

Energy



India: Towards Energy Independence 2030

January 2014

India: Towards Energy Independence 2030

January 2014

Introduction

India is the world's fourth largest economy¹ as well as the fourth largest energy consumer. India imports a substantial portion of its energy — 80 per cent of its oil, 18 per cent of its gas, and now even 23 per cent of its coal. As the Indian economy continues to grow, so will its energy consumption, especially as the growth of its manufacturing sector catches up with services and agriculture. With domestic resource production facing various challenges, the general expectation has been that Indian energy imports will continue to grow, and energy security concerns will intensify.

The outlook and options for Indian energy independence therefore becomes an important topic. A 2030 outlook is particularly relevant since it is difficult to significantly change energy policy in 5 or 10 years, but almost any boundary conditions can be changed over a 15-year period. Moreover, there have been few if any, in-depth perspectives on this topic for 2030.

This white paper builds off the '2030 Global Energy Perspective', McKinsey's substantial body of research on energy demand and supply, and our understanding of the evolution of the global and Indian energy sectors. We have tried to address some of the basic questions that arise about Indian energy in 2030:

- Is India's current energy trajectory sustainable, as is or with some adjustments?
- To what extent can India aim to achieve energy independence by 2030? What opportunities does India have to increase domestic energy supply and curb demand over and above the current trajectory?
- How can we make the most of the new global supply dynamics and technologies?

This paper is a thought starter, intended to offer one set of directional options, rather than a singular prescription. We look forward to feedback, suggestions and dialogue.

Vipul Tuli
Director
McKinsey & Company

Amit Khara
Partner
McKinsey & Company

¹ Adjusted for purchasing power parity.

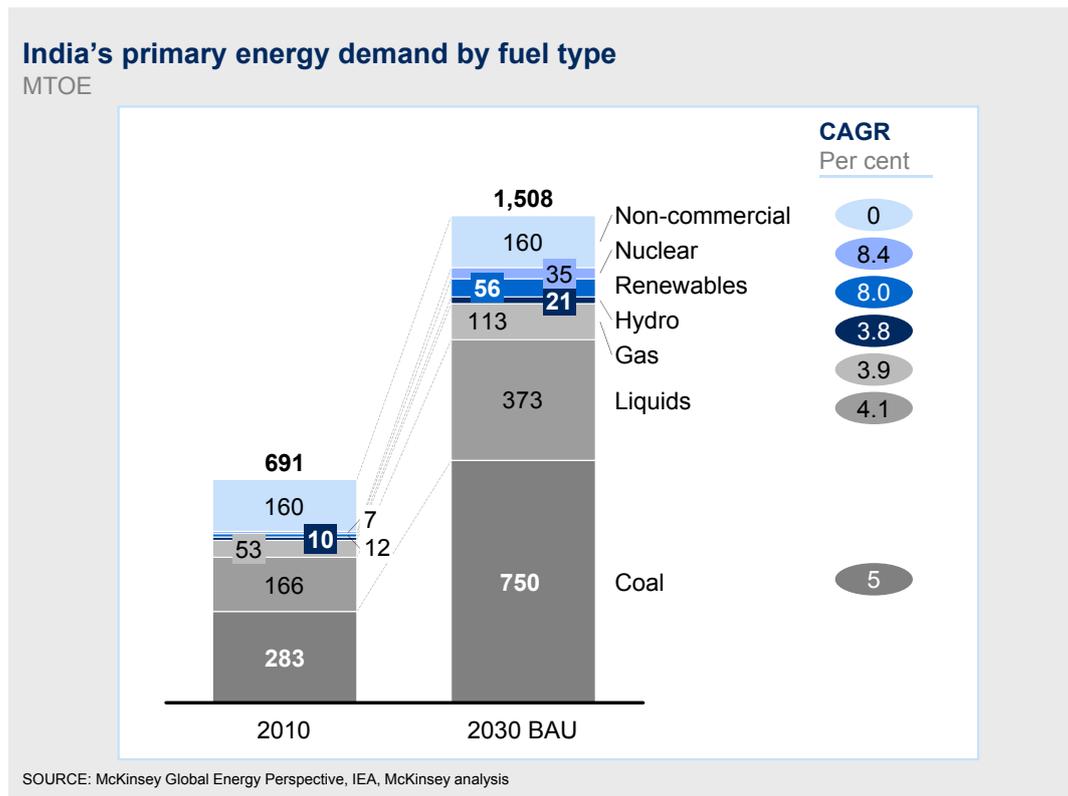
Is India's energy trajectory sustainable?

India's energy demand, which was nearly 700mtoe (million tonnes of oil equivalent) in 2010, is expected to cross 1500mtoe by 2030. Its dependence on imports is expected to increase from 30 per cent to over 50 per cent, suggesting the need for a new way forward.

Doubling demand and continued fossil fuel focus in BAU

Exhibit 1 shows India's primary energy demand by fuel type in 2010 and business as usual (BAU) projections for 2030. Primary demand in 2010 stood at 691mtoe. Of this, about 41 per cent was coal, 24 per cent was liquids, 23 per cent was non-commercial fuel, 8 per cent was gas, and the remainder was a mix of hydro, renewables and nuclear power. Despite recent strides in renewable and nuclear power, this is a predominantly fossil fuel based mix, with 73 per cent of primary energy coming from coal, oil and gas.

Exhibit 1



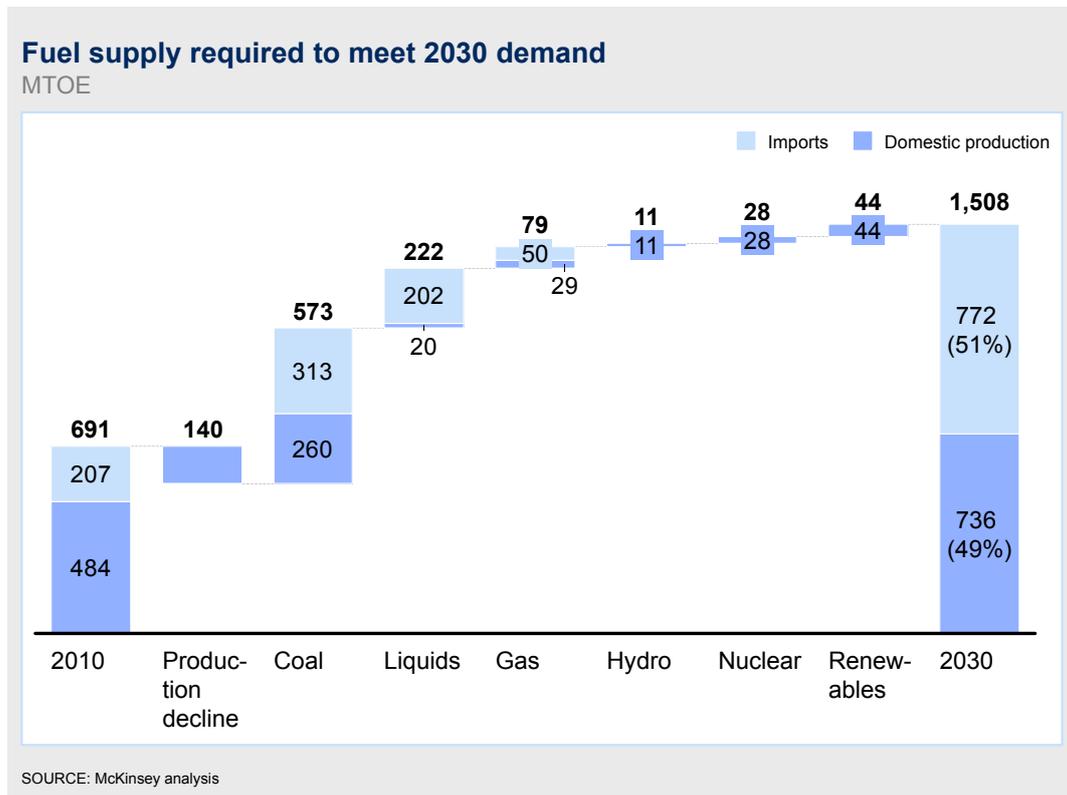
Our 2030 BAU case projects India's primary energy demand in 2030 at 1508mtoe, based on bottom up estimates of GDP growth, the composition of the Indian economy, and the consequent demand growth from industry, buildings, transportation and other segments. Power demand is assumed to grow at 5 per cent per annum through 2030. Energy efficiency gains are also built in at 1 per cent per annum improvement through 2030, reducing energy intensity from 0.56koe/USD in 2010 to 0.47koe/USD in 2030.

In the 2030 BAU scenario, 60 per cent of India's power generation is assumed to come from coal, taking coal demand up to 750mtoe. Liquids demand, primarily for transportation, grows at 4 per cent per annum to 373mtoe. Gas demand grows to 113mtoe, constrained by high LNG prices that compete with liquid alternatives. Hydro power reaches 21mtoe. Renewable and nuclear power grow as per stated policy objectives and at similar growth rates thereafter through 2030. The balance of primary energy will therefore need to come from non-commercial sources.

Import dependence rises to 51 per cent

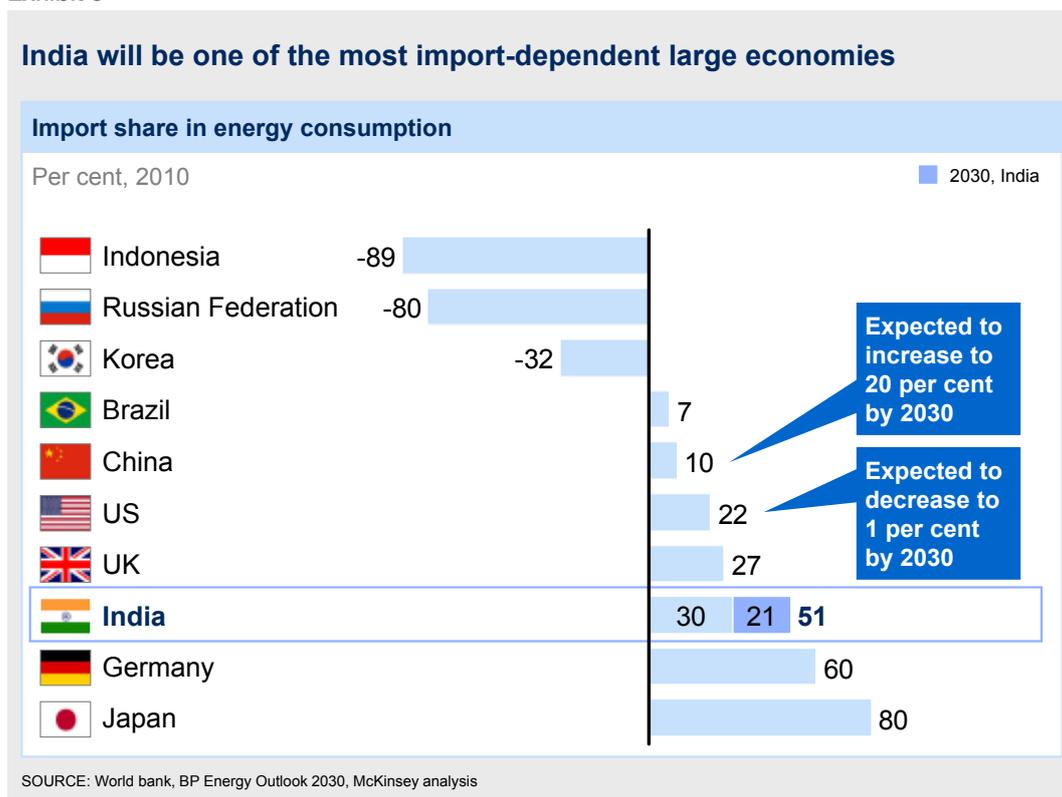
In 2010, India imported 30 per cent of its primary energy requirements (38 per cent of its primary commercial energy requirements). Exhibit 2 lays out the increase in fuel supply from indigenous and imported sources that will be required to meet the 1508mtoe of primary energy demand in 2030. Although BAU assumes substantial increases in domestic production of coal, oil, gas, hydro, nuclear and renewables, these are far short of the requirements to make up for declines in producing fields and mines, and meet demand. As a result, import dependence would increase to 51 per cent of primary energy requirements.

Exhibit 2



At the estimated 51 per cent primary energy imports, India will be one of the most import-dependent countries in the world, as shown in Exhibit 3. By comparison, the US and China are expected to have import dependence of 1 per cent and 20 per cent by 2030. In the case of China, this includes imports through long distance oil and gas pipelines from central Asia, Indochina and Russia. Moreover, using 2010 numbers from the major energy consuming economies as an indicative comparison, only Japan and Germany have higher import dependence at 80 and 60 per cent respectively. But unlike India, these countries have greater affordability and the International Energy Agency (IEA) emergency response measures as a backup.

Exhibit 3



A new way forward is possible

Possible import dependence above 50 per cent of 1500mtoe and growing is a clear indication that a different set of energy outcomes versus BAU will be required if India is to keep its growing economy supplied with sufficient reliable and cost effective energy. Domestic resources will need to be explored and exploited to target levels that have not been traditionally considered in current long-term plans. This will require stable, viable market mechanisms that attract sufficient investment across the value chains. All possible energy sources will need attention, including coal, conventional and unconventional oil and gas, renewables, nuclear power and energy efficiency.

There are six factors that give India the opportunity to address its energy security concerns:

- With estimated coal reserves of 293 billion tonnes and minimal recent additional exploration, India has ample opportunity to increase coal production, provided transparent resource access and development regulations are put in place
- The experience of North America has shown the potential of unconventional oil and gas. It is clear that India has substantial unconventional hydrocarbon potential, even though reserve estimates vary widely at this early stage
- Conventional oil and gas still holds great potential in India, especially via the redevelopment and intensive exploitation of existing mature basins, provided viable pricing and taxation mechanisms are in place
- India has had remarkable momentum in increasing renewable power capacity (both wind and solar), and doing so while setting global cost benchmarks
- With a vast proportion of India's infrastructure yet to be built, India can leapfrog the developed world in energy efficient buildings, long distance rail transportation, and an optimal road-rail modal mix

- India has a unique opportunity to create stronger and more secure supply partnerships with oil and gas supplying countries in the Middle East and Africa, who will be seeking large and stable markets to absorb imports displaced by the US.

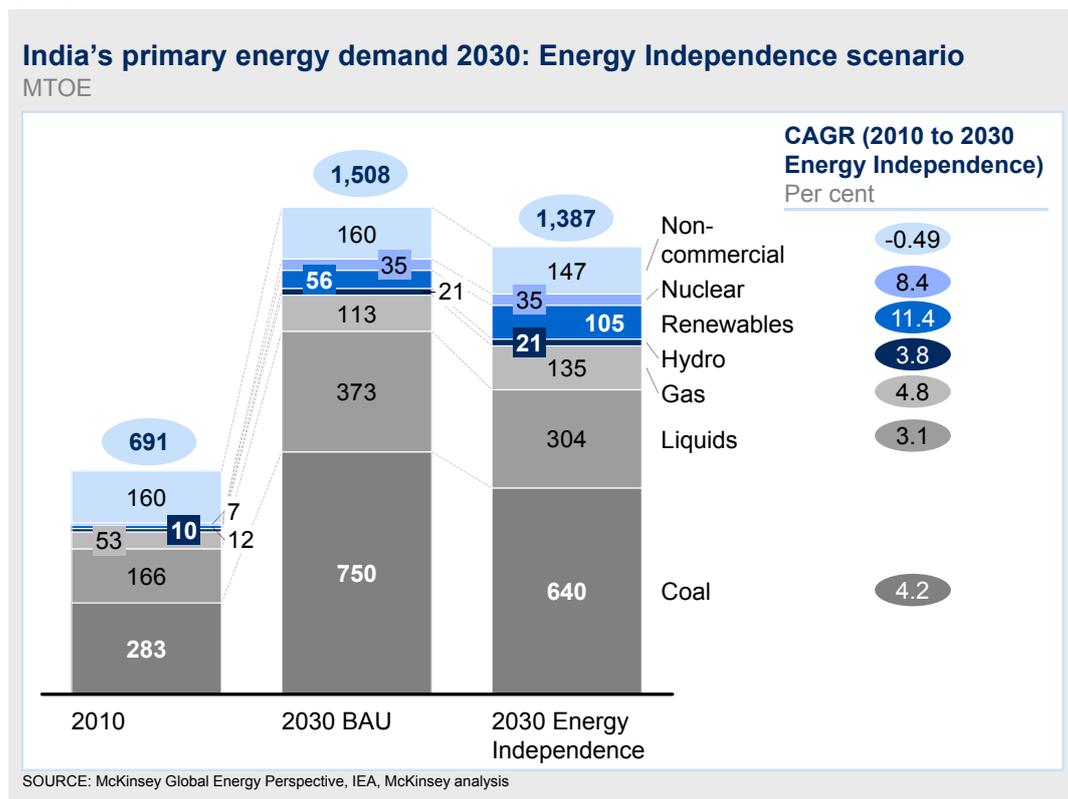
As described in the next section, we believe that it is possible for India to achieve substantially higher domestic energy supply, lower demand, and more secure imports than in the BAU case.

10 initiatives towards energy independence by 2030

This section describes a set of 10 initiatives that can help India move closer towards energy independence by 2030. These initiatives have the potential to help India reduce energy imports from 51 per cent of demand by 2030 to 15 to 20 per cent, while increasing the reliability of imported energy.

In this 'Energy Independence' scenario, presented in Exhibit 4, the total primary energy demand in 2030 is lower at 1387mtoe (versus 1508mtoe in BAU). The fuel mix shifts towards renewables and gas, although fossil fuels remain dominant at 78 per cent of the mix (vs 83 per cent in BAU). Underpinning the Energy Independence scenario is a strong supply response and a focus on demand management. The implied supply response is represented in Exhibit 5. This is higher than current plans, but not beyond reach given enabling market conditions.

Exhibit 4



The 10 initiatives required are summarised in Exhibit 6, along with the impact in mtoe that they have on imports relative to the BAU case.

Exhibit 5

Domestic supply implications

	Units	2010	2030 BAU	2030 Energy Independence
Coal¹	MTPA	484	775	1,220
Liquids	MTOE	34	39	80
Gas	MMSCMD	132	165	390
Hydro	GW (capacity)	37	70	70
Renewables²	GW (capacity)	20	80	145
Nuclear	GW (capacity)	4.5	23	23
Non-comm.	MTOE	160	160	147

¹ Does not include coking coal

² Includes Solar, Wind, Biomass, Small Hydro, Urban & Industrial Waste

SOURCE: McKinsey analysis

Exhibit 6

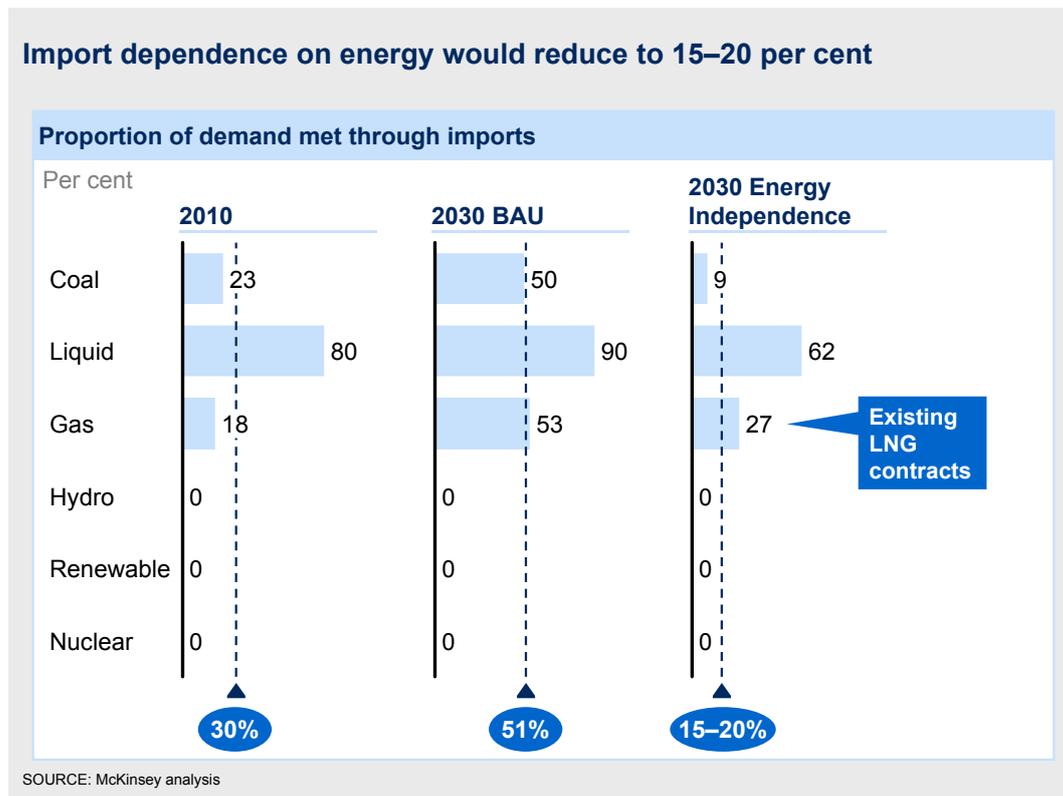
10 initiatives to help reduce India's energy import dependence

Initiative		Impact on energy demand, MTOE
		2030 BAU imports 772
Increase supply	1 Achieve 1200 MTPA coal production	213
	2 Unlock unconventional gas potential	33
	3 Support oil and conventional gas production	90
	4 Light-up 50,000 villages through solar	13
	5 Add 100+ GW of grid connected solar and wind	31
Reduce demand	6 Reduce industry & building power demand by 30 per cent	92
	7 Change transport modal mix, introduce efficiency norms	29
Secure imports	8 Enable globalisation of energy companies	271
	9 Create an India-Middle East energy corridor	
	10 Establish gas positions in North America and East Africa	
		2030 Energy Independence imports

SOURCE: McKinsey analysis

The biggest shift in the Energy Independence scenario, however, is in the import dependence, as shown in Exhibit 7, which reduces to 15–20 per cent (vs 51 per cent in BAU). Coal imports reduce to 9 per cent (vs 50 per cent in BAU), liquids imports reduce to 62 per cent (vs 90 per cent in BAU), and gas imports reduce to existing LNG contracts (vs 53 per cent in BAU). While liquid imports remain high in this scenario, there is considerably higher flexibility and tolerance across the fossil fuel basket, to optimise between coal, liquid and gas import volumes.

Exhibit 7



The remainder of this section describes each of the 10 initiatives for energy independence, and the actions required to make them a reality.

1. Achieve 1200mtpa domestic coal production

Coal will remain the bedrock of India's energy requirements for the foreseeable future. Achieving 1200mtpa of coal production by 2030 will require incremental annual production of 950mtpa, to make up for existing mines that will decline over the next 15 years. This will require India to:

- Accelerate development of 180-odd Coal India projects which are at various stages of approval and development
- Fast-track 220 captive coal blocks which have already been allocated, with a production potential of 850mtpa. 110 of these blocks are awaiting approvals or land acquisition, and another 110 have seen no development
- Allow private players to explore, develop and market coal. India has 7 per cent of the world's coal reserves and only 0.5 per cent of its exploration expenditure. Exploration and development at scale will require market-based pricing and a robust coal market.

2. *Unlock unconventional gas production (shale, CBM², HP/HT³)*

Several recent progressive steps have resolved many pending bottlenecks in upstream oil and gas. To enable rapid development of 100mmscmd of unconventional gas, India must:

- Expand the scope of its shale gas policy to include private and public sector players alike
- Ensure sufficient fiscal and infrastructural incentives to attract investment in unconventional supply chains and services
- Allow full exploration and exploitation of all resources in NELP blocks
- Allow market determined pricing for unconventional gas and the freedom to market gas.

3. *Support conventional oil and gas production*

To achieve 150mtoe of conventional oil and gas production in 2030, India will need to ensure the viability of redeveloping its existing mature basins, e.g., western offshore, attract sufficient investment into new licensing rounds, and remove the remaining bottlenecks to resource development. In particular, it will require to:

- Allow market pricing of crude oil from nomination blocks, to make the necessary high cost investments in EOR⁴—and the related technology development—viable
- Ensure market pricing for gas and the freedom to market gas produced under NELP or the proposed open acreage policy
- Streamline contract administration by enforcing time bound deemed approvals with management committee accountability, codifying standard practices around grey zones in product sharing contracts, defining policies for license extension, exploration in producing blocks and extension of block areas, strengthening and empowering DGH⁵ and making it a statutory body focused on approving and monitoring work programs, budgets and field development plans.

4. *Light up 50,000 villages through off grid solar*

Traditional models are increasingly proving unviable to electrify and supply villages. Yet, the demand surge and economic benefits in newly electrified villages are plain to see. Off grid solar (and in places wind, bio mass and micro hydel) are better suited, scalable solutions to electrify remote villages and supplement supply in partially electrified ones. To scale up off grid solar, India will need to:

- Fine-tune, scale up and roll out models that have been successfully piloted, such as the revamped DDG⁶ scheme, while introducing new elements like competitive bidding and viability gap funding to ensure competition and transparency
- Introduce village level O&M capabilities and governance to manage distributed solar assets
- Devise interventions/ incentives for rural micro-enterprises and other anchor loads (e.g., telecom towers) to shift to renewable solutions vs using diesel power
- Channelise and attract funds from central and state budgetary allocations, corporate social responsibility budgets, as well as private risk capital.

2 Coal Bed Methane.

3 High Pressure/High Temperature Gas.

4 Enhanced Oil Recovery.

5 Directorate General of Hydrocarbons.

6 Decentralized Distribution Generation.

5. Add 100+ GW of grid connected solar and wind

India has demonstrated exceptional progress on the renewables front, more than doubling installed capacity in the last 5 years, from 14.5 GW in 2008 to approximately 30 GW by December 2013. This translates to more than 3 GW of installed capacity per year. Though outstanding, India would need to, on average, double this rate over the next 15 years to achieve the 100 GW aspirations. This would need India to:

- Enforce Renewable Purchase Obligations (RPOs) unilaterally. Targets have been set for each state, but only 7 out of 29 states have achieved them. Renewable Energy Certificates (RECs) remain unsold, forcing REC prices to floor levels, significantly eroding developer returns. Mandating states to meet RPO targets, and enforcing penalties for non-compliance would be required
- Invest in low wind speed technology with focus on building domestic R&D and manufacturing capabilities to add 40+ GW by 2030
- Devise interventions and incentives for rural micro-enterprises and other anchor loads (e.g., telecom towers) to shift to renewables vs using diesel
- Introduce a peaking power policy to allow developers to invest in storage to make solar viable for evening peaks.

6. Reduce industry and building power demand by 30 per cent

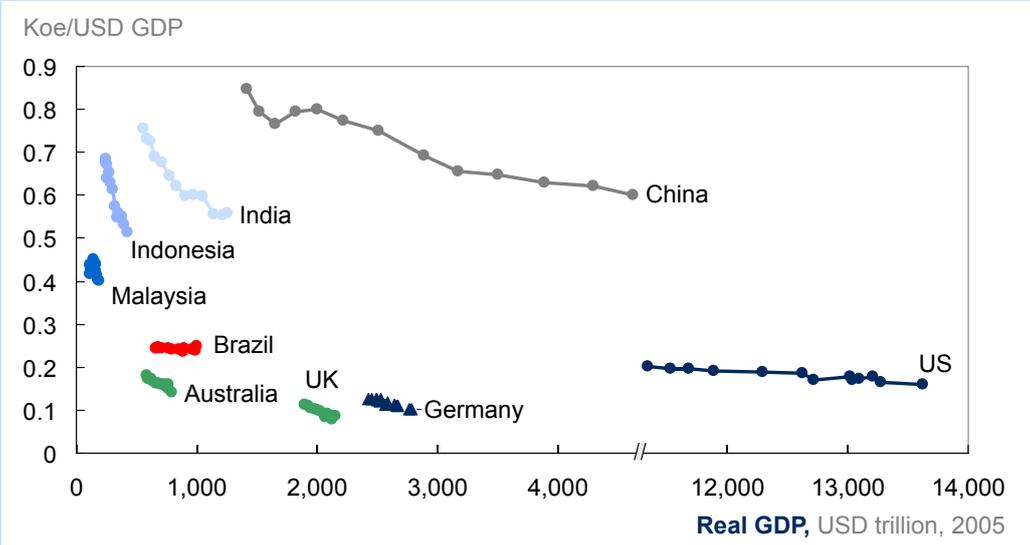
India's overall energy intensity at 0.56koe/USD is high compared to even other developing countries like Brazil at 0.25koe/USD or Malaysia at 0.4koe/USD, indicating significant improvement potential, as shown in Exhibit 8. India has started positively on this journey, achieving energy intensity reductions of 1 per cent per year. A substantial amount of demand reduction is already assumed in the BAU case (equivalent to 344mtoe with energy intensity dropping to 0.47koe/USD). An energy intensity of 0.4koe/USD by 2030 could be achieved by:

- Reducing residential and commercial energy intensity. This would involve increasing penetration of labelled appliances from 20 to 90 per cent, CFL/ LEDs from 15 to 90 per cent, and stringent implementation of the ECBC norms for commercial buildings
- Targeting energy reduction in power intensive industrial segments through year on year targets, time of day tariffs and incentivising production of energy efficient industrial equipment
- Driving energy efficiency in agriculture, moving towards electric pumps (from diesel) and mandating use of Bureau of Energy Efficiency (BEE) star labelled equipment
- Reducing AT&C losses: India's AT&C losses at about 23–24 per cent are extremely high compared to 5 to 7 per cent in best practice countries like Japan, Germany and Korea. Even some developing countries, e.g., Malaysia have achieved sub-10 per cent loss levels. India could achieve these levels through a mix of technology (e.g., smart grids) and effective distribution ownership and management.

Exhibit 8

India's energy intensity is high compared to even developing countries

Energy intensity vs GDP, 2000–2012



1 Improvement from 0.56 koe/USD in 2010 to ~0.47 koe/USD in 2030 already included in BAU case
 2 Energy efficiency improvement in industry already considered in 2030 BAU energy demand projection
 SOURCE: Global insights, IEA, McKinsey analysis

7. Change transport modal mix and introduce efficiency norms

India has a natural advantage of lower average size of cars, which translates to lower emissions and higher fuel efficiency. Yet it lags the European Union in car fuel efficiency, and has not yet enacted transport fuel efficiency norms. Efficiency of trucks is even further off from the European standards, due to older technology and poor road infrastructure. To save an additional 47mtoe per year relative to the BAU case (reducing transportation fuel demand from 184mtoe in 2030 to 137mtoe), India should:

- Incentivise a shift in long-distance cargo from road to rail, increasing rail from 39 per cent of ton-kms moved in 2012 to 54 per cent by 2030
- Draft and implement a policy to promote higher tonnage commercial vehicles
- Introduce fuel consumption norms at the earliest with built-in year on year improvements
- Implement the national bio-ethanol policy to start blending 5 per cent bio-ethanol in petrol and diesel
- Incentivise faster adoption of electric vehicles to shift demand from liquids to power, especially during off-peak hours.

8. Enable globalisation of Indian energy companies

Strong global energy companies are a necessary foundation for energy security. To enable its energy companies to secure supplies and create sufficient surplus for investment, India will need to:

- Ensure financial strength of its energy companies, to enable them to invest in new capacity, make acquisitions, take risks, and develop technology

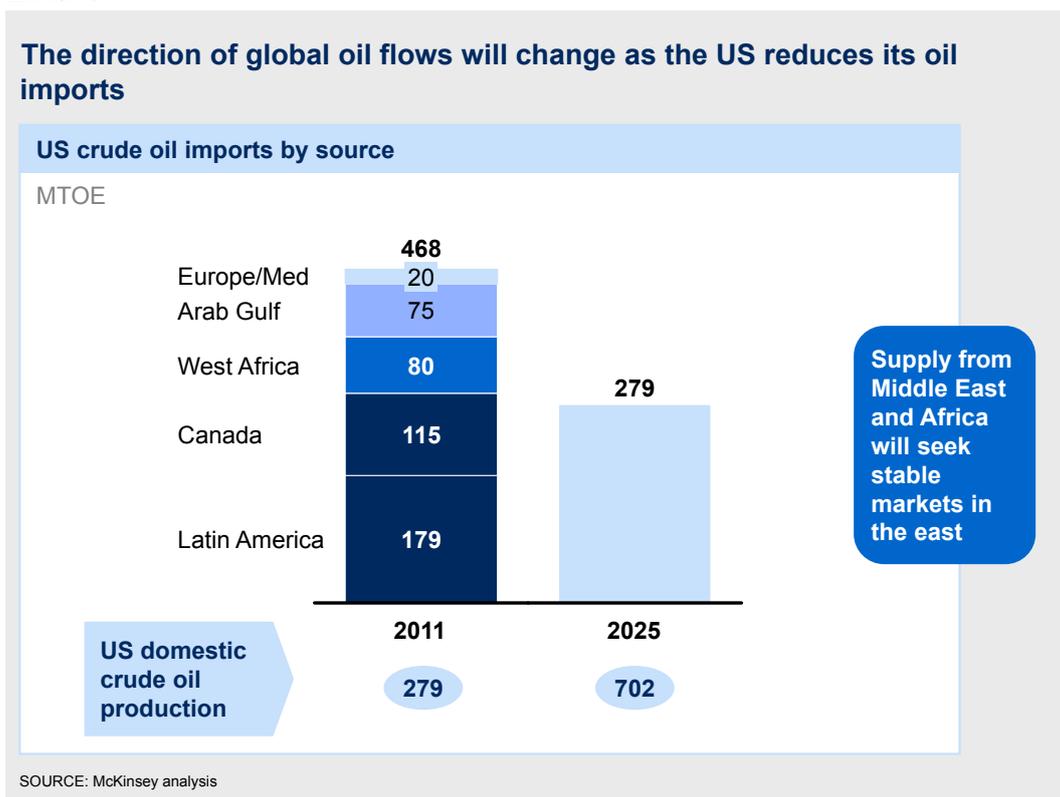
- Allow its energy PSUs sufficient freedom to develop global talent pools that can seamlessly operate in multiple markets, and transfer capabilities across borders
- Enable energy companies to make cross border corporate acquisitions for capability, presence and momentum, not merely assets, and establish material, deep presence in a few relevant geographies
- Strengthen energy company processes and organisations to allow effective governance, capital and operating efficiency and monitoring.

9. Create an India-Middle East energy corridor

Shale oil production in the US is expected to rise to levels beyond the current US imports from outside North and Central America. This will shift global crude oil flows (Exhibit 9). The Middle East and Africa, from being exporters to the west, will seek stable, large markets in the east. This shift gives India a unique opportunity to create an ‘India-Middle East energy corridor’ to:

- Enter into new contractual arrangements with oil and gas suppliers, and potentially consider establishing an Asia–Middle East Energy Agency, to share information and facilitate emergency response agreements
- Make joint complementary investments across upstream and downstream, including Middle Eastern investments in Indian refining and petrochemicals, Indian upstream investments in the Middle East, and feedstock and energy intensive production of urea, aluminium, steel and petrochemicals in the Middle East
- Create shared energy infrastructure between India and the Middle East, such as pipelines, ports and storage, strategic storage and dedicated mega ships. Such infrastructure has already been established between Russia–EU, Russia–China, Myanmar–China, and North Africa–Southern Europe.

Exhibit 9



10. Establish gas positions in East Africa and North America

India is already helping catalyse a shift in the structure and conduct of the global LNG industry, through its forays into Henry Hub indexed LNG exports from the US, and its upstream investments in East Africa. To take full advantage of the shale gas revolution in North America, and consolidate its natural advantage in the Indian Ocean rim, India should:

- Continue to expand its presence in North America through upstream and midstream positions in the US and Canada, serving to expand volumes, defray regulatory risk and serve as a natural hedge against Henry Hub
- Work towards a lead role in the sustainable development of East Africa as an integrated gas supply hub, including exploration and production, local industry development, relevant local manufacturing such as urea, and LNG liquefaction for export.

Mobilising institutions and markets

Changing India's energy trajectory through the 10 initiatives outlined above—or other initiatives—will require close inter-ministry coordination, a strong technology ecosystem, and catalysing industry participation, and a central energy fund.

Inter-ministry coordination

With 8 to 10 central ministries involved in energy decisions besides the states, a mechanism for effective, continuous coordination would be needed to achieve the supply and demand shifts required.

A cross-ministerial body on energy with representation from the key ministries at the minister and secretary level could be a possible option. Such a body would help ease approvals required at the state and central level, drive initiatives to shift demand from liquids to power and renewables, and maintain the government-to-government interface required to help international acquisitions.

In addition, a central minister-level appointment with a small secretariat to coordinate energy issues and drive towards the aspiration of energy independence could provide a strong impetus to an energy independence agenda.

A stronger technology ecosystem

India must focus on increasing technology depth across all parts of the value chain through:

- Larger R&D investments, since Indian energy companies spend between half to one-fifth of their global counterparts on R&D, on a per barrel basis
- Greater R&D effectiveness through stronger R&D processes and approaches, dedicated research cadres, closer monitoring of outcomes and a greater commercial orientation
- Global and Indian collaborations, which could take the form of bilateral alliances, industry forums, academic alliances or venture investments in technology firms
- Incentivising and attracting local manufacturing in the energy value chain, including oil field services, specialised materials and chemicals, and energy efficient storage and usage technologies.

Catalysing industry participation and investment

While some of these have been mentioned earlier, the importance of reliable market mechanisms in attracting private investment cannot be over emphasised, including:

- Market-linked prices and marketing freedom for gas and coal
- Moving subsidies to an arm's length basis, directly to consumers as far as possible, to avoid distortions in industry conduct and inappropriate incentives for consumption
- Ensuring new policies are not enacted with retrospective effect.

A central energy fund

An ambitious agenda for energy independence would benefit from a source of funding to be able to drive targeted investments and influence outcomes. An energy fund established with contributions from large Indian energy players and the government, run on the lines of a professional fund, could serve to:

- Enable and catalyse consortia to bid for large international assets and corporate entities (primarily across coal, gas and liquids), and
- Share investment risk during development of unproven technologies and applications, and incubate new technology ventures.

□ □ □

An agenda for energy independence for India by 2030 is ambitious but by no means unachievable. The need for change is clear. Many efforts are already underway. Alignment on a practical set of initiatives, backed up with strong institutional support and leadership commitment are now required.

