and low (or near-zero) variable running costs.*[148]

The OECD report also warned that, globally, the proliferation of out-of-market agreements will exert downward pressure on wholesale prices, especially when overall electricity demand is also falling, as has been the case in some OECD countries. Not only does this drive the death spiral described above, it exacerbates what some energy company representatives call the "missing money" problem, in which "short-run marginal cost pricing does not guarantee full recovery of capital costs for all plants, including renewables."[149] In other words, by lowering wholesale energy prices, out-of-market interventions to encourage renewables end up cutting into operating margins for *all* generators, putting the financial viability of *all* of them at risk. The study concluded that "the current designs of wholesale liberalised electricity markets are often not strategically aligned with the low-carbon transition" and that this market design had also brought about "fragmentation in clean energy

investment and financing." This fragmentation occurs because lenders are only prepared to commit small parcels of capital to projects, preferring to share the risk with other lenders. This leads developers to seek financing from multiple sources (so-called "bank clubs").

But what would it take for liberalized wholesale markets to become "strategically aligned with the low-carbon transition"? According to the OECD, this will require "new market arrangements to ensure competitive investment in low-carbon capacity, and to ensure that renewable electricity is generated when it is of most value to the overall system." One such arrangement is the introduction of a "supplementary premium payment" (feed-in premiums) in order to guarantee that generators make a profit when large amounts of renewable power are disruptive to the smooth functioning of "spot markets."

Crucially, the OECD report warns that the effect of more finely tuned out-of-market interventions would only be temporary:

> *In order to unlock investment in renewable electricity, policy makers need to consider options to address existing obstacles to investment, especially concerning existing fragmentation in electricity markets and policy misalignments with climate change goals.*[150]

In other words, the source of the fragmentation itself—not merely its symptoms—still needs to be addressed. So-called "competitive" electricity markets, with layers of out-of-market measures superimposed on top of them, have created battleground conditions that have had a chilling effect on investment throughout the power generation sector.

Public Funding Masks Limited Private Sector Interest in Renewables

Changes in policy have also begun to change the balance between public and private investment in renewables. Although precisely distinguishing their relative contributions is far from straightforward.

According to the Climate Policy Initiative's (CPI), *Global Landscape of Climate Finance 2015*, private investment was the largest source (62%) of global climate finance, totaling $193 billion. The engagement of private investors was attributed to the impact of "Policy and market signals, predictable and stable profits, and the strategic potential of investments."[151] Of the $193 billion invested by the private sector, commercial financial institutions provided $46 billion, or 19% of the total. Project developers accounted for $92 billion (38% of the total) and corporate actors $58 billion, or 24%. The contribution made by individual households' investment (mostly in solar PV) accounted for $43 billion (18% of the total).

What is most striking about these numbers is the very large contribution from public sources. CPI's *Landscape* notes the increasingly important role of "public actors and intermediaries," which reached at least $148 billion in 2014—an 8% increase from 2013 levels and a 10% rise from 2012.

Interestingly, the CPI considers households as part of "private sector" investments—a choice that hardly seems entirely natural. If household investments ($43 billion) were put in a separate category (neither private nor public sector) then global levels of public and private investment would be nearly the same ($148 billion and $150 billion respectively).

It could also be argued that such household investments should be counted as "public" investments—albeit made by members of the public rather than public authorities. When counted this way, total public investment would be $198 billion and rising, with private sector investment at $150 billion, having fallen $31 billion or fourteen percent from 2012.

Given these ambiguities, it at least seems fair to say that public financing currently makes up at least half of total investment in renewable energy. CPI also notes that if "public budgets targeting climate-related development" were included, the public contribution to existing investment levels could be larger by as much as $60 billion (2015 estimates).[152]

Order over Chaos—Reclaiming Markets

Despite the shift towards greater public financing and spending to advance the deployment of renewables, overall investment in renewables remains far below what is necessary either to reach agreed climate targets or to be even remotely consistent with the mitigation scenarios discussed above. At the same time, in many countries there is not enough investment across the entire power generation sector to replace aging capacity and thus ensure stability of supply in the years ahead.

A March 2015 paper from the right-wing Center for Policy Studies (CPS), *Central Planning with Market Features: How Renewable Subsidies Destroyed the UK Electricity Market*, called attention to the political options available in order to deal with the investment crisis in the sector.[153] The report proposed that policy support for renewable energy had brought disastrous consequences and should end entirely. It is more important, the report argued, to protect the competitive electricity market (circa 1990) than to move forward with market-disrupting and heavily subsidized renewable power.

While few in the trade union movement would likely support the report's recommendations—to ditch support for renewables in order to recreate and reassert truly competitive markets—the concerns raised in the paper echo points made in the OECD's *Business and Finance Outlook 2016*[154] and are pertinent to any serious investigation of the investment deficit and the limitations of the for-profit approach to driving renewable power forward.

Two points in the CPS report especially stand out. First, it notes that it is "impossible to integrate large amounts of intermittent renewables into a private sector system and still expect it to function as such." This is not a reference to the *technical* challenges associated with incorporating significant quantities of variable renewable energy (VRE) into existing grids—although these challenges are perhaps very significant—but rather a reference to the *economic* impacts that intermittent supply has on competitive wholesale markets. When the wind is blowing strongly or the sun is shining brightly, renewable power floods into the grid, driving down the price of electricity and disrupting wholesale markets. This wreaks havoc on the business plans and performance of the traditional utilities and cuts into their already thin profit margins.

Second, the CPS paper shows that policy interventions to protect renewables from competition led to "an outcome that promises the worst of all worlds—state control of investment funded by high-cost private sector finance." Because policy was directed almost entirely towards mobilizing private capital, government money has been used as a means to guarantee profits for the private sector. The government's "asymmetric treatment" of different energy producers, the report predicted, "will lead to underinvestment in dispatchable technologies" and thus increase risks to the security of supply. And because private investors end up having to price and manage political risk, this results in "a further upward twist to costs and prices." In simpler terms, the current approach is not only more expensive than it needs to be but also threatens to choke off investment in the entire energy system.

These conclusions are very significant. If the starting point for trade union policy is that

large-scale renewables are essential then they should be both driven by public sector financing and publicly owned. In this way, renewable power generation that the public has paid for will remain in public hands and serve the public.

Part Five: The Return of the State?

In part four of this paper we showed how both industry analysts and commentators have drawn attention to some of the reasons behind the investment deficit and how the current "competitive" market model has, in Europe and in many other parts of the world, turned the power generation sector into a high-risk battleground between competing, profit- or revenue-seeking interests. This has contributed to a crisis of viability *across the entire sector*, which in turn has generated concerns about the prospects for investment in future capacity as well as in the kinds of grid modernization and storage technologies that are essential to the successful integration of renewables.

Today, key policy voices have concluded that liberalized electricity markets, already distorted by "out-of-market" measures like competitive bidding, will not deliver the investment needed to reach climate targets.

For some on the political right, the solution is to abandon *both* renewable energy (which they characterize as subsidized, costly, and unreliable) *and* decarbonization targets (seen as unnecessary and/or unachievable) and let a truly competitive market determine the energy mix. But for the "green growth" policy mainstream, the overriding goal remains unchanged: to mobilize the levels of private investment needed to accelerate the transition to a renewables-based and low-carbon future.

In this fifth section, we examine several additional issues pertaining to the current investment regime: the potential role of institutional investors, the persistence of public-private partnerships (P3s) in energy, the "financialization" of P3s, and the shifting roles of public and private actors. We also look at the reasons behind the growing significance of "green bonds" and long-term financing for renewables.

This section further illustrates the impasse of the current approach and how the ideological firewall erected to avoid any discussion of public ownership and needs-based public investment is visibly crumbling under the pressure of economic realities and policy contradictions.

The Next Big Target: Institutional Investors

In part two, we discussed how the major policy institutions monitoring and promoting the energy transition (IEA, UNEP, BNEF, IRENA, etc.) have been unable to offer convincing solutions to the investment deficit. The seriousness of the deficit is acknowledged, and it is universally accepted that, unless it is resolved, decarbonization of the power sector will not happen and emissions reduction targets will almost certainly not be reached. Alongside the deficit in renewables, the lack of investment in other critically important areas (energy efficiency, for example) is even more acute, and the solutions proposed by mainstream institutions in these instances even less convincing.

However, the problems generated by the current market model, and the need for a radical change, have yet to be widely acknowledged.

Rather, the challenge is defined more narrowly. One US-based policy group representing development finance agencies has concluded:

> *It is unrealistic to expect the banking industry to meet the project financing needs for clean energy [...]. The shorter financing term from commercial banks exposes borrowers to higher debt service payments and refinancing risk when loan balloon payments come due.*[155]

Investors with longer-term horizons—such as so-called "institutional investors"—are therefore needed. These investors have the capital, take a longer-term approach to investments, and have in some instances been very public about their willingness to commit capital to building a low-carbon future.

The World Bank notes how institutional investors are "increasingly looking for new sources of long-term, inflation-protected returns." However, the Bank notes:

> *[W]hile growing rapidly, institutional investment in infrastructure is still limited (for example, pension fund investment in infrastructure currently represents only around 1 percent of total assets on average across the OECD) and major challenges remain before a substantial increase in allocations can occur.*[156]

In the case of "green infrastructure" the challenges include "regulatory and policy uncertainty and inexperience with new technologies and asset classes."[157]

The category of "institutional investors" is somewhat malleable but generally refers to large pools of funds that are managed based on specific parameters and objectives (acceptable risk, expected returns, maturity of claims, etc.) and includes pension funds, insurance companies, endowments, sovereign wealth funds and investment managers.[158]

That institutional investors have captured the interest of policy makers in recent years is not surprising. The size of the investment deficit, the failure of the existing investment regime and—given the scientific realities expressed in the Paris targets—the short time frame remaining in which to deal with the problem have together created a situation where "big money" players will have to become actively engaged, and quickly.

As UNEP notes, institutional investors hold $93 trillion of assets under management in OECD member countries alone. Thus, it asserts, "Given their growing interest in renewable energy, it is thus possible to attract institutional and other large-scale investors now and in future. Indeed, this is essential if investment volumes are to be scaled up."[159] In 2014, investors "with $43 trillion of assets under management said they stood ready to invest in new climate-aligned assets."[160] The OECD estimates that around $2.8 trillion per year is potentially available from pension funds and insurance companies for new clean energy investment.

Similarly hopeful, IRENA (an intergovernmental organization that supports sustainable energy) notes, "Institutional investors such as pension funds, insurance companies, endowments and sovereign wealth funds could play a particularly important role in scaling up renewable energy investment in future as the largest potential source of private capital."[161] Of this amount, around half ($45 trillion) of these assets "are invested in service of long-term institutional obligations. Due to their expertise and scale, it is suggested that they (the investors) have the ability to potentially lower the costs of finance for risky low-carbon energy projects."[162]

Who Has the Money?

It is worth noting that the "assets under management" of institutional investors, while enormous, are not the only potential source of in-

vestment capital. In 2014, a group of roughly 211,000 "Ultra High Net Worth Individuals" (UHNWIs)—meaning, extremely rich people—were worth $29.7 trillion, whereas OECD pension funds were worth a total of $24.7 trillion. An Oxford University survey of this group showed that many of these individuals, when considering their investments, are "motivated in part by environmental, social and governance considerations." But the survey showed they were decidedly *more* motivated if the investments could "generate appropriate risk-adjusted returns across their portfolios."[163]

But if extremely rich individuals are not likely to invest without some expectation of making even more money in return, how can institutional investors be enticed to play this role? For UNEP, "to increasingly allocate their [institutional investors'] capital to climate-friendly assets, these investments must offer competitive financial risk-adjusted returns to attract more investor capital."[164] In other words, as with the "rich individuals" group (UHNWIs), investments must be a source of solid returns from the outset. These returns are needed in order generate a "herd effect" whereby other investors move into the market for renewables and other low-carbon economic activities.

However, as a UK-based policy group notes:

> *The vast majority of money in financial markets is structurally required to be in low risk investments. 90% of funds held by the largest institutional investors are in bonds and shares of investment-grade companies. Whilst higher risk capital is no doubt available, the volumes by comparison are probably too small to address the scale of infrastructure investment required.*[165]

The strategic policy goal is therefore fairly straightforward: there is a need to remove investor risk by ensuring a guaranteed return over long periods of time. If this can be accomplished, then it would be possible to gain access to large sums of capital for investment. In this way, the investment deficit could be addressed.

P3s Persist

For the OECD, the World Bank, the World Economic Forum, and other major institutions, when it comes to renewables the job of governments is to make profitable what would otherwise not be profitable. And the main—perhaps only—vehicle to achieve this is through P3s. For more than two decades, these institutions have promoted P3s as a means of funding infrastructure projects. In the past, governments would have made these investments, but in the neoliberal era of fiscal (and political) constraints on government borrowing, they are politically prevented from playing this role.

The OECD has identified three key conditions important for attracting private sector investment into energy and other large infrastructure projects. These conditions, it says, can be put in place by "government interventions." First, governments must commit to providing investment opportunities. Second, they must boost returns on investment, including by helping to limit the costs of investment. Third, governments need to reduce the risks faced "over the lifetime of the project." It adds:

> *It is necessary to distinguish between targeted financial instruments that reduce risks for investors and instruments that offer access to capital, such as public-private partnerships, credit lines, loan guarantee instruments and equity investments in projects or companies. Further examples of instruments that can be designed to address risks include feed-in tariff, risk insurance, credit enhancement of project debt, and first-loss public/private funds. Generally, these instruments enhance investor confidence and lower the cost of capital and of investment.*[166]

Similarly, for the World Bank, getting private investors to finance infrastructure projects "requires closing the financial viability gap (i.e., the gap between costs and expected revenues), using public resources complemented by existing legislative and institutional provi-

sions supporting private financing of infrastructure in countries." As the Bank notes:

> *While the issue of a long investment horizon arises with traditional infrastructure investment, it is particularly relevant for low-carbon infrastructure projects, due to higher risks and lower expected returns. The additional financing requirements to orient economies towards a green trajectory are considerable.*[167]

According to a separate study produced for the World Bank, P3s (sometimes called "PPPs") play a pivotal role in the power generation sector, especially in the global South:

> *The push for privatization and PPPs from 1990 to the present has led to a large proportion of electricity services being delivered by PPPs in developing countries. In fact, since 2004, PPPs have represented the lion's share in electricity generation and distribution, particularly in middle-income countries.*[168]

Furthermore, according to that study, "Given the higher costs and risk of renewables, companies—particularly in the private sector—are unwilling to invest unless they are required to or offered economic and financial incentives to do so (such as through price support mechanisms)." For the Bank, such incentives are vital, since "private investors are needed to supplement public sector investment, especially given the additional daunting tab that will come from investments to cope with climate change mitigation and adaptation."[169] The long investment horizons of major infrastructure projects, coupled with the high cost of borrowing, mean that private investors and corporations need governments to play the role of investment partners.

The Problems with P3s?

Even while maintaining its commitment to a policy orientation in which P3s are seen to play a necessary role, the Bank signaled awareness of some significant problems. In the same study describing how "a large proportion of electricity services [are now] being delivered by PPPs in developing countries," the Bank notes: "However, many countries have reported problems in recent years about delayed or cancelled projects, raising worries about whether PPPs are up to the job and whether the financing gaps are manageable." [170]

Numerous studies have explored the problems associated with P3s, although relatively few have looked especially closely at their use in the energy sector. PSIRU's March 2015 report *Why Public-Private Partnerships Don't Work* very usefully reviews a wide range of problems with P3s, including at least some in the power sector.

Broadly, P3s are contractual arrangements between governments and private "service providers" that provide low-risk opportunities to investors in search of "bankable" projects. Under P3s, "a private company finances, builds, and operates some element of a public service," and then "gets paid over a number of years, either through charges paid by users [often called a 'concession'], or by payments from the public authority, or a combination of both."[171] The contracts governing P3s are invariably highly complex, the negotiations producing them are generally highly secretive (ostensibly to protect "commercial secrets") and they are frequently finalized with little or no public consultation. Their complexity and lack of transparency allow P3s to effectively conceal public borrowing by keeping obligations "off the books." For the same reason—and because they generally involve enormous sums of money—they are also prone to corruption, as even the World Bank acknowledges.[172]

Importantly, these problems with P3s are only amplified by the fact that they are increasingly imposed under the various investor-protection treaties being aggressively pursued in recent years, under the guise of agreements

to promote "free trade": the Trans-Pacific Partnership (TPP), the Transatlantic Trade and Investment Partnership (TTIP), the Trade in Services Agreement (TiSA) and others—all of which have also been roundly criticized for their secrecy, lack of public consultation, and undermining of democratic accountability. As PSIRU's paper puts it, "These trade deals not only facilitate PPPs but will also lock them in, making it next to impossible to reverse them, regardless of outcomes."[173]

In power generation, P3s have relied upon power purchase agreements (PPAs) with private companies to "eliminate risk" by essentially locking in revenue streams at public expense. This has mostly applied to renewables, but not exclusively so.

Financializing P3s

P3s took on special significance after the financial crisis of 2008. Investors wanted to avoid the risk of investing in stock markets or "listed equities" and according to the World Bank sought refuge in bills and bonds from governments with strong creditworthiness—so-called "safe assets." The financial crisis therefore accelerated a long-term increase in bond allocation that started in the early 2000s.[174] But the "financialization" of P3s runs counter to the kind of public service and "public goods" rationale that guided investments in utilities and services in decades past. The financialization of P3s involves taking advantage of the credit ratings and low borrowing costs of government entities, the benefits of which are then packaged in the form of a PPA that allows the private corporation to negotiate within a wider margin of available profit.

In recent years the World Bank has urged governments to "financialize" P3s, ostensibly in order to access the trillions of dollars held by institutional investors:

> *By contributing to the stock of high quality and well-structured infrastructure projects, the [Global Infrastructure Facility, created by the World Bank] can be expected to help develop [emerging markets' and developing economies'] infrastructure as an asset class attractive to the full range of private investors seeking diversification into long-term assets in faster growing economies. Until now, these investors have been presented with limited infrastructure investment opportunities that meet their risk tolerance and investment profiles.*[175]

The term "financialization" has been used quite differently in different contexts, and some of the debates have been vigorous.[176] While the term is sometimes used to refer to the growth of the financial industry and financial markets in general, the University of Sussex's Lucy Baker offers a definition that is more apt for present purposes, focusing on "the growing financial activities of non-financial firms" (as distinct from their productive activities as such) and "the increasing share of national income from the financial sector."

As Baker recounts, since the 1970s, "financialisation has included the proliferation of financial markets and institutions, the expanding range of financial services, increased international integration of national economies and the separation of industrial from finance capital." This has made whole areas of social and economic life increasingly dependent on financial systems and therefore vulnerable to instability in financial markets.

Writing about South Africa's renewable energy sector in particular, Baker notes:

> *[O]ne likely effect is that the ownership of firms will rest increasingly with financial investors as shareholdings become tradable financial assets and are in turn distanced from their original productive asset, with the maximisation of return on equity as the key objective [...]. The focus therefore shifts to short term financial gain and the extraction of rents rather than the long term success and sustainability of the business in question.*[177]

Today, P3s increasingly resemble straightforward moneymaking ventures that have little or nothing to do with providing decent, affordable public services. When P3s take place in the global South, they are often packaged as "sustainable development" projects. Perhaps it is not surprising, then, that in addition to the World Bank, the IEA and UNEP, leading energy and technology companies like Siemens and General Electric, and elite NGOs like the World Resources Institute have enthusiastically endorsed "financialization."[178]

Mobilizing What?

Supporters of P3s claim they are necessary in order to mobilize investment from institutional investors, therefore saving governments money while sourcing potentially large volumes of capital for long-term investments. But this is simply not true. As PSIRU notes, like any form of borrowing, a P3 can spread the cost of a project (say, a wind or solar farm) over many years. In the case of building and integrating electrical power capacity, the borrowed money is repaid through charges to consumers.

P3s take advantage of governments' low borrowing costs, but this does not generate extra capital. Whether a P3 or a government-only project, the result is the same: "Money is borrowed from the same financial institutions – banks, pension funds and other investors. In reality, over the lifetime of a project, a PPP will invariably involve higher public spending than a conventional project, because of the higher costs of capital."[179]

This higher cost of capital is likely far from trivial, as are the implications for the overall costs of the project. In the UK, a 2015 review by the National Audit Office found that "the effective interest rate of all private finance deals (7%-8%) is double that of all government borrowing (3%-4%)."[180] This means the cost of capital for P3-operated services or infrastructure facilities is double what it would have been if the government had borrowed directly from private banks or issued bonds directly.

Moreover, as noted by Romero and Vervynckt in their chapter of a recent publication by Transnational Institute (TNI), *Reclaiming Public Services*, "private sector companies are expected to make a profit on their investment, which means an increased cost for the public purse and/or for users."[181] According to the non-profit organization Counter Balance, P3s supported by the European Investment Bank between 1990 and 2015 generated typical annual profits of 12%. For P3s in the global South, where the risks are perceived to be higher, investors expect 25% or more.[182] Governments have also been subsidizing P3s, "mainly by lending public money at low rates of interest that the private sector could not otherwise obtain—despite the obvious intrinsic contradiction of using public finance to finance [P3s]."[183]

The main point here is this: According to the dominant policy discourse promoted by the major institutions, there can be no transition to renewables that is not driven by the private sector, and there can be no transition driven by the private sector that isn't driven by the P3 model. Private sources (including institutional investors) are purportedly needed to provide the volumes of capital required while the role of governments is to absorb risk and guarantee investors a return on investment. This asymmetry makes a mockery of the characterization of such arrangements as a "partnership," and any social and economic benefits that might result have little to do with any unique contribution made by the private sector.

From Traffic Cop to Chauffeur

We have shown that the global trend is toward more public financing of renewables. However,

the benefits of this financing are being transferred from the public account to private-sector profit margins extending over fifteen years—or longer—by way of PPAs negotiated in the context of P3s.

Nevertheless, while the P3 model remains dominant, there has been a gradual shift in the narrative around the role governments should play in driving renewables and green investments more broadly. This is particularly noticeable in the context of climate change. Although the discourse is still saturated with empty references to the wonders of the private sector and the crucial role of private investment, the role of governments is more openly acknowledged. That role is also being redefined: The once widely held view that governments should "send clear signals" to investors and markets has, over time, progressed to a point where governments are now increasingly seen as occupying the driver's seat—but with private companies and investors giving the directions.

An interesting illustration of this shift in narrative has occurred at the level of the UNFCCC and, specifically, its "extended work programme on long-term finance" (referred to as "LTF") that began mid-2012 and officially ended in late 2014. The UNFCCC has continued to provide a space to address the investment deficit, particularly with regard to the needs of developing countries.[184] Among the main conclusions that emerged from the work of the LTF process was the need to build the capacity of national public and financial institutions, including national development banks and hosts of green funds, and to "blend, direct and track climate finance." The LTF's 2014 report also referred to the importance of "national climate change ministries, inter-agency committees on climate change and national climate change trust funds":

> *These diverse institutional arrangements within countries are envisioned to better contribute and more effective delivery of finance at the local level by pooling and blending domestic and international funds in order to support national priorities.*[185]

These recommendations did not fall on deaf ears. In late 2015, the Paris Agreement would reference the need for governments in developed countries to "mobiliz[e] climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds."[186]

Mission Creep Not Allowed

For the major institutions, among them the World Bank and the OECD, the "significant role of public funds" is confined to government entities providing the means to access cheap debt financing from lenders interested in long-term and safe investments—virtually serving as a public-sector ATM, dispensing low-interest capital for the private sector. These same institutions emphatically oppose governments going beyond this role. The Climate Bonds Initiative, for instance, sternly warns:

> *Governments' role is not to fully fund, but to* enable *the climate finance we need. That means sorting out economic and energy planning and then to reduce key risks—notably government-related policy risk—enough to deliver secure long-term investment returns. That's how to channel private capital towards low-carbon investment.*[187]

Such a declaration amounts to little more than an ideologically driven attempt at maintaining a kind of rhetorical firewall to prevent serious discussion of the proven efficacy of governments to drive the provision of essential services—as amply demonstrated by their many past successes in doing so. But such efforts cannot alter the fact that public financial institutions have been pivotal in achieving the important advances that renewables have made in recent years. Public institutions and public funds have helped deliver profits and revenues to private wind and solar companies that oth-

erwise would have faced losses and potentially bankruptcy or that would have remained on the margins of the economy.

For example, the European Investment Bank (EIB)—100% publicly owned and guaranteed by all the member states of the EU—has played a leading role in driving investment in renewables. According to PSIRU, the EIB's public status allows it to "raise funds at the lowest possible rates." Since it does not try to maximize profits, "it also lends at rates very close to its own cost of borrowing." In 2015, the EIB provided about 13% of all finance for P3s in Europe—as much as all the equity capital invested by private partners themselves.[188]

Not surprisingly, the EIB is one of the largest investors in clean energy projects in Europe, committing €4.5 billion in 2012 alone. According to UKERC, "The quantity of finance committed from the EIB and quality of overall projects thus far shows from an EU level the important role public bodies provide in strategically managing risk and securing finance from the wider investment community for low-carbon energy projects."[189]

The EIB is also a key vehicle for promoting and advising on P3s beyond the EU.

The German state-owned development bank, KfW, is today a leading low-cost financing entity for renewable energy and a major contributor to capital markets in Europe. Founded after World War II as part of the US Marshall Plan, KfW is eighty percent owned by the Federal Republic of Germany, with the various States of Germany holding the remaining twenty percent.[190] The KfW banking group covers over ninety percent of its borrowing needs in the capital markets, mainly through bonds that are guaranteed by the federal government. This allows KfW to raise funds on advantageous terms. Its exemption from having to pay corporate taxes—due to its legal status as a public agency and unremunerated equity provided by its public shareholders—allow KfW to provide loans (for purposes prescribed by the KfW law) at lower rates than commercial banks. KfW is not allowed to compete with commercial banks, but it facilitates their business in areas within its mandate. KfW banking group has three business units with distinct functions, as well as several subsidiaries.

KfW has been a major player in the development of offshore wind (OSW) generation in Europe, as have Denmark's EKF and Belgium's Delcredere-Ducroire. The European Investment Bank and other multilateral banks have also been important.

United States: Clean Energy Deployment Administration (CEDA) and State Clean Energy Banks

As with Europe, renewable energy in the United States has been, and continues to be, dependent on government support. This support has taken several forms, principal among them tax incentives and government loans, both of which incur costs to the government. However, even quite mainstream policy groups concerned to advance renewables have called for a new federal financial entity, provisionally named the Clean Energy Deployment Administration (CEDA), to oversee the future scale up of renewable energy, which we will discuss in more detail below.

Much ink has been spilled over the Trump administration's announced withdrawal of the United States from the Paris Agreement. It is not necessary here to discuss in detail the various polices supporting renewables in the US other than to say that policies under the Obama administration generated significant investment and deployment. In March 2017 modern renewables contributed 10% of electricity supply for the first time, of which about 8% came

from wind installations and 2% from solar PV.[191] Cumulative installations reached almost 125 GW by the end of 2016. Annual investment in 2016 was around $46 billion, higher than any other country.[192]

Such achievements help contextualize the reactions to Trump's withdrawal from the Paris Agreement. At the same time, it should be kept in mind that, in order to honor its stated commitments under that agreement, the United States would need to install an additional 400 GW of new renewable capacity by 2025—a task requiring nearly $600 billion over the next eight years. Current investment trends under the market-driven model would leave a shortfall from this requirement of nearly $200 billion.[193]

Tax Incentives and Government Loans

Over the last decade, Federal tax incentives—mainly in the form of "Production Tax Credits" (PTCs) or "Investment Tax Credits" (ITCs)—have been critical to the rapid growth of renewable electricity generation in the United States, as have state-level "Renewable Portfolio Standards" (RPS), which mandate state-level targets for renewable energy, normally as a proportion of total electricity generated or consumed.[194] Under the PTCs, the option of a cash grant in lieu of tax credits expanded the pool of renewable energy investors and attracted significant amounts of private capital.[195]

In terms of government loans, as of 2013 the US Treasury had extended $6.65 billion in long-term loans to energy projects (including nuclear and CCS) under the Obama Administration's "American Recovery and Reinvestment Act of 2009" (ARRA) and the Department of Energy's (DOE's) Loan Guarantee Programs (LGPs). By 2017, the US Treasury had received more than $1.79 billion in interest payments but also lost $810 million as a result of unpaid loans.[196]

Until quite recently, both Republicans and Democrats viewed federal support as an essential means of keeping the United States as an energy technology leader, based on the understanding that the required capital spending to commercialize the technologies "is beyond the capacity of venture capital investors, while the risk is too high for private equity and debt financing." Under President Obama, the DOE provided "loan guarantees for eighty percent of renewable energy projects' cost for the greater of 30 years or 90% of their useful lives." But tax credits for wind and solar are being phased out and soon will end—in 2020 in the case of wind and 2022 for solar.[197]

To this day, renewable energy interests in the United States argue that incentives are "essential for continued scale up and market momentum as they generate the competitive internal rates of return investors require."[198] Using familiar arguments, they insist that support is still needed in order to "effectively address the particular capital-intensive nature of renewable energy. Renewable energy systems typically have high upfront capital costs but zero fuel costs. The federal tax incentives help offset these relatively high upfront capital costs."[199] These sources argue that "the PTC and ITC extensions amount to a guarantee that the wind and solar industries will survive and thrive until they can fully stand and compete successfully on their own against the fossil fuel and nuclear incumbencies without any subsidies whatsoever. This is a watershed moment for renewable energy."[200]

Whatever the impacts of tax incentives on the viability of for-profit renewable energy projects and companies, they effectively transferred substantial costs to the federal government. In 2010, federal incentives covered 58% of total project costs for wind power, 48% for small solar PV, and 52% for large PV (based on median project costs and expected future market prices for the electricity generated).[201]

A New Federal Financial Agency?

In 2009, the US Congress failed to pass into law a climate bill that would have established an emissions trading system as well as an economy-wide carbon price. The proposed legislation also called for a new federal financial entity, provisionally named the "Clean Energy Deployment Administration" (CEDA). The political impulse behind the proposal was to make sure that the United States positioned itself as the world leader in "clean energy technologies." The proposed CEDA would be capitalized with public funds and then partner with private energy sector corporations. According to the Center for American Progress (CAP), renewable energy companies were in need of adequate financing on favorable terms. Toward this end, a government financial entity could play the role of a "green bank":

> *CEDA can vastly expand the tools available to lenders by providing them with direct support through direct loans, letters of credit, and loan guarantees, as well as indirect support such as the authority to issue bonds, convertible bonds and warrants, and purchase debt securities and other financial products. These services will jumpstart business investment, increase capital at reduced loan rates, lower energy prices, and spur the construction and operation of clean technology projects throughout the country.*[202]

CEDA, according to CAP, would have been able offer loan guarantees, insurance products, and clean energy-backed bonds to accelerate private sector investment in the commercial deployment of new energy technologies. The draft legislation would fund CEDA with an appropriation of $10 billion, allowing it to become a self-sustaining entity based on "profit participation" mechanisms that would allow it take a financial stake in the projects it supported.

The defeat of climate legislation in the US Senate in 2009 did not, however, put an end to the calls for a new federal financial institution. By 2013, key voices in the renewables lobby said CEDA could productively partner with and help develop "state clean energy banks." Together, CEDA and the banks could address both the limitations of government loan programs and fill "other market gaps in private sector renewable energy finance and investment." Again, CEDA's mission would be to provide various types of credit supports to stimulate private sector investment in breakthrough or more established renewable energy technologies:

> *Many breakthrough technologies fall into a 'commercialization gap' commonly described as the 'valley of death' as they are too capital intensive for venture capital, yet too risky for private equity, project or corporate debt financing. More established technology projects, such as wind farms, have been plagued by the high cost of capital caused by credit constraints in the debt and tax equity markets.*[203]

According to the American Council on Renewable Energy (ACORE), CEDA and state banks could, "help ensure sufficient depth to the renewable project finance market":

> *[T]he lower credit risks for a portfolio of these technologies would allow CEDA to maximize leverage and private sector financing on an aggregate level. If successful, a CEDA focus[ed] on more established generation could also create demand 'downstream' in the renewable energy supply chain, thereby supporting a long-term market for breakthrough technologies.*[204]

A CEDA or state clean energy bank would have authority to approve projects at a portfolio level as opposed to an individual level, which would allow it to better manage credit risk: "The primary objectives are to keep a balanced risk profile in order to leverage the capability to provide additional financing for more risky projects, whereas the end goal of a typical private investor is to have invested in the lowest possible risk portfolio and received the highest return."[205]

It is interesting, if not particularly surprising, that the role of the private-sector players within this configuration of a P3 was, first, as beneficiaries

of low-cost and long-term government-backed loans and, second, as parties to low-risk power purchase agreements (PPAs). The latter would guarantee revenues and profits from sales of electrical power at above-market rates for up to thirty years. Together the loans and the PPAs would "help create market security sought by project developers and their financiers."[206]

What emerges from this history is that, even in the United States, there is clear recognition on the part of policymakers of the necessary role a public entity can play in leading the energy transition. In the case of the CEDA as it has been proposed, much effort was put into confining its role to one of ensuring profits for private interests. But there is no reason for trade unions and their allies to accept this as a necessary—or even an appropriate—role for a powerful public agency to occupy in the struggle for an energy transition that keeps the public good at the center of its vision. Although a detailed analysis is beyond the scope of the present paper, the "100 by '50 Act" recently introduced in the US Senate by Senators Merkley, Sanders, and others—which calls for creation of both a National Climate Change Council and a Climate Fund to be funded by climate bonds—seems to reflect an embrace of this perspective and to represent a real step in the direction of a genuinely public-driven approach.[207]

Across these various contexts, the shift in narrative about the role of governments in driving the transition to renewables has been accompanied by a resolute commitment to ensuring that such arrangements generate guaranteed, subsidized wealth for private corporate interests and investors. What must originally have sounded benign or even helpful to innocent ears—public-private partnerships—has proven to be little more than a growing body of state-enforced and taxpayer-funded corporate welfare programs. The resulting policy landscape is one where either "command and control" or carefully managed "competition" is an acceptable policy approach, as long as the net movement of value is from the public at large to private interests.

New Agents? Green and Climate Bonds

In the past several years, the volume of capital mobilized through "green bonds" has increased quite dramatically. More recently, financial institutions have proposed developing even more precisely tailored financial instruments under the name of "climate bonds."

To the almost audible relief of the major institutions and green growth advocates, the spectacular emergence of the green bond market is seen as a sign that institutional investors are showing more interest in renewable energy and in green investments more generally. Almost 46% of green bonds issued are to finance renewable energy projects. A further 20% finance energy efficiency projects. The value of green and climate bonds issued globally across all sectors is thought to amount to just 0.13% of the $100 trillion global bond market, but this relatively small commitment is deemed already to have had a perceptibly positive impact on the investment environment.[208] The major institutions therefore regard green bonds as a debt instrument that could play an important role in bridging the investment deficit in renewables.[209]

What Are Green Bonds?

Green bonds are fixed-income securities that raise capital for use in projects or activities with specific climate or environmental sustainability purposes. They can be either taxable or tax-exempt and are structured like standard bonds—with similar characteristics in terms of seniority, rating, execution process, and pricing—but with proceeds dedicated to climate or environmental projects.[210]

Neither green bonds nor climate bonds have strict legal definitions, and concerns have been expressed with regard to loose labeling of bonds under pressure to deliver profitable returns, enabled by a permissive definition of "green." In June 2016, the International Capital Market Association proposed a set of voluntary "Green Bond Principles," as guidelines for issuing green bonds.[211] The Climate Bond Initiative, which describes itself as "an international investor-focused nonprofit," has developed criteria under a "Climate Bond Standard" that rely upon a process of certification purporting to be independent.[212]

According to the European Commission's definition, "green bonds offer an opportunity for investors to make informed, explicit decisions to invest in green projects. Green bonds are a means of attracting new investors and hence mobilizing liquidity for green investments."[213] Or, in the telling words of the UN Secretary General's Climate Change Support Team, green bonds can help fill "the current gaps and weaknesses in private sector climate finance."[214]

According to BNEF, a record $41 billion in green bonds was raised in 2015 to finance renewables and energy efficiency projects.[215] By the end of 2016, this had grown to $96 billion and is expected to reach almost $130 billion by the end of 2017.[216] A December 2016 European Commission study pointed to the fact that $2.6 billion in green bonds were issued globally in 2012, but by 2015 total issuance had risen to $41.8 billion and to $74.3 billion by the end of November 2016. Globally, European and Chinese issuers accounted for most of the climate-aligned bond market.[217]

Why Have Green Bonds Emerged?

The growth in the global green and climate bonds market is a clear indication of the leading role government entities are playing in creating the conditions necessary to attract institutional investors—a point that is seldom made explicit beyond token acknowledgements that "governments are playing their part" in the effort to engage investors. To say the least, this minimizes the fact that, without the lower borrowing costs and guarantees offered by government entities, institutional investors would still be looking elsewhere for satisfactory returns.

It is also crucial to note that the rise in green bonds has not produced any significant increase in total investment in renewables and decarbonization projects. Globally, these investments remain flat in dollar terms and, as we have seen, are actually falling in some OECD countries. Rather than attracting new, additional investment, green bonds have drawn investors away from higher-risk project financing towards low-risk and longer-term investments. The economic downturn of 2008 has had a lasting impact on the fund management industry and on long-term asset allocation strategies of institutional investors, resulting in more cautious investment strategies and a greater focus on portfolio risk management. Heightened volatility and muted performance (particularly in the US and European equity markets) has lowered investors' risk appetite for listed equities. As noted above, investors have sought refuge in bills and bonds from governments with strong creditworthiness (so-called "safe assets").[218]

The Role of Public Financial Institutions

Multilateral Development Banks (MDBs, essentially public institutions) initiated the development of the green bond market in 2007 – 2008, with the European Investment Bank (EIB) and the World Bank leading the way.[219]

Key points in this history are summarized in a December 2016 policy note issued by the International Finance Corporation:

The first green bond was issued in 2007 by the European Investment Bank, under the label Climate Awareness Bond, as a structured bond with proceeds dedicated to renewable energy and energy efficiency projects. The World Bank issued its first green bond in 2008, a SEK 2.3 billion bond with a maturity of six years for a group of Scandinavian investors. And in March 2013 IFC issued a $1 billion benchmarked bond.[220]

The World Bank describes the rationale for issuing its first green bond as threefold:

⇒ First, it responded to specific demand from Scandinavian pension funds seeking to support climate-focused projects through a simple fixed-income product. It also fit well with IBRD's efforts to cater to investors interested in sustainable and responsible investing (SRI).

⇒ Second, it supported the World Bank's strategy to introduce innovation in climate finance.

⇒ Third, by focusing on climate change mitigation and adaptation projects, World Bank Green Bonds helped raise awareness among investors and the financial community about how developing countries can take action on climate change but also stand to be affected by it.

As of the end of June 2015, the World Bank had issued green bonds worth a total of $8.5 billion, supporting roughly seventy mitigation and adaptation projects in developing countries.[221]

In 2010, the International Finance Cooperation (IFC), European Bank for Reconstruction and Development (EBRD), and other public entities also began issuing green bonds. Municipalities and local governments later joined the market, and by the end of 2013 it was worth some $11 billion.[222] Since 2013, private sector players—such as Bank of America and Vasakronan (a Swedish real estate company previously owned by the Swedish government, but now privately held)—have also begun issuing green bonds. Utilities, car manufacturers, and a host of other corporate entities today issue green bonds. In 2015, many of the most significant positive developments spurring the green bond market have arisen in emerging economies.[223]

In the US, states and municipalities largely drive the green bond market, and the United States led the world in green bonds issued at the national level in 2015, with a total bond issuance that year of $10.5 billion. But China's green bond issuance reached $36.2 billion in 2016, accounting for 39% of all global issues that year, and more than doubling the global total from the previous year. Significantly, the People's Bank of China (PBoC) has been the driving force behind that surge. According to the PBoC, public funds will contribute around fifteen percent of the capital required for green investments, with bonds being issued to help meet the remaining requirements.[224]

Public Policies Are Crucial

Public financial institutions and municipal authorities not only led the way in terms of bond issuances, but public policies have created a favorable environment for institutional investors.

Bonds are therefore to a large extent the product of the policy environment and the drift toward "concessional lending." It was noted above that the UNFCCC working group on long term financing (LTF) had recommended that governments play a larger role in generating long-term commitments of capital. According to the report, institutional investors "are particularly risk-averse, leveraging will likely be feasible when concessional public/climate finance is used to reduce risk levels."[225] Embedded in the technical language is a simple idea: In order to bring renewables to the levels required, governments must provide the capital, in the form of concessional financing or loans.[226]

The size and significance of the bond market seems to be inseparably tied to the capacity of policy makers either to reduce investor risk or to increase returns—and the policies that are in place today in many countries normally attempt do both. This was discussed in some detail above in the context of P3s in the power generation sector and the use of PPAs as a "policy of choice." These policies reduce investor risk and guarantee a long-term revenue stream—perfect conditions for a thriving bond market. For investors, the green bond is an instrument, a means to reduce risk while enhancing returns and, in the words of the Climate Bonds Initiative, "to achieve the necessary scale and allow expansion of green bond issuance to other entities and structures, de-risking mechanisms are crucial."[227]

But as we have seen with the dramatic rise and fall of investment in renewables in the EU, policies that provide *financial* certainties of this nature are vulnerable to changing political tides. As a European Commission study on the *potential* of green bonds notes:

> *Increasing the returns of green investments through, for example, tax incentives is a possible public measure for boosting the green finance market in general. Yet, from the perspective of the investor, it creates another risk—the policy risk. This means that the return is only high as long as the policy is in place, or as long as its effects endure. Once policy priorities shift and public support is withdrawn, the return decreases if the root of the underlying risk has not been eliminated. This policy risk is taken into consideration by the investors and may make them reluctant to invest in green bonds.*[228]

In some respects, then, we are back to square one. In the case of renewables, both revenues and profits today still largely depend on out-of-market protections, essentially subsidies and PPAs in many parts of the world. The growth in the bond market reflects the presence of these subsidies (reducing risk) combined with the post-recession appeal of low-risk projects. But the underlying sources of risk have not been eliminated. The future of renewables is still tied to their capacity to generate profit for private investors. Should these profits be uncertain or absent, then the future of renewables is thrown into doubt—regardless of their crucial role in reaching decarbonization targets, let alone achieving broader social and ecological aims.

The Road Not Taken

It is worth speculating at this point on what the prospects for renewables might have been had privatization and liberalization *not* occurred.

For unions, there is perhaps some ironic satisfaction in being informed by sections of the investor and policy communities that public financing through issuing bonds ("capital steerage") is a good way to develop renewable energy and other "green" technologies, and that, historically, "the use of bond finance has been enormously successful" and a "recurring financial instrument" to meet public and social needs for many decades—facts of which many unions have long been well aware.

The main tasks needed to complete an energy transition to a renewables-based system are nevertheless still present. Principal among these tasks is to develop and deploy renewable energy at a rapid, steady pace, consistent with both their technical potential and with climate targets and timetables. For many countries in the global North, deployment would need to take into account replacing the generation capacity of aging coal- and gas-fired power stations, as well as older nuclear plants. In the South, it would need to prioritize finding ways to combat energy poverty where this exists—mainly in sub-Saharan Africa and large parts of the Indian sub-continent.

A successful transition would also need to provide sufficient generation capacity from renew-

able sources to charge hundreds of millions of electric vehicles while conventional petroleum-powered vehicles are phased out. New infrastructure, such as charging stations, would need to be put in place in millions of locations, including public spaces, while mass public transport systems—some using digital systems—are designed to facilitate mobility.

Developing integration and storage technologies would also need to be given top priority and supported by government-backed R&D programs tied to top universities and research bodies. Intellectual property laws would need to be amended in order to allow for the widespread, unhindered dissemination of the best available technologies. Aggressive and creative measures to promote energy conservation across all economic sectors would also be a priority.

Had privatization and liberalization not occurred, the kind of long term planning and cooperative processes needed to achieve these tasks would be not only conceivable but quite obvious. The costs of capital would be lower; private companies could be engaged as and when needed but with clear social and environmental conditions written into any contracts; the public would own the new generation of renewables' capacity it had invested in; and so on. With costs falling, the world could benefit from inexpensive renewable energy while climate goals could be met and perhaps surpassed.

In that sense, then, the main task before us is to overcome the toxic—and potentially catastrophic—legacy of neoliberalism and its aftermath. In particular we must reject the falsehoods that "there is no alternative" to an energy transition led by private interests and that the latter's demand for profits must remain paramount even in the face of a civilizational emergency. This is not primarily a *technical*, nor even a *financial*, but primarily a *political* challenge—and we may only have a few years left in which to meet it.

Conclusion: The Public Pathway

As noted at the outset, this paper aims to achieve two main goals.

The first goal is to draw attention to the scale of the investment deficit in renewable energy, and why this situation is sufficiently serious, urgent and formidable as to demand a major shift in both public policy and trade union strategy. By now it should be clear that the dominant approach to advancing the energy transition by "mobilizing the private sector" has failed to produce the results its proponents promised. Furthermore, there is no basis on which to believe it can succeed. Even the IEA has starkly admitted, "Market-based, unsubsidized low-carbon investments have been negligible."[229] The inability of the dominant policy institutions to find ways to generate adequate levels of private sector financing is part of a crisis of the profit-driven "green growth" framework. The hopeful phraseology and formulations may linger on, but they are every day belied by hard economic realities.

The second goal is to encourage and enable unions and their allies to reject the false notion that "there is no alternative" to relying on market mechanisms and private sector investment to deliver the energy transition we need and to begin to devote time, attention and resources to the task of articulating clear and concrete alternative approaches. If nothing else, it should by now be strikingly obvious that, in order to address the investment deficit, the enforced

chaos of the so-called "competitive" electricity wholesale markets must be brought to a close. This is the starting point for a fresh discussion among unions on public financing and public ownership.

In this concluding section, we aim to provoke discussion among unions about the need to cultivate a trade union counter-narrative that is clear, bold, and persuasive and—given the formidable nature of the challenge—that offers some hope of decisively interceding in the global energy system's worrying trajectories. Such a narrative must be able to assert, confidently and from an informed perspective, that only a planned, coordinated, publicly driven approach to investment has a credible chance of delivering the dramatically scaled up deployment of renewable power that we urgently need.

Based on their own studies and analyses of the current status of investment in renewables, influential voices within or surrounding the dominant policy instituvtions have concluded that the market model that emerged from privatization and liberalization has proven to be an impediment to the kind of energy transition that is required. These same institutions instruct governments to increase their role as *enablers* of investment by absorbing risk, providing support, and guaranteeing revenues and returns through P3s and PPAs.

The introduction of capacity payments speaks to the extent to which the "competitive market" is not only no longer competitive, it can no longer be usefully described as a market. Rather, we see governments, trying to ensure the energy-demand needs of the entire system are met, *paying for unused electrical power*—from both incumbent utilities *and* renewables companies—in order to ensure that *all* providers walk away with "returns on investment" that they—and the investors behind them—consider "satisfactory."

Nationalization, (Re-)Municipalization, and Cooperatives

The case against P3s from a pro-union perspective can be found in several sources, including PSIRU's *Public Ownership of the UK Energy System—Benefits, Costs and Processes*,[230] Transnational Institute's recent *Reclaiming Public Services*,[231] and some of TUED's Working Papers—especially P*ower to the People: Toward Democratic Control of Electricity Generation*.[232] These sources examine various options, challenges, and strategies that a determined struggle to recover energy resources and systems in service of the public good can and should consider.

Encouragingly, a decidedly pro-public narrative has begun to take shape within the trade union movement and is gaining political momentum. Under Jeremy Corbyn's leadership, the UK Labour Party's 2017 manifesto incorporated a commitment to "take energy back into public ownership to deliver renewable energy, affordability for consumers, and democratic control."[233] In Canada, some large unions are supporting *The Leap Manifesto*, which, among other things, advocates for democratic control over energy systems, as well as turning public post offices into community hubs that generate solar power and offer low-cost financial services.[234] In Australia, unions are in the process of advancing specific measures in order to reclaim the privatized sections of the electricity system.[235]

The question of what should replace the current model is, of course, central. The many distinct perspectives on what would be the right balance between community, municipal, and national levels of ownership, control, and management are too varied and complex to be dealt with here. Whatever path is chosen in a given setting to reclaim energy to the public—nationalization, reasserting or expanding municipal control, networks of cooperatives,

or some combination of these and other options—the issue of financing lies at the heart of the discussions.

Acknowledging the Investment Deficit

It is therefore important to collectively acknowledge that, as a movement, we are just beginning to discuss how to finance the energy transition. Relatively few in the trade union and broader progressive community seem to be aware *either* of the extent of the investment deficit *or* of its implications for the green economy they might otherwise support.

The investment question is also likely drowned out by misplaced celebration of pyrrhic victories that have little or nothing to do with any real transition to renewable energy. Some environmental NGOs and activists appear to be preoccupied by ensuring the adoption of ambitious emissions reduction targets by governments and major institutions—despite the fact that, even when these are adopted, they are not accompanied by any credible plan for achieving them. This reinforces the demonstrably false idea that there is nothing fundamentally wrong with the existing approach to deploying renewables, that real progress is being made, and that we only need to do more of the same but faster.

Regardless of where investment levels currently stand—and despite increasing calls even from mainstream voices for dramatic departures from business as usual—the dominant narrative essentially remains captive to the idea that policy should continue to focus on mobilizing private capital and that it is perfectly appropriate for public resources to be devoted to advancing this aim. The predictable result of such an orientation is a tendency to support whatever the private renewables companies say they need in order to be able to attract investment for renewable energy projects.

NGOs to Governments: Mobilize the Private Sector… Only More!

The widely read annual publication *Energy [R]evolution*, sponsored by Greenpeace International and others, has calculated that full decarbonization via "100% Renewable Energy For All by 2050" will require approximately $1.23 trillion in investment per year in renewables—more than four times higher than 2015's record levels. What will it take to generate this higher level of investment? According to the report, it will require "direct government support through a variety of fiscal instruments […]. There is thus a role for the public sector towards increasing investments directly and in correcting market and regulatory obstacles." This is because investors "need to know if the electricity from the power plant can be sold to the market for a price that guarantees a good return on investment (ROI). If the ROI is high, the financial sector will invest, if it is low compared to other investments, and financial institutions will not invest."[236] This kind of thinking has become almost instinctive for many NGOs and reflects the dominant narrative: because no public alternative can be given serious consideration, the role of governments is to do whatever is necessary to meet the needs of private investors and companies.

Moving the Debate in the International Trade Union Movement

At the global level, trade union debates on energy have been dominated by unions representing workers in the existing power sector and energy-intensive industries. However, the International Trade Union Confederation (ITUC) has taken the lead on framing global labor's approach to climate protection.

A 2012 ITUC report titled *Growing Green and Decent Jobs* acknowledged the investment challenges discussed in this paper and insisted that "investing in the green economy should be an economic priority for all governments and business leaders [...]. All countries need to generate investments of 2% GDP each year to green their economies." This, said the ITUC, would require a "new green investment model" based on "planning and managing national economies and demonstrates how public and private investment in the green economy can create decent green jobs."[237]

However, the estimated proportions of public and private investment and the nature of the relationship between the different entities making these investments are not currently made explicit by the ITUC.[238] And while there have been many differences of emphasis between the ITUC and the major policy institutions on key issues around climate change and energy transition (particularly with regard to the role of organized labor), the differences regarding how to generate investment are far less obvious. For example, the ITUC has consistently emphasized the need for "a stable, reliable and economically meaningful price on carbon." Overall, there is little in the ITUC's positions on energy and climate change to suggest that governments should position themselves as direct drivers of the transition in the same way they once drove the development of essential public services in decades past.

Global Union Federations

Among the Global Union Federations (GUFs), we see a fairly diverse picture and a broader spectrum of trade union positions.

IndustriALL represents unions in the energy sector. Reflecting its membership base in fossil fuels and energy-intensive industries, its positions have tended to be circumspect and cautious.[239] GUFs representing public and transport sector workers have, however, supported public sector approaches to the energy transition and have been more critical of green growth assumptions and approaches. Since 2010, the International Transport Workers Federation (ITF) has supported public approaches to climate protection through expanding public transport systems, reducing unnecessary movement of goods, shifting from road to rail (less trucks, more trains), and other potentially transformative proposals.[240]

Public Services International (PSI) and its affiliates have been at the forefront of the global labor movement's resistance to further privatizations of public services. PSI has declared strong support for "renewable energy initiatives, including public ownership and management, decentralised to municipal and local levels."[241] PSI also seeks to "explore examples of public ownership of renewable energy systems, including at the municipal level."[242] It notes that, "Some communities are taking parts of the energy system back under public control, or into cooperative structures, exactly in order to more rapidly transition away from fossil fuels and into renewable energy sources."[243] As noted above, PSI's research unit (PSIRU) has for over a decade developed a detailed, thorough critique of the P3 system and PPAs in the power sector.

The International Union of Food Workers (IUF) has put considerable effort into resisting international investor-protection agreements—often misleadingly referred to as "trade agreements"—and its opposition to such agreements is explicitly grounded in the conviction that such agreements will "further empower corporations and undermine public services."[244] In debates on development aid, both the GUFs and the ITUC have fought against the privatization of basic services and P3s.[245]

Reasserting Public Approaches

From this very basic summary, two things can be learned. First, to varying degrees, major

global trade union bodies support a strong public role in the green economy and, more broadly, sustainable development. This constitutes the outlines of a political platform that can be utilized to reassert public approaches to energy transition and how the transition might be financed. Second, despite a commitment to a strong public role *in principle*, unions have for one reason or another been reluctant to propose that the public sector be the *driving force* behind the transition. In the case of power generation, this would imply the need to *reclaim* to the public some or all of the key system functions—such as generation, transmission, and distribution as well as conservation, research and development, etc.

In any case, a convincing and effective trade union narrative on the need for public approaches to energy transition will need to be based on a rigorous engagement with the issues. Given the urgency of the situation and the current trajectories around energy use, pollution, and emissions, there is no room for ambiguity or reluctance in asserting the role that governments and public institutions at all levels need to play.

The "Budgetary Priorities" Approach

There are, of course, many progressive leaders and activists who understand that the energy transition is in need of more capital and that the way the transition is proceeding will fail both in terms of achieving the speed and scale required and in terms of achieving any social and economic aims.

This is often interpreted as if the question is one of budgetary and societal priorities. For example, progressive voices (unions among them) have called for the removal of subsidies for fossil fuels—estimated by the IEA to be $320 billion in 2015—in order to level the playing field and allow renewables to compete. Some have suggested shifting these subsidies away from fossil fuels and toward renewables, although how that might happen is often left unexplained.[246] A major impediment to that strategy is that the bulk of the $320 billion in annual subsidies are actually paid to *consumers* in poor and middle-income countries to help them afford to pay for gasoline, diesel, electricity, and natural gas in order to meet basic needs for heat, light, cooking, and transportation. Even aside from the fact that removing such social supports is all but untenable from the perspective of basic social justice, it is hardly clear that government savings from removing them would translate into investment in renewables, as some have implied.[247]

Others have focused attention on ways to generate revenue for renewables from dedicated taxes, such as a carbon tax or financial transaction tax (FTT), and various estimates of the funds such taxes could generate have been put forward. For example, using data generated by the Tax Justice Network, a recent study produced by Friends of the Earth International estimated that as much as $790 billion is lost to the public purse each year as a result of tax evasion and the non-declaration of assets hidden offshore. As the study notes, "The extra investment required to power half the world with 100% renewable energy is an average of $507 billion per year over the 15 year period. This is well below the estimates for tax revenue lost through tax havens annually."[248] This very robust proposal and others of a similar nature draw attention to the fact that the financial resources to drive an energy transition could be generated by a shift in budgetary priorities or by using various means, such as a carbon tax, of securing additional revenue.

Such suggestions for generating funds for renewables are perfectly valid but often do not engage with key questions of ownership and control or how to produce the best social and ecological outcomes.

As noted in Part Five, the massive volumes of money classed as assets under management—roughly $93 trillion in the OECD countries alone[249]—are sufficient to illustrate that the main issue is not a lack of *money*. It is, simply put, that there is not a lot of *money to be made* from renewables and associated technologies—at least not without massive government intervention to ensure returns that have little to do with the actual costs of generation and much to do with recovering the additional costs of private capital and generating satisfactory profits for investors.

Public Capital Should Serve the Public

As noted above and elsewhere, the Public Services International Research Unit (PSIRU) has made a particularly valuable contribution to understanding the problems associated with privatization, having produced several papers that together offer a wide-ranging and thorough critique of public private partnerships (P3s) and power purchase agreements (PPAs) involving private energy companies and other third party operators. PSIRU has also made a solid economic case for reasserting the role of the public sector in building infrastructure.

One of the key economic arguments for public renewable power pertains to low-cost financing:

> *The public sector can raise long-term, cheap finance at lower interest rates and over far longer time periods than could any private company, by using tax revenues, or user charges, as security to raise loans or issue bonds to be repaid out of future income. It can decide on the balance between user charges and taxes to finance a service, and vary this balance over time according to changing circumstances. It can also choose to finance investment directly out of current revenues or taxes. The benefit of low borrowing costs can be gained by local as well as central and federal governments. Many countries have developed special mechanisms for financing municipal investment at low rates.*
>
> *The public sector also gains greater flexibility, control, and comparative efficiency—because of reduced transaction costs and contract uncertainty, as well as economies of scale—and also the efficiency gains of more democratic accountability.*[250]

Elsewhere, PSIRU also notes, "the overwhelming majority of renewable energy has been developed by public sector or non-profit organisations, not by private companies [...]. Moving to public ownership therefore makes it easier to develop renewable energy systems, rather than using public money to offer financial 'incentives' for private companies to choose investments in renewables sold through a dysfunctional market system."

In part four of this paper we referred to the Centre for Policy Studies' (CPS) paper titled *Central Planning with Market Features: How Renewable Subsidies Destroyed the UK Electricity Market*. Although coming from a right-wing source, the paper makes a crucial point:

> *At no stage has there been any published analysis demonstrating that the use of private capital delivers better value for money than a public sector comparator. By subsidising the provision of capacity, the Government is taking control of electricity generation, but not taking ownership of it. The logical solution is for the public sector to finance and own investment in such assets.*[251]

The Simple Economics of Public Renewable Power

In articulating a vision for how public investment can help make a decisive break with the current approach, we can begin by rejecting the idea that completing the energy transition will cost trillions of dollars of public money invested in renewables at the taxpayers' expense.

The economics of a public sector approach are simple. Under public control, electricity can be treated not as a commodity but a service—or

even as a right—managed locally, but coordinated at regional, national, or wider levels, which is already the case in some parts of the world, where electricity is bought and sold across national borders. Either way, user fees can easily cover the costs of building new capacity and, in the case of certain types of renewables, fairly quickly. The main variable of this model is not the quantity of electricity sold in a given time period, but the overall costs of generating the power and protecting and upgrading the system on an ongoing basis.

Under the currently dominant approach, the costs of energy are recouped from user fees. Since these costs currently include a substantial factor to cover the higher costs of capital, as well as profit—and almost certainly higher legal, accounting, and other costs involved in the complex and lengthy processes involved in setting up P3s—the upfront costs of publicly owned projects can either be recouped more quickly, or user fees lowered, or some combination of these.

To ensure that these costs are covered and revenues are set aside for future investments, public entities must be able to control the price of electricity and, if necessary, use revenues from other sources—such as a dedicated tax on carbon or an FTT—to make up any shortfalls in the short to medium terms. Many governments already play a ringmaster role in terms of determining energy choices and capacity-related questions and have exerted control over prices on innumerable occasions. In effect, all out-of-market interventions amount to price control mechanisms of one sort or another.

Within a framework of public ownership, shifting budgetary priorities and creating purpose-specific revenue streams are important options available to governments. But it is reasonable to conclude that, given what we know about the real costs of generating renewable energy, the bulk of the public investment committed to the transition will initially be recovered through electricity bills. Some revenues can be earmarked for operation and maintenance, R&D in non-mature technologies and options, and—perhaps most important of all—energy conservation.

Low-Cost Public Energy

As we have seen, private sector for-profit renewables companies are currently being put under pressure on two fronts. First, there is pressure to reduce costs and prices. Second, there is pressure from investors seeking to secure satisfactory returns.

The pressure on the renewables sector to lower costs is explained by the need to become competitive with electrical power generated by fossil fuels. However, in the current "price is might" policy environment, it is also needed for political reasons in that the renewables sector must demonstrate that it is becoming progressively less dependent on out-of-market measures, essentially subsidies.

One major problem with the way in which costs and prices currently shape debates over energy policy is that major societal costs associated with fossil fuel use—both ecological and health-related costs, for instance—are still treated as externalities and not counted toward true, total costs. According to one estimate of such costs, by Stanford University's Mark Jacobson, fossil fuels and renewables are roughly equal in cost when such societal costs are ignored. When they are counted, the true costs of fossil fuels are more than triple that of renewables:

> *Transitioning to 100% clean, renewable wind, water, solar (WWS) energy has an up-front cost for wind turbines, solar panels, etc. and for storage and transmission, but there is zero fuel cost, so the average 'business' cost if the energy turns out to be the same or less than that of a 2050 fossil-fuel economy, around 11 U.S. cents/kWh. How-*

ever, because fossil fuels also cause health costs of around 15 cents/kWh and climate costs of another 9 cents/kWh for a total of 24 cents/kWh, the total social cost of energy (business+health+climate) cost for WWS is 11 cents/kWh versus 35 cents/kWh for fossil fuels, so WWS is much cheaper.[252]

In part three of this paper we described how this price-related pressure has increased with the global drift from a "come one, come all" FiT approach to one based on competitive bidding by auction. The bidding process has also served to depress the strike price of the PPAs, putting further strain on profit margins.

From the perspective of *public* investment, falling prices for renewable energy would unquestionably be a *good* thing. Along with the impact of maturing technologies and economies of scale, the falling cost of renewables reflects the fact that the source is effectively unlimited in supply terms and requires no payment.

To the extent that existing technologies and financial arrangements have thus far been able to deliver ever-cheaper prices in kWh terms, we can calculate how much lower these prices could be if the higher borrowing costs and profits from PPAs—not to mention the high salaries of CEOs—were subtracted. In that case, falling prices—a curse for private renewables companies—become a clear advantage from the perspective of the broader public interest, which also includes ecological and climate-related needs.

However, while controlling prices is essential, public approaches to energy financing and planning will likely operate on the understanding that lowering or containing prices should not be the sole—or even primary—policy goal. Pricing must plan for future investment needs. Residential electricity use in OECD countries is roughly one third of the total consumed in any given year—and considerably less in percentage terms in non-OECD countries—with industrial and commercial users together accounting for more than 60% in most instances. Therefore electricity prices can be structured in a manner that is equitable and where the energy transition does not inflict a disproportionate share of the burden on low-income people.

The Curse of Certainties

The second source of pressure on for-profit renewable energy companies comes from investors. Seeking satisfactory returns, investors are concerned that prices for renewables will fall to levels that will squeeze company profits and jeopardize their own returns as lenders. Therefore any given project must be able to provide "certainties" of various types. Certainties about demand are essential, which means there needs to be a guaranteed buyer for the power generated. Revenue certainties are also needed, and at a level to ensure full cost recovery, including the cost of borrowing money. Finally, profit certainties are needed to remove the risk of either loan renegotiations that stretch out repayment schedules or bankruptcies.

As we have seen, to establish these certainties, investors normally require a PPA before committing capital to any given project—one that stipulates the terms needed to protect the investor. The P3 further reduces risk, in that the involvement of a governmental partner provides credit enhancement by reducing the risk of default. This increases the overall credit rating of a project, which in turn brings down the cost of capital needed to finance projects and companies.

But here we confront an important contradiction: While an *individual* PPA removes *financial* risk for any given project, the *widespread adoption* of PPAs raises the level of *political* risk for all such projects, thus exposing the *entire* renewables sector to uncertainty. This contradiction produced the nightmare scenario for renewables that unfolded in the UK, where the cur-

rent Conservative government declared that it was time for renewables to "stand on their own two feet," leading almost immediately to a precipitous drop in investor commitments. In the United States, the 2011 mid-term Congressional elections led to withdrawal of tax credit support, which was followed by a substantial drop in renewables investment. In Europe, the paring back of FiT rates has seen investment plummet in a region that was once the global leader in renewables deployment.

Even when PPAs are in place or imminent, wind companies in particular have tried to spread lender risk by borrowing smaller amounts of capital from multiple banks in order to get the required financing. This door-to-door method of financing increases transactional costs and thus adds more pressure on companies.

Given all these factors, there is no denying that renewables companies are operating in a policy environment more likely to repel investors than attract them. We cannot afford to leave the pursuit of an urgent, necessary transition to renewable energy at the mercy of such an approach. We must instead pursue a broad, coordinated "public goods" approach that can deploy renewable energy at a faster speed and larger scale—an issue we return to below.

Public Funding or Public Financing?

It may be useful here to highlight the differences between government *funding* and government *financing*. Government *funding* typically refers to direct allocation of funds from public budgets, normally raised through taxes, customs fees, etc. For example, in 2015 the US government gave $534 billion for the Department of Defense (the largest annual amount ever) plus an additional $51 billion in war funding.[253] No repayment was expected, and none was offered. By contrast, government *financing* typically refers to the securing and provision of up-front cash for projects, but this cash is borrowed and must eventually be repaid with interest. The funds that support government financing generally come primarily from private investors who purchase government bonds, which are secured by the "full faith and credit" of the government in question. Repayment may come from general government revenues, but it may also come from user fees, dedicated taxes, or new tax revenues that result from the project.

In terms of this discussion, either public funding or public financing would open the door to new public forms of generation in renewables. Public entities—either existing ones (including public utilities) or new ones mandated by the public to oversee the energy transition—could purchase new generation capacity outright and use public workers or community based organizations to perform the installation work.

Where governments have the capacity to direct production of renewable energy technologies, this capacity can be factored in to national or regional energy transition plans. Some large wind turbine companies already include significant state ownership, and the prospect of a major scale up of wind deployment is likely to be attractive. In the case of solar PV, the technical barriers of entry are less challenging as a result of less complex technologies and fewer components. Therefore publicly owned manufacturing facilities of panels and components are perhaps more conceivable and could be an option under certain circumstances, as could bulk purchasing of solar panels on the (currently over-supplied) global market.

Battery and storage technologies are of critical importance if renewable generation is to be ramped up substantially, and additional research in this area should be an urgent priority. There is some evidence that a shift to government-led investment may already be underway: In 2016, corporate spending on R&D fell sub-

stantially in both Europe (down 37%) and the United States (down 24%) while government spending increased in both settings (EU up 24%; US up 51%).[254]

In the event that private companies may be required to supply or service new generation capacity, the terms will need to be balanced and fair, with social conditionalities written into the arrangement. As one indicative example—albeit with mixed results—the ANC government in South Africa has attempted to have renewable energy companies source their materials from local suppliers, employ local residents, and involve communities in decision making.

Ideally, expanding direct public financing of renewables will allow for ownership in the sector to move decisively towards the public, beginning with transmission and distribution interests and other non-generation functions and operations. Just as the political right often took a strategic approach to privatization and liberalization of many public services, returning the power sector to public ownership will necessarily take different forms and unfold at different speeds in different circumstances.

In some respects, the issue of financing is the least intimidating of the obstacles currently obstructing the path to large-scale renewable power, and public financing will strengthen the arm of public institutions in advancing a bold deployment schedule and dealing with private interests.

Their Bonds, Our Bonds

It is currently the case, however, that public financing of renewables, either by way of development banks or—as is increasingly the case—by engaging institutional investors by issuing green bonds or climate bonds, is in most instances serving to change ownership relations in power generation in a way that favors private companies and further undermines public control and regulation of the sector.

We discussed in part five of this paper the effort among energy and climate policy makers to attract institutional investors to renewable energy and the green economy more broadly. We also described how green bonds have emerged as an increasingly important financial instrument, an emerging asset class that can reduce financial risk for lenders. When packaged in the form of a P3 with a PPA at its core, it guarantees revenue and profits for the private company and allows the company to maintain ownership over generation infrastructure.

At this point it, is worth reminding ourselves why the logic of P3s and PPAs actually make a strong case for "public only" solutions where the main economic driver is already a public sector agency (or agencies) and private actors are engaged only as and when needed. For example, after considering the prospects of offshore wind in the United States (where only one thirty megawatt installation exists) one US-based energy consultant has stated, "Without a long-term PPA offshore wind farms in the US are unlikely to obtain financing. As the cost of energy from offshore wind farms is uneconomic without government subsidy, some states are forcing the hand of utilities to sign PPAs. PPAs have come under tremendous scrutiny for the increased rates electricity customers would pay."[255] The PPA is therefore a direct subsidy to the energy producer, via the utility (investor owned or publicly owned), the cost of which is likely to be passed on the electricity consumers.

One particularly revealing P3 configuration is the "Morris Model" in the United States. According to its advocates, "the public entity issues a government bond at a low interest rate and transfers that low-cost capital to a developer in exchange for a lower PPA price. Under this model, a public entity (the administrator) issues a request for proposals for a solar developer

to build, operate, and own one or more solar projects on public buildings ("local hosts"). The administrator sells bonds to finance the development costs of the PV installation and then enters into both a lease-purchase agreement with the winning bidder and a PPA (on behalf of the local hosts) to buy the electricity from the PV system."[256]

Here a private company partners with a public entity, takes advantage of low-cost public finance through an issued public bond, and installs solar PV on the roof of a public school—built using public money for the purposes of educating the children of the general public in the interests of the broader public good. The public entity also commits to pay bondholders in the event of a default in bond payments.[257]

It is not difficult to see what is wrong with this arrangement and how it could be done differently. Among other things, the PPA deprives the public entity of revenues that a public PV installation would have generated once the initial costs of the PV and installation had been completed. Furthermore, a traditional public funding model could be extended to *all* public buildings with solar potential in a given jurisdiction, could use a public entity to purchase the PV and public workers to install and maintain the systems. Revenues generated from the production of electricity would first pay back the costs of the panels and installation, and once the costs have been recovered, revenues could be used to offset electricity bills incurred by the public authority, thus reducing energy costs.

Under such an approach—a "public-*public* partnership" (PUP) between two or more public institutions—the benefits of low borrowing costs could return to the public in the form of revenues over the longer term. There is relevant experience with such PUPs on which to draw, especially involving water services:

> *PUPs allow two or more public water utilities or non-governmental organizations to join forces and leverage their shared capacities. PUPs allow multiple public utilities to pool resources, buying power and technical expertise. The benefits of scale and shared resources can deliver higher public efficiencies and lower costs. These public partnerships, whether domestic or international, improve and promote public delivery of water through sharing best practices.*[258]

The fact that the P3 and PPA approach generates no additional capital, but incurs capital costs that are higher than government-only long-term borrowing through bonds, means that the private company in these instances is securing benefits that should return to the public—principally revenues and ownership of generation capacity. A public only approach would not only be less expensive, but projects could also be developed faster, accelerating deployment.

With interest rates currently low, government entities and/or reclaimed utilities can issue bonds in order to finance this kind of renewable energy deployment. These can be labeled, say, as "public renewable energy bonds" in order to tap into individual and institutional investor interest in investment in renewables, but such labeling is probably not essential. For these entities to raise the levels of capital needed, the kind of certainties currently enjoyed by private interests need to become part of the public financing equation. The need to control the price of electricity at any given time, factoring in fluctuations in demand, is an essential means of ensuring that cross-subsidization of the energy transition is as much as possible avoided.

Union Pension Funds

In recent years shareholder activists have urged union pension fund trustees and managers to divest from fossils fuels and to invest in renewables instead.

In the last two or three years some unions have played their part in the movement aimed at driving divestment from fossil fuel interests.

This has helped fuel the idea among activists that union pension funds might also have an important role in financing renewable energy.

But there are reasons why pension fund investment in renewables has not happened. Clearly, the current market-based approach is simply not conducive to union pension funds serving as a significant source of finance for renewables. Fund managers are undoubtedly aware of the volatility in the renewables sector. Several of the largest renewable energy developers hold credit ratings in the non-investment grade, "highly-speculative" range.[259] High profile bankruptcies have cast doubt on the ability to reliably forecast long-term costs of debt and equity in the industry.[260]

Public financing of renewable energy is, therefore, perhaps the only plausible means of attracting significant investment from union pension funds. Union representatives who serve as trustees can join the political effort to reclaim the power generation sector and to re-exert firm control over electricity pricing and therefore set the stage for government entities and reclaimed utilities to negotiate directly with pension fund managers and trustees regarding appropriate rates of return on public renewable energy bonds and other debt repayment issues. Union pension funds could thus help fund a massive scale up of public renewable power, with the gains in visibility and public approval that serving in such a role could bring. Guaranteed user fees on their own could lower risk to the fund, and satisfactory returns could be negotiated that protect workers' pensions and the integrity of the fund over the longer term.

An "Energy Armistice"

The case for public ownership and public financing is compelling and may be the only way to overcome the investment deficit—likely the most significant impediment to the effort to decarbonize power generation—as a crucial step toward reaching climate targets. However, reaching these targets is not simply a matter of raising enough investment capital; it is also an historic task that will require a virtually unprecedented level of long-term planning, coordination, and cooperation. If the science is even remotely correct, human civilization will soon enter "emergency mode," and remain in that mode for at least several decades.

One of the immediate problems created by the enforced chaos of the current model is that it makes it difficult to distinguish between the *technical* challenges associated with incorporating significant-to-large quantities of variable renewable energy (VRE) into existing grids and the policy-inflicted *market* impediments to renewables. For this reason, a short-term goal for unions and their allies would be to attempt to bring to an end to the destructive and unnecessary competitive struggle among different energy interests around market share and revenues. This battleground was described earlier in this paper, as were some of its negative implications. This is a far more important and strategically sensible approach than simply supporting renewable energy *per se*—especially given the fact that, on the basis of the current market model, the level of renewable energy deployment us very unlikely to reduce fossil fuel use significantly in the immediate future.

The current battleground conditions impose many obstacles to the energy transition that a public approach could either avoid or more easily overcome. As we described in the 2014 TUED Working Paper, *Power to the People*, incumbent utilities often do their utmost to slow down connecting disruptive wind and solar power to the grid. A World Bank report recently showed how, while new wind and solar projects can be completed in as little as six months, the transmission upgrades necessary to integrate the new renewable power have in many cases been delayed for years, or in some instances have yet

to be competed. Renewable energy investors will therefore not fund projects until adequate transmission infrastructure is guaranteed to be in place. And transmission companies are not going to conduct (sometimes costly) system upgrades until instructed to do so by a regulatory authority.[261]

Interestingly, the World Bank study called for an end to these "reactive approaches" and urged "proactive transmission planning" whereby transmission upgrades are made in order to attract investors in renewables with the costs shared across the entire system. This, the report stated, is a less expensive and faster way to scale up renewables:

> *Waiting for generators to express their interest in interconnecting to networks and attending to such requests individually can strain utility resources and finally delay the interconnection process. In addition, reacting to interconnection requests individually can lead to significant cost inefficiencies.*[262]

But "proactive transmission planning" only makes sense in the context of a regional or national transition plan that ensures capital is mobilized in a way that takes advantage of economies of scale and pools the necessary skills and expertise. The World Bank concludes that a "public sector-led proactive planning effort" is needed.[263] According to one US-based policy group, "grid modernization for renewable energy [is] a major national undertaking [...]. President Franklin Roosevelt led the massive project of building an electrical grid system that could serve rural America during the New Deal era."[264]

The need for planning is further underscored by the EU's 2016 *The State of Renewable Energies in Europe*. As that report notes, "Public authorities have found it very difficult to establish the balance between the interests of the grid users and the prosumers.[265] The absence of Europe-wide regulatory uniformity and common vision on this issue does nothing to promote the deployment of this market."[266] But the problem here is "the market," which pitted "prosumers" and "grid users" against each other in the first place.

Overall, investments in transmission upgrades and expansion are required, but they are currently trailing behind what is needed to integrate new renewables coming on line.[267] Building a nation-wide smart grid could in some instances easily cost hundreds of billions of dollars.[268] Nevertheless, transmission continues to constitute a relatively small percentage of overall electricity costs, therefore the costs of such upgrades could be comfortably absorbed or equitably recouped if spread across the entire system.[269]

The National Renewable Energy Laboratory in the United States has summed up the kind of transformation that is needed:

> *This transformation, involving every element of the grid, from system planning through operation, would need to ensure adequate planning and operating reserves, increased flexibility of the electric system, and expanded multi-state transmission infrastructure, and would likely rely on the development and adoption of technology advances, new operating procedures,* evolved business models, and new market rules.[270] (emphasis in the original)

As this paper has hopefully made clear, such invocations of "evolved business models" and "new market rules" are not merely unhelpful but actually counterproductive when no "evolved models" or "new rules" are presented in detail. The constant reliance on such vacuous phrases should be recognized for what it is: an ongoing attempt to maintain the illusion that nothing is fundamentally wrong and to mask the fact that the current market-dependent paradigm is not working.

As this paper has hopefully *also* made clear, the need for planning, coordination, cooperation, and flexibility is indisputable. This is particularly necessary given the recent, very sharp disagreement between high-profile scientists over

the potential of renewable energy play the role assigned to it in various science-based mitigation scenarios referred to at the outset.[271] Similarly, there is no current consensus with regard to how to deal with technical and system-balancing challenges posed by variable renewable energy (VRE) or source intermittency. Some regard VRE as a relatively easy problem to solve—with the right investments—while others regard it as virtually insurmountable. And if nuclear power continues to steadily decline in terms of the proportion of electrical power it will provide—as existing trends and investment levels suggest is likely—and carbon capture technologies remain stuck in the pre-commercial phase, then the debate around the true potential of renewable energy and related technologies will grow considerably more intense.

How Many Market Signals Does It Take to Screw in a Light Bulb?

According to Wind Europe, the voice of large wind energy companies, the answer to VRE is to establish

> *properly functioning cross-border electricity markets with adequate grid infrastructure. We then need to make better use of demand response and storage technology. And then we look to other forms of power generation as flexible back-up—and within this hydro is a cleaner and more cost-effective form of back-up than gas.*[272]

On a technical level, this integrated cross-border "solution" to VRE sounds convincing and encouraging. But it is hard to have any confidence in the proposed market approach to dealing with VRE when these same markets—or non-markets—have clearly failed to mobilize the investment needed either to develop storage technologies, upgrade grid infrastructure, or install modern demand response systems. As we have seen, it is only through a combination of government-backed funding and out-of-market protections that renewables have made any headway in Europe. In 2015, wind and solar power generated 13.2% of the EU's electrical power, the highest regional level in the world.[273] Despite the maturity of the market and the levels of policy support, the investments needed to facilitate higher levels of deployment in a manner that could address the challenges of source intermittency were inadequate.

The same can be said about less mature renewable energy technologies. Globally, these are being left behind. This is despite the fact that all renewable energy options will need to become fully developed in order to achieve decarbonization targets. For example, solar thermal in Europe is currently "on a relentless downward spiral abetted by the lack of public authority ambition and the low price of fossil energies. The same applies to biogas, which remains a niche market, and to deep geothermal energy that produces heat and electricity in large installations but cannot compete with crude oil at such low prices."[274] This is the "properly functioning market" in action, and it favors fossil fuels more often than it favors renewable energy.

However, if power generation systems (in the EU and elsewhere) were publicly owned and managed, then adequate investments into grid upgrades and development of new technologies could be made and could be done in partnership with those adding new generation capacity. Although current levels of VRE may not yet pose serious risks to grid stability, these challenges seem likely to become significantly more formidable as levels begin to approach those necessary to achieving emissions reduction targets, and the current, competitive approach seems profoundly ill-suited to resolving them.

"Public Renewable Power": A Unifying Vision, an Unstoppable Movement

Ending the market that never was by reclaiming energy systems therefore opens up an al-

together different set of possibilities and an entirely new energy transition scenario where there can be full attention paid to the technical challenges without the policy-inflicted distractions generated by obstructive and destructive "competition" between different private actors and interests. The battleground created by for-profit focused energy policy needs to be brought to an end.

By promoting public financing of renewable energy, unions can help advance clear, credible solutions to the investment deficit that unquestionably serve the public good and that can give us a fighting chance of reaching climate goals. In so doing, we can articulate the idea that public renewable power also supports the interests and aspirations of many professional-managerial staff, scientists, and engineers currently working for private (or marketized public) companies in various parts of the energy sector, including those who are today working for fossil fuel interests. Many workers and professional staff in these companies would surely welcome being included in an energy transition effort that served the public good and the welfare of future generations.

Unions and their allies are well positioned to challenge the myth that a transition to renewable energy can only be accomplished by catering to the interests of big companies and private investors. The global labor movement can and should demand and fight for a viable transition pathway—one that is anchored in public financing, social ownership, and democratic control.

References

1 Acknowledgments: While this paper has been informed by far more conversations than can be recounted here (or even necessarily recalled), the authors would like to acknowledge the following people for comments on an earlier draft: David Boys (PSI), Daniel Chavez (TNI), Béla Galgóczi (ETUI), David Hall (PSIRU), Maité Llanos (TUED Europe), Samantha Mason (PCS), Lance McCallum (ACTU), Philip Pearson (Greener Jobs Alliance), Michael Renner (Worldwatch Institute), and Yuliya Yurchenko (PSIRU).

2 BP, 2016. Hydropower remains the main source of renewable energy and accounts for more than sixteen percent of global electricity generation globally. But while hydro capacity is rising roughly three percent per year, much of today's capacity was installed decades ago, and its potential for further expansion is far more constrained than it is for so-called "modern renewables" like wind and solar. Therefore the main hope for a renewables-based electricity sector currently rests on the shoulders of these two sectors.

3 Of course, estimates of needed investment are based on data and projections from various sources and make various assumptions about economic growth and energy consumption that may be unlikely or even unattainable. This does not change the fact that there is almost certainly a very substantial investment deficit in renewables for any future scenario that avoids large-scale, chaotic societal collapse.

4 According to IEA / IRENA: "Renewables would account for half of the near USD 40 trillion spent in the power sector, with a similar level of investment (just under USD 7 trillion) each spent on wind and solar (both solar PV and concentrated solar power) generation. G20 countries would account for the majority of the investment in low-carbon electricity." IEA / IRENA, *Perspectives for the Energy Transition: Investment Needs for a Low-Carbon Energy System*, 2017.

5 Along with others, TUED has advocated a "public goods" approach to energy transition, particularly in its Working Paper #4: *Power to the People: Toward Democratic Control of Electricity Generation*. The case for this approach will not be repeated here; instead, we attempt to clarify and sharpen some of the questions regarding alternative approaches to financing a rapid scale up of renewables that unions and their allies could pursue in future.

6 See for instance *TUED Working Paper 7: An Injury to One is the Concern of All.*

7 See, e.g., IPCC, *Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN)*; M.Z. Jacobson, M.A. Delucchi, M.A. Cameron, and B.A Frew, "Low-cost solution to the grid reliability problem with 100% penetra-

tion of intermittent wind, water, and solar for all purposes," *Proceedings of the National Academy of Sciences of the United States of America*, 112(49), 2015.

8 Chris Mooney, "A bitter scientific debate just erupted over the future of America's power grid," *Washington Post*, June 19, 2017.

9 IEA/IRENA, *Perspectives for the Energy Transition: Investment Needs for a Low Carbon Energy System*, 2017.

10 CDP, "World's first investment-grade carbon pricing for power sector launched by industry heavyweights," May 25, 2017.

11 CDP and We Mean Business, *Carbon Pricing Corridors: The Market View*, 2017.

12 IEA/IRENA, *Perspectives for the Energy Transition*.

13 B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, and L.A. Meyer, eds., *Climate Change 2007: Mitigation of Climate Change*, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, 2007.

14 Ibid.

15 IEA/IRENA, *Perspectives for the Energy Transition*.

16 United Nations Development Programme, "Goal 7 Targets," *Sustainable Development Goals*, undp.org/content/undp/en/home/sustainable-development-goals/goal-7-affordable-and-clean-energy/targets/.

17 B. Metz, et al., eds. *Climate Change 2007.*

18 IEA/IRENA, *Perspectives for the Energy Transition.*

19 Mission 2020, *2020: The Climate Turning Point*, 2017. Other sources allow an additional five or ten years to reach a similar level of investment, but even this seems highly unlikely given current trends.

20 Of course, estimates of needed investment are based on projections and other data points from key agencies and research groups, and these often assume levels of economic growth and energy consumption that may never materialize. But none of this changes the fact that there is an investment deficit in renewables no matter what mainstream scenario might be taken into consideration.

21 IEA, "World needs $48 trillion in investment to meet its energy needs to 2035," June 3, 2014.

22 IEA, "World Energy Investment 2016," September 2016.

23 Bloomberg New Energy Finance, "Clean energy defies fossil fuel price crash to attract record $329bn global investment in 2015," January 14, 2016.

24 Barbara Buchner, Martin Stadelmann, Jane Wilkinson, Federico Mazza, Anja Rosenberg, and Dario Abramskiehn, *Global Landscape of Climate Finance 2014*, Climate Policy Initiative, November 2014.

25 According to IEA / IRENA: "Renewables would account for half of the near USD 40 trillion spent in the power sector, with a similar level of investment (just under USD 7 trillion) each spent on wind and solar (both solar PV and concentrated solar power) generation. G20 countries would account for the majority of the investment in low-carbon electricity." IEA / IRENA, *Perspectives for the Energy Transition*.

26 Global Wind Energy Council, *Global Wind Report: Annual Market Update*, 2015.

27 Solar Power Europe, *Solar Market Report & Membership Directory*, 2016.

28 Climate Action Programme, "A record 161 GW of renewable capacity added in 2016," June 7, 2017.

29 BNEF, 2017.

30 World Economic Forum, *Global Energy Architecture Performance Index Report 2017.*

31 IEA, "World Energy Investment Outlook 2014 Factsheet."

32 IEA, "World Energy Investment 2016."

33 Carbon Tracker, *Unburnable Carbon – Are the world's financial markets carrying a carbon bubble?*, 2012.

34 IEA / IRENA, *Perspectives for the Energy Transition.*

35 IEA, *World Energy Investment Outlook*, 2016.

36 Carbon Capture & Sequestration Technologies @ MIT, "Cancelled and Inactive Projects," 2016.

37 Laszlo Varro, "Commentary: We can't let Kemper slow the progress of carbon capture and storage," IEA, July 7, 2017.

38 World Nuclear Association, "Nuclear Power in the World Today," August 2017. world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today.aspx.

39 IEA, "Executive Summary," *World Energy Investment Outlook*, 2016.

40 IEA, *Next Generation Wind and Solar Power: From Cost to Value*, 2016.

41 REN21, "Chapter 8: Feature: Deconstructing Baseload," *Renewables 2017: Global Status Report*, 2017.

42 IEA, *World Energy Investment 2016*. "In addition, part of the appropriate policy response to these challenges are interventions that increase access to finance across the economy, including for SMEs and households. This might include establishing credit registries, reducing the costs of registering or repossessing collateral and introducing specific legislation to underpin modern financial technology—including leasing and factoring, electronic finance, and mobile finance."

43 IEA, "World needs $48 trillion."

44 IEA/IRENA, *Perspectives for the Energy Transition.*

45 IEA, *World Energy Investment 2017*.

46 World Bank, *State and Trends of Carbon Pricing 2016* (October).

47 Ibid.

48 World Economic Forum, *Global Energy Architecture Performance Index Report 2017*.

49 "Directive 2009/28/EC of the European Parlia-

ment and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC," *Official Journal of the European Union* 140, 2009.

50 "Questions and Answers: Energy Policy," European Commission Press Release Database, Brussels, September 19, 2007.

51 Ibid.

52 Quoted in New Economist, "Climate change: 'the greatest market failure the world has seen,'" October 30, 2006

53 Nicholas Stern, "Executive Summary," *Stern Review: The Economics of Climate Change*, Cambridge University Press, 2007.

54 David Robinson, "The Scissors Effect – How structural trends and government intervention are damaging the major European electricity companies and affecting consumers," *The Oxford Institute for Energy Studies*, August 2015.

55 Sean Sweeney, *Carbon Markets After Paris: Trading in Trouble,* Trade Unions for Energy Democracy, March 2016.

56 British Institute of Energy Economics, "Prof David Newbery University of Cambridge," YouTube, January 5, 2015.

57 The most recent World Bank data released May 2017 estimates that the percentage of emissions covered by a price had reached 15%; 75% of these emissions were priced at under $10 per ton. World Bank, *Carbon Pricing Watch 2017*.

58 World Bank, State and Trends, 2015.

59 Carbon Pricing Leadership Coalition, *Report of the High Level Commission on Carbon Price*, May 29, 2017.

60 This price will generate "a 66 percent chance of maintaining temperature change below 2°C." Ibid.

61 Ibid.

62 World Bank, *State and Trends*, 2015.

63 According to Robinson, "The Scissors Effect": "In the longer term there is little, if any, confidence that future emission allowance prices will be high enough, or stable enough, to drive low-carbon investment [...]."

64 CPLC, *Report of the High Level Commission*.

65 David Hall, Sandra van Niekerk, Jenny Nguyen, and Steve Thomas, *Renewable energy*, PSIRU, September 2013.

66 Ibid.

67 Eurostat, "Net electricity generation, EU-28, 2015 (% of total, based on GWh) YB17," *Statistics Explained*, 2017.

68 It is possible to formulate a "pathway towards a 100 per cent renewable energy supply system by 2050" for "electricity, heating and cooling as well as transport" throughout all member states of the European Union. The challenge lies not in a lack of available technologies but in how to make the right "enabling" policy changes: reducing demand; expanding renewable energy capacity tenfold; properly mixing hydropower, wind, photovoltaics, biomass, geothermal, concentrated solar power and wave power; phasing out all subsidies for fossil and nuclear energy; introducing an EU-wide carbon and energy tax; *and liberalizing the energy market* (emphasis added). Arthouros Zervos, Christine Lins, Josche Muth, and Eleanor Smith. "RE-thinking 2050; A 100% Renewable Energy Vision for the European Union," European Renewable Energy Council, January 14, 2014.

69 Richard Baron, *Renewable Energy: a Route to Decarbonisation in Peril?*, OECD Round Table on Sustainable Development, 2013.

70 "Directive 2009/28/EC of the European Parliament."

71 "Directive 2009/28/EC of the European Parliament."

72 REN21, *Renewables 2015 Global Status Report.*

73 EWEA, *Wind in power: 2015 European statistics,* February 2016.

74 European Commission, *Assessing the European clean energy finance landscape.*

75 "EU on track to meet 2020 renewable energy target, report shows," Agence France-Presse, December 1, 2016.

76 European Environment Agency, "Executive Summary," *Trends and projections in Europe 2016 - Tracking progress towards Europe's climate and energy targets*, December 2016.

77 100% Erneuerbare-Energie-Regionen, 100-ee.de.

78 "Subsidies and costs of EU energy," Report for European Commission.

79 "The rise in that surcharge is the single biggest reason that the amount the average German household spent on electricity rose to 1,060 euros in 2016, up 50% from 2007." However, in Germany's case, renewables contributed 32% of the country's electricity consumption during the same year. Jeffery Ball, "Germany's High-Priced Energy Revolution," Fortune Energy, March 14, 2017.

80 Tommaso Rondinella and Elena Grimaccia, "How austerity put a brake on the energy transformation in Italy," in Béla Galgóczi, ed., *Europe's energy transformation in the austerity trap*, ETUI, 2015.

81 Robinson, "The Scissors Effect."

82 Bohringer, et al., "Cost-effectiveness and Incidence of Renewable Energy Promotion in Germany," *Energy Journal* 1:38, 2017, 189-209. Robinson, "The Scissors Effect" refers to the additional charges to consumers that reflect the cost of the subsidies in consumer electricity bills as the "government wedge" which, he points out, "accounted for close to half of the final price for residential consumers in Spain and Germany in the second half of 2014. This wedge finances a range of public policies, especially out-of-market payments to renewable generators."

83 Environmental Audit Committee, "The Green Investment Bank," UK Parliament, March 2011.
84 According to the European Commission, "the regulator will need to ensure effective and non-discriminatory access to the transmission and distribution networks for electricity and gas. The regulator controls tariffs in order to prevent unduly high tariffs. Regulators often also have other tasks which relate to the efficient functioning of the market and ensuring competition, as well as the protection of consumer interests." "Questions and Answers: Energy Policy," Press Release Database, Brussels: European Commission, September 2007.
85 Patrick Hennessy, "101 Tories revolt over wind farms," *The Telegraph*, Feb 4, 2012.
86 Ofgem, "Action Needed to Ensure Britain's Energy Supplies Remain Secure," Press Release, February 3, 2010.
87 "Appendix 5: Electricity Market Reform (EMR)," *2010 to 2015 government policy: UK energy security*, Policy Paper, Department of Energy & Climate Change, May 2015.
88 Public and Commercial Services Union (PCS), "Just Transition and Energy Democracy: A Civil Service Trade Union Perspective," 2016.
89 Renewable Energy Focus, "DECC releases results of UK's first Auction for Contracts for Difference," February 26, 2015.
90 Oscar W Fitch-Roy and Bridget Woodman, *Auctions for Renewable Support in the United Kingdom: Instruments and Lessons Learnt*, AURES, March 2016
91 Florence School of Regulation, "UK's Energy Market Reform Policy by David Newbery | FSR Monthly Interview," YouTube, February 2013.
92 UK Government, "Department of Energy and Climate Change: Statement on Ofgem project discovery," Press Release, February 3, 2010.
93 EMR Settlement Limited, "Capacity Market," emrsettlement.co.uk/about-emr/capacity-market.
94 Albert Cheung, "Cheung: Power Markets Need a Redesign – Here's Why," Bloomberg New Energy Finance, May 24, 2017.
95 Wind Europe, "A European power market designed to deliver a clean future for European citizens," Press Release, June 26, 2017.
96 European Commission, *Energy prices and costs in Europe*, January 29, 2014.
97 Renewable Energy Focus, "EU rubber stamps UK's CfD support mechanism, approves 5 CfDs for offshore wind projects," July 23, 2014.
98 Adam Vaughan and Terry Macalister, "The nine green policies killed off by the Tory government," *The Guardian*, July 24, 2015.
99 Amber Rudd, "Statement on ending subsidies for onshore wind" Oral Statement to Parliament, UK Government, June 22, 2015.
100 Scope Ratings, *Phase-out of feed-in: Renewables open to market risk*, March 2, 2016.
101 EWEA, *Design Options for Wind Energy Tenders*, Position Paper, December 2015.
102 Ankur Paliwal, "Lanco found guilty of false commissioning of plants," *Down to Earth*, March 20, 2012; Ankur Paliwal, "Full bank guarantees of three solar companies encashed," *Down to Earth*, April 5, 2012; Angus McCrone, *Global Trends in Renewable Energy Investment 2013*, FS-UNEP, June 2013; Colin Bennett, "Taking Shape," *Renewable Energy Focus* 13:2, March 2012.
103 Fitch-Roy and Woodman, *Auctions for Renewable Support in the United Kingdom*.
104 Renewable Energy Focus, "DECC releases results."
105 World Future Council, "Parliamentarians can revive German Energiewende," June 17, 2016.
106 Karl-Friedrich Lenz, "German Renewable Auction Model Failure," *Lenz Blog*, November 22, 2016.
107 Karl-Friedrich Lenz, "German Renewable Auction Model not an Absolutely Catastrophic Disaster," *Lenz Blog*, July 6, 2017.
108 Craig Morris, "Why no one seems happy with 96% citizen wind power," *Energy Transition*, August 7, 2017.
109 McKinsey & Company, "CO2-Ausstoß," mckinsey.de/img/1703_ewi_umwelt_co2.png.
110 Fiona Harvey, "European clean tech industry falls into rapid decline," *The Guardian*, March 23, 2016.
111 EurObserv'ER, *16th Annual Overview Barometer*, 2016.
112 Ibid.
113 Wind Europe, "The European offshore wind industry – key trends and statistics 2016," January 26, 2017.
114 Adam Vaughan, "EU sets targets of 40% carbon cut and 27% share of renewables by 2030," *The Guardian*, January 22, 2014.
115 European Commission, "Commission proposes new rules for consumer centred clean energy transition," November 30, 2016.
116 EEA, *Trends and Projections in Europe 2016: Tracking progress towards Europe's climate and energy targets*, 2016.
117 EWEA, *Wind energy: backbone of EU leadership on renewables*, September 2016.
118 VkU, *A Sustainable Energy Market Design for Germany (Condensed Version)*, June 24, 2013, 26.
119 Koen Rademaekers, et al., *Assessing the European clean energy finance landscape, with implications for improved macro-energy modelling*, European Commission, March 2017.
120 Meredith Fowlie, "The Renewable Energy Auction Revolution," *Energy Institute Blog*, August 7, 2017.
121 IEA, "World needs $48 trillion."
122 EurObserv'ER, *16th Annual Overview Barometer*.
123 Eberhard, et al., *World Bank Group, South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons*, May 2014.
124 Ibid.

125 "South Africa," *Climate Action Tracker*, climateactiontracker.org/countries/southafrica.html.
126 "How to lose half a trillion euros: Europe's electricity providers face an existential threat," *The Economist*, October 15, 2013.
127 David Frankel, Kenneth Ostrowski, and Dickon Pinner, "The disruptive potential of solar power," McKinsey Quarterly, April 2014.
128 UKERC, *Financing the Power Sector: Is the Money Available?* Working Paper, April 2014, 14-15.
129 John Farrell, "5 Reasons Utilities Are Hating on Their Solar-Producing Customers," *Renewable Energy World*, August 24, 2015.
130 IRENA, *Letting in the Light: How solar photovoltaics will revolutionise the electricity system,* 2016.
131 Robinson, "The Scissors Effect," 5.
132 Ibid.
133 Ibid., 6.
134 Swaminathan S. Anklesaria Aiyar, "Roll Out the Sun, But Gently," *Swaminomics*, May 10, 2017.
135 VkU, *A Sustainable Energy Market Design for Germany.*
136 Florence School of Regulation, "UK's Energy Market Reform Policy by David Newbery."
137 Megha Bahree, "Solar power price slump casts shadow on India's green future," AFP, June 9, 2017.
138 Aiyar, "Roll Out the Sun."
139 Anisha Dutta, "Coal India will set up 1,000 Megawatt solar power generation capacity: Piyush Goyal," ETEnergyWorld, June 12, 2017.
140 Lalit K. Jha, "India shows the path for cheaper solar energy: World Bank," *ETEnergyWorld*, April 21, 2017.
141 In 2015, India's primary energy consumption rose by 5.2%; its share in global coal consumption exceeded 10% in for the first time ever; and India had its largest increase in oil consumption. Also in 2015, India registered an increase in CO_2 emissions of 5.3%, higher than any other country. So the commitment to 175 GW of renewable energy—of which 100 GW will be from solar—needs to be seen in this context. "The largest increase in global CO_2 emissions from energy use in 2015 came from India," *Ecologise.in*, June 13, 2016.
142 Bahree, "Solar power price slump."
143 Aiyar, "Roll Out the Sun."
144 Bahree, "Solar power price slump."
145 Utpal Bhaskar, "Chinese solar module firms reneging on India contracts," *LiveMint*, August 24, 2017.
146 Cheung, "Cheung: Power Markets."
147 Ibid.
148 OECD, *Business and Finance Outlook 2016*.
149 Ibid.
150 Ibid.
151 Climate Policy Initiative, *Global Landscape of Climate Finance 2015*.
152 CPI, *Global Landscape*. In this context, public actors include governments, bilateral aid agencies, Climate Funds, multilateral, bilateral and national Development Finance Institutions (DFIs). Significantly, these public entities are identified as helping to reduce "the costs and risks of climate investments." In 2014, DFIs' commitments reached $131 billion, the highest single source of capital. The two big DFI investors that year were the Chinese Development Bank ($69 billion, or 55% of DFI flows) "mostly as low-cost debt" and Multilateral DFIs, which committed $43 billion of their own resources (34% of all DFI flows).
153 Darwall, *Central Planning with Market Features*.
154 OECD, *Business and Finance Outlook 2016*.
155 The Clean Energy Group and Council of Development Finance Agencies.
156 World Bank, et al., *Long-Term Investment Financing for Growth and Development: Umbrella Paper*, February 2013; World Bank, *Financing for Development*, October 2013.
157 Ibid.
158 For a discussion on this topic, see UKERC, *Financing the Power Sector: Is the Money Available?* Working Paper, April 2014.
159 IRENA, "Unlocking Renewable Energy Investment: The Role of Risk Mitigation and Structured Finance," 2016.
160 Beate Sonerud and Sean Kidney, "Towards the Trilions," UNEP, December 2015.
161 IRENA, "Unlocking Renewable Energy Investment."
162 UKERC, F*inancing the Power Sector*.
163 Lucas Kruitwagen, Elizabeth Harnett, and Ben Caldecott, *Summary of Proceedings*, Ultra High-Net-Worth Individuals, Private Banks, and the State of Sustainable Investment: 5th Stranded Assets Forum, Smith School of Enterprise and the Environment, University of Oxford, April 15, 2016.
164 Sonerud and Kidney, "Towards the Trilions."
165 UKERC, *Financing the Power Sector*.
166 *Report on the outcomes of the extended work programme on long-term finance*, UNFCCC, Conference of the Parties: Nineteenth Session, Warsaw, November 11-22, 2013.
167 World Bank, et al., *Long-Term Investment Financing*; World Bank, *Financing for Development*.
168 World Bank, R*evisiting Public-Private Partnerships in the Power Sector*, 2013, 1.
169 Ibid.
170 Ibid.
171 David Hall, *Why Public-Private Partnerships Don't Work: The Many Advantages of the Public Alternative*, PSIRU, March 2015.
172 Public-Private Partnership in Infrastructure Resource Center (PPPIRC), *Transparency, Good Governance and Anti-Corruption Mechanisms*, World Bank Group, ppp.worldbank.org/ppp/overview/practical-tools/good-governance-anticorruption.

173 Hall, *Why Public-Private Partnerships Don't Work.*
174 World Bank, L*ong-Term Investment Financing*; World Bank, *Financing for Development.*
175 World Bank, "Global Infrastructure Facility - Objectives & Principles," Brief, April 15, 2015.
176 See, e.g., Lucy Baker, "The evolving role of finance in South Africa's renewable energy sector," *Geoforum* 64, August 2015, 146-156; Ben Fine, "Financialization from a Marxist Perspective," *International Journal of Political Economy* 42:4, January 2013, 47-66; and L. Chester and S. Newman, "Analysing finance and production in the contemporary capitalist era." Paper presented at the 5th Annual Conference of the International Initiative for the Promotion of Political Economy (IIPPE), September 2014.
177 Baker, "The evolving role of finance," citing Chester and Newman.
178 Hall, *Why Public-Private Partnerships Don't Work.*
179 Ibid.
180 UK National Audit Office, *The choice of finance for capital investment.*
181 María José Romero and Mathieu Vervynckt, "Unpacking the dangerous illusion of PPPs," *Reclaiming Public Services*, Dumontier and Doherty, eds., Transnational Institute, June 2017.
182 Nicholas Hildyard,Corrupt but legal? Instutionalised corruption and development finance, Brussels: Counter Balance, 2016.
183 Romero and Vervynckt, "Unpacking the dangerous illusion of PPPs."
184 "Long-term climate finance events in 2017," In-session workshop at the UNFCCC Climate Change Conference, Bonn, May 15, 2017.
185 *Report on the outcomes of the extended work programme on long-term finance*.
186 UNFCCC, "Climate Finance," unfccc.int/cooperation_and_support/financial_mechanism/items/2807.php.
187 Climate Bonds Initiative, "The role of policymakers in scaling the green bonds market," climatebonds.net/role-policymakers-scaling-green-bonds-market-0
188 Hall, *Why Public-Private Partnerships Don't Work.*
189 UKERC, *Financing the Power Sector.*
190 "KfW," *Wikipedia*.
191 EIA, "Wind and solar in March accounted for 10% of U.S. electricity generation for first time," *Today in Energy*, June 14, 2017.
192 Greg Wetstone, "The State of Play for Renewable Energy – REFF Wall Street 2017 Presentation," ACORE, June 20, 2017.
193 Ibid.
194 "Renewable Electricity Production Tax Credit (PTC)," Energy Department, energy.gov/savings/renewable-electricity-production-tax-credit-ptc.
195 ACORE, "ACORE Releases New Study Highlighting Key Strategies to Scale-Up U.S. Renewable Energy Investment," Press Release, June 25, 2013.
196 Ibid.
197 Ibid.
198 Ibid.
199 "Renewable Electricity Production Tax Credit (PTC)."
200 Chris Nelder and Mark Silberg, "Congress extends the renewable investment tax credit: What now," *GreenBiz*, December 28, 2015.
201 Ibid.
202 Jake Caldwell and Richard W. Caperton, "A New Clean Energy Deployment Administration: Renewable Energy Needs More than a Price on Carbon," Center for American Progress, June 16, 2010.
203 ACORE, "ACORE Releases New Study."
204 Ibid.
205 Ibid.
206 Ibid.
207 Jeff Merkley, "Merkley, Sanders, Markey, Booker Introduce Landmark Legislation to Transition United States to 100% Clean and Renewable Energy," Press Release, April 27, 2017.
208 Climate Change Support Team (CCST) of the UN Secretary General, *Trends in Private Sector Climate Finance*, October 2014.
209 European Commission, *Study on the potential of green bond finance for resource-efficient investments*, European Union, November 2016.
210 International Finance Corporation, World Bank Group, *Mobilizing Private Climate Finance—Green Bonds and Beyond*, Newsletter, December 2016.
211 International Capital Market Association, *Green Bond Principles, 2016: Voluntary Process Guidelines for Issuing Green Bonds*, June 16, 2016.
212 Climate Bonds Initiative, "Eligible Debt Instruments," climatebonds.net/standards/certification/types-of-bonds.
213 European Commission, *Study on the potential of green bond finance.*
214 CCST of the UN Secretary General, *Trends in Private Sector Climate Finance.*
215 Jessica Shankleman, "Green Bond Market Will Grow to $158 Billion in 2016, HSBC Says," *Bloomberg*, January 26, 2016.
216 Michael Liebreich, Presentation at Bloomberg New Energy Finance Summit, April 25, 2017.
217 European Commission, "Green bonds: New study shows extraordinary growth and signals potential in financing Europe's climate and environment goals," Press Release, December 2, 2016.
218 World Bank, et al., L*ong-Term Investment Financing*; World Bank, *Financing for Development.*
219 World Bank and PPIAF, *What Are Green Bonds?* 2015.
220 IFC, "Mobilizing Private Climate Finance—Green Bonds and Beyond," *EMCompass*, December 2016.
221 World Bank and PPIAF, *What Are Green Bonds?*
222 European Commission, *Study on the potential of green bond finance.*

223 CCST of the UN Secretary General, *Trends in Private Sector Climate Finance.*
224 Ibid.
225 *Report on the outcomes of the extended work programme on long-term finance,* UNFCCC.
226 IMF, *External Debt Statistics: Guide for Compilers and Users*, June 25, 2003.
227 Climate Bonds Initiative, "Improving risk-return profile: Increasing returns or reducing risks," climatebonds.net/policy/policy-areas/improving-risk-return-profile.
228 European Commission, *Study on the potential of green bond finance.*
229 IEA, *Re-powering Markets: Market design and regulation during the transition to low-carbon power systems*, 2016.
230 David Hall, *Public Ownership of the UK Energy System—Benefits, Costs and Processes*, PSIRU, April 2016.
231 Satoko Kishimoto and Olivier Petitjean, eds., *Reclaiming Public Services: How cities and citizens are turning back privatisation*, TNI, June 2017.
232 Sean Sweeney, Kylie Benton-Connell, and Lara Skinner, *Power to the People: Toward Democratic Control of Electricity Generation,* Trade Unions for Energy Democracy, June 2015.
233 *The Labour Party Manifesto 2017*, labour.org.uk/index.php/manifesto2017.
234 *The Leap Manifesto: A Call for a Canada Based on Caring for the Earth and One Another*, leapmanifesto.org.
235 Queensland Labor Environment Action Network, R*enewables: Powering Queensland's Future*; New South Wales Labor Environment Action Network, *Our Power, Our Jobs, Our Future*.
236 Sven Teske, *Energy [R]evolution*, Greenpeace International, September 2015.
237 ITUC, *Growing Green and Decent Jobs*, April 2012.
238 On the role of public and private investment, the ILO is somewhat more specific: Government should, it says, "encourage the private sector towards a green transition and overcome the problems of missing private price signals. In this sense, public investment plays a complementary role to larger market-based mechanisms." ILO/UNEP. "Working towards sustainable development: Opportunities for decent work and social inclusion in a green economy." ILO, June 12, 2012.
239 "We need proactive energy policies which establish security and sustainability as the foundations of industrial production world-wide." IndustriALL Global Unions Sectoral Sustainability Report, 2016.
240 ITF Climate Working Group, "Transport Workers and Climate Change: Towards Sustainable, Low-Carbon Mobility," Discussion Document, ITF Climate Change Conference, Mexico City, August 4, 2010.
241 PSI, "Programme of Action 2013-2017: Social Justice through Trade Union Rights and Quality Public Services," 2013.
242 PSI, "Affiliates Resolutions and Emergency Resolutions," 2013.
243 PSI, *Annual Report 2015*.
244 IUF, "Trade Deals That Threaten Democracy: How the US-EU and TransPacific Trade and Investment Agreements will further empower corporations and undermine public services, social and environmental protection and trade union rights," 2014.
245 *Trade Union Priorities for Development*, General Council Resolution, São Paulo, Brazil, October 9-10, 2015; Pierre Habbard, *The Private Sector and Its role in Development: A trade union perspective*, Trade Union Development Cooperation Network, April 2014.
246 IISD Reporting Services, "Scaling Up Green Energy Finance Swapping Fossil Fuel Subsidies for Sustainable Energy Solutions," YouTube, May 16, 2017.
247 Alex Morales, "Fossil Fuels With $550 Billion Subsidies Hurt Renewables," *Bloomberg*, November 11, 2014.
248 Patrick Hearps and Sam Cossar-Gilbert, "An Energy revolution is possible: Tax Havens and Financing Climate Action," FOEI, September 2016.
249 Angel Gurría, "Leveraging pension funds for financing infrastructure development in Africa," Introductory Remarks, Third International Conference on Financing for Development, OSAA-OECD high-level side event on leveraging pension funds for financing infrastructure development in Africa, Addis Abbaba, July 15, 2015.
250 Hall, *Why Public-Private Partnerships Don't Work*.
251 Darwall, *Central Planning with Market Features*.
252 Mark Jacobson, "COP21: 9 questions for a renewable energy expert," Interview, CNN.com, December 10, 2015.
253 Doug Hall, "President Obama's Budget: Five Small Steps Forward, One Big Step Back," *Huffington Post*, February 20, 2015.
254 Frankfurt School-UNEP Centre/BNEF, *Global Trends in Renewable Energy Investment 2017,* 24.
255 Navigant 2011, Andy Wickless Webinar.
256 Clean Energy Group, cleanegroup.org
257 Ibid.
258 Food & Water Watch and the Cornell University ILR School Global Labor Institute, *Public-Public Partnerships: An Alternative Model to Leverage the Capacity of Municipal Water Utilities*, January 2012.
259 Moody's Investors Service, "Moody's Downgrades NRG Yield to Ba2," October 6, 2015; and Moody's Investors Service "Moody's downgrades TerraForm Power and TerraForm Global to B3 CFR; outlook negative," February 24, 2016.
260 Tom Hals and Nichola Groom, "Solar developer SunEdison in bankruptcy as aggressive growth

plan unravels," Reuters, April 21, 2016.
261 Marcelino Madrigal and Steven Stoft, *Transmission Expansion for Renewable Energy Scale-Up Emerging Lessons and Recommendations*, The World Bank, June 2011.
262 Ibid.
263 Ibid.
264 CAP/PERI study, cited PttP.
265 "Prosumer" is short for a household, farm, or commercial entity that both produces and consumers electrical power, usually by way of a solar PV or wind installation.
266 EurObserv'ER, *16th Annual Overview Barometer*.
267 Michael Liebreich, "Michael Liebreich State of the Industry Keynote at BNEF Global Summit 2017," *Bloomberg New Energy Finance*, April 25, 2017.
268 Jesse Jenkins, "Economic Stimulus, Clean Energy and the Scale of Our Challenge: Grading the Stimulus Energy Investments," *Huffington Post,* April 17, 2009; Jesse Jenkins, "Detailed Summary of Energy Investments in Stimulus," Watt Head, February 13, 2009.
269 Madrigal and Stoft, *Transmission Expansion*.
270 M.M. Hand, et al., eds., *Renewable Electricity Futures Study*, NREL, 2012. Emphasis added.
271 Richard Heinberg, "Controversy Explodes over Renewable Energy," Post Carbon Institute, July 11, 2017.
272 Wind Europe, "A European power market designed to deliver a clean future for European citizens," Press Release, June 26, 2017.
273 Eurostat, *Statistics Explained*, ec.europa.eu/eurostat/statistics-explained.
274 EurObserv'ER, *16th Annual Overview Barometer*.

Background Notes

Find additional material on the topic at http://unionsforenergydemocracy.org/resources/tued-publications/tued-working-paper-10/background-notes

TUED Working Papers Series

No. 1 | June 2014
Global Shale Gas and the Anti-Fracking Movement: Developing Union Perspectives and Approaches

No. 2 | September 2014
Climate Change and the Great Inaction: New Trade Unions Perspectives

No. 3 | January 2015
Syriza's Program and the Transition to Renewable Power

No. 4 | June 2015
Power to the People: Toward Democratic Control of Electrical Power Generation

No. 5 | October 2015
The Hard Facts About Coal: Why Trade Unions Should Re-evaluate Their Support for Carbon Capture and Storage

No. 6 | March 2016
Carbon Markets After Paris: Trading in Trouble

No. 7 | July 2016
An Illness to One is the Concern of All: The Health Impacts of Rising Fossil Fuel Use

No. 8 | November 2016
Up From Development: A Framework for Energy Transition in India

No. 9 | January 2017
Energy Transition: Are We Winning?

TUED is a global community of unions in partnership with: