

Sizing India's climate economy

India's low-carbon energy market will
grow over five-fold by 2020

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Disclaimer & Disclosures

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- ▶ **2011 marks the third anniversary of India's climate plan, which has been followed up with a special focus on solar power and energy efficiency**
- ▶ **We expect 2011 to be another record year for renewable installations and energy efficiency savings**
- ▶ **We estimate that India's market for low-carbon energy solutions will grow to cUSD135bn in 2020, equivalent to c3.3% of GDP**

Rapid growth in climate solutions

In our global sector thematic entitled *Sizing the Climate Economy*, September 2010, we estimated that the global market for low-carbon energy solutions would triple to USD2.2trn by 2020. We highlighted that India is one of the fastest growing markets. In this report, we look in detail at the prospects for India's climate economy to 2020.

India's ambitions for low-carbon growth are driven by the twin imperatives of achieving climate and energy security: reducing emissions and dependence on energy imports. The 2008 National Action Plan on Climate Change (NAPCC) has been followed by a series of policy measures, which have made India one of the world's most attractive clean energy markets. As a result, we expect 2011 to be another record year for renewable installations and energy efficiency savings.

Looking out to 2020, we forecast annual sales of renewable technology and electricity to grow six-fold to USD34bn, with total installations at 71GW (39GW wind, 15GW solar). We forecast that solar will achieve wholesale grid parity by 2018-19, laying the foundation for rapid growth after 2020.

It is energy efficiency that stands out as the largest market opportunity at USD77bn by 2020, however. Industrial efficiency is the largest segment, with savings driven in part by the new Perform, Achieve and Trade (PAT) system, which will be launched in April. Tightening standards will also underpin the building efficiency market, notably lighting and HVAC. On the transport front, the fastest growth is likely to be in electric vehicles, where we forecast annual sales of 400,000 by 2020.

In our companion report, *Investing in India's climate economy*, we highlight companies positioned to benefit from this growth, and evaluate the carbon intensity of India's largest companies.

Summary

In our global sector thematic, *Sizing the climate economy* (September 2010), we highlighted India as one of the fastest growing markets for low-carbon energy solutions. In this report, we look in detail at the evolution of India's climate and clean energy policies since the first National Action Plan on Climate Change in 2008. We project the markets for low-carbon energy supply (notably renewables and nuclear) as well as building, industrial and transport efficiency through to 2020, and estimate the potential for over five-fold growth. We also estimate the embryonic markets responding to India's vulnerability to climate impact. We conclude that the policy framework for low-carbon growth has become substantially more robust in the past three years – indicated by the record renewable installations and efficiency savings expected in 2011 – but highlight that regulatory risks remain.

Choosing low-carbon growth

In June 2008, the Government of India (GoI) released the National Action Plan on Climate Change (NAPCC), the country's first strategy on the subject. This set in motion eight national missions on various dimensions of the problem. Six months later,

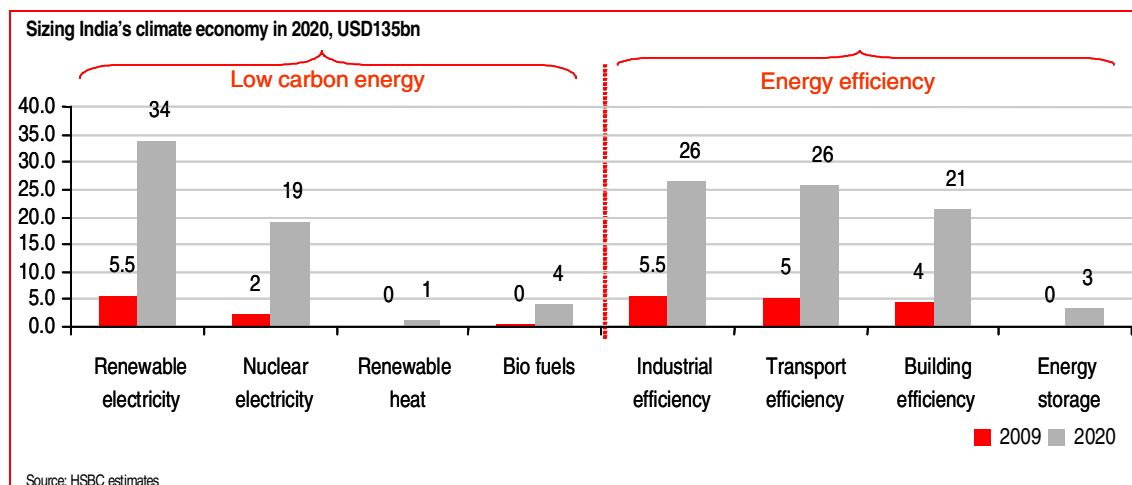
we published our first assessment of the investment implications of the Plan, concluding that India had a “*wide spectrum of choices*” to address the strategic risks and opportunities posed by climate change.

Almost three years on from the launch of the NAPCC, it is evident that India has chosen

India's key low-carbon policy targets

Policy focus	Target
Carbon intensity	Reduction of 20-25% in the emissions of carbon dioxide per unit of GDP from 2005 by 2020
Renewable electricity	1% increase in the renewable share of electricity, reaching 15% by 2020
Solar	Total installations of 20GW by 2022
Bio-fuel	20% blending by FY17
Nuclear	Cumulative installed capacity of 60GW by 2030
Energy efficiency	Reduction of c100 million tonnes of CO ₂ every year by 2015 through efficiency measures
Industrial efficiency	Reduction in specific energy consumption of Designated Consumers in industry by c5% from the base year 2009-10 to the target year 2014-15
Forests	Doubling the rate of forest cover restoration over the next 10 years, taking the total area to be afforested to 20m ha by 2020

Source: HSBC



decisively in favour of low-carbon growth: the table on the previous page lays out India's key targets. These targets reflect the government's mounting concern about the nation's vulnerability to climate change, along with growing recognition of the potential for solar power and efficiency savings to deliver energy security for the growing economy.

This potential was made clear in our report, *Sizing the climate economy* (6 September 2010), which forecast that the global market for low-carbon energy solutions would almost triple to USD2.2trn by 2020. Within this, India – along with China – would be the fastest growing market, moving up from fifth to fourth position in terms of overall global share.

In this report, we provide a detailed assessment of this growth potential across a range of investment themes using country-specific costs and prices. We estimate that India's climate economy will grow around five-fold over this next decade, from cUSD23bn in 2009 to cUSD135bn in 2020, implying a CAGR of c17% over 2009-20. By 2020, India's climate economy will be equivalent to c3.3% of India's estimated GDP¹ - 50% larger than the global average of 2.1%.

Low-carbon energy supply: USD58bn in 2020

Six-fold growth in renewables

We estimate the size of India's low-carbon energy supply market in terms of sales of equipment as well as commodities (eg electricity and fuels). We expect this to grow at a CAGR of 19% to USD58bn in 2020. The largest sub-segment will be the renewable electricity market at USD34bn, implying a six-fold increase from 2009. The growth will be driven by a strengthening policy framework based on renewable portfolio obligations (RPO), the generation-based incentive (GBI) mechanism, feed-in-tariffs (FIT), the Renewable Energy Certificate (REC) Scheme and other incentive schemes.

By the end of 2020, we estimate cumulative renewable installations of c71GW: wind 39GW, solar 15GW and other renewables 17GW. This means that India is likely to be the fifth largest installed base for wind turbines after China, the US, Germany and Spain, and the sixth largest base for solar installations. In total, we expect renewables to account for around 10% of total electricity generation, up from c4% in 2009. Our estimates are lower than the NAPCC proposal for a 1% increase per annum in the renewable share, implying 15% by 2020. In order to achieve the NAPCC proposed target, the cumulative renewable capacity will need to reach c125GW. Closing the gap will involve more

¹ India's GDP in 2009 stood at USD1.24trn; we estimate that this will grow to USD4.1trn by 2020, which we have extrapolated using IMF forecasts for 2009-2015 in domestic currency and using exchange rate of 1USD = INR45

focus on implementation at the state-level, particularly in terms of penalising non-compliance with clean energy goals.

Solar: Reaching grid parity

Over the next decade, we expect wind energy to continue to be the largest renewable theme. But it is solar that will have the fastest growth, rising from close to zero capacity in 2009 to c15GW by 2020. In our global solar thematic entitled *Global Solar Power*, September 2009, we estimated that solar technology in India will reach retail grid parity by 2015 and wholesale grid parity by 2018/2019. This will lay the foundations for rapid growth after 2020. This downward push on solar prices is also reflected in the recent discounts offered by generating companies on the Central Electricity Regulatory Commission (CERC)-approved tariff. In the reverse bidding process held in November 2010, discounts of c32% for PV and c25% for solar thermal were offered, implying a sale price of INR12.16/Kwh (USDc27/kwh) for solar PV and INR11.49/Kwh (USDc27/kwh) for solar thermal.

Nuclear: Eight-fold growth

We estimate that the nuclear market will grow around eight-fold to cUSD19bn by 2020. Currently, the GoI is planning the award of contracts for the construction of 30GW of nuclear capacity to foreign companies (primarily US, French, Japanese and Russian conglomerates). We estimate that c20GW will be installed by the end of this decade and the remaining capacity during 2020-30. This would take the nuclear share of electricity generation to c7.5%. Issues around the Treaty on the Non-Proliferation of Nuclear Weapons (also called the Nuclear Non-Proliferation Treaty or NPT) are still pending resolution, and foreign companies continue to have concerns regarding the Civil Liability for Nuclear Damage Bill (also called the Nuclear Liability Bill) which has now been passed by the Indian parliament. Public concerns about nuclear safety at the local level also remain strong. These concerns

could result in commissioning delays and hence pose risks to our estimates.

Energy efficiency: USD77bn in 2020

We estimate India's energy efficiency market at USD77bn in 2020, implying a CAGR of 16% over 2009-20.

Industry: The largest segment (USD26bn)

Last year, the National Mission on Enhanced Energy Efficiency (NMEEE) singled out the potential for reducing the specific energy consumption of Designated Consumers (DC) in industry by 5% between the base year of 2009-10 to 2014-15, thereby saving 19GW of additional generation capacity. This will be realised through the introduction of the Perform, Achieve and Trade (PAT) system this April, as well as through a range of targeted measures from the Bureau of Energy Efficiency (BEE). We forecast a market size of USD26bn in 2020, with a 2009-20 CAGR of c15%.

Transport: The fastest growing theme (USD26bn in 2020)

We estimate transport efficiency will be the fastest growing investment theme with a 2009-20 CAGR of 17%, resulting in a 2020 market size of USD26bn. This comprises the estimated spending on the engines of smaller efficient cars, the build-out of metro rail systems and the expansion of electric and hybrid vehicles in the latter half of the decade.

Building: Diversified growth

Tightening building codes, replacement of inefficient lighting and new appliance standards will drive growth in the building efficiency theme of 16% CAGR to an annual market size of USD21bn in 2020.

Plucking the low hanging fruit

The BEE is promoting energy efficiency on a broad front. Over the coming decade, we expect the focus

to shift from low-cost/easy-to-implement opportunities to costlier/relatively difficult options.

Over the next three years (2011-13), building efficiency will be promoted through the integration of the Energy Conservation Building Codes (ECBC) into the municipal byelaws across key states. In addition, efficient lighting (primarily CFLs), good-quality insulation, the use of labelled appliances and efficient HVAC systems will also be promoted. For industrial efficiency, the focus is likely to be on the replacement of inefficient boilers, as well as on installing efficient motors and pumps, besides industry-specific products across the eight industries covered by the PAT scheme. For transport efficiency, the focus will be on the build-out of metro railways and building dedicated freight corridors.

From 2014 to 2016, the focus will switch to LED lights, building control and management systems, efficient glass and various green building products. In industry, process automation across SMEs will be encouraged. And in the transport sector, the emphasis will be on ensuring compliance with automobile efficiency standards launched in 2011/12 by 2014/15. In the final years of the decade, the focus will be on higher cost/difficult-to-implement options, such as electric vehicles, efficient batteries for increased storage and smart grids.

Green trading: USD2.5bn in 2020

Although there are no plans to introduce carbon trading in India – unlike China – the government is keen to use market mechanisms. We expect Renewable Energy Certificate (REC) and Energy Saving Certificates (ESCs) trading of USD0.5bn by 2014 (60% ESCs + 40% REC). By 2020, we estimate REC market size of cUSD2.5bn, while the market size of ESCs will depend on the policy targets established after the first phase of the PAT cycle.

2011: All set for a record year

We believe 2011 is set to be another record year for climate investment themes. During FY11 (April 2010-March 2011), we expect renewable electricity installations of more than 2.7GW and annual energy savings of more than 3GW, levels that have never been achieved before.

For FY12 (April 2011-March 2012), we expect new capacity additions of over 3GW and energy efficiency savings of over 3.5GW. We forecast that this means India is set to deliver 90% of the 14GW in new renewables' target during the Eleventh Five Year Plan period (April 2008-March 2012). For energy efficiency, we are projecting energy efficiency savings of c11.5GW, implying an over-achievement of 11.5% vis-à-vis the BEE proposal of 10GW savings.

Risks to our estimates

Besides the usual risks of long-term economic modelling, there are specific regulatory risks coupled with technological challenges and implementation issues. In the past, we have observed capacity installations in the power sector at an average of c50% of the capacity proposed in India's Five Year Plans. However, we do expect an improvement in the achievement rate in the current Five Year Plan (FY2008-12).

The key downside risk is delay in policy implementation. This encompasses the risk of limited progress in minimising the bureaucratic hurdles to project delivery, weak or no penalties on the state utilities for missing RPO targets, along with the regulatory uncertainty that any changes in the government at the national and state level might bring. For solar, deployment could be slowed by insufficient institutional support for financing and technology transfer.

Key upside risks are the stimulus provided by higher fossil fuel prices, the potential for more ambitious policies, and higher-than-estimated electricity and technological breakthroughs that reduce the cost of low-carbon alternatives.

Beyond 2020

This report projects the growth of India's low-carbon economy over this decade. While India will continue to add large capacities of coal-based generation facilities during this period, we expect a decline in momentum during the latter half of the decade. In the 2020s, we expect a radical change in the pace of development of India's low-carbon economy with accelerated deployment of nuclear, solar, offshore wind energy and electric vehicles.

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The road to 2020

- ▶ Low-carbon growth is required not just to reduce emissions, but also to improve India's energy security at risk from rising imports
- ▶ The 2008 National Plan laid the foundations for eight national climate missions, capped by the country's first carbon intensity goal in 2009
- ▶ We estimate India's climate economy will grow at a CAGR of c17% over 2009-20

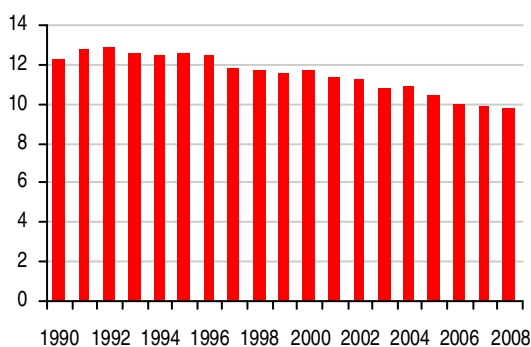
In search of climate security

India's strategy on climate change has many dimensions. The country is a *de facto* low-carbon economy, with per capita emissions of less than 2 tonnes, compared to a global average of around 7 tonnes. Although it is the fourth largest emitter of GHGs from energy use after China, the US and the EU, its emissions are a fifth of China's. India has contributed little to the global climate problem, and is insistent in international negotiations of the fundamental principle of equity – climate solutions that reflect responsibilities and capabilities.

Furthermore, both its energy and carbon intensity – measured in terms of GDP – have been steadily falling over the past two decades, with India converging towards the global average.

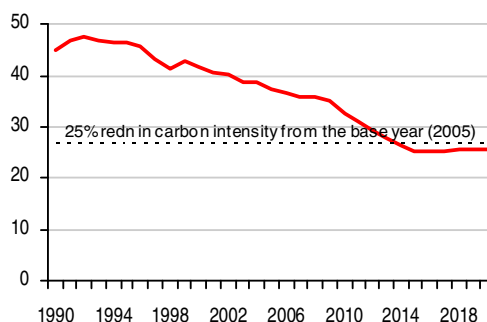
India also faces significant risks from climate change. In our *Too Close for Comfort* report (December 2009), we concluded that India was the most vulnerable of the G-20 economies to the disruptions to natural systems brought by a changing climate. In 2009, India suffered losses from extreme events of USD2.7bn, followed by extreme temperatures and flooding in 2010. And as India's

India's energy intensity (toe / m INR GDP Constant prices)



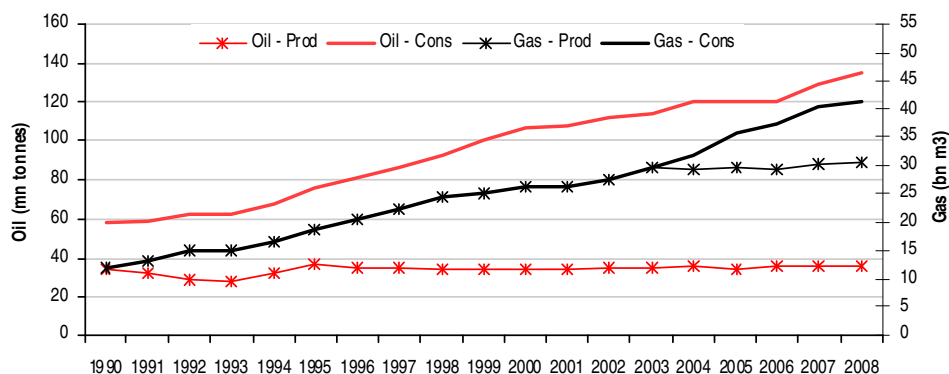
Source: BP Statistical Review 2009, IMF

India's carbon intensity (tCO₂ / m INR GDP constant prices)



Source: Netherland Environmental Agency, IMF

Increasing dependence on imports: Growing divergence in India's Oil & Gas production and consumption



Source: HSBC

economy grows, the country's dependence on imported sources of energy (fossil fuel) will grow as a proportion of the total and in absolute terms.

Switching to a low-carbon path is therefore not just an environmental imperative, but essential for continued economic growth.

Managing energy growth

In its 2006 Integrated Energy Policy (IEP), the GoI's Planning Commission projected growth in energy demand to meet the country's development goals assuming c8% GDP CAGR. India needs to expand energy production six-fold from 327mtoe in 2003-04 to 1,858mtoe in 2031.

According to the Planning Commission, India's power sector is poised to grow along with GDP – from c723TWh in 2007-08 to 3,225TWh in 2030-31, implying a CAGR of 6.7%. Currently, with almost half of all Indian households (c44%) still with no access to electricity² and average annual per capita electricity consumption at 25% of the world's average, we expect strong growth in electricity demand over the coming years and have forecast a 2009-20 CAGR of 6.3%.

Strong growth in energy in the transport sector is also expected. India had about 12 light-duty vehicles

(LDVs) per 1,000 people in 2007, in contrast to over 800 in the US. The auto market has been growing at a CAGR of c14% over the past four years and is likely to remain strong in the coming decade. This will drive a c40-50% increase in oil consumption over the next decade.

India's current fossil fuel dependence coupled with limited domestic oil reserves and lower-than-projected coal resources is generating increasing reliance on energy imports, as illustrated in the chart above. In 2008, the country imported c75% of its oil, c11% of its coal, and c26% of its natural gas requirement. This produced an oil and gas import bill equivalent to c5.6% of GDP. In our October 2010 report, *Same Problems, New Execution Risks* written by our India power sector analyst, Arun Kumar, we project that coal production will not be able to keep pace with the acceleration in generation capacity. As a result, over FY2010-17, coal imports will increase at a CAGR of 26%.

India's Planning Commission also projects that the country's dependence on imports could almost double, rising from about c25% in 2003-04 to c53% of commercial energy consumption in 2031-32. We estimate that c35% of India's 2020 energy demand is likely to be met by imports, up from c30-32% in 2008.

² <http://go.worldbank.org/TPFMOR4Y50>

As well as requiring a surge in absolute imports of oil, gas and coal, this will expose the economy to increasing volatility in energy price and supply. We have observed the price of gasoline in Delhi rise c14% from INR45.62/litre at end 2008 to INR51.83/litre in October 2010, while the global oil price during this period declined 17% from USD101/barrel to USD81/barrel. In the electricity sector, we have seen state distribution companies facing increasing losses year-on-year, as it remains politically difficult to pass on the increased costs of electricity to end consumers. The net result is increased power cuts across many states.

Mobilising India's domestic energy capabilities in a sustainable way has emerged as a critical policy objective. In practice, this means making the best use of India's renewable energy resources – particularly solar, which has yet to be tapped – as well as further reducing the energy intensity of the economy through efficiency measures.

After the plan, action

The 2008 NAPCC marked the first attempt by the GoI to develop a strategic response to climate and energy security (see *A wide spectrum of choices*, November 2008). It stimulated the creation of eight missions to flesh out the broad policy ideas: Solar Energy, Enhanced Energy Efficiency, Sustainable Habitat, Water, Sustaining the Himalayan Ecosystem, Green India, Sustainable Agriculture and Strategic Knowledge for Climate Change. Furthermore, in the run-up to the Copenhagen Climate Summit in 2009, India made a voluntary commitment to reduce its carbon intensity by 20-25% from 2005 levels by 2020. The Planning Commission is now in the process of developing a strategy to implement this intensity target.

Key pillars of the country's low-carbon growth ambitions include renewables (notably solar), nuclear, as well as energy efficiency in buildings, industry and transport.

Driving renewable growth

Investments in renewable generation in India started in the mid-1990s, primarily in wind energy. The Ministry for New and Renewable Energy (MNRE) introduced a common single-part tariff along with certain income tax benefits (primarily the accelerated depreciation of 80% in the first year), capital grants and loans from the Indian Renewable Energy Development Agency (IREDA). From 2000 until mid-2008, feed-in-tariffs (FIT) fixed by the State Electricity Regulatory Commissions (SERCs) replaced the MNRE's single-part tariff, while the other incentives continued.

The NAPCC suggested a new target of increasing the share of renewables in electricity generation by 1% per annum from a 5% baseline. We assume that this implies a 15% goal by 2020. After the NAPCC, a range of new policy initiatives have been taken at the national and state levels, which are now starting to show results. For the first time in 2009, the federal electricity regulator, the Central Electricity Regulatory Commission (CERC) fixed the FITs for renewable technologies. In addition, a number of SERCs increased the FITs or introduced them, if none existed before. Around 20 out of 28 states also introduced Renewable Portfolio Obligations (RPO) for electricity distribution, specifying the level of clean power required. In December 2009, the central government introduced an additional Generation Based Incentive (GBI) for new wind installations in lieu of accelerated depreciation. In June 2010, a further GBI was announced for rooftop solar PV and small solar with installed capacity of 100kW to 2MW, connected to a distribution network at voltage levels below 33KV(v). Most recently, a tradable Renewable Energy Certificate (REC) mechanism has been established, which will run parallel to FITs.

Target solar

The National Solar Mission has adopted a 3-phase approach. It aims to ramp-up capacity of grid-connected solar power generation to 1GW by 2013, and an additional 3GW by 2017 through mandatory use of the Renewable Purchase Obligation (RPO) by utilities, backed by a preferential tariff. Reaching 10GW or more installed power by 2017 is conditional on the availability of international finance and technology transfer. The mission is targeting 20GW of solar capacity by 2022 and extending this to 100GW by 2030 and to 200GW by 2050. The solar power purchase obligation for the states will start with 0.25% in Phase 1 and go up to 3% by 2022. The government has already approved INR43.37bn (USD960m) for the activities proposed under the first phase of the mission till March 2013.

Apart from these grid-based applications, the mission target for off-grid applications is 2,000MW by 2022, including 20m solar lighting systems and 20 million square metres (m sqm) solar thermal collector area. Under Phase I, 1.7m sqm of installed collector area is targeted by March 2013.

Mobilising low-carbon finance

In the 2010-11 budgets, the government supplemented these regulatory measures with targeted financial provisions to boost renewables. A new Clean Energy Fund has been established, financed by a tax of USD1 per ton of coal. This is estimated to provide USD1.1bn of funds in FY11. Discussions about a 'green investment bank' to leverage these funds are at an early stage.

Boosting nuclear power

For years, India has been isolated from the global nuclear market as a result of its refusal to sign the Nuclear Non-Proliferation Treaty (NPT). This stand-off ended in 2008 when India reached a civil nuclear agreement with the US, thereby ending years of isolation from global atomic commerce. Following this, India has also signed nuclear deals with France,

the UK and Canada. It is now in discussions with Japan, which would enable Japanese companies that hold stakes in key US and French nuclear players to provide nuclear technology to India. In August 2010, the country also passed a much-needed Nuclear Liability Bill. These agreements are critical to enable the country to achieve its ambition of c60GW nuclear generation by 2030.

Energy efficiency gathers steam

Action on efficiency stretches back to the 2001 Energy Conservation Act and the establishment the following year of the Bureau of Energy Efficiency. Following the NAPCC in 2008, the BEE has accelerated its work, mobilising Energy Service Companies (ESCOs), launching demand-side management (DSM) initiatives in agriculture, and introducing the carbon market-financed Bachat Lamp Yojana (BLY) programme for mass distribution of compact fluorescent lamps (CFL). It has also introduced a star rating programme for office buildings to create demand for energy-efficient buildings, as well as made standards and labelling (S&L) mandatory for air conditioners, tube lights, frost-free refrigerators and distribution transformers.

In June, the National Mission on Enhanced Energy Efficiency (NMEEE) set the target of cutting specific energy consumption – energy per unit of product - of designated industrial consumers by around 5% from 2009-10 to 2014-2015. This mission aims to save c23mtoe, avoiding power capacity additions of 19MW and curbing CO2 emission by c100mt CO2 annually, or c6% of 2008 emissions. The NMEEE also proposed setting up of two funds. The partial risks guarantee fund (PRGF) would act as guarantor of energy efficiency investments and enter into agreements with commercial banks that originate transactions. The venture capital fund (VCF) would invest in innovative efficiency technologies. The government has provided initial financing of

After the Plan: Key policy announcements following India's 2008 National Action Plan on Climate Change

Date	Milestones
Climate Strategy	
3-Dec-09	India announces it will reduce carbon intensity by 20-25% from 2005 levels by 2020
1-Feb-10	Official commitment to reducing carbon intensity made in Copenhagen Accord
1-Mar-10	Budget 2010: Introduces a Clean Energy Cess, or Coal Tax (cUSD1.1/ton)
25-Jun-10	India cuts petrol subsidies
Renewables	
Jun-09	Report from MNRE on the development of a Renewable Energy Certificate mechanism for India
17-Sep-09	CERC notifies tariff regulations for green power
19-Nov-09	Cabinet approves National Solar Mission
17-Dec-09	Generation-based incentive (GBI) for Wind power (INR0.5/kWh) announced
14-Jan-10	Notification by CERC on the regulation for Renewable Energy Certificates
26-Feb-10	Budget 2010: Excise duty exceptions at 5% for Solar PV and STEG.
1-Mar-10	Budget 2010: Proposes to impose Clean Energy Cess, or Coal Tax (cUSD1.1/ton)
26-Apr-10	CERC issues a tariff order for determination of generic levelised generation tariff for green power
15-Jan-10	PM launches National Solar Mission
16-Jun-10	MNRE releases guidelines for Rooftop Solar PV and Small Solar Generation Programme (RPSSGP)
26-Jul-10	Guidelines for National Solar Mission released
18-Nov-10	REC trading is launched on approved exchanges
22-Nov-10	NVVN selects seven parties for construction of 480MW of solar thermal capacity under Phase1 of National Solar Mission
Low Carbon Power: Nuclear	
10-Oct-08	Nuclear Deal: 123 Agreement between India and the US finally operationalised
5-Feb-10	The UK and India reach an understanding on civil nuclear cooperation
28-Jun-10	India and Canada sign a civil nuclear deal
25-Aug-10	The Lok Sabha passes the Nuclear Liability Bill; the Rajya Sabha subsequently passed it on 30 August
Energy Efficiency	
24-Nov-08	BEE launches report on accredited ESCOs
1-Feb-2009	Launch of pilot phase of agricultural pump DSM
Feb-2009	Launch of Bachat Lamp Yojna (BLY) Programme of Activities
Feb-2009	Launch of Building Star Rating programme
Jul-09	BEE revises the Energy Conservation Building Code (ECBC)
6-Jan-10	BEE makes Standards and Labelling mandatory for ACs, tube lights, frost free refrigerators and distribution transformers.
25-Jun-10	Indian Cabinet approves Energy Efficiency Mission
10-Aug	Energy Conservation Amendment Bill 2010 passed in both Houses of Parliament
11-Nov-10	Incentives launched for the electric vehicle industry
Adaptation	
14-Oct-09	Indian network of climate change assessment launched
24-May-10	India unveils draft National Green Mission
10-Jul-10	Supreme Court passed an order on CAMPA, releasing INR112bn for forestation

Source: Government websites, HSBC

INR1.7bn (USD37m). This is expected to be leveraged with support from other agencies, including multilaterals. The funds are likely to become operational by April 2011.

In August 2010, parliament passed an amendment to the Energy Conservation Act 2001, which gave the government and the BEE more powers to implement energy efficiency initiatives, broaden the range of covered stakeholders, set up an Appellate Tribunal for Energy Conservation and increase the penalty for non-compliance 100 times to INR1m (USD0.02m).

Doubling forest cover

In May 2010, the GoI released a draft of its National Green Mission, which calls for doubling the rate of forest cover restoration and removing 43mt of CO₂ each year, or c6% of India's annual greenhouse gas emissions, by 2020. The total mission cost is estimated at USD9.7bn over 10 years.

2011: Another record year

As with other countries, the financial crisis has had a negative impact on India's delivery of its low-carbon ambitions. In particular, installations of new renewables have been pushed below government projections. Nevertheless, 2009 was a record year for renewables and installations in 2010 are likely to exceed those in 2009. We expect more than 2,700MW to be deployed in FY11 and expect this momentum to continue in FY12 with installations of over 3,000MW. As a result, we estimate renewable installations during the Eleventh Five Year Plan to be c90% of the proposed target, helped by the policy developments after the release of the NAPCC in mid-2008.

Renewable installation: Actual vs plan

Financial year (April-March)	Capacity added (MW)	Proposed (MW)	Remarks
FY 2007-08	2153	1987	Actual
FY 2008-09	2083	2580	Actual
FY 2009-10	2330	3226	Actual
FY 2010-11	2700	6207	HSBC estimates
FY 2011-12	3000		HSBC estimates
Total	12266	14000	

Source: MNRE, HSBC

An even better picture emerges for energy efficiency. The BEE has set a target of 10GW of energy savings during the Eleventh Five Year Plan (FY2008-12). Various initiatives undertaken by the Bureau discussed earlier in the report have generated energy savings of c5GW over the first three years, with record savings being achieved y-o-y.

We estimate that savings in terms of new capacity generation of 3.2GW will be achieved in FY2010-11 and 3.5GW in FY2011-12. As a result, we forecast savings of c11.5GW during the Eleventh Five Year Plan period, an over-achievement of 11.5%.

Set for over-achievement: Energy savings 2007-12

Program year	Avoided capacity (MW)	Remarks
FY 2007-08	621	Actual
FY 2008-09	1504	Actual
FY 2009-10	2868	Actual
FY 2010-11	3200	HSBC estimates
FY 2011-12	3500	HSBC estimates
Total	11693	Proposal was 10000MW

Source: BEE India, HSBC

Key milestones for 2011

India's policy framework for low-carbon growth is still a work in progress. But the momentum is largely positive across the main climate investment themes – in contrast to the widespread policy risk affecting industrialised country markets. For more details on our latest policy risk assessment, see *Climate Investment Update 13 January 2011*. We expect the positive policy momentum to be sustained this year with a series of milestones (listed in the table below).

Looking out to 2020

Using the same methodology developed for our global *Sizing the climate economy* report, we have projected revenues for key segments of India's climate economy out to 2020, as illustrated in the chart below. We focus on the supply and

Key climate policy milestones for 2011

Milestones / Event	Expected Date
Launch of new Automobile Fuel Efficiency standards	Mar-11
GBI scheme for biomass-based electricity generation	Mar-11
Operationalisation of Partial Risk Guarantee Fund and Venture Capital Fund	Apr-11
Launch of Perform, Achieve, Trade (PAT) industrial efficiency scheme	Apr-11
Development of guidelines for improving efficiency of urban water supply system	Apr-11
Strategy document from the Planning Commission detailing India's roadmap to achieve its 20-25% reduction in carbon intensity by 2020	Apr-11
Final selection of projects under the second stage of Phase-1 of the National Solar Mission	2011
Launch of Green India Mission	2011
Launch of the Green Investment Bank or an institutional mechanism for utilising the Clean Energy Cess	2011

Source: HSBC

consumption of energy, which is responsible for around 60% of India's GHGs. In our global sector thematic, we provided an indicative geographical break-down of market sizes using the average global capital costs and commodity prices. In our country-specific reports, we refine these indicative market sizes using country-specific costs/prices.

Supplying low-carbon energy

Our model calculates revenues from the sale of low-carbon energy technologies for power, heat and fuels, as well as the resulting revenues from the sale of low-carbon commodities (notably electricity, heat and fuels). We have aimed to be cautious in our projections, especially given the historical performance rate of delivery of power capacity additions against government targets. However, we note that renewables have a better track record on installations compared to fossil-fuel-based capacity. In this exercise, we have not modelled potential

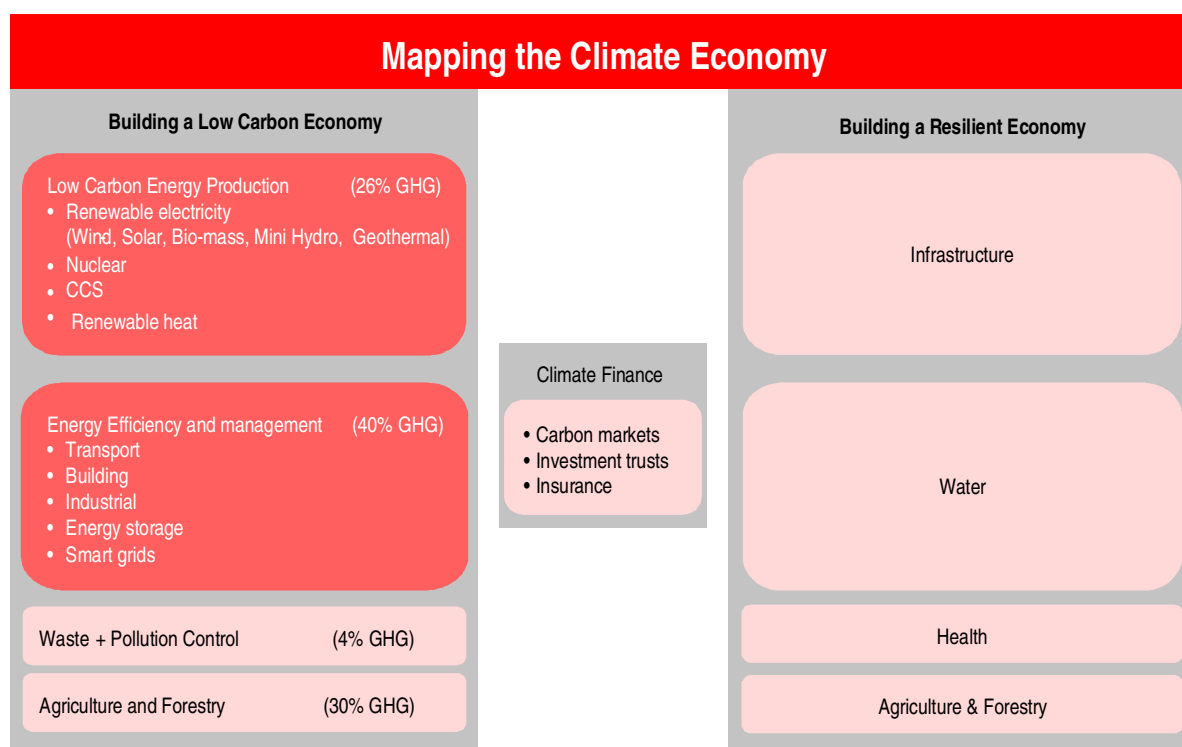
revenues from 'clean coal' – coal-fired power stations equipped with carbon capture and storage (CCS) as there is limited appetite for deployment in India at present.

Meeting demand for energy efficiency

This model considers the goods and services required to improve the use of energy in buildings, transport and industry, as well as for energy storage.

The other side of the climate economy

In our global report, *Sizing the climate economy*, 6 September 2010, we did not model the investment potential of adaptation to climate change. However, given India's vulnerability to climate change, we have made a preliminary evaluation of the economic value of India's spending to build infrastructure, water, health and food production resilient to the impact of climate change.



Note: Dark pink indicates the themes covered in this report.
Source: HSBC

Supplying low-carbon energy in India

- ▶ We estimate that the low-carbon energy market will be worth USD58bn in 2020, implying a CAGR of 19% from 2009
- ▶ We estimate that renewable generation will grow from a c4% share in 2009 to c8.5% in 2020, with 71GW of installed capacity
- ▶ We project that nuclear generation will grow to an c7.5% share, with c25GW of installed capacity

Six-fold growth

The low-carbon energy market consists of goods and services that supply power, heat and fuel with low or zero carbon footprint. Our market size estimates comprise both forecasts of sales of technology as well as revenues from low carbon energy commodities, such as bio-fuels and renewable electricity.

We estimate that India's low-carbon energy market was worth around cUSD9bn in 2009. We project that this will increase to USD58bn in 2020, implying an overall CAGR of c19%. This includes renewable electricity market of cUSD34bn (CAGR 18%), nuclear electricity market of cUSD19bn (CAGR

21%), bio-fuel sales of cUSD4bn (CAGR c30%) and renewable heat of USD1bn (CAGR 17%).

Overall, we expect India's total electricity generation to more than double by 2020. Currently, the market expectation is that this will be delivered primarily by supercritical and ultra-supercritical coal installations. However, conventional thermal power expansion is likely to face increasing constraints from limited water availability. Our March 2010 report, *Over Heating*, published jointly with the World Resources Institute, concluded that 74GW - over half of the existing and planned capacity for major power companies in India, is located in areas where water is scarce. Of the planned capacity, c79% is in

Low-carbon energy growth: Estimated new capacity additions to 2020 (MW)

Resource	11th Plan (FY 2012)	Perspective Plan for 12 th and 13 th plan period (FY 2022)	Achievement by FY2010	Remaining Target (FY2022e)	HSBC Expectation (2020e)
Wind power	10500	22,500	4713	28,287	Likely
Small hydro	1400	3140	760	3780	Likely
Bio power	2100	4363	1059	5,404	Likely
Solar Power*		20000	10	19,991	Likely
Nuclear**	3160	21800	660	24,300	Unlikely
Total	17160	71803	7200	81,762	

Note: *Targets of National Solar Mission by FY2022 ; **Only till 2020 based on 12th Five year plan and DAE optimistic target of 29GW by 2020; Source: Planning Commission; HSBC

areas that are already suffering from water shortage. The water constraint was also highlighted in Arun Kumar's report, *Same problem, new execution risks* (4 October 2010) which cited the example of the 2GW Chandrapur power project, which remained closed for three months due to the unavailability of water. The report concludes that at the sector level (power utilities), water scarcity could erode FY13 earnings by as much as 5%. Rising vulnerability is thus likely to provide another stimulus for renewable generation technologies.

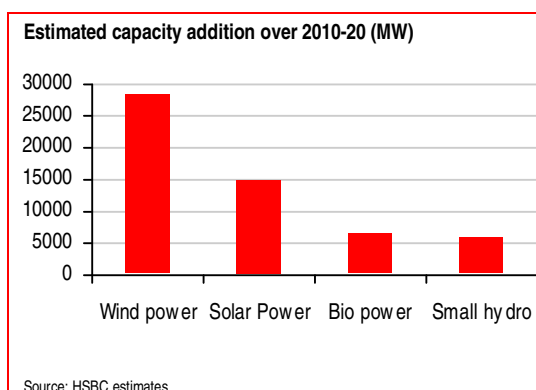
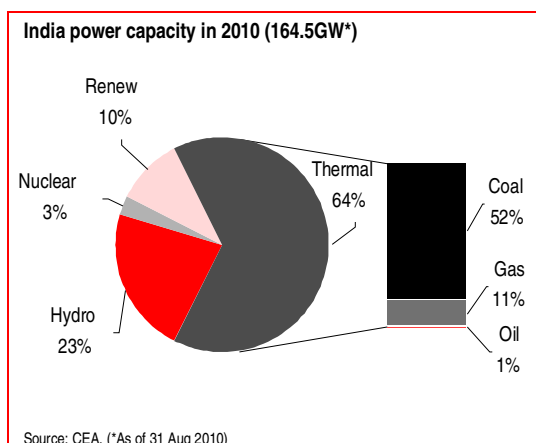
The NAPCC stipulated that the minimum renewable purchase standards should be set at 5% of total power purchases and increased 1% each year thereafter for the next 10 years, thereby taking the proportion of renewables in the electricity mix to 15%. We estimate, however, that the proportion of renewable generation is likely to increase from c4% in 2009 to c8.5% in 2020. We also estimate that the share of nuclear generation will increase from 2% in 2009 to c7.5% in 2020. As a result, the share of low-carbon power in India's electricity mix (including renewable and nuclear technologies but excluding large hydro) is estimated to increase from c6% in 2009 to 16% in 2020.

Renewable electricity: USD34bn in 2020

Between 2009 and 2020, we estimate India's renewable electricity market will grow at a CAGR of c18% from cUSD5.5bn in 2009 to cUSD34bn by 2020.

In August 2010, India had c16.5GW of renewable installations, c10% of the total installed capacity. We estimate that c55GW of renewable capacity will be installed between 2010 and 2020, with a large proportion coming on-stream in the latter half of the decade. This implies an average annual installation rate of c5GW, with an overall CAGR of c16%. We estimate that over 2010-20, more than 75% of the new capacity addition will be in wind and solar

technologies. Our estimates take into consideration the current/proposed policy framework, issues with the implementation of policies, technology costs and other related factors.



Incentives: FIT vs. REC

Currently, India has two mechanisms to support the growth of renewable electricity generation. As mandated by the Electricity Act 2003, the SERCs have set the RPOs and fixed the FITs at which utility companies have to purchase renewable electricity in their states. The CERC has also determined FITs for renewable technologies (see table below). But the CERC tariffs are only advisory in nature and are used as a guide by the SERCs.

In order to promote inter-state transfer of renewable electricity, CERC launched the Renewable Electricity Certificate (REC) trading system on 18 November 2010. Under this mechanism, developers can sell renewable electricity to their state utilities at

an average grid tariff and get REC certificates. These certificates can be sold to any utility across India that is not able to meet its clean energy obligation. Utilities that have exceeded their RPO obligations can also sell the RECs to other utilities. The CERC has designed two types of RECs – a solar REC and a non-solar REC. The Commission has fixed the floor prices of non-solar RECs and solar RECs at INR1,500/MWh and INR12,000/MWh, respectively, while forbearance prices (price cap) are fixed at INR3,900/MWh and INR17,000/MWh, respectively.

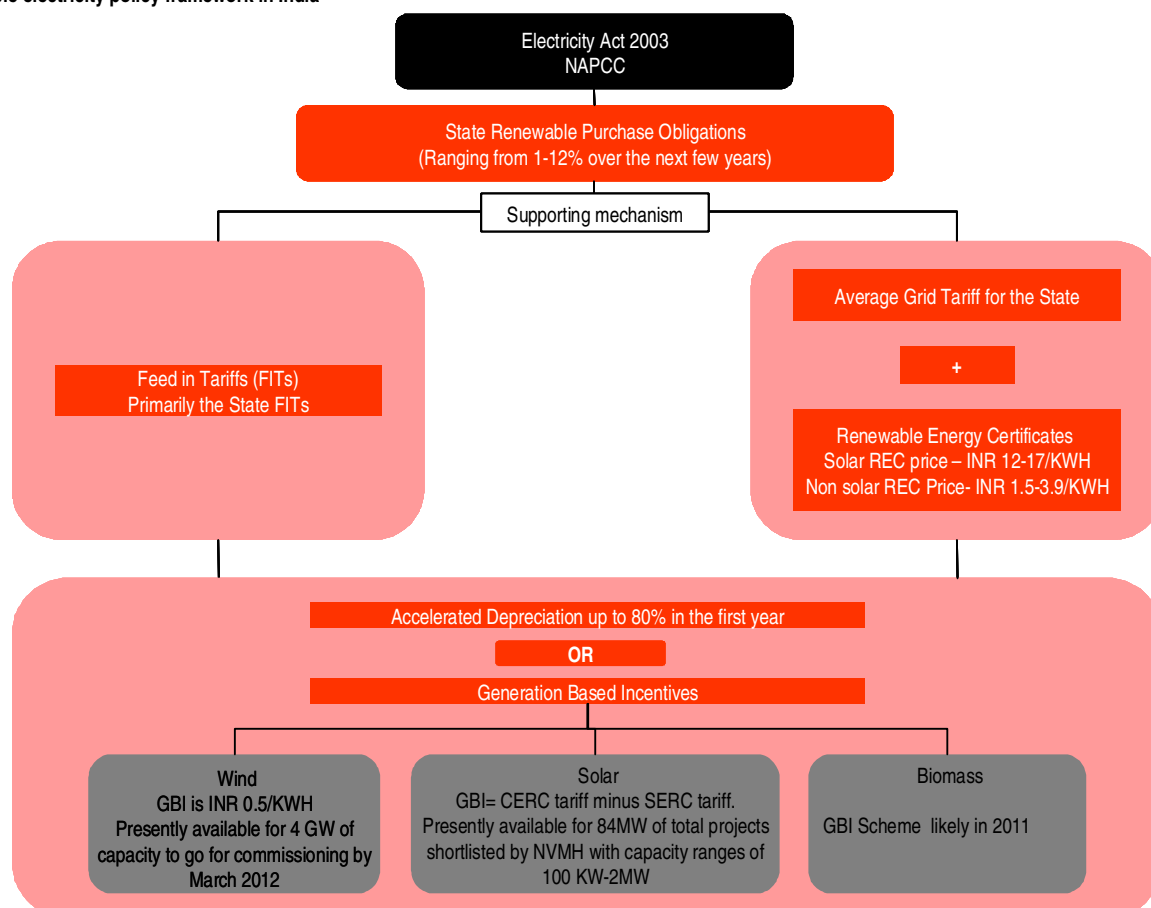
CERC tariff vs. state tariffs (INR/kWh)

	CERC Tariff	Current state tariffs
Biomass	4.6-3.4	4.9-3.0
Cogeneration	4.5-3.7	
Solar PV	17.9	15.0-13.0
Solar Thermal	15.3	13.8-8.5
Small Hydro	4.3-3.1	3.2-2.4
Wind	5.1-3.4	4.3-2.9

Source: CERC, State websites

Using the average grid tariff of the selected key states and the REC floor and forbearance prices for non-solar and solar technologies, we conclude that the REC mechanism is more attractive than the FIT mechanism. Further details are provided on page 39 in the annex. However, the bankability of this novel and market-driven mechanism for project financing still needs to be tested. Over the long term, we believe the market-driven REC incentive will become dominant.

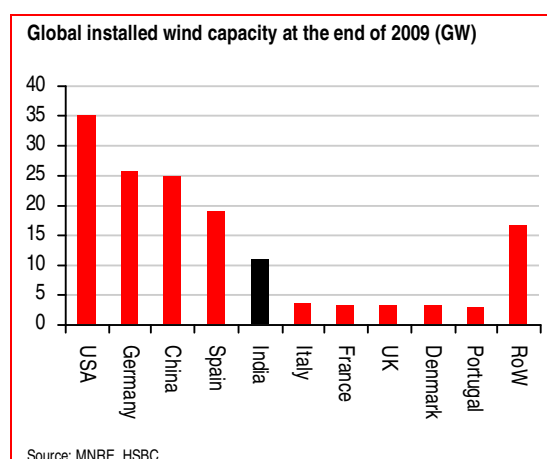
Renewable electricity policy framework in India



Source: HSBC

Wind: USD13bn in 2020

According to the MNRE, total potential for wind power in India is c48.5GW, which we estimate translates into c100TWh of electricity generation. However, the Ministry had estimated the potential many years ago and it is now re-estimating. The Indian Wind Energy Association argues that with the current technology, the onshore potential for the utilisation of wind energy for electricity generation is of the order of 65GW.



In 2009, India brought online c1.7GW of wind capacity, the third largest amount after the US and China. It now ranks fifth in total installed capacity, with c11GW as at the end of 2009. We estimate that the market size of India's wind industry will grow at a CAGR of c12% over 2009-20 to cUSD13bn in 2020.

We estimate that by 2020, total wind installations will reach around 39GW. As a result, India is likely to continue to be the fifth largest installed base for wind turbines after China, the US, Germany and Spain. Between 2009 and 2020, we forecast new

wind installations will increase at a CAGR of c10%, and an average annual installation rate of c2.5GW.

We do not expect any large offshore wind installations in India over the next five years. But we do expect to see some offshore wind installations by 2020, due to India's long coast line, limited onshore wind potential and reduced risks, as offshore technology matures with growth in global installations. For our detailed views on the global and Indian wind sector, please see *Becalmed? Is it all over for the global wind markets?*, 31 August 2010.

Solar: USD7bn in 2020

The theoretical potential for solar power in India is estimated at c600TWh (Source: MNES). The National Solar Mission aims to achieve grid parity for solar by 2022 and also deploy 20GW of grid connected solar capacity by the same date: see table below for details.

Under the first phase, NTPC's Vidyut Vyapar Nigam Ltd (NVVN) has been appointed to procure solar power. In November 2010, NVVN announced the list of companies that offered the largest discounts to CERC-approved tariffs under the reverse bidding process. These include seven solar thermal technology projects, based on concentrated solar power (CSP) technology, with a project capacity of c480 MW. In addition, 30 companies were short-listed for solar PV projects up to 5MW each. The bids resulted in discounts of c30% on the CERC-approved tariffs for solar PV and thermal technologies, which highlights that competition is increasing and costs are declining in the Indian market.

National Solar Mission: Implementation plan

Application segment	Phase I target (2010-13)	Phase II target (2013-17)	Phase III target (2017-22)
Solar collectors	7m sqm	15m sqm	20m sqm
Off-grid solar applications	200MW	1,000MW	2,000MW
Utility grid power, including rooftop	1,000MW	4000-10,000MW	20,000MW

Source: MNRE

We estimate that the market size of India's solar industry will grow to cUSD7bn in 2020, implying a CAGR of c37% over 2009-20. We estimate total solar installations will reach 15GW by 2020, up from a few MWs at the end of 2009. As a result, India is likely to have the sixth largest installed base of solar power by 2020.

We expect 150MW of solar installations in 2011, but expect this to rise to an annual average of c1.3GW of installations between 2010 and 2020, comprising roof top, ground mounted and building integrated. We expect retail grid parity to be achieved in 2015 and wholesale grid parity in 2018/19.

A recent study by The Energy Research Institute (TERI) for HSBC entitled *Investment Prospects in Concentrating Solar Power in India* indicates that cumulative solar installations in India will be in the range of 11.4-30.4GW by 2022, with a base case estimate of 20GW, in line with the government's target provided in the National Solar Mission. The study assumes that 50% of this installed capacity is likely to be solar thermal, with the parabolic trough technology being the dominant technology at 30% of total solar thermal installations (70% in Phase 1, 45% in Phase 2 and 25% in Phase 3). The other three solar thermal technologies – central receiver, parabolic dish stirring and compact linear fresnel reflector system – will have a smaller share initially, but this will gradually increase over time. Initially, India will be dependant on CSP technology imports from the US and Europe, but there is growing interest in developing specific components indigenously. The report also highlights that the states of Gujarat and Rajasthan are likely to be solar leaders, given their good insolation levels, availability of waste land and connectivity to road and the grid infrastructure. The Clinton Climate Initiative (CCI) and TERI are jointly assisting the central and state governments in developing solar parks, where

solar power plant project developers can establish large-scale power plants (3-5GW capacity) and/or manufacturing facilities for solar projects.

Biomass: USD7bn in 2020

India has annual biomass availability of 150m tons, which is equivalent to a potential of c16GW of power. An additional 5GW of power can be generated through bagasse-based cogeneration from the 550 sugar mills in the country, if these sugar mills were to adopt technically and economically optimal levels of cogeneration. A large proportion of the estimated biomass is used in the unorganised sector, especially by low-income groups, for heating and cooking purposes, and is unavailable for commercial power production.

In 2007-08, total installed biomass capacity stood at c1.4 GW, which by the end of 2009, had increased to c2.1GW, with c385MW of biomass and bagasse cogeneration power added in 2009. Our estimates for incremental capacity addition in 2010 and 2011 are c400MW and c500MW, respectively. Between 2009 and 2020, we estimate new biomass electricity capacity addition at a CAGR of c11%. This takes the total installed biomass generation capacity to 8.5GW by 2020. As a result, we estimate the market size of the biomass industry grows at a CAGR of c16% over 2009-20 to cUSD7bn in 2020. We understand that in the near future, the government is likely to propose a GBI for biomass projects, which will help stimulate growth.

Mini-Hydro: USD6bn in 2020

India has mini-hydro potential of 15GW, but less than 3GW of this had been utilised by the end of 2009. In the short term, we estimate mini-hydro capacity addition of around 270MW and c300MW in 2010 and 2011, respectively. Between 2009 and 2020, we estimate new installations will grow at a CAGR of c17%. As a result, we expect the market size of mini-hydro generation to grow at a CAGR of

c16% to reach a market size of cUSD5.5bn. We estimate total small-hydro installed capacity to be 8.5GW by 2020.

REC trading: USD2.5bn by 2020

By 2014, we estimate an REC trading market of USD0.2bn, growing USD2.5bn by 2020, with considerable upside potential. Based on the current framework, we believe power trading companies are the likely beneficiaries of the scheme besides developers and OEMs.

Nuclear: USD19bn by 2020

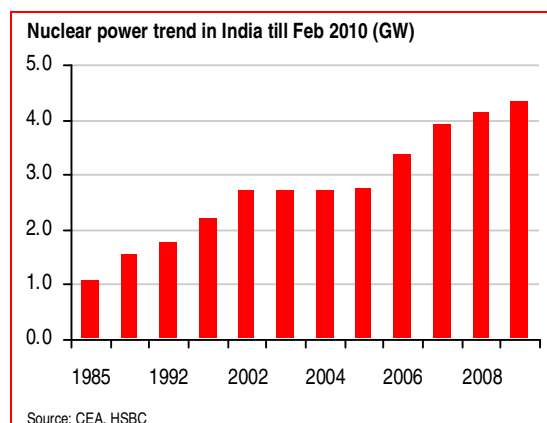
Currently, India has 17 operational nuclear power reactors. During the Eleventh Five Year Plan (FY2007-12), the government aims to add 3.2GW of nuclear capacity. However, we expect slippages and estimate only c2.4GW capacity will be added, which will take total installed capacity to c6.3GW by end-2011.

We expect the Indo-US Civil Nuclear Deal signed in 2008 to boost India's nuclear power generation capacity, and the government is targeting 60GW of total nuclear capacity by 2030. Since 2008, India has signed cooperation agreements with France, Canada, the UK and Russia. The GoI is also in discussions with Japan for a possible agreement, which will enable Japanese companies to support nuclear projects in India.

According to our estimates, the market size of the nuclear industry will grow at a CAGR of 21% over 2009-20 to reach cUSD19bn by 2020. We estimate new capacity addition at a CAGR of c19%, thereby taking total installed nuclear capacity to 25GW by 2020. In the 2009 World Energy Outlook, the IEA estimates that in its 'Reference scenario', India's installed nuclear generation capacity will increase to 20GW by 2020.

Clean heat: cUSD1bn in 2020

We estimate the market size of the solar water heating industry based on the growth in capacity additions between 2000 and 2008 (a CAGR of 30% on a small base). We estimate 20% CAGR over the decade to reach an annual capacity addition of 15GWth in 2020. At an average cost of capital of USD0.36m/MWth, this implies a market size of cUSD1bn in 2020. This is around six times our estimated market size in 2009.



Biofuels: USD4bn in 2020

India launched its Biofuel Mission in 2003, and in November 2006, the government mandated that ethanol should be blended in a 5% proportion with petrol. In November 2009, this target was made mandatory. The government is targeting 20% biofuel (gasoline + diesel) blending by FY17.

However, oil marketing companies (OMC) have been unable to implement the 5% ethanol blending target, given the high demand for ethanol for industrial use and potable liquor at market prices, against the unfavourable regulated price for blended ethanol.

Commercial production of biodiesel in India is low and most of the capacity caters to experimental projects and the unorganised rural sector. Industry sources estimate current biodiesel finished production cost at INR32-40/litre, significantly above the government-advised purchase price of INR26.5/litre. Consequently, there has been no commercial sale of biodiesel at government purchase centres.

We believe biofuel blending is unlikely to exceed 5% by 2020. But the market will grow on the back of rising transport demand, yielding revenues of cUSD4bn in 2020. The gap could be closed with the introduction of second generation biofuel as well as an improvement in the regulated biofuel price. Over time, we believe biofuel targets will be scaled down in favour of electric vehicles.

Ethanol production in India (million litres)

Calendar Year	2006	2007	2008	2009	2010	2011
Opening Stock	483	747	1,396	1,673	1,243	1,145
Production	1,898	2,398	2,150	1,073	1,435	1,859
Imports	29	15	70	280	300	300
Total Supply	2,410	3,160	3,616	3,026	2,978	3,304
Exports	24	14	3	3	3	10
Consumption						
Industrial Use	619	650	700	700	720	750
Potable Liquor	745	800	850	880	950	1010
Blended petrol	200	200	280	100	50	200
Other Use	75	100	110	100	110	110
Total Consumption	1639	1750	1940	1780	1830	1970
Ending Stocks	747	1,396	1,673	1,243	1,145	1,224
Total Distribution	2,410	3,160	3,616	3,026	2,978	3,304

Source: India Biofuels Annual 2010 - USDA Foreign Agricultural Service

Meeting demand for energy efficiency

- ▶ We estimate that India's energy efficiency market will expand to cUSD77bn in 2020, five times that in 2009
- ▶ Industrial efficiency is the single-largest segment, in part driven by the new PAT scheme being launch in April
- ▶ Transport efficiency is likely to be the fastest growing sub-theme, involving fuel efficiency, modal shift and towards the end of the decade, expansion of electric vehicles

Four-fold growth

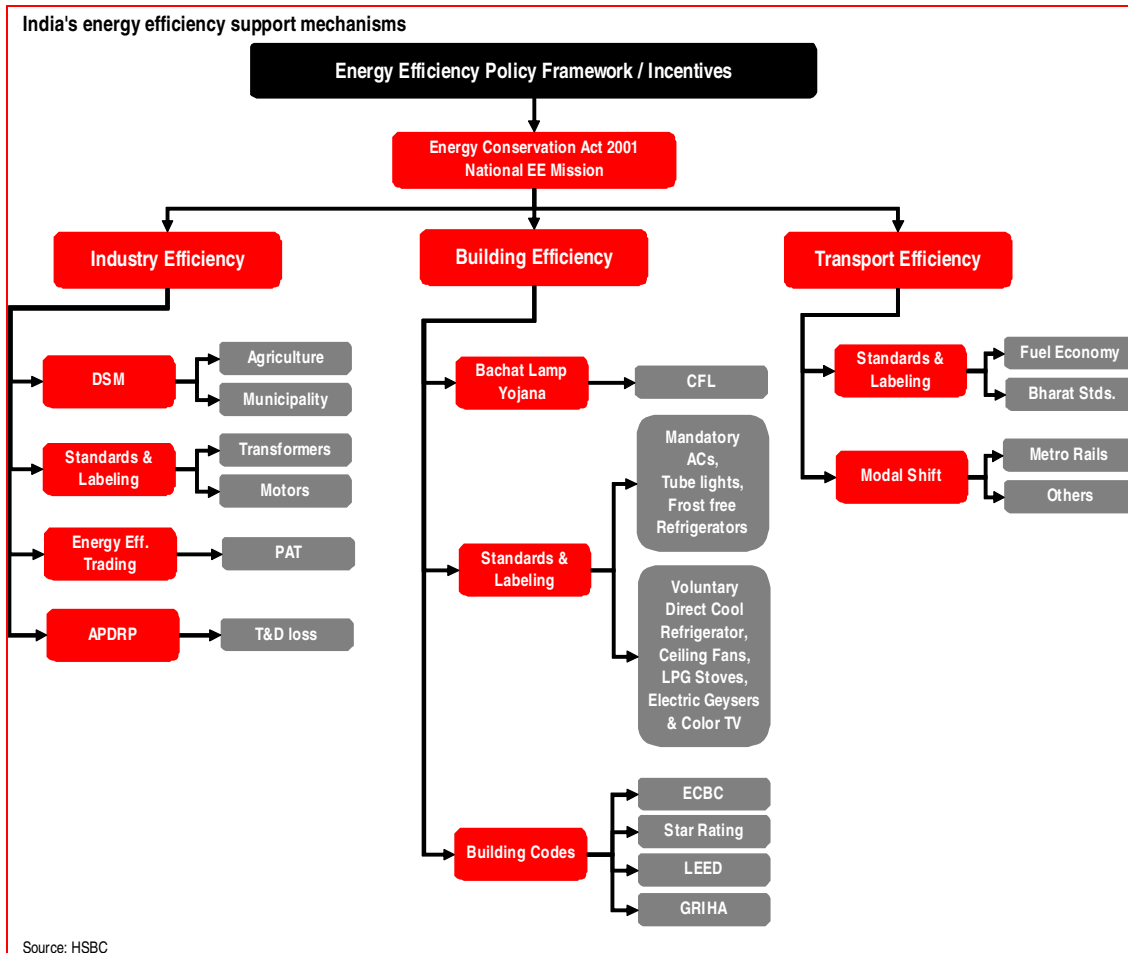
With India's energy demand likely to double and imports likely to increase to c35% by 2020, there is a pressing need to develop innovative ways to

conserve energy – a viewpoint underscored by the National Mission on Enhanced Energy Efficiency (NMEEE).

Energy efficiency programmes in India

Measures/Incentives	Description
Building Efficiency	
Bachat Lamp Yojana	Replace 400m inefficient, incandescent light bulbs with energy-saving compact fluorescent lamp (CFL) bulbs
Energy Conservation Building Code	1. Recommends minimum energy performance standards for commercial buildings. The programme was launched on 27 May 2007 2. BEE Star Rating Program for office buildings. The programme was launched on 25 Feb 2009.
Energy Service Companies (ESCOs)	35 ESCOs are empanelled with BEE based on the accreditation rating created by CRISIL/ICRA.
Green Buildings	Voluntary standards like IGBC's Leadership in Energy and Environmental Design (LEED) rating system and TERI's Green Rating for Integrated Habitat Assessment (GRIHA)
Standards & Labelling (S&L)	1. Mandatory S&L for ACs, Tube lights, Frost-free Refrigerators from 6 Jan 2010 2. Direct Cool Refrigerator, Ceiling Fans, LPG Stoves, Electric Geysers, Colour TV are in voluntary phase.
Industrial Efficiency	
Demand Side Management (DSM)	1. Improve efficiency in the agriculture sector through new high efficiency pumps 2. Improve energy efficiency levels of Municipalities through investment grade energy audits
Energy Efficiency Targets	1. Energy efficiency targets for more than 700 industrial units 2. Launch of 'Perform, Achieve and Trade' (PAT)
Standards & Labelling	1. Distribution Transformers fall under the mandatory category from 6 Jan 2010 2. Other industrial products like Induction Motors and Pump Sets are in the voluntary phase.
Other Programmes	Re-structured Accelerated Power Development and Reforms Programme (APDRP) during the XI Five Year Plan for T&D loss reduction
Transport Efficiency	
Standards & Labelling	1. Plans to increase fuel economy standards by 8% per year during the XI Plan and 5% beyond the XI Plan. 2. Bharat Stage IV (Euro 4) now commenced from April 2010 in Delhi and ten major cities.

Source: HSBC



Energy efficiency investments can have short payback periods and involve negative net abatement costs, as the fuel cost savings over the lifetime of the capital stock often outweigh the additional capital cost of the efficiency measure, even when future savings are discounted.

Based on this, we are optimistic about India's energy efficiency solutions market and estimate that its four sub-segments – buildings, industrial, transport and energy storage – will grow from around cUSD15bn in 2009 to cUSD77bn in 2020.

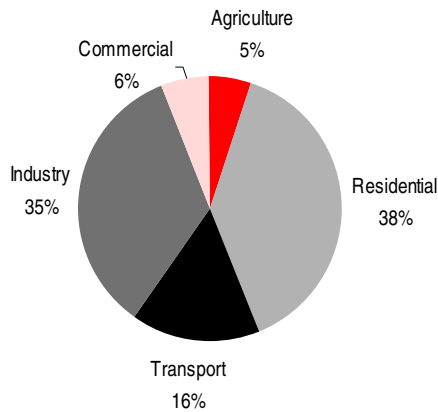
Energy efficiency in India: Estimated market size (2020, USDbn)

Sub-theme	Market size
Transport efficiency	26
Building efficiency	21
Industrial Efficiency	26
Fuel cells and energy storage	4
Total energy efficiency	77
CAGR (2009-20)	14%

Source: HSBC

The chart below gives the final energy use by sectors. The residential sector, with extensive use of biomass/wood, especially in rural areas, is the largest energy consumer, followed closely by industry.

India's final energy use across sectors in 2005 (12..6 EJ)



Source: HSBC

Industry: USD26bn in 2020

According to the BEE, 15-25% of industrial energy consumption could be saved. A range of measures are now being deployed to mobilise these savings, and we estimate 2020 market size of industrial efficiency at USD26bn, with a 2009-20 CAGR of c15%. The key industrial efficiency solutions will include enhanced pumps, motors, boilers, other critical aspects of process control technologies in different industries, energy control and optimisation solutions, power management solutions, power transmission and distribution products.

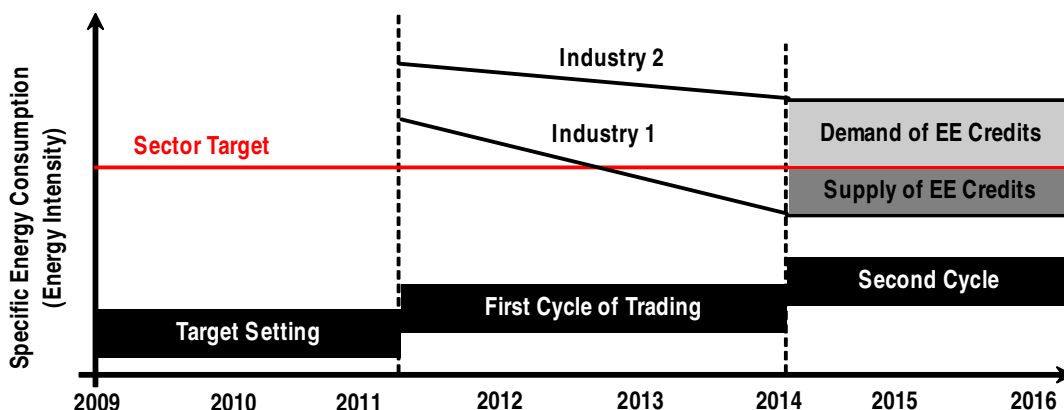
Key initiatives to harness this potential include:

- **Energy Efficiency Trading:** The new Perform, Achieve and Trade (PAT) scheme

- **Grids:** The restructured Accelerated Power Development and Reform Programme (APDRP) aims to cut Aggregate Technical and Commercial (AT&C) losses to 15%. It has a budget of INR500bn spread over a five-

will be introduced in April. The scheme will be applicable to around 600 industrial units across 8 energy-intensive industries – aluminium, cement, iron & steel, chlor-alkali, thermal power plants, fertiliser, pulp & paper and textiles. The scheme aims to save c10mtoe per annum by 2014. PAT will assign energy efficiency targets to the country's most energy-intensive industries, based on their energy consumption (ie energy consumed to produce a unit of product). These targets will form the basis for a national Energy Saving Certificate (ESC) trading scheme. Businesses that exceed energy efficiency targets will be able to trade the ESCs with those that have failed to meet the goals. The government will reimburse as much as 50% of unpaid bank loans extended to companies that invest in energy efficiency projects. We estimate that the scheme is likely to create an energy efficiency certificate trading market of cUSD0.3bn in 2014. The market size beyond 2014 (PAT phase I) will depend on the targets for Phase II and the number of companies covered.

PAT scheme: Overview



Source: BEE, HSBC

year period (FY08-12), of which cINR200bn has already been sanctioned for various projects. We estimate that by March 2012, the programme will be able to establish the baseline data on AT&C losses for 1,400 cities. This will facilitate further investments aimed at reducing distribution loss.

- ▶ **Agriculture:** About 20% of electricity sales are to agricultural consumers, largely to operate water pumps. Under this demand-side management pilot initiative, the government will give energy-efficient pumps free of cost. The cost of the pumps will be recovered by reducing the power subsidy given by the state governments. As of March 2008, India had about 15.4 million fully installed pump sets. The BEE estimates that 45-50% energy savings can be achieved, representing 62bn units of electricity or 9,000MW capacity.
- ▶ **Municipalities:** About 2.5% of India's total electricity consumption is for public water pumps and c1% for public lighting. The BEE estimates 25-40% savings can be achieved, representing 6-9bn units of electricity or 900-1,400MW capacity. This demand-side management scheme will boost demand for street lighting solutions and efficient water pumps.
- ▶ **SMEs:** According to the BEE, India has c26m micro-, small- and medium-sized enterprises that consume c75-90mtoe annually. The potential for savings is c15-40%. Pilot studies are currently being undertaken, and we expect steady but slow progress, as it will require considerable effort in terms of information dissemination, capacity building and establishing a suitable financing mechanism.

The BEE is also introducing standards and labels for a range of key industrial products, such as

distribution transformers (mandatory), as well as induction motors and pump sets.

Transport: USD26bn in 2020

Globally, about one-fourth of total energy demand is from the transportation sub-segment. However, it represents a small share (15%) of total energy demand in India, but is the largest user of oil, at 43% of total oil consumption. Our market size estimate for the transport efficiency segment is USD26bn in 2020, with a 2009-20 CAGR of c17%.

We split the transport efficiency theme into three main categories, as given below:

- ▶ The fuel efficiency segment includes estimated spending on the engines of smaller efficient vehicles - Type A cars and micro LCVs (using the Global Insight classification).
- ▶ The modal shift segment addresses the switch to low-carbon modes of transport. Here, we focus on growth in metro rail, monorail and other high-speed trains.
- ▶ The low-carbon vehicle segment focuses on hybrids, plug-in electric and pure electric vehicles. Here, we use HSBC's global autos team forecast.

In 2007, India had about 12 light duty vehicles (LDVs) per 1,000 people, compared to more than 800 in the US. In 2009-10, c2.4m vehicles were sold in India, with an average test fuel consumption of 15.7 km/l (37mpg), much better than the US average (27.5mpg).

The main regulatory driver at the moment is a series of local air pollution requirements for passenger cars and LDVs. These closely resemble the Euro standards, but are labelled Bharat Stage. In 2011, however, we expect that new standards based on average fuel economy (in miles/litre or km/litre of fuel consumed) will be released, which will be applicable to vehicles sold in the future. We

estimate the 2020 market size of this sub-segment at USD9bn.

Indian emission standards

Standard	Reference	Date	Region
India 2000	Euro 1	2000	Nationwide
Bharat Stage II	Euro 2	2001	NCR*, Mumbai, Kolkata, Chennai
		Apr 2004	NCR*, 12 Cities†
		Apr 2005	Nationwide
Bharat Stage III	Euro 3	Apr 2005	NCR*, 12 Cities†
		Apr 2010	Nationwide
Bharat Stage IV	Euro 4	Apr 2010	NCR*, 12 Cities†

Note: * denotes National Capital Region (Delhi); † denotes Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad, Pune, Surat, Kanpur, Lucknow, Sholapur and Agra
Source: HSBC

In the modal shift segment, we estimate a market size of around USD2bn in 2020, assuming the current rate of investments is maintained.

India's key metro rail investment projects (USDm)

Upcoming Metro Projects	Estimated investment	Proposed completion date
Delhi - Extension of Delhi Metro Phase II to Gurgaon	353	End 2010
Central Secretariat Badarpur Corridor	801	End 2010
High Speed Express Link to IGI Airport	684	End 2010
Extension of IGI Airport to Dwarka Sector - 21	176	End 2010
Extension of Dwarka Sector 9 to Sector - 21	79	End 2010
Additional Funds for Rolling Stock (Delhi)	686	End 2011
Bangalore Metro Rail Project	1813	End 2012
Kolkata: East West Metro Corridor	1083	End 2015
Chennai: Metro Rail Project	3244	End 2015
Mumbai Metro Rail Project - First Corridor Phase I	524	End 2010
Mumbai Metro Rail Project - Second Corridor Phase I	1833	End 2014
Hyderabad Metro Rail Project	2696	End 2014
Total investment	13972	

Source: Ministry of Urban Development Annual Report 2009-10; MMRDA; HSBC

India is currently lagging in the deployment of hybrid and electric vehicles. The OEMs in the four-wheeler electric vehicles segment in India are small. Electricity-driven two wheelers came to India only a few years ago. Recently, the government announced incentives of USD21m (INR950m) for electric vehicle makers. The incentive will be available until March 2012 and is expected to be a main market driver.

Electric vehicle subsidy in India

Vehicle type	Subsidy/vehicle (INR)
Two wheelers	4000/5000
Three-wheeled vehicles	60,000
Cars	100,000
Electric minibuses	400,000

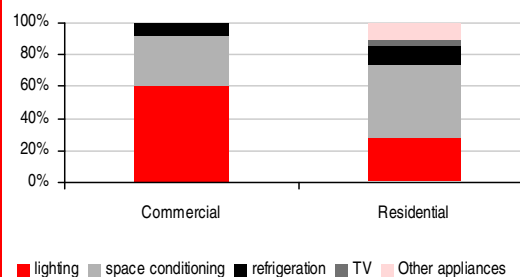
Source: GOI

The scheme is expected to support just 140 units of passenger cars until March 2011, and 700 units in the following financial year. The Society of Manufacturers of Electric Vehicles expects the electric two-wheeler market to grow 100% during 2011/12. Various state governments have also announced sales/road tax exemptions for electric vehicles. We expect more government support in the Twelfth Five Year Plan. Our global autos team estimates that by 2020, the four-wheeler electric and hybrid vehicles market in India will grow to c400,000 units, implying a penetration range of 8-10%. We have used this number to estimate the 2020 market size, of USD15bn.

Buildings: USD21bn in 2020

Buildings consume approximately 47% of India's electricity, with lighting and space conditioning accounting for more than 70% of total consumption. Various estimates, including one from the BEE, forecast significant energy savings - approximately 50% in commercial buildings - that can be realised with minimal incremental investment. We estimate a building efficiency market size of USD21bn by 2020, with a 2009-20 CAGR of c16%.

Consumption of electricity in residential and commercial buildings across various equipment segments



Source: BEE

The building efficiency market is diverse and often fragmented. It comprises advanced insulation and glass materials; improved building materials that control the transfer of heat into and out of buildings; efficient heating ventilation and air conditioning (HVAC) and solar water heaters; efficient lighting, such as light emitting diodes (LED) and CFLs; and smart systems that can control and manage power consumption. Key initiatives to drive the market include:

- ▶ Standards and labelling for air conditioners, tube lights, frost-free refrigerators and distribution transformers on a mandatory basis. In addition, ceiling fans, LPG stoves, electric geysers and colour TVs are covered on a voluntary basis. By FY12, the programme aims to save c18bn kWh per annum, equivalent to c3,000MW.
- ▶ The Bachat Lamp Yojana will deliver mass replacement of incandescent light bulbs with energy-saving CFLs, with the CFLs being provided at INR15/unit.
- ▶ The integration of Energy Conservation Building Codes (ECBC), which set the minimum energy performance standards for commercial buildings, into municipal by-laws across key states, with an estimate of eight states by end-2012.
- ▶ A star rating programme for commercial buildings.
- ▶ State-level initiatives, such as a ban on the sale of incandescent bulbs in Karnataka from January 2011 and a ban on the use of ICLs in government buildings and in organisations receiving government assistance.

Payback for green buildings

A recent TERI study for HSBC, *Market study on energy efficiency in buildings*, analyses the data/information on seven green buildings. According to it, the incremental cost of these green buildings can be in the range of 4-32% more than

for conventional buildings, depending on building parameters. The discounted payback period for the incremental expenditure is in the range of just 1-3 years. In *Surveying Risk, Building Opportunity*, jointly published by the World Resource Institute (WRI) and HSBC in April 2010, we estimate a payback period of 3-5 years. The TERI study also highlights that green buildings have lower lifecycle costs, thereby generating higher energy and water savings for the building owners/occupants. The savings to investment ratio (SIR) is in the range of 1.9-15.3 and the adjusted internal rate of return (AIRR) ranges from 19% to 30% (using a discount rate of 16%), which means that using green buildings makes considerable economic sense.

Currently, India's green building market is very small, with only 703 green building projects registered with the India Green Building Council (GBC). Of these, 112 green buildings have been certified through two rating systems in India – LEED and GRIHA. Using the analysis done by McKinsey, the TERI report highlights that by 2020, green buildings will constitute 3% of the organised market sector, up from 1% currently. The slow pace is owing to price constraints and difficulties in sourcing green building materials, technologies and service providers or facilitators in India.

Energy storage: USD4bn in 2020

The energy storage and fuel cell segment provides a critical bridge between low-carbon power supply and efficient use. We believe that growth of renewable electricity and the electric vehicle industry in India and neighbouring countries, such as China, will drive the growth of the Indian energy storage and fuel cell market.

Currently the market is tiny, but we estimate that it could grow to USD4bn by 2020. We expect key Indian battery makers, currently producing lead acid batteries, to switch to the more efficient lithium ion and Ni MH batteries.

Building a resilient economy

- ▶ We believe that India is the most vulnerable G20 economy to climate change
- ▶ We conduct a preliminary assessment of the market size for adaptation
- ▶ We estimate that government spending on adaptation will grow five-fold to cINR1trn (USD22.2bn) by 2020

Climate vulnerability

In our report, *Too Close for Comfort*, 8 December 2009, we projected that among the G20 countries, India will be the most vulnerable to climate change by 2020.

Its high vulnerability arises from its geographical positioning, which exposes it to a variety of climate-related disasters. This is compounded by the high concentration of population and assets in risk-prone areas. India also has a low adaptive capacity in terms of per capita income, life expectancy and literacy rate. This means that there is little cushion in the event of an adverse climate change impact.

Even now, a large number of lives are lost and significant assets are destroyed due to climate-related disasters. Our time-series analysis of disaster losses suggests that during 1958-88, India lost on average USD0.4bn annually, which shot up to USD1.7bn in 1988-2008.

Over 80% of India's land area is currently estimated to be water stressed, with the western and southern

parts the most affected. We believe that water scarcity has already started interfering with industrial development in the country.

Measuring the market

The government recognises the current adaptation deficit to climate change and is also aware of the likely future vulnerabilities. In fact, the NAPCC focused much of its attention on adaptation rather than mitigation, estimating that central government spending on adaptation exceeded 2.6% of GDP in 2006-07.

Adaptation spending in India's budget in recent years (INRbn)

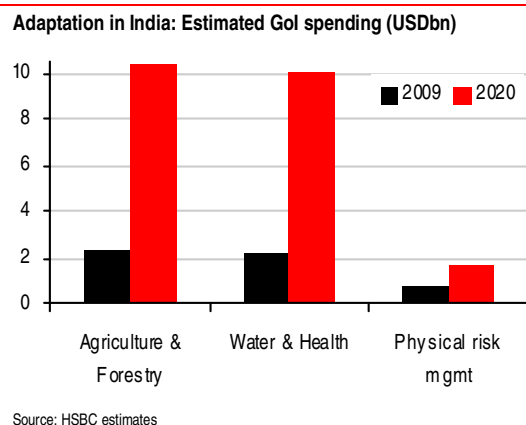
Sectors of Adaptation	2006-7	2007-8	2008-9	2009-10	2010-11
Agriculture	90	146	200	96	150
Water	46	63	75	81	96
Health	21	26	29	19	24
Risk Financing	10	19	17	24	17
Adaptation_Infra	5	3	3	8	10
Forestry	6	8	9	7	6
Total expenditure on adaptation	178	266	334	235	303
Total GDP (Projections*) - at current prices	41291	47234	53217	57412	66953
Adaptation exp as % of GDP	0.43	0.56	0.63	0.41	0.45

Source: Oxfam, Centre for Budget and Governance Accountability, HSBC

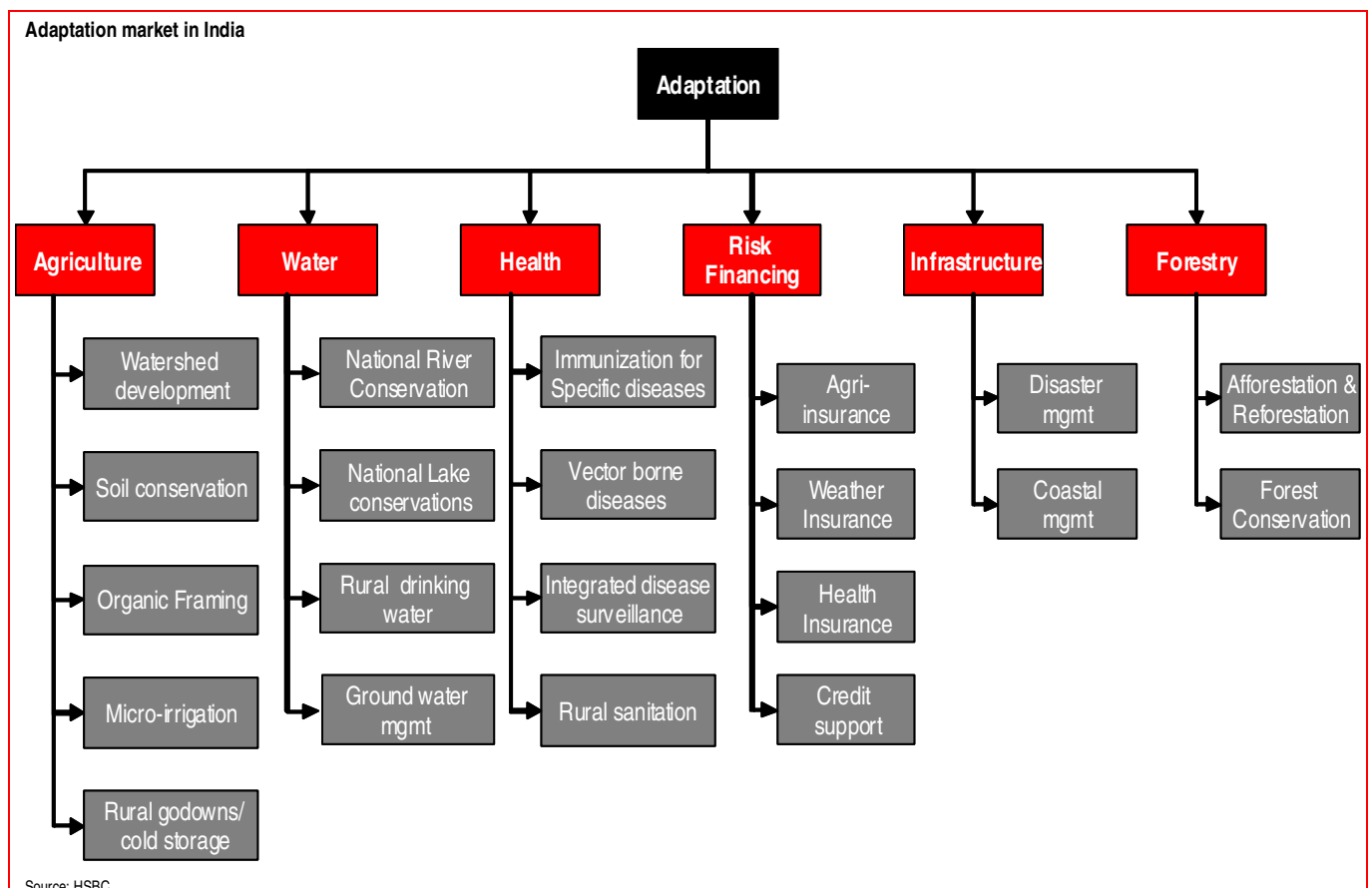
However, a report by Oxfam and the Centre for Budget and Governance Accountability (CBGA) has qualified this, suggesting it was at 1.7% of GDP for the same year (2006-07). Our own analysis suggests adaptation spending in 2009-10 was 2.5% of GDP.

Social security-related expenditures, such as spending on food security, livelihood security and poverty alleviation, constitute the bulk of the Union Budget spending. If we exclude these expenditures, our estimated expenditure is much lower, at cINR235bn (USD5.2bn) for 2009-10. We expect this spending to increase to cINR1trn (USD22.2bn) by 2020. We expect that the full adaptation market will be much larger as it would include spending by consumers and industry.

The bulk of the current adaptation spending is focussed on agriculture and forestry as well as water security (see on the right).



Looking ahead, one of the biggest adaptation investments is likely to come from the Green India Mission. This aims to double the area for afforestation in India over the next 10 years to 20m hectare. The total mission cost is estimated at USD9.7bn over 10 years. Draft mission documents were released last year and will be finalised in 2011.



Water is also a key focus for the government and the final report of the National Water Mission this year will be a key investment driver. This Mission's indicative goal is to improve water use efficiency by 20% between 2009 and 2017.

Risks and the way forward

- ▶ Besides policy, technology and financing risks, our estimates carry all the usual risks of long-term economic modelling
- ▶ Key upside risks are higher fossil fuel prices, more ambitious policies, higher-than-expected electricity demand, and technological breakthroughs that reduce the cost of low-carbon energy
- ▶ Key downside risks are policy momentum losing steam, hurdles in project implementation, lack of international support for financing and technology transfer

Key risks

Given the decade-long projection period, our estimates carry all the risks attached to long-term economic modelling – as well as the specific policy, technology and market risks facing the climate economy

Key downside risks

- ▶ Inadequate monitoring and enforcement of existing regulations
- ▶ Cuts in the existing or proposed policies and regulatory incentives, such as FITs, RPS, the REC mechanism and PAT Scheme
- ▶ Failure to resolve implementation issues arising from land availability, grid connectivity, bureaucratic hurdles to project approval and sanctions
- ▶ Limited ability of the central government to implement the policy framework across the various states in the country, as electricity is a

state subject according to the Indian Constitution

- ▶ Low take-up of energy efficiency initiatives, particularly those that rely on large-scale involvement of consumers
- ▶ Absence of necessary infrastructure to support the rollout of new technologies, such as electric vehicles
- ▶ Inability to reach a global climate agreement to succeed the Kyoto Protocol, Phase I of which expires in 2012
- ▶ The National Solar Mission has highlighted that under Phase 2 (FY13-17), the solar installation target will reach 10,000MW (from 3,000MW). This depends on better access to international finance and technology transfer.
- ▶ Our wind and solar estimates assume lower technology costs for offshore wind and solar technologies. Issues with transfer of some of the

renewable technologies pose downside risk to our estimates.

- ▶ Economic conditions diverting attention away from climate change and clean energy priorities

Key upside risks

- ▶ Faster-than-expected decline in the cost of key technologies, such as solar, offshore wind and electric vehicles
- ▶ High and volatile rises in oil, gas and coal prices, somewhat similar to the trends seen in 2008
- ▶ Government commitment in the form of stringent targets, mechanisms to achieve them (such as the PAT Scheme, the REC Scheme, FITs, etc) and penalties for failure to meet the targets
- ▶ Development of new business models, such as the REC Scheme, which will overcome the resource and price obstacles in the market
- ▶ A valid and authoritative international climate agreement that builds confidence for additional action at the national level
- ▶ Resurgence of public and government concerns, on the back of extreme weather events

Annex

India's emission profile

Fifth largest energy consumer and fourth largest emitter

India is the world's fifth largest consumer of primary energy supplies and the fourth largest emitter of carbon dioxide from energy, after China, the US and the EU.

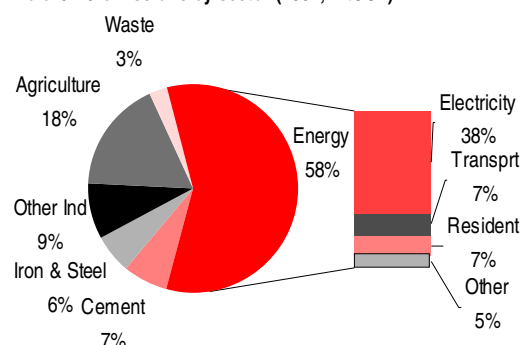
However, the gap between China and the US, and India is significant, as China and the US contribute 17% and 26%, respectively, of global emissions, while India stands at just c5%.

Emission of key countries (2009; bn ton CO₂)

China	8.06
USA	5.31
EU-27	4.07
India	1.67
Russia	1.57
Japan	1.18
Others	9.44

Source: Netherland Environmental Agency

India GHG emissions by sector (2007; mtCO₂)

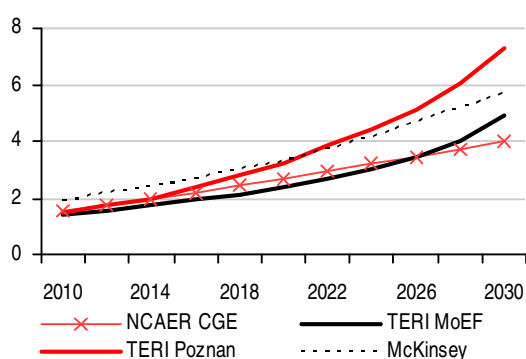


Source: India: Greenhouse Gas Emissions 2007 by MoEF, May 2010

Footprint to double by 2030

The Ministry for Environment and Forests (MoEF) has released the results of the five model studies on India's GHG emissions from 2010 to 2030.³ In a BAU scenario, the carbon emission projections to 2030 range from 2.77 ton CO₂ per capita (by the National Council of Applied Economic Research (NCAER) study using CGE modelling) to 5.0 ton CO₂ per capita (by TERI, using the MARKAL model). These studies assume that India's GHG mitigation policy will remain constant until 2031. The BAU scenario suggests that India's per capita emissions in that year (except in the TERI 2008 study) will stay below the global average of 4.22 ton per capita in 2005.

Emission pathways for India (GtCO₂)



Source: India's GHG Emissions Profile, MoEF, Aug 2009

Thus, based on the MoEF studies, it appears that India will be able to maintain its per capita GHG emissions below the world average, as committed to by the NAPCC. However, the bottom line is that

³ <http://moef.nic.in/downloads/home/GHG-report.pdf>.

India's total emissions are likely to more than double from the current levels over the next two decades, under the BAU scenario. We therefore believe that India is not left with any other option but to pursue the development of low carbon energy technologies, such as nuclear and renewables (solar, wind, biofuels, small hydro, biomass, biofuels, etc) and to increase energy efficiency to reduce demand for energy and carbon emissions.

Renewable energy: Policies and incentives

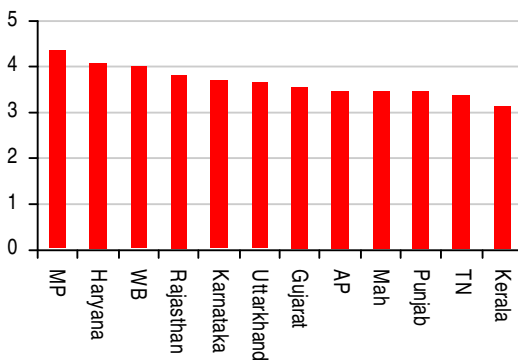
State FITs and RPOs

A comparison of tariffs across various states is provided in the following four illustrations. We also list the state FITs and the RPOs in table below.

Pricing RECs

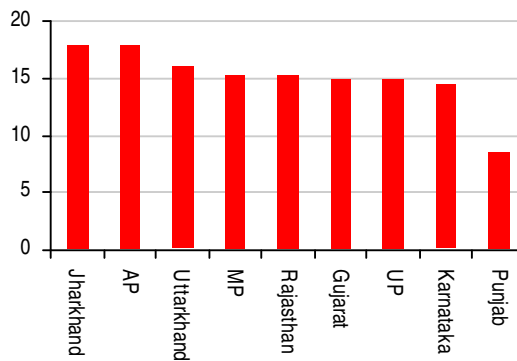
The CERC has suggested a mechanism to price RECs. We show how the state FITs perform against the REC pricing range for solar and non-solar generation in the charts on the following pages.

Wind Feed in Tariffs across Indian states (INR/kWh)



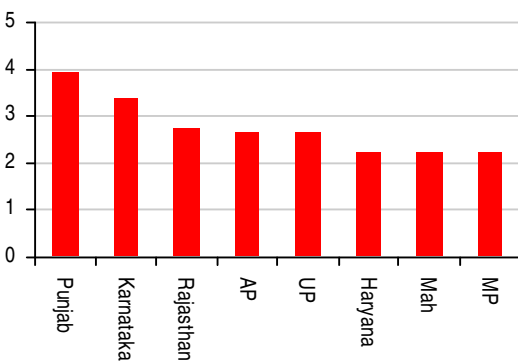
Source: State Govt. SERC websites; HSBC

Solar Feed in Tariffs across Indian states (INR/kWh)



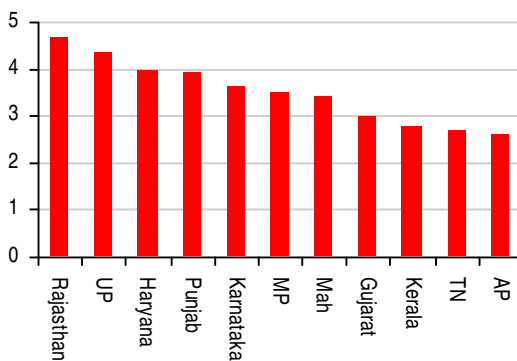
Source: State Govt. SERC websites; HSBC

Small Hydro Feed in Tariffs across Indian states (INR/kWh)



Source: State Govt. SERC websites; HSBC

Biomass Feed in Tariffs across Indian states (INR/kWh)



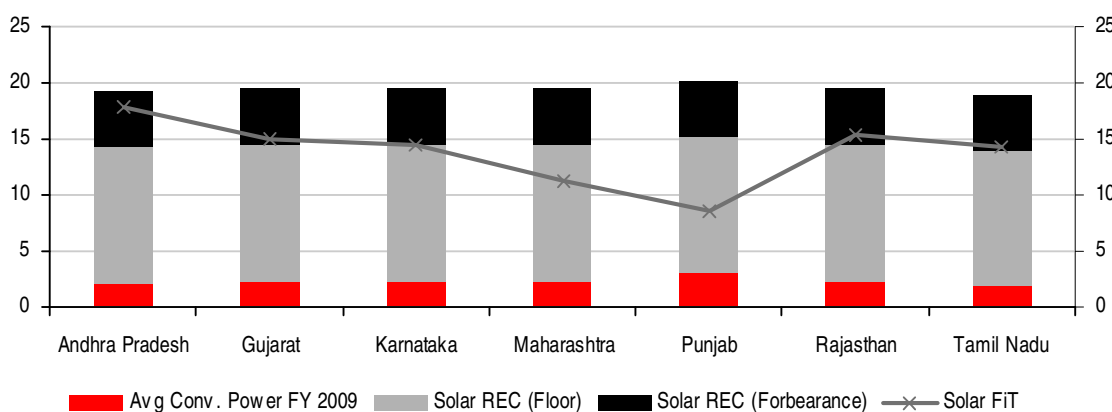
Source: State Govt. SERC websites; HSBC

Indian state renewable incentives

State / UT	Feed-in tariff (INR/kWh)				Renewable Portfolio Standards
	Wind Power	Small Hydro Power	Biomass Power	Solar power	
Andhra Pradesh	3.50 from 09.09.2008 (frozen for 10 years)	2.69 (04-05)	2.63 (05-06) Esc @ 1% for 5 yrs	PV-17.91 for 25 years	Minimum 5% from 2005-06 to 2007-08 (including a minimum 0.5 per cent from wind).
Assam	-	-	-	Base rate of 5.5 with 3% annual esc.	1.4% in FY10 progressively increase to 7% by FY14
Chhattisgarh	-	-	2.71 (05-06)		2009-10: 10% 2010-11: 10%
Gujarat	3.56 fixed for 25 years	-	3 No escalation	PV- 15 for 12 years and 5 from 13 th to 25 th year STP- 11 for 12 years and 4 from 13 th to 25 th	2009-10: 2% 2010-11: 5% 2011-12: 6% 2012-13: 7%
Haryana	4.08 for 5 years with annual escalation of 1.5%	2.25 (94-95)	4.00 for Biomass and 3.74 for Cogen (Esc @ 2% for base 2007-08)		1% of electricity consumed and for which Solar RPO is 0.25% for FY10 with annual inc of 0.25%
Himachal Pradesh	-	2.5	-		2010-11: 10% 2011-12: 11.1% 2012-13: 12.1%
Jharkhand	-	-	-	PV-17.96 STG-13.12	2010-11: 2% 2011-12: 3% 2012-13: 4%
Karnataka	3.70 fixed for 10 yrs	3.40	3.59-cogen. 2% esc. 3.66 - Biomass 2% esc annual	PV-14.50 STG-11.35	Minimum 5% and maximum of 10% Add 4.2 GW by 2014- 3GW of wind, 600MW of small hydro
Kerala	3.14 (Fixed for 20 yrs)	-	2.80 (2000-01) (Esc @ 5% for 5 yrs)		5%, which will include 2% from SHP, 2% from wind and 1% from sources other than SHP and wind
Madhya Pradesh	4.35 for 25 years	2.25	3.33-5.14 Esc. @ 0.03-0.08 for 20 yrs.	PV - 15.35 for 25 yrs STP - 11.26 for 25 yrs	2009-10: 10% 2010-11: 10%
Maharashtra	3.50 (Esc @ 0.15 per yr)	2.25 (99-00)	3.05 for Cogen 3.04-3.43 for biomass (Esc @ 1% for 13 yrs)		2009-10: 6% 2010-11: 6% 2011-12: 7% 2012-13: 8%
Orissa	5.31 for 13 years	5-25MW: 3.64 for 13yr <5MW: 3.91 for 35yrs	Biomass: 4.09 for 13 yr Cogen: 4.40 for 13 yr	PV- 17.8 for 25 years STG-14.73 for 25 years	5% for FY11-12 and 0.5% increase every year up to FY 15-16 reaching 7%
Punjab	3.49 (Base Year 2006-07) with annual escalations @ 5% upto 2011-2012	3.92	3.92	8.52 PV- 33-40% subsidy	2009-10: 2% 2010-11: 3% 2011-12: 4%
Rajasthan	3.83 in Jaisalmer, Jodhpur, Barmer; 4.03 for rest of 3 districts fixed for 20 years	2.75 (98-99)	4.72-5.17 water-air cooled	PV: 15.32 STG: 12.58	2009-10: 7.45% 2010-11: 8.50% 2011-12: 9.50%
Tamil Nadu	3.39 (No Escalation)	-	2.73 (2000-01) (Esc @ 5 % for 9 yrs)		2009-10: 13% 2010-11: 14%
Uttar Pradesh	-	3.67 – 4.29 based on PLF	Bagasse- 4.21 in FY10 increase to 4.4 in FY 14 Biomass- 4.38 in FY10 increase to 4.92 in FY14	PV- 15 STEG- 13 fixed for 30 years	2010-11: 4.0% 2011-12: 5.0% 2012-13: 6.0%
Uttarakhand	5.15-2.9	3.75-3.00	Biomass 1.8 Cogen 2.6	Solar PV-16.05 Solar Therm-11.8	2010-11: 4.0% 2011-12: 4.5% 2012-13: 5.0%
West Bengal	4.00 fixed for 5 years and as cap	-	-	-	2009-10: 4-6.8% 2010-11: 7-8.3% 2011-12: 10%

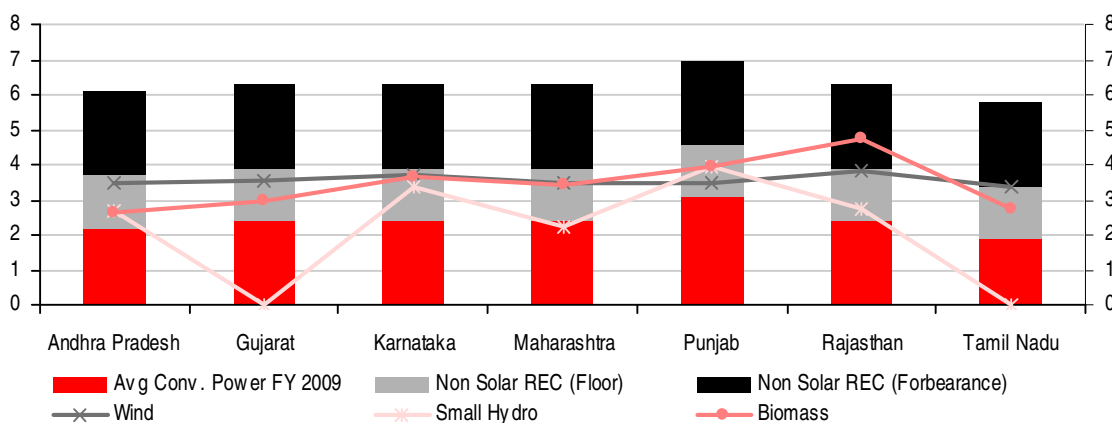
Source: MNRE, HSBC

Comparisons of state FITs vs. the pricing range provided by the REC mechanism for solar generation



Source: HSBC

Comparisons of state FITs vs. the pricing range provided by the REC mechanism for non solar generation



Source: HSBC

Abbreviations

AT&C	Aggregate Technical and Commercial Losses
AIRR	Adjusted Internal Rate of Return
APDRP	Accelerated Power Development and Reforms Programme
BAU	Business As Usual
BEE	Bureau of Energy Efficiency
BLY	Bachat Lamp Yojana
CAGR	Compound Annual Growth Rate
CBGA	Centre for Budget and Governance Accountability
CCI	Clinton Climate Initiative
CCS	Carbon Capture and Storage
CEO	Climate Equity Opportunity
CERC	Central Electricity Regulatory Commission
CERs	Certified Emission Reductions
CFL	Compact Fluorescent Lamp
CSP	Concentrated Solar Power
DC	Designated Consumers
DSM	Demand Side Management
DT	Distribution Transformers
ECBC	Energy Conservation Building Codes
EScerts	Energy Saving Certificates
ESCO	Energy Service Companies
FIT	Feed in Tariff
GBI	Generation-Based Incentive
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GOI	Government of India
GRIHA	Green Rating for Integrated Habitat Assessment
HVAC	Heating Ventilation Air Conditioning
IEA	International Energy Agency
IEP	Integrated Energy Policy
IGBC	Indian Green Building Council
IREDA	Indian Renewable Energy Development Agency
LDV	Light Duty Vehicle
LED	Light-Emitting Diode
LEED	Leadership in Energy and Environmental Design
MNRE	Ministry for New and Renewable Energy
MoEF	The Ministry for Environment and Forests
NAPCC	The National Action Plan on Climate Change
NCAER	National Council of Applied Economic Research
Ni MH	Nickel-Metal Hydride
NMEEE	National Mission on Enhanced Energy Efficiency
NPT	Nuclear Non-Proliferation Treaty
NTPC	National Thermal Power Corporation
NVVN	NTPC Vidyut Vyapar Nigam
OMC	Oil Marketing Companies
PAT	Perform, Achieve and Trade
PPA	
PRGF	Partial Risks Guarantee Fund
PV	Photovoltaics
REC	Renewable Energy Certificate
REC	Renewable Energy Certificate
REN	Renewable Energy
RPO	Renewable Portfolio Obligations
RPO	Renewable Purchase Obligation
S&L	Standards and Labelling
SCADA	Supervisory Control and Data Acquisition
SERC	State Electricity Regulatory Commissions
SIR	Savings to Investment Ratio
SME	Small and Medium Enterprises
TERI	The Energy and Resources Institute

Notes

Disclosure appendix

Analyst Certification

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For each stock we set a required rate of return calculated from the risk free rate for that stock's domestic, or as appropriate, regional market and the relevant equity risk premium established by our strategy team. The price target for a stock represents the value the analyst expects the stock to reach over our performance horizon. The performance horizon is 12 months. For a stock to be classified as Overweight, the implied return must exceed the required return by at least 5 percentage points over the next 12 months (or 10 percentage points for a stock classified as Volatile*). For a stock to be classified as Underweight, the stock must be expected to underperform its required return by at least 5 percentage points over the next 12 months (or 10 percentage points for a stock classified as Volatile*). Stocks between these bands are classified as Neutral.

Our ratings are re-calibrated against these bands at the time of any 'material change' (initiation of coverage, change of volatility status or change in price target). Notwithstanding this, and although ratings are subject to ongoing management review, expected returns will be permitted to move outside the bands as a result of normal share price fluctuations without necessarily triggering a rating change.

*A stock will be classified as volatile if its historical volatility has exceeded 40%, if the stock has been listed for less than 12 months (unless it is in an industry or sector where volatility is low) or if the analyst expects significant volatility. However,

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