



INDIA INDIANS TELUGUS

VISION 2047

Draft for discussion



Global Forum for Sustainable Transformation

FIVE STRATEGIES FOR INDIA AS A GLOBAL LEADER



Global Forum for Sustainable Transformation

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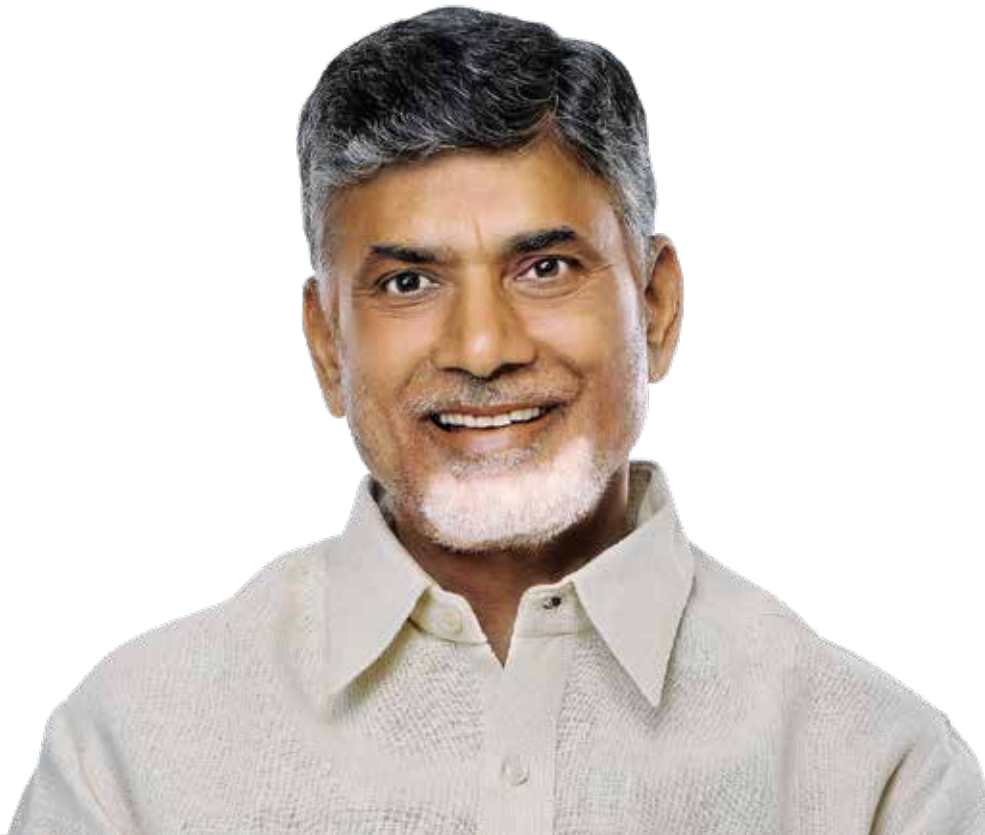
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Foreword

Vision - Leadership and Resolve

India has been able to overcome the pandemic with relatively limited impact. The growth rate of the economy, which is the highest among the G20 members, is an indication of the country's resolve and tenacity. Firm indications are that Indian economy is expected to become the 3rd largest economy in the world behind only USA and China in next five years.

With the combined contribution of its current growth rate, investment climate, technology advancement and skilled human resource capital, India is on the path to become a developed country by 2047 coinciding with the 100th year of its independence. Multiple global agencies have also estimated that the country can become the second largest economy in PPP-adjusted terms by 2047.

India was one of the largest economies from around 500 BC until 1758 AD and We, as a nation, have to challenge ourselves to once again become the largest economy of the world when we celebrate 100 years of independence.

In my experience and opinion, India needs to set up a challenging target of becoming a global leader through a structured vision and strategy. Post the economic reforms of 1991, as the Chief Minister of Andhra Pradesh (1995 -2004), I was able to understand the outcome of the economic reforms of 1991 and used the combination of technology, knowledge and the advantage of the country's demographic dividend to drive the economy of the state to unprecedented levels.

The "Swarna Andhra Pradesh 2020" vision document published during my tenure is a prime

example of the impact of advanced planning and visualization of the economy. The economy of Cyberabad envisioned as a greenfield city is a testimony of this vision. In fact, the Hyderabad ecosystem reached a level of 4% of India's GDP during the past few years.

Again, during my tenure as the Chief Minister of the newly formed state of Andhra Pradesh during 2014-19, I was instrumental in preparing a vision document, "Sunrise Andhra Pradesh 2029" which resulted in the economy of the state growing faster than all the bigger states with a five-year CAGR of 10.8%.

Learning from these experiences, it is my belief that a vision document should be planned for the country setting specific strategies to achieve the challenge of becoming the world's largest economy. It is my desire that every Indian citizen should rise to this challenge to make these 100 years as the "Century of India".

While formulating this vision and strategy we should not lose our focus on our traditional values of family and community togetherness. Towards creating a harmonious community, the document, the "Sunrise Andhra Pradesh 2029" emphasized the values of "Samaja Vikasam" and "Kutumba Vikasam".

The true classification of a developed country can only be achieved by the participation of people. Towards this objective, I would like to introduce the concept of P4, which envisages a People, Public and Private Partnership, targeted at reducing the gap between the poor and rich. This "Poor to Rich" concept is elaborated in this publication.

Information, knowledge and technologies are increasingly becoming the fuel for the progress and prosperity of the world of today and the future. That is why some of the thought leaders ascribe that we are at the "Beginning of Infinity" where limitless growth is possible through knowledge. The use of artificial intelligence, augmented/virtual reality, natural language processing, machine learning etc. have immensely changed how information/ knowledge is now accessed

and used. At the same time, inaccessibility of information/ knowledge will handicap such people to move forward in the world.

Providing a solution to this asymmetry are knowledge platforms that can greatly enhance accessibility and reduce such disadvantages. India 2047 needs to consciously develop and promote targeted knowledge management to reach out to all sections of Indians, to ensure that the digital divide is not accentuated, but is reduced.

To work on these issues and to offer innovative solutions to the people, I have established a research & innovation think tank, Global Forum for Sustainable Transformation (GFST) as a platform for promoting sustainable transformation of global economies and communities. GFST intends to do this through knowledge dissemination, policy research, advocacy and setting up a start-up ecosystem. The vision is to create a platform for networking, mentorship support and investment funding to nurture innovative entrepreneurship in India and across the world, including strengthening of the public policy mechanism.

In the present publication, GFST explores a set of 5 select themes along with many sub-themes, that have the potential to make India redeem its natural status of global economic leader. The publication is not meant to be a comprehensive compendium of all actions to be taken, but focuses on some significant strategic areas for consideration. I invite suggestions from thought leaders, corporates, leaders, students and others to create valuable ideas and strategies for India to adopt. I also hope that the publication will enthuse the readers into reflecting and stepping forward in making their contribution to what I consider as the most significant nation-building agenda for India's future.

Nara Chandra Babu Naidu

Chairman,
Global Forum for Sustainable Transformation

Introduction

New India Needs New Governance Model

With GDP having nearly doubled over the past 10 years, India has become the world's third-largest economy in PPP terms and the fifth-largest in nominal terms. India's per capita annual income has quadrupled since 1991. Although this remains well below the world, the rapid rise in per capita income has led to a significant fall in India's poverty rate, a growth in life expectancy, education access and well-being.

The share of the labour force in the agricultural sector has declined from about 70% in 1990 to less than about 40% today. There has been a corresponding rise in labour demand from the industry and services sectors, in which employment has more than doubled in the past three decades (MoSPI, 2019). This has gone hand in hand with growing urbanisation, with the share of the urban population increasing from 26% in 1990 to 34% in 2019, and many cities experiencing rapid growth. India is also pursuing a structural economic shift towards manufacturing. The sector has seen an annual average growth rate of 7%, outpacing agriculture but growing more slowly than the services sector (RBI, 2020).

Foundation of this growth was laid by the economic reforms during 1991. Thereafter, many reforms for structural shift, policy changes, improving the investment climate, simplification of taxation rules, investment in health and education of its people, and multiple other actions have manifested in many achievements.

We believe that, India has reached tipping point in its journey of economic growth and well-being of its people affording an opportunity to double its economy in every seven to eight years instead of current trend of nine years or more. Basis, next generation of reforms, and future ready institutions, India can envision to be a net exporter of services including technology, net exporter of

energy, deploying skilled Indian men power as a global workforce in addition to exporting its goods.

Hence, it is imperative for India to focus on several institutional and policy modifications in order to effectively harness the global potential and better prepare citizens to avail themselves of these changes. Among many challenges that India has before it, some are listed below

Low participation rate of women in its labour force

Challenges of internal security particularly arising from misinformation and hate campaigns on social media

Modify the blue books for response to tackle the disruption of global supply chains due to pandemics and other disasters

India would need multiple think tanks, both domestic and global, and research organizations to stay ahead of curve and forecast

Government, both state and central, would have to set up new institutions for facilitating and regulating requirements of emerging economy and the challenges posed by it.

Agile governance , strategy of change management and institutional development on a log frame based approach, in a flat world, should guide governance, both public and private, on this journey of economic growth of India to be global economy. Every one, Indians, governments, corporates and other institutions will have to share their responsibility for their own growth and be part of nation building.

Vision@2047 is a new challenge before the entire nation, its governments, its people and its business. The enormity of this venture may be gauged from the fact that it entails making the destiny of over one and half billion people towards

one aspiration – to be affluent, to attain a good quality of life and to be happy both individually and as a community.

The driving force of this vision will likely be an expansive social and economic transformation program covering the whole geography of the country and across all sections of the people and their respective communities and cultures. The focus always remains on farmers, women, youth, MSME and those left behind. This transformation program will also simultaneously be factor, efficiency and innovation driven since different sectors of the country's economy is at different levels of developmental maturity.

Such an immense nation building program cannot be achieved adhering to the Business-As-Usual approach of the last so many decades. It warrants adoption of a new vision driven approach with setting of clear and definite but transformational targets to be achieved within specific timelines and accomplishing determined milestones. This includes developing and nurturing new governance institutions with vastly enhanced capabilities through organization development, change management and skill building.

This document is a draft for initiating and provoking thoughts around these and other strategies possible. Going forward, GFST will be engaging with all stakeholders, thought leaders, thinkers, experts, students and others through multiple platforms of social media, debates, conferences among others to work out future strategy and action plan around each of the themes and sub themes. Therefore we solicit your comments, suggestions and critique for working out a detailed strategy and action plan in next few months.

Satya Prakash Tucker IAS (Retd)



Strategy 1

**INDIAN ECONOMY AS GLOBAL
ECONOMY – INDIANS AS
GLOBAL CITIZEN AND INDIAN
INC AS MULTINATIONAL**



Share of India in Global GDP, Trade, Data Flow, Patents and Research

Indian economy accounted for more than a quarter of global GDP and trade from the time of recorded (estimated) economic history till about 1600 AD. Thereafter, the share of India declined drastically after invasions and during colonial rule. Currently India has 3.4 % share of global GDP, 0.35% share of global trade, 1.95% share of global patents and 5.08% of international peer reviewed research papers which underlines the quantum of challenge for India to be an economic superpower and Indians to be global citizen.

Mindset of a Winner

Global macro-economic environment is just right for India to redeem its leadership position. Global consensus is that current decade is 'Decade of India'. "Can India convert this decade of India to century of India?" is the question. The answer to this question can be answered by the following- Indians, Indian Companies, Indian Research & Innovation Organisations (ecosystem) and government(s). Each of these need to have the mindset and conviction of that of a winner to achieve goals. Indians will need to have skills and creativity; Indian Inc will need to have efficient and innovative production system with ever improving benchmark standards; Indian Research Organisations will need to create design and technologies of future. Both the central and state governments must work together to foster a conducive environment, coordinate with the stakeholders involved, and serve as enablers. Following sections will be examine these expectations in detail for actions to be taken.

People – Job Ready Manpower – Global Performers

Changing Landscape of Skill Requirement

Countless researchers have established the positive effects of education and skilling on economic development, productivity, equitable growth, life expectancy and health, demographics, and other socio-political benefits linked with quality of life. Starting from a very low base, India has universalized elementary education and increased the enrollment in higher education. However, innovations in technology, automation, and globalization are changing the landscape of skill demand at an unprecedented rate. India Skill Report 2023 indicates that only about 50% pass outs from various courses are employable.

Contemporary jobs are increasingly dependent on cutting-edge technologies, but the technical curriculum is

struggling to keep up with this pace. Thus, creating a skill gap at the time of graduation itself. As automation replaces routine and physical jobs, millions across the world need to reskill/upskill or risk becoming obsolete.

Globalization is fast depleting location advantages and remote work has made it possible for organizations to hire from virtually anywhere for a myriad of job roles. In India, in addition to these global megatrends, the rising income, higher female LFPR and improving quality of life are further altering the skill demand landscape with higher cognitive and creative skills increasing in demand at the expense of menial IT skills and manual labour.

A study by McKinsey Global Institute (Skill Shift: Automation and the Future of the Workforce, 2018) looked at the impact of automation on the skill landscape and highlighted increasing importance of socio-emotional, higher cognitive, and technological skills and decline of basic cognitive and physical & manual skills.

- Skill vocabulary is becoming more specific and modular
- Technological, socio-emotional, and higher cognitive skills are generally more in demand; basic cognitive and physical & manual skills are declining in importance.

Among technological skills, advanced IT skills, advanced data analytics, and technology design skills are rapidly increasing in importance. Basic digital skills, which have been very important during last decade, continue to grow in importance.

Higher cognitive skills such as creativity and critical thinking are rapidly growing requirements for the employers

Socio-emotional skills, especially skills like leadership, team management, negotiation, teaching-mentoring, etc. are becoming even more important.

Green jobs are emerging and existing jobs are becoming greener. A recent study on green skills and jobs (LinkedIn, 2022) found that while share of talent with green skills has increased at a CAGR of 6% in past five years, it has not kept pace with the growth in job roles requiring green skills (CAGR of 8%).

Reducing gap between curriculum and job requirements

Information asymmetry is one of the biggest challenges plaguing the skill ecosystem. Most of the students have to make a number of important decisions about their prospective career paths at secondary or senior secondary school stage. However, they do not have access to any information about the job roles on offer. Even at a later stage in their journey, most of the jobseekers are clueless about the quantum and breadth of opportunities available, and the associated skill requirements, expectations, job tasks, salary offered, etc.

Information asymmetry also poses certain challenges for employers. They lack a centralized source of information regarding the supply, demand, and quality of skilled workforce in the economy. Further, diplomas and degrees have lost part of their signalling power due to proliferation of programs & institutions and a lack of specificity. Some intermediaries, such as LinkedIn, have tried to fill the void by creating skill assessments which provide additional datapoints to the employers on metrics that matter to them. However, the scope and reach of these intermediaries are limited in nature. Therefore, it is essential to unite corporates and higher/vocational institutions. Businesses shall be rewarded for their efforts in mentoring educational institutions and pushed to set up incubators. Corporates spending time as Professor of Practice in Universities should be recognised and incentivised through tax benefits for a minimum number of hours of teaching.

Several countries across the world have labour market observatories and career service portals (similar to the National Career Service Portal for UK) that provide these intermediary services and information to the employers as well as job-seekers. Singapore has a one-stop portal for all skilling needs (Skills Future) that the learners and employers can use for a host of services. We propose to create a unified portal that acts a labor market observatory as well as a one-stop portal for Indian jobseekers, employers, as well as education providers. Accordingly following two actions are proposed

Unified Skill & Employment Tracking System

A comprehensive information guide on each program at each level with detailed information on course content, rigor required, admission requirements, and labour market outcomes, can help youth make more informed decisions. Similarly, detailed information on job roles such as key tasks, qualifications required, selection process, salaries on offer, etc. can help students not just plan their higher education better, but also to make their transition to workforce smoother.

Academic institutions and employers will be onboarded on the portal as partners. Academic institutions can bulk upload their present and past students' data to the extent available. They will also create a profile of the institution on the portal and list information on their course offerings, including admission requirements, program details, graduate outcomes, etc. The industry partners will be encouraged to post their job roles along with details of qualification requirements, recruitment process, salary range, competencies expected, etc. The portal will also facilitate interactions between industry and academic institutions for curricula upgradation, on-the-job training, exposure visits, guest lecture, live projects, research partnerships, internships, etc.

Skills And Emerging Technological Universities/ Centers

Technological advancements, automation, and globalization call for an academic institution that is agile enough to respond quickly to changing market needs. The new age employers are increasingly looking for skills rather than degrees and diplomas. Further, to fully capitalize on the demographic advantage window that our country has, we need to provide employable skills at a very large scale in a short timeframe. While the government has invested significant finances and efforts in short-term skilling, the results have not been very encouraging as the quality assurance has been far from ideal, and the market doesn't see the certificates as credible alternative to the degrees. At the same time, proliferation of institutions in vocational education and training has taken the sheen from them. There's also a social stigma attached with traditional vocational education and training institutions. Therefore, the need of the time is a skilling university that is flexible enough to offer micro-credentials but has the prestige of a regular university; has academic rigor, but also provides sufficient practical exposure through industry collaborations Key attributes of the proposed university can be

- Modular curriculum of varying duration
- Pedagogy – learning while doing, instructors from prospective hiring companies
- Focus on employability

ITI and Polytechnic has worst employability ratio

The India Skill Report 2023 indicate that among the vocational/ professional courses ITI and Polytechnics have worst employability ratio, 34% and 20% respectively. To improve their employability, these institutions need to be linked to industry and require complete reform of curriculum and investment in infrastructure and labs. The remote availability of these centers need to be leveraged to provide access to skills to those residing in remote areas. These ITI and Polytechnics will also play a major role in preparing skill ready persons for low skill high volume job providing industries as well as imparting soft skills.

Reskilling and lifelong learning

Improving skills to do the same job with more efficiency or as per new protocols or learning new skills as some of the current jobs will start becoming obsolete or less lucrative. To keep oneself employable, the need for continuous skill upgradation and expanding one's knowledge base has become more prominent like never before in the era of fast technological advancement. Many countries have initiated dedicated schemes and set up new institutions that guide the employees about the new skill set required

and connect them with the skill upgradation centres specifically established for the purpose.

Job ready education can create wealth in short span of one generation. For an example, due to large number of private engineering colleges established during early nineties in Andhra Pradesh, providing Information Technology and Computer Science degrees which were in demand by companies in USA, people from twin Telugu states had first mover advantage and therefore now constitute about one third of the diaspora of USA. Consequently, these early movers got the advantage of offshore service experience of about two decades which afforded them to move up in the administrative hierarchy of corporate governance and many of them they are now playing the leadership role of renowned global companies. Therefore it is essential that India identifies and focus on the technology and jobs of future to accordingly provide the education and skilling/reskilling. The expenditure on upskilling/reskilling up to a certain limits can be made tax free.

Hybrid working mode (Online and Physical) to harness global opportunities

Crisis of COVID created an opportunity – Work from Home (WFH). In USA there was about 12 times jump as more than 60% people adopted to WFH during COVID. However, post COVID the percentage of WFH did not drop to pre-COVID levels. As of May 2022, about 30% people were still working from home as a planned option with varying number of days of WFH per week. In India, post COVID, the employers are planning, on an average, about 1.8 days WFH per week which is highest in world and almost matches the expectation of employees who as per survey desire to work about 2.1 days from home on an average. Generally, and more specifically for India, women have higher preference to WFH which may have positive impact on women labor force participation rate, if planned and encouraged systematically.

Companies have assessed the tradeoffs of WFH on productivity vis a vis cost reduction. Employees are reporting multiple benefits. Primary among them being reduction in commuting time. Not all the jobs can be discharged remotely. Even the jobs that are suitable for WFH, may need few office visits. As a result, a new category of jobs is emerging that can be discharged remotely – work from

home or work from anywhere. Therefore, the norms and protocols of WFH are becoming more and more structured as companies are reoptimizing working arrangements.

WFH opens up huge opportunity for people with skills but residing in remote areas or rural areas due to certain constraints. Now these people can join formal labor force and provide services to offshore or domestic clients. The affordable, reliable and extensive internet network in India provides the basic infrastructure for WFH. Government and companies need to coordinate to place a system that can link the people with WFH jobs.

Companies - Indian Inc to be trillion \$ multinational companies

Market Capitalisation of Indian Companies - Economic history of developed economies is evidence that the growth, welfare and wealth is created by the businesses which may be owned by government or private. Be it auto and machine manufacturing companies driven growth of Europe and USA, semiconductor companies driven growth of Taiwan, IT companies driven growth of USA, manufacturing companies driven growth of China, Chaebol driven growth of South Korea, small scale sector companies driven growth of Bangladesh, Mexico and Vietnam and so on, these companies have provided employment, created wealth and played a major role in economic growth and social welfare. Breaking the administrative frontiers, these companies have played the same role in countries other than the country of their origin, provided employment and created wealth.

While Indian economy is vying for 3rd rank in the next five years from its current 5th rank, Indian companies are nowhere near the top ranks. The highest rank an Indian company holds in global ranking by market capitalisation is about 50th rank. In fact there are only three companies in top 100 companies by market capitalisation. India has largest number (5215) of companies listed on stock market, followed by USA (4266) but market capitalisation of about 2.5 trillion US\$ of Indian companies is a fraction of market capitalisation of 44.7 trillion US\$ of companies listed in USA. India ranks seventh in terms stock market capitalisation but in terms of average market cap of companies listed on stock market, its rank is 47. Indian companies have a long way to go to realize the global ambition.

Rank	Country	Total market capital (in mil. US\$)	Total market capital (% of GDP)	Number of domestic companies listed	Avg Capital per Domestic Company (in mi. US \$)	Rank on Avg Capital per Company
1	United States	4,47,19,661	194.5	4,266	10483	3
2	China	1,32,14,311	83	4,154	3181	11
3	Japan	67,18,220	122.2	3,754	1790	22
4	Hong Kong	61,30,420	1768.8	2,353	2605	15
5	UK	35,70,894	116.5	1,858	1922	21
6	Canada	26,41,455	160.7	3,922	673	41
7	India	25,95,465	97.3	5,215	498	47
8	Saudi Arabia	24,29,102	347	207	11735	1
9	France	23,65,950	84.9	457	5177	6
10	Germany	22,84,109	60	438	5215	5

Indian Inc to think and act big to be global entrepreneur–

For India to realise its aspiration of a developed country, businesses will play a major role. India needs to create a considered agenda, ecosystem of policies, infrastructure and skilled manpower to create Indian multinationals in pre-identified sectors. There are examples of performance related government support with transparency for corporates for extending the global presence. Similar support can be thought of for companies beyond certain value for creating global value. On the other hand the India Inc need to invest in research and development of products and services of the future. They need to establish private research institutions of global excellence carrying out cutting edge research. On the strength of patented, innovative products and services, Indian companies should have a vision of investing in other countries instead of seeking investment from foreign companies. On the strength and experience of BPO and product development for foreign clients, Indian technological companies should become innovative product developers for global use and thus technology leaders. Specified Indian MNCs could be provided special support by Indian Embassies overseas to help them access the market and opportunities, understand the local culture and laws, resolve disputes.

Indian Multinational Trillion \$ Companies - Sectors for future –

There exists vast literature on sectors those will drive growth of future. Some of these are mentioned here in from Indian perspective. This is an indicative list merely to meant to spark discussions about the possibility that these and other industries might potentially contribute a trillion dollars to India's GDP by the time the country celebrates its 100th anniversary of independence.

- **Green energy including hydrogen** – India is a pioneer in solar energy and is contemporary in research advances in green hydrogen
- **Pharma and vaccine** - India is one of the biggest exporters of pharma. Vaccine discovery and production during COIVID has established India as a force to reckon with.
- **Fintech and Banking** – UPI/BHIM/ e-rupee/NPCIL linked with Aadhar have established India as leader in digital transactions. UPI is now poised to provide international transactions to send and receive money from India. It is a matter of time and vision to make UPI a global platform for international transactions between two countries. The consolidation among the PSU banks has laid a foundation for an Indian bank to aspire for place among top ten banks in world.

- **FMEG** – India is one the biggest and fastest growing market of consumer electronics. The sector is completely dominated by foreign multinationals. With focused approach, India has emerged a dominant net exporter of mobile phones in last few years. Similar effort and push by Indian companies with support from government of India is required for consumer electronic segment
- **Retail** – Indian organized retail market is of the size of 690 bn US\$ growing at a CAGR of about 8% and it is poised to be biggest globally. However, Indian organized retail market is dominated by foreign giants, hence this calls for investment in retail segment by domestic companies to provide global standard services and products to the satisfaction of customer. ONDC platform established by government of India provides a platform to both large and small enterprise for B2B and B2C opportunities.
 - Defence
 - Semiconductor and telecommunication equipment
 - SaaS and IT related
 - Auto and Machinery
 - Entertainment and AVGC - Riding on one of the cheapest internet rates globally

Indian OTT market is fastest growing in world. With a digital video universe of about 420 million in 2022, it is second to China and is projected to reach 500 million by end 2023. Overseas OTT services, which possess more than 95% of these subscribers, reap the most benefits from this large audience. However, users prefer local material, with English making up only approximately 5% of the total. This scenario presents a huge opportunity for Indian players to increase their presence and capture the market share through quality offerings and presenting international content in local languages.

Similar is the opportunity in AVGC market of about 380 billion US\$ currently and expected to reach about 590 billion US\$ by 2030. India is the second largest user of AVGC but accounts only for 0.7% share of global revenue.

Non-Resident Indians for investment, knowledge transfer and growth

As per the estimates by UN, India has the largest diaspora in world. As of 2020, about 17.9 million international migrants are from India, which excludes persons of Indian origin. As per Ministry of External Affairs, annually about 2.5 million Indians migrate to other countries which is highest in world. In terms of wealth and education, Indian Americans significantly surpass native-born/ local Americans while making up only one percent of the total population.

Indians in the United States earn around \$130,000 per year or twice as much as their American counterparts. A comparable trend is developing in other nations, with the notable exception of the Gulf States.

Indians remitted back about 108 billion US \$ in 2022 which is highest globally and accounts for about 12-14% of global remittances and about 2.8% of Indian GDP. The remittances constitute about 12% of GSDP of Kerala. These remittances far exceed the FDI of about US\$ 84 bn during 2022, which by itself was the highest recorded FDI to date.

BRAIN GAIN - India should make efforts in skilling the people to access the global opportunities to be the global supplier of well-educated work force, technology leaders and global entrepreneurs. India should aim at a diaspora of about 100 million by 2047 remitting a trillion dollar back. These business-savvy and influential NRIs may network with locals and set up shop in India, bringing with them cutting-edge tools, procedures, protocols, global work ethics and standards, and valuable knowledge transfer in addition to their remittances. Therefore, there must be an ecosystem in place to help people take advantage of global possibilities. Similarly, a streamlined ecosystem is essential to effectively channel NRI remittances towards productive investments that generate new businesses, new jobs, and sustained economic growth in India.

Research, Innovation and Technology – Creating Leaders of Future

India need to grow in nominal terms at about 10% or more per year to realise its aspiration of being a globally leading economy. There are very few examples in global economic history where a country grew with this kind of CAGR for a period of 2 decades or more. These few example of economies that have maintained this level of CAGR on the basis of natural resources (like oil) or restructuring or on the basis of continuous research and innovation for developing the products and services which are hitherto unknown. Therefore it is essential that India invests a considerable share in research and development for creating technology and products of future. India here includes both the government as well as Indian companies investing in research and innovation. A rapid expansion of the economy is impossible without constant research and innovation that yields novel goods and services, defying the law of diminishing returns. Considering the importance and the potential of this sector, it is dealt separately in Chapter 3.

Facilitating Role of Government– New Age Institutions and Change Management

The term government here will include Government of India, the state governments and their entities. To successfully navigate the local, national, and global challenges emerging out of the India@2047 vision, India will need to have careful and forward-looking policy responses underpinning high-quality governance and regulatory institutions. To realize India's Vision of becoming a global economic leader the government must act as a coordinator, a facilitator, a regulator, and the driving force of the whole process.

Governance Related Actions - To develop a resilient economy, India will need stable governance that supports broad-based growth throughout society and strong macro-economic fundamentals. These would include:

- Fair efficient and stable tax regime
- Forward looking policy environment
- Rule of law for ensuring implementation of business contracts and security of individuals
- Maintaining government effectiveness that ensures the quality of public services and the credibility and accountability of the government to implement sound economic and social policies;

- An appropriate degree of intellectual property rights and privacy rights protection which ensures individuals and businesses are rewarded for their innovations, stimulating technological progress and entrepreneurship;
- Effective environmental regulation which promotes sustainable and green economic growth;
- Globally competitive infrastructure like industrial corridors, ports, airports, fast speed road and rail network, digital infrastructure

New Age Institutions and Change Management – New set of technologies and new set of economic products and services will create demand for new set of standards, regulations, statutes and policies and consequently new set of government institutions managing these demands. Few examples are UIDAI for managing Aadhaar, national payment corporation of India limited for managing the Upi, the new data privacy bill, the social media regulations, and many more. These organizations, actions and statutes were unheard of a decade back. However, they are a reality and a necessity now. With technological advancement necessary for new institutions, new regulations, new statute and policy would come up to create a facilitating environment and to regulate the activities fully stock. Some of the areas that may require new institutions and regulations can possibly be Artificial Intelligence related, autonomous vehicles, Cyber security, Data protection and



Privacy, department facilitating rural entrepreneurs and producers to connect with e-commerce using ONDC etc.

With the advancement of technology, the response time for government institutions would be reduced as the expectation of people for near real time redressal of issues will go up. This will create the need for agile government, less government and more governance. Similarly the role of many existing departments of government will change like Police Department would have to equip itself for ever increasing and more complex white collar crimes and cyber-crimes. As the export of many products and services will increase, related government departments would have to create inhouse capacity for adherence to global quality standards. Employment exchanges should become skill and job facilitation centres; urban ministry may have urban re-development as major role; environment department may require competence for promoting and regulating circular economy.

Emerging Geo-political Role to further the principle of “Vasudhaiva Kutumbakam”- With india emerging as a developed economy, third largest globally by 2047, will have far-reaching consequences for global political and economic governance, as well as for relationships among countries and geographic regions. The United States, China, and India would form a new trifecta atop the global economic hierarchy. India has been playing the a significant role in geo-political arena. However, as India houses an exponentially larger share of people, capital, and technology, its share of global GDP will increase, shifting the economic balance of power towards it.

- **Economy and Trade** - The rising Indian middle class with disposable surplus income will convert Indian market as most attractive emerging market. In fact there are estimations that the demand of Indian middle class will be a hedge against a global slowdown in future. India can leverage its huge market demand in negotiating various trade agreements and can force the production processes to be more sustainable.

- **Humanitarian** - An example of that is the free supply of more than 300 million COVID vaccines doses to more than 100 countries. Many Southern countries have recognised India as “Voice of South” for placing their concerns at G20 forum. India has also argued the principle that the pandemics and conflicts should exempt the fertilizers, food grain, and vaccines and medicines from various kind of trade embargo.
- **Regional Power and Pacific** – With growing economic clout and military power, India plays a significant role in South Asia and South East Asia for strengthening the economy of the region and in addressing the strategic concerns. India has also emerged the important member of QUAD to maintain the balance of power in Pacific ocean.
- **Climate Change and Renewable Energy** – India is in forefront of reducing the carbon footprint through voluntary declarations and following them to meet the targets. India is also in league of most advanced country as far as research on green hydrogen for energy. As a result, India has emerged as a role model amongst the developing economies. International Solar Alliance is one such platform for expansion of solar power in developing world in cost effective manner.

Furthermore, India will need new institutional mechanisms for understanding the implications of its emerging economic strength and its impact on geo-political power to further the concept of “Vasudhiva Kutubakam”. India will need to engage from strength in the emerging geo-politic/ geo-economic situations and give rise to a new world order in terms of diplomacy, economy and strategic security regime not only to bolster its political and economic sovereignty but also to protect and consolidate its global economic and trade value chains. Its role in engaging and resolving issues of global commons such as global security, trade disputes, major economic crises and dealing with climate change, etc. will enhance requiring India to take a more proactive position in formulating policies and taking decisions in maintaining the cohesion of the international community.

Strategy

**DEMOGRAPHIC
MANAGEMENT AND P4
MODEL OF WELFARE**

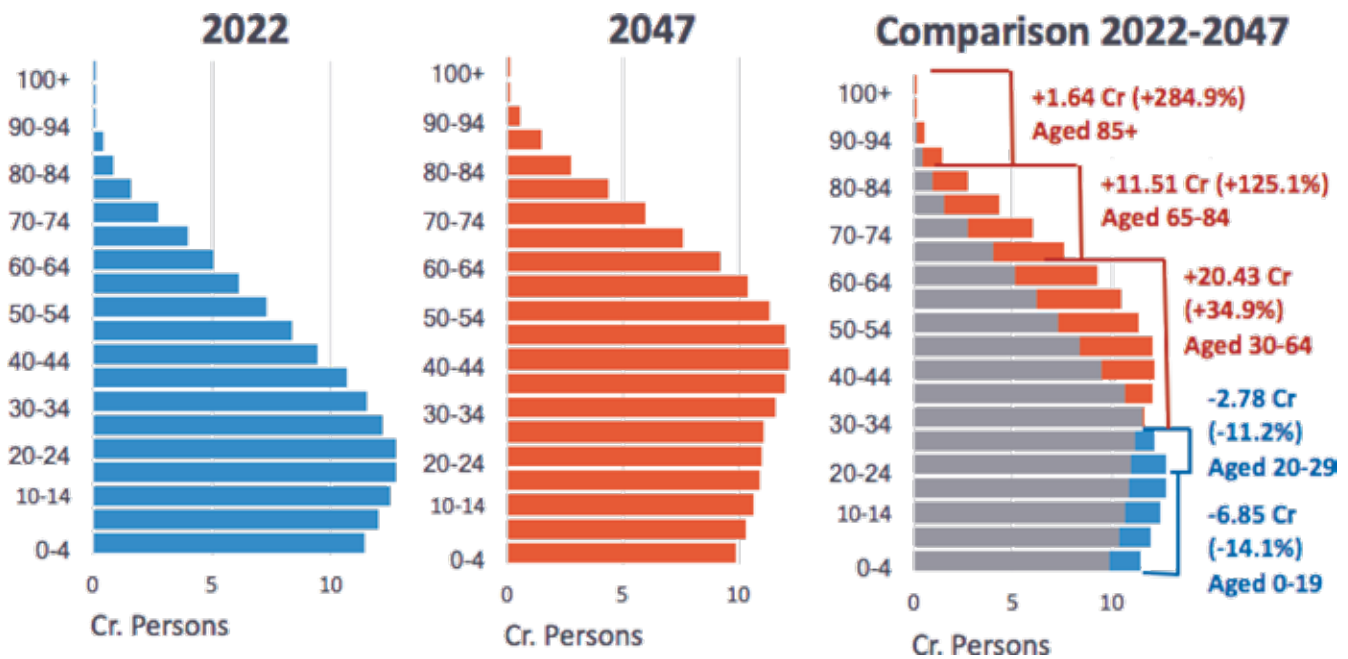


Section A – DEMOGRAPHIC MANAGEMENT

Continued Demographic Dividend- Population as an Asset

Globally India is recognized not only for its young population but also because this young age population is skilled and technically qualified. This qualified young population is serving the global requirements both domestically and abroad. Thus, population can be asset if adequately managed in terms of health, education and skills to access the global opportunities and create wealth. India currently

has this advantage as the median age of its population is 29 years with about 35% population below 20 years whereas the median age of Japan is 49 years and 39 years China and USA. The reduced population growth rate and higher life expectancy is changing the profile of the population. During 2021 to 2036, population of India will multiply by 1.3 times but the population in age group below 15 years it will multiply by only 0.8 times while the population in age group above 60 years will multiply by 2.2 times during the same period. Therefore, the median age of Indians will increase to 34.5 years in 2036 from 24.9 years in 2011.



Currently India has advantage of more working age population. As the younger population represented by the bulge of population between 15 years to 25 years, India will have more working hands. This is reflected in the trends of Age Dependency Ratio which has reduced from 53.7 to 47.5 in India during the period of 2013 to 2022, whereas the age dependency ratio is increasing in other competitive economies like Japan (63 to 71), USA (50 to 54), China (38 to 45) France (57 to 64) and Germany (51 to 56). However, this advantage for India would continue for say next 25 years or so when the current population in working age will move to the age group of more than 60 years. India also needs to learn from the population trends of Japan, Europe and USA etc. who have more dependent population than working age population leading to a disadvantage. This disadvantage is result of the past population management policies of lesser number of children. In fact, in some of the European countries and Japan, government is providing multiple incentives like maternity and paternity support,

pregnancy care, free education, child allowance etc. to promote child bearing. Learning from these countries, India would require to rethink its population policy to maintain the age dependency ratio at current levels or below it to continue its demographic dividend and by adequately educating and skilling its young age population to become an asset for the country and to the society in general.

Population Trends of States and Its Implications

Interstate Differential of Population Trends - Huge divergence in Total Fertility Rate (TFR) of states from 3.1 in Bihar to 1.3 in Kerala will alter the share in all India population with implication on financial devolution, political representation, requirement of health and education infrastructure and citizen support services

- States/UTs with high PCI whose share in all India population will reduce - Kerala, Tamil Nadu and Delhi,

have the lowest TFR, below 1.4, and among the highest income per capita and growth. Their share in India's total population is expected to reduce from 12.2% in 1971 to 9.3% in 2036.

- States/UTs with relatively higher to low PCI whose share in all India population will reduce - Andhra Pradesh, Telangana, Karnataka, Uttarakhand and Himachal Pradesh have relatively high income per capita and growth, but the states of Maharashtra, Punjab, West Bengal, Jammu & Kashmir have medium to low per capita income with low to very low growth. The state of Odisha appears to be in transition, with a relatively low TFR, low income per capita but with high growth. Their share in India's total population will reduce from 39.3% in 1971 to 34.4% in 2036.
- States/UTs with almost stable share in all India population - Haryana, Gujarat, Chhattisgarh, Assam - first two recording high income per capita and high growth, while the other two states record very low income per capita with low growth. Their share of population will remain more or less stable around 12.2%.
- States/UTs whose share in all India population will increase are among the lowest per capita income group - Share of population of Rajasthan, Jharkhand, Madhya Pradesh, Uttar Pradesh and Bihar is expected to increase from 35.7% in 1971 to 42.2% by 2036
- Higher TFR and lower per capita income have strong correlation with the exception of Maharashtra, Punjab, Bengal and J&K. States of Uttar Pradesh and Bihar have high TFR both in urban and rural areas.

Implications of Population Trends and Interstate Differential - Change in demography would mean that:

More number of jobs required - Working age population is expected to increase by more than 20 crores in next 25 years meaning thereby creation of these job opportunities and additional jobs for the workers shifting out from agriculture.

Inter-state migration likely to increase with implications on facilities for migrants- The population in age group 15-59 year has already started declining in Kerala, Tamil Nadu, Andhra Pradesh and the North-East states. It is expected to start declining from 2026 onwards in the states of Karnataka, Maharashtra, and Telangana. It will continue to increase in Bihar (54% in 2011 to 61% in 2036), Madhya Pradesh (59% to 65%), Uttar Pradesh (57% to 66%). One can expect migration for workers from the "surplus-adult" states to the "deficit-adult" states if adequate economic opportunities are not created in "surplus states". It will be important to increase the level of education and employment in the emigration states of the north, on one

side, and to ensure safety nets of nutrition, health and other social schemes in receiving states.

Lesser number of primary schools and aanganwadis - The population of school going children in the age group of 5-14 years is expected to fall by 2.6 crores from 2021 to 2036. This will have implication of reduced requirement of primary schools and aanganwadis in some states with lower TFR and more requirement in states like Uttar Pradesh and Bihar where TFR is still very high.

More investment on old age pension, family security and health services - The age group of 65 years and above will add more than 14 crore people in next 25 years adding to the demand of pensions, health care services, security and emotional support. By 2036, population of age group of 60 year and above will become more than the age group 0-15 years in states of Kerala Tamil Nadu, Karnataka, Andhra Pradesh and Telangana and Maharashtra with implications on above support schemes.

Pressure on urban infrastructure -Of the total population increase in India in next 25 years, about three fourth will take place in urban areas implying focus on increasing urban planning capacity, urban infrastructure like road, water, electricity, urban policing. The quality of urban infrastructure will also decide the investment potential and profitability of business. The urban infrastructure will be one of the most important determinant of quality of life and ease of doing business.

Section B- P4 Model for Inclusion and Growth

P 4 Model - People-Public-Private Partnership- A Model for Empowerment and Sustainable Development

Conceptual Framework of P4 Model - Public Private Partnership (PPP - P3 Model), are contractual and collaborative arrangements to provide public goods (largely infrastructure projects) and public services wherein the cost of the projects is recovered by upfront investments and/or by user charges and/or by annuity or other deferred payments mode. The P3 model delivered world class infrastructure like airports, highways, communication infra etc., enhanced people's satisfaction and created wealth for the private partner.

The P4 model is an extension of the P3 model by including 'people' to P3 for leveraging the strengths of private and government entities to enhance overall well-being of the people, distribution of wealth and reducing the gap between rich and poor. The 'family' is at the core of the model and is the basic unit for administration of the model.

The model aims to assess the endowment of each family as a unit, find out the gaps in these resources, identify feasible opportunities, enable the family to access them for overall well-being (economic, social and emotional) and happiness.

To assess the endowment of a family, the robust 5 capital model is adopted. These 5 capitals (edited to suit the P4 framework) are outlined below.

- Human capital - it includes health, education and skill, leadership and risk taking capacity, enterprise and motivation.
- Social capital-it consists of families and communities and other formal and informal platforms for mutual interaction and social security.
- Physical capital-it comprises of physical assets and other goods owned by the family; availability and access to infrastructure like roads, education and skilling facilities, healthcare facilities, banks, markets, broadband, mobile connection etc
- Financial capital- It includes access to financial services and instruments ownership of liquid assets, bank account, credit worthiness and access to funds etc
- Natural capital-it consists of the natural endowment like water, land, trees, forests and other natural endowments and environment in which one resides.

The families so identified may be active in economic activities that are relevant to different phases of economic growth. Some of the families may be involved in activities related to factor driven phase of economic growth like agriculture and animal rearing; some other families may be involved in efficiency driven phase of economy like e-commerce aggregator or involved in efficient manufacturing processes; similarly some of the families can be involved in innovation driven phase of economy such as working in quantum computing or product development or working in research organizations. The B4 approach will cover all these 3 types of families and does not aim only at bottom of the pyramid.

Land pooling by more than 32000 farmers for constructing the capital of Andhra Pradesh at Amravati is one of the finest models of P4 collaboration. The people participated by pooling their lands, government acted as a partner for development of land and private entities came in for creating the job opportunities, educational institutes, public facilities like banks etc. Similarly in one of the Indian states, more than 20,000 schools work constructed through the investment of private individuals or companies. Inherent strength of this model necessitates that the current dispersed acts be formalised for structured implementation at larger scale covering not only tangible assets but also intangible assets. This is a conceptual framework and a new approach which will be modified as we learn while implementing it.



Operationalisation of P4 Model - The aim of the P4 model is to establish a collaboration of private entities and government to enhance the compound value of 5 capitals of a family by filling up the gaps, guide them to access the domestic and global opportunities in terms of services and goods markets and thus raise the standard of living of each family. In a way, it is a large-scale mentorship program.

- The model is proposed to be implemented on a digital stack of information of a family which will be housed in a secured environment.
- AI models will be deployed to assess the endowments (and gaps) of a family based on above 5 capitals model and categorise them according to inputs and possibilities of future growth.
- A digital networking platform will be established to link the private entities to different geographies/ villages/ urban area etc. The private entities here include private companies, NRIs, private individuals and organizations.
- Partners – a private company, any organization or institution, any individual or group of individuals, or NRIs can participate in the program. The aim of the program is each one empower one or more.
- Projectisation - These gaps in 5 capitals will be converted into projects for the convenience of the private entities to identify the location and number of families or villages that the entity would like to cover.
- Projects- the projects can lead to creation of tangible outcomes like infrastructure related to schools, anganwadis, healthcare centres or connecting roads or drinking water supplies or skilling centres and similar projects. The projects can also lead to intangible outcomes like enhanced skills, motivation, broader understanding of opportunities etc. The projects can be located both in rural and urban areas. Some of the indicative projects can be
 - a NRI family or group of friends buying and improving a local ITI or Polytechnic so as to better equip the local populace for employment prospects.
 - any private company or a hospital chain can take up the health service upgradation in a group of villages;
 - A private college or a private university can step in to help families in vulnerable rural areas/ vulnerably identified villages or families get a better education.
 - a private entity can take up the responsibility of filling up of all or desired infrastructure gaps in a identified village.
 - A Digital marketing expert can skill a group of young entrepreneurs helping them in connecting to domestic and global markets
 - An apparel expert can skill a group of women for better

designing of garments and connect them to high-end labels

- A private entity can take up the projects on improving the soft skills like communication, etiquettes, behaviour of identified number of families.
- Projects aimed at enhancing critical thinking, analytical capabilities, problem solving, leadership qualities, digital and financial literacy.
- An organization like Falcon X founded by a group of US based NRIs with the aim of developing a start-up support ecosystem, can assist a few individuals in India to set up a similar ecosystem and can also hand hold some of the promising start ups and connect them global entrepreneurs.

Investment - The investments can be both tangible and intangible. The P4 model's kind of investment is akin to viability gap funding for infrastructure projects or viability gap includes skilling, both of which are already in progress as part of various government programs and as part of CSR initiatives undertaken by various firms.. Private investment sector investment can take the form of monetary aid, or it can be transfer of knowledge or creating a network with opportunities or investing one's own time for enhancing the capacities. Crowd funding approach for funding the infra projects, skilling and inclusion projects can also be seen as a viable option

Many of these investments can be productive investments made by private entities expecting reasonable returns on their investments through various means like the Amravati Capital model. Creating business opportunities will make the model more sustainable.

Organisational Development - the P4 model is by concept implementable in all the geographies and can cover any number of families in all rural or urban settings. The programme will cover multiple and diverse activities aimed at the welfare of each and every family. It is therefore essential that a responsive and agile public private collaborative institution should be established to implement and monitor the program. Some of the function of the proposed organization would include to projectize the requirements, make toolkits for operation, create the digital infrastructure and maintain it, network with multiple partners like private individual companies etc. This group should focus solely on fostering connections and providing a hospitable environment, rather than assuming the role of a financial regulatory body. In addition to developing and maintaining standards, the group would be keeping all stakeholders in the loop.. The organization should also create a connect between the overseas program partners and the local families for an organic touch and as an evidence of outcome.

OUTCOMES

- The intended outcome of the P4 model is to optimise the gains for a family to its ability in terms of wealth, health, education, knowledge, skill, and assets through an evidence and capacity driven mentoring and continued support for overall wellbeing, optimum and sustainable utilization of resources, and growth of economy.
- Inclusion and reducing the gap between rich and poor - Another intended outcome of this model is to make hitherto excluded families as an active partner in the growth of the country. At its current rate of expansion, the Indian economy will double in size in just under a decade.. This in turn creates wealth in the hands of individuals and organizations. The P4 model's goal is to guarantee that all households share in the benefits of a country's expanding economy.. No one should be left behind.
- Democratisation of knowledge - In a knowledge economy, access to skills information and knowledge is key to growth of an individual and a family. The model aims at universal availability of skills and knowledge collaboration private entities to the benefits of have nots
- Leadership and enterprise - Sometimes a family or an individual is unable to make the optimum use of its 5 capital endowments due to lack of risk taking capacity, absence of leadership and entrepreneur capabilities. The P4 model aims to build up that missing "enterprise capital" which will enable them to make optimum use of its 5 capitals to maximise their gains in terms of wealth, knowledge and utilising the opportunities.
- Preparing society for next level of growth - as India grows at a fast pace, digital and financial literacy will become as essential as having access to housing and electricity currently is. The projects under the P4 approach would specifically aim at financial and digital inclusion of each family. Similarly the society will have to learn the art of communication, etiquettes, civilised behaviour, concern and respect of others as the finest example of traditional Indian culture.
- Ease of living - the P4 model would also lead to ease of living as it will create connectivity to infrastructure, will ensure availability of basic amenities like water etcetera, will create ability to access government programme, will enhance the entrepreneurial capacity, will enhance access to livelihood opportunities and capability to utilise them. And thus ultimately leading to ease of living and happiness

Strategy



**RESEARCH,
INNOVATION AND
TECHNOLOGY –
LEADING THE FUTURE**



TECHNOLOGY - RESEARCH AND INNOVATION ECO SYSTEM for INNOVATION DRIVEN ECONOMY

From Technology Transfer to Defining the Future – Invest in Knowledge Based Capital

The economy of the future will be driven by continuous investigation into new materials, processes, and products. The newly industrialized nations have relied on Deep Technology and knowledge-Based Capital (KBC) to fuel the transition of their economy from factor-driven to innovation-driven. The Deep Technologies are the disruptive technologies that completely redefines the products are not just incremental improvements. KBC comprises of three classes: computerized information (software and databases), innovative property (patents, copyrights, designs, trademark), and economic competitiveness (including brand equity, firm specific human capital, networks of people and institutions, and organizational knowhow that increases enterprise efficiency). Business investment in KBC in many OECD countries is exceeding the investment in physical capital which improves productivity. Such investments in USA and some EU countries have contributed 20 to 34% labour productivity growth. An analogous imperative for India would afford it the advantage of capitalizing on the potential to rapidly advance in new technological domains that will be at the core of future economic growth, therefore establishing itself as an economy driven by innovation. The country will incur significant opportunity costs by neglecting investment in the research, development, and innovation system. By allocating resources towards research and development, India can enhance its capacity to export technology rather than relying on technology transfer.

A financially supported and shared vision driven by government, industry and academia

In order for India to establish itself as a knowledge hub, it is imperative to prioritize the development of ecosystems that nurture knowledge production through the utilization of these technologies. Simultaneously, these ecosystems should also support and facilitate the growth of trade centered around these technologies. Current literature on national and regional innovation systems defines that interaction of several agencies and factors between government, industry and academia would shape the innovation ecosystem. Thereby, a systemic drive converging the efforts of all the stakeholders would be the only way forward for developing an ecosystem around these technologies. A well-researched and thought-out agenda for research in technologies, materials and

processes for next say twenty years shall be worked out by these three players. This agenda shall be supported by adequate financial resources to establish research facilities, Centers of Excellence around the selected technologies to run these facilities. The approach adopted for promotion of innovation and emerging technologies in the country is based on the twin pillars of developing technological creating capability and technological diffusion capability.

Development of Technology Diffusion Capacity

Technological diffusion is the process by which innovations such as new products, new processes or new management methods spread within and across economies. The process of technological diffusion leads to the realization of benefits from technological advancements i.e., innovation and R&D. Technological Diffusion Capability involves components that enable firms in accumulation, assimilation and adoption of technologies. This requires developing capability in firm for selection, application, and development of the technologies. The key components include availability of technological infrastructure, governance and policy interventions, human resources, investments etc. The facilitation of technology diffusion within an economy can be expedited by the government through the strategic selection and endorsement of innovations, as well as the establishment of robust technical infrastructure and supportive.

Development of Technology Creating Capability

This involves capacity to create new technologies based on research and development, intellectual property rights and is focused on creating first-mover advantages in the market. It depends upon developing scientific research and intellectual property by providing support through research labs, centers of excellence, effective intellectual property rights protection, scientific training and courses, promotion of research at universities, linking research with industry, availability of funds for research, collaboration and knowledge sharing among research institutions etc. Focus shall also shift from publication to patents to create value for the respective stakeholder.

Competition and Innovation Promoting Ecosystem

Indian economy is transitioning from factor driven phase to efficiency driven phase and in parallel is engaged in innovation driven sectors of economy. For sustaining the efficiency, India needs to invest in physical capital whereas to be a leader of innovation driven economy, India needs to step up its investment in KBC and physical capital R&D. A shared vision, as mentioned above, will outline the contours and roles various stakeholders have to play. Going forward, a framework consisting creation of physical infrastructure, human capital, policy regime, taxation, cross

border enterprise, would be required to create competition and innovation ecosystem. Some of the areas, that require attention in India are listed below

- Intellectual property right regime should keep pace to cover innovation in new areas particularly in digital technology.
- Faster patent turnaround time to reduce innovation deficit
- Financial and investment rules that promotes early-stage investment in KBC and less stringent bankruptcy laws in case of failures in KBC
- A tax regime that incentivises the investment in research and development. The innovative products with export potential can be considered for lower taxation rates to promote investment in KBC.
- A Competition Policy should be framed in consultation with multiple stakeholders and learning from many countries who have moved ahead in research and development.
- Research Centers for Technologies of Future - Specialised centres for research in to deep technologies of future including KBC shall be established by both government and private companies independently or in collaboration. Although it would be hazardous to list the disruptive technologies of future, some of the promising technologies or the ones nearing maturity for commercial applications and would require dedicated research will include:
 - Bio-Science – vaccines, personalised and genome mapped drug discovery.
 - Transport – new fuels, green hydrogen, autonomous vehicles, green vehicles, batteries
 - Information Technology – cyber security, AI, quantum computing, metaverse, blockchain, Fintech, AR, VR
 - Materials and nanotech
 - Sensors, IoT, drones
 - Industrial robotics, precision manufacturing
 - Additive and 3-D printing.

Nurturing Innovation and Future Job Providers – START UPS

World Economic Forum estimated that 70% of new value created in the economy globally over the next ten years will come from digitally enabled platform business models. These start-up hubs will be critical value drivers for Asia as well as the global economy. As per Ease of Doing Business rankings 2020 by World Bank, three Asian ecosystems have been ranked among the top places to do business

globally - Singapore ranking second in the list, Hong Kong ranking third, and the Republic of Korea securing the fourth position. Beijing, Shanghai, Seoul, Tokyo, Singapore, Shenzhen, Bangalore, Delhi, and Mumbai have been among the top performing startup ecosystems in Asia and globally. Evolving Asian Start Up System and India Rising

The Asian landscape is changing very rapidly, and Indian Startup Ecosystem is seeing rapid growth. FY 2021-22 has been a pivotal year for Indian Startups Ecosystem with total VC funding reaching \$38.5 billion; investments growing at 3.8x over 2020 as compared to 1.3x for China. India has minted 44 unicorns in 2021 with exits rising to \$14 billion, leading to a 10x increase over 2020. India witnessed 22 unicorns in 2022. Bangalore, Delhi, and Mumbai have been ranked among the top startup ecosystems globally with Hyderabad, Telangana, and Kerala catching up fast as one of the fastest growing startup ecosystems as per a report by Startup Genome and Global Entrepreneurship Network. Enabling Policy and Institutional Framework for Start Ups in India

The government of India has launched various initiatives and programs to accelerate the Startup ecosystem in India such as Startup India Seed Fund Scheme, Standup India, MAARG Platform, etc. The Government of India has also kicked off various initiatives in partnership with Corporates, State Governments, and educational institutions to promote collaboration and provide support to startups. Institutional and policy support has been a significant contributor to sustaining the growth of the Startup ecosystem in India.

State Governments are also leading the way in stimulating the regional startup ecosystem. T-Hub by the Government of Telangana is a pioneering collaborative model of innovation and entrepreneurship by bringing key stakeholders in the Startup Ecosystem together - government, corporates, academia, investors, and mentors. In addition to this, the plug-and-play model and infrastructure at T-Hub eases out the initial pre-seed to seed stage journey for an entrepreneur. Startup Karnataka, Start in UP, Kerala Startup Mission are other successful examples of government, corporate, and academia collaboration to stimulate the regional startup ecosystems.

There are various successful examples of successful initiatives by Governments across Asia for promoting collaboration among startups, academia, and corporate, enabling growth capital, and provisioning plug-and-play infrastructure models to handhold startups on their growth journey. Enterprise Singapore, SGInnovate, NUS Enterprise are one of the most successful startup initiatives in Asia and globally working towards enabling infrastructure, growth capital, and R&D support for startups. Kyoto

Startup Ecosystem Promotion Council, Plug and Play Kyoto, Dedicated Startup City in Kei Hanshin region are among the many initiatives by the Government of Japan to enable 360° support to startups

However, as the technology and business landscape is rapidly changing, the policy and institutional framework and educational system in India would also need to evolve to keep up pace with this dynamic landscape and drive sustainable growth

Building the Funnel of Innovators and Startups for the Future

The startups in India have been primarily focused on building solutions for driving efficiencies and connecting users such as B2B and consumer SaaS, eCommerce, Fintech, Digital Media, Aggregator platforms, etc. This phase of growth has come from driving efficiencies and building platforms that connect users, however, the next phase of growth will be driven by research and development and building intellectual capital. To capture this next phase of growth, the Indian economy will require heavy investments in research and development in both public and private R&D institutes, corporates, and educational institutions. Collaboration with corporates will be a critical driver for accelerating research, product development, and building intellectual capital. Corporates can provide access to knowledge base and APIs to startups and researchers, R&D infrastructure, launch joint research projects, etc. This will help corporates drive innovation, invest in potential technologies in early stage, and provide ample resources to startups and researchers to innovate and build intellectual capital. This will provide vitality to the next generation of companies and innovators who are testing and releasing solutions in developing technology. This will also be critical for Indian Startups to build a competitive edge over their global counterparts in product innovation and building the value proposition.

Establishing Global Linkages and Global Brands from India

India has a large community of non-resident Indians across the globe working in tech, research, academia, venture capital, and more, who are keen to contribute to the startup community in India. Establishing linkages with this global community of non-resident Indians across geographies and industries would enable knowledge transfer and networking opportunities for Indian Entrepreneurs. These linkages will help in building a vision among Indian

Entrepreneurs to go global at an early stage; enabling them with the knowledge and exposure to global markets. These global communities of mentors and startups would be a significant contributor to the next phase of growth of Indian Startups.

An abundance of elite MBAs with experience venturing into global markets already occupy the ranks of Indian and multinational corporations. This enables a strong GTM machinery available locally which can drive commercialization of these technologies and execute global go-to-market strategy sitting from India. Additionally, the local MSME and manufacturing ecosystem will play a crucial role in the fast and cost-effective commercialization of technologies in fields like space tech, advanced manufacturing, robotics, etc. Investments and institutional support for productivity enhancements and digitization of MSMEs will lay a base for Indian Startups for building an edge over their global counterparts.

Driving Hyper Growth through Emerging Start Up Hubs

The government of India has launched various initiatives to develop Incubator and Accelerator networks pan India. Even yet, expanding the accelerator network in India has an enormous amount of untapped potential. India has leading incubators and accelerators such as 100xVC, Let's Venture, Entrepreneur First. Expanding this network and bringing global accelerators such as YCombinator, 500 Startups, MassChallenge, TechStars to India; connecting them to upcoming Startup hubs such as Hyderabad, Kochi, and IT clusters such as Indore, Ahmedabad, etc. will push the local startup ecosystem towards hyper-growth.

Stimulating entrepreneurship in emerging Startup hubs and IT clusters such as Hyderabad, Kochi, Indore, Ahmedabad than a few concentrated Startup hubs would be a critical lever for the next phase of growth. This will help the startups in managing the cost benefits of setting up infrastructure in the initial stages in non-metro locations, leveraging a large and affordable talent pool locally, and proximity to major manufacturing and MSME hubs.

The next era of Startup growth for the Indian economy would be led by the development of multiple tech nodes and scaling emerging Startup hubs pan India, fuelled by investments in R&D, global mentor networks, and best-in-class local manufacturing capabilities. To leap ahead of leading Startup ecosystems in Asia and globally such as the USA, China, Singapore, Seoul, and Tel Aviv, the R&D ecosystem in India will be a critical enabler for building the funnel of the next generation of Startups and innovators.

DIGITAL TECHNOLOGY – Backbone of Future Growth

India – A leader in Public Digital Good

India has been at the forefront of developing digital public infrastructure, which it has used in a variety of fields, including digital identity, finance, and health, in order to improve public services, efficiency, and the standard of living for the average person. Of its many success stories, few notables are

- Aadhar – This unique biometric ID system created a unique digital identity, so far for about 1.2 billion Indians, as backbone of public digital infrastructure
- Digital banking and Financing - e-rupee, linking Aadhar and PAN which is being used for, among others, for direct benefit transfers to crores of beneficiaries. Since its launch in 2014, about 470 million Jan Dhan Accounts have been opened providing access of financial services to hitherto un-served population. UPI for digital payment with billions of monthly digital payment transactions is a global success story, now being adopted by many countries.
- Digi-locker – one stop digital storehouse for important documents
- Health – Cowin platform is used for providing more than 200 crore vaccines. Ayushman Bharat Digital Mission is established to set up integrated digital infrastructure for health records to bring multiple service providers to same platform.
- Open Network for Digital Commerce – This is one of its kind platform that aggregates producers (including remote and small ones), buyers, traders, logistic players Retail, access, quality, regulation – Linking the unorganised enterprise – Expanding the reach of market and enhancing consumer choices
- India Stack – It is a revolutionary integrated approach to bring identity and digital transactions for multiple usage through layered APIs.
- As India marches through its Amrit Kaal, digital technology will be one of the most effective enablers to deliver its growth aspiration, ease of living for its people and ease of doing business for its producers, traders, and service providers. Although India has already established itself as a global leader in digital public goods and numerous innovative initiatives are now ongoing, it would still need to begin specific actions for avoiding the digital divide and should shift from the adoption of technology to the invention of new. From Back Office to Front Runner of Technology - Research and Development Centers - Setting up of Centers of Artificial Intelligence is one such

step to encourage AI driven technologies. India would need an umbrella agenda for digital technology research, innovation, and development for technologies on horizon and technologies of future, for next one decade with adequate funding. For this purpose, the country as a whole needs to establish multiple networked centers of excellence, centered on a pre-identified set of technologies that are periodically reviewed, to work together under an overarching agenda with synergy, avoid duplication, and advance the general agenda. The corporates, academia, entrepreneur, and startups will be natural stakeholders of this initiative.

- Faster adoption of 5G – Estimates by various research groups on impact of 5G on economy of states may vary but they are unanimous that adoption of 5G will provide better and faster services to the individuals. As per a study by Ericsson “With regulatory and government support, countries could benefit from GDP growth between 0.3% and 0.46% through 2035, with an estimated three-to-seven-fold cost-to-benefit ratio”. Manufacturing, retail, agriculture, health services and entertainment stand to gain most out of the roll out and adoption of 5G. The effort should be on extending the 5G infra to rural areas while keeping the cost of handset and data low for faster adoption.
- Infrastructure and Software Localisation – Not only form geo-political, privacy and economic purposes but from security (internal and external), India should aim at complete localisation of all hardware, software and infrastructure within its geographical boundaries. This should include data servers located within India, indigenous operating system and software, communication infrastructure, entertainment and retail platforms among others. Recent collaboration under “Initiative on Critical and Emerging Technologies” with USA on localisation of military hardware, semiconductor, telecommunication and AI is a step in this direction.
- Avoid Digital Divide – Access to digital services and financial inclusion are now as basic a need as Roti, Kapda Aur Makaan are. As explained elsewhere in this document positive health outcomes have very strong correlation with access to mobile phone and bank account. Moreover, the ease of availing the services through digital mode and availability of certain services only on digital mode like retail, EdTech, online classes, entertainment, social network provides a distinct advantage to those who can avail and benefit from these digital services. In such a scenario the access to 4G or higher network and a smartphone will assume higher meaning in welfare agenda to avoid digital divide -that is those who have access to digital technology and those who don't have. Governments would have to be

conscious and take affirmative actions beyond market forces, to avoid "digital poverty".

- Digital Public Infrastructure for Agriculture – The government of India has announced establishing Digital Public Infrastructure for Agriculture as an open source, open standard and inter operable public good to provide variety of services to farmers. This infrastructure should focus on one of the major issues of credit to farmers to enable them to access the desired amount at desired time by providing a credit rating to the farmers and linking financing institutions to them. The infrastructure should also aim to establish a credit rating of the farmer’s family as a unit by analysing the family’s assets and obligations.
- Government should establish a similar Digital Public Infrastructure for MSME for providing easier access to finances, skills, technology and market. This will enable formalisation of the unorganised MSME sector that accounts for more than three fourth of the employment of total sector. GeM (Government eMarket Place) open access digital public good initiative of government of India which is a networked platform, available free of cost, enabling producer, trader and buyer to connect seamlessly for D2C and B2B business transactions avoiding middlemen and providing cost benefits.
- Cyber Security – More and more sectors are now dependent on digital infra for their day-to-day operations. Aviation, railways, highway tools, finance, banking, retail, electricity grids, physical security networks, telecommunications, Businesses are extremely vulnerable to cyber threats and fraud because they rely so much on digital infrastructure. Moreover, it is a game of one upmanship requiring continuous development and deployment of security walls to safeguard the critical public and private infra and operations.

DEEP TECHNOLOGY FOR GROWTH AND WELFARE

Basis analysis of VC investments, R&D trends, and emerging use cases for consumers and enterprises, the next phase of growth will come from advanced segments of Deep Technology with the intersection of basic science, and technologies like Artificial Intelligence and related, Big Data, Advanced Manufacturing, Robotics, Blockchain, Space Tech, etc.// and Design concepts. Product development and commercialization in these segments require heavy investments in research and supporting infrastructure for development and prototyping. Competing in these advanced segments requires a high level of R&D investments for developing the technology and building intellectual property.

Mature Phase	Emerging & Growth
Agtech & New Food	AI & Big Data
Cleantech	Blockchain
B2B SaaS	Advanced Manufacturing and Robotics
Cybersecurity	Spacetech
Fintech	Hyperscale Edge Computing
Gaming	Immersive Internet & Metaverse
Life Sciences	Superapps
EdTech	Sustainable technology to enable ESG Outcomes\
Digital Media	

Advances and new products developed through deep technologies will impact all walks of life. Some of the areas where we can soon see the developments are listed below for indicative purposes.

E-Governance and Citizen Services: - Robust single window AI & Blockchain driven e-governance platforms for seamless access to government services, Technology for transparent and efficient delivery of essential services.

Health Care and Well-being - Telemedicine for remote health monitoring and accessibility, AI for disease detection and personalized medicine

Sustainable Agriculture and Food Security – Precision agriculture, through IoT and data analytics to optimize crop yields, credit access, digital platforms for farmers to access market information and fair prices, drones, sensors, and data analytics should be adopted to optimize crop yields, monitor soil conditions, and manage resources efficiently at scale.

Logistics: Transforming the logistics industry by leveraging Blockchain, Fintech, AI, robotics, and automation to optimize supply chains, enhance last-mile delivery, and improve customer experiences. Also, develop advanced solutions for supply chain optimization, asset tracking, and real-time monitoring, benefiting agriculture, shipping, and transportation industries.

Utilities: The deployment of smart grids and Internet of Things (IoT) technologies to improve energy efficiency,

monitor and manage utilities in real-time, and integrate renewable energy sources into the power grid. Also, focus on water management technologies, given its arid climate. We must create a startup eco-system for water-efficient irrigation systems, leak detection solutions, and desalination technologies.

Clean Energy: Focus on renewable energy technologies, including solar power, storage, and innovative solutions for sustainable energy production and consumption

Education: EdTech platforms in harness personalized learning using AI, virtual reality (VR), and online learning tools to provide personalized and interactive educational experiences, reaching a broader audience and enabling lifelong learning, enabling advanced and relevant education for the remotest of remote parts of the state.

Infrastructure: Use of IoT and sensor technologies for smart city & smart village initiatives, enhancing urban planning, traffic management, waste management, and public safety.

Financial Services: Embraced FinTech innovations, including blockchain technology for secure transactions and digital payments, robo-advisors for automated financial planning, and AI-driven risk assessment for lending.

Manufacturing: Industry 4.0 initiatives involve the integration of IoT, AI, and automation in manufacturing processes, leading to smart factories, predictive maintenance, and improved productivity.

Entertainment: Augmented reality (AR) and virtual reality (VR) have transformed the gaming and entertainment industries globally, providing immersive experiences and new forms of storytelling. Create Gaming Parks and enable support for tier-2 cities to create jobs and live-service studios for global outsourcing.

Cybersecurity: Developing advanced solutions to protect critical infrastructure, networks, and digital assets from cyber threats.

Aerospace and Defense: Advanced military technologies, including drone systems, missile defense systems, and satellite technologies, eco-systems to be created.

Automotive: Development of autonomous vehicle technologies, including computer vision, AI, and sensor integration for self-driving cars.

Biotechnology: Build a hub for biotech startups, leveraging genetic research, personalized medicine, and medical innovations.

In two decades from now, we will be using the products that are hitherto unknown and these products will drive the global value chains. Share in global value chains will be strongly dependent on competitiveness and innovation and therefore contribute a substantial share in the future to GDP which will come from research and innovation. Arguably, India's role and performance in research, innovation, creation of KBC and disruptive technology will largely determine the growth path of India, Indians and Indian companies.





Strategy



**ENERGY -
DEMOCRATISATION,
DECARBONATION AND
DIGITALISATION**



Energy Secure India – Now and the Future

Energy and the Indian Economy

The impressive growth of the Indian economy over the past two decades, at a pace of 6.8% per year on average, has resulted in a rise in the country's need for energy. This growth coupled with some other factors are adding to the demand of energy.

- In addition, India is also pursuing a structural economic shift towards manufacturing. A higher share of industries (including manufacturing) in GDP and the material intensity of future economic growth will have profound implications on the outlook for the energy sector.
- The resulting construction activity has led to rising demand for steel, cement, aluminum, plastics and chemicals. India has also emerged as a manufacturing hub for vehicles, electronics and pharmaceuticals as energy demand from industry has tripled over the past three decades.
- Rapid industrialization is coupled with commensurate increase in urbanization. with the share of the urban population increasing from 26% in 1990 to 34% in 2019, and many cities experiencing rapid growth.
- India has, almost, achieved the goal of 100% electrification of houses. Thus access to electricity is not a challenge anymore.
- India's per capita annual income has quadrupled and poverty head count ratio reduced to one fourth since 1991 representing changing lifestyle adding to the demand of energy. Domestic electricity consumption has nearly tripled over the past two decades as near-universal access, and rising disposable leads to more use of household appliances

Among end-use sectors, India's industry sector has been the main source of energy demand growth since 2000, around half of which was met by coal. Transport energy demand grew 3.5 times, while demand in buildings has grown by 40% since 2000, largely because of growing appliance ownership and increased access to modern cooking fuels. The agriculture sector has seen the smallest amount of growth in energy use.

The rising need for energy is a direct result of India's booming economy, which in turn has been propelled forward by the country's increasing demand for energy.. However, India's energy intensity of GDP has improved at an average rate of 3% per year during these three decades, meaning it has required less energy over time to produce an additional unit of economic output. This has happened

as a result of the growth in the Indian services sector, energy efficiency improvements and a transition away from inefficient biomass towards modern fuels.

Energy in India Today - Conventional but Transforming

Energy consumption in India has more than doubled since 2000, propelled upwards by a growing population and robust economic growth. Near-universal household access to electricity was achieved in 2019, meaning that over 900 million citizens have gained an electrical connection in less than two decades. However, electricity use on a per capita basis is one third of the global average, (1255 kWh in 2021-22) and there are widespread differences in energy use and the quality of service across states and between rural and urban areas. The affordability and reliability of energy supply are key concerns for India's consumers. Since 2000, India has been responsible for more than 10% of the increase in global energy demand. On a per capita basis, energy demand in India has grown by more than 60% since 2000, although there are widespread differences across different parts of the country as well as socio-economic groups.

The current energy demand in India is about 1000 Mtoe. The International Energy Agency has made projections for the future trajectory of energy sector growth in India up to 2040. These four scenarios are computed based on four possible growth trajectories of economy of India. The energy demand of India is expected to increase by about 50% to reach a level of about 1500 Mtoe.

On the supply side, coal remains the predominant energy supplier by accounting for about 57% of total demand. Traditional biomass – primarily fuelwood but also animal waste and charcoal – was the largest energy source in India in 2000 after coal, constituting about 25% of the primary energy mix. Overall energy demand has doubled since , but the share of traditional biomass in the energy mix has decreased to 12% in 2019, largely because of efforts to improve access to modern cooking fuels, in particular LPG.

In the power sector, fossil fuel accounted 57% of total installed capacity as of May 2023. Renewables accounted for 41% of which 11.2% is hydro, 10.3% is wind and 16.1% of solar. The rise of solar PV has been spectacular; the resource potential is huge, ambitions are high, and policy support and technology cost reductions have quickly made it the cheapest option for new power generation. In fact, the Government of India has announced to add 50 GW of renewable energy capacity (10 GW per annum of wind) for five years starting from FY 23-24 to achieve the 500 GW capacity of non-fossil fuel by 2030. This is in accordance

with the announcement by Prime Minister at CoP26. The existing non-fossil installed capacity makes this goal all the more important. India currently has a total renewable energy capacity of 168.96 GW (as on 28th February 2023) with about 82 GW at various stages of implementation and about 41 GW under tendering stage. India has emerged as one of the world leaders in energy transition.

As per International Energy Agency

- Transport is currently the fastest-growing end-use sector in terms of energy demand, and urbanization will foster further growth. In many Indian cities, increasing demand for transport has so far led to much congestion and poor air quality. This has prompted a range of policy initiatives on fuel efficiency and quality, mass transit, and the electrification of transport. However, today's policy settings are not yet enough to avoid a large projected increase in oil demand for road transport, which doubles by 2040. There is a doubling in oil demand in road transport by 2040 in the STEPS, largely as a result of the addition of 170 million passenger cars and 25 million trucks to the vehicle stock between 2019 and 2040. Oil consumption is also lifted by a tripling of feedstock demand in the petrochemical industry. However, the transport sector energy consumption source may change from oil to electricity and/or hydrogen depending upon commercialization of EV and Green Hydrogen technologies.
- Industry is the end-use sector that currently uses most energy, and its share in total final consumption will rise from 36% today to 41% by 2040.
- The electrification of the Indian energy economy continues apace in all scenarios. The share of electricity in total final consumption grows in all sectors, and particularly in the buildings sector, where there is a continued pivot away from traditional biomass and a steady uptake of appliances. In the STEPS model, the

share of demand met by electricity rises from around 17% today to nearly a quarter by 2040.

- The dominance of coal in India's energy system continues to recede. Coal is the slowest growing energy source in the STEPS, meaning its share in the energy mix falls from 44% in 2019 to 34% by 2040. As the incumbent fuel in the power sector, coal faces strong competition from renewables in general and from solar PV in particular.

The energy mix in India becomes much more diverse. More than 80% of the demand is now met by coal, oil, and traditional biomass. In 2040 modern bioenergy and renewables including solar, wind and hydropower meet nearly a quarter of India's total energy demand in the STEPS. Primary energy use per unit of GDP falls by half as the link between economic growth and energy consumption weakens further.

In the STEPS, total CO₂ emissions in 2040 are 45% higher than in 2019, and emissions per capita also rise, but emissions intensity goes down significantly. India's NDC under the Paris Agreement include a reduction by 2030 in the emissions intensity of GDP by 33-35% compared with 2005 levels. The energy sector achieves this target under the STEPS, with a CO₂ emissions intensity reduction of over 40% by 2030.

Issues in India's Energy Sector

Geographical Variation in Energy Consumption

Within India, there is considerable variation in overall energy use across states, resulting from differences in economic and demographic trends, resource availability and industrial profiles. A detailed review of the available state-by-state data shows that the range between the lowest-consuming and highest-consuming states varies by a factor of five measured in toe units.

Energy and Economic Indicators in Selected States in India, 2018

States	Urban Population (million)	Rural Population (million)	GDP per capita (PPP) (\$)	Total final consumption per capita (toe)	Electricity demand per capita (kWh)
Higher Income	192.7	233.8	12,159	0.6	1,615
Delhi	16.4	0.4	19,970	0.6	1,548
Haryana	8.8	16.5	12,900	0.8	2,082
Telangana	13.6	21.4	11,170	0.5	1,896
Karnataka	23.6	37.5	11,520	0.6	1,396
Kerala	15.9	17.5	11,150	0.5	757
Gujarat	25.7	34.7	10,790	1.1	2,378
Uttarakhand	3	7	10,860	0.5	1,467
Maharashtra	50.8	61.6	10,480	0.5	1,424
Tamil Nadu	34.9	37.2	10,590	0.5	1,866
Middle Income	84	220.6	6,540	0.5	1,129
Punjab	10.4	17.3	8,470	0.6	2,046
Andhra Pradesh	14.6	35	8,260	0.5	1,480
Rajasthan	17	51.5	6,040	0.5	1,282
West Bengal	29.1	62.2	5,980	0.4	703
Chhattisgarh	5.9	19.6	5,290	1	1,961
Odisha	7	35	5,200	1	1,628
Lower Income	88.7	352.1	3,930	0.3	647
Madhya Pradesh	20.1	52.6	4,970	0.4	1,084
Assam	4.4	26.8	4,490	0.3	341
Jharkhand	7.9	25.1	4,150	0.6	938
Uttar Pradesh	44.5	155.3	3,640	0.3	606
Bihar	11.8	92.3	2,400	0.2	311

Notes: kWh = kilowatt-hours

Average citizens in Delhi consume about half of the global average, while their counterparts in Bihar consume less than 20% of the global average. Traditional cooking fuels are most prevalent in states with lower per capita income. In states with higher per capita incomes, the share of electricity and oil products - which include transport fuel and also LPG - is higher, and it rises with increasing energy use.

Access to Clean Cooking

Having electrified nearly every household in the country, India's next major challenges lies in achieving a full transition to clean cooking. As per National Family Health Survey 5 nearly 40% of Indian households do not use clean fuel and continued to rely on traditional uses of biomass for cooking, mostly in rural areas. This percentage is 57% for rural areas. Access to clean cooking goes

beyond technical availability; it also extends to issues of adequacy, reliability, convenience, safety and affordability. Affordability is the key factor that has made biomass hard to dislodge as a cooking fuel. In rural India, biomass and other traditional fuels are practically free or are available at a very low cost, compared with a significantly more expensive cylinder of LPG.

There has also been growth in the use of pipeline natural gas (PNG) in urban areas. In April 2019, there were 5 million domestic PNG connections, over 90% of which were concentrated in four Indian states. The government now has plans to expand this city gas distribution network to cover 70% of all households by 2030. There is also potential for an accelerated uptake of induction and other electric cooking appliances, especially in urban areas, even though they accounted for less than 1% of cooking energy demand in 2019.

Mobility and Transport

With a growing economy, Indians are now travelling farther than ever before. On average, Indians travel nearly 5 000 km each year, a threefold increase since 2000. Vehicle ownership per capita has grown five fold since 2000. The rapid growth of mobility has been enabled by the expanding road network in India, which increased from 3.3 million km in 2000 to 5.9 million km in 2016. India's total road network is now the second largest in the world, behind the United States.

Indians are also travelling on rail twice the distance they did in 2000. India's per capita distance travelled on rail increased from 430 km in 2000 to nearly 860 km in 2019.

There has been a steady growth in India's aviation industry over the past decade. The per capita distance flown in India was 10 km in 2019, which is three times as much as 10 years ago. Domestic passenger numbers, too, have nearly tripled in the last decade to over 140 million, up from around 50 million in 2010

As Indians travel more and transport freight in larger volumes, the transport sector has become the fastest growing energy end use sector in the country. Energy use in India's transport sector has increased fivefold over the past three decades, reaching more than 100 Mtoe in 2019. While other sectors are fuelled by relatively diverse sources of energy, transport is heavily reliant on oil, with 95% of demand being met by petroleum products. Just under half of India's oil demand is accounted for by transport.

Towards Goal of Net Zero Transition

India declared to be Net Zero by 2070 at COP26 during 2021. It presented its Long-Term Strategy for Low Carbon Development (LT-LEDS) at COP27. In December 2022, a "Net Zero Emissions" Bill was introduced to provide a framework to achieve net zero emissions by 2070. It provides for specific action areas for transport, industry, power, urban sectors and building. India has set itself a goal to reduce the emission intensity of its gross domestic product by 45% from the levels year 2025 to the year 2030. It has also kept a target to achieve about 50% cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030. India has also put forward a program called Lifestyle for Environment (LiFE) to propagate a healthy and sustainable way of living.

Renewals - Solar and Wind

The most remarkable story in India's power sector in recent years has been the growth of solar PV and wind, which have rapidly increased their share of the overall energy mix in recent years as coal and hydropower capacity growth has slowed. Over the past five years, solar PV capacity has grown at an average growth rate of around 60% and wind capacity of around 10%, outpacing the 7% growth in overall installed capacity.

The policy actions that have facilitated the growth of grid connected renewables include reverse auctions resulting in progressively falling prices, lower corporate tax rates for developers, renewable purchase obligations mandating utilities to procure a certain minimum purchase of renewable power, investment in transmission infrastructure, and support for solar parks that help reduce project development and land acquisition risks.

However, there are still important structural, regulatory and institutional challenges that could hamper further growth, and progress has been uneven across different renewable technologies. The challenges include the poor financial position of many state distribution companies, difficulties in obtaining access to finance and in acquiring land, grid congestion, and uncertainties over grid infrastructure development.

DECENRALISATION - Local Grids - Local Production and Local Consumption

The expansion of rooftop solar has lagged the growth in utility scale projects, constrained by higher costs and the lack of attractive financial models for consumers. Rooftop solar had a share of 40 GW in the 100 GW solar target for 2022, but deployment remains at well under 10 GW. Similarly, despite an identified potential of 10 GW to 20 GW, offshore wind has not yet taken off in India owing to the high cost of capital and to supply chain and infrastructure bottlenecks.

In addition to rooftop solar, solar energy production in agriculture fields holds the potential of large scale local production and local consumption. Similarly, greenhouses with solar panel on top will not only improve the productivity commerce save water but also will generate power to run the greenhouses and the surplus can be shared with the grid.

Another advantage of this local production and consumption would be to set up local grids integrated with main grids and feeders. This local grid can be remotely monitored using current technology. The local production and local consumption will also reduce the cost of transportation of energy and thus improving overall efficiency. Dedicated policy framework and incentive schemes need to be put in place to tap this huge potential and to reduce the cost of energy. It will also bring down the subsidy bill of the states towards the agriculture consumption and thus improving the financial health of distribution and transmission corporations.

E-Vehicles

While India has a range of policies that support the increased adoption of a wide variety of electric vehicles (EVs), electrification in road transport so far has largely come from two and three wheelers. The number of electrified two and three wheelers has grown by more than 60% each year on average since 2015, and there were 1.8 million such vehicles in 2019. Despite this rapid rise, they still constituted only 3% of overall two and three-wheeler sales that year. The electrification of transport has accelerated in other modes of transport too. India's railway network now has a target of 100% electrification of its tracks by 2022, up from 51% of the railway network (in route kilometres) in 2019. There has also been a rapid increase in urban light rail in cities. In 2020, over 650 km of metro rail was operational in 18 cities.

To increase the uptake of EVs, a subsidy program called the Faster Adoption and Manufacturing of Electric Vehicles (FAME) was introduced in 2015. The second phase of the policy, FAME II, was approved in 2019 with a budget of \$1.4 billion for a five year period. This includes policy incentives for the purchase of electric and hybrid vehicles as well as for the installation of charging stations.

To ensure the development of EV charging infrastructure, the Bureau of Energy Efficiency has laid out targets for the installation of at least one publicly accessible charger within a grid of 3 km by 3 km in cities, and one charging station every 25 km on both sides of highways. There is an additional target of one fast charging station every 100 km on highways. The government has also complemented its measures to promote the use of EVs and associated infrastructure by announcing a production linked incentive for the manufacture of advanced chemistry batteries for EVs, renewable energy and other applications. However, as many of these incentives are relatively recent, much of the growth in vehicle electrification lies ahead. Lighter and longer life battery, more kilometer per charge and charging infrastructure are key concerns in the sector.

Bio-Fuel and CNG

In April 2017, India put in place corporate average fuel consumption (CAFE) fuel efficiency norms for passenger cars, and these will become more stringent from 2022. The government mandated the leapfrogging of vehicle fuel standards from Bharat Stage IV to Bharat Stage VI for all new vehicles sold starting April 2020. This standard is in line with Euro 6.

A comprehensive National Policy on Biofuels (NBP) was approved in 2018 that envisages a target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel by 2030. India's push for compressed natural gas (CNG) in transport over the past decade has resulted in the doubling of CNG use in transport since 2010. There are now over 3 million CNG fuelled vehicles registered in the country, 92% of which are concentrated in four Indian states. These vehicles are largely three wheelers, buses and cars, most of which are used for shared mobility, for example as taxis, or for public transport. There is a need to expand the CNG distribution infrastructure to other states to meet the targets set by government of India.

Green Hydrogen as a Renewal Alternative

India's distinct advantage in low-cost renewable energy generation makes green hydrogen the most competitive form of hydrogen in the long run. This enables India to potentially be one of the most competitive producers of green hydrogen in the world. Green hydrogen can achieve cost parity with natural gas-based hydrogen (grey hydrogen) by 2030, if not before. Beyond cost, since hydrogen is only as clean as its source of generation, green hydrogen will be necessary to achieve a truly low carbon economy. It will also enable the emergence of a domestically produced energy carrier that can reduce the dependence on imports for key commodities like natural gas and petroleum. India intends to be a global hub for green hydrogen to be the basis of green growth through green jobs.

Hydrogen demand in India could grow more than fourfold by 2050, representing almost 10% of global hydrogen demand. Initial demand growth is expected from mature markets like refinery, ammonia, and methanol, which are already using hydrogen as industrial feedstock and in chemical processes. In the longer term, steel and heavy-duty trucking are likely to drive most of the demand growth, accounting for almost 52% of total demand by 2050. From a price parity basis alone, green hydrogen's share of this demand could grow from 16% in 2030 to almost 94% by 2050. This translates to an implied cumulative electrolyser capacity demand of 20 GW by 2030 and 226 GW by 2050, promising a sizeable opportunity for indigenous manufacturing of a global emerging energy technology. The cumulative value of the green hydrogen market in India could be \$8 billion by 2030 and \$340 billion by 2050. Electrolyser market size could be approximately \$5 billion by 2030 and \$31 billion by 2050.

Adoption of green hydrogen will also result in 3.6 giga tonnes of cumulative CO₂ emissions reductions between 2020 and 2050. Energy import savings from green hydrogen can range from \$246 billion to \$358 billion within the same period. Beyond the financial savings, the energy security that green hydrogen provides will translate to less volatile price inputs for India's industries as well as strengthen India's foreign exchange situation in the long run.

The Government of India on 4th January 2023 has approved the National Green Hydrogen Mission. The initial outlay for the Mission will be Rs. 19,744 crores with following likely outcomes by 2030:

- Development of green hydrogen production capacity of at least 5 MMT (million metric tonne) per annum with an

associated renewable energy capacity addition of about 125 GW in the country

- Over Rs. 8 lakh crores in total investments
- Creation of over 6 lakh jobs
- Cumulative reduction in fossil fuel imports over Rs. 1 lakh crores
- Abatement of nearly 50 MMT of annual greenhouse gas emissions

The Mission will have wide ranging benefits- creation of export opportunities for green hydrogen and its derivatives; decarbonization of industrial, mobility and energy sectors; reduction in dependence on imported fossil fuels and feedstock; development of indigenous manufacturing capabilities; creation of employment opportunities; and development of cutting-edge technologies. The Mission will facilitate demand creation, production, utilization and export of green hydrogen. Under the Strategic Interventions for Green Hydrogen Transition Programme (SIGHT), two distinct financial incentive mechanisms – targeting domestic manufacturing of electrolysers and production of green hydrogen – will be provided under the Mission. The Mission will also support pilot projects in emerging end-use sectors and production pathways. Regions capable of supporting large scale production and/or utilization of hydrogen will be identified and developed as green hydrogen hubs.

The current significant limitations are the high manufacturing and transportation costs of hydrogen. To reduce the cost of production and transportation, investment in research and development is essential. Some of the big Indian companies have identified the business potential of green hydrogen as the next oil. India desires to have first mover advantage in developing the technologies related to production transmission and utilization of green hydrogen to emerge as exporter of energy from the current status of net importer of energy.

The government needs to speed up the enabling policy framework, robust standards and regulations framework, a public-private partnership framework for R&D which is goal-oriented, time bound, and suitably scaled up to develop globally competitive technologies. A coordinated skill development programme also needs to be taken up as the requirement for green jobs will be increased in the years to come.

Water Needs for Energy Sector

Today, the energy sector withdraws roughly 30 bcm of water (the volume of water removed from a source) and consumes almost 6 bcm (the amount withdrawn but not returned to a source). The energy sector accounts for less

than 5% of India's total water withdrawals and less than 2% of consumption, but water availability is nonetheless essential for India's energy security. It is estimated that 9 litres of water is consumed for production of one litre of hydrogen. The ambitious program of green hydrogen based energy production would create demand for more water consumption. India would need to scout for places with water availability to set up the green hydrogen production plants.

National Smart Grid – Digitalisation of Energy Sector

The National Smart Grid Mission (NSGM) was established by Government of India in 2015 to plan and monitor implementation of policies and programmes related to smart grid activities in India. The primary aim of the smart grids is to improve reliability of the electricity networks and make the grid amenable to renewable energy inputs through distributed generation. Further, increased efficiencies with smart grid and smart meters empower the consumers to manage their electricity consumption in a better manner and help them in reducing their bills. In addition, the NSGM also envisages capacity building initiatives for distribution sector personnel in the field of smart grids.

Smart grids can be achieved by implementing efficient transmission and distribution systems, system operations, consumer integration and renewable integration. Smart grid solutions help to monitor, measure and control power flows in real time that can contribute to identification of losses and thereby appropriate technical and managerial actions can be taken to arrest the losses. Smart grid solutions can contribute to reduction of T&D losses, peak load management, improved quality of service, increased reliability, better asset management, renewable integration, better accessibility to electricity etc. and also lead to self-healing grids.

Smart grid can therefore transform the Indian power sector in to a secure, adaptive, sustainable and digitally enabled ecosystem that provides reliable and quality energy for all with active engagement of stakeholders.

The features of smart grid include real time monitoring; automated outage management and faster restoration; dynamic pricing mechanisms; incentivize consumers to alter usage during different times of day based on pricing signals; better energy management; in-house displays; web portals and mobile apps; track and manage energy usage; and opportunities to reduce and conserve electricity; etc.

Smart Grid will also facilitate distributed generation, especially roof top solar generation, by allowing movement

and measurement of energy in both directions using control systems and net metering that will help "prosumers" i.e., the consumers who both produce and consume electricity, to safely connect to the grid.

The benefits of smart grid deployments to the utilities, customers and the regulators include reduction of T&D losses; peak load management, improved quality of service and reliability; reduction in power purchase cost; better asset management; increased grid visibility and self-healing grids; renewable integration and accessibility to electricity; increased options such as ToU tariff, DR programs, net metering; satisfied customers and financially sound utilities; etc.

Energy Efficiency

Ministry of Power, through BEE, has initiated a number of energy efficiency initiatives in the areas of household lighting, commercial buildings, standards and labeling of appliances, demand side management in agriculture/municipalities, SME's and large industries including the initiation of the process for development of energy consumption norms for industrial sub sectors, capacity building of SDA's etc.

India's Energy Policies and Governance- Digitalisation

India's energy policies and ambitions are often disparate and sector specific because they emanate from different ministries and agencies. However, these policies and ambitions all relate to the overall goal of providing affordable, reliable and sustainable energy services.

The energy industry in India is regulated in many ways by both the federal and state levels of government. Under India's constitution, the petroleum, natural gas, aviation and railways sectors come within the legislative ambit of the central government, whereas electricity comes within the legislative ambit of both the central and state governments. As a result, India's energy sector is governed by multiple ministries and agencies at both the central and state levels.

In the central government, various ministries and agencies have energy related responsibilities under the overall purview of the Prime Minister's Office (PMO). Each of these in turn has under it a range of specialist agencies and regulatory bodies, as well as public sector undertakings (PSUs), which are publicly owned companies. There are also agencies under the 28 state governments with responsibilities related to electricity, road transport, buildings and energy efficiency; these include State

Electricity Regulatory Commissions (SERCs) in charge of managing intra state transmission, distribution, trade and other aspects of electricity supply. There is also a Forum of Regulators (FOR) to facilitate co ordination among the multiple state regulatory agencies and the central regulator. The administrative burden of having multiple agencies involved with energy is substantial. To achieve One Nation One Grid in the energy industry, we need creative and digital solutions.

The Government of India has articulated seven focus areas for its energy economy, including a move towards a “gas based economy”, cleaner use of fossil fuels, greater use of biofuels, rapid scaling up of renewables, a focus on electric mobility, a shift towards emerging fuels including hydrogen, and digital innovation across energy systems. There are specific targets to be achieved by 2030, including 500 GW of renewable power capacity, a 15% share of natural gas in the primary energy mix, a 30% share of passenger car sales for eVs and a 20% blending of biofuels in petrol. There are also targets for increased energy efficiency across

sectors, affordable housing for all, the electrification of railways, the reduction of crude oil imports, and the ending of coal imports in the 2020s.

India hence needs to pursue multiple policy objectives in parallel, to support a growing population and economy, including energy access, energy security and sustainability. In order to do so effectively, there is a need to approach energy policy making and planning with a view to the system wide impacts of different policy choices. For example, road or rail transport policies formulated by the respective ministries in India have potential implications not only for transport demand, but also for power generation capacity, refinery configurations, natural gas supply infrastructure, GHG emissions and air quality. And India’s policy choices will also have significant impacts for global trends given the scales in its energy demand and consumption. Hence making the right energy sector policy choices will be critical for India to achieve its India@2047 vision goals.





Strategy

5

WATER SECURE
INDIA



Water and Climate Change- Availability and Access

India is one of the world's most water-stressed nations due to the fact that it has only 4% of the world's freshwater resources but is home to about 18% of the world's population. Around 45% of its population faces acute water shortages. Groundwater, which provides 85% of the country's rural drinking water and about 60% of its irrigation water, is being rapidly depleted. The difficulty is in ensuring that India's rapidly expanding economy isn't slowed down by its dependence on a limited natural resource.

The National Environment Policy of the GOI has stated that anthropogenic climate changes will have severe adverse impacts on India's precipitation patterns, ecosystems, agricultural potential, forests, water resources, coastal and marine resources. It further states that large-scale planning will clearly be required for mitigation and adaptation measures for climate change impacts if catastrophic human misery is to be avoided.

The Fifth Assessment Report (IPCC, 2014) of the Intergovernmental Panel on Climate Change (IPCC) shows that climate change is likely to directly impact the water sector. Climate change may affect both the short-term variability of water resources through increased frequency and intensity of droughts and floods or induce long-term changes in mean renewable water supply. There are anticipated to be a number of changes, including include heavier rainfall during fewer, longer periods, which will lead to more severe floods and droughts the shift of the rainfall towards winter; and significant reduction in the glacial mass resulting in increased flows in the initial few decades but substantially reduce thereafter. Many of the areas that are already facing water shortages will have less supplies in the future thus impacting surface and groundwater availability for irrigation.

The IPCC report further projected that the quantity of surface run-off due to climate change would vary across the river basins as well as sub-basins in India. The Indo-Gangetic basin will experience increased water availability from snowmelt up to around 2030 but face gradual reductions thereafter resulting in increased dry-season water shortages in the downstream. However, there is a general reduction in the quantity of the available run-off. An increase in precipitation in the Mahanadi, Brahmani, Ganga, Godavari and Cauvery are projected under climate

change scenarios; however, the corresponding total run-off for all these basins does not increase. This may be due to an increase in ET on account of increased temperature or variation in the distribution of rainfall. In the remaining basins, a decrease in precipitation is noticed. The overall inference is that most of the surface water storages will have increased run off during periods of heavy rains but at the same time will have increased evaporation from large open surfaces of reservoirs due to increase in mean temperature.

Further, the increasing inter-annual variability of the monsoon in the future due to climate change will also affect groundwater recharge. Falling groundwater levels in various parts of the country have threatened the sustainability of the groundwater resource, as water levels have gone deep beyond the economic lifts of pumping. Climate change is likely to increase the demand for groundwater to manage the increasing intermittent periods of limited water availability. Lower groundwater tables and the resulting increase in the energy required to pump water will make irrigation more expensive and increase its carbon footprint.

Analyzing a trend of rising temperature and declining rainfall during 1970-2015, the Economic Survey 2018/19 of the Government of India observed that during the years when rainfall levels drop to 100 mm below average, farmer incomes would fall by 15% during the kharif and 7% during the rabi crops seasons. It points out that climate change could reduce annual agricultural incomes in the range of 15 to 18% on an average for irrigated areas and up to 20-25% for unirrigated areas. To make farming more robust in the face of climate change, it urges the efficient use of technology and crop insurance schemes.

It is an accepted fact that in the post-climate change scenario, systems that are more controlled will fare better than systems that are less controlled. In water resources parlance, control means appropriate engineering infrastructure, institutions and management practices that enables the water managers to store, transfer and deliver water with greater certainty, thus reducing the impact of uncertainty.

The Standing Sub-Committee of Ministry of Water Resources in its projection for all India water demand by 2050 estimates it around 1,447 bcm. This is primarily due to increasing population, and rapid urbanization and industrialization in India by 2050, leading to higher water demand from all user sectors.

All-India Projected Water Demand in India by Different Uses (2010, 2025 and 2050)

Water demand in BCM									
Different use	Standing Sub-committee of Ministry of Water Resources			National Commission on Integrated Water Resources Development					
	2010	2025	2050	2010		2025		2050	
				Low	High	Low	High	Low	High
Irrigation	688	910	1,072	543	557	561	611	628	807
Drinking water	56	73	102	42	43	55	62	90	111
Industry	12	23	63	37	37	67	67	81	81
Energy	5	15	130	18	19	31	33	63	70
Other	52	72	80	54	54	70	70	111	111
Total	813	1,093	1,447	694	710	784	843	973	1,180

Note: BCM: Billion Cubic Meters.

Source: Compendium of Environment Statistics India, 2011, Central Statistical Office, Ministry of Statistics and Programme Implementation, Government of India.

Therefore, improved water management at the system and user levels, including supply-side and demand-side management interventions, will be necessary to deal with rising demands and climate change. These estimates may require revision if green hydrogen is adopted for large scale energy generation, which requires approximately 9 liters of water to produce 1 kg of hydrogen. India needs to revisit water policy to address the requirements of a growing economy, the structural shift in the economy, urbanization and energy requirement including green hydrogen. Some potential solutions are discussed further below.

Optimising Water Use Efficiency and Water Productivity

Water cannot be created. However, on-going rapid industrialization and urbanization would create competitive demand for water in the medium to long term future. India would have to manage its water to meet the demand of a growing economy and increasing population and that water availability should not become a constraint for growth of economy. Agriculture with a share of 80% of freshwater use, is the largest water consumer sector in India. However, Niti Aayog, Government of India reports that the current efficiency of the irrigation systems in India is low at 30 to 38% for surface water and 55% for ground water and the overall efficiency of irrigation assets is as low at 30%.

The availability of water for human consumption and other commercial uses, as well as the prevention of a water crisis, necessitates greater efficiency and productivity in agricultural water usage.

Central Water Commission (CWC), Government of India assesses the water resources potential of India as about

1,999.20 billion m³ (BCM). As regards utilization, however, due to various constraints such as topography and spatial and temporal variation of rainfall, only about 1,123 BCM of the total annual water potential can be used beneficially. Of this amount, it is estimated that 690 BCM is from surface water sources and 433 BCM from groundwater sources. Groundwater, which provides 85% of the country's rural drinking water and about 60% of its irrigation water, is being rapidly depleted. A third of India's groundwater reserves are currently overexploited. Moreover, almost 70% of India's water is contaminated. India also suffers frequently from natural disasters: between 1996 and 2015, 19 million people a year in India were impacted by flooding and 17.5 million people a year were affected by drought.

Studies by the International Water Management Institute on future water demand and supply in India found that the Business-as-Usual scenario projects that the total water demand will increase from 680 BCM in 2000 to 833 BCM by 2025, and to 900 BCM by 2050 (22% and 32%, respectively). The study also projects that of the 19 river basins in India, 9 river basins comprising 75% of the total population, will be physically water-scarce by 2050, with the industrial and the domestic sectors accounting for 54% and 85% of the additional demand by 2025 and 2050, respectively. It is predicted that 10 river basins, home to 80% of the total population will see their groundwater tables declining considerable by 2050.

Also, by 2047, while India will continue to be home to about 18% of the world population, it will grow to about 15% of the world GDP and about 15% of global trade, yet having only just 4% of the world's freshwater resources. Additionally, factors such as increase in per capita water demand due to improvement in the standard of life, adverse impacts

of climate change and anthropogenic pollution of water sources and waste water generation may aggravate the situation. India might join the ranks of the world's most water-scarce nations as early as 2047. Yet assessment shows that average annual per capita availability of water (under business-as-usual scenario) will reduce to 1,140 m³/year in 2050, which stood at 5,177 m³/year in 1951 and reduced to 1,820 m³/year in 2001 further plummeting to just 1,545 m³/year by 2011. This means there has been a decline of 70% since 1951.

Consequent to this growth induced demand and anthropogenic factors, the sector focus of water resources

in India will need to transit to managing water scarcity and improving use efficiency and productivity.

increasing water use in river basins lead to build up of pressure from demand on water resources and how technical and institutional arrangements may be adapted to cope with this pressure. Based on the changes in technical and institutional arrangement adopted in the water sector, four broad phases have been identified of river basin management: (i) Development; (ii) Utilization; (iii) Allocation; (iv) Restoration./ In each of these management phases different needs and therefore different technical, institutional and organizational structures exist.



MANAGEMENT PHASES OF RIVER BASIN

In the development phase the amount of naturally occurring water is not constrained and expansion of demand drives the need for construction of new infrastructure, with relevant organizations heavily involved in planning, design and construction of water resources projects. Civil engineers dominate the development process. As water becomes scarce due to growing demand, additional spare capacity is created through the construction of more infrastructure, particularly dams, resulting in steep changes in the amount of water available for use.

In the utilization phase the infrastructure is established and the broad goal is to make the most out of these facilities. Creation of additional supplies through further construction activities is constrained and thus increased attention is paid to water management to save water and optimize productivity of available water. In this phase organizations are primarily concerned with management within discrete units for irrigation, water supply, industry, hydro-electric power, etc.

In the allocation phase, as depletion approaches the potential available water there is limited scope for further development. Various measures are taken to maximize the productivity of water and managing demand becomes an issue. With little opportunity for making real water savings, reallocation of the available water from lower to higher priority/ value uses takes place. Organizations are primarily involved in allocation, conflict resolution and regulation, with several management and regulatory functions gaining prominence, such as inter-sectoral allocation and water trading. Coordination between the different, competing interests becomes an issue and moves are made to form

coordinating bodies for river basin management to resolve conflict and facilitate management.

During the restoration phase, efforts are made to reestablish a sustainable equilibrium between the river basin and its renewable resources. In many cases water is being abstracted beyond the renewable resource, this is particularly the case with groundwater where the resource is mined and groundwater levels fall year-on-year. Measures here may include tight controls on groundwater abstraction, taking irrigated areas out of production and limiting industrial development in the river basin. Some technical interventions may be possible in this phase, such as inter-basin transfers or groundwater recharge, but regulation (particularly enforcement) and management will likely play the largest roles.. Political involvement is also required where tough decisions are required to return the basin to a balanced situation.

It may be anticipated that increasingly states and river basins in India will progress into the allocation and restoration phases as the country grows to become a developed economy with world's 3rd largest GDP with a huge urbanized and middle-class population by 2047. This presents a challenge for India's water resources sector across all areas of use (agricultural, drinking water, industry, and energy), to ensure that it does not become a roadblock for the India@2047 vision. Using appropriate technological, institutional, management and economic interventions, managing water scarcity and improving use efficiency and productivity will emerge as the primary sector strategy and areas of investment.

More Storage Capacity For Better Managed River Basins – New Projects And Completion Of Incomplete Irrigation Projects

Despite the huge investment made in developing the irrigation potential in India through construction of irrigation projects and command area development, there still remain a number of such projects across different states/ UTs which are either under construction / or incomplete for a long time due to lack of resources or other bottlenecks.

To complete the incomplete irrigation projects, government of India has launched specific programs like Accelerated Irrigation Benefit Program in 1996-97 to complete the incomplete irrigation projects. Subsequently, during the year 2015-16, the centrally sponsored scheme Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) was launched with an aim to enhance physical access of water on farm and expand cultivable area under assured irrigation, improve on-farm water use efficiency, introduce sustainable water conservation practices, etc. PMKSY is an umbrella scheme, consisting, inter alia, of two major components namely, Accelerated Irrigation Benefit Programme (AIBP) for completion of irrigation projects, and Har Khet Ko Pani (HKKP) for on farm development of irrigation facilities

Yet of the 110 irrigation projects been taken up under the PMKSY-AIBP, only 50 projects have been completed and the remaining 60 are still under implementation. In addition, there are many projects started by state governments which are yet to be completed. Faster implementation of these projects would assist in better managed river basins.

It is crucial for India's development and progress to liberate agriculture from monsoon fluctuations and allow farmers to conduct their trade with assured and reliable irrigation services. Delay in completing the irrigation projects translate into loss of income for farmers, reduced food security for people and depressed agricultural growth and GDP. Hence, priority needs to be given in allocating public funds and enhancing investments to the necessary levels in completing these on-going and under construction irrigation projects in a time bound manner, both in terms of main distribution system (dams, canal networks, etc.) and the on-farm works (field channels / field drains).

Further, completing the on-going and under construction irrigation projects will enable the water managers to store, transfer and deliver water with greater certainty, thus reducing the impact of uncertainty in terms of climate change impacts and facilitate states and river basins to

progress into the allocation and restoration phases of water sector management and governance, preparing India all the better for its future water security.

Inter linking of rivers - National Water Grid

The idea behind the interlinking of rivers is that many parts of the country face problems of drought while many others face the problem of flooding every year. The Indo-Gangetic rivers are perennial since they are fed by rains and the glaciers from the Himalayas. The peninsular rivers in India are, however, are more seasonal in nature as they are rain-fed mainly from the south-west Monsoons. Due to this, the Indo-Gangetic plains, more often than not, suffer from floods while the peninsular states suffer from droughts. If this excess water can be diverted from the plains to the peninsula, the issue of floods and droughts can be managed to a large extent.

The National River Linking Project (NRLP) envisages the transfer of water from the water-excess basin to the water-deficient basin by interlinking 37 rivers of India by a network of almost 3000 storage dams. This will form a gigantic India National Water Grid. There are two components to this project:

- Himalayan Component (14 Projects)
- Peninsular Component (16 Projects)

Under the Himalayan component of the NRLP, there are 14 projects in the pipeline. Apart from controlling flooding in the Ganga-Brahmaputra River system, it will also benefit the drought-prone areas of Rajasthan, Haryana and Gujarat. This component has two sub-components:

- Connecting the Ganga and Brahmaputra basins to the Mahanadi basin
- Connecting the Eastern tributaries of the Ganga with the Sabarmati and Chambal river systems

The Peninsular component of the NRLP envisages the linking of the 16 rivers of southern India. Surplus water from the Mahanadi and the Godavari are proposed to be transferred to the Krishna, Cauvery, Pennar, and the Vaigai rivers. Under this component, there are four sub-component linkages:

- Linking Mahanadi and Godavari rivers to Cauvery, Krishna, and Vaigai river systems
- Ken to Betwa river, and Parbati and Kali Sindh rivers to Chambal river
- West-flowing rivers to the south of Tapi to the north of Bombay
- Linking some west-flowing rivers to east-flowing rivers



The Inter-linking of Rivers has many challenges like sub-project feasibility, environmental impact management, inter-state disputes, international disputes, financial resources, and implementation capacity. A dedicated national agency with state participation and time bound programs with financial resources is essential to meet the objectives of the program and accommodate the demands of a dynamic economy.

Interlinking of Rivers In Andhra Pradesh – Godavari-Krishna Link and Krishna-Pennar Link

The Krishna and Pennar river basins are closed basins as the dependable water yields are fully utilised for irrigation, industry and drinking water. Moreover, part of the Pennar river basin is drought prone area with rainfall of about 600 millimetre per year. On the other hand, the Godavari river basin has surplus water due to multiple technical constraints on utilization and as result more than 2000 TMC water flows into the sea every year. Therefore it was envisaged to create a link to transfer surplus water of Godavari river to Krishna river which in turn to be

transferred to drought prone areas of Pennar river basin. The government of Andhra Pradesh, in record time and as a first in the country, completed the Pattiseema Lift Irrigation Project on Godavari river to transfer 80 TMC surplus water travelling over 174 km to about 12 lakh acre ayacut of Krishna delta, downstream of Nagarjuna Sagar project. As a result, this saving of 80 TMC of water in Krishna basin could be transferred through Pothireddypadu regulator upstream of Nagarjuna Sagar and Srisailem projects, to Pennar basin via a network of canals, balancing reservoirs, major, medium and minor irrigation projects. Upon completion, Polavaram project will transfer this water through a gravity canal.

Managing Ground Water Sustainably

In the latest assessment in 2022 by the Government of India, the total annual ground water recharge has been assessed as 437.60 bcm. Keeping an allocation for total natural discharges at 36.85 bcm, the annual extractable ground water resource works out as 398.08 bcm. The total annual ground water extraction (as in 2022) has been assessed as 239.16 bcm. The average stage of ground water extraction for the country as a whole works out to be about 60.08%.

The extraction of ground water for various uses in different parts of the country is not uniform. The 7,089 assessment units (blocks/ districts/ mandals/ talukas/firkas) in the country are in different stage of ground water extraction.

Sl. No.	Category	Number of Assessment Units		Recharge worthy Area		Annual Extractable Ground Water Resource		
		Number	%	lakh km	%	bcm	%	
1	Safe	4,780		67	16.18	66	291.88	73
2	Semi Critical	885		12	3.03	12	47.00	12
3	Critical	260		04	0.77	3	13.02	3
4	Over-Exploited	1,006		14	4.30	17	46.05	12
5	Saline	158		02	0.40	2	NA	NA
	TOTAL	7,089			24.69		398.08	

The over-exploited assessment units are mostly concentrated in (i) the north western part of the country including parts of Punjab, Haryana, Delhi and Western Uttar Pradesh where even though the replenishable resources are abundant, there have been indiscriminate withdrawals of ground water leading to over-exploitation; (ii) the western part of the country, particularly in parts of Rajasthan and Gujarat, where due to arid climate, groundwater recharge itself is limited, leading to stress on the resource and (iii) the southern part of peninsular India including parts of Karnataka, Tamil Nadu, Telangana and Andhra Pradesh, where due to inherent characteristics of crystalline aquifers, the ground water availability is low.

The main source of replenishable ground water resources is recharge from rainfall, which contributes to nearly 61% of the total annual ground water recharge and the share of recharge from 'Other sources' viz. canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures summed is 39%.

It may be recalled that currently groundwater provides 85% of the country's rural drinking water and about 60% of its irrigation water. Moreover, it is anticipated that a substantial part of increasing demand of water will have to be met from ground water sources leading to higher stress and over exploitation. As a result, IWMI projects that by 2050, groundwater tables would fall significantly in 10 river basins which are home to 80% of India's total population.

To prevent water from becoming a bottleneck in India's economic and social development,

the government must implement a long-term program of sustainable ground water management.

These may include both supply and demand side interventions ranging from technical, institutional, regulatory, productivity and management actions, especially through improved data-driven decision making and participation of all stakeholders for all user sectors. Several states have successfully piloted such interventions demonstrating feasible strategies with reliable positive results. It may be necessary to critically review all these interventions and develop a comprehensive program for sustainable management of ground water within an aquifer and river basin framework.

Managing Water Pollution - Water Recycling – "Creating" Water

Water pollution is one of the biggest emerging water resource issues facing India right now. While untreated sewage is the biggest source of such form of pollution, there are other sources too such as runoff from the agricultural sector (fertilizer contaminated) as well as unregulated discharges from industry, primarily the small-scale industries. Almost 80% of India's waterbodies are considered to be severely polluted, and the situation is so dire that it's possible there is no water body in India that has not been contaminated to some level or another.

The single biggest source for water pollution in India is urbanization which is happening at an unregulated rate across the country. This has led to several environmental

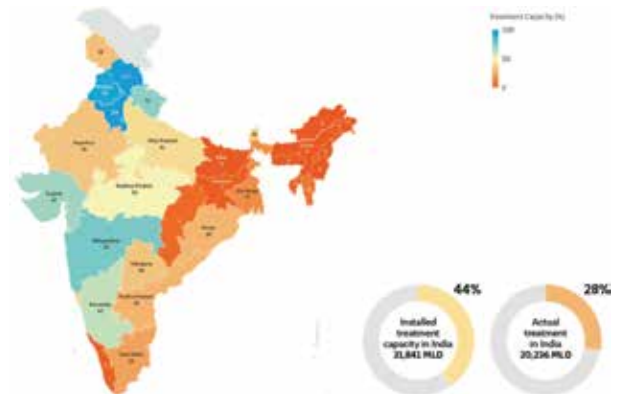
issues like paucity in water supply, generation and collection of sewage and waste water, etc. to name a few. The treatment and disposal of sewage and wastewater has also been a major issue in this regard. In most cases, cities and towns use the neighboring water body – river or lake, etc. as the disposal site with or without treating the sewage and waste water, leading to high pollution levels in these water bodies. Urban polluted water also seeps through the surface and poisons the groundwater.

About 35% of India’s total population is concentrated in urban centers, where the estimated sewage and wastewater generation is 72,368 million liters per day (MLD) (CPCB 2021). This estimate is almost double of its rural counterpart, which is 39,604 MLD, making the total sewage and waste water generation in India to 111,972 MLD.

Inadequate and limited sewage and wastewater treatment facilities pose a threat to water quality and public health. In India, the total installed capacity to treat wastewater (domestic sewage) from the urban areas is 44%. However, actual treatment being done is only about 28%. Even in class I (whose populations are above 100,000) and class II (whose populations are in the range 50,000–100,000) towns - which represent 72% of the urban population - only 30% of the sewage and wastewater is treated. The remaining untreated wastewater is discharged into natural water bodies, such as rivers and lakes, which leads to pollution and impacts the water quality, especially for the communities in the downstream areas.

Nevertheless, India has made substantial progress in strengthening its operational treatment capacity, from only 18,883 MLD in 2014 to 26,869 MLD in 2020, which is an increase of over 40%. But there is still a long way to go before we can effectively manage sewage and wastewater and meet the problems posed by water contamination from the dumping of untreated sewage and waste water.

Sewage Treatment Capacity in Most States is Below 50% of Sewage Generation



Promoting Recycling of Water

As mentioned above, the severity of water crisis in India is increasing with each passing day. The reuse of treated waste water (TWW) can act as a crucial resource to meet the rising demands across different sectors. However, TWW reuse is very limited even in the major urban agglomerations of the country. For instance, it is 49% in Chennai, 19% in Delhi, and 6% in Hyderabad (IWA 2018). Although India’s sewage treatment capacity has seen an increase of over 40% in the last few years, there is still a significant gap in terms of mainstreaming TWW reuse across different sectors. However, TWW is receiving increasing traction. If treated (to the desired quality standard) and reused, this offers tremendous potential in addressing the water supply and demand gap on one hand and reducing the pressure on freshwater resources on the other.

According to an analysis based on urban population projections (using data from MoHUA 2019) and considering that 80% of water supplied to domestic users in urban areas returns as waste water (CPCB 2021), sewage generation is estimated to more than double by 2050 from the sewage generation level of 2010. India should aim at about 80% of the sewage being recycled for multiple non-potable usage which seems feasible, given the accelerated addition to the sewage treatment capacity in India over the last few years (2014–20). This TWW water is equivalent of irrigation requirement of about 5 million Ha. The reuse of TWW for irrigation presents an opportunity to reduce pressure on groundwater and also to minimize fertiliser use on account of the inherent nutrient value of waste water, assuming that secondary treated waste water will be used for irrigation.

However, the reuse and recycling of TWW has still not become mainstream in India. Only a few Indian states have framed policies and guidelines to promote the reuse of TWW. Further, a national-level framework on the safe reuse of TWW that provides guidelines on preparing reuse policies was launched only as recently as January 2023. Therefore, the existing state policies might also require a thorough revision to make them comprehensive and channel the financial and technical support available through national programs. The central and state governments may also consider providing incentives to private investors under PPP projects to promote reuse of TWW and support awareness generation campaigns amongst the people and other stakeholders to create a willingness and demand for TWW reuse. In the future, commercialization of desalination of sea water will open new avenues for water supply augmentation.

EPILOGUE

Forging Coalition for Definitive Future Actions

The present publication provides a summary synopsis of the thinking of Shri Nara Chandra Babu Naidu, Chairman, Global Forum for Sustainable Transformation and within GFST on the 5 issues of

- Indian Economy as Global Economy - Indians As Global Citizen and Indian Inc as Multinational;
- Demographic Management and P4 Model of Welfare;
- Technology and Innovation - Leaders of Future,
- Energy Secure India - Democratisation, Decarbonation and Digitalisation; and
- Water Secure India;

The team consider as significant strategic areas for consideration for India 2047. As mentioned by Shri. Naidu in his Foreword, the publication is not meant to be a comprehensive compendium of all actions to be taken for India to become a developed economy by 2047, but as a catalyst to ignite wide-ranging discussions and action amongst the stakeholders, not only on these 5 ideas but also on others' ideas by other groups/ people in accordance to their respective priority thinking.

Shri. Nara Chandrababu Naidu is releasing the draft version of the present publication on August 15th, India's Independence Day to seek reviews and comments from all concerned stakeholders - think tanks, corporates, research and academic institutions; public leaders, people in general, students, etc. It is hoped that overtime GFST will be able to forge partnerships with like thinking groups and people in taking these and other emerging ideas forward to fruition through definitive actions.

To facilitate such partnership building, GFST will establish and host multiple communication platforms for exchange of knowledge and ideas. It will set up Task Force/ Working Groups around each of the 5 strategies proposed here by inviting sectoral thinkers and practitioners to join and contribute. GFST will also create and host five online discussion groups around these 5 strategies to make ease for contributors to provide their inputs. A series of stakeholder consultations/ symposium/ webinars/ etc. may be organized by GFST for more structured discussions on specific aspects to elicit specific inputs towards finalizing the 5 strategizes. Based on reviews, comments, inputs received across all these multiple communication platforms, GFST will then consolidate the ideas and revise it into a final publication for forging coalition for definitive future actions.

To take this initiative in formulating the 5 Ideas for India 2047 to a successful and doable conclusion, GFST hence solicits your time, knowledge and experience in putting together a sincere effort towards a vision of DEVELOPED INDIA by 2047.





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