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The Disruptive Politics of Renewable Energy

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In making the shift to renewable energy, India has to manage the disruption of long-standing institutional and political arrangements in ways that enable clean energy in a sustainable manner.

1.Introduction

Electricity is deeply entwined with India's political economy. Among the first acts of newly independent India was the passage in 1948 of the Electricity Act: provision of electricity to its citizens was among the most powerful symbols of the benefits of an independent nation. The electoral salience of electricity has scarcely dimmed, with claims and counter-claims even in 2019 from the major parties of being the ones to provide electricity to rural populations. Promises of price controls and subsidies to farmers and other groups is the currency of electoral competition in many states. Almost a quarter century of electricity reform has sought to sever the link between electricity and politics, by re-making governance of the sector along market lines or by introducing arms-length technocratic governance. Yet, the relationship between the two remains stubbornly persistent; Indian electricity remains deeply woven into the fabric of Indian politics.

However, the electricity sector worldwide is poised on the edge of a fundamental disruption. Driven by concerns such as energy security, a heightened attention to environmental challenges like air pollution and climate change, and most important, by steep declines in costs, India is accelerating toward a renewable energy (RE) future. While current levels of RE are relatively low, and a full transformation may take decades, the economic trends suggest RE is the future. Thus, solar power has fallen from Rs 12 per unit in 2010 to as low as Rs 2.44 per unit in 2018, competitive with the running costs of coal-based power.

What does this impending transition mean for the long-standing relationship between electricity and politics in India? Will RE simply be absorbed into the current pattern of accommodation: using the electricity sector for political patronage and subsidy payments? Or will renewable energy, with its ability to be provided, at small scales and at usage sites, lead to a shift in electricity politics and how?

So far, debates over renewable energy have remained focused on technical questions and challenges. Boosters of this shift celebrate what they see as an inevitable transition to renewable energy, loosening electricity from environmentally damaging fossil fuels. Sceptics of this renewable energy transition argue that any RE future is a long way off-RE currently accounts for about 9% vs 78% for thermal (CEA 2019)-and highlight the challenge of "intermittent" renewables dependent on when the sun shines and wind blows.

> Ultimately, whether there is a transition to RE, the speed of that transition and its effect will be shaped not just by technology, but by how technological shifts interact with institutional and political changes to disrupt that equilibrium.

This essay argues that the transition to RE is by no means a technical question alone. The current system is also supported by a historically entrenched set of institutional forms, such as distribution companies, which also have considerable inertia. Ultimately, whether there is a transition to RE, the speed of that transition and its effect will be shaped not just by technology, but by how technological shifts interact with institutional and political changes to disrupt that equilibrium. If RE is to rise, the existing entrenched configuration of technology, politics and institutions will have to give way to a new such configuration that supports an RE future. This transition is unlikely to be linear or smooth, and the result will determine not only whether RE grows rapidly and displaces coal, but also who wins and who loses in the process.

Consequently, we lay out an understanding of India's likely impending RE transition based on the interplay of technical, political and institutional factors. In doing so, we seek to make two points to two discrete audiences. First, to electricity and energy practitioners, we suggest that looking at the spread of RE only through a technical lens is highly incomplete; the likelihood, speed and impact of RE will be determined by non-technical factors as well. Second, to broader analysts of India's economy and politics, we suggest that disruptions in Indian energy are highly likely to also imply disruptive politics and economics; any story of Indian political economy in the coming decade is incomplete without an exploration of energy-driven shifts.

We begin by explaining the existing long-standing political structure in Indian power that has proved resilient over decades: a pattern built around using the sector as a form of redistributive welfarism. We then examine two distinct pathways through which RE could disrupt this extant power structure, tracing through their implications for institutions and politics, including the ways in which the central government uses control over energy to wield political power. We then turn to the broader ripple effects outside the electricity sector, resulting from upstream and downstream linkages with other parts of Indian politics. We conclude by returning to our two overarching messages.

2.The Structure of Power

Over the seven decades since Indian independence, electricity has got ever more deeply enmeshed in India's welfare economy. As its importance has grown as an instrument of welfare, so has its political currency. Demands for electricity access, quality and subsidies have increasingly featured in electoral promises, and have consequently shaped electricity priorities in the states as well as at the national level. Ongoing technological transitions in electricity will not only alter the electoral priorities in the sector, but are also likely to be constrained and shaped by them. To understand the future of Indian electoral politics, it is important to understand the electricity politics of today.

2.1 The Rise of Redistributive Welfarism

The early structure of Indian electricity was shaped by provincial demands, expectations of Indian businesses, and the success of public electrification in other major economies (Kale 2014b, 2014a). To pursue the development priorities of powering industrialisation, electrifying rural areas and, thus, addressing regional disparity, India took the path of gigantism-large-scale infrastructure and monolithic institutions-that could assure economies of scale, faster electrification, and centralised coordination.

Over time, this approach was subject to the pressures of democratic politics in a poor nation; electricity as enabler transitioned to electricity as means of welfare. Political mobilisations through the 1970s, challenging the single-party hegemony of the Congress, resulted in mobilised rural communities demanding state provision of a range of public goods at a subsidised cost (Bardhan 2005). At the same time, the introduction of input-intensive green revolution technologies led the mobilised peasantry to demand subsidised electricity for their farms and houses (Dubash and Rajan 2001; Kale 2014a). Both incumbent governments and challengers responded to these pressures. Village electrification and pump energisation became the dominant sector priority through the 1970s and 1980s. With direct control over tariffs, state governments kept rates low for households and farmers. Over time, welfare provision through competitive populism became a central objective of the functioning of electricity (Dubash and Rajan 2001; Kale 2014a).

But states had to find a way to pay for cheap or subsidised electricity to constituents. This was accomplished by charging above cost tariffs to industrial and commercial users. Over time, this pattern of explicit cross-subsidisation from business consumers to keep tariffs for households and farmers low has spiralled to unsustainable proportions, and has become a unique and debilitating feature of Indian electricity. Despite causing multiple inefficiencies through price distortions, the perceived political rewards have led to cross-subsidies becoming entrenched as a necessary counterpart to redistributive welfare, even as the original vision of reliable and low-cost electricity to build a strong and competitive industry has receded.

2.2 Federalism and Electricity Gigantism

As a concurrent subject, electricity is subject to joint control by the centre and the states. As Kale (2014a) shows, the result has been a see-saw relationship of control across the Indian federal system. The states have historically had a greater responsibility for electrical development and managing electricity demands, while the centre wields influence through its planning oversight and control over vital resources. But ownership of over a quarter of generation capacity, particularly following the creation of central generating companies such as the National Thermal Power Corporation (now NTPC) and National Hydroelectric Power Corporation (now NHPC) in the 1970s and all coal resources have been instrumental to the centre's growing influence in electricity over time. The centre also controls a significant part of the public investment in the sector through the budgetary allocation for specific interventions, credit from the Rural Electrification Corporation, Power Finance Corporation, and nationalised banks. Allocation of these resources to states has given the centre a lever to influence and shape the electricity sector trajectory in the states. States have variously succumbed to or resisted these pressures, based on their capacity to manage local electricity demands, dependency on the centre and political alignments (Dubash, Kale, and Bharvirkar 2018).

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Gigantism in electricity technology has also reinforced the power of the centre, which has better been able to mobilise finance on the scale necessary to realise these visions. From the early dependence on large hydroelectric dams (famously Nehru's "temples of modern India") to coal-fired generation, leading over time to nationalisation of coal, the history of electricity has trended in the direction of concentration of control. While the need to mobilise large finance is a credible explanation, the result is also the ability of the centre to wield more power.

Control over power also has provided intangible political gains: the symbolic power of visually startling large dams and thermal plants, the ability to promise and deliver largesse through siting decisions that yield employment and boost the local economy. For state governments, the actual provision of power became the strongest basis of political promise, leading to an emphasis on grid expansion within the state. This has led, over time, to fragmented grids on a state-by-state basis even as the centre consolidated its power over generation.

The central government increasingly took control over electricity generation, driven in part by the economies of scale of electricity gigantism, and the need to bear the associated higher risks. The state governments, for their part, have had to manage the stresses of re-distributive welfarism, to the cost of their exchequer.

2.3 Towards Reform: The Limits of Cross-Subsidy

By the early 1990s, the dual structure of electricity welfare and cross-subsidy was taking its toll on the sector's performance. States had little incentive to provide poorer consumers with good quality electricity since they lost money for every unit sold. For their part, consumers saw little reason to pay for poor quality electricity, and indeed, levels of theft were high. Industry and commercial users were shouldering the increasing burden of balancing the books. And since in many states the books did not balance, maintenance and investment in new capacity suffered and the quality and availability of electricity further deteriorated.

By the early 1990s, the calls for electricity reform grew ever lounder. But driven in part by international trends and a failure to translate global prescriptions to local contexts, these reforms had decidedly mixed outcomes. The starting point was deregulation of power generation in 1991 with the objective of attracting private investment to ensure adequacy of generation capacity. India chose a pro-business approach, offering tax benefits and risk protection to independent power producers (IPPs). This led to a boom and bust cycle, with several deals signed but few realised (Dubash and Chella Rajan 2001).

> The model of redistributive welfare through the electricity system has resisted two decades of reform.

The root of the problem lay in the distribution sector and the pattern of cross-subsides and poor finances. Consequently, a wave of state-level distribution sector reforms was initiated. However, these reforms tended to follow a global reform prescription aimed at commercialisation, introduction of regulators and ultimately privatisation of distribution companies. Distribution companies built around welfarism and cross-subsidies proved unattractive to private capital. Moreover, attempts to delink political and welfare considerations from economic decision-making through independent regulation have not gained much success. Regulatory agencies had evolved as weak institutions and imperfect buffers between technical and political aspects of decision making. While some states have managed to improve performance through managerial reforms, in many states the situation remains dismal. The distribution reform agenda remains incomplete at best. Badly performing state distribution sectors have come to rely on regular cycles of central government designed bailouts to stay afloat. The model of redistributive welfare through the electricity system has resisted two decades of reform.

With ill-functioning distribution systems, the government has had to intervene to maintain incentives to invest in generation. In recent years, it has become government policy that "all direct and indirect political risks are…assigned to the utility" (MoP 2014). In addition, the rush to attract private generation has also displaced mechanisms for careful generation planning, to match new capacity to need. Thus insulated, private generation has flourished.

The result has been an overshoot of excessive and sometimes high-cost power. Ironically, by 2016-17, many states had "surplus" capacity (Josey, Mandal, and Dixit 2017), accounting for up to 10% of costs in some cases. Without enough well-paying customers due to a broken distribution sector, the quantum of stressed assets in the sector has grown; by 2018, 34 IPP projects, with 40 GW of coal

capacity were on the verge of being declared non-performing assets (NPAs). The outstanding debt of these projects amounts to Rs 1.74 trillion, accounting for 20% of the banking sector's overall NPAs (Sharma, Layak, and Kalesh 2018). Moreover, power plants that are in operation are running at low levels due to over-capacity, placing stress on their finances.

Yet another effort at reform focused on the creation of markets. If generators could transact directly with large customers-referred to as "open access"-then they could bypass the cross-subsidy mechanism. However, this would starve the distribution companies of finances, and the ability to provide welfare through electricity. To preserve the model, consumers seeking to contract directly were charged additional fees-a cross-subsidy surcharge-specifically to create a disincentive to any change from the status quo (Singh 2016). Ultimately, despite a strong legislative and regulatory push, market share in electricity trade has stagnated at about 10% (CERC 2018).

The outcome is a low-level but stable equilibrium that hurts all stakeholders. Small consumers are locked-in to low cost but perpetual poor-quality supply. The welfare approach to affordable electricity access has undermined creation of a virtuous cycle of supplying better quality electricity for productive use and thereby raising incomes and the paying ability of the poor. The burden of cross-subsidies certainly does not aid the global competitiveness of Indian industry. Despite cross-subsidisation and subventions from governments, the utilities are trapped in compounding loss and debt cycles. State governments have had to increase their budgetary support for electricity, even while the central government implements repeated bailouts for utilities. Indian electricity has substantially been trapped in this dynamic for nearly two decades. The track record varies by states, with some states able to generate a virtuous cycle climbing out of populist driven electricity welfarism, others trapped in a low-level equilibrium, and yet others spiralling into a deeper cycle of debt and poor performance (Dubash, Kale, and Bharvirkar 2018). In all cases, however, the forces of inertia holding the technology of electricity gigantism, the institutional model of the distribution company, and the politics of welfarism together in a stable configuration have been considerable.

Renewable energy risks disrupting this stability. Driven by concerns over energy security, and growing concern with environmental issues such as air quality and climate change, successive governments have instituted mechanisms to promote RE. These include establishing a reverse auction system to discover RE prices and signalled intent by setting strong domestic targets: 20GW of solar by 2020 established by the United Progressive Alliance government, enhanced to 100GW of solar and 175GW of RE by the National Democratic Alliance government (Niti Aayog 2015) 2. Notably, international forces have helped a great deal: global prices have tumbled driven by heavy investment in China and strong subsidies by Germany. Collectively, these efforts have disrupted the world of electricity and, by extension, Indian electricity. In 2017-18 and 2018-19, India added more RE capacity than coal capacity and in recent years both capacity and generation from RE has grown at more than 18% (*ET Energyworld* 2018; Chatterjee 2018). What could these developments, and their expected acceleration in coming years, mean for the future of Indian electricity?

3.Disruptive Power of Renewable Energy

How can a technology shift-thermal power to renewable energy-disrupt an entire electricity system? The answer lies substantially in two technical attributes that distinguish renewable energy technologies from the incumbent technologies. First, RE technologies are modular: deployment can be at any scale (GW to KW), faster, and easily movable, without much loss in economies of scale. While wind energy technology has some locational requirement, solar, the dominant RE technology, can be deployed at the point of consumption (rooftops, moving vehicles, etc.) and at a scale as low as few watts. Second, RE production is intermittent: solar modules and wind turbines generate electricity only when the sun shines and wind flows, respectively. The first is a substantial advantage, the second a disadvantage to be managed through institutional and technical solutions. Of course, RE is also clean and low-carbon energy, placing it at a considerable advantage in a world increasingly concerned about climate change. However, it is only when costs started falling to a level competitive with coal that the prospect of substantial disruption has emerged. How will the electricity institutional architecture and politics, shaped by conventional technologies, react to RE penetration? What are the likely political economy consequences?

3.1 Disruptions in Redistributive Welfarism

The modularity of RE, and therefore its ability to be installed at a small scale, when combined with its growing cost competitiveness with thermal power, provides a serious challenge to grid-based power. In particular, those who can afford the up-front costs of RE, who are already paying high costs-notably industry and commercial users-and who seek better quality power, could simply migrate in part or completely away from the grid to generate an increasing share of their power from decentralised RE or, over time, RE combined with storage technology.

In particular, industrial and large commercial consumers are likely to start delinking from discoms in reaction to increasing costs of grid supply and persistent unreliability (Josey et al 2018). As discussed earlier, efforts at by-passing the burden of cross-subsidy by allowing "open access" for large consumers to private generators was stymied by imposition of a cross-subsidy surcharge for access to the grid through which to transport the electricity. With RE, this hurdle is harder to erect because there is potentially less dependence on the grid: industrial consumers could set up their own stand-alone RE power, potentially backed by storage. While discoms could take other measures to retain their high-paying load, by increasing service quality and limiting prices, early signs of load migration are already visible. In 2018, Delhi Metro Rail Corporation signed a power purchase agreement (PPA) with Rewa Ultra Mega Solar Ltd, located in Madhya Pradesh, to procure 90% of its electricity requirement at a tariff about half of the discom tariff, correspondingly reducing its cross-subsidy to the discom (PTI 2018). Simultaneously, many commercial establishments, housing societies and high consuming households are already installing rooftop solar. Large industry and commercial users, who have been bearing a growing cross-subsidy load, are likely to be clear winners from the RE transition.

> Migration of cross-subsidising industrial and commercial load will shrink the revenue that is used to subsidise the tariffs for agriculture and low-income households.

Equally, there are clear losers: those on the other side of the cross-subsidy approach to distributive welfarism; agriculture and low-income consumers. Migration of cross-subsidising industrial and commercial load will shrink the revenue that is used to subsidise the tariffs for agriculture and low-income households. In addition, it will reduce the states' income from electricity duties that is utilised to provide subventions to discoms in order to keep the tariffs low for the poor. As load migration scales up, shrinking the fiscal space of discoms, redistribution from the wealthy to the poor will become increasingly infeasible. Instead, discoms will be required to increase tariffs for farmers and low-income households, who constitute a large part of India's electorate. This will make electricity-centred clientelism unviable; politicians will no longer be able to make electoral promises around electricity prices. The pressure to charge cost-reflective tariffs to the poor may also impact India's goal of providing full electricity access to all 3.

Load migration will also create uncertainties and require institutional shifts in the nature of discoms. Discoms will no longer be able to plan resources for a predictable load growth. In a context of surplus capacity and uncertainty about demand, the discoms have to be more flexible and agile. They will be required to chase low-cost RE and complementary resources so that they can offer lower tariff and better reliability to their consumers. The new energy technologies will require the discoms to be nimble actors, with greater planning ability and market disciplines (Singh and Swain 2018). RE creates pressure on discoms to abandon their welfare obligations and act as active market players. The nature of discoms, as instruments of the state's aims of redistributive welfarism, will come under growing pressure.

Notably, the withdrawal of electricity as a medium of redistribution and welfare limits its role as electoral currency. The transition to RE may fundamentally change a long-standing game: the use of electricity sops in response to competitive populism, which has a history of undercutting efforts at long-term and sustained improvements in the sector. But even if this transition thereby forces harder decisions in the sector with long-run gains, the short-term adjustment impacts could be substantial.

Some states already recognise the urgency and have taken initiatives in anticipation of impending changes. Andhra Pradesh seeks to harness the low-cost potential of the disruptive new energy technologies to reduce electricity bills for both citizens and businesses. They also aim to retain the business and commercial consumers by promising them price stability and improved reliability of supply. In this direction, the state is pursuing a five-point strategy: i) improve supply through enhanced RE generation, energy storage technologies, and full capacity utilisation of conventional power plants; ii) implement energy efficiency measures; iii) strengthen the transmission and distribution network to bring down losses to below 6%; iv) adopt IT for better consumer services; and v) improve financial management of power projects including loan swaps (Swain 2018).

Maharashtra seeks to provide the low-cost benefits of RE directly to farmers through solar feeders for agriculture: feeder level (above the level of individual farms) solar arrays that provide power to clusters of farmers. These solar feeders will bring down the costs of providing electricity to farmers by half and are expected to reduce the subsidy burden on discoms, big consumers and the state government, while ensuring reliable day time supply to farmers (Gambhir and Dixit 2018). In both cases, the goal is to preserve public power and electricity as a state provided public good. While Andhra Pradesh seeks to compensate cross-subsidy revenue loss by harnessing low-cost RE at the discom end, Maharashtra seeks to reduce cross-subsidy requirement by providing low-cost RE electricity directly to the needy.

The Centre has recently indicated an interest in sharing the responsibility for subsidy provision with states, potentially through a direct benefit transfer mechanism. This has clear political implications, shifting electricity's electoral value from states in part to the centre. And it also allows for a shift from a rate-payer-based cross-subsidy system to a tax-payer-based fiscal subsidy system. This mechanism would allow a subsidy-based approach to electricity continue, but with a political shift towards the centre, and greater fiscal pressure (Swain, Bhatia, and Dubash 2018). In all these initiatives, there is a struggle to retain public power. While it is too early to predict whether they will succeed, these efforts are worth watching.

3.2 Disruptions in Public Power

The system of public power has been based on technological gigantism, institutions that prioritise stability and enable predictable long-term financing, and a central role for the state in ensuring stability and providing and backing finance. This has also allowed the state a central role: electricity as public power.

> The intermittency of RE...provides a serious challenge to the organisation of the electricity system.

The combination of intermittency and modularity of RE are likely to shake the foundations of this configuration of public power in a number of ways. Here we discuss two of the most salient: the scale and forms of operation of the electricity market, and the reliance on long-term power purchase agreements. Both these institutional changes in reaction to a technology push, which are illustrative but not exhaustive in the sorts of shifts required in an RE future, have potentially far reaching political implications.

The intermittency of RE-RE only provides power when the sun shines and the wind blows-provides a serious challenge to the organisation of the electricity system. The system is designed for coal and hydro, which can operate on-demand and provide baseload (continuous) electricity supply. One way of accommodating RE is for the scale at which the electricity system operates to be broadened considerably. By enabling the purchase and sale of electricity at a larger scale than individual states, the system potentially allows for a more heterogeneous mix of energy resources. In other words, even if the sun does not shine in one place or the wind not blow, the sun may well be shining or the wind blowing in another place from where power can be procured. Increasing the breadth of the system, particularly what is referred to as the balancing area across which electricity is kept stable, helps to address the intermittency of RE (Palchak et al 2017).

But to enable this requires enabling an integrated electricity system that allows procurement from shifting sources of electricity, based on cost parameters and all to be done while maintaining stable voltage to keep the lights on. This is a complex institutional task. So far, the national rhetoric of "one nation one grid" notwithstanding, electricity grids are typically administered at the state level to manage political demands and the electricity market in India remains small and stagnant.

One likely reason is that shifts to an electricity market inevitably undermines the use of electricity for patronage. Nimble and responsive markets, practically by definition, require the state to surrender control. They also require building the underlying ability in discoms to engage and manage the market in ways that keep the lights on. As discussed earlier, this necessarily implies that discoms have to change their stripes: from instruments that mediate re-distributive welfarism to instruments of seeking low-cost power in an ever expanding market, in response to market signals and in ways that ensure predictability. States will no more be electricity islands; state governments will lose the tools for patronage in electricity.

A second major shift is the role of modularity of RE in overturning electricity gigantism, loosening the ties between large-scale electricity and state-backed finance. Historically, conventional electricity structures have been led by the state, since it requires long-term and large-scale investments. As discussed earlier, even though there has been a significant increase in private participation in generation over the last two decades, many of these enterprises are backed by the state through guarantees of various forms, or funded by public sector financial institutions. For example, an analysis of 125 large coal-fired plants financed during 2005-15 revealed that 82% of funding came from government controlled financial institutions (Sengupta and Athialy 2016). The typical institutional arrangement through which predictability in returns is enabled are long-term PPAs, which lock in stable purchase of power for long periods, and around which power procurement planning occurs.

Conventional power generation, then, has historically been dominated, and continues to be dominated, by a small pool of public and private entities, which also creates scope for self-dealing and patronage. Failures in such systems are "too big" to let go with the result that the costs of failures are socialised. In a notable recent example, there was a dispute around whether PPAs could be re-negotiated for three massive power plants that collectively supply 45% of Gujarat's power. The stated grounds for re-negotiation were that rescuing

these plants, after haircuts and safeguards, would still be cheaper overall than buying power from other sources (such as the spot market) (DNA 2018). Ultimately, the government's high-powered committee justified a rescue act by saying that the plants were "too big to fail" and that "fuel cost risk will be mostly borne by…the end consumers" (Dasgupta and Thakurta 2018).

The modularity of RE, combined with the creation of electricity markets to facilitate flexible and nimble power, is likely to bring in institutional transformations in two ways. First, the potential for small-scale deployment will bring new, and possibly smaller, generators into business. Second, the small investment requirement of the new projects will mobilise new financiers. Embryonic signs of these changes are already visible. New generators include big industries as well as small consumers, who are financed by private banks, financial cooperatives, international capital and development assistance. The reduction in need for long-term stable returns, replaced with returns through a power market, are likely to cause disruptions in the existing PPA model. While discoms and suppliers will possibly continue to contract PPAs to limit market risks, the tenure of these contracts will reduce progressively to keep pace with demand variability and be structured in a manner complementary to a power market.

The long-term political implications of these institutional changes are due to the decreased role of the state in structuring power generation through finance. The scope to use the power sector as the basis for rent-seeking will invariably diminish. There is also scope for reduced exposure of the state to capital risk and the greater availability of public capital for other public purposes.

Simultaneously, erosion of public power will reduce the centre's influence on electricity in states. Through its control over public capital, coal and generation capacities, the centre has been in a position to wield influence on electricity in states and some clout on state politics through allocation of these resources. As the share of coal-fired electricity in energy mix and dependency on public capital reduces over time, the centre will lose these important levers over the states.

However, it is important to note that this may well be a long and uneven transition. Recognising these tensions in the transition, the centre and a few states have started responding. But the approach seems chaotic and incoherent. In the short run, already stressed generation assets (due to overcapacity in recent years) could get further stressed as investors turn to RE. The Government of India's currently planned solution is to "warehouse" stressed assets through a special purpose vehicle and aim to salvage them as new demands come up (Narayan 2019). However, in a free and competitive market, cheaper cost RE may well capture new electricity demand, further risking locked-in public capital and exposed public financial institutions.

In a bid to bolster the current model of PPAs, the Government of India has proposed amendments to the Electricity Act and the National Tariff Policy, which make it mandatory for discoms and suppliers to lock-in adequate medium-term and long-term PPAs to meet their annual average demand. By contrast, the Central Electricity Regulatory Commission (CERC) is propelling a transition to markets, and hence flexibility over predictability, by promoting market based economic dispatch of electricity through redesigning a national "day-ahead" market. While PPAs can indeed coexist with the proposed markets, uncertainties about future electricity demand and how it will be met by different sources makes it unfeasible to maintain long-term PPAs. For example, responding to the evolving RE price, the Andhra Pradesh Electricity Regulatory Commission has proposed to reduce PPA tenures to five years from 25 years (Chandrasekaran 2019).

Meanwhile, at the state level, several states have already signalled that they prefer to pivot to greater flexibility, surrendering a cumulative of 6.6 GW of allocations from central thermal generators (MoP 2018). But decisions that favour RE are not the only option exercised;; West Bengal has taken a bold stand by deciding not to chase the ambitious RE target prescribed by the centre (Majumdar 2018).

To further complicate matters, it is important to note an impending further technological shift that may address intermittency and cause a re-think of how electricity evolves: the development of low-cost electricity storage technologies. Electricity matched with storage essentially overcomes the intermittency problem, and makes RE comparable to coal in how it can be used by the system. This development could accelerate disruption, but could also reverse some trends. Because RE plus storage retains the characteristic of being modular, it could lead to much faster and deeper decentralisation in the electricity system. On the other hand, large-scale energy storage enables re-centralisation, and a return to the world of large-scale government-backed capital and public power. The outcome will depend on whether storage costs fall sufficiently fast enough to reverse changes that have already started, or whether a new trajectory for the sector becomes well established, harnessing storage technology as a further disruptive force, rather than as an opportunity to reverse course.

3.3 Disruptive Implications for Broader Political Economy

Since the electricity sector is linked upstream and downstream to other sectors of the economy, disruption in electricity is also likely to ripple through other political economy arenas. While indications of the disruption in electricity structures are already apparent, these broader political and economic implications are likely to unfold in the long term. Here we discuss three illustrative ripple effects of the electricity transition to provide an illustration of the breadth of effects we can anticipate in an RE future.

a) Decline of coal-dependent economy

A closely linked effect of electricity disruption is a slow unravelling of India's coal economy if, indeed, over time RE substitutes coal. At the moment, coal is the dominant fuel for electricity generation in India, and accounts for half of the commercial primary energy in the country. Few expect coal to lose its salience overnight. In a high-RE scenario, India may cross its coal capacity peak by the late 2020s (Pachouri, Spencer, and Renjith 2019) although this peak may be even later according to other studies. Even once peaked, coal use is likely to decline only relatively slowly.

> Disrupting the coal economy means fostering regional imbalance, disrupting the economies of several Indian states and affecting the lives of many millions.

Even if this transition takes a few decades, the scale of the transition and its significance for regional economies requires considerable advance thinking and planning. Coal companies directly employ half a million people and create about the same number of jobs indirectly. In addition, they provide livelihood opportunities and key social infrastructures (by building roads, schools and hospitals) to a broader population of 10-15 million concentrated around coal mines. Royalty from coal mines accounts for a considerable part of the economy of coal-rich states, including Jharkhand, Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Odisha and Maharashtra. For example, in Jharkhand and Chhattisgarh, coal contributes 10% and 9%, respectively to the state economy (Spencer et al. 2018). Most coal states are ill-equipped to deal with disruption of a major part of their economies. Other than Maharashtra and Andhra Pradesh, the coal states are poor, with lower GDP per capita than the national average and have a low level of industrialisation. Disrupting the coal economy means fostering regional imbalance, disrupting the economies of several Indian states and affecting the lives of many millions.

An RE-driven decline in coal also affects central government financing. Though coal-rich states are touted to be dependent on coal taxes, the centre has been taking a larger share of the pie. States get about one-fifth of the tax revenue (as royalty and contribution to the District Mineral Fund) and the remaining four-fifth goes to the national treasury. Between 2009-10 and 2016-17, taxes and duties on coal and its transportation went up by 225% to boost the centre's coffer. Besides, the centre also gains from dividends from Coal India Limited (Tongia and Gross 2019).

Notably, there are strong political forces behind coal as it continues to be "the primary axis of political mobilisation" in coal rich states (Chandra 2018) and a "glistening source of graft" to power brokers (Sengupta 2018). These forces of inertia, combined with the likely long slow retreat of coal, suggest that this transition will be a gradual process spread over years. But, equally, the economics of RE, combined with a growing environmental sensibility driven by air pollution and climate change, suggests it is inexorable and irreversible. Advance planning for regional disruption in coal-dependent states is likely to be a wise decision.

b) Disruptions in the Railway economy

India's rail economy is built around a form of cross-subsidisation, much as is India's electricity economy: the Indian Railways are dependent on coal freight to cross-subsidise politically important passenger freight. In 2016-17, coal freight contributed Rs 10,800 crore to cross-subsidise about 13% of passenger freight costs. Passenger freight required 45% subsidisation that year, up from 30% in 2006 (Kamboj and Tongia 2018), suggesting that coal freight pays a major role in enabling low cost passenger rail.

The requirement of cross-subsidising passenger rail has bumped up against another historical objective in coal pricing: ensuring cheap coal to power plants. Over time, states distant from mines have chosen to import less coal-during the last five years, average coal transport distance has fallen by 30% (Kamboj and Tongia 2018)-and perhaps not coincidentally, have been leaders in investing in RE. In an indication that the motivation of keeping passenger fares low is the more important objective, the Indian Railways have sought to compensate for the loss in revenue by increasing coal freight charges faster than other freight charges, making coal-fired electricity ever less competitive with RE. Thus, the ability of the coal economy to prop up the rail economy is already declining. Over the long term, the retreat of coal will entirely disable this arrangement, by reducing the ability of Indian Railways to rely on over-charging stable coal freight to provide cheap transport for citizens. Instead, passenger fares will have to increase, with attendant political costs or the government will have to compensate with enhanced fiscal support to the railways.

c) Fuel import dependency to technology import dependency

India imports nearly half of its commercial primary energy, including a considerable amount of coal. The import of coal has increased rapidly in recent years, reaching up to 200 million tonnes per year, making it one of the top five products India imports. Advocates of RE claim that transition to a RE heavy system will not only reduce coal import dependency, but also reduce oil import dependency by increasing scope for electrification of transportation and industrial process. Rising energy import dependency puts India's energy security at risk, drains the national treasury and causes geo-political risks.

But is RE a smooth alternative for India's energy security? While RE will reduce India's fuel import dependency, it is likely to increase the import of new energy technologies. Among the rapidly growing RE nations, India has an incoherent growth in technology innovation and deployment; the country has much slower growth in technology patents compared to its scale of deployment. A major part of India's RE deployment has been based on imported technologies, predominantly Chinese solar panels. This can be explained by limits of Indian manufacturing capacity and their cost competitiveness. Shifting import dependency on conventional fuel to new energy technologies will not help to build energy security. Ad hoc measures to check these new imports and promote Indian manufacturers-through domestic content requirement earlier and recent safeguard duties on imported solar panels-are seen in a negative light.

4.Conclusions

The transition to renewable energy is not just about substituting one technology for the other, but about shifting from one interlocked configuration of technology, institutions and politics to a completely different such configuration. Significant uncertainties about the rate and nature of technological innovation and forces of inertia in both institutions and politics suggest that it is by no means clear how these disruptions will play out. The likelihood is that this will be a long transition, with overlapping hybrid coexisting configurations, allowing for significant contestation over the pace and nature of change. In the interim, we are likely to see a hybrid, rapidly changing power system and surprisingly extensive spillover effects on the political economy of the nation.

> That this transition is inevitable, even if uneven, unpredictable and slow, demands engagement with the question of what happens to the vulnerable as these political transitions play out... How should the costs of the transition be distributed, and is the Indian state capable of the foresight to address this question?

Despite these uncertainties, a few likely impacts have already come into focus. First, the long-standing conceptualisation of electricity as a welfare good is likely to be no longer feasible, welfare in electricity is likely to shift from the domain of the rate payers with the sector to the broader collective of tax payers. As an important corollary, the deployment of the electricity sector as part of electoral politics, whether as a cash cow or mechanism to harness a vote bank, is likely to decline. Second, the public sector risks losing its longstanding power in a key sector which it has historically dominated. At the same time, the flip side is that the transition will deleverage the state from some of its historical risks and inefficiencies. Finally, the political models of the broader economy (coal, railways and major PSUs) will need to be recreated in step with the evolving electricity sector.

That this transition is inevitable, even if uneven, unpredictable and slow, demands engagement with the question of what happens to the vulnerable as these political transitions play out. This includes not only rural and small domestic electricity consumers but also the potentially "left behind" coal workers and their families. How should the costs of the transition be distributed, and is the Indian state capable of the foresight to address this question? The lock-in to redistributive welfarism has had perverse implications for the human development of India's poor in the past. Low cost and clean renewable power provides an opportunity to break this cycle, but to do so will take foresight and the envisioning of a new politics of power.

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