Infrastructure and Communication

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While the Infrastructure Sector consists of many entries, in this paper we focus on the following**;** **Transportation Infrastructure** (Roadways, Trains, Ports, and Airway), **Energy Infrastructure** (Electricity, Fuel, Dams, etc.

The current state-of-affairs of Infrastructure sectors in India

a) Transportation (Roads & Highways)

- India has the 2nd longest road network in the world (~6mn km) and transports two-thirds of goods. Some issues:
    - Highly inefficient and carbon intensive;
    - Quality of state and local roads is poor (Pace of construction is good at NH level)
    - Low level of automation (and electrification)
    - No regulator for the Roads & Highways sector renders policy making incoherent (NHAI plays role of operator, financier, and regulator!)

b) Transportation (Ports)

- Ports in India handle 95% of international (merchandise) trade in and out of India. Capacity of 1.5 bn tonnes/year. Some issues:
    - Ports lacking capacity to handle expected growth in trade. Close to capacity.
    - Most Indian ports suffer from low draft and Inland and coastal shipping are way below potential despite programs like Sagarmala
    - Regulator for Ports sector (TAMP) is weak, has less powers, and lacks capacity

c) Transportation (Railways including Metro projects)

- Indian Railways (IR) is one of the largest rail network in the world under one management; it is the largest employer in the world (maybe second to Chinese Army). Some issues:
    - Due to issues with GoI freight policies, losing most of it to inefficient road traffic. Main revenue from moving coal. Passenger fares are subsidised vastly. Expensive physical assets.
    - Lack of investments in IR for several decades until the past decade (electrification, and dedicated freight corridor projects have boosted investments)

c) Energy Infrastructure (Electricity, Oil & Gas, Hydro, Renewable, and Nuclear)

- India is currently the 4th largest consumer of energy after USA, China, and Russia and the electricity access in India has reportedly reached nearly 100% in 2021.
- Thermal power plants (Coal, Oil, Biomass and Gas) constitute 68% of total power generation in India of which Coal is 58.5%. The other sources include Hydro (17%), Renewable (Solar and Wind= 12%), and Nuclear (3%). India has achieved one of her NDC goals of 40% power capacity from RE.
- Surplus in electricity generation, but per captia consumption is still low. Fragile infrastructure with last mile losses.
- By the end of 2019, import dependence on crude oil and coal is estimated to be 78% and 22% of the demand respectively.
- Solar power has the potential to meet 7% of our power needs by 2022, mitigate 2.6% of carbon emission, and reduce coal imports by 71 million tonnes per annum saving Rs 33,000 crore.
- There is no National Policy on Energy endorsed or supported by Parliament.

Communication infrastructure:

Communication infrastructure is and will be a critical component of India's growth saga, particularly given the modern-day dependence of business and daily lifestyle activities on ICT.

Wired Infrastructure: Wired internet infrastructure is the most reliable and stable way of providing internet to households. The two most popular technologies in this regard are the Fiber and DSL. These technologies (particularly Fiber) will allow data rates upwards of 100 Mbps to a few Gbps. However, in India only 9.1% [2] of the households have fixed broadband access. Out of these connections, about only 6% are in Rural India. While Fiber and DSL provide network connectivity to home/office, the last meter connectivity is through WiFi.

Wireless Infrastructure (Cellular): Cellular (Mobile) broadband is the main mode of connectivity for a majority of Indian population. About 600 million people in India [1, 2] are connected to the internet using their mobile phones, which is significantly higher than wired connections. In addition, it should be noted that the cellular tariff in India is one of the lowest in the world [3]. Cell phone assembly is being done in India (in the recent years, there is a significant increase of assembly because of Govt Policies on PLI). Some observations:

1) Cellular is the main mode of broadband connectivity in India and *India has almost lowest tariff*.
2) Most of the cellular infrastructure is still imported. Also, major importer of chipsets (Cellular and WiFi) and royalty outflow is quite high.
3) Also the cellular penetration is still low because of the lower ARPU.

Projected Vision for 2047 of the above Infrastructure sectors in India

a) Transportation Infrastructure

- To become the #1 roadways in the world through a comprehensive network of highways.
- To become the #2 railways system in the world with 100% private operators with integrated connectivity in urban areas with other transportation systems. To become the #2 hyperloop alike infrastructure in the world
- Metro and Metro like urban transportation in all Tier 1 and Tier 2 Cities across India.
- To integrated transportation across the roadways, railways, ports, and airways through an operation i.e. An integrated national transportation system that can economically move anyone and anything anywhere, anytime, on-time.
- To achieve a national integrated transportation system that has low dependency on foreign energy and is compatible with the environment.

b) Energy Infrastructure (Electricity, Oil & Gas, Hydro, Renewable, and Nuclear)

- Through smart grid and other mitigation initiatives, India will have to reduce this projected oil demand by 75% to 1 mb/d, thereby reducing foreign dependencies.
- Coal generated electricity should be down to 25%. This requires we have a substitute baseload fuel
- To achieve 60% share of renewable sources out of the total energy supply.
- To leverage the clean hydrogen economy to 20% of the total energy demand.
- The share of non-fossil fuels in electricity generation capacity reaches almost 60%, well above the 40% that India pledged at the Paris Convention.
- India's leadership in the deployment of clean energy technologies expands its market for solar PV, wind turbine and lithium-ion battery equipment to over $40 billion per year.
- India's clean energy workforce grows by 5 million over the next twenty five years.
- To develop robust smart grids with 100% national coverage
- India becomes a global leader in battery storage with a target of 200 GW capacity.

C) Communication infrastructure:

- Real broadband connectivity: 1 Gbps average per house hold and 100 Mbps minimum internet speed across the nation and good QOS (available 99.99%).
- Broadband everywhere: Good quality broadband should be available at every nook and corner of the country. This means that ICT infrastructure should be scaled massively for rural connectivity.
- Indigenous infrastructure connectivity: 90% of the Network infrastructure should be designed and manufactured in the country.

- Indigenous Cell phones: We should have an Indian company who can manufacture the cellular SOC and WiFi SOC and can produce these in India.
- Local standards for global adoption: India should play a significant role in global standards and should have (Indian companies and organisations) 15-20% IPR in any wireless global standard.

What can the GoI do to achieve Vision 2047 in Infrastructure

Transport

- Central Govt. must declare that "Transportation & Energy Infrastructure area the foundation of our entire economy and quality of life". Create a permanent National Infrastructure Advisory Committee, that reports directly to the Ministries, with representatives from all stakeholders
- Formulating a strategy for winding down coal usage
- Create a transportation investment fund with the transportation sector . Significantly increase funding for long-term, high risk enabling research over the next 10 years.
- Create National Centres of Eminence, with a strong industry participation, in the promising areas such as (a) Hydrogen Economy, (b) New Battery Technologies, (c) 3D Printing of infrastructure, (d) Digital Twins for Infrastructure, etc. that will make a difference over the next 25 years.

Electricity

- Create a comprehensive policy and provide an effective action plan for achieving energy security through increasing fuel availability by narrowing demand-supply gap; addressing energy pricing through periodic tariff revision, reforming free and unmetered agriculture supply etc.; bringing policy reforms; and ensuring power sector reforms such as reducing distribution losses etc.
    - Privatise discoms and give DBT based subsidy to poor households and agriculture (sub-scale farmers only).
    - Strengthen SERCs (today they are puppets of state governments) by giving them a constitutional budget and composition of members from outside government.
    - Structural reforms required in wholesale electricity markets

- Create Innovation programs for MSME, like SBIRs and STTRs that are prevalent in the US, to fuel innovation and Entrepreneurial in the infrastructure sector through industry-academia-end user partnerships.
- Create Large and Comprehensive Testbeds for testing and validation of new technologies for infrastructure developmental projects, like NATRIP initiatives for intermodal transportation and energy transport sectors.
- Encourage further research and development to advance smart grid functionality by developing innovative, next generation technologies.

Railways

- IR needs to corporatized and privatised for improving efficiency and viability.
- Cargo pricing should be recanalized and subject to competition. Likewise passenger fares. Subsidies for passenger fares can be given through DBT or such means for better direction.
- IR should move to full mercantile accounting at the earliest. Technology upgradation for digital asset tagging (bridges, track sections, all railway assets along the network) for monitoring/maintenance

Communications:

- Incentivising Indian wireless start ups by preferential access to market.
- Design and fabricate in India.
- Focused R&D research areas: Become world experts with multiple centers of excellence in a few areas.
- Govt incentives for infrastructure rural coverage.