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Transitioning Towards a Sustainable Energy Future: Challenges and Opportunities for India[1]

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India sits at the nub of the crisis of the current high carbon model of development. It is not responsible for this crisis and it can legitimately argue that it must not bear the costs of adapting and mitigating its consequences. However, it cannot escape the reality that it is amongst the most vulnerable nations to global warming. This paper identifies five factors that define the reality of India's energy sector and argues that these factors should be regarded as predetermined trends that will influence the shape of India's future energy profile, at least for the foreseeable future, irrespective of the specifics of policy. It underlines that the Indian government recognises the severity of the problem and has embarked on an ambitious programme to tackle the crisis on its own. However, it requires better alignment of the political, institutional and financial framework for implementation in a given time-frame. Further, the paper lays out five propositions that are necessary first steps towards a low carbon future.

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1 This paper is an adaptation of the keynote address delivered at the ISAS-ESI Conference on "Towards a Low Carbon Asia: The Challenges of Ensuring Efficient and Sustainable Energy", on 28 November 2017. The conference was organised by the Institute of South Asian Studies (ISAS), an autonomous research institute at the National University of Singapore (NUS), in partnership with the Energy Studies Institute (ESI), also from NUS.

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Introduction

New Delhi in India has become the most polluted city in the world.[3] In New Delhi, one can smell the noxious fumes emitted by the burning of harvest stubble and vehicular traffic and one feels surrounded by the sight and noise of a construction site. A visit to New Delhi would persuade even the most hardened environmental skeptic that the present model of economic development is unsustainable; that the growing chorus of concern about climate change is not a scientific hoax; and that the world simply does not have the luxury of staying on the treadmill of high carbon growth.

Therefore, the organisers of the conference[4] must be commended on the framing of the topic because it recognises this urgency. It compels reflection on the 'how', not as is all too often the case, on the 'why' or the 'what'. Much of the discussion and analysis, so far, has focused on the reasons for and the shape of the current crisis. There is also a library of literature on what needs to be done to adapt to and mitigate the consequential impact. Not enough work has been done, however, on how to implement the identified solutions. This conference focused on 'how' and, in particular, the modalities of moving forward down the pathway towards a low carbon future, and thus, an attempt to correct this imbalance.

Global Consensus on the Way Forward

The scientific and physical evidence regarding global warming is overwhelming. Temperature change is not a recent phenomenon. It has been a characteristic of our ecosystem for millennia. What is different today is the pace of change, and the fact that the natural ecosystem is not able to accommodate to this pace. Human activity has disrupted the balance. United States (US) President Donald Trump may question the causality but he will be hard pressed to dismiss the empirical and physical evidence. Global mean temperatures are today approximately 1.5 degrees higher than in pre-industrial times and the concentration of Greenhouse Gas (GHG) in

[3] "How Delhi became the most polluted city on Earth", Umair Irfan, *Vox*, 25 November 2017. https://www.vox.com/energy-and-environment/2017/11/22/16666808/india-air-pollution-new-delhi. Accessed on 28 November 2017.

[4] The ISAS-ESI Conference on "Towards a Low Carbon Asia: The Challenges of Ensuring Efficient and Sustainable Energy" was held in Singapore on 28 November 2017.

the atmosphere is fast moving to the tipping point of 450 parts per million, beyond which, our planet will face severe and possibly irremediable consequences.[5]

The global community has now acknowledged this reality. The Paris accord[6] is a testament of this recognition. The accord does not commit the signatories to actions that will contain the increase in global temperatures to below 2 degrees Centigrade relative to the temperature prevailing in the pre-industrial era – the level beyond which the scientific community believes the ecological system will be structurally imbalanced – but it does establish that the world is aligned on the objective of low carbon development. The Paris accord also establishes that, whilst its signatories continue to differ over details, for instance, the treatment of carbon, the optimal mix between risk and reward, the financing mechanism and, in particular, the paymaster, that is, who should pick up the tab, they agree on the steps that must be tread to achieve this objective.

The world must move away from a fossil fuel-based energy system – it must enhance the share of renewables in the energy basket; it should improve the efficiency of energy usage and encourage demand conservation; the protection of forests and reforestation must be a policy priority and greater resources should be allocated for research and development (R&D) of clean energy technologies.

What the Paris accord could not achieve was alignment on the political, institutional and financial framework required for implementation of these measures, and the time frame. This was a lacuna, for, as history teaches us, we cannot assume that technology is panacea for all our problems. We may have the technological answers to a problem but there is a long lag between the development of those answers and their full impact on systems, processes and our way of life.

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5 Some of these consequences include stronger hurricanes and severe heat waves; crop damage due to higher heat levels; reduced water availability due to rising temperatures, changing precipitation patterns and increasing droughts; health issues due to heat waves, air pollution and diseases linked to climate; damage to forests, and animal and plant life due to shifting weather patterns, drought and wildfires. https://archive.epa.gov/climatechange/kids/basics/today/greenhouse-gases.html. Accessed on 23 December 2017.

6 The Paris accord was negotiated by representatives of 196 parties at the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change in Paris, France, and was adopted by consensus on 12 December 2015. As of November 2017, 195 members have signed the agreement, and 171 have become party to it. http://unfccc.int/paris_agreement/items/9444.php. Accessed on 12 December 2017.

Historical Caveat

Information technology may have made us complacent, for its impact has been immediate and dramatic. It has revolutionised our lives within a generation. History, however, offers an opposite and somewhat salutary lesson. It tells us that the full impact of new technology depends on a slew of complimentary investments in infrastructure, structures, organisation and training. These investments are often delayed and, consequently, there is a long lag between the development of new technology and its impact on society.

Two economists from Dartmouth University, Diego Comin and Bart Hobijn, provide empirical confirmation of this historical trend. They surveyed the application of 15 technologies across 166 countries and concluded that, on average, countries adopted technologies 45 years after their invention.[7] More specifically, Edison illuminated the lower half of Manhattan in 1885. However, it was not until the mid-1930s that all the factories in the US had converted from steam power to electric power. This was because they were not structured for this revolutionary new technology. Most had to be redesigned; some had to be rebuilt.

The larger point is that the 'the clean energy' technologies required to shift away from a fossil fuel-based energy system towards a low carbon energy system are known to us and they are fast approaching the threshold of commerciality and competitiveness against incumbent 'fossil fuel' technologies. There is good reason, therefore, to be optimistic about the pace at which solar and wind can replace oil, gas and coal for electricity generation and industrial processes. India has, for instance, targeted an exponential growth of solar electricity from the current approximate of 15 Gigawatt (GW) to around 100 GW by 2022. However, this optimism must be tempered. History is signalling caution. It is forewarning that, in the absence of these associated investments coupled with statesmanship and political will, the clean energy option will only appeal to a small, specialised section of the country. The historical cue is that it is one thing to have the technological answers; it is another to scale its application and effect a systemic change.

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[7] Comin, Diego, and Hobijn, Bart, "An Exploration of Technology Diffusion", *American Economic Review 100*, No 5, December 2010, pp. 2031-2059. https://www.dartmouth.edu/~dcomin/files/exploration_technology.pdf. Accessed on 23 December 2017.

India: Epicentre of Global Warming

India presently finds itself at the crux of the high carbon model of development – a crisis for which it is not responsible. As such, it can rightly argue against bearing any cost to deal with its ramifications.

However, it cannot escape the reality that it is amongst the most vulnerable nations to global warming. Two-thirds of its population are agriculturalists dependent on the monsoons for their livelihood. They would be hugely impacted by climate change-induced unseasonality in rainfall. Another 150 million or so live alongside its 7,000-kilometre coastline. They would face the consequences of climate change rise in the mean sea level. Its northern perimeter is fringed with approximately 10,000 Himalayan glaciers. Scientists have observed an alarming increase in the rate of retreat of these glaciers. The evidence is mixed but most people agree that climate change is, most likely, a contributory cause. What is indubitable is the fact that glacial recession will worsen the cycle of flooding and drought that currently afflicts large parts of North India every year.

The Indian government recognises the severity of the problem. It also realises that it does not have the luxury to wait upon the actions of the global community. It needs to tackle the crisis on its own. So, towards this end, it has embarked on an ambitious, some might say audacious, programme of development of solar, wind and bio energy; it has publicly committed its intent to increase the share of renewables in electricity generation to 40 per cent by 2030; to reduce the emissions of GHG by between 30-35 per cent relative to 2005 by 2035 and to shift the production of new cars to electric vehicles (EV) by 2030. This is a laudable programme.

The question is whether it is feasible or indeed advisable. Some, including the Indian government's Chief Economic Adviser Arvind Subramanian, are suggesting that it is not feasible or advisable. While the later part of this paper touches upon his reasons for caution, it is important to stress that the feasibility of such an ambitious programme will depend on timely investments in the associated and complimentary infrastructure. And for that, pragmatic answers will have to be found to questions such as:

- How does one remove the roadblocks to the development of smart infrastructure, smart cities, and smart buildings?

- What needs to be done to accelerate the implementation of energy efficient technologies?

- What new financial instruments must be created to raise the required capital? and

- What organisational and institutional changes must accompany these efforts?

The answers to these questions must be framed within the existing socio-economic and political realities of the energy sector for a greater practical value.

India: Framework for Implementation

Five factors define the reality of India's energy sector. These should be regarded as predetermined trends that will influence the shape of India's future energy profile, at least for the foreseeable future, irrespective of the specifics of policy.

The first is the fact that energy is a concurrent subject under the Indian constitution. This means that the Central government, the 29 State governments and 6 Union territories have concurrent legislative competence and authority for administrative action. The consequence of this overlap of roles and responsibilities has been the creation of a fragmented energy market. India does not have a single unified market for energy. This is exemplified by the tariff structure for electric power. There are today, nearly 100 varying tariffs. A religious establishment pays a different tariff than a bus station; a farmer with irrigable land is charged a higher tariff than a farmer dependent on the monsoons; a breeder of rabbits is treated differently than one who keeps poultry. This extraordinary potpourri reflects the competing tugs and pulls of competitive federalism, populist politics and the influence of vested stakeholders. Therefore, a systemic shift of radical dimensions will be required to simplify, straitjacket and unify the energy market.

The second is the fact that the natural resource base for energy is unevenly spread in terms of endowment, geography, investment and structure. India has the fifth largest deposits of coal in the world. The bulk of these deposits are, however, located in the North and East of India whereas the principal consumption centres are in the West and South of the country. Further, the Coal industry is effectively controlled by the Indian government through the state-owned monolith, 'Coal India'.

In contrast, India is not comparably well endowed with oil. It produces barely 20 per cent of its requirements and imports the balance 80 per cent from predominantly the Middle East, Nigeria, and Venezuela through principally the deep water ports of Mumbai, Jamnagar and Hazera. Unlike coal, the oil industry has been liberalised and whilst the oil and gas value chain is dominated by state-owned entities – Oil and Natural Gas Commission in the upstream, and Indian Oil Company, Bharat Petroleum Company and Hindustan Petroleum Company in the downstream. The private sector has a presence (and, in the case of refining, the dominant presence) and the operating and commercial conditions are aligned to the market.

Regarding renewables, although these contribute a minuscule share of India's energy requirement, it is worth noting that the investments in solar and wind have been skewed towards a handful of States. Eight of the country's 29 States attract the entirety of the investment. This is, in part, because of weather patterns and, in part, because of specific State government incentives. The private sector is the lead player but the economics of the business depends almost totally on government largesse.

This uneven spread of resources, policy, structure and investment has created vested political, social and economic linkages that militate against change. The coal industry exemplifies this reality. 'Coal India' is choked by strong labour unions, the Mafioso and cronyism. It is subject to the vagaries of the road and railway transport infrastructure. It confronts, in short, the tugs and pulls of several competing stakeholders. The most effective way of managing these pressures is by subserving the status quo. This systemic reality is not unique to the coal industry. It afflicts the entire energy industry.

The third is the fact that fossil fuels and coal, in particular, will remain the backbone of India's energy system for the foreseeable future. The government think tank the National Institution

for Transforming India (NITI Aayog) has projected that coal, oil and gas will account for 77 per cent of the country's energy system in 2040. Their projection is not intended to call into question the government's commitment to develop renewables. It is simply to acknowledge an economic and political reality. Coal is the cheapest and most abundant source of energy, and politicians and the government need to meet their commitment to provide every citizen access to affordable and reliable electricity. Hence, India faces a conundrum.

How does India square the circle between, on one hand, its commitment to reduce GHG emissions and, on the other, its investment in the 'dirtiest' of fuels? There is no easy way to crack this issue. The Chief Economic Adviser has suggested that India simply accept that, whilst renewables are an important offset against global warming and environmental degradation, the time has not yet arrived for the government to put its eggs into the renewables basket. His argument is grounded on solid economics. Solar and wind are not competitive against coal and they will not be so for years, notwithstanding Swanson's law that the cost of solar photovoltaic panels will drop by 20 per cent for every doubling of cumulative shipped volumes – that is, at the present rates of production, the costs will halve every 10 years – and notwithstanding, the inclusion of a carbon charge. He has forewarned the government against the 'double whammy' implications of pushing renewables for two reasons. First, it will increase the subsidy bill because renewables are not sustainable without subsidies. And, second, it will strand existing thermal power plants. The plant load factor (PLF) of thermal power plants has been trending downwards for some time and a surge in renewable energy capacity could well push the PLF below the threshold of viability of approximately 50 per cent. Dr Subramanian has invoked St Augustine to summarise his approach to renewable, "Lord give me continence and chastity but not yet". One may challenge the assumptions that underpin his conclusions and one may counter St Augustine with a paraphrase of Blaise Pascal's famous remark regards divinity – the price of denying the existence of God could be an eternity in hell if one was wrong (about global warming) – but that still does not take away from the prevailing reality. Coal will remain the bulwark of our energy system for the foreseeable future because of 'good politics'.

The fourth is the fact of surging demand. India has a huge population; a rising percentage of this population are migrant and aspirational. They are moving from rural to urban India and they are looking to trade up, metaphorically speaking, from a cycle to a motorised two wheeler

to eventually a car. Moreover, its economy has now entered its most energy-intensive phase of development with the 'Make in India' manufacturing, the centrepiece of government policy. Finally, there is the 'consumption-inducing' impact of subsidies. Petroleum products (liquid petroleum gas [LPG], kerosene and diesel) have been subsidised for years. This has distorted the market and led to what people have often referred to as the 'dieselisation' of the economy. This government has taken advantage of the fall in international oil prices to lower the level of subsidies and rationalise the price structure. This has corrected somewhat the distortions but not fully. LPG and kerosene continue to be subsidised. Population, prosperity and policy explain the historic surge in demand. One should presume that all three factors will remain in play and the demand for petroleum products will continue to ratchet upwards.

The fifth and final is the fact that energy sits at the core of every politician's deepest dilemma. Democratically-elected leaders have to reconcile the calculus of 'good economics' with the pressures of 'good politics'. They often know what needs to be done. What they do not know is how to get re-elected thereafter! This is why, all too often, they push 'good economics' to the side. New Delhi is today blanketed by the smoke caused by the burning of the residue of the recent harvest by farmers in the neighbouring States of Haryana, Punjab and Rajasthan. Every year, the farmers burn the residue to prepare their field for the next sowing cycle. And every year, the wind blows the smoke across to New Delhi. Good environmental economics would have prompted the governments of the four States (New Delhi is also a State) to provide the farmers with the equipment required to prevent the burning. The cost is inconsequential relative to the cost of air pollution. However, that has not happened because of competitive politics. And so, every year, New Delhi and its surrounding areas choke under a deathly blanket of smog.

Ultimately, the effectiveness of any 'low carbon' programme will rest on striking the right balance between economic logic, political compulsion and environmental imperative. The dilemma will, however, persist.

The Way Forward: Five Propositions

This section lays out five propositions that fit within the above framework and are necessary first steps towards a low carbon future. The hope is that, in taking these first few steps, the platform will be laid for subsequent much larger steps, all towards the destination of a low carbon future.

At the outset, it is important to emphasise the criticality of the role of the government. There is no other entity capable of creating the appropriate ecosystem for catalysing this initial movement. The government is required to create the enabling incentives. It will have to weigh in against the inertial tendencies of incumbent vested interests; to develop the regulatory systems and processes that encourage entrepreneurialism and, at the same time, check the excesses of the market; to encourage the search for new technology horizons; and perhaps, most importantly, find a way of balancing the demands of its domestic constituency with the imperatives of ecological balance. This may be an obvious point but it cannot be overemphasised that, in the drive towards a low carbon future, the government will have to lead from the front.

This leads to the second proposition that, to weaken the linkage between energy demand and environmental degradation, the policy on energy must be developed holistically and not through the siloed processes of State politics, bureaucratic verticals and vested interests. This will require a major institutional overhaul and that might be a stretch too far in this initial phase. However, to lay the ground work and, in particular, to create awareness of the embedded interconnections between energy, environment and the macro economy, Indian parliament should legislate an omnibus ‘energy and environment responsibility act’ and place the subject of energy and environment policy in the hands of a ministerial czar. The government has, in the past, legislated acts like the ‘fiscal responsibility act’ and the ‘food security act’ which placed a moral, if not a legal obligation, on governments, to exercise fiscal prudence and provide food to all. A similar legislation on energy would provide a platform for integrated discussions.

The third proposition is that local governments be empowered to act autonomously on issues related to energy efficiency, demand conservation, waste management, urban redesign and

transportation. The current system of governance does provide municipal authorities such powers on paper. In practice, however, these powers have been straitjacketed by the tugs and pulls of electoral politics. The reality is that whilst municipal authorities have enormous powers to stymie progress – they can hold up files indefinitely- but have lost the powers to initiate new policy. Those powers are now vested with the politician whose priorities are dictated by the electoral cycle. This imbalance needs to be corrected.

Its first step is the vesting of energy management in an autonomous, constitutionally created, city energy ombudsman comparable to the Comptroller and Auditor General of India or the head of our Union Public Service Commission. The consultants McKinsey have done a report called 'Deadline 2020'. This report prioritises four action areas for cities – the decarbonisation of the electrical grid; the optimisation of energy efficiency; the development of next generation mobility; and the improvement of waste management. A similar study should be carried out for each of our tier-one cities and the identified actions should be the deliverables of this Ombudsman. The underlying objective of this proposition is to, on one hand, forewarn against one-size-fits-all macro solutions and, on the other hand, encourage the development and implementation of focused, small scale and distributed solutions.

The fourth proposition is to develop a raft of new financial products. The shift to a low carbon energy system requires investment in complementary infrastructure (smart cities, smart grids, smart meters, charging infrastructure, etc.), organisational restructuring and skill development. The investment levels are beyond the balance sheets of any Central or State government entity or indeed the private sector. And even if they were, the returns would be deemed too low and risky. However, there is no dearth of liquidity. The challenge is, therefore, to create the financing models to direct this money into 'green investments'. We have the financial and technology talent to develop such innovative financing techniques. What is required is to direct this talent towards the fulfilment of this objective.

The fifth proposition is akin to the fourth. India needs to place greater emphasis on clean energy R&D. It can, of course, hope to piggy back on the research that is being carried out across the world. However, that would lead to a relationship of dependency. Today, the competitiveness of our solar and electric vehicle initiatives depends on the availability of cheap Chinese made solar photovoltaic panels and lithium ion batteries. The Chinese products are the cheapest

available because China has invested substantially in battery technology and in the creation of photovoltaic manufacturing capacity. Were India to impose countervailing duties on Chinese imports, it would 'kill' the economics of India's domestic solar and electric vehicle investors. However, if these products are allowed unfettered entry, it would create a relationship of import dependency on a country with which India has a somewhat ambivalent relationship.

India has a 'clean energy' fund to finance clean energy research. The fund is well endowed. The money in this fund has, however, not been used for clean energy research. Instead, it has been diverted to bridge budgetary deficits or some politically-favoured project like the cleansing of River Ganges. This diversion should be stopped. India has capable technocrats. What it does not have is an enabling R&D system? Therefore, India should create such a system and initiate primary research on third generation, new horizon and clean energy technologies and in partnership with international universities, research laboratories, government entities and private scholars.

The final proposition is, in some ways, a doff to the existing system. The inevitability of India's dependence on coal, oil and gas does not provide the luxury to trundle along in the hope that development now would allow India to clean up later. So, as India moves towards a non-fossil fuel-based energy system, the government is urged to look to 'greening' India's current fossil fuel portfolio. There are many prongs to this effort, including the gasification of coal but one, in particular, needs to be placed on an immediate fast track, that is, the development of a national gas grid. Currently, much of South and East India have limited or no access to gas because of the inadequacy of the pipeline infrastructure. The Central government is aware of the importance of creating such a grid but its efforts have been constrained by the difficulties related to land acquisition and 'rights of way' to lay the pipeline; the public perception that 'gas' poses a risk to safety; finance and competitive politics between the Centre and the various States.

The former Prime Minister of the United Kingdom, Winston Churchill, once remarked that an era of procrastination will inevitably lead to an era of consequences. The Indian government needs to heed this forewarning and put the weight of its power behind efforts to remove these roadblocks.

Conclusion

India knows it has an energy and environment problem. It knows what needs to be done. It also knows that the transition to a different energy system will not be smooth but dissonant, disruptive and possibly dislocatory. However, it no longer has a choice! It has to forge a new social, institutional, regulatory and legislative contract for energy. It has to invent a new energy future and navigate towards this destination.

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