Energy Security Challenges:

Non Traditional Security Planning in India

CPPR® Centre for Public Policy Research

CPPR-Centre for Strategic Studies

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In keeping with these traditions, CPPR launched its focus study centre in the arena of security and strategy, the CPPR-Centre for Strategic Studies in August 2013. The CSS is an interdisciplinary academic study centre focusing on strategic positioning and policy making in the South Asian region. Special attention is given to the relationship between politics, geography and natural resources, economics, military power, and the role of intelligence, diplomacy, and international cooperation for security and defence.

Important fields of research include energy and maritime security, strategy, terrorism, inter-state and inter-country cooperation and extremism, developing resources and building expertise on matters relating to national security, Centre-State relations and responsibilities, surveillance and security systems are also key areas of focus. The Centre has been hosting eminent experts in the strategic domain and have been organising national and international seminars, workshops and conferences on the emerging themes within its domain. CPPR CSS aims to develop a niche in the area of strategy through these knowledge building process and assist the state in its activities.

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Abbreviations and Acronyms

ADB	Asian Development Bank
AERB	Atomic Energy Regulatory Board
ANERT	Agency for Non-conventional Energy and Rural Technology
APEC	Asia Pacific Economic Cooperation
APM	administrative pricing mechanism
ASEAN	Association of South East Asian Nations
BARC	Bhabha Atomic Research Centre
BHAVINI	Bharatiya Nabhikiya Vidyut Nigam Ltd.
BJP	Bharatiya Janata Party
BP	British Petroleum
CAGR	compound annual growth rate
CDM	Clean Development Mechanism
CEERA	Centre for Environmental Law, Education, Research and Advocacy
CERC	Central Electricity Regulation Commission
CEA	Central Electricity Authority
CFL	compact fluorescent lamp
CII	Confederation of Indian Industry
CLNDA	Civil Liability for Nuclear Damage Act
CNG	compressed natural gas
CPPR	Centre for Public Policy Research
CTBT	Comprehensive Test Ban Treaty
CSC	Convention on Supplementary Compensation (on nuclear damage)
CSCAP	Council for Security Cooperation in the Asia Pacific
CWET	Centre for Wind Energy Technology
DAE	Department of Atomic Energy
DG	distributed generation
DGH	Directorate General of Hydrocarbon
DOE	Department of Energy (US)
ECB	external commercial borrowings
EIA	Energy Information Administration
EIA	Environment Impact Assessment
EMC	Energy Management Centre
E&P	exploration & production
ESCO	Energy Services Company
FBR	fast breeder reactor
FERC	Federal Energy Regulatory Commission

FDI	Foreign Direct Investment
FICCI	Federation of Indian Chambers of Commerce and Industry
FTA	Free Trade Agreement
GAIL	Gas Authority of India, Ltd
GBI	generation-based incentives
GDP	gross domestic product
GHG	greenhouse gas
GIC	General Insurance Corporation
GOI	Government of India
HNLU	Hidayatullah National Law University
IAEA	International Atomic Energy Agency
IAF	Indian Air Force
IDSA	Institute for Defence Studies and Analyses
IEA	International Energy Agency
IPP	independent power producers
IT	information technology
IREDA	Indian Renewable Energy Development Agency
JNNSM	Jawaharlal Nehru National Solar Mission
KG	Krishna-Godavari (basin)
LNG	Liqueified natural gas
MCA	Maximum Credible Accident
MNRE	Ministry of New and Renewable Energy
MRTP	Monopolies and Restrictive Trade Practices (Act)
MSEB	Maharashtra State Electricity Board
MTCR	Missile Technology Control Regime
MOEF	Ministry of Environment and Forests
MOOTW	military operations other than war
NAPCC	National Action Plan on Climate Change
NATO	North Atlantic Treaty Organisation
NATCOM	National Communication (project)
NELP	New Exploration Licensing Program
NERA	National Economic Research Associates
NES	Nuclear Event Scale
NFU	No First Use (policy)
NGIMA	National Greenhouse Gas Inventory Management Authority
NGIMS	National GHG Inventory Management System
NHPC	National Hydro-electric Power Corporation
NIST	National Institute of Science and Technology
NLSIU	National Law School of India University

NPCIL	Nuclear Power Corporation of India Limited
NPT	Non-Proliferation Treaty
NSG	Nuclear Suppliers Group
NSRA	Nuclear Safety Regulatory Authority
NTPC	National Thermal Power Corporation
NTS	non-traditional security
OAPEC	Organization of Arab Petroleum Exporting Countries
OMC	oil marketing company
ONGC	Oil and Natural Gas Commission
OPEC	Organization of Petroleum Exporting Countries
PACE	Partnership to Advance Clean Energy
PEACE	Promoting Energy Access through Clean Energy
PGCL	Power Grid Corporation Limited
PLF	plant load factor
PRB	Powder River Basin
PSC	production sharing contract
PWR	pressurized water reactor
RBI	Reserve Bank of India
R&D	research and development
RE	renewable energy
REC	renewable energy certificate
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RPO	renewable purchase obligation
SARI-E	South Asia Regional Initiative-Energy
SDA	State Designated Agency
SEB	State Electricity Boards
SEC	specific energy consumption
SEEM	Society of Energy Engineers and Managers
SERC	State Electricity Regulation Commission
SEZ	special economic zone
SIPS	Special Incentive Package Scheme
SNA	State Nodal Agency
T&D	transmission and distribution
TAPI	Turkmenistan-Afghanistan-Pakistan-India (pipeline)
TERI	The Energy and Resources Institute
UNFCC	United Nations Framework Convention on Climate Change
UPA	United Progressive Alliance
WEC	World Energy Council
WTO	World Trade Organization

Foreword

The International conference on *Energy Security Challenges–Non Traditional Security Planning in India* was yet another attempt by the Centre for Public Policy Research (CPPR), to focus on one of the most challenging themes of current times. Given its global outlook and ramifications, energy security demands an integrated approach and strategic positioning, especially for a country such as India.

Several factors have contributed to the unprecedented predominance that the energy security debate has achieved in international dialogue and diplomacy: the growth of new economic power centres; the fluctuating price of fossil fuels over the last three years; global warming due to climate change; the threat of terrorism, instability in some exporting nations; power blackouts and chronic shortages of power in several countries. Power blackouts have occurred on the east and west coasts of the United States, in Europe and in Russia while chronic shortages of electric power are being faced by China, India and other developing countries. Given the fundamental need for energy to fuel a country's economic growth[1], these power crises have caused concern not only about the reliability of electricity supply systems, but also raised fears of a scramble for energy supplies and heightened geopolitical rivalries.

Thus the situation at the global level does not seem very positive. However, there have been attempts by several countries to streamline and reassert state control by installing new transportation channels and pipelines, hoping to offset the stark scarcity of their domestic resources through diversification, trade and investment in the energy sector.

“Energy independence" is a phrase that has become a mantra since it was first articulated by Richard Nixon four weeks after the 1973 oil embargo was put in place. This national aspiration had long been at odds with reality for the United States. The real mood and the state of the nation was captured by President Obama in 2009 when he stated, “At a time of such great challenge for America, no single issue is as fundamental to our future as energy” In recent years, new energy suppliers, technological developments like hydraulic fracturing and the US shale gas boom have redrawn the global energy scenario and caused significant geopolitical shifts.

That energy issues are fundamental to India's future is an undeniable fact. The country's energy imports come at the cost of 7% of its GDP and is more often ruptured by the country's balance of payment, which takes an ugly turn with the fluctuations in the energy market. India, the world's fourth largest energy consumer, imports 80% of its crude oil and 25% of its natural gas requirements. Around 600 million Indians do not have access to electricity and about 700 million Indians use biomass as their primary energy source for cooking, according to Indian Government sources.

India's energy demand is expected to become more than double, from below 700 million tonnes of oil equivalent (mtoe) in 2013 to around 1,500 million tonnes of oil equivalent by 2035[2], according to estimates made by the oil ministry. Hence, the issue of energy security is undoubtedly a major concern for India as well as the United States.

It is in this context that the CPPR-Centre for Strategic Studies, organized this international conference with the support of the United States Consulate in Chennai. Petronet and the Indian Oil Corporation were the two associate sponsors that took an active interest in this conference and extended their sponsorship. Petronet LNG Ltd is one of the fastest growing world class companies in the Indian energy sector. The Indian Oil Corporation and its group of companies is India's largest commercial enterprise, operating ten of India's twenty refineries.

Distinguished panelists spoke on various energy-related themes during the conference. There was also excellent participation from practitioners, academicians, activists, security agencies, especially the Indian Navy, representatives of the departments of energy and public sector undertakings (PSUs) dealing with power, as well as entrepreneurs and students.

Public interest in energy security was so high that this conference was oversubscribed and CPPR was forced to limit registrations due to its own constraints. The active interest evinced by various quarters put additional responsibility on both organizers and participants and the conference witnessed animated interactive discussions on key issues pertaining to India's energy security quest.

As more and more nations recognize the importance of non-traditional security planning and focus increasingly on issues such as energy to enhance national security, it is worth recalling the words of US Founding Father Benjamin Franklin, who observed in a letter written in 1783: "*...in my opinion, there never was a good War, or a bad Peace. What vast additions to the Conveniences and Comforts of Living might Mankind have acquired, if the Money spent in Wars had been employed in Works of public utility!*"

Indeed the time has come to turn away from big-budget spending on weapons and military hardware and focus on non-traditional aspects of security such as energy. Investing heavily in that most vital public utility of the 21st century will not only fuel economic growth and boost prosperity levels but also strengthen national security significantly.

[1]Foreign affairs, http://www.foreignaffairs.com/articles/61510/daniel-yergin/ensuring-energy-security

[2] IDSA, NTS Newsletter, Vol 1, No.4, 2013

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Introductory Remarks

Dr. D.Dhanuraj

The subject of non-traditional security (NTS) gained prominence in strategic discussions only after the end of the Cold War and the dissolution of the USSR. Yet it does not mean that the tenets of non-traditional security – ranging from climate change to transnational crime to poverty and gender security – never existed prior to that. So, why has the subject of non-traditional security become so important? The so-called 'soft' threats such as hunger and malnutrition, lack of safe drinking water and proper sanitation, as well as endemic diseases kill millions of people around the globe every year, far more than the traditionally perceived threats to security. Energy security constitutes a crucial challenge that shapes and realigns strategic relationships between countries. It is therefore imperative to focus on these non-traditional security challenges and deal with them effectively in the larger interests of national security. This broad-based approach has prompted the Centre for Public Policy Research (CPPR) and its focus study centre, the Centre for Strategic Studies to conduct in-depth research, analysis and policy studies aimed at integrating NTS into major discussions on security and strategy.

With the current Indian government and the international community giving high priority to energy security, CPPR considered it appropriate to discuss and propose a framework for the government to identify, strategize and tackle energy security challenges. The CPPR's international conference on *Energy Security Challenges: Non Traditional Security Planning in India* sought to accommodate varied opinions and highlight ways to strengthen strategic planning in the energy domain as a facet of non-traditional security. The conference, supported by the US Consulate, Chennai Region attracted participation by practitioners, academicians, policy makers and energy specialists. The presentations, discussions and deliberations were geared towards bringing non-traditional security planning into the mainstream discourse on national security.

Energy Security Complexities and Challenges

The strategic linkage between energy resources and comprehensive national security is self-evident. Energy security involves the reliable, stable and sustainable supply of energy at affordable prices and social costs. Energy resources are considered crucial assets for economic, social and military development. Almost every activity that augments a country's economic and political power is dependent on reliable access to energy and efficient utilization of energy resources. Exploring and implementing long-term sustainable solutions in this complex field are vital to promote peace and economic growth.

India's fragile energy security is under severe pressure due to several factors: rising dependence on imported oil, regulatory uncertainty, opaque natural gas pricing policies, limited pool of skilled manpower, poorly developed upstream infrastructure and continuing dependence on fossil fuels as the dominant source of energy for the near future. A truly integrated and consistent energy security policy is critical to guide and direct India's energy sector.

The Energy-Environment Conundrum: The Indian Dimension

Although environmental sustainability has only recently emerged as an energy policy issue, the magnitude of energy impacts on environmental systems suggests strong links to energy security. Unchecked growth in fossil energy consumption and the ensuing acceleration in global climate change as well as related air and water pollution constitute threat multipliers that impinge on national security on a global scale. These environmental dimensions are just a subset of a larger array of ecological concerns that threaten energy security, including degradation of arable land, dwindling forest cover and loss of biodiversity. Our burgeoning population with its growing industrial and energy needs makes it imperative to pursue aggressive development while managing emissions growth and promoting cutting-edge clean technology industries. India has been struggling to balance the huge demand for energy with environmental concerns. Confusion has often been manifested in the clearance of energy projects due to stifling opposition, bureaucratic hurdles and the need for Environment Impact Assessment (EIA).

India's Future with Alternative Sources of Energy Generation

Renewable energy forms an increasingly important part of India's energy mix. Given its vast potential, renewable energy is no longer seen as an alternative energy source to conventional energy, but as a critical element in pursuit of key policy objectives (MNRE, 2011a). It enhances India's energy security by diversifying its energy mix and reducing import dependence on fossil fuels. Solar power, in particular, is viewed as having the potential for India to attain energy independence in the long run. Currently, India is facing challenges in the availability of technology and skills as well as the competency in manpower and service providers needed to provide quality service at a competitive cost. In providing energy access to the Indian masses, renewable energy is expected to meet basic needs, especially in rural and remote areas.

Nuclear Power in India: Issues and Challenges

India's energy demands are skyrocketing in line with economic growth. In order to meet the growing demands in the power sector, the Government of India (GOI) plans to induct nuclear plants into the overall energy strategy. Nuclear energy has always featured significantly in discussions on meeting India's energy needs. The Indo-US nuclear deal was a watershed agreement in this context. However, the deal had run into some implementation hurdles, mainly on the issue of supplier's liability, that needed to be resolved. The GOI plan documents envisage having 14,600 MWe nuclear capacity on line by 2020 and aims to supply 25% of electricity from nuclear power by 2050. However, the installation of nuclear plants has run into resistance from the local population at several locations. Environmental issues and nuclear safety concerns are the main stumbling blocks for development of this sector. Following India's civil nuclear deal with Australia signed in September 2014, and the diplomatic breakthrough achieved during the visit of US President Barack Obama in January 2015, the future nuclear energy road map looks more promising.

Managing India's Energy sector

Several policy reform initiatives over the past two decades have shifted India's energy sector from a predominantly government-owned system towards one based on market principles, offering a more

level playing field for both public and private sectors. Political complexities and traditional socialist economic practices have hindered the complete liberalization of India's energy sector, leading to sub-optimal outcomes in efficiency and the management and pricing of key energy resources. Professional management must be able to operate freely, based on sound market analysis and economic deliberations. The participating entities should be allowed to embrace the latest energy technology and improve their managerial expertise. Effective policy implementation must be made possible through improved bureaucratic and administrative processes in order to ensure timely completion of energy projects.

India still lacks a national energy security agency established on the basis of an Integrated Energy Policy. The Government has adopted a deregulation and liberalization policy, which includes a new exploration licensing policy and dismantling of the administrative pricing mechanism (APM). It should take appropriate legal, fiscal and regulatory steps to create a more attractive environment for foreign investors such as streamlining the license approval process for private power producers, offering more incentives for upstream oil and gas exploration and promoting joint ventures.

Regulatory Systems and Pricing Issues

The current rigid pricing-setting mechanism, which is *de facto* determined by the government, is a major impediment to energy security. Regulatory systems based on sound market principles are essential to ensure freedom from political influence. End-use pricing should support the government's policy for demand-side management and facilitate a rational allocation of resources along the value-chain. The power sector faces a shortage of fuels, insufficient infrastructure and financial weakness of state-owned power companies due to distorted pricing mechanisms and systemic weakness in enforcing legitimate revenue realization. The cost-plus principle does not offer incentives to power generation companies to improve and invest in energy efficiency. Poorly targeted subsidy mechanisms, under which power tariffs are kept artificially low, fails to reach the most needy sections of society, while it sends the wrong signals to those who can adjust consumption to price changes.

Conference Objectives and Activities

The main objectives and activities that the CPPR conference aimed to achieve are: mapping of information sources on Indian energy security issues; gathering data and publications on a regular basis from such sources and storing them in a database; conducting energy security studies and developing capacity on multiple fronts; developing strategies to tackle energy security challenges and address multiple issues in identified fields; developing consultancy capabilities and formulating plans for governments; building up public awareness on energy security through multiple knowledge-dissemination platforms; bringing various energy security stake holders to a common platform to discuss the issues, challenges and prospects of linking energy to the national security framework; proposing better linkages between the national security framework and energy security challenges; and proposing a framework for better and effective management of non-traditional security within the national security framework.

India's Energy Security: Prospects for Indo-US Energy Trade

Tom Cutler

The concept of energy security can mean many things. In its simplest terms, energy security may be defined as having adequate supplies of reliable energy at affordable cost. However, beyond this basic definition there are a multitude of factors that come into play in determining a nation's energy security. There is no set formula for attaining energy security. Every nation is different but in every case, the challenge faced by policy makers is that energy security is inextricably intertwined with economic policy, social policy, the environment, technology, national defense and foreign policy. For example, a common policy dilemma is how to balance energy security with environmental security, especially in nations that use a lot of coal such as India, the United States and China. Expanding energy access for its population and having reliable electricity supplies are also key drivers for India's energy security but new challenges are emerging.

This chapter will focus on India's growing dependence upon imported fossil fuels as an emerging vulnerability, and explore how America's growing export potential (stemming from the revolution in horizontal drilling and hydraulic fracturing) changes the calculus of India's energy security. India's most fundamental energy challenges are at home and require domestic solutions but there is a growing need for India to strengthen the international aspects of its energy security equation. As part of this strategy, the United States can be an increasingly valuable ally for India in its quest for energy security and economic prosperity since the US is poised to become an important exporter of coal, oil and natural gas, and a supplier of commercial technology for nuclear power.

India's Coal-centered Energy Scenario

Coal is king in India's energy scenario, accounting for almost half of the total energy consumption. Even though its per capita energy consumption is only about one-third of the global average, India is now the world's fourth largest energy consumer. India's demand for energy has increased dramatically in recent years propelled by the nation's economic growth of around 8% per year. Although this rate of growth is expected to slow down, the Energy Information Administration (EIA) projects that India's energy demand will continue to grow at 2.8% per year.[1]

The Asian Development Bank (ADB) projects that although the greatest growth in demand will be in the transport sector which is 93% supplied by oil, coal will remain the dominant fuel in India, accounting for a 43% share in 2035. Oil use will grow to 25% of demand while natural gas will register the biggest jump, growing at 4.8% annually to reach an 11% overall share of demand by 2035. Hydro-power will be about 2% and nuclear just under 4%, with renewables accounting for 15%.[2] The use of biomass, waste and other non-commercial fuels will decline over time as the country's population shifts from rural areas to urban cities.

Given the sheer scale of India's energy needs, priority should be given to moderating demand and making consumption more economically efficient. Thus, government policies that emphasize market pricing and promote energy efficiency can have a substantial impact on energy security as India's energy demand is expected to double over the next twenty years, supplied by growing consumption of high-ash coal-fired power and increased imports of oil, natural gas, coal and uranium.

New Vulnerability from Growing Fossil Fuel Imports

There has been a long term decline in India's domestic self-sufficiency in fossil fuels from 85% in 1990 to 62% in 2012. Looking ahead, India's imports of oil, gas and coal will increase significantly as domestic production fails to keep up with demand. The ADB projects that from 2010 to 2035, India's coal import dependence doubles from 16% to 33%, oil jumps from 76% to 92%, and gas, mostly LNG, grows from 20% to 36%. This trend of growing energy imports poses a new vulnerability that will form an increasingly important element in India's energy security challenge, as it can no longer insulate itself from market trends and energy events beyond its borders.

Increasing Coal Imports

A key concern is the alarming growth in coal imports because of its dominant role in India's energy demand and 2/3 of its power generation. Despite having almost 70 billion tons, the fifth largest coal reserves in the world, and being the world's third largest producer of over 600 million tons per year, India has been importing increasing amounts of coal. The country imported 142 million tons in 2012 and then 180 mt in 2013, and is now the world's third largest coal importer.

India's inability to satisfy its enormous appetite for coal stems from various bottlenecks in its domestic coal mining and transport sector which have increasingly compelled power plant operators to import more expensive foreign coal to satisfy their needs. This situation has been aggravated with the Supreme Court decision on September 24th, 2014 cancelling 214 out of 218 coal block allocations and the estimates are that coal imports in 2015 will be in the 220-240 million ton range, almost double what it was a few years ago.

Growth Potential of the US-India Coal Trade

Indonesia and Australia are the source of three-quarters of the coal imported by India, while last year the United States had a 5% share, supplying 9 million tons of mostly metallurgical coal out of the east coast port of Norfolk. Endowed with the world's largest coal reserves accounting for over one-fourth of the global supply base, the United States recently became the world's third-largest coal exporter due in part to the shale gas boom. Between 2009 and 2012 US coal exports more than doubled to a record 126 million tons and the EIA forecasts that US coal exports will increase to 169 million tons by 2040.

Most of this increase is expected to come from ports on the west coast supplied by the world's largest coal mine in the Powder River Basin (PRB). The PRB mine accounts for 40% of US steam coal output and the International Energy Agency (IEA) has speculated that it could be a “game changer in global

coal markets" if uncertainties due to infrastructure limitations are resolved. The IEA reports that if 150 mtpa of export capacity came on line it would have the short-term effect of decreasing international coal prices by up to $15/ton and that PRB coal can be "competitive under the right set of market conditions as and when the export rail and port links are built." Although PRB coal might not always be cost competitive for Indian importers depending upon market conditions, the United States can be a swing supplier across the Atlantic or the Pacific, and can have an indirect impact on global supply availability and pricing.

Uncertainty over Increased Powder River Basin Exports

Like India, the United States faces infrastructure bottlenecks in its coal sector, especially on the west coast, which lacks adequate rail and port links to maximize coal exports. Efforts are underway to build 50 million tons of additional coal export capacity in Oregon and Washington and the EIA estimates that another 100 million tons of rail and terminal capacity could be constructed. However, there is strong resistance by environmental groups and local residents to this new infrastructure in the Pacific Northwest that makes it uncertain whether it will be built or not. In fact, the IEA concluded in its 2013 Medium Term Coal Market Report that "while the Powder River basin is cost-competitive in Asian markets, we do not project significant exports, mainly because of infrastructure challenges" and does not even develop forecasts for PRB coal exports. While there are compelling economic and energy security benefits to PRB coal being exported it is uncertain when it could come fully on line. Thus, in the near term it seems likely that coal from US East and Gulf coast ports will be the primary source of US coal entering Indian power and steel markets.

Vulnerability due to India's Growing Reliance on Imported Oil

The IEA forecasts that India's demand for oil will grow faster than that of any other nation between now and 2035. India produces almost 1million b/d, half of which is off-shore, and that falls short of satisfying growing demand that reached 3.7 million b/d in 2013, according to the EIA. India is the world's fourth largest net importer of oil averaging more than 2.5 mbd with total imports reportedly reaching as high as 3.9 mbd. Saudi Arabia is the largest supplier with a 20% share, as the Middle East is the source of about two-thirds of India's oil imports.

To diversify its sources of foreign oil, India has pursued a strategy of having its state–owned energy companies acquire equity stakes in overseas exploration and production blocks. In addition, in order to increase domestic oil production India has relied upon the New Exploration Licensing Program (NELP) to attract greater levels of foreign investment and deep water expertise. Despite these efforts, the outlook is for domestic oil production to remain flat.

The bright spot is in the refining sector, where India has become "a global exporting hub of refined products" with a capacity of 4.35 mbd in 2013 that could reach 6.3 mbd by 2017. With India's west coast conveniently located near crude suppliers in the Persian Gulf, Indian refineries such as the Reliance refinery at Jamnagar are well positioned with their world-class facilities to economically process crude into products for markets as far away as the US east coast. However, over the next

decade or so, these surpluses will likely be absorbed by India's growing need for oil and additional capacity will be required if India is to avoid becoming a net product importer.

Meanwhile, the United States is poised to pivot from being an oil importer to also being an oil exporter as the shale gas boom has also sparked a renaissance in oil output, notably the production of "tight oil," that made the United States the largest oil and gas producer in the world in 2013.

Economics Favors US Crude Oil Exports

US oil production jumped almost 50% from 5 mbd in 2008 to 7.4 mbd in 2013, and will likely rise to 8.5 mbd this year, and 9.3 mbd in 2015. This surge in US oil production has led to a policy debate about repealing the ban on crude oil exports, which was enacted in 1975 by the Energy Policy and Conservation Act, at a time when price controls were in place. The rationale for the ban was that with domestic price controls on oil, prices in the United States might be less than in foreign markets, and thus oil might flow out of the country in search of higher returns.

Although President Reagan ended price controls on oil in 1981 the ban had no real impact since the United States did not have any oil surpluses to export. The recent surge in the US tight oil production, which is of a light grade, has caused distortions in the US refining sector which is calibrated to process heavy grades of crude. Many US refineries, mostly along the US Gulf Coast, cannot efficiently process large volumes of light oil and so the economic rationale for exporting the light oil has led to an effort to lift the ban.

Various studies point to the benefits of lifting the ban, including a million new jobs, a 3 mbd increase in US oil production, and lower gasoline prices. Proponents are urging Congress to lift the ban in 2015 as gross crude exports could exceed 2 mb/d within a year and climb to 4 mb/d within a decade (according to a NERA study commissioned by the Brookings Institution). If this occurs, India would benefit directly in terms of access to US crude oil while we are already seeing the price effects of more supply on the world market.

Despite Strategic Location India Needs More Emergency Oil Stocks

India's location near the Persian Gulf has strategic significance for its energy security not only in terms of its proximity to major oil and gas fields but also as a gatekeeper, since over 15 million barrels pass its shores every day en route from the Middle East to Asia. Robert Kaplan has estimated that 70% of the world's oil trade, 60% of LNG and 70% of coal trade is transported across Indian Ocean sea lanes and that the United States, India and China will inevitably compete for blue water dominance, thus raising questions about India's increased reliance upon sea borne trade in energy and the future US naval role as a guarantor of safe passage.

The threat of an oil supply disruption is a policy planner's nightmare and so India took a major step in 2005 when it decided to establish a strategic petroleum reserve, initially 37 million barrels at three

locations to provide a few weeks supply. These facilities (at Visakhapatnam, Mangalore and Padur) are expected to be completed by 2015 but will still have to be filled to become operational. The government has announced plans to build an additional 91 million barrels in storage capacity by 2017 so that by 2020 India will have crude stocks equivalent to 90 days of demand.[3]

India is not a member of the IEA and its oil sharing scheme but as it has become a major player in world oil markets, the IEA has reached out to New Delhi to establish links to ensure coordination among major consumers in the event of an oil supply emergency. The IEA and India have conducted a number of joint activities, including seminars on oil stocks (as has the DOE) and joint emergency response simulation exercises, and in October 2011 they signed a MOU for "Cooperation in Oil and Gas Security." These efforts will enable the development of Indian policy doctrine governing the deployment of its strategic stockpile to be informed by IEA principles. However, it seems that India will have to reach out more internationally as it is not a member of any multilateral group that addresses questions of emergency oil stocks and oil sharing.

LNG Import Option Pursued as Gas Pipeline Projects Stall

India's natural gas demand doubled between 2004 and 2011 since gas is seen as a clean alternative to coal in the power sector. Natural gas plants account for about 10 percent of India's total electricity generation capacity but many remain idle due to non-availability of gas, as domestic production has been unable to satisfy demand. Meanwhile, proposed projects to import gas by pipeline from Bangladesh and Iran have failed to materialize while a gas supply contract with Turkmenistan was signed in May 2012 but it is unclear if the proposed Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline project will ever get off the ground.

Owing to the lack of progress on gas import pipelines, India began to import LNG in 2004, and by 2012 LNG imports accounted for 29% of its demand of 2.1 trillion cubic feet. By 2013, India had become the world's fourth largest importer of LNG. More LNG imports are expected if the necessary infrastructure can be built and the domestic pricing system is revised to reflect market forces that might also help spur the development of India's indigenous unconventional shale gas resources.

India's quest for natural gas supply security has recently turned toward the United States which is an emerging exporter of LNG due to the shale gas boom. This strategy is designed not only to diversify supply sources but also in the expectation that relatively inexpensive US gas supply in world markets might result in lower prices even after factoring in the cost of shipping and conversion.

Shale Gas Boom Transforms US Gas Production Outlook

The shale gas revolution has transformed the outlook for natural gas production and trade in the United States in a relatively short period of time. Shale gas production amounted to 5 bcf/d in 2008 and it could end up this year being more than six times higher and reach 32 bcf/d. Shale gas now accounts for about 40% of US gas production, and this rate of growth is expected to continue such that EIA projects by the 2035-2040 timeframe, shale gas output could exceed 50 bcf/d.

Growth in US LNG Exports

The EIA forecasts that by around 2018, the US will become a net exporter of gas and by 2029, LNG exports will reach 3.5 tcf per year (15 bcf/d). Most of this increase will come from the Lower-48 states on the assumption that the US government will grant the necessary approvals for LNG exports under a law that was passed when natural gas reserves were thought to be in decline and domestic supplies were expected to be scarce, which is no longer the case.

Under the Natural Gas Act of 1978 the Department of Energy (DOE) has the authority to regulate natural gas exports and must automatically approve applications to countries with which the United States has Free Trade Agreements. For those countries with which it does not have FTAs, DOE must issue export permits unless after a period of public comment and open hearings, it finds such exports are contrary to the public interest. In addition, the FERC must also approve the siting of LNG export terminals so there are two main steps to the approval process.

The DOE has approved 36 applications for LNG exports of 38.2 bcf /day to FTA countries but not all of these projects will be built. Many of these proposed projects have also filed for non-FTA approval. The DOE has approved eight LNG projects to non-FTA countries with another 20 or so awaiting approval. These approved projects would export 9.5 bcf/day, if they are built to capacity. FERC authorization has been issued for four of the eight DOE approved LNG projects.

Although US laws regulating the approval process for LNG exports to non-FTA countries such as India cannot be changed without an Act of Congress, the DOE export review process has produced positive results. The Gas Authority of India, Ltd (GAIL) already has gas supply contracts in place for two LNG export projects which have received approval by DOE, the Cheniere Sabine Pass project which will supply 3.5 mt/y and Dominion Resource's Cove Point project which will supply 2.3 mt/y. In addition, Petronet has signed a 20-year contract for the supply of 4 mt/year from the Main Pass project, for which non-FTA approval is still awaited. The Reliance-BP joint venture “India Gas Solutions” has a 20 year contract for 4.4 mtpa with the planned Freeport project. Lastly, the Reliance-BP joint venture India Gas Solutions has a 20 year contract for 4.4 mtpa with the planned Freeport project.

Viable Power Sector Central to India's Energy Security

India will never reach its full potential so long as its economy is plagued by persistent electricity shortages and so the viability of the power sector is central to India's energy security. The deficits in peak load can be attributed to a number of factors including fuel shortages, high transmission losses, and the need for true market-based pricing so fuel suppliers and power generators can recover their costs and earn a profit that can be reinvested for greater growth. India has set ambitious targets for additional power generation capacity from nuclear and renewable sources but the country will still rely on coal for the foreseeable future.

Nuclear provides almost 4% of the nation's power supply and India is moving forward to expand this sector despite the Fukushima disaster, with plans to attain 60 GW of power generating capacity by 2030 compared to current capacity of about 5 GW. Although the civil nuclear deal has yet to fulfill its expectations of US firms building new reactors in India, the country has several new reactors of both domestic and Russian design under construction. Nuclear power is arguably a clean energy source but it is a matter of energy security that concerns over safety, security and waste disposal be continually addressed.

India is also working to increase the share of renewable power generation which stands at about 13%, excluding hydro power. While the deployment of solar and wind energy is very important, renewables cannot be expected to replace fossil fuels and nuclear for base load power but they can make a huge difference in rural areas not served by the grid. In urban areas, improved energy efficiency for buildings has tremendous potential for enhancing energy security since most of India that will exist in 2030 has not been built yet.

India will need $2.3 trillion in energy investment by 2035 according to the ADB. Thus, a key imperative for Indian energy security will be to develop an attractive investment climate that will give birth to large, capital intensive energy infrastructure projects all the way down to smaller sized projects embedded with cutting–edge technology. However, such progress is not without risk, as new energy security threats will arise as India's upgrades its energy systems. For example, the deployment of smart grid technologies will only heighten the risk of cyber-threats to the reliability of its energy infrastructure.

India sits at the geographic center of South Asia and as a major consumer of energy could benefit from intra-regional infrastructure links to deliver natural gas and electricity. The USG has recognized this need and sought to bring the parties together to promote greater regional integration and cross-border trade, notably through USAID's South Asia Regional Initiative-Energy (SARI-E).

The United States also works closely with India bilaterally in energy, and since 2011, the US public and private sectors have invested over $2.4 billion in clean energy projects. Indo-US energy cooperation features the US-India Energy Dialogue and the Partnership to Advance Clean Energy (PACE) which has established a Joint Clean Energy R&D Center which is a five-year, $125 million initiative to sponsor joint research in solar energy, energy efficiency in buildings and second generation biofuels. In addition, in September 2013 a new initiative was established to promote increased energy access named the “Promoting Energy Access through Clean Energy (PEACE)” program.

Changing Calculus of India's Energy Security

Many of the challenges facing India require the government to make difficult decisions requiring considerable political will. Although energy security begins at home, India's growing import dependence renders it increasingly vulnerable to developments beyond its borders, such as supply fluctuations and price volatility. Thus, India's changing calculus of energy security should include expanding the scope of its international cooperation. And as the shale gas revolution continues to

transform world energy markets and create new strategic alignments, the United States can become an increasingly valuable partner for India in its quest for energy security through various bilateral mechanisms already in place for energy cooperation and technology development, the prospect for increased energy trade and investment, and through closer coordination of high-level policies on the global energy stage.

Notes

1. See "India" Country Analysis, US Energy Information Administration (EIA), June 26, 2014, page 2. The link is: http://www.eia.gov/countries/analysisbriefs/India/india.pdf
2. See Asian Development Bank (ADB) "Energy Outlook for Asia and the Pacific", October 2013, co-published with APEC, pp. 261-267. The link is http://www.adb.org/sites/default/files/publication/30429/energy-outlook.pdf
3. Op cit, EIA, p. 12.

Strategic Dimensions of Energy Security

Shebonti Ray Dadwal

Once again, the world is witnessing major transformations in international energy markets that will have far reaching consequences not only for the global economy but also for international politics. Not only is energy security imperative for a nation's economic growth and prosperity, but having access, and indeed control of, abundant and affordable energy resources is often viewed as a currency for power. For years, the traditional industrialised powers used their access to global energy reserves – be it through international oil companies or state-owned companies -- to influence international politics. However, over the last few years, the energy landscape has seen rapid changes as energy markets tilted gradually towards emerging economies and away from the traditional western nations. Against the backdrop of this ongoing tilt, new developments in the oil and gas market are once again rewriting energy equations, with global economic and political consequences. Whether the resultant turbulence will push the players into a cooperative stance or force them into a more belligerent posture remains to be seen.

What are the factors that are linked to these emerging energy issues?

(1) New energy suppliers: New energy suppliers are entering the market, and changing the supply scenario, which had been traditionally dependent mainly on the volatile Middle East region. Apart from traditional oil and natural gas production coming from Africa, Latin America, the Eastern Mediterranean and Eurasia, supplies of unconventional or tight oil and gas are also coming into the market, threatening to unseat the Middle East sheikhdoms as prime producers. As a result, the Organization of Petroleum Exporting Countries (OPEC), which has traditionally played the role of oil price setter by fixing quotas for its member nations to ensure that oil prices are maintained at a price suitable to them, has now decided, albeit at Saudi Arabia's prodding, to maintain production in order to retain market share rather than cut output to increase the oil price. This decision has caused oil prices to go into free fall. In January 2015, oil prices were ruling at around $48 a barrel (for Brent crude) which reflects a 30 per cent drop from June 2014.

No doubt, the rationale behind OPEC's (mainly Saudi) decision to maintain production, was based on their need to discourage investments in new projects such as the Arctic, Canadian oil sands, US shale and Brazilian deep offshore projects. Moreover, Saudi Arabia, with its low production costs – at $4-5 a barrel -- and huge savings from revenues accrued during the era of high oil prices can afford to wait it out. However, other OPEC members may not have Riyadh's staying power. A substantial drop in revenues will make it difficult for the Gulf producers to sustain their welfare schemes, imperative for keeping their people from becoming restive. And if their concerns over the possible withdrawal of the US security umbrella are realized then the Gulf region can turn into a tinderbox of political volatility, which will in time spread beyond it..

Huge reserves have also been identified in the previously inaccessible Arctic region, and there is greater possibility of this area opening up in the not-too-distant future as a consequence of global warming.

(**2) Tilt towards emerging markets:** With more energy supplies flooding the market at a time when demand from the industrialised countries is falling due to economic slowdown and climate change concerns, energy producers are turning increasingly to the emerging economies, where the appetite for energy is growing exponentially to sustain their fast-paced economic trajectories.

(**3) Enhanced role for the United States:** With the advent of hydraulic fracturing or 'fracking', the United States is on track to become not only the dominant player in global energy markets – not just as yet another producer – but also a possible swing producer in future, thereby taking over a role that the Saudis have played till now.

(**4) Geopolitical shifts:** As the US becomes less dependent on the global market for its oil and gas imports, there is speculation, indeed consternation, regarding its continued presence in the Persian Gulf region. For years, the Arab Gulf regimes have depended on the US security umbrella for their survival in return for stable oil supplies. Now, if the United States does indeed turn its back on these regimes, it would have a destabilising regional impact, particularly at a time when new threats in the garb of radical Islamic forces have emerged.

Falling oil prices have also impacted greatly on Russia, which like its West Asian counterparts, is largely dependent on oil revenues. At a time when it has been placed under stringent economic sanctions by the United States and several European countries due to its Crimean adventure, Moscow can ill afford to see prices go southwards. Consequently, it has not only adopted an increasingly aggressive posture in its region as well as in the Arctic, but is also looking to diversify its market eastwards. Recent reports of Russia's military build-up in its near abroad is indicative of Moscow's new belligerence.

In the gas market too, the US shale bonanza is also set to transform the current regionally structured market to a more international one by transforming the oil-indexed pricing mechanism preferred by traditional gas exporters such as Qatar and Russia, to a hub-based one. Although both can absorb more economic pain than many other countries, a huge drop in their energy revenues, and in Russia's case, the imposition of sanctions, may force President Putin to adopt a more aggressive posture.

(**5) Realignment of partnerships:** The Gulf states as well as Russia have responded to the changing energy market by showing a proclivity to strengthen their ties with Asian states, particularly China, both from an economic as well as political perspective. Having recently overtaken the United States as the largest oil consumer, and positioning itself as one of the largest prospective gas consumers, China is now perceived as a coveted customer by energy-producing nations. Beijing has recently signed

billions of dollars' worth of oil and gas deals with two Middle Eastern states – Iran and Saudi Arabia, as well as with Russia and the Central Asian states, thereby enhancing its regional position. Moreover, it has expressed interest in bolstering its presence in Afghanistan, and has recently made sizable investments in the country's copper and oil sectors, including a $3 billion agreement to develop the Aynak copper mine. At a time when the United States has begun to withdraw its troops from the region, an enhanced Chinese presence would have enormous implications for the South Asian region as a whole, as well as energy projects in particular.

For the consumer nations, the changes, at least in the short term, are viewed as beneficial for their economies. However, they also realise that it is only a matter of time before prices rebound. Despite the surge in renewable energy, particularly in the developed world, economic considerations, and current low fossil fuel prices has seen several countries go back to using oil and gas and even coal, given their more competitive prices vis-à-vis renewables. At the same time, sustained economic growth in the emerging economies is expected to keep their demand for energy on an upward trajectory. China has already surpassed the United States as the largest oil importer and is on track to become the largest energy consumer over the next decade.

In order to ensure their access to energy resources, China is not only scouring the globe, including Africa and Latin America, as well as Central Asia, for oil, gas, and minerals, it is also laying claim to the resources believed to be present around its own region. This has triggered growing tension between China and its south-east Asian neighbours and particularly Japan, as the East and Southeast Asian states are resisting their giant neighbour's attempts to expand its zone of influence in the surrounding seas. Tensions are increasing in the South and East China Seas arising from disputed territorial claims in the region, many of which are believed to have rich hydrocarbon reserves. As China seeks to protect its maritime routes from an impending US-led threat, following Washington's declaration of its Pivot to Asia policy, it is adopting an increasingly muscular posture, claiming large swathes of the seas as its own territory, much to the consternation of its neighbours.

For India, poised to become the third largest energy consumer in the near future after moving up from its current fourth position, the prevalent price situation may be conducive for now. Already, its oil import bill has been reduced by around $50 billion, bringing substantial relief for its foreign exchange outflow. However, given that energy sector developments are driven as much by geopolitics as by the economics of demand and supply, it may not be long before the energy markets witness the return of price volatility. It is important to remember that if low prices prevail for a length of time, they will impact on future production, causing prices to escalate due to tightening of supplies. Any addition to future reserves would require investments to be made eight-to-10 years in advance for a field to come into production and resources to reach the end-user. On the other hand, companies are averse to committing large capital resources during a low price period. Hence, when demand picks up, supplies may be in short supply, causing prices to escalate. Of more concern is the fact that this may prompt a greater scramble for access and leverage over resources.

In order to prevent the above, and to ensure a more comprehensive energy security climate for all, be they energy producers seeking secure and sustainable energy markets, or energy consumers, who seek assured and affordable energy supplies, there is an urgent need for all countries to work in tandem to develop a system beneficial to all. That the world leaders realise this was clear from the deliberations at the G20 summit in Brisbane in November 2014, where for the first time, a session was dedicated to global energy issues. The final communique of the summit only focused on the need for energy efficiency – to tackle the growing demand for fossil fuels and to contain growing greenhouse gases. However, the leaders of the world's most powerful economies agreed at the summit that energy security must become a priority, given that stability in the oil markets was critical for lifting global economic growth by 2.1 per cent over the next five years.

More importantly, the leaders discussed whether to institute a new agency that would reflect the current and changed realities of the global energy market. They also agreed that the new mechanism would have to be more equitable and just and be positioned above the existing organisations: the International Energy Agency (IEA), which is viewed as a mechanism working primarily for the benefit of its creators, the developed nations and OPEC, the oil cartel set up by producers to provide adequate revenue for member states. Several leaders also underscored the need for giving a greater voice to rising economies, addressing their energy security concerns, and for drawing up principles of governance for all participants in energy markets. They also discussed the need to secure energy supplies from being exploited as foreign policy tools. However, it is significant that the need for a new agency was not included in the final communique.

Whether a new agency will eventually be established remains to be seen. However, it is evident that all countries recognize that with the changing political landscape, existing mechanisms are no longer capable of dealing with emerging challenges and there is an urgent need for an effective system for global energy governance which will address the needs of both energy consuming and producing nations. In order to break out of this cycle of repeated volatility and instability, a more robust and fair system of energy governance is imperative wherein the interests of both producers and consumers are safeguarded and a more equitable form of energy trade and relations is established.

Climate Change and National Security: Issues, Linkages and the Indian Context

Dr. W. Lawrence S. Prabhakar

The vicissitudes of national security have been analyzed and debated in the post-Cold War and the post post-Cold War period. New Issues of transnational order and security have emerged with strong environmental linkages *inter alia* with states and regions. Intra-state and interstate conflicts have always been derived from social, economic, civic and political contexts, but the neglected dimensions of climate change and the resulting environmental degradation, which impacts on the geography of states, has now emerged as a significant issue in the comprehensive analysis and debate on national security.

Post-industrial societies and states have evolved a viable framework of normative and structural constructs that elucidates these concerns and the structural challenges have been well negotiated through common and comprehensive security paradigms. Given the huge and substantial global territory spanned by the post-colonial Third World, the issues and challenges of climate change and the imperatives stemming from their normative and structural import have to be addressed as they constitute pivotal aspects of the global commons.

The Indian context is a good case illustrating the linkages between the post-colonial order and development. It would also serve as a good analysis that interlinks issues of energy security, littoral security and the concourse of maritime trade and development. The impact of rising sea-levels, sea erosion, carbon emissions and the resulting developmental challenges would place Asian powers like China and India into the rigorous regimen and examination of the global imperatives on climate change.

This paper endeavours to achieve the following:

a) Elucidate the theoretical contexts of climate change and national security;

b) Examine the issues, challenges and consequences of climate change on post-colonial societies and analyze their impact;

c) Assess the Asian national security contexts and Indian responses to the imperatives of global climate change;

d) Analyse the Indian context of climate change and national security and derive appropriate responses.

Theoretical constructions of climate change have 'securitized' the issue, warranting an institutional security response for a systemic imbalance that calls for policy and governance responses. Climate change has been securitized with a view to understand and assess its ecological and physical impact on societies and more so on national public policies. National security concerns of individual states vary widely on climate change and they exhibit the 'divide' between the post-industrial world and the developing world of 'rising economic powers'. The rising economic powers are more focused on industrial development and often view curbs on their emissions as arbitrariness by the developed powers. Climate change is an 'interdependent construct' that links socio-economic development, post-colonial apprehensions and the resource contention. Climate change impacts human security, national security and the ecological balance, affecting food and water security and the spillover with regional-global effects. Today the climate change debate has no consensus in its substantive detail although there is now growing unanimity on the procedural aspects. There are three theoretical constructions evident in the scholarship on climate change and national security:

a) Security Theory or Securitization
b) Social Constructivism and Climate Change
c) Critical Theory-Green Theory and Climate Change

Security Theory or Securitization of Climate Change refers to process outcomes of the "successful securitization of a transnational issue as an existential threat justifying an extraordinary (usually military) response. Securitization is conceptually challenged by i) What does it mean to be secure? ii) Who is doing the securing? iii) Who or what is being secured? Securitization is process-driven by a) Identities—the labeling of entities; b) norms-rules socially enforced; c) cultures—the way entities classify, codify & communicate. Therefore what constitutes a paradigm of climate change is the securitization by the dominant culture, which does not conform to other cultures. Securitization of climate change by the developed world suits their agenda of focused responses in the realm of military operations other than war (MOOTW). However, in the regional-global spillover spectrum they are unintended, diffuse and are trans-boundary, operating over long time scales, implicating a wide range of actors, and require painstaking negotiation and cooperation among several stakeholders. In the Security Theory or Securitization of Climate Change, one of the dominant schools is the Realists and Neorealists. Realists and Neorealists have no conceptual appreciation on climate change *inter alia*, with its human security consequences. They dismiss it as the "construction" of a transnational challenge having secondary and tertiary consequences. Realists and Neorealists however, advocate the employment of military force—to secure the state-centric interests, should the unintended consequences of protracted climate change trigger political conflict, refugee flows, contestation of resources and spillover of border and boundary issues into the realm of inter-state conflict or regional conflict;

The securitization process transforms a full range of issues from a non-politicized form to politicization. It triggers a governmental decision of intervention culminating in a contingency leveraging military and security prioritization. Thus the securitization of climate change diverts focus from the real challenges.

One important aspect of this process is addressing the complex problems of human security and developmental issues by framing the debate in terms of a unitary world-view although the challenges of human security in the developing world are varied and complex. Secondly, the imperative is to ameliorate the three aspects of human security: food security, water security and environmental refugees. Thirdly, human security challenges emerging from climate change must elicit a sound response in governance and civilian regime capacity rather than an enforced military-operational response. Non-military responses may take the form of regional cooperative frameworks that involve the stakeholders of civil society, local communities and the governance process. There are nationally appropriate governance responses that should be linked with the global response to climate change as it would address the uniqueness of each national or regional setting.

The second construct in this debate is **Social Constructivism and Climate Change**. Constructivism envisages the world as coming into being or constructed through an interactive process between agents (individuals, states, non-state actors) and objective elements of physical reality. The constructivist definition of security is "an action or sequence of events that (1) threatens drastically and over a relatively brief time span to degrade the quality of life for the inhabitants of a state; or (2) threatens to narrow significantly the range of policy choices available to the government of a state, or to private, nongovernmental entities (persons, groups, corporations) within a state. Social constructivism views climate changes as a "threat multiplier" and urges activism to change peoples' attitudes from apathy to action. Constructivism envisages the enabling of equity and sustainability in climate change and contends against the securitization process. Constructivism challenges the systemic realities of climate change while offering an emancipative agenda for societal and economic transformation through better governance and human security based on human dignity and human development.

The third construct is the **Critical Theory-Green Theory and Climate Change**. Critical Theory has an ambient platform that helped to formulate a Green Theory in International Relations and provides a rationale on climate change and sustainable development. Critical Theory rejects the piecemeal, 'problem-solving' approaches that fail to address the social and economic structures of domination perpetuated by global hegemony. Green Theory focuses on the critical issues of environmental domination and marginalization--domination of a non-human nature, neglect of future generational needs, and the skewed distribution of ecological risks among different social classes, states and regions. Green Theory repudiates the lopsided frames of causes and consequences of climate change with an advocacy of equity and sustainability. Green Theory is premised on the quest to reduce ecological risks across the board and preventing unfair externalization and displacement through space and time onto innocent third parties.

Climate change and post-colonial societies

The dominant narrative of the developed world presents a different perspective on post-colonial societies and their impact on the international system. Post-colonial societies are viewed in the global prism to be catalysts of violent climate change owing to their persistence with the 'old economy'. Post-colonial societies are urged to abandon 'unsustainable' economics and energy strategies, including mass agriculture (which is seen as a methane emitter) and move towards a better system of green

agriculture. However, post-colonial societies are still in the realm of 'resources' and 'technology' deficit as they progress towards new strategies that would ameliorate environmental ravages. Post-colonial attitudes give priority to industrialization and economic growth rather than provide any impetus for sustainable development. Weaker governance and institutional capacities are the critical fault lines to tackle violent climate change consequences. There are fundamental differences in approaches. The developed world's preference is for a consensus-based global response versus nationally appropriate state-centric responses preferred by developing countries. While discussing post-colonial societies, it is essential to consider the Asian national security context and the Indian imperatives within the perspective of global climate change.

Asian national security contexts are based on the realist-monolith conception of security—since the state-centric security conception predominates in the region. National development spans a time-spatial context that warrants rapid economic industrial growth, rise in GDP, accumulation of comprehensive national power; aggressive mercantilism and strategic competition. Asian economic and industrial growth, which entails high levels of carbon emissions, is mandated to leverage higher living standards and ameliorate the socio-economic conditions of the people. The persistence of Asian countries in not sacrificing growth for climate change mitigation explains their considerable reluctance to join the global consensus on 'cap and trade.'

The Asian security contexts also demand that the developed world should address climate change mitigation taking into account their own disproportionate share of environmental ravages based on long linear spatial-time contexts. Asian and Third World contexts are marked by state-centric policy formulation and elucidation with regard to climate change mitigation—often plagued by inefficiency, corruption, bureaucratic inertia and lack of political will. For India, the focus remains on equity and responsibility, which constitute the main planks of climate change policy.

Therefore, any climate change agreement ought to be based on a balanced assessment of development needs and strategic interests and must be backed by subsidies and technology transfers to ensure compliance with international standards of climate change mitigation. Asian economic and institutional capacities have developed considerable resilience in withstanding violent environmental changes. However, the Asian context demands an incremental capacity-building in institutional capital, innovation, human and material resources and new direction to tackle natural-physical, socio-economic and civic-political challenges and problems induced by climate change.

Matrices of climate change threats and challenges: The Asian context

The Asian context of climate change perceives a wide spectrum of threats and challenges that arise from its dramatic experience of climate change and its disastrous impact. The Asian continent has witnessed accelerated glacier meltdown and runoff of river waters, which complicates existing river-water sharing arrangements resulting in the abrogation of treaties and the triggering of wars (e.g. India-Pakistan Indus River Treaty). The meltdown of Himalayan glaciers is causing floods during the

high monsoon seasons on the Brahmaputra in the Indo-China river basin. Accelerated climate change has witnessed the loss of littoral land and rising sea-levels, resulting in population displacement, increased trans-border illegal migration into contiguous areas and stoking of ethnic conflicts based on prevalent fault lines of conflict (Bangladesh-India's northeast). In the oceanic contexts, there has been the submergence of the boundaries of islands in the Indian Ocean and the displacement of populations, leading to 'environmental refugees' and settlement challenges (Maldives, Mauritius, etc). The melting of the Arctic ice is opening up the North-West passage, changing the geopolitics of the Arctic region, and resulting in new preferred shipping routes. It is also witnessing changes in the strategic naval balance between the United States and Russia, as nuclear submarines find easier transit between the two oceans. Similarly, various physical and geographical changes in the Himalayan region could lead to large-scale relocation of Indian and Chinese military installations, as well as naval and littoral infrastructure being redeployed owing to sea-level rises

In the Southern Asian context, there are considerable changes and shifts. In the India-Pakistan Theatre, Jammu & Kashmir faces greater effects from the Himalayan glacier meltdown with medium possibilities of extreme weather, with an increased war risk due to water-sharing disputes. In the India-China theatre there are higher probabilities of glacial meltdown and medium possibilities of extreme weather, with the risk of natural disasters leading to the diversion of river waters and trans-border spillage or flooding due to high-rise dam constructions and new human-made lakes in the Tibetan plateau. Along the India-Bangladesh border, there are higher probabilities of river overflows due to trans-Himalayan climate changes featuring high probabilities of rising sea-levels and mass displacement of people, high probabilities of extreme weather and greater risk of the mass displacement of people as refugees. Similarly the rising sea levels in the littorals of the northeast provinces of Sri Lanka could trigger mass displacement of Tamils to India as environmental refugees from a country that has recently featured war-torn refugees. The India-Nepal theatre also faces higher probabilities of glacial meltdown with possible natural disasters in the Trans-Himalayan region triggering mass displacement of people into India.

Indian contexts and linkages between climate change and national security

The Indian contexts of climate change and economic growth does not conform to the broader *Western apologia* that calls for drastic changes in the prevalent patterns of high economic-industrial growth that is ongoing in India and much of Asia. The Indian contexts of climate change and economic growth have a different 'constructivist lens' from the Western construction of ideational and material factors, which from the start was catastrophic in relation to the global environment. India refutes Western propositions of 'blanket-globally enforceable' climate change regimes, which are lop-sided and flawed since climate change regimes from Rio to Copenhagen do not focus on equity and balanced development and the technological-capacity of weaker economic states to cope with the changes. India's 'securitization' of climate change is both a primary and a secondary variable linked to the national security in its 'traditional sense' and human security in the 'comprehensive sense'.

Therefore, India's approaches to climate change need to strike a fine balance between how it

configures the turbulent Southern Asian-Indian Ocean region and how it handles its domestic development paradigm, leveraging its own benchmark of sustainability. The following are several critical impacts that India would be facing:

i) Adverse impact on Indian agriculture with diminished returns will reverse high-input and high-yield farming operations. Ravaging of small and medium farmers will result in starvation and greater social-civic tensions;

ii) Reversal of monsoons over the subcontinent will affect water tables and agricultural production, leading to ravages of land and loss of subsoil;

iii) Rising inequality with increase in the number of people below the poverty line (BPL), increase in public subsidies and a rural surplus labor force that is unemployed and in poverty;

iv) Changing energy use patterns and constraints on coal, oil and gas would cripple India's economic growth and productivity with no credible alternatives to a green economy;

v) Forced migration from other South Asian countries into India could trigger mass riots and ethnic invasions

These critical impacts would aggravate India's dilemmas and complicate its climate change mitigation strategy.

India's responses

Several Indian responses are possible, which could vary in terms of capacity and capability based on affordability:

a) *Governance response*: It is imperative that India develops better governance and crisis response capacity. However there are disparities in various state machinery capabilities and problems stemming from lack of professionalism, inefficiency, wastage and corruption;

b) *Infrastructure responses:* The imperative is to enhance infrastructure developments; plug critical resource shortfalls in India's critical infrastructure, improve maintenance and provide alternate infrastructure options;

c) *Economic redemption responses*: Perspective planning is crucial to balance traditional and non-traditional security challenges by optimal deployment of economic resources; It is also essential to enhance standards of human security, as well as food, water and health security;

d) *Technology development responses*: Alternate energy technologies have to be developed, with priority for R&D investment in non-conventional energy sources;

e) *Co-operation responses*: There is an urgent need to develop convergent civil-military interoperable plans and strategies to cope with state failure and extreme natural disasters;

f) *Integrated state-civil society responses*: State-centric architecture is ineffective for climate change-induced threats and challenges and effective state-civil society coordination is imperative. Deployment of state machinery and effective backup by social and civic groups could result in better grassroot responses;

g) *Military operations other than war (MOOTW)*: Imperatives for the Indian Armed Forces include joint

synergies for constabulary and humanitarian operations. There must be a boost for new amphibious and expeditionary capabilities along with existing coercive capabilities.

In summation, India's climate change-national security stand cannot be autarkic. It must be robust enough to respond to the vagaries of the global discourse—yet maintain its autonomy. India's co-operation with the international community is vital for reciprocity, since international technological, investments and subsidies would be forthcoming for a rising power located in a turbulent neighborhood. India would be the pivotal state, the 'first respondent' to extreme weather and climate change patterns in the Indian Ocean Region. With its augmented civil-military capabilities for humanitarian relief missions, Indian entities, whether state, non-state, civil society or the military would be catalytic in responding to state failures, state-implosions, ethnic invasions and refugee flows, catastrophic tsunami incidents, starvation and river water disputes stemming from severe climate change. India's climate change posture should strike a fine balance taking into account Indian Ocean geopolitics that is in flux; catastrophic weather changes; the interplay of traditional and non-traditional challenges and perils; and the imperative to build up its own human security paradigm and systemic resilience.

Policy and Legal Dimensions of Energy Security in India: An Environmental Perspective

Dr. Sairam Bhat,[*] Manjeri Subin Sunder Raj[**] and Shibhu Sweta[***]

Energy security is imperative to meet the rising demand for clean energy to power industries and households and to save the planet from the effects of global disasters. As the world strives to secure energy resources in consonance with environment[1] preservation, India as a developing nation is not indifferent to the challenges of energy conservation. All forms of conventional energy, wood, coal, oil, hydro and nuclear, have environmental ramifications. This underscores the need for proper evaluation of benefits and costs, including ecological concerns, which have long term effects. The energy crises and associated ecological problems have forced India to recognise that conventional sources of energy will not save it from the energy crisis and that fossil fuels cannot provide all the country's energy needs, hence non-conventional, non-polluting alternate sources are needed[2].

In fact, the key issues for India are accessibility, dependence and self security in energy. According to the US Energy Information Administration[3], by 2025, India would be the third largest energy consumer in the world after Japan, United States and China. The Indian energy market faces two critical issues: energy security and climate change. Growing energy demand has prompted companies to consider the feasibility of acquiring coal mines in foreign countries, while the government simultaneously attempts to balance energy requirements with conservation initiatives for the future. To overcome the issue of limited sources of energy production, the government is now increasingly investing in renewable forms of energy to promote energy accessibility and self-sustainability. India's National Action Plan[4] on Climate Change serves as critical forum for a discussing a sustainable, conservation approach to energy efficiency and for protecting the natural ecology of the country and the earth itself, from the deplorable environmental degradation arising from human interventions.

While the developed countries took time to understand the need for conservation, being focused on extracting and exploiting limited natural resources, the onus of balancing conservation and uplifting the economy fell upon the developing nations who were expected to be torch bearers in guiding the world out of danger. Necessity paved the way for invention and in turn inventions facilitated the exploitation of natural resources to meet the massive demands of evolving civilization.

Energy conservation and environmental challenges go hand in hand as one impacts the other. The transformation of fossil fuel into crude oil and coal into black diamond gave birth to large-scale industrialization. In the extraction of various forms of energy, be it from coal, fossils, solar or nuclear sources, the term “sustainable” has become the buzzword of all nations and economies.

Three main objectives of the government in the energy sector should be: energy accessibility to all

citizens, less dependence on imported fuel and energy security. An overall concern is how to balance energy needs with environmental protection, especially in the climate change threat scenario. In all this, the state or the government cannot be the sole provider and hence privatisation is the way forward. This article critically examines the legal and policy dimensions of the energy sector in India. The second part explores energy conservation and energy security challenges that India will face as a developing economy. The third part focuses on socio-legal challenges that the energy sector poses for the protection and conservation of the environment.

Energy Conservation and Security in India

Energy conservation has emerged as a major policy objective, as 35.5% of the population still lives without access to electricity. The Energy Conservation Act 2001 was passed by the Indian Parliament in September 2001. This Act requires large energy consumers to adhere to energy consumption norms; new buildings to follow the Energy Conservation Building Code; and appliances to meet energy performance standards and to display energy consumption labels. The Act also created the Bureau of Energy Efficiency to implement the provisions of the Act.

The International Energy Agency (IEA) defines 'energy security' as "*the uninterrupted availability of energy sources at an affordable price. The term energy security has two aspects, namely, long term energy security aspect which deals with timely investments to supply energy in line with economic developments and environmental needs. While a short term aspect focuses on the ability of the energy system to react promptly to sudden changes in supply demand balance*[5]*."*

Energy security, as defined by the Integrated Energy Policy of India, encompasses three critical dimensions: (a) meeting India's large energy demand to sustain an annual economic growth rate of 8-9 percent through 2031-32 (b) meeting lifeline energy needs of all citizens to address social development, health and safety of the energy poor and (c) to ensuring sustainability in energy supply and use. In the current context, energy security also encompasses an overlapping element of energy efficiency across all energy security aspects. Energy security thus entails a complex set of coordinated initiatives and calls for energy strategies, policies and regulations to be aligned in making specific choices as India seeks to chart a low-carbon and energy-secure growth path.

Part 1: Energy Sector - Law & Policy in India

Political independence in 1947 set a huge task before the Indian government to simultaneously protect the social and economic status of the country. Since Indian policy makers by and large had strong faith in socialism, it was natural that the state played a dominant role in setting the socio-economic foundation for the country[6]. Thus, the pre-1991 era witnessed an economy with the public sector and big monopoly capitalists having the larger share compared to small private entities in the economy[7]. As a result, the Industrial Policy Resolution of 1948 was adopted, which was later followed by the Industrial Policy Resolution of 1956. The highlights of this era included centralized economic planning, huge public investments, extremely high tariff rates, strict licensing and extreme land reforms. Thus, economic activities and industries that emitted energy or required energy for their functioning were

incurring huge investment costs, while the output was still not satisfactory to meet the rising demands of households and businesses. Also, the Indo-China War of 1962 and Indo-Pak War of 1965 had forced India into an extreme financial crisis with the World Bank and the International Monetary Fund[8]. This incident followed the worst droughts of 1965-67[9] which led to the alarmist Indian stand at the World Trade Organization (WTO), which besides affecting so many lives had thrust the country into a huge budgetary crisis and slowed down industrial production. Hence, the Indian monopolistic model was reformed by introducing the nationalization of banks in 1969 and passing the Monopolies and Restrictive Trade Practices (MRTP) Act 1969[10].

The biggest reform came after the oil shock of 1973[11] that led to economic stagnation and inflation of the Indian economy. Consequently, Indian policy makers were forced to resort to liberalization in their Industrial Policy of 1973 allowing the participation of private players in the economy and abandoning the policy of import substitution[12]. This was perhaps the darkest era of energy accessibility and affordability in the country as it challenged the future availability of energy resources in the country. The subsequent years 1977-1982 & onwards[13], saw reduction in industrial licenses, and by 1982-83 onwards, foreign collaboration was invited to reform the economy.

Over the years, India has portrayed itself as an investment destination and outward investor in terms of its strategic business relations on energy security with other countries[14]. In the post-independence era, India joined hands with Russia, which offered great support in energy development and expertise in different forms of energy extraction and industrialization[15]. Russia helped India to build several hydropower stations and coal-based industries, including thermal power plants in east and south India. It also helped India to discover onshore and offshore oil and most importantly, establish the energy major, the Oil and Natural Gas Commission (ONGC)[16]. Later, Indo-Russian cooperation helped India in staking a 20% claim in the London-based Imperial Energy Corporation Plc with its Russia-focused interests centered on Sakhalin–1 in the Tomsk region[17]. The demand for nuclear energy has prompted India's collaboration with the United States in 2008 on mutually agreed terms and conditions to envisage and enhance nuclear capacity from 4.8 GW to 30 GW by 2030[18]. Apart from dealing with the usual environmental hazards of earthquakes and cyclones, the country has focused on severe threats of civil and nuclear hazards that constitute hurdles on the road to energy conservation and security. Conflict between the public and private energy sectors and inflation in the global prices of energy resources are other serious issues that India needs to address simultaneously.

The post-1991 era marked visible progress towards liberalization and globalization of the industrial sector in India. This meant that resources like coal and fossil fuel which formed the most important raw material of many heavy industries, witnessed rising demand for securing energy requirements and production. The changing power sector dynamics introduced measures to ensure greater efficiency, reduce losses, provide reliable accessibility through smart systems, segregate network assets and subsidize electric tariffs to meet the demands of households, industries and agriculture. The government introduced economic reforms, allowing private players to acquire stakes through privatization in heavy industries, mining, electricity and telecommunications. Various corporations were established: State Electricity Boards (SEB), National Thermal Power Corporation (NTPC),

National Hydro-Electric Power Corporation (NHPC) and Power Grid Corporation Limited (PGCL)[19] to regulate the rising demand for energy and power in the country, which was constantly falling short in supply. Finally, the government also invited independent power producers and foreign companies to build power generation projects in India. All these projects would be regulated by the Central Electricity Regulation Commission (CERC) & State Electricity Regulation Commissions (SERC)[20], which would look into matters of compliance, transmission & distribution among consumers. Thereafter, in one of the most promising joint ventures between government and foreign collaboration, USA-based Enron Corporation was invited to invest in clean and reliable energy generation by setting up the Dabhol project in Maharashtra.

Energy Sector Privatization: The Good, the Bad and the Ugly

Several policy reforms over the past 20 years have shifted India's energy sector from a predominantly government-owned system towards one based on market principles, offering a more level playing field for both public and private sectors. Political complexity and a tradition of socialist economic practices, however, hindered the complete liberalization of India's energy sector, leading to sub-optimal outcomes.

The liberalization of the Indian economy in 1991 witnessed multi-national companies investing in different sectors, including the energy sector. The Maharashtra Government invited the Houston-based Enron Corporation, a natural gas service provider and a fast growing international company to create innovative and efficient mechanisms for energy solutions and a better environment. The company through one of its subsidiaries, the Enron Development Corporation identified Dabhol district in Maharashtra (with the only deep water port) to set up its 2015 MW power plant[21]. The Maharashtra State Electricity Board (MSEB) was selected to aid the corporation in building and running the ambitious largest invested plant in India. The Enron-funded Dabhol Power Project was prevented from running its operations owing to some contractual glitches. The Munde Committee[22] (appointed specially for investigation) found that there was lack of transparency and accountability in the accounts, little focus on environmental concerns and issues and no competitive bids. Enron decided to pull out its operations and slammed India at the international arbitration level for violating the terms of its contract and non-payment of its dues[23]. Eventually, it was revealed that Phase 1 of the project failed to secure power to its local consumers at a cheaper rate as against the agreed quotation. This incident grossly affected the financial resources of India's economy and eventually pushed India into a long legal battle at the International Court of Arbitration.

Part II – Energy & Ecological Concerns

Today India should ask not only 'how much' energy is produced but also 'how' it is produced, as that will deeply impact the collective future of humankind and the health of the planet[24].

The United Nations organized a special Conference on New and Renewable Sources of Energy in Nairobi, Kenya on August 10, 1981. This conference recommended a 'plan of action' for the development of non-conventional sources of energy. Delivering the keynote address at the opening ceremony, late Prime Minister Smt. Indira Gandhi called upon the world community to make energy a

focal point of contemporary international cooperation and collaboration based on a more equitable sharing of conventional energy and joint development of new and renewable sources. She attributed energy crises to the reckless exploitation of conventional energy by the technologically advanced industrialized countries and affirmed that they could not now evade the responsibility of helping the developing world[25].

Historically, the energy debate has been primarily focused on economic aspirations. While that still remains the case, in today's world the environmental consequences of power generation simply cannot be ignored[26].

Environment being a prime concern and a foundation for life has been integral to all policies, plans and activities. The Constitution of India incorporated Article 48A[27] and Article 51A (g)[28] to protect, preserve and promote ecological concerns in the country. In fact, the judiciary through its liberal interpretation powers extended the scope of Article 21[29] to include the right to a clean and healthy environment as part of the Indian citizen's rights. Several judgments such as *Subhas Kumar v. State of Bihar*[30] and *M.C.Mehta V Kamal Nath*[31] and many more, have held that the right to environment is a fundamental right of every citizen of India and is included in the “right to life” guaranteed under Article 21 of the Constitution of India. On the subject of energy security, the 7th Schedule of the Constitution[32] has pinpointed industries within the purview of central and state lists and given them autonomy to decide the fate of energy concerns and activities emanating from these industries. There is also a list of legislations[33] enacted by statute to look into specific areas of ecology protection, which directly or indirectly lay down the standards for energy conservation and sustainable development[34]. There are three main policies that cater to environment protection in India apart from legislations enacted for energy-specific areas: the National Forest Policy of 1988, Policy Statement for Abetment of Pollution, 1992 and the National Conservation Strategy and the Policy Statement on Environment & Development, 1992. It is important to note that in matters of environmental violations, India recognizes both civil and criminal liability. Identifying the concept of “absolute liability” [35]the judiciary over the years has been pronouncing judgment based on this rationale for any activity that deviates from the set standards. For example, to reduce carbon emissions[36], the state regulatory authorities have made it mandatory to provide a certain proportion of electricity from renewable sources such as wind, solar & biomass to curb the negative impacts of non-renewable sources of energy and achieving sustainability.

Every form of energy, whether renewable or non-renewable, raises a bundle of ecological issues. With global warming and climate change becoming more crucial issues, it is time to make energy security accountable in environmental terms with respect to each of these sources. It would be interesting to discuss some of these sources and the environmental concerns surrounding them.

Non-renewable forms of energy

Coal: This black diamond, which forms the foundation of several small, medium and large industries is scarce and indeed a prime source of environmental pollution. In fact, coal-based plants are major sources of global warming37. At the local level, the effects of coal-fired electricity generation are unacceptable. Apart from CO2 emissions, fly ash, the fine residual dust resulting from coal combustion

in a thermal power plant and the several train loads of coal needed each day requires a humungous amount of fuel and puts extraordinary pressure on the transportation infrastructure in the country. There is enough evidence over the years that the coal industry has caused respiratory and cardiac diseases, while extensively polluting the air, land, water bodies, flora & fauna through the waste and ash it emanates[38].

Oil & Petroleum: The crude refining process of the oil refinery releases several chemicals into the atmosphere daily. Consequently, there is substantial air pollution emission and notable odor accompanying its operations[39]. Aside from air pollution impacts there are also waste water concerns, risks of industrial accidents such as explosion and industrial noise that accompanies this energy source. One example is the recent oil spill in the largest contiguous tidal mangrove areas of the Sunderbans in Bangladesh[40], which poses a serious threat to the spectacular array of species native to the area. This incident is a cause of concern for India too, as parts of the Sunderbans extends into West Bengal. Home to rare species of Irrawaddy and Gangetic Dolphins and the endangered Bengal Tiger[41]; the biodiversity of this rich region is under serious threat following this devastating incident.

The scenario of pollution caused by renewable sources of energy is no different and some sources have the potential to make generations redundant. This aspects merits further discussion

Renewable Sources of Energy

Several alternative energy sources – biomass, hydel, tidal, wind, solar, thermal and nuclear, are usually considered as clean, safe and sustainable. It cannot be denied that these alternative sources promise to solve India's energy crisis in long run if tapped effectively on a large scale. However, the location of these plants and projects has often led to serious deadlock between business interests and human settlements around the identified project site. Hydro power projects are considered a clean and efficient source of power and energy generation but they cause displacements, ruin flora and fauna and disrupt the natural course of rivers. The rise of the Narmada Bachao Andolan[42], Mullaperiyar Dam & the resulting accidents[43] and lately the Kashmir floods[44] in Sept 2014 and the Uttarakhand floods[45] of 2013 bear testimony to the human-induced disasters that have occurred due to decades of over-exploitation. The Uttarakhand disaster was so serious that the Supreme Court ordered the Ministry of Environment to appoint an Expert Committee in June 2013[46] to ascertain whether existing and under-construction hydropower plants and projects in the area contributed to the flood disaster. Nuclear power generation, which India considers as an option to cope with the energy crisis is no less controversial in terms of environmental pollution. Radioactive waste and its disposal pose serious threats to biodiversity, human, animals and even aquatic life for generations.

In thermal power plants, running the plant itself involves huge energy requirements. Water used as a coolant in these power units is discharged at a higher temperature, decreasing the oxygen level in the atmosphere and affecting ecosystems[47]. The discharge of sewage into the environment causes emission of toxic gases in air and water that seriously disrupts aerial and aquatic lives, thereby contributing immensely to climate change and global warming. Similarly, the smoke from toxic gases

like CO2, CO and nitrogenous gases derived from the combustion process target the lives of several people in rural areas[48]. India is set to become the world's second largest coal consumer by 2025, overtaking the United States. Coal power is regarded as necessary for energy security, but contributes enormously to climate change in India, where the coal quality is inferior[49]. Biomass is also a major energy source in India and pollution from this source can even surpass that of coal-based industries[50]. Wind farms require huge tracts of land and often such acquisitions by government and business entities displace communities although its objectives lie in boosting energy security for the nation.

Under such complicated circumstances, how can India strike a balance between solving the energy crisis and safeguarding the environment? How far can India apply the principle of "the polluter pays[51]" for repairing environmental damage? And how far can the state ensure safety, security and sustainable development of the environment by using its "public trust doctrine[52]? How far can India counter the threat of nuclear incidents under the Civil Nuclear Liability Act, 2010[53] when the Act itself is being opposed on the grounds that it is unjustified and violates the spirit of the Paris and Vienna Conventions, and the Convention on Supplementary Compensation[54] and also contradicts bilateral nuclear treaties and nuclear liability agreements? While India needs alternative forms of energy to secure its energy demands, due to the finite nature of conventional energy sources, it cannot ignore the pollution released into the atmosphere & environment by these sources, in addition to the pollution already being emitted by existing conventional sources. Perhaps Indian legislation, laws and protection activities are still not effective enough to solve the energy crisis. The intense climate change negotiations taking place at the international level and India's participation as a major player highlights the seriousness of the situation. In fact, India has been trying hard to fulfill the objectives of the Clean Development Mechanism (CDM)[55] for reducing greenhouse gas emissions to much lower levels in future. How far can the country channelize the emissions from several projects without compromising on the environment?

To resolve these issues, the government had placed significant emphasis on the Environment Impact Assessment (EIA) reports, which were intended to serve as crucial parameters before initiating a project. However, the circumstances and cases filed before the court have shown that the EIA generated more controversy instead of resolving pressing ecological issues. In 1980, the Environmental Appraisal Committee laid down specific environmental guidelines for the clearance of large projects. In this context, the Department of Environment issued the *Guidelines for Environmental Assessment of River Valley Projects,* which specified various studies that were necessary as part of an Environmental Impact Assessment (EIA)[56]. However, the guidelines only incorporated the technical aspects of the project, such as submergence zones and seismicity, but had no provisions to provide project information to the public, or mandate the people's involvement in decision-making.

Similarly, in the case of the Jaitapur power plant[57], despite legally binding guidelines from the Ministry of Environment and Forests (MOEF), the EIA report ignored them entirely. In fact, it also ignored the legal mandate of giving 30 months advance notice in the local language to the people to attend meetings and hold discussions. It also downplayed the fertile soils of the Madban plateau as being rocky & infertile, thus raising protests from communities settled in the area[58].

Natural gas is seen as one of the finest, sustainable and cleanest sources of energy in the country. However, extracting and harnessing it requires investments worth millions. This means that the government alone cannot tap into this source of energy without the joint efforts of private enterprises in the entire project. This focuses attention on the issue raised in the auctioning method, where profit and social objectives are to be met simultaneously from the common venture.

Under such circumstances, how does the country ensure a smooth linkage between business goals and ecology in the areas of energy generation and security? Undoubtedly, investment in mining and extraction of energy resources and power generation is a costly and risky affair and requires multiple stakeholders to pool their money, skills, expertise and infrastructure. Hence, participation in the form of public, private and joint ventures is absolutely necessary in today's business scenario where trade flows across borders. How does India ensure that the interests of private players are protected in the energy sector? How can the government play a supporting role in the entire transaction without losing its legitimate share of revenue?

Consider the case of Reliance Gas, which operates in the Krishna-Godavari basin (KG D6) across 50,000 sq km in Andhra Pradesh[59], viewed as the largest natural gas basin of India. The Government of India (GOI) opened up hydrocarbon exploration & production (E&P) opportunities in 1991, inviting private and foreign players and several small and medium-sized blocks were allocated under this strategy. This paved the way for opening up bigger blocks through the New Exploration and Licensing Policy (NELP). It was through NELP that Reliance was able to bag the rights to explore the D6 block[60]. The government entered into a production sharing contract [61](PSC) with Reliance Industries and monitored the exploration & production process. When Reliance split, the government abstained from its responsibility under the public trust doctrine (while the Ambani brothers were fighting over who owned the natural gas resource). In June 2004 the National Thermal Power Corporation (NTPC) stepped in by inviting bids for the supply of gas for its 2600 MW power plant in Kawas and Gandhar[62]. The entire episode ended in a compromise deal of $2.34 per mmBtu (million British thermal units)[63] which raised issues over the credibility of government policies, dilution of pre-qualification norms and the terms of the deal itself, while reducing exploration activity to yet another natural resource exploitation episode in the history of the country.

The Reliance deal is yet another example of a joint venture going wrong due to ineffective administration by the government and lack of transparency in the bidding of contracts. However, since the venture gave India an opportunity to harness natural gas from its largest river basin and still continues to provide gas, the project cannot be labelled as a total failure. Moreover, had it not been for the support of Reliance which made critical investments in infrastructure, manpower and expertise in this project, the government could not have tapped into this clean renewable energy source. However, since the government suffered loss of revenue from the compromised deal, this highlights the dilemma of how to maintain balance between the government revenue and the need to provide tax incentives and subsidy.

While tariffs are necessary to ensure affordability and accessibility of energy to all sections of society, subsidies awarded by government policies for basic entitlements are crucial factors in the deal. As far as private and joint participation is concerned, encouraging tax exemptions will surely encourage several business entities to take up ventures in the field of energy. Currently, the government has also introduced generation-based incentive (GBI) schemes in parallel with existing fiscal incentives, which provides for Re. 0.50 per unit with a cap of Rs 62 lakhs per MW over and above the tariff approved by State Electricity Regulatory Commission[64]. Similarly, the harnessing of wind energy is eligible for a tax holiday under Section 80 IA of the IT Act 1961[65]. "*In the Solar energy sector, incentives includes 10-year tax holiday for photovoltaic (PV) and thermal solar plants set up by 2020, reduced customs duty and zero excise duty on specific capital equipment, critical materials and project imports, besides loans at cheap interest rates. Also, in Special Incentive Package Scheme (SIPS) for semi-conductors, GOI would provide an incentive of 20 percent capital expenditure during the first ten years for the units in special economic zones (SEZs) and 25 per cent of the capital expenditure for other units*[66]*.*"

It should be stressed that such tax incentives and government policies should not in any way sacrifice environmental quality or standards by allowing pollution or accepting misleading accounts. The government can strike a good deal to boost energy security by providing transparency, efficient monitoring, investment-friendly policies and ensuring compliance by energy investors and producers.

Notes

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[1] For more, read *National Energy Policy* 1986, Lok Sabha Secretariat, New Delhi, 1986.

[2] SK Agarwal, Eco-Informatics, Vol. V "Non Conventional Energy Systems," APH Publishing Corporation, New Delhi, 2002, p. 14.

[3] *Live Mint*, May 13, 2014, "India to overtake Japan to become third-largest oil consumer: US", available at [http://www.livemint.com/Industry/9dYI7IYqh3AmR67Rj1kPKJ/India-to-overtake-Japan-to-become-thirdlargest-oil-consumer.html] last accessed 11th Dec 2014.

[4] National Action Plan for Climate Change, GOT, Prime Minister's Council on Climate Change, available at [http://www.moef.nic.in/downloads/home/Pg01-52.pdf] last accessed 11th Dec 2014

[5] International Energy Agency, available at [http://www.iea.org/topics/energysecurity/] last accessed on 8th Dec 2014.

[6] Dr. Kapil Jain, "Economic Reforms in Indian Economy: A Step Towards Change," *IJARS*, Vol 2, Issue 11, Nov 2013

[7] Ibid.

[8] Ibid, pg 2

[9] Ibid, pg 2

[10] The MRTP Act, 1969 is now replaced by Competition Act, 2002. It was a grim reminder of the "licence-quota- permit-raj" of the 1970s & 1980s. The Act had become redundant post-July 1991 when the new economic policy was announced and Chapter III of the MRTP Act dealing with restrictions on M&A activities was made inoperative.

[11] The oil crisis began in October 1973 when the Organization of Arab Petroleum Exporting Countries (OAPEC), consisting of the Arab members of OPEC, plus Egypt, Syria and Tunisia) proclaimed an oil embargo. When the embargo ended in March 1974, the price of oil had risen from $3 per barrel to nearly $12. This oil "shock," had many short-term and long-term effects on global politics and the global economy.

[12] Supra note 9

[13] Ibid.

[14] International Energy Agency, "Understanding Energy Challenges in India- Policy, Players & Issues", 2012, last accessed 11th Dec 2014 [http://www.iea.org/publications/freepublications/publication/India_study_FINAL_WEB.pdf]

[15]Russia & India Report, last accessed on 10th Dec 2014, available at [http://in.rbth.com/articles/2012/10/11/energy_cooperation_between_ india_and_russia_policy_and_approach_ 18291.html]

[16] Ibid.

[17] Ibid.

[18] Ibid.

[19] S. Jindal, A. Kushwaha, R. Gupta & D. Prasad, "Performance Evaluation of Power Sector: Pre & Post Electricity Act, 2003 and Their Implications", *International Journal of Emerging Technology and Advanced Engineering*, ISSN 2250-2459, Volume 4, Special Issue 1, Feb 2014

[20] Ibid.

[21] Preeti Kundra, "Looking Beyond the Dabhol Debacle: Examining its Causes and Understanding its Lessons", *Vanderbilt Journal of Transnational Law* [Vol. 41], pp 907- 935.

[22] Infra note 47, p. 917.

[23] Infra note 47, pp. 923-926.

[24] Pratap M Anam, Nuclear Power, *Electrical India*, December 2014, 118.

[25] National Energy Policy 1986, Lok Sabha Secretariat, p. 36.

[26] Pratap M Anam, Nuclear Power, *Electrical India*, December 2014, 116.

[27] Article 48 A, Constitution of India. "The State shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country," Directive Principles of State Policy (PART IV).

[28] Article 51 A (g), Constitution of India. "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures." Fundamental Duties.

[29] Article 21, Constitution of India. "No person shall be deprived of his life or personal liberty except according to procedure established by law." Fundamental Rights (PART III).

[30] AIR 1991 SC 420.

[31] (1997) 1 SCC 388.

[32] 7th Schedule, Constitution of India. Entries under the Union List comprise industries, regulation and development of oil fields and mineral oil resources, regulation of mines and mineral development, regulation and development of inter-state rivers and river valleys & fishing and fisheries beyond territorial waters. Entries under the State List comprise agriculture, land colonization, fisheries, regulation of mines and mineral development & industries relating to the provisions of List-1.

[33] The list is available at [http://www.cpreec.org/environadvance.htm] last accessed 17th Dec 2014.

[34] C.P.R Environmental Education Centre, MOEF, GOI.

[35] M.C. Mehta v UOI [AIR 1987 SC 965]. The basic question posed today is whether the 'absolute liability principle' has been diluted with the enactment of the Civil Nuclear Liability Act 2010, wherein the liability in case of a nuclear accident is capped at 1500 crores.

[36] Ajay Shaw, *The International Comparative Legal Guide to: Environmental Law* 2010, DSK Legal, Chapter 24, Pg 190.

[37] Available at [http://www.ucsusa.org/clean_energy/coalvswind/c02c.html#.VJG7vl4AGA] last accessed 17th Dec 2014.

[38] Greenpeace, "Coal Kills – An assessment of Deaths & Diseases caused by India's Dirtiest Energy Source," Mumbai.

[39] G.St. Cholakov, "Control of pollution in petroleum industry," *University of Chemical Technology & Metallurgy* Vol III, Sofia, Bulgaria.

[40] *National Geographic*, Dec 16, 2014. "After Oil Spill in Bangladesh's Unique Mangrove Forest, Fears About Rare Animals", last accessed 18th Dec 2014, available at [http://news.nationalgeographic.com/news/2014/12/141216-sundarbans-oil-spill-bangladesh-tigers-dolphins-conservation/].

[41] Ibid.

[42] Friends of River Narmada, available at [http://www.narmada.org/introduction.html] last accessed 17th Dec 2014.

[43] Available at [http://en.wikipedia.org/wiki/Mullaperiyar_Dam] last accessed 17th Dec 2014.

[44] *The Indian Express*, available at [http://indianexpress.com/topic/jammu-and-kashmir-floods-2/] last accessed 17th Dec 2014.

[45] *Down to Earth*, "Uttarakhand floods: is the disaster human induced?" June 16, 2013.

[46] *Down to Earth*, "Did hydel projects have a role in Uttarakhand disaster? asks Supreme Court," August 14, 2013.

[47] Thermal pollution available at [http://en.wikipedia.org/wiki/Thermal_pollution] last accessed 17th Dec 2014

[48] Bloomberg, "Air pollution from biomass burning exceeds coal," April 4, 2014.

[49] Ancha Srinivasan, Frank Hiroshi Ling and Hideyuki Mori, *Climate Smart Development in Asia*, Earthscan from Routledge, London, 2012, p. 230.

[50] Ibid.

[51] Invoked in M.C.Mehta v UOI (1987) 1 SCC 395. An extension of absolute liability, it extends the liability of the polluter to the costs of repairing the damage caused to the environment.

[52] Adopted in US jurisprudence in the Span Motels case [(1997) 1 SCC 388], it laid down that the State is the trustee of all natural resources which are by nature meant for public use & enjoyment.

[53] The Act was enacted in September 2010 and aims to provide a civil liability for nuclear damage and prompt compensation to the victims of a nuclear incident through a no-fault liability to the operator, apart from appointment of a Claims Commissioner, establishment of a Nuclear Damage Claims Commission and for matters connected therewith or incidental thereto.

[54] G. Balachandran, "A Primer on the Indian Civil Liability for Nuclear Damage Act 2010", Institute of Defence Studies & Analysis, Sept 23, 2014.

[55] CDM provided in Article 12 of the Kyoto Protocol enables developing countries to participate in joint greenhouse gas (GHG) mitigation projects. CDM were agreed on at the 7th Conference of Parties (COP-7), UNFCCC, Marrakesh, Morocco in October-November 2001. Available at [http://envfor.nic.in/sites/default/files/cc/cdm.htm] last accessed 17th Dec 2014.

[56] *India Together*, "EIA: the Foundations of Failure," 10 March 2006.

[57] Greenpeace India, "Environmental Impacts," last accessed on 17th Dec 2014, available at [http://www.greenpeace.org/india/en/What-We-Do/Nuclear-Unsafe/Nuclear-Power-in-India/Jaitapur-nuclear-power-plant/Environmental-Impacts/].

[58] Ibid.

[59] *Business Standard*. "10 things you should know about Reliance KG D6 deal," Feb 12, 2014, Mumbai.

[60] Ibid.

[61] The PSC lays out roles and responsibilities of all parties, specifies the detailed procedures to be followed at different stages of exploration, development and production. It also specifies the cost recovery and profit sharing in the contract. Directorate General of Hydrocarbon (DGH) monitors the PSC.

[62] Supra note 88.

[63] Ibid.

[64] "Incentives and tax exemptions by the Government in the non-conventional energy sector", available at [http://ww.oifc.in/Uploads/MediaTypes/Documents/Incentives-and-tax-exemptions.pdf] last accessed 18th Dec 2014.

[65] Ibid.

[66] Ibid.

Energy and the Environment

Raymond E. Vickery, Jr.

The production of energy has both immediate and lasting impacts on the environment. These impacts are largely negative and harmful to the environment. However, energy is absolutely necessary to secure the benefits of economic development and national security. Therefore, it is counterproductive to consider the environmental effects of energy production and use separately from the need for available, affordable, and secure energy.

Similarly, it is counterproductive to deal with the environmental impacts of energy from the perspective of a single impact. For example, climate change is but a single impact of the use of hydrocarbons for energy generation. Use of hydrocarbons also causes far more immediate and more serious health impacts that arise from pollution.

The thesis of my book *India Energy: The Struggle for Power* (which received its India launch on December 12, 2014 at the Centre for Public Policy Research) is that it is in the interests of India and the United States to work together on energy issues across the board. This cooperation should cover aspects such as availability, affordability, security as well as environmental impact and focus on solving India's energy crisis.

Coal, Biomass and Oil

The energy/environment dilemma cannot be tackled effectively without taking into account the importance of coal. In India approximately 44% of all energy, 60% of installed electricity capacity, and 70% of electricity production is derived from coal. Indeed, coal is the largest source of energy for India by a wide margin. Also notable in the Indian energy mix is the outsized role played by solid biomass (chiefly non-commercial wood, dried dung and waste). In quantitative terms, this solid biomass is as important as petroleum in the energy mix. Coal and biomass provide India with almost two-thirds of its energy.

Biomass dominates residential energy demand today with 79% of all residential energy demand being supplied by biomass. In rural areas, the dependence on biomass is even more important, with some 90% of rural households depending on biomass for cooking. One study estimates that 400,000 to 550,000 premature deaths occur annually in India due to household emissions from biomass.

From an environmental perspective, India needs to decrease reliance on coal as the dominant source of primary energy and lower reliance on biomass for home use. Instead of moving in this direction, India is presently heading in the opposite direction. As the Planning Commission has noted in regard to the period through 2017, “The most important point to note is that coal remains the dominant source of primary energy.” As a share of total commercial energy supply, coal is expected to increase from 53.45% to 55.41% by the end of the Plan period and nearly 60% by 2022. Coal and non-commercial biomass are by far the worst polluting fuels. Oil and its derivatives are not far behind.

Oil and its derivatives offer their own environmental challenges. However, India sees its importation of almost 80% of its oil needs as its main problem with this energy source. Chiefly used in transportation, the environmental challenges of oil use must be solved in the context of moving from an over-reliance on imports.

Natural Gas

Natural gas has potential to operate as the “bridge to the future” in which there is less reliance on coal for the production of electricity. Natural gas in compressed form can also be used to substitute for petroleum derivatives. India has been a leader in using compressed natural gas as a substitute for diesel and gasoline because of judicial action. If infrastructure could be put in place, natural gas could also assist India considerably in moving away from non-commercial biomass.

India has a significant gap between supply and need for natural gas from both domestic and international sources. The discoveries by Reliance Industries in the Krishna Godavari Basin of the Bay of Bengal were the largest in the world for 2002. ONGC followed with discoveries of its own. However, Indian domestic production has dropped for both economic and technical reasons.

A new source is LNG from the United States, which is the largest producer of natural gas in the world with low prices set by competition. Of the applications for export to non-FTA countries granted by the US Department of Energy, India stands to participate in three projects. The Gas Authority of India Limited (GAIL) is participating in two approved projects (Cheniere Sabine Pass and Dominion Cove Point) and Reliance through its joint venture with BP may be marketing gas from another (Freeport). A fourth project, the Main Pass project of Freeport-McMoRan, may produce gas for India through Petronet.

Nuclear

Fundamental to the argument for nuclear power is that its production creates no greenhouse gases or other forms of pollution likely to aggravate climate change. However, radiation emissions are central to nuclear power production and must be controlled to prevent major health and environmental damage. Proponents of nuclear power argue that the safety features of nuclear power plants ensure that the risk is extremely low. Nevertheless, in India as elsewhere, the nuclear accidents at Three Mile Island, Chernobyl, and Fukushima Daiichi have raised concerns about safety and environmental degradation from nuclear power production. The related problem regarding the safe disposal of radioactive spent fuel has yet to be satisfactorily solved.

India's goal for 2050 is for 25% of its electricity to be generated from nuclear power plants, when 1094 gigawatts of base-load capacity are likely to be required. During the visit of Russian President Vladimir Putin to New Delhi in December 2014, an announcement was made regarding the Russian intention to develop ten additional nuclear power projects in India. This statement and further announcements at the Modi-Obama summit in January 2015 confirmed India's intent to proceed with meeting its civil nuclear goals.

In conjunction with the US-India civil nuclear agreement, each of the supplying countries was to get two power plants of about 2000 MWe each. The Russians and French resolved their liability issues but the United States has not done so. The Russian model of using insurance from Indian government-owned insurance companies to defray risks may prove useful in resolving the liability conundrum for US companies. At the Modi-Obama Republic Day summit, the leaders announced a “breakthrough” agreement based on the Russian liability model. Whether this agreement and the promised Attorney General's memorandum will induce Westinghouse and/or GE and their Japanese colleagues to proceed with civil nuclear development in India remains to be seen.

Hydro-power

The rivers that fall rapidly from the Himalayan mountains constitute a huge but not easily exploitable resource for electricity generation. There are also existing power plants in south India, particularly along the relatively low-lying ranges of the Western and Eastern Ghats that are located inland from the southwestern and southeastern coasts respectively. The estimated total hydroelectric resource for India is estimated at 149 gigawatts of which only about 32% or 48 gigawatts is presently developed or under development. Although hydro power presently accounts for only about 3% of India's total energy needs, it is more important in the generation of electricity. In 2012 about 20% of India's generation capacity and 14% of actual generation came from hydro-power.

The government of Narendra Modi has revived the linking rivers project. This project has a long history dating from the days of British rule and was a favorite project of the previous BJP-led government. Although the primary purposes of the project are to transfer water from wet to dry regions and facilitate transportation, the project also envisages a hydro-energy component.

The local opposition to the building of hydroelectric facilities in India is fierce and sometimes turns violent. Much of the exploitable hydropower potential is in areas inhabited by citizens who feel aggrieved by the government and neglected by institutions of development. In particular, the flooding of land resources and displacement of persons has provoked strong opposition.

Internationally, tensions created by the damming of rivers that cross international borders serve as a detriment to hydro-power development. Perhaps the most notable example of this phenomenon involves a series of dams that India plans to build on the upper reaches of the rivers that water the Indus basin in Pakistan.

With regard to China, India claims that waters from Tibet that flow into the Ganges and the Brahmaputra rivers are being diverted for use in China. Bangladesh has accused both India and China of impeding its water supplies.

During the monsoon season of 2013, thousands were killed by flooding in the mountainous Himalayan state of Uttarakhand. Bordered on the east by Nepal and the north by Tibet, Uttarakhand is the site of much of India's current hydropower development. When the floods came, many blamed their destructive nature on poorly situated or constructed dams.

Unlike fossil fuels, there is no impact on climate change when hydroelectric projects generate electricity. However, the damage to forests and habitat, as well as human habitation in many cases, is devastating to large tracts of land both during the construction and impoundment stages.

Thus, while India has considerable theoretical hydro energy potential, the costs of development and resistance created by those directly affected limit the efficacy of hydropower in significantly ameliorating India's power problem. These factors will probably keep hydro sources from having a major impact in satisfying India's struggle for power. Nevertheless, the Modi government's intent to revive the linking of rivers project could change this outlook.

Solar Power

Since India lies predominantly in the tropics, it receives abundant energy from the sun. Solar bombardment is intense, particularly across the desert areas of Rajasthan and Gujarat as well as on the dry interior plains. The Planning Commission has estimated that India receives the equivalent of 50 mw per square kilometer of solar radiation, or some 150,000 gigawatts for the entire nation. This is a phenomenal amount of energy.

At this point, solar power is simply not a significant factor in meeting India's power needs. In 2013, solar accounted for less than 1% of India's electricity generation capacity. Although there has been rapid development since, solar energy's contribution to India's overall energy needs remains miniscule.

However, recognizing its solar potential, India has embarked upon the “Jawaharlal Nehru National Solar Mission” in an attempt to turn the abundant sunshine into a significant source of power. The goal of the National Solar Mission is to have 20 gigawatts (20,000 megawatts) of additional solar generation capacity by 2022. This is to be compared with the 1.8 gigawatts solar generation capacity in 2013. (Thus, 22 gigawatts total grid-connected capacity is expected by 2022 plus off-grid and micro-grid capacity.) At the start of the Modi administration, the plan to use distributed solar technology to give 400 million electricity-deprived Indians access to electricity in the form of at least one working light bulb by 2019 received widespread publicity.

In its first budget, the Modi government announced four new ultra mega solar power plants financed by increased tax on coal. It has also upped the 2022 goal for solar to 100 gigawatts. However, at a cost of approximately $1 billion per gigawatt, an expansion of the solar goal by a factor of 5 means India needs an additional $100 billion to finance this goal. This will not come from government funds alone and will require a strong public/private financing effort in international capital markets to become a reality.

The good news in the solar energy sector is that production costs are dropping rapidly. The price for photovoltaic technology (chiefly solar panels) had fallen so fast that solar was reportedly close to competing in price with wind power and coal-based power in 2014. Environmentalists have argued for years that if the costs to public health and welfare and the environment generally were priced into the costs of carbon-based energy sources, the prices for solar are already competitive with coal, oil, and

gas. When does solar become as cheap as coal for India? According to an A.T. Kearney study, this occurs in 2016-2018 while McKinsey has predicted the year 2022.

One advantage used by states such as Gujarat in attracting foreign investment in solar energy was that manufacturing within India was not necessary for solar contractors based in that state. Other Indian states are taking a similar view and are rapidly implementing plans to follow the Gujarat lead.

Solar has few significant adverse effects on the environment. There is some concern about the taking of large acreages of undeveloped land for industrial size solar power plants. Regardless of the technology involved, these projects require large numbers of solar collectors that cover the land upon which they are arrayed. These arrays render the land upon which they are located largely unfit for native flora and fauna. Nevertheless, human health is not jeopardized by exploitation of the solar resource, and the environmental threat is insignificant compared to hydrocarbons, and even hydro and nuclear power.

Wind Power

For planning purposes, India estimates its wind energy resources between 50 and 300 gigawatts. However, wind resources are insufficient for pan-India exploitation. The Planning Commission identifies only seven Indian states as being suitable for wind power development.

Availability of wind power is further constrained by the remoteness and difficulty of terrain for many of the best sites for wind generation equipment. This not only inhibits development by virtue of location, but also complicates the laying of transmission links to collection sites.

India's installed capacity for wind generation is approximately 22 gigawatts, which ranks India fifth in the world for installed capacity. Wind accounts for about 8% of installed electricity capacity. However, much of this installed capacity does not generate its full potential and less than 2% of electricity is actually generated from wind. In terms of consumption, wind power accounts for about 1% of energy consumed.

The Indian wind energy industry rose to third position in the world on the backs of subsidies and tax incentives in the form of accelerated depreciation. Without these subsidies and incentives (and without hydrocarbon fuel having to bear the costs of pollution), wind energy has had difficulty being affordable within the Indian energy context. These incentives and subsidies were in place from 2003 to 2012. During this period, 17 gigawatts of wind-generated electrical capacity were added. Prior to the global economic crisis of 2008 and the later withdrawal of subsidies and tax incentives, India had obtained international prominence not only for the installation of wind capacity but as a manufacturer of wind generation equipment.

Environmental concerns around wind power include the damage done to forests during the siting and installation of generators as well as possible harm caused to birds from revolving blades. In India, there have been calls for greater regulation to minimize environmental damage. With regard to pollution and climate change, wind energy has negligible environmental and adverse health effects. The Indian and world experiences suggest that subsidies and tax incentives are necessary to make wind-generated

electricity competitive. With only seven Indian states seen as suitable for wind power, wind may be important only regionally. The gap between installed wind generation capacity and actual electricity production is probably indicative of a poorly designed incentive system that brought about installation of generators but did not provide adequate infrastructure to make much of the electricity generated useful to consumers.

Energy Efficiency

The dean of energy writers, Daniel Yergin, has referred to efficiency as the "fifth fuel". Presumably, the other four fuels are petroleum, coal, nuclear, and renewables or "alternative" sources of energy. While not usually considered as a fuel, efficiency has the characteristics of a type of fuel. It can be subjected to the same analysis as other fuels in terms of its availability, affordability, security and environmental impact. On each of these aspects, efficiency compares favorably with all other fuels.

With renewed emphasis on "sustainability", energy efficiency (whether referred to as "conservation," "energy productivity," or "energy ingenuity") can be as important to solving India's energy conundrum as any other type of fuel. The United States, India and its other international energy engagement partners have recognized the role of energy efficiency and taken steps to disseminate the technology and best practices necessary to utilize the efficiency tool. India has rightly taken pride in its increasing energy efficiency as evidenced by a declining energy intensity factor. This energy intensity factor is a measure of efficiency since it describes the unit value of energy that it takes to create an additional unit of economic output. India's energy intensity approaches that of several developed nations and is better than that of China.

Conclusion

India cannot afford to disregard the environmental impacts of its energy policy. Millions of Indians are sickened or sentenced to premature death each year by pollution caused by energy generation. The environmental impact of energy creation is an immediate and pressing health issue. In addition, it is a longer term climate change issue that will affect India in the form of extreme weather and eventually in the loss of island and coastal territory. Solar and wind energy backed by natural gas supplemented by conservation seem at this time to be the energy sources of choice for coordinating adequate energy production with environmental preservation in the long run. There is an argument for adding nuclear to this long run view. However, cost and the safety concerns of Fukushima, Chernobyl and Three Mile Island coupled with the question of radioactive waste make this an open question. In the shorter run, shifting away from oil and coal, and toward cleaner technologies for the coal that must be used, is an imperative. An Indian-US strategic energy partnership has much to offer. India and the United States should redouble their efforts to increase trade and investment in gas as well as renewables and nuclear energy to levels that are significant to both nations and sufficient to shift India away from primary reliance on coal and oil.

The technology, goods, services and financing necessary to help build the Indian solar, wind, and nuclear industries, to increase energy efficiency, and to make Indian oil and gas exploration and production more effective are all available from the United States and US-based private sector companies. However, the promise of India-US cooperation, and by extension, the Indian engagement with the international community, will never be fully realized unless US and Indian energy policies keep pace with the energy needs of their economies and their citizens.

India's Nuclear Energy Plans: The Challenges Ahead

Dr. Happymon Jacob

India is planning a two-fold increase in its nuclear energy production during the next decade, and the Modi government seems set to follow its predecessor, the UPA government headed by Dr. Manmohan Singh. Given the many strides that India has made in the nuclear energy sector in the previous decade, ever since it pioneered a civil nuclear dialogue with the United States, there have been many impressive debates in the country regarding the promise and problems posed by nuclear energy. And yet, the Indian energy discourse has been very limited and there is a need for a broad-based debate on the nation's energy future. For instance, there is hardly any serious discussion on creating the infrastructure necessary for alternative sources of energy. Nor has there been a debate on conserving the huge amount of energy that is lost through pilferage or during transmission. In any case, India needs a healthy balance of various forms of energy, including nuclear energy.

India faces two kinds of challenges in implementing its ambitious nuclear energy expansion plans:

1) international collaboration challenges and acquisition of cutting-edge nuclear technology;

2) Institutional challenges relating to transparency and regulation.

Status of the India-US nuclear deal

The Indo-US nuclear agreement seems well poised to become operational, but has not yet crossed all the hurdles. US President Barack Obama's visit to New Delhi in January 2015 and the personal attention given by him and Prime Minister Modi to iron out the operational differences in the Indo-US nuclear agreement have taken the deal another step forward. Indeed, the inability to implement the nuclear agreement, which was signed in 2008, had been a major source of disquiet for both countries. For New Delhi, mainstreaming itself into the international nuclear order seemed difficult without American help. For the Americans, despite doing the heavy groundwork to enable India to engage with major nuclear suppliers, they were unable to reap the economic benefits of nuclear trade with India.

The biggest breakthroughs have been the decision by the United States not to insist on the so-called 'tracking clause,' which would have enabled Washington to keep track of how the nuclear technology or material supplied to India would be used, to prevent cross-feeding of fissile material between India's civilian and strategic nuclear programmes. New Delhi considered this clause a violation of its sovereignty. The administrative arrangements for civil nuclear cooperation currently finalized by the two sides, have dropped this controversial provision.

The other major achievement is the Obama Administration's willingness to accept the Indian position that the Civil Liability for Nuclear Damage Act (CLNDA) is on par with the Convention on

Supplementary Compensation for Nuclear Damage (CSC), which India has signed, though not yet ratified. In other words, Clause 17 (B) of CLNDA giving the Indian operator Right of Recourse from the supplier, and Clause 46 of CLNDA allowing suppliers to be sued under any law, need not be amended for the Indo-US nuclear agreement to become operational. The United States is now willing to abide by CLNDA if India ratifies the CSC as they believe that Indian ratification of CSC could shield them from any future liability given that the United States does not recognize the Right of Recourse by CSC signatories against its suppliers. That said, it should be noted that while the United States is not pleased with the Indian law that holds suppliers liable, the US law unambiguously allows victims to file for damages against operators.

Challenges confronting the deal

Several outstanding issues remain to be discussed and sorted out before the nuclear deal can be considered a 'done deal.' India has offered to create an insurance pool to cover the claims against suppliers that might arise out of any unfortunate nuclear accident. This Indian proposal clearly runs contrary to the spirit of the country's liability law, CLNDA. Whereas the statute itself and the parliamentary deliberations during its passage, demand that equipment suppliers should be held liable for the damages caused by a nuclear accident, the government is now proposing to cover the costs involved. As of now there is no clarity on whether or not India will have to pay up the insurance premiums in full. If indeed the government contributes any more than 50% of the premiums, it would add considerably to the price of the reactors and consequently raise the unit cost of electricity produced. Indeed, India's deals with Russia and (potentially) with France also suffer from a similar problem.

The larger question is whether the Indian liability law is such a negative enactment in the post-Fukushima world. The reality is that CSC and other international instruments, which were essentially created by the nuclear supplier nations, only protect their interests and not those of the consumers and buyers. So in the post-Fukushima world, the international community needs to consider seriously the objections from the Indian side. After all, the Indian law is aimed at safeguarding the welfare of its people and promoting debate on the safety aspects of nuclear energy generation.

The second challenge is the absence of an Indo-Japanese civil nuclear agreement. This may prove to be a spoiler in the further implementation of the Indo-US nuclear deal. The non-proliferation lobby in Japan leads the opposition to the deal. It may be noted that Japan was reluctant to endorse the Nuclear Suppliers Group (NSG) deal. An agreement with Japan is important, partly because it is at the forefront of key nuclear technologies. More importantly, major US-based firms, such as Westinghouse and General Electric (GE) would not be able to sell reactors to India without an Indo-Japanese nuclear agreement given that Hitachi recently bought 40% stake in GE's international joint venture, and Toshiba fully acquired the Westinghouse Electric company in 2008. An Indo-Japanese deal may not be very easy to ink given the tough Japanese demands, such as no further Indian nuclear testing, and spent fuel to be returned to Japan for reprocessing. New Delhi's claim that other alternatives are available is not convincing enough.

The other related issue is the sale of enrichment and reprocessing technologies (ENR) to India. There is no clarity yet on whether non-NPT states such as India can engage in the international commerce in ENR technology. While the 2008 Nuclear Supplier Group (NSG) decision allowed its members to sell sensitive nuclear technologies to India, NSG's 2011 decision to limit the scope of the transfer of nuclear technologies to non-NPT countries has complicated India's ability to acquire ENR technologies. These technologies are crucial for India to acquire adequate commercial uranium enrichment capacity in order to reduce dependence on advanced nuclear states for the supply of nuclear fuel.

Should India radically enhance its reliance in nuclear technology without being a part of the international order? Given that India is not a member of international strategic cartels such as the NSG, Australia Group, Wassenaar Arrangement, and the Missile Technology Control Regime (MTCR), it will have to make back-room deals in future to engage in nuclear commerce. This is certainly not an advisable option. At a press conference held on January 25, 2015 the Foreign Secretary Sujatha Singh claimed that India would be given a phased entry into these cartels. This is not a new assurance, but one that has been repeatedly given for the last 7 years without any follow-up action. In any case, the prospect for India's entry into these cartels does not look very promising at this point in time.

Finally, while the political roadblocks may now have been overcome, the big question is whether the nuclear industry in the United States and elsewhere would find it commercially attractive to sell nuclear reactors to Indian operators. Only when the commercial negotiations begin and the operators and suppliers complete their own risk-assessments will it become evident how soon India can generate more nuclear energy. While attention is focused mainly on the international suppliers and their unease with the Indian liability law, it must be noted that Indian suppliers are equally hesitant. Private suppliers in India like Larsen &Toubro and Godrej are concerned about liability under the 2010 law and have already expressed their concerns.

Institutional challenges

Lack of Transparency about nuclear safety and security: There are other institutional problems that India needs to resolve before massively enhancing its nuclear industry. One such challenge is the regressive culture of secrecy prevalent in the country's civilian nuclear establishment. Historically, given that India's nuclear programme was under sanctions and isolated by the international community after the 1974 peaceful nuclear explosion, there was a culture of extreme secrecy within the establishment. This was intended to ensure that the nature of the country's nuclear programme was not disclosed to outsiders (due to concerns that its nuclear weapons programme would be detected). This reluctance to disclose any information has had a negative impact on the Indian nuclear establishment. Today, despite India's increasing integration into the global nuclear order, its nuclear establishment is not inclined to be transparent about nuclear safety issues. Moreover, the culture of public debate and consultations with stakeholders is largely absent. Another reason for the past lack of

transparency stemmed from the fact that the country's civilian and strategic nuclear programmes were not separated. However, today, India has clearly separated its civilian facilities from its strategic facilities.

Powerless Regulatory Body: India does not have an independent nuclear regulatory authority to oversee the functioning of its government-run nuclear projects. The Atomic Energy Regulatory Board (AERB), established in 1983 through a gazette notification, is tasked with regulating the safety and security aspects of the country's civilian nuclear facilities. However, it is not an autonomous body as it depends on the Department of Atomic Energy (DAE) for all practical purposes. Consequently, it has been unable to perform its regulatory functions effectively.

In 2011, the Nuclear Safety Regulatory Authority (NSRA) Bill was drafted by the DAE and submitted to the Union Cabinet for approval. However, even the NSRA, as currently envisioned, does not propose a truly autonomous regulatory authority. The Council of Nuclear Safety to be established by the NSRA Bill — with the Prime Minister as the Chair and mostly government representatives as members — will be a very strong body with the power to appoint the chairperson and members of the new regulatory body. This will diminish the powers of the regulator since it will be subordinate to the Council chaired by the Prime Minister. Consequently, India will end up having a government-controlled regulator again. This does not mean that the NSRA Bill is not an improvement over the existing AERB. Clearly, there are significant differences between the two. Firstly, while the AERB was set up by a government order, the new regulator will be established by an Act of Parliament, thereby making it more powerful. Secondly, while the AERB reported to the AEC, the new authority will submit its report to Parliament.

Conclusion

Undoubtedly, India needs to generate more energy, including nuclear energy. However, the country needs to adopt innovative policies and create new institutional structures that can aid the generation and management of nuclear energy in an optimal manner. More importantly, the above-mentioned challenges need to be met creatively and innovatively to ensure that the country's nuclear projects do not pose any danger to the well-being of the public at large.

The Eightfold Path to India's Nuclear Fuel Supply Security

Nitin Pai and Pranay Kotasthane

Energy security will continue to remain a critical determinant for India's growth story. If India expects to resuscitate its economy, the domain of energy security will need immediate and dedicated focus. Moreover, within a few years, 24x7 electricity will become a *sine qua non* for a dignified life in India just like broadband internet has become an indispensable part of the urban Indian middle class today. As a result, one of the important demands that the politics of tomorrow will be contested on is an uninterruptible, affordable and reliable power supply. The words “energy security in India” need to be seen in this context, as an engine of growth for today and as a natural public expectation tomorrow.

Nuclear power is one of the significant pathways towards energy security for India. On the demand side, it has the potential to become a clean and reliable option for meeting rising popular expectations. On the supply side, India's continuous investment in nuclear power for civilian use since the 1960s makes it a familiar territory for scientists and policymakers. Given the vast benefits of utilising the nuclear power option, this paper focuses on presenting a way forward for India to secure supplies for its nuclear energy infrastructure. This is done by outlining an eightfold path for achieving nuclear fuel supply security, which can make nuclear power a major contributor to India's energy mix.

The Eightfold Path

The eightfold path presents eight principles which will help India secure its nuclear energy infrastructure.

0. Create a national energy supply risk assessment and management framework

The zeroth rule for securing energy supplies of any kind is the formation of an energy supply risk assessment and management framework. This is especially important for India which imports nearly 28% of its net energy requirements. Domestically, the supply of coal, India's primary energy contributor has been crippled due to an unclear policy on coal mining thereby raising the risks of inadequate energy supply. Thus, India needs a framework which anticipates risks associated with plausible geostrategic scenarios, so that these risks can be managed. Such a framework will build redundancy in the overall energy supply chain so that perceptible risks can be managed without any significant impact on energy availability.

This framework will also answer key questions: Does India need strategic fuel reserves? Or will it suffice to have monetary liquidity to buy fuel in an emergency? A transparent framework to answer such questions will also serve as a powerful signaling instrument to Indians, as well as to other nations.

1. Invest in diversity across the board

With one of the lowest per capita electricity consumption among the developing countries, India simply needs all energy sources that it can procure. At a macro-level, this means being agnostic to any source of affordable energy in the short term: whether it is coal, natural gas, oil, nuclear energy or renewables.

At the micro level, India needs capabilities for handling different nuclear fuels: whether it is the domestically available low grade uranium, imported enriched uranium or the indigenous thorium. Diversity leads to a loss in the economies of scale, but that is the price we must pay for energy security. An upside to this diversity is that operating and integrating diverse systems gives our talent pool a competitive advantage akin to the expertise the Indian Air Force (IAF) and Information Technology (IT) fields have developed as a result of their continued exposure to a variety of platforms.

2. Trade with suppliers, buy from trading partners

Since India is short of domestic supply of fuels like uranium, it will have to rely on strategic purchases from other countries. In such a trade dominant scenario, there are broadly two principles that can be operationalised:

a. Diversify trade in multiple sectors with countries which are providers of reactors, fuel or other allied nuclear infrastructure. This will ensure that India has appropriate levers to hedge against the changing geopolitical equations with the supplier nation.

b. Buy nuclear fuel and reactors largely from existing trading partners. This is because countries with robust economic relations with India are less likely to block supplies in a crunch situation.

In practice, this means either diversifying trade relations with suppliers like Nigeria and Iran or substituting them with countries that already have significant trade relations with India.

3. Purchase preferably from competitive markets

As a predominant buyer of nuclear fuel, India needs to manage political risks by purchasing fuel supplies from markets which have multiple players instead of depending on a supply chain which is oligopolised by a few countries. The nuclear fuel is available in the market at all four processing stages: mined uranium, milled yellowcake, enriched uranium and fuel fabricated uranium. Since enrichment facilities are available in only a handful of countries, this is the bottleneck in the supply chain. India can de-risk this by purchasing uranium in all of these intermediate forms. There could be separate contracts with different suppliers at each step of the process, while retaining two or three suppliers for each stage of the fuel cycle, who compete for their business by tender.

4. Make markets more competitive if they are not

The uranium market is a seller's market which means that India is at a disadvantage from the outset. As a result of this imbalance, suppliers have formed cartels like the Uranium Club and the Nuclear Suppliers Group (NSG). India should look to work with these cartels if the opportunity costs are manageable. If not, India must consider how these cartels can be dismantled altogether.

5. Fuel is fungible, so use it wisely

India's has domestic ore but this may not necessarily be the cheapest. The guiding principle for nuclear fuel purchase should be price. As fuel is fungible, it can be put to different uses like power generation or nuclear weaponry. Instead of reserving a certain source of fuel for a particular purpose, it is advisable to use price sensitivity as a purchasing principle.

6. Share the risks between plant communities and user communities

Plant community refers to the populace in the vicinity of a nuclear reactor. User community refers to the populace benefited by nuclear power supply. The problem with power plants is that while the burden of

risk falls on the plant community, the user community is largely a free rider. To undo this imbalance, risk needs to be shared by the user community as well. One way is to price this risk and design a public health insurance with a co-payment model that safeguards the plant community in case of any untoward incident. The premium of the insurance will be paid by the user community to a larger extent with the plant community sharing only a small portion of the monetary costs. Further, the government can allow states and local communities to set the risk premium.

7. Secure supply routes

The risk management framework for energy security needs to factor in the sea/land route availability and safety. India needs to ensure land, sea ports and terminals that allow fuel passage. There must be safeguards against cases of theft and proliferation during transit. India can seek commercial guarantees from suppliers or from groups like the IAEA or NSG.

8. Invest in domestic industry

India would do well to hedge against the prospect of trade restrictions or transport disruptions affecting its supply security by investing in a domestic industry that works on all verticals of nuclear power generation: from extraction of indigenous sources of uranium (and other fuels) to the technology of transforming uranium into reactor fuel. The good news is that because so little uranium is needed to produce a large amount of electricity, and a few years supply can easily be stockpiled, nuclear fuel can be considered to be effectively an indigenous energy source.

The eightfold path outlined above will be instrumental in realising India's vision of becoming a world leader in nuclear technology and ensure that its growth trajectory is not impeded due to energy insecurity.

Nuclear Energy: A Gateway to Disaster, not Prosperity

M.P. Parameswaran

During the fifties and sixties of the 20th century, nuclear energy raised great expectations. Dr. Bhabha even claimed that a time would soon come when energy from the atom would become so abundant and so cheap that countries might not even bother to meter the energy supplied.

However, by the mid-sixties a different picture began to emerge. Cases of radioactive spills began to multiply. Researchers found that the deleterious impact of radiation on humans was much more severe than imagined earlier: Reactor designs had to become more and more stringent in terms of safety standards and consequently, costs began to rise substantially.

Meanwhile, the implications of nuclear accidents became clearer and more alarming. The first major, publicly known nuclear reactor accident took place in 1969 at Three Mile Island in the United States. It was a narrow escape from a total blow up. Earlier, an even graver accident occurred in a Soviet radioactive material storage facility, which was revealed only much later. Thereafter, the well-known accidents in Chernobyl (1986) and Fukushima (2010) occurred. As the first vintage reactors in United States, Europe and India, are getting older the probability of more accidents is growing.

The highly radioactive spent fuel from nuclear reactors has to be kept under surveillance and safe custody for hundreds of years as there is no way to “dispose” it off. All the spent fuel so far generated is stored under stringent care, at a huge financial cost to society. Processing to recover plutonium does not reduce radioactivity significantly. Moreover, radioactive waste management remains an unresolved issue.

Decommissioning of nuclear power stations is yet another unresolved issue. No major station has been fully and properly decommissioned. To postpone the decommissioning expenditure US reactor operators have been given a 20-year extension for operation, increasing its life from 40 to 60 years. Soon there will be too many such 'aged' reactors, with a manifold increase in the probability of major accidents.

Due to heightened awareness of the hazards posed by nuclear reactors, a large number of scientists, many of them Nobel Laureates, under the leadership of Harold Urey came out in 1974 with a statement: “*Our Nuclear Power Programme Involves Unacceptable Risks*.” Another group of scientists, mainly physicists, under the leadership of Nobel Laureate Eugene P. Wigner countered with

the statement: "*Nuclear Reactors Offer Surest, Safest Way of Meeting Our Energy Needs*". A four-year long national debate ensued. More and more scientists and public activists joined the anti-nuclear group. Finally, in 1978, the US government ordered a moratorium on new nuclear power stations. Since then, no new nuclear station has been constructed in the United States although some additional reactors were added to already operating stations.

Countries around the world, especially developed nations, have begun to backtrack on nuclear energy. Only some developing countries like India and China are still aggressively promoting nuclear energy. All the arguments presented by the Government of India in favor of nuclear energy are fallacious. Nuclear energy is *neither safe*, nor *cheap*, nor *abundant* and is certainly *not unavoidable*:

1. **No nuclear reactor is absolutely safe:** The argument that Indian reactors are hundred percent safe and no serious accident of the magnitude of Chernobyl will *ever take place* is mathematically and socially unacceptable. India has to be prepared for such a disaster at any time. If not, the people will be forced to pay an enormous price. In Chernobyl, the Soviet authorities managed to evacuate more than 30,000 people in three hours by commandeering 1000 buses. If such an accident ever happens in the Kudankulam reactor in Tamil Nadu, how will India evacuate lakhs and lakhs of people living within the 30km radius to safe places? There is absolutely no possibility of mass evacuations as there are not enough vehicles and no proper roads. None of the Indian nuclear reactors have any emergency evacuation protocol. No accident in a thermal station can do as much damage as a Nuclear Event Scale (NES) 7 level accident as in Chernobyl or Fukushima. Fortunately, there has never been an NES-8 accident, known as Maximum Credible Accident (MCA) anywhere in the world so far. But it could well happen in the future, as nuclear reactors are just not safe and the risks involved are too high.
2. **Nuclear energy is not cheap**: The capital cost of the proposed Jaitapur Nuclear Power Project in Maharashtra is said to be more than Rs. 200 million/megawatt. The plant load factor (PLF) cannot be taken as 80 or 90%. The average PLF so far achieved throughout the world is about 60%. The capital cost itself will come to Rs.5-6 per unit. After adding the fuel cost (though comparatively lesser), decommissioning provision, waste disposal measures and accident preparedness provision, the cost will definitely shoot up to levels that are not easy to predict.
3. **Nuclear energy is not abundant:** Many of the nuclear statistics placed before the public are either misleading or exaggerated. All the existing commercially running reactors belong to the category of thermal reactors, working on slowed down neutrons. The fuel for such reactors is U^{235} reserves of which are limited and rapidly depleting. It is the next stage of reactors, the Fast Breeder Reactors (FBRs), which could make nuclear energy abundant. In these reactors, working with fast moving neutrons, there is a possibility not only of renewing the fuel but also of growing more fuel. Hence the term "breeder." While small and large FBRs have been running on an experimental basis for several decades, none have yet come into commercial operation. The United States and Europe have almost written off FBRs. These reactors are considered risky plants equipped with molten sodium-potassium alloy as coolant – a dangerously explosive alloy.

Many Indian politicians and some "senior" scientists are very confident that India will break the impasse and bring FBR into commercial realms. The completion of India's first 500MW prototype FBR has been getting delayed continuously. This has plutonium-239 and uranium-235 as full, and U^{238} and thorium as fertile material. A very small quantity of U^{233} will be formed in thorium. It will take between 15 to 25 years to breed fuel for a second reactor. After three or four generations of breeding, India would be theoretically ready to proceed to the next stage – using plutonium as fuel and thorium as fertile material in which U^{233} will be generated. It will take another two or three generations of breeding before U^{233} is produced in sufficient quantities to embark on the final stage of operating true U^{233} thorium breeders.

The second and third stages of converters are still in the stage of mathematical equations and physics experiments. Few believe that these reactors are even technologically feasible, not to speak of supporting commercially viable operations. Even the first stage breeder – the plutonium-uranium-thorium breeder, is yet to be commercially established. To go all out to expand the thermal reactor base, rejecting India's advantageous position with natural uranium reactors, hoping there will soon be a high demand for large quantities of plutonium is unwarranted and unsupported by the experience so far.

Even the present "ambitious nuclear plan" being implemented at enormous cost to the people of India does not envisage more than 8-9% contribution from nuclear energy by the year 2031. What may be more worthwhile to consider is a slower program based on indigenous natural uranium-heavy water technology, but using imported natural uranium, where the shortfall will be only marginal.

However, even such an expansion based on Indian technology is undesirable. The nuclear fission taking place in a bomb and a reactor are identical in nature. Both produce an identical array of radioactive products. In the Nagasaki-Hiroshima bombs, about 3 Kg of U^{235}/Pu^{239} was fissioned. In a 1000 MW(e) reactor working 24 hours on full load will cause fission of an equal quantity of uranium and produce an identical quantity of radioactive material. A 1000 MW reactor working at 60% PLF will produce annually, radioactive materials equivalent to that produced from 200 Nagasaki bombs. The only consolation is that in the absence of an accident, these materials are confined within the fuel rods and kept under constant surveillance in cooling ponds. The legacy of radioactive material being left behind for future generations is indeed frightening.

An Unnecessary Nuclear Deal

Under these circumstances, it is difficult to understand the rationale of the Indo-US nuclear agreement for India's energy sector. Although there might be other considerations behind the deal, it is difficult to comprehend or justify from a pure energy perspective. In fact, many retired scientists from the Department of Atomic Energy, including the present author, had opposed the Indo-US agreement as being absolutely unnecessary.

Energy Efficiency and Renewable Energy Policies: A Few Rational Thoughts

Dr. R. Harikumar

One answer to global warming and energy security is to replace and retrofit current technologies with alternatives that have comparable or better performance, but do not emit or emit less carbon dioxide. This could be termed alternate or clean energy. Renewable power, conservation, energy efficiency, more efficient vehicles and clean fuels belong to this category. This paper emphasizes energy efficiency policies, examining the current relevance, if any, of certain barriers to energy efficiency improvements as identified by Dr Reddy[1] in 1991, rationally assessing how far India can succeed in addressing these, suggesting a few policy initiatives to overcome these barriers and posing a few questions that appear researchable, open and potentially important.

Barriers to energy efficiency/renewable energy

The ignorance of consumers regarding the potential of energy-saving technologies/systems, the higher initial cost of efficient devices, energy cost not being significant enough for certain high energy consuming categories as compared to other consumables, the difficulty faced by home owners in identifying technicians/service providers for energy efficiency investments, the prevailing interest towards centralised energy generation options and the lack of institutional capacity to formulate comprehensive energy efficiency programs continue to be listed as barriers to energy efficiency.

Initiatives in addressing barriers

Enacting the Energy Conservation Act in 2001 and introducing many schemes as per the provisions of this Act, such as the star labelling of energy efficient equipment, accreditation of energy professionals, soft loan for energy efficiency investments and experimentation to make ESCOs successful in the country are the major initiatives from the Government side. While India can successfully address some of these barriers, there are a large number of barriers that can only be surmounted through a careful choice of policy options and initiatives.

What more can be done?

In this age when different media, including the social media, have been used profusely to influence people's behavioural changes, they are seldom deployed for effecting social engineering or impacting energy efficiency.

Subsidies or incentives, though seen as 'bad words' may have to be formulated so as to reach the right target audience rather than the affluent group still enjoying the fruits of subsidy along with the deprived. Telescopic tariffs for electricity may be revised to increase the cost for high-end energy consumers and dis-incentivise them from any irrational misuse of power. There should not be much increase for low-end consumers so that they would be enticed to survive as energy misers. ESCOs, which proved a wrong option for industries in the United States and Europe are still being experimented in this country. Instead, ESCOs and facility management groups that were successful elsewhere and in many Indian locations may be promoted. While India could successfully create a housing boom with low rate loans, it has not managed to evolve soft loans for energy efficiency/renewable energy investments nor motivate industries to avail of such instruments whenever they are made available.

Branding of renewable energy gadgets, such as solar products, may be done to attract the upper and upper middle classes. State Nodal Agencies (SNAs), with the collaboration of the Ministry of New & Renewable Energy (MNRE) and reputed manufacturers could roll out suitable promotional campaigns.

The primary contact of a home owner for any alterations in the electricity system or plumbing circuit is either the electrician or plumber. Unfortunately, both are not professionally trained nor even given any orientation to think in terms of energy efficiency, electrical safety and water-use efficiency. Skill upgradation of this semi-skilled workforce could be treated as a priority program by the SNAs or the State Designated Agencies (SDAs).

While sharing of best practices in various fora, including meetings organised by professional associations continues, the lack of opportunities to caution consumers with certain points to consider before taking decisions, leads to many consumers opting for non-scientific options or making the wrong decisions. Many products, systems and buildings certified as 'green' have proved otherwise.

Institutions are created to promote clean energy and their capacities are being strengthened. However, when institutions move from the project mode to program mode, the formulation and implementation of energy efficiency programmes require technical and managerial skills of a high order, which is lacking. Given the gravity of energy security issues, tinkering with policies would not lead to the desired results. Technological leap-frogging gave this generation the convenience of electrical induction cookers, 3G phones, laser-jet printers, etc., contributing towards increased productivity, user-friendliness and simultaneously increasing the absolute energy consumption/demand. Energy pricing and policies need to be evolved to address this rebound effect.

Conclusion

Despite all the virtues of the market as an allocator of capital, raw materials and manpower, it cannot be solely depended upon to safeguard equity, inclusive growth, environmental externalities and the long-term interests of society. Acknowledging this reality, debates, discussions and studies need to be commissioned to evolve inputs for special policies to protect the poor and the environment in the long term.

Disclaimer: The views expressed here are solely those of the author in his private capacity and do not in any way represent the views of the EMC, Department of Power, or any other entity of the Kerala Government.

The Missing Links in Renewable Energy

Ashish Gupta

Fossil fuels (coal, oil and gas) fulfil over 93% of India's demand for commercial energy currently and their role is expected to shrink only marginally to 90% by 2022 as per the 12th Five Year Plan of the Planning Commission. Dependence on fossil fuels is thus inevitable for India in the short to medium term. However the installed capacity generation basket has undergone significant change in the last few years with renewable capacity proliferation steadily increasing. India is well endowed with non conventional sources but so far, coal remains the leading source of electricity generation in the country.

Given the climate change issue and some negative impacts of the coal-fired power plants, India is embarking on renewable energy in a big way. The country has made significant progress in renewable capacity addition in the last five years by adding about 31,692 MW with highest cumulative annual growth rate of 14 percent. Though renewable energy technology has increased significantly there is still huge potential waiting to be tapped. The technology-wise potential of renewable sources is given below:

Technology	Potential (GW)	Estimating Agency
Biomass	18	MNRE
Bagasse based cogeneration	5	MNRE
Wind Energy	49.1	CWET
Small Hydro	19.7	MNRE
Wind Energy (at 80 m hub height)	102	CWET
Solar Energy (Grid connected)	5000 trillion Kwh/ per annum	MNRE

MNRE – Ministry of New & Renewable Energy; CWET - Centre for Wind Energy Technology

The Modi government has also announced a very ambitious target of adding 100,000 MW by 2022 up from 20,000 MW goal announced by the previous UPA government. Despite these genuine efforts, the Jawaharlal Nehru National Solar Mission (JNNSM) initiated in January 2011 has flourished but not at the envisaged pace. The crucial question remains: why was JNNSM unable to achieve the desired results? Some underlying issues and challenges are proving to be major barriers for the renewable sector.

On the market mechanism front, the government has taken many initiatives but these measures are not proving sufficient to boost the renewable energy market in the country:

- ***Private sector participation**:* It is undeniable that most of projects that came up in recent years were developed by private players. However, limited capacity and the financial crunch have forced them to quit the market. The high cost and risk associated with renewable energy projects makes lending institutions reluctant to provide low cost finance, rendering these

projects unviable. Interestingly, renewable energy projects constitute part of infrastructure financing but these measures are not enough to change the perception of the financial institutions.

- ***Renewable Energy Certificates (REC):*** REC is a market-based instrument to facilitate renewable trading at the national level. Non-compliance of the Renewable Purchase Obligation (RPO) by most states led to a declining trend in REC demand. Moreover, the Central Electricity Authority Commission (CERC) has determined the REC prices up to 2017 only and therefore the projects which are set up on REC trading are finding it difficult to achieve financial closure.
- ***No coordination among Centre and the States****:* The mismatch between centre and state-level renewable targets is a clear example of non-coordination among them. JNNSM has failed due to such lack of cohesion as most of the projects which came online are awarded under the state flagship program (for e.g. Gujarat).
- ***No uniformity in fiscal incentives:*** The packages announced for one source is not applicable for another renewable source. Accelerated depreciation allowed for solar plants is not allowed for wind plants. This approach undermines clarity and fails to provide a clear roadmap for development of the renewable sector.
- ***Local content requirement:*** With regard to overseas participation, the domestic content requirement is proving to be a major hurdle. Though the JNNSM objective is to empower the indigenous renewable industry, overseas companies do not favour the same. The government still faces the dilemma of how to strike a balance since the domestic industry is vulnerable to cheap Chinese silicon and American thin film manufacturers.
- ***Classification of renewable energy****:* No serious thought has been given to classification, though it is not a very complex problem. The categorisation of renewable energy is more related to individual perception. Any source which is "new and renewable" comes under renewable, but any source which is "old and renewable" is not covered. Hence, hydro and nuclear are not included in the renewable sources although they are effectively renewable sources.
- ***Infrastructure Issues:*** India has come a long way in renewable energy but infrastructure issues still pose a hurdle in terms of evacuating renewable-based electricity. Grid integration of renewable energy plants poses challenges due to infirmity, remote location of the plants and inability to generate reactive power.
- ***Distributed Generation (DG) approach to renewable energy:*** *The* DG approach for renewable energy is projected as the most promising solution for hinterland areas where grid connectivity is not viable. However, establishing decentralised projects is associated with high financial and organisational risks.

Another key issue is whether the State Electricity Boards (SEBs) are empowered enough to make the difference in reshaping the framework. They are well empowered in terms of the policy framework but not empowered enough financially to absorb the high cost of renewable power and also suffer from lack of implementation capacity. The financial crunch is a major reason why most distribution companies were unable to fulfil their RPO obligation as reflected in their balance sheets. RPO is no longer a matter of obligation but the question is of financial viability. Making SEBs financially strong is the only way forward so that they will undertake the obligation willingly and not forcefully. In addition, various other measures need to be adopted to give the desired push to the renewable sector.

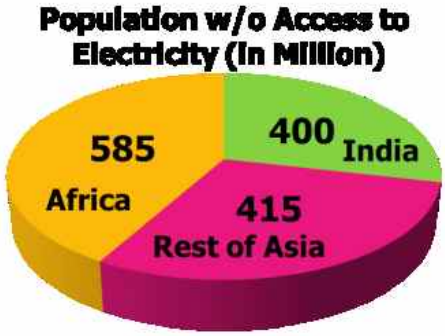
- ***Low cost financing****:* Increasing availability of low-cost financing options infuses confidence among the project developers. Moreover, increasing the viability of renewable energy projects through subsidised new innovative technology increases the confidence of financial institutions from the long-term perspective. Micro-level financing for DG projects will be a significant step in this direction.
- ***Collaborating Centre and State efforts:*** It would be encouraging to define clearly the specific responsibilities and role of the centrally instituted organisation along with key requirements to empower the state-level institution under the ambit of one central administrative body.
- ***Uniformity in fiscal incentives:*** Bringing about uniformity in fiscal incentives for all the renewable sources would boost the industry.
- ***Infusing confidence among domestic industry players****:* A favourable policy push coupled with government financial and infrastructure support will create a more conducive environment for the domestic manufacturing industry. Investing in indigenous manufacturing R&D would help create a progressive ecosystem for renewable technologies, which in the long run would help reduce their cost.
- ***Erecting transmission network****:* Investing in the creation of a reliable grid with enough spinning reserves to manage intermittency is very crucial for states having huge renewable energy potential.
- ***Integrating nuclear and renewable ministries:*** Integrating the nuclear and renewable ministries under one administrative set-up will ease the turf war between them.
- ***Push the DG approach****:* The adoption of a multidimensional push for addressing technical, commercial and regulatory aspects is essential for successful implementation of DG projects.

Lastly, renewable sources are often compared with coal in terms of carbon emissions. This is an unfair comparison in the Indian context because the country's sustainability is very much linked with affordability. Given the prevailing situation, renewable energy must complement coal until energy access for all in India becomes a reality. Therefore, an inclusive approach is required where all energy sources play their crucial role in achieving India's broad vision of energy security. In this regard, there have been some encouraging steps and some missing links, which will hopefully be corrected in future.

Sustainable Energy Access and Security for Rural India

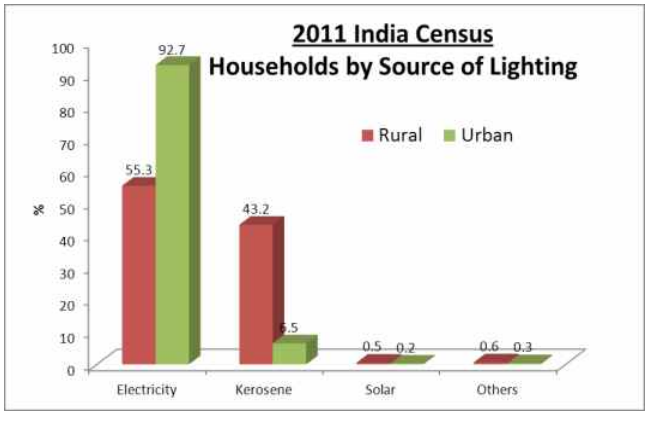
Dr. Ashok K. Das

According to the IEA's report[1] on *World Energy Outlook 2011*, one-fifth of the world's population, (1.4 billion people) do not have access to electricity. Of this number, 80% live in rural areas. While 585 million reside in Sub-Saharan Africa, the majority of 815 million live in Asia, with India alone accounting for 400 million. The Indian census data of 2011[2] reveals that only 53% of the rural population has access to grid electricity and 43% still use kerosene for lighting. Worldwide, the situation is considered so grave that the United Nations has declared 2014-24 as a *Decade of Sustainable Energy for All!*



Source: World Energy Outlook, 2011, IEA

According to Chandrabhan Sharma, Pradhan of Vidhuni in Shrawasti, Uttar Pradesh, people pay between Rs.100-150 per month for kerosene. However, the use of kerosene leads to several ill health effects, and fails to address other needs such as power for mobiles, fans, TV/Satellite, irrigation pumps, agriculture machinery and school computers. Local entrepreneurs have long exploited this situation, particularly in Bihar and UP by providing just enough diesel generator power to light one CFL bulb for Rs.100 per month. A shopkeeper at Mansahi in Katihar, Bihar, said he pays Rs.60 per month for one CFL bulb for 3 just hours of light every night! Our ground studies in Jharkhand and Odisha reveal similar realities.



Source: India Census Data 2011

Most of India's rural economy revolves around agriculture. However, most farming activities are focused on growing food, which often does not fetch sufficient earnings. Little effort has been made to implement post-harvest processing of crops, and to create appropriate storage facilities to increase the life and value of rural agricultural produce. Establishing local micro-enterprises in rural areas is imperative to improve the socio-economic status of the rural populace, and lead to 'Gram Swaraj'.

Access to energy plays a key role, not only in promoting rural development but also in enabling employment and education. A 2010 study[3] by the World Energy Council confirms that “energy poverty is the main reason for rural poverty which in turn gives rise to health issues” and “restricts the income level and industrial and commercial activity leading to economic stagnation or slow growth.” The socioeconomic development of rural India thus revolves around the nexus of Education, Employment and Energy, and achieving these three goals will lead to Empowerment of the community. Access to energy is the crucial element in this strategy as it enables both employment and education. For a secure energy future, India must intensify energy security at an accelerated pace for the rural masses. The efforts made over the past decade have not yielded the desired results, leaving rural India aspiring and hungry for power! The question is how can this huge latent demand be met?

Source: SunMoksha Power Pvt. Ltd.

Increasing Energy Access to Achieve Security

The obvious option is to expand grid-electrification to villages. The pace of grid-electrification in India has increased manifold since the launch of the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY[4]) scheme in 2005 by the Ministry of Power. As of April 2012, about 93.8% villages are electrified leaving some 36,700 villages un-electrified out of a total of 593,700 villages. However, electricity generation has not kept pace with increased grid-access under RGGVY, whereas demand has been increasing rapidly. The Load Generation Balance Reports[5,6] by the Central Electricity Authority (CEA) of India, shows that the gap in average supply and demand varied from 8 to 11% between 2007 and 2012, while the gap during peak demand varied from 9 to 18%. There has been a general decrease in the deficit, but there is still a long way to go. However, grid expansion raises several other issues and challenges. The grid incurs 30-40% transmission and distribution (T&D) losses and requires massive investments. Moreover, due to the generation deficit, almost 45% of the grid stays un-energized and idle almost 80% of the time. This is a colossal waste of investment. Furthermore, even if there is impetus on large-scale power generation, rural areas remain the last priority, except in the case of irrigation.

Over the past decade, several attempts have been, and are still being made to address the energy

deficit and improve energy access by the poor and rural populace. In this context, decentralized renewable energy technologies are playing a significant role, as summarized in a recent article[i7]. Rural micro-grids with renewable power generation have gained popularity over the past few years. For socio-economic development, the creation of jobs and micro-enterprises are paramount and this calls for electrical power and thermal energy. Micro-grids are the best option to supply electrical power for these economic activities, and decentralized renewable energy is ideal for power generation and for thermal applications. Several solutions have been and are being implemented to make the micro-grid model succeed in the rural hinterland. However, these solutions have been unable to achieve scale, due to several challenges:

Micro-Grids for Rural Electrification: Issues and Challenges

1. *Focus on supply not demand management:* The traditional approach is to generate power to meet the peak demand, whereas normal demand keeps changing throughout the day, and shifting over the seasons. Generation is geared towards providing power to the customers as per *their* demand and schedule. Very little consideration has been given to energy efficiency of the end appliances to manage demand. All this results in overdesign, lower efficiency, and lower plant load factor.
2. *Single-source power generation:* Most efforts are focused on supplying power through a single source of renewable energy. This has resulted not only in limited scope to meet all types of demands, but also limited scalability.
3. *Operational issues:* The operational cost of collecting fees for electricity supplied to customers and issues of non-payment are also high due to manual operations and collection methods.
4. *Field support and skill gap:* Difficulties are faced in getting skilled personnel and transferring the technology nuances to rural personnel. The need for hand-holding of local personnel has hindered scaling.
5. *Inadequate business models and lack of access to finance:* Lack of appropriate business models and access to finance to make these decentralized solutions self-sustaining and scalable has been an impediment.

A Holistic Solution: *NanoPower*

The SunMoksha[8] company has invested years of effort to understand the challenges of energy access and develop solutions to meet these challenges. It has focused particularly on issues hindering the scaling of micro-grid solutions. *SunMoksha* has adopted the 'systems' approach to energy access in rural areas for socio-economic development, instead of the piecemeal component approach followed by several other players. It has developed and patented[9] a holistic solution, *NanoPower,* to address these challenges. The word "*Nano*" signifies small, modular, and affordable for the masses. *NanoPower* provides sustainable and scalable energy solutions through seven key innovative interventions:

1. IT-based automated remote monitoring, management and maintenance of the micro-grid operations and demand-supply management (*NanoSoft Remote)* over cloud server and mobile devices such as tablets and smartphones (*NanoMobile*);

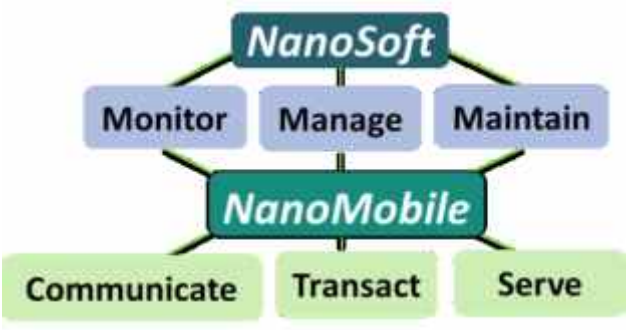
2. Dynamic balancing of integrated hybrid renewable power generation (*NanoGen*) including solar, wind, bio and hydro sources and varying energy efficient demand loads (*NanoAppliance*) in a closed mini/micro-grid system (*NanoGreenGrid*);
3. Customer interface for all energy services over mobile devices such as tablets and phones (*NanoMobile*);
4. Utilization of existing grid infrastructure, where available, to improve efficiency and reduce cost (*NanoGreenGrid*);
5. Innovative energy business models, access to finance and close partnerships with grassroots organizations for scalable and sustainable operations and socio-economic development (*NanoBiz*);
6. Integrated partnership with technical, vocational, and business institutions to develop skill sets and entrepreneurial capacity (*NanoSkills*) for socio-economic development;
7. Development and testing of solutions at a living laboratory within an academic institution to leverage research and training (*NanoLivingLab*).

Key technical interventions

NanoSoft Remote and *NanoMobile* form the brain and veins of the system and utilize state-of-the-art telecommunication, information and mobile technologies, communicating over Ethernet, WiFi, GPRS, ZigBee, and integrating SCADA, GIS, SGIP and WSN protocols for universal compatibility and security. *NanoSoft Remote* monitors, manages and maintains the micro-grid and its components.

- It actively schedules and controls the demand to meet supply constraints in a decentralized micro-grid.
- It makes data available to experts in real time for a timely intervention, in case of failures or malfunctions, thus bridging the skill gaps. It disseminates expert knowledge through digital libraries to remote local personnel, as well as brings the villages in touch with experts who are not physically present.
- It includes a complete software package to manage the entire operations of a micro-grid: generation, distribution, delivery, collection and control. Personnel and clients also receive training and education through *NanoSoft Remote*.

NanoMobile is the main interface between *NanoSoft*, the customer & field operators – through mobile tablets and phones. It performs three major functions: communication, transactions and service delivery. It also serves as a training device for the operators & entrepreneurs and educational services for the farmers, women and children.



Source: SunMoksha Power Pvt. Ltd

Key social interventions

Creating viable business models, understanding consumer behaviour, access to finance and creating a skilled workforce are the keys to scaling energy solutions. *NanoBiz* develops business models based on the creation of micro-enterprises not only to sell electricity to village consumers, but also to move the villagers up the agricultural value chain by creating micro-enterprises addressing post-harvest processes and trades.

- SunMoksha provides value-added technology services, business partnership and access to finance to these microenterprises to improve their socio-economic status.
- *NanoBiz* develops diverse micro-enterprises in the villages not only to make them self-sufficient, but also to stimulate local economic growth and move the villagers up the economic value chain.

NanoSkills creates a skilled workforce through a holistic ecosystem to address gaps in skill-sets, enabled by *NanoSoft* and *NanoMobile.* Its institute partner and incubator, the National Institute of Science and Technology (NIST[10]), provides the physical infrastructure for training engineers as well as technicians and entrepreneurs for rural energy and other micro-enterprises. In a worldwide first-of-its-kind endeavour, *NIST* is uniquely incubating *SunMoksha,* not only to emulate the entire village on the campus in a "living laboratory," *NanoLabs*, but also to help develop and test *NanoPower*. *NanoSoft/NanoMobile* is the virtual training media. *NanoSkills* also helps to create entrepreneurs who can implement viable business models (*NanoBiz*) for scaling *NanoPower* solutions, with technology and finance as supporting pillars.

Source: SunMoksha Power Pvt. Ltd.

Ecosystem for Rural Electrification and Socioeconomic Development

SunMoksha has thus sought to address the challenges of rural electrification and social development by creating an *ecosystem* encompassing all key components of technology, business, skills and social development. The solutions have been developed by engineers from villages in Odisha, Jharkhand and Bihar, for the villagers and their development. *NanoPower* has been developed not only to implement model smart villages by SunMoksha, but is also available to anyone interested in implementing such projects in villages.

Notes

1 IEA World Energy Outlook, 2011. http://www.worldenergyoutlook.org/publications/weo-2011/

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3 Energy Access through Rural Electrification and Renewable Energy, A report by World Energy Council's Indian Member Committee (WEC_IMC), APRIL 2010.

4 Rajeev Gandhi Vidyutikaran Yojna, RGGVY, http://rggvy.gov.in/rggvy/rggvyportal/index.html

5 Load Generation Balance Reports, Government of India, Ministry of Power, Central Electricity Authority. http://www.nrpc.gov.in/reports/lgbr.html

6 Power Shortages in India's Southern Region: Challenges for Growth, S Narayan, ISAS Insights No. 168 – 13 June 2012. http://www.isas.nus.edu.sg

7 Tamaso Maa Jyotirgamaya – Energizing Rural India, Ashok K. Das, SunMoksha, October 2012. http://www.sunmoksha.com/publication_ashok.html

8 SunMoksha Power Pvt. Ltd., Bangalore, India. http://www.sunmoksha.com/rural.html

9 SunMoksha Provisional Patent Application: Method and system for building smart micro/macro/nanogreengrid for generation, transmission and distribution of electricity and other energy forms with zero emission.

10 National Institute of Science and Technology, http://www.nist.edu

Concluding Observations

The two-day international conference on *Energy Security: Non-Traditional Security Planning in India* was conceptualised and organised by the Centre for Strategic Studies of the Centre for Public Policy Research, Kochi with the support of the US Consulate-General, Chennai Region. Within the larger framework of dealing effectively with non-traditional security challenges, the conference studied energy security as a crucial issue that is not only vital for securing economic growth but also shapes and realigns strategic relationships between countries.

The unprecedented predominance of the energy security debate in international dialogue and diplomacy was attributed to several factors. These include the growth of new economic power centres; the fluctuating price of fossil fuels over the last three years; global warming due to climate change; the threat of terrorism, instability in some exporting nations; power blackouts and chronic shortages of power in several countries. Given the indispensability of energy for a country's economic growth, these power crises have caused concern about the reliability of electricity supply systems, and raised fears of a scramble for energy supplies and heightened geopolitical rivalries, The introductory remarks also highlighted the linkages between energy security and maritime security, underscoring the need to secure the sea lanes of communication between India and West Asia and the energy flows into East Asia. Given its global outlook and ramifications, it was stressed that energy security demands an integrated approach and strategic positioning, especially for a country such as India.

The challenge for Indian policy makers is that energy security is inextricably linked with economic and social policies, environmental issues, technological considerations, national defence and foreign policy. The keynote address revealed that although India's per capita energy consumption is only about one-third the global average, demand has grown phenomenally, making it the world's fourth largest energy consumer. Simultaneously, self-sufficiency in fossil fuels has declined, making India the fourth largest importer of oil and LNG. Ironically, it is the third largest coal importer despite being the third largest coal producer with the fifth largest coal reserves. In this context, it is imperative to stimulate domestic energy production, including nuclear and renewable sources and to promote energy efficiency. Meanwhile, the shale gas boom has positioned the United States as a major producer of oil and gas and an emerging exporter of both. India's growing import dependence makes it increasingly vulnerable to supply fluctuations and price volatility in the world energy markets. India's fundamental energy challenges primarily call for domestic solutions, but the country needs to strengthen strategic alliances and broaden international cooperation to boost its energy security. The United States can become a valuable strategic partner in this quest, through existing bilateral mechanisms for energy cooperation, technology development, greater energy trade and investment and high-level energy policy coordination.

While recognizing India's energy complexities and enormous challenges, attention was drawn to India's energy dependence on both renewable and non-renewable sources and the burgeoning needs

of the industrial and transport sectors. Energy demand is expected to grow even further, leading to massive import dependence. Concerns were expressed about internal and external threats to energy security in India. The CPPR presentation also examined some of the key international factors that could lead to energy disruptions.

Outlining the national and international pressures on the Indian electricity sector, attention was drawn to the challenges of high demand and the current means by which India attempts to generate electricity. The central issue is to secure electricity production without environmental degradation. The politics of nuclear agreements and the manner in which India had negotiated the agreements was discussed. It was pointed out that with the US-China agreement on greenhouse gas emissions there would be greater pressure on India to comply with international commitments and agreements. With regard to the Indian nuclear power situation, it was emphasized that the cost of imported nuclear reactors is 3-4 times that of the coal plants and double that of indigenously set up nuclear reactors. There is also a constant hold over fuel supply. Whether or not nuclear power can be justified under these circumstances can be determined only by a thorough study of the power situation in conjunction with other potential energy sources. Concerns were raised about the management of the Indian nuclear sector and the failure to distinguish between the civilian and defence fields. This joint approach led to an unnecessarily secretive stand even in the civilian nuclear area.

Energy is gaining precedence over traditional security issues because of its economic and strategic dimensions. Underscoring the strategic dimensions, it was noted that oil is not only about markets but also about politics and control. Major transformations taking place in the international energy markets have profound geopolitical implications. With the advent of hydraulic fracturing (fracking) and the associated shale gas boom, the United States is expected to become a key player. Although fossil fuels are likely to remain the dominant fuel around the world in the coming years, the oil market is getting skewed increasingly towards the Asian economies. China has already surpassed the United States as the largest oil importer, and is set to become the largest energy consumer over the next decade. Russia is looking eastward and is likely to be more involved in Asian politics. New non-OPEC supplies of oil and gas are entering the market from North America, eastern Mediterranean, Africa and Latin America. This coupled with falling demand due to the economic slowdown in developed countries has caused hydrocarbon prices to fall. OPEC is currently trying to maintain output in order to increase its market share. The plummeting of oil prices is causing consternation in the Persian Gulf states, which are already facing an existential threat from the militant group ISIS and anxiety over the possible withdrawal of the US security umbrella. Meanwhile, there is a surge in pipeline diplomacy across the world. India has very limited options but China does not have such constraints because Beijing is buying assets all over the world. In terms of creating strategic petroleum reserves in India, a 90-day reserve is difficult to achieve considering storage constraints. In formulating its energy strategy, India has to consider energy politics and market dynamics in addition to oil prices.

The open discussion that followed threw up various questions on the safety of nuclear energy, the possibilities of thorium production and the elusive third stage of the nuclear fuel cycle in India.

The second thematic session on the energy-environment conundrum discussed India's emission rates, which had increased over the past few years. Electricity generation produced the highest greenhouse gas emissions in India, with thermal and hydro-electric power sectors affecting the environment more. The panel examined the nexus between climate change, resource constraint and national security. One of the critical aspects of climate change has been the need to have low carbon strategies for inclusive growth as an optimal initiative in sustainable development. Studying climate-related threats to energy and sustainable development issues are crucial and such analysis requires a multi-disciplinary approach.

On the subject of climate change and national security, three theoretical approaches were identified for a post-colonial society like India: security theory, social constructivism, critical or green theory. Climate change and its consequences are often identified with and blamed on the rising powers, by the developed economies. Rising powers do suffer from technology deficits as their main priority is to develop industries and not to focus on climate change. The Asian national security discourse and context is based on realist ideas of security with no intention to sacrifice growth and development for climate change. There are state-centric polices which also raise issues of corruption and inefficiency. One of the major incentives for climate change mitigation could come from technology transfers and subsidies from the developed countries. There have been environmental refugees from climate change in the developing world. Such drastic future climate changes could also involve relocation of military installations in the coastal regions. India, Pakistan, China, Bangladesh and Sri Lanka have specific issues with environmental refugees. The Indian context of climate change does not call for a broader Western approach. The imperative is for India to focus on the regional situation. Indian responses could include better governance, crisis management capacity, infrastructure responses, economic redemption, R&D, cooperation responses and an integrated state-civil society response. The Indian response cannot be autocratic but must enlist vital cooperation from the international community. The country needs to strengthen human security and human development to deal with climate security issues.

In considering the policies and legal dimensions of energy security, it was noted that constitutionally, energy is a subject in the concurrent list. The outcome is that the state exercises a monopoly over energy production. In the initial stage of economic liberalization, the Enron-Dabhol Power Agreement proved to be a disastrous experiment as it was one-sided. There were various flaws not only in the agreement but also in the operational process. The moot question is whether privatization of the energy sector is a good or a bad idea. The subsequent amendments to the Electricity Act in 2003 tried to deal with the lacunae. In public-private partnership projects most states cooperate with the Centre and such partnerships generally run smoothly until the transfer stage. From the environmental

perspective, governance now rests with the higher judiciary. The Supreme Court outlines the basis for grant of licenses in India. The involvement of state institutions in environment policy regulation is flawed since they hold private players accountable and absolve themselves of any primary responsibility. The reason is that the state and its institutions lack monitoring and compliance mechanisms to evaluate adherence to environmental norms and conditions.

Offering a US perspective on the theme *India's Energy: The Struggle for Power*, it was reiterated that India and United States should deal with India's energy issues across the board as that would lead to a positive thrust for climate change. The Indian energy crisis is very broad in its dimension and infrastructure is one way for India to move forward. Energy and environment cannot be viewed in isolation but have to be dealt with in tandem. Coal and biomass are dominant in Indian energy requirements and specific health consequences stem from this energy scenario. The United States wants to partner with India in confronting such energy challenges. In the transportation sector, it is necessary to move in a progressive direction. India could use natural gas as a bridge to the future as it is among the least polluting hydrocarbons. The United States is not asking India to adopt nuclear power. It is seeking solutions to the liability problem and the attendant risks. The Modi government has declared its intention to pursue the nuclear power option. The government also has solar ambitions which go beyond the nuclear projects. The required funding can only be raised by devising end-to-end solutions through equity and borrowing. The blame-game approach to pinpoint responsibility for global warming will be tantamount to signing our collective death warrant. The US-China Agreement has substance and it could be helpful for India to follow a similar commitment. Both the United States and India should adopt a holistic approach and undertake integrated energy planning with regard to availability, affordability, as well as related environmental and security affairs.

The open discussions focused on the mitigation of climate change; national security considerations in climate change analysis and the reconciliation of state regulatory power and environment conservation.

The spotlight shifted to the issues and challenges of nuclear power in India. The CPPR overview presentation highlighted the fact that private players are not permitted to invest in the nuclear energy sector, while the government is keen to invest and expand its position. India, with its vast resources of thorium is keen to develop the thorium cycle for its nuclear energy future.

Analyzing the strategic and security challenges posed by nuclear power in India, it was noted that the country had adopted a cautious approach. Seven major challenges to India's nuclear future were identified. India's nuclear liability law was enacted in a specific context but there are international concerns about its implications. Regarding the supplier's liability to the government of India, Washington is worried that clause 46 could trigger litigation in the United States in case of an accident in India. Concern also stems from India signing the Convention on Assistance in case of a Nuclear

Accident. The Russians on the other hand have agreed to abide by Indian law but have requested insurance cover. The General Insurance Corporation (GIC) will cover each component of the reactor and the Indian operator will pay the premium. The French also favour this arrangement and seek to continue with the Russian template. Domestic suppliers in India are also unhappy with the law. The law basically says that safety and welfare of the people should be considered. However, the law runs counter to various agreements signed by India. Abiding by the law puts a burden on the tax payers and the law also cannot be amended. India thus faces a dilemma in reconciling its multi-lateral nuclear energy commitments with its own domestic liability laws. Following the visit of US President Barack Obama in January 2015, and the resolution of pending issues, more progress is anticipated in the Indo-US nuclear deal.

Another key aspect considered at the conference was how to ensure supply security for India's nuclear energy infrastructure. It was argued that despite heightened public concern, there was in fact no loss of life in the Fukushima nuclear accident, indicating that safety and engineering aspects of the reactors worked effectively. The history of civilization shows that human ingenuity can help to ensure the safety and welfare of the people. Nuclear technology will improve over time and the future will not be as unsafe as the past. As a fuel-deficient country, Indian needs are huge. The country does not really have the luxury of choice and it needs to utilize all forms of energy. As the economy grows there will be more demand and higher energy targets and growing public expectations. Having sufficient fuel will become a political issue. How does India ensure nuclear fuel requirements? An Eight-fold path to energy supply security was outlined. The imperative is for a National Energy Supplier Risk Assessment and Management Framework for India. The following principles constitute the eight-fold path: 1-Diversity across the board, in fuels, reactors etc; with a premium on security; 2-Trading with countries that are energy suppliers and acquiring supplies from nations with whom India has broad trading relationships; such a two-way process can be more secure and sustainable; 3-Buying fuel from competitive markets rather than from specific companies as market suspicion can prove to be a barrier; 4-Making markets more competitive all along the supply chain and developing a strategy to break the cartels; 5-Taking advantage of the fact that fuel is fungible; 6-Providing insurance cover for people near nuclear reactors with the premium paid by people who benefit from those reactors. Reactor locations could be based on the extent of risk people in the vicinity are willing to take; 7-Working out suitable geopolitical strategies to secure supply routes; 8-Investing in the domestic nuclear industry by promoting science education and nuclear technology.

A nuclear scientist, presenting a practitioner's perspective, warned that more nuclear plants would be disastrous for India. He based his assessment on the following points: 1-Nuclear energy is neither abundant, safe nor cheap. Only when controlled fission is feasible will it become abundant and the third stage of the nuclear cycle is just imagination; 2-Nuclear reactors produce bomb equivalents of radioactive material; 3-Nuclear accident management is unimaginably complicated and costly and in India there is no real preparedness; 4-The second stage of nuclear reactors involves taming the nuclear material; India should not go in for more nuclear reactors than it has already; 5-It is not really

shortage of energy that causes blackouts in the country; 6-The factors of per capita energy and longevity must be considered. There is practically no impact on longevity; 7-The Limits to Growth report of the Club of Rome predicts a global disaster. How does the human race survive this crisis? Even if coal production is stopped, global warming will occur as the world has already crossed the tipping point. Producing a large range of goods does not necessarily enhance the quality of life but only feeds human vanity. India must seriously consider how much energy it really needs to produce and for what purposes.

The open discussions centred on the cost-effectiveness of nuclear power, the commercialisation of nuclear energy, the high risks involved in nuclear power generation, nuclear safety concerns and the insurance coverage for nuclear liability.

India's future with alternate energy sources was discussed in the last session. Renewable energy (RE) contributes 12.8% of the total installed power generation capacity. Wind power is the largest contributor among RE technologies, followed by solar power. RE power tariffs are comparable to conventional power tariffs in a few Indian states, and complete grid parity is expected by 2020. The annual manufacturing capacity utilization in India for renewable energy is less than 30%. Solar sector manufacturing deserves special attention and it is important to develop India as a global hub for RE manufacturing. The Modi government has initiated the drafting of an RE law and announced a target of 100GW of wind energy and 100GW of solar energy in the next decade. Meeting these targets will demand massive efforts and mobilization at state levels, provision of finance for manufacturing and removal of policy uncertainties.

Energy efficiency and conservation is another form of energy creation. The imperative is to disseminate knowledge to consumers on using energy effectively but in India there is no energy information bureau. Ignorance about the potential of energy-saving technologies, higher initial cost of efficient devices, insignificant energy costs for high energy consumers, difficulty in identifying suitable technicians and service providers, prevailing preference for centralized options and lack of institutional capacity to formulate energy efficiency programs are some of the barriers to achieving greater energy efficiency. India needs innovative finance mechanisms and effective branding of renewable energy. Other key issues are centralized supplies; high technical and managerial skills required in energy programmes and lack of technology transfer on energy efficiency. The renewable energy market cannot be depended upon entirely to deliver long term benefits to society as a whole.

Rural India in particular faces several energy security challenges. According to the IEA's *World Energy Outlook 2011*, as many as 1.4 billion people (a fifth of the world's population), do not have access to electricity, with India accounting for about 400m, Africa 550m and rest of Asia 450m. A whopping 80% of this population lives in rural areas. Worldwide, the situation is so grave that UN has declared 2014-24 as a *decade of sustainable energy for all!* For India, the latest census data show that only 53% of the

rural population has access to grid electricity; and 43% still use kerosene for lighting. The Pradhan of Vidhuni village in Shrawasti District, UP reveals that people pay anywhere between Rs. 100 to 150 per month on kerosene. However, while this leads to several adverse health effects, it fails to address other needs such as power for charging mobile phones, operating fans, powering TV/Satellite, running irrigation pumps, operating agricultural machinery and powering school computers. Local entrepreneurs have long exploited this situation, particularly in Bihar and Uttar Pradesh by providing diesel generator-based power just enough to light one CFL bulb for Rs. 100 per month. A shopkeeper in Mansahi village of Katihar District in Bihar, revealed that he pays Rs. 60 per month for one CFL bulb for just 3 hours every night! For a secure energy future, India must provide energy security for these rural masses at a much higher intensity. The efforts of the past decade have not yielded the desired results. On the other hand, rural India is aspiring and hungry for power! How this huge latent demand can be met is a crucial challenge. Clean energy technology companies such as SunMoksha are offering energy solutions through micro-grid systems to address the challenges of rural electrification.

While underscoring the need for sustainable energy, various economical and justifiable alternatives to nuclear power were explored. Coal will be exhausted within a few decades so what is the best fuel to produce power? It is a fact that 80 per cent of products manufactured are derived from petroleum, which has huge potential for power generation. However, resource nationalism is going to grow in future. Energy supplies will not be needed for the sake of growth, as materials constraints will halt economic growth by 2050. The way forward is to phase out fuel imports and use indigenous sources. The energy constraints will come from macroeconomic factors. Oil market dependence must be reduced and India must embrace new technologies. It is worth noting that Kerala state, despite its low energy consumption enjoys a better quality of life.

Does India currently have enough energy to power everything it needs? With unlimited and open access to solar power and other renewable sources, this question seems to be misconceived. Indications are that seventy five per cent of India's total energy requirements can be produced from alternative sources. Thus India's sustainable energy future lies in developing clean technologies and tapping renewable energy sources to the maximum extent possible while reducing fuel imports and increasing energy efficiency.

Author Profiles

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D Dhanuraj gained his PhD in Science and Humanities from Anna University, Chennai. He also holds postgraduate degrees in Physics and Political Science and a Post-Graduate Executive Diploma in International Business. He serves as Managing Director of Civitas Consultancies Pvt Ltd and Chairman of the Centre for Public Policy Research (CPPR). A social entrepreneur by profession, Dhanuraj is also a seasoned policy researcher. He has worked with several national and international organizations and government bodies in the development sector. He writes regular columns and publishes his findings on websites and blogs.

Tom Cutler

Tom Cutler has nearly 40 years' experience in international energy affairs, which included a 36-year career at the US Department of Energy (DOE). He served two terms as Chairman of NATO's Petroleum Planning Committee (1983-1987) and was instrumental in developing major US programs in energy cooperation and investment with India, Indonesia, Philippines, Bangladesh and the Asian region, including APEC and ASEAN. Later, as Director of DOE's Office of European and Asia Pacific Affairs, he played a key role advising senior DOE leadership on energy policy, energy security, energy cooperation, joint energy technology R&D programs, as well as energy trade and investment matters. Cutler has managed DOE energy policy dialogues with Indonesia, India, China, Japan, Korea, Australia, Pakistan, Bangladesh, Norway, the United Kingdom and the European Union. He has developed and managed several multi-million dollar US technical assistance and capacity building programs in Asia that conducted activities in power sector reform, oil, gas, coal, renewables, energy efficiency and other areas. He helped organize and also participated in many energy trade missions to Europe and Asia. Cutler managed DOE's participation in all-source oil tanker tracking programs with the US Navy in the early 1980s and worked in the DOE's Office of Intelligence from 1981-1982. Cutler's work has been published in reputed journals including *Petroleum Economist* (5 times), *Petromin* (twice), *World Affairs*, *NATO Review*, *Armed Forces Journal*, *Journal of Asian Studies*, *Journal of Energy & Development*, *Journal of International Affairs* and *Business Times*. His book *The Military Demand for Oil* was published in 1989. From 1988 to 1991 he was a guest lecturer on the subject of military jet fuels at the College of Energy Studies in Oxford. He has received a number of DOE awards as well as the NATO Outstanding Service Award in 1987.

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