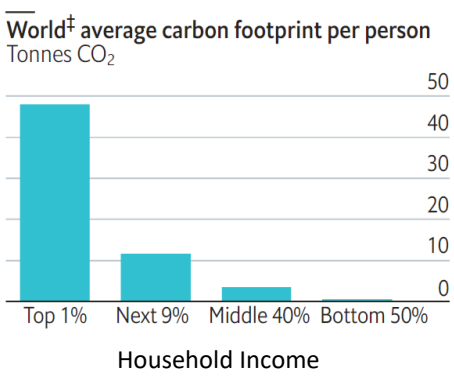
Energy & Net Zero

There is unanimous consensus around the world today that Green House Gas (GHG) emissions is rapidly destroying the earth. Currently, India ranks 103rd in terms of per captia CO2 emissions, and therefore may not be considerd a primary culprit. However, in terms of total emissions, India ranks 3rd and its GHG emissions has been increasingly rapidly as its GDP grows[1]. For example, home air-conditioning is estimated to grow from about 25 million units in 2010 to about 500 million units by 2040. India would soon become the second largest contributor. It is to be noted that it is the low-income people in India or in the the world, who contribute the least to the problem, but would be the hardest-hit as the climate changes.



India therefore needs to strive to be amongst the leader in the world in this transition towards net-zero energy and also help others accelerate this shift. How do we go about doing this? The first tasks would be to identify, develop and demostrate technologies, make it economically viable and enable scaled commercialisation of technologies, which would help us get there. The second and an equally important task is to manage the change, as a large number of people and industries associated with traditional fossil-fuel sector will be disrupted in the process.

Technologies to move India towards Net-Zero

Fortunately, continuous technology advacement over the last twenty years, has made the cost of electrcity generated from solar and wind fall even lower than that for coal. Yet over 75% of electrcity generated in India today uses fossil fuels. Renewable Energy (RE) does amount to almost 25% of generation capacity, but in terms of electricity generated, it contributes to a mere 8% of the total, because of its lower capacity utlisation factor. Therefore, even as we aim to install 500 GW RE (targeted by 2030), coal-based energy may continue to dominate. We would therefore have to move to RE even faster and would need to invest heavily to get there. Instead of always depending on the Government inititives and funds, one may look at tapping our higher-income group sections to enable this shift to RE based systems. As long as there is Return on Investment (RoI), they would be ready to garner the required funds. The task therefore would be to develop technologies which would give a strong RoI. Even though several technologies are available today towards this, much more would need to be done. While significant R&D efforts will be required, it is equally important to take these tecnologies all the way to commercialstion. Therefore the steps involved include (i) R&D → (ii) early pilots to prove technology readiness → (iii) pilots towards proving economic viability → (iv) early stage commercial deployments with some government support and conducive policies → (v) full-scale commercial deployments. While stages (i) and (ii) would require some R&D funding and grants (including CSR), venture funds could be tapped in for stages (iii) and (iv). Stage (v) will tap in banks and other commercial financing. It is important to understand which technologies could reach different stages in 0 to 5 years, 5 to 10 years and 10 years and beyond.

[1] https://businessindia.co/magazine/moving-india-towards-net-zero

Near-term technologies (0 to 5 years for commercialisation)

Solar and wind based electrcity has already proven its economic viability. With R&D going on in solar cells, it is expected that the cost of solar-based electrcicity would further come down (say with Perovskite). Higher height and larger-capacity wind-turbines would similarly reduce costs . As solar and wind energy is not available 24 x 7, energy storage would be the next important thing to scale RE. The short-term energy storage options are (i) Li Ion Battery Storage and (ii) chilled water storage, especially in places where air-conditioning usage is high. With some engineering innovations, the add-on costs of storage could be reduced to make 24x7 electricty from RE cost competitive to fossil-based energy, in the near future. Cleaning up our hydro-electrc genertion plants will add-on to the clean electrcity push. Further strenthening of the electrcity grid would be required to carry this energy efficiently across the country. This electrcity can also be used to power electric vehicles (EVs) to replace petrol / diesel based vehicles, which heavily contribites to GHG emissions today. 2-wheeler and 3-wheeler EVs are already cost-competitive, whereas as 4-wheelers may take a couple of more years to get there. We can also start working on convesrion of construction and agricultural equipment to electric, though the full conversion may require R&D beyond five years. Enhancing energy efficiency in all appliances, especially in heating and air-coditioning, would play a key role. Similary effective integration and management of energy generation, storage and consumption would be critical to move towrds 100% RE.

Mid- to long term technologies (5 to 15 years for commercialisation)

While Li-Ion and chilled water storages are great for short-term (a few hours to a few days), storing energy for months together would require a different set of technologies. Some batteries like Zn-air and Al-air look promising, but would take significant R&D for a few years, before becoming vaible. Same is the case for all Green Hydrogen based technologies; they remain too expensive today. But in 5 to 7 years, new electrolysers and fuel-cells are likley to reduce costs substantially. One could then use this Green Hydrogen to make Ammonia for feritilisers, and for use in steel and cement manufacturing[2] to reduce the use of fossil fuel consumption. Even then there will be significant CO2 emssions, especillly from calcination of lime-stone. One would need to capture CO2 from such plants, carry it (possibly in gas pipes) and sequester it in concrete blocks or under the sea in the form of hydrates. There is no reason for India not to be on top of such technogies in the next 7 to 10 years. The other technology that may help India to get to net-zero is electricty generation from ocen and tidal waves. A lot of work is however required for these sources to compete with solar and wind based electrcity. Simailarly, Small modular Nuclear reactors and compressed air energy storage are also technologies which may play a major role in future. R&D in these areas need to start soon to enable commercialistion in 12 to 15 years.

Managing Change

Moving towards Net-Zero in India will disrupt many existing industries and business units, and heavily impact employment in these sectors unless carefully managed. One of the worst affected industries will be the coal mining and coal-based power plants. While coal mines were privatized a decade ago, almost 65% of todays coal plants were also set up in the last decade alone. The investments made in these plants would not have been recovered to any significant extent yet, and the banks especially in the public sector may be holding a large part in it. These sectors are also very large employers of low and middle-income people. The transition to RE would be a massive disruption across the board. The third industry affected would be the State-owned Power Distribution companies (DISCOMS). Most of them are already in the verge of bankruptcy, even though they provide essential services to people. While RE would also require transmission and distribution, most State utilities are not prepared for this change. Note that coal mines, coal-based power plants and DISCOMS are all under the control of States

[2] Steel and cement plants are estimated to contribute to over 16% of total GHG emissions in the world today

and their impairment could escalate center-state tensions as well. The fourth and fifth industries that would be disrupted are the automobile sector and refineries & fossil fuel distribution companies. Along with their ancilliaries, they contribute to over 12% of the country's GDP and also generate huge employment.

The transition to net-zero will not reduce GDP or employment, if India carries out R&D, design and manufacture of every subsystem required for RE generation, storage and consumption, along with recycling of all batteries for recovery and reuse. The employment and GDP would both only go up. On the other hand, if it largely depends on imports or just assemble products with imported know-how there would be a negative impact. India's young S&T talent can be nurtureed to carry out R&D, design & development efforts across the entire valuechain. We must motivate, support, challenge and believe in these young minds. Equally important would be to mange this massive change carefully such that the existing industries are able to transition to this new and renewable energy future. Enabling this shift in an effective manner would be a significant governance challenge to address.