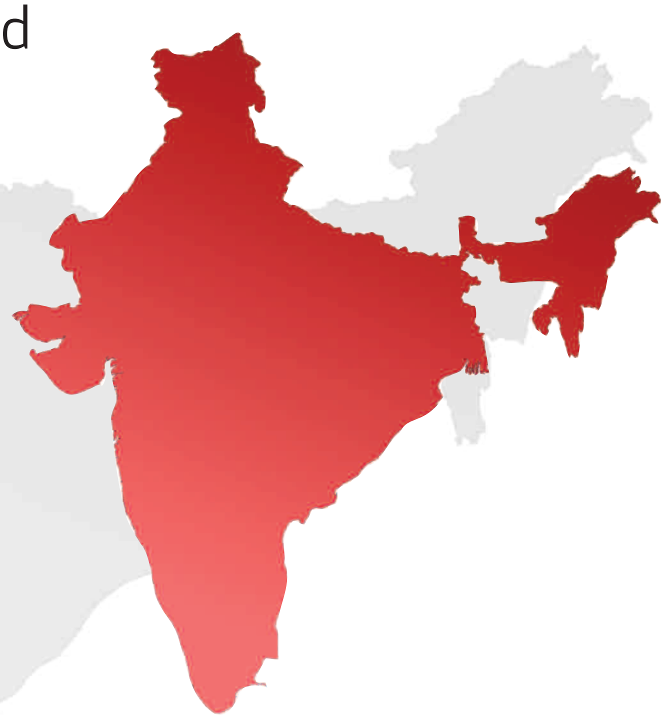
The International CHP/DHC Collaborative

Advancing Near-Term Low Carbon Technologies

CHP and District Cooling: An Assessment of Market and Policy Potential in India



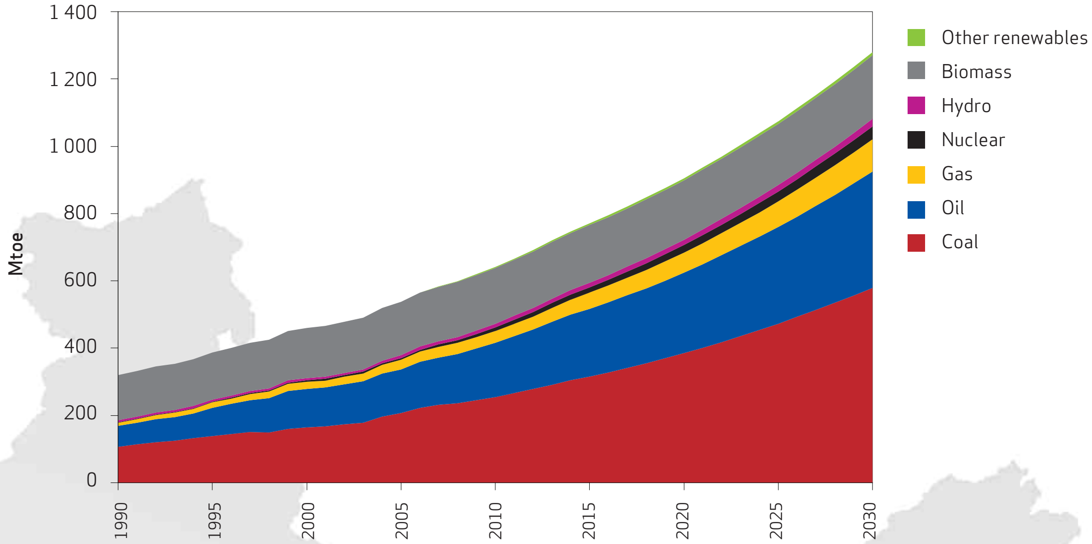
Over the past decade, India's economy has seen unprecedented growth, which has given rise to an increase in energy demand and greenhouse gas (GHG) emissions. The availability of clean and affordable energy and electricity has become a growing concern for the Government of India (GOI), as well as industrial, commercial and residential end-users. The GOI's Planning Commission's Integrated Energy Policy states that lowering the energy intensity of India's GDP is critical to meeting the country's energy needs; accordingly, the GOI has set an energy efficiency target of 25% from current usage. While the GOI is exploring a number of policy options to incentivise greater energy efficiency in all sectors of the economy, this study finds that policy makers should assess in particular the potential of combined heat and power and district cooling (CHP/DC) and the role that these technologies can play in tackling the challenge of meeting the country's growing energy needs in a cost-effective and environmentally friendly manner. The country has a growing track record with cogeneration in targeted industries; this offers a strong base to build from in the future.

This report contains an assessment of India's CHP/DC status and recommendations for addressing barriers to allow India to meet its energy efficiency targets. Such barriers include a lack of governmental emphasis on CHP, the absence of a clear methodology for calculating CO_2 emission reductions from CHP/DHC, and a tax and duty structure for CHP capital equipment that is not as attractive as for other renewable energy technologies.

Energy Overview

The role of energy in India's economy has grown in significance on account of the country's high economic growth, resulting in increasing energy consumption and environmental impact. Currently, the demand for commercial energy in the country outstrips production, creating a gap that has been filled with imported energy. About 35% of India's commercial energy needs are imported. Figure 1 shows the evolution in energy use in India by fuel source from 1990 projected to 2030.

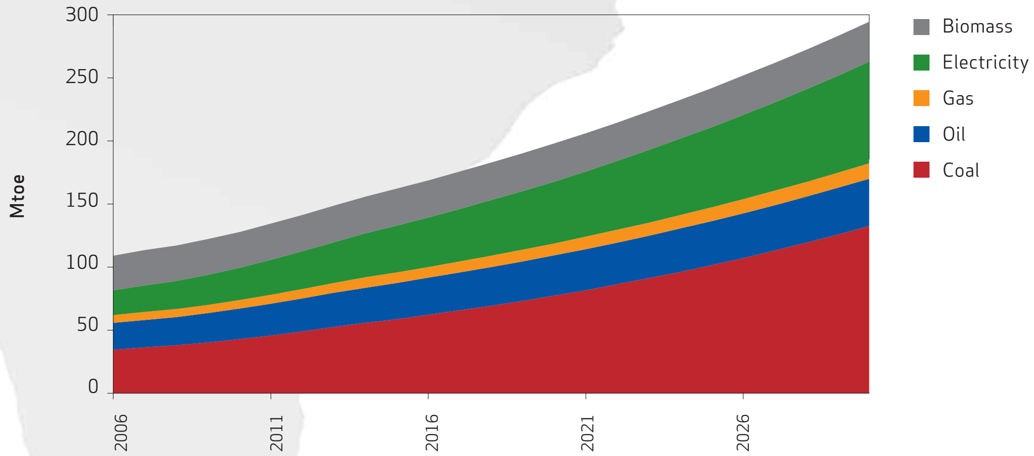
FIGURE 1.
INDIA'S TOTAL PRIMARY ENERGY DEMAND BY FUEL
SOURCE: *WORLD ENERGY OUTLOOK 2008* REFERENCE SCENARIO, IEA.



India has seen a sustained period of high economic growth, averaging 7.8% in the 10th Plan (2002-07) and 9.6% in 2006-07.[1] It is estimated that the overall rate of growth of GDP during 2007-08 was 9.0%.[2]

The industrial sector (an important target for cogeneration) is also expected to experience strong growth. Industrial output is currently fuelled by a mix of coal, oil, natural gas, electricity and biomass. The use of coal and electricity are forecast to increase over the next two decades (see Figure 2).

FIGURE 2.
INDUSTRIAL ENERGY DEMAND BY FUEL IN INDIA
SOURCE: *WORLD ENERGY OUTLOOK 2008* REFERENCE SCENARIO, IEA



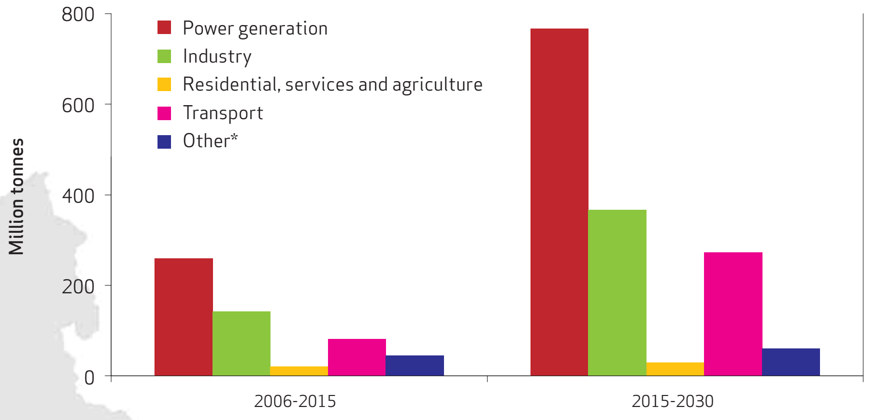
Climate Change Context

India is a non-Annex I signatory to the United Nations Framework Convention on Climate Change (UNFCCC), and signed the Kyoto Protocol in 2002. As a result, India is not required to reduce GHG emissions. CO_2 emissions have been on the rise and are estimated to increase sharply in coming decades as a result of high economic growth and higher consumption of energy (see Figure 3). It should be noted, however, that India's per-capita emissions are among the lowest in the world's largest economies, at one tonne per capita compared with 11 tonnes per capita in the OECD in 2005.[3]

1. GDP is at factor cost at 1999-2000 prices. Source: Survey of India, Government of India, 2007-08, p. 4.
2. As per the Advance Estimates of CSO, Monthly Economic Report, September 2008, Department of Economic Affairs, Economics Division, Ministry of Finance, GOI, http://finmin.nic.in/stats_data/monthly_economic_report/2008/indsep08.pdf.
3. *World Energy Outlook 2007*, IEA.

FIGURE 3.
PROJECTED INCREASE IN CO_2 EMISSIONS BY SECTOR

SOURCE: *WORLD ENERGY OUTLOOK 2008* REFERENCE SCENARIO, IEA



Over 50% of India's CO_2 emissions are in the power sector. Cement, shipping, and iron & steel are also growing industries that make important contributions to India's GHG emissions (see Table 1).

TABLE 1:
SECTORAL CO_2 EMISSIONS IN INDIA (TERAGRAMS OF CO_2)

Sector	1985	1995	2005	CAGR* (%) (1985-2005)
Power	146	392	638	7.7
Road	47	89	143	5.7
Railway	20	6	6	-5.8
Aviation	2	3	5	4.7
Shipping	0.4	0.6	1	4.7
Cement	28	62	98	6.5
Iron & Steel	56	86	103	3.1
Fertilizer	20	23	24	1
Other Industries	62	93	109	2.9
Other Sectors	59	94	102	2.8
All India	**440**	**849**	**1229**	**5.3**

*CUMULATIVE ANNUAL GROWTH RATE

SOURCE: GARG, A, P.R. SHUKLA, AND M. KAPSE, "THE SECTORAL TRENDS OF MULTIGAS EMISSIONS INVENTORY OF INDIA," *ATMOSPHERIC ENVIRONMENT*, 2006.

While India is not obligated to reduce its GHG emissions, the country is a leader in the area of Clean Development Mechanism (CDM) project development. The GOI's National Clean Development Mechanism Authority is extremely active in developing CDM projects; 337 projects are registered with the UNFCCC with estimated annual emission reductions of almost 32 Mt CO_2/year).[4] This offers a basis for increased attention to the possibility of CHP/DC as CDM projects in India.

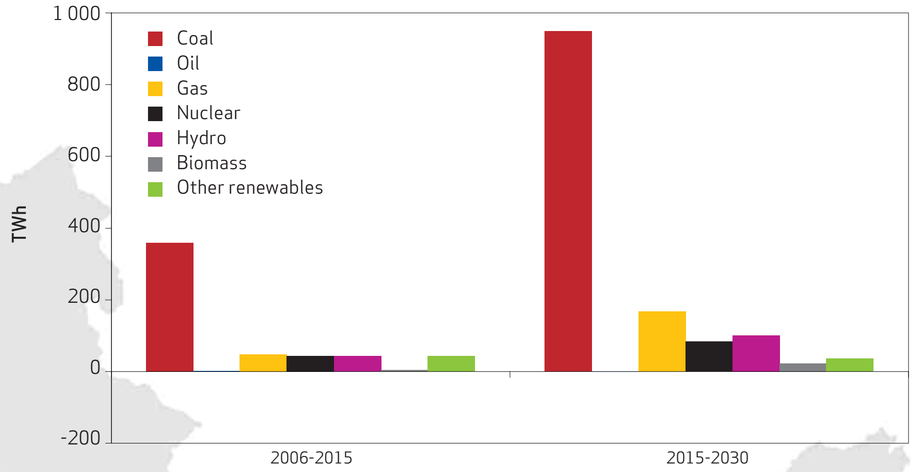
Electricity Generation

Currently, the total installed electrical capacity in India is almost 145 gigawatts (GW).[5] In addition, there is another estimated 45 GW of capacity at self-generating plants, of which 22 GW is generated by small diesel and gas-fired generator sets under 1 MW of capacity.[6] The GOI estimates that there will be an addition of 12 GW of this type of self-generation in the Eleventh Plan period (2007-12).[7] Due to its low cost and domestic availability, coal is the dominant fuel source for electricity generation in India, and its use is forecast to grow between now and 2030 (see Figure 4). For this reason, India is investing in a number of coal-fired power plant efficiency measures. These strategies are only part of the solution; however, there are important options for CHP in the industrial sector that can contribute to cleaner power generation.[8]

4. UNFCC CDM project database as of 11 May 2008.
5. This figure does not include captive or self generation, which is estimated at 45 000 MW and includes small liquid fuel-based genset capacities. In the 1 MW and above category, the capacity is estimated at 23 000 MW with about 2500-3000 MW added each year in power-intensive industries. Source: *Powerline*, Vol.12, No.4, December 2007, p. 68.
6. Power Sector Reports, Central Electricity Authority (CEA), www.cea.nic.in.
7. *Powerline*, Vol. 12, No.4, Dec. 2007, p.68.
8. *Fossil Fuel-Fired Power Generation: Case Studies of Recently Constructed Coal and Gas-Fired Plants*, IEA 2007.

FIGURE 4.
PROJECTED CHANGES IN ELECTRICITY GENERATION MIX

SOURCE: *WORLD ENERGY OUTLOOK 2008* REFERENCE SCENARIO, IEA.



Currently, there are severe peak and general electricity shortages in the country. The overall peak deficit stood at 16.6% and the energy deficit at 9.9% in 2007-08.[5] The GOI aims to address this; the 17th Electricity Power Survey (EPS) Projections for the requirement of power states that all households must be electrified by 2012.

CHP/DC Status

Estimates of CHP and DC in India have been lacking and those that exist have been based on differing definitions of CHP. The GOI estimate is restricted to bagasse-based cogeneration, where the current capacity is estimated to be over 700 MW, predominantly in the states of Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu and Uttar Pradesh.[9] However, this is likely to strongly underestimate the total use of cogeneration in India. Using the best available data, the IEA estimates that in 2005, CHP capacity in India was over 10 GW from over 700 units, with a heat-generating capacity of 170 MW.[10] This is about 5% of the total electricity generated. This demonstrates that a good first step would be to commission further work in India to improve cogeneration/CHP definitions and improve data quality. There is currently no district heating in India for climatic reasons; district cooling is as yet not in use but holds promise (see below).

CHP/DC Policy Environment

India foresees an increase in its captive generation by over 12 000 MW in the Eleventh Plan period (2007-12). Over the past 5 years, major changes have been made in the legislative, policy and regulatory environment, which have provided the foundation for competition and efficiency in the power sector. As a result, almost all states have created State Electricity Regulatory Commissions (SERCs); they have also unbundled vertically integrated State Electricity Boards (SEBs) into generation, transmission and distribution entities. Following SERC regulations, states have also provided for open access on the transmission and distribution networks. The Central Electricity Regulatory Commission (CERC) has incorporated an incentive mechanism (called the Availability Based Tariff) for generators to supply power during peak demand and penalties for generating during off peak times when load is low. Finally, there are various fee structures and feed-in tariffs set in place for supplying power into the grid. However, while the framework below offers promise, to date, the government has not utilised these policies to promote CHP. See Table 2 for a summary of the key GOI policy measures relevant to CHP/DC.

9. Annual Report 2007-08, Ministry of New and Renewable Energy (MNRE), GOI, Tables 1.1 and 5.4.
10. "Combined Heat and Power: Evaluating the Benefits of Greater Global Investment," IEA 2008, http://www.iea.org/Textbase/Papers/2008/CHP_report.pdf.

TABLE 2.
SUMMARY OF POLICY AND REGULATORY ENVIRONMENT FOR CHP/ DC

› 1993	• GOI announces **policy for advanced Bagasse Sugar cogeneration** including plant configuration, operating and efficiency standards • Establishes methodology for fixing tariffs for sale of cogenerated power to the SEBs[11]
› 1998	• **Electricity Regulatory Commissions Act** enacted to authorise CERC to regulate inter-state transactions and SERCs to regulate intra-state transactions • States given the option to create SERCs
› 2001	• **Energy Conservation Act 2001** enacted to provide for energy efficiency and conservation • **Bureau of Energy Efficiency (BEE)** created with mandate to promote energy efficiency, including CHP and demand-side management
› 2003	**Electricity Act 2003 (EA 2003)** • Enacted to consolidate laws in the power sector, and to promote competition, efficiency and consumer interests • Mandates creation of SERCs • Recognises electricity trading as a licensed activity • Relicenses electricity generation from transmission and distribution • Liberalises captive power generation to include group captives[12] • Mandates unbundling of transmission and trading • Mandates open access on transmission and distribution networks at rates prescribed by SERCs[13] • Announces the creation of district-level committees to promote energy efficiency and conservation[14] • Promotes cogeneration and renewable energy through a non-fossil fuel obligation[15]
› 2005	**National Electricity Policy 2005** • The Policy states: "*Industries in which both process heat and electricity are needed are well suited for cogeneration of electricity. A significant potential for cogeneration exists in the country particularly in the sugar industry. SERCs may promote arrangements between the cogenerator and the concerned distribution licensee for purchase of surplus power from such plants. Cogeneration system also needs to be encouraged in the overall interest of energy efficiency and also grid stability.*"[16]
› 2006	**Tariff Policy 2006** • SERCs required to fix a percentage of electricity procurement from renewable sources via the non-fossil fuel obligation (can include CHP) • States that procurement shall be done at preferential feed-in tariffs determined by the appropriate state commissions • CERC asked to establish guidelines for pricing non-firm power, especially from non-conventional sources
› 2008	**CERC discussion paper**[17] • Proposes preferential treatment (exemption from inter-state open access charges for transmission, wheeling, standby power, grid connection, and scheduling) to renewable energy sources for arranging inter-state transmission when open access is used • Allows reactive energy charges to be applied by the host utility under the Indian Electricity Grid Code

11. The tariff was defined as FCC + 0.8 * variable cost where FCC was the Fixed Cost of Capital. Open access had not been mandated at that time and there was no legislative foundation for sale to other users.
12. The Electricity Act of 2003, Section (2) (8).
13. The Electricity Act states that distribution open access would be in phases but within one year of the Act. Most ERCs that have announced open access regulations on transmission networks have also done so for distribution networks. The newer ERCs have yet to frame the regulations. CERC frames the regulations for inter-state transactions on transmission networks. The SERCs frame regulations on intra-state regulations on transmission and distribution networks.
14. Electricity Act of 2003, Section 166 (5) (c).
15. Electricity Act of 2003, Section 86 (1).
16. National Electricity Policy 2005, Section 5.12.3.
17. "Arranging Transmission for New Generating Stations, Captive Power Plants and Buyers of Electricity," CERC Staff Paper, July 2008.

CHP/DC Market Activity and Applications

Background

The Indian foundation for CHP centers around bagasse-based cogeneration, largely in the sugar industry, which is supported as a renewable energy resource. However, CHP in India could potentially be much larger, as CHP improves energy supply efficiency for all primary fuels. Industrial CHP has been of interest in India for over a decade on account of the government's need to supplement unreliable grid supplies and the desire to use scarce energy resources more efficiently.

One of the first CHP projects in India began in 1989 when a tube manufacturer, Samtel Colour Ltd., near Delhi, contracted to receive gas from the HBJ pipeline.[18] The Gas Authority of India Ltd. (GAIL) forced the company to off-take more gas than it required. As a result, Samtel Colour installed a gas turbine CHP unit to meet all of the company's power, heating and cooling needs. The payback for this initiative was three years. This successful project helped to pave the way for future use of cogeneration.

The Major CHP technology applications in India are:

1. Gas turbines for electricity production, cogeneration and if possible, trigeneration (electricity, heat and cooling) via the use of vapour absorption chillers (VACs);
2. Diesel engines with the capacity to provide hot water and cooling with the addition of VACs; and
3. Biomass CHP plants in a variety of industrial and smaller-scale settings.

Case Study 1.
Arvind Mills Cogeneration Plant

Arvind Mills, a textile manufacturer located in the Western State of Gujarat near Ahmadabad, has an innovative CHP plant in use. The gas turbine CHP facility of over 27 MW meets the company's power, heating and cooling requirements. The plant also integrates a Zero Liquid Discharge Effluent Treatment plant that decreases their fresh water requirement by 85%.

The total investment in 1996 was US$ 50 million, and project completion time was 16 and 18 months for the two facilities. The payback was less than four years.

The company had three critical requirements in order to approve the project investment:

1. Generate steam and power competitively to reduce energy costs;
2. Ensure reliable supply of high-quality steam and power for uninterrupted production and superior product quality; and
3. Guarantee an efficient and flexible management of steam and power to meet the fluctuating process demands.

Two natural gas/naptha-fired plants generate 90 tonnes per hour (TPH) of steam and 27.5 MW of power. GHG reductions have not been calculated as of yet.

Unique features of the project:

- **Energy and Environment Integration**: The first ever captive cogen plant in India to provide a comprehensive water treatment and recycling facility.
- **Flexibility**: The plant is configured to provide for a number of variations in plant fluctuations in power, steam and water loads with a high degree of availability.
- **Inlet air cooling:** The plant incorporates an inlet air cooling system to optimise turbine operation throughout the year, including peak summer, high humidity conditions. The source of inlet air is waste steam from the extraction port.
- **Availability**: Plant design, philosophy and equipment selection has ensured plant availability above 90%.

18. The Hazirapur-Bijapur-Jagdishpur pipeline was built in 1998 to supply natural gas from Gujarat to customers along the pipeline which extends close to Delhi.

District Cooling

Given India's tropical climate and limited heating pipeline infrastructure, district heating applications are limited or nonexistent. However, district cooling has begun to be applied and can play an important role to help meet energy demand growth. Until recently, air conditioning was considered a luxury and sparsely used in the commercial and industrial sectors. With increasing industrial activity, especially in the information technology (IT) industry and high-end commercial activities, the need for cooling is becoming more obvious. There is potential for CHP/DHC to be implemented in smaller industrial parks, special economic zones and other areas where there is a concentration of large commercial and software establishments which have on-site power plants or backup power using fossil or alternate fuels.

Case Study 2.
International Tech Park, Bangalore

A joint venture comprising Singapore's Information Technology Park, Tata Industries and the Karnataka State Government has developed an integrated, self-contained complex of multi-storied offices, residential and recreational facilities supporting over 130 companies with 20 000 employees.

During the planning stages, the concept of heat recovery and cooling was developed and all of the generator sets were equipped with waste heat recovery systems. Heat was recovered from a new 7.4 MW high-temperature water-cooling system, and designed to generate chilled water using VACs.

The total peak power demand for the facilities is 54 MW, with a total system efficiency of 67%.

The success of this project has led another IT park developer in Chennai to use waste heat recovery for cooling.

The prospect for CHP/DC growth appears promising as increased competition and higher energy costs drive industries and commercial establishments to attain greater energy efficiency and "total" solutions to meeting their energy needs. Further, the Electricity Act 2003 provides for liberalised generation policies, and for greater use of distributed generation. As a result, malls, offices and residential complexes in Mumbai have begun to use compressed natural gas to fuel small generation sets. This presents an opportunity (see Case Study below) to use waste heat to provide space cooling.[19]

A potential next step for India is to assess how infrastructure for cooling networks can be financed and encouraged.

Potential for Growth

As awareness about the benefits of CHP and district cooling grows, additional stakeholders are developing analyses of these technologies' future potential. A recent estimate by the energy institute TERI looked at 300 existing industrial units in 10 different sectors and concluded that today, a technical potential of 7.5 GW exists for these plants. Nearly 69% of the estimated potential, or 5.1 GW, was found to be in the sugar industry.[20] Table 3 shows the breakdown of TERI's results by sector.

Table 3:
CHP POTENTIAL IN INDIA IN SELECT INDUSTRY SECTORS

#	Industry	Potential (MW)
1	Alumina	59
2	Caustic Soda	394
3	Cement	78
4	Cotton Textile	506
5	Iron & Steel	362
6	Man-made fibres*	144
7	Paper	594
8	Refineries	232
9	Sugar	5131
10	Sulphuric Acid	74
	Total	**7574**

*Note: * includes Nylon and Polyester Filament Yarn*

Source:, Indian Market Potential for Introducing CHP in SMEs and Future Collaboration Strategies with European CHP Suppliers, TERI (India) and SEED (Italy), 2007.

It is clear that CHP potential estimates need to be enhanced in India (see Policy Recommendations for further discussion of this point). Furthermore, if CDM credit revenue potential is considered (see Box below), there will likely be additional profitable project opportunities. As a result, further work is strongly recommended to perform a detailed economy-wide analysis of CHP and district cooling potential in India.

19. *Business Standard*, 15 August 2008. The CNG is supplied by the local city gas company Mahanagar Gas, through its gas network. While the article does not specify space cooling, it is the natural extension of commercial captive generation.
20. The CHP estimates in the TERI Report are based on the internal heat-to-power ratios, which would meet the plant's energy requirements based on the existing production capacities of the various industry categories. Of the total estimated potential of 7 574 MW, nearly 69% is estimated to exist in the sugar industry alone. If the power maximisation options were to be considered, the CHP potential is expected to increase significantly. This figure can go up to 10 000 MW.

Case Study 3.
CHP in Tata Sponge Iron Ltd. (TSIL)

Tata Sponge Iron Limited (TSIL) was one of the first CHP projects in India to be registered with UNFCCC as a CDM project. TSIL is located in Orissa and produces sponge iron. Currently TSIL has two 120 000 tonnes per annum (tpa)[21] kilns along with a 7.5 MW power plant. Iron ore and non-coking coal are the primary resource inputs. To maintain the temperature inside the kilns at 950-1050°C, it is important to control coal combustion to remove oxygen. A waste heat recovery boiler generates steam for a 7.5 MW multistage condenser turbine; power is generated from the waste heat. A 100 tonnes per day (TPD) kiln can generate unto 2 MW of usable power. TSIL claims the project produces an estimated annual revenue equivalent to Rs. 30 million.

In addition, the project offers other benefits, which are estimated in the table below.

ESTIMATED BENEFITS POTENTIAL

	7.5 MW	18.5 MW (Proposed)	26 MW (Proposed)
Annual electricity (kWh)	463,000	1,142,100	1,605,100
Revenue generation potential (Rs./annum)	926,000	2,284,100	3,210,100
GHG abatement (tonnes CO_2)	410,000	1,011,300	1,421,300
Earning potential from sale of Certified Emissions Reductions (CERs) (Rupees)	205,000,000	505,666,700	710,666,700

SOURCE: TATA SPONGE IRON LTD.

Based on the initial project's success, TSIL is undergoing a major expansion to include a third kiln (150 000 tpa) along with a 18.5 MW power plant. Future plans include three more kilns along with power plants and steel making.

21. Tonnes per annum is a term commonly used by industry in India to describe plant capacity. In this case, it means 120 000 tpa of sponge iron production.

Stakeholders

Government

The Ministry of Power (MOP) is responsible for planning, policy formulation, approving investment in some projects, monitoring of power project implementation, training and manpower development and the administration and enactment of legislation in regard to thermal and hydro power generation, transmission and distribution. Although distribution comes within the jurisdiction of the state, the MOP does have certain related powers. The Accelerated Power Development Programme, National Electricity Policy, Rural Electrification Policy, and the Electricity Act are all areas through which the MOP has a role in distribution. The MOP's Bureau of Energy Efficiency has also taken the initiative to build capacity for CHP/DC development.

The Ministry of New and Renewable Energy (MNRE) is responsible for harnessing renewable power, energy to rural areas for lighting, use of renewable energy in urban, industrial and commercial applications and development of alternate fuels and applications. The MNRE has formulated policies for all types of renewable energy, including biomass for cogeneration.[22]

State/Local Government

To supplement the MOP, every state has jurisdiction over renewable energy and CHP policies. Some state regulatory commissions provide incentives for renewable and CHP/DC utilisation.

Industry

There are several industrial players (primarily in the biomass industry) utilising CHP/DC and/or developing projects. These include, among others: BHEL, Capstone Turbines, Rolls Royce, Siemens, Turbomach, Thermax Power, and Wartsila.

Non-government Organisations

Currently, there are a small number of organisations, including TERI and the Administrative Staff College of India, that conduct research and promote CHP/DC. TERI and the World Alliance for Decentralised Energy (WADE) also work with industry and government to advance deployment of clean and efficient decentralised technologies, including CHP.

Barriers to CHP/DC Development

In India, most industrial facilities are connected to the main grid for their power needs. High energy costs and lack of available power has led some industrial plants to invest in on-site generation via CHP. While this is a start, there appears to be substantial additional potential for CHP and district cooling uptake if policy issues can be addressed. Some barriers include the following:

Legislative and Policy

- While there have been some policies enacted (e.g., the 1993 Cogeneration Policy and approval for feed-in tariffs for CHP), there is a lack of government emphasis on CHP. This has led to a lack of a clear definition of cogeneration or CHP; the term cogeneration is often assumed to be limited to bagasse-fired CHP. In addition, there has not been a detailed study of India's CHP and DC potential (and associated benefits) completed. Such a study could provide important data.
- The sale of surplus power from CHP units through open access rules is currently expensive due to high surcharges and the imposition of duplicative transmission charges that appear to be unnecessary.
- CHP/DC systems often require standby power and need to synchronise with the electric grid. Stand-by charges, while justified, may present an economic barrier to the use of CHP.
- There is a lack of a clear methodology for calculating CO_2 emission reductions from CHP and district cooling applications. There is also a lack of understanding of the potential for GHG reduction benefits nationally from these technologies. This limits important opportunities for CDM credits.

Technological Constraints

- There appears to be limited availability of competitively priced turbines and engines used for CHP/DHC.
- There is a lack of an available pipeline network and/or rights-of-way within the major cities for district cooling; this limits the potential for district cooling in the short term. City gas is currently restricted to liquefied petroleum gas (LPG) for cooking and compressed natural gas (CNG) for vehicles, with very limited use for space heating. Despite this, CNG use is slowly gaining ground but city gas investments cannot be sustained by LPG use in households. Thus, only certain areas in the proximity of gas sources have distribution pipelines for local household or commercial use.

Financial Constraints

- The tax and duty structure for CHP capital equipment is not as attractive as for other renewable energy technologies.

22. MNRE's renewable energy policies are available on their website, http://www.mnes.nic.in, under "Programmes/Schemes."

Summary Policy Recommendations

The GOI and industry are beginning to take important steps toward greater use of CHP and DC to meet energy efficiency goals. However, to realise the benefits of greater CHP/DC investment in India, the following steps are recommended:

1. Create Greater Awareness in Central, State, and Local Governments

The GOI has made some changes in the Electricity Act of 2003. However, it is recommended that the GOI improve its analysis of the benefits related to CHP/DC cost-effectiveness, energy efficiency and GHG emissions reductions/CDM potential. The Bureau of Energy Efficiency (BEE) has been set up under the Energy Conservation Act and a greater role for CHP/DC promotion should be entrusted to it.

State governments should encourage and enable local entities capable of utilising CHP/DC (including airports, shopping malls, industrial parks and others). This could be achieved by any of the following ways:

- Explore improvements in education for state and local governments about the potential for CHP/DC at new industrial and commercial plants. If these levels of government have better information about incentives and other technical issues, they can help industrial and commercial organisations to understand the benefits of local CHP/DC investments.

- Consider a requirement that all special economic zones, industrial parks, commercial complexes and other networks of commercial, business and high-end residential complexes examine the viability of CHP/DC at the plan approval stage. This will enable them to appropriately consider the possibilities of energy efficiency via district cooling and other approaches.

- Target inefficient industries and work with them to improve utilisation of efficient CHP. Industries such as aluminum, cement, fertilizer, iron and steel, petrochemicals, pulp and paper, refineries, sugar, and thermal power plants have many opportunities for expanded use of CHP.

2. Perform CHP/DC Analysis

India is starting to see the value of CHP/DC in a liberalised market. However, benefits can be accelerated if a detailed study of CHP/DC market potential is carried out and appropriate targets incorporated into national and state energy planning initiatives. This could be further enhanced by:

- Developing a database of projects and technologies to assess current technology performance and develop success stories for replication; and

- Ensuring that energy audits clearly indicate prospects for CHP/DC via retrofitting and refurbishing existing plants.

3. Establish an Industry Initiative on CHP/DC

Currently, there is no clear private sector leader on CHP/DC policy or technology best practices in India. To remedy this, it is suggested that the existing networking infrastructure of industry associations be utilised more effectively to carry out capacity building, data collection, education and outreach to different stakeholders.

4. Consider Extending Regulatory and Policy Support

SERCs should consider issuing regulations regarding CHP/DC in the context of the National Electricity Policy. Possible approaches could be to specifically state that efficient CHP units that meet certain criteria should be allowed to sell their surplus power through open access. Leading countries have found that targeted incentives of this sort are effective at developing commercial markets for CHP. Typically, these types of incentives are then phased out, after market commercialisation is achieved.[23]

The GOI should also weigh the benefits and costs of expanding feed-in tariffs to non-bagasse CHP applications. A number of promotional measures have been proposed for renewables, including non-fossil fuel obligation, use of open access without cross-subsidy surcharge among other fiscal measures. These are important measures for CHP as well. Further, other countries have successfully extended their support for renewable energy to biomass and other types of CHP applications.

5. Enhance International Cooperation

India is an active participant in the international dialogue on energy and the environment. However, there are very few international cooperative activities targeting CHP/DC. India could benefit from increased cooperation with international experts, which would allow government policy makers, industry and consumers to learn from relevant experiences and best practices from other countries who successfully use large amounts of CHP/DC.

23. See "CHP/DHC Country Scorecard: Denmark," http://www.iea.org/g8/chp/profiles/denmark.pdf.

The International CHP/DHC Collaborative

The **International CHP/DHC Collaborative** was launched in March 2007 to help evaluate global lessons learned and guide the G8 leaders and other policy makers as they attempt to assess the potential of CHP as an energy technology solution.

The Collaborative includes the following activities:
- collecting global data on current CHP installations
- assessing growth potentials for key markets
- developing country profiles with data and relevant policies
- documenting best practice policies for CHP and DHC
- convening an international CHP/DHC network, to share experiences and ideas

Participants in the Collaborative include the Partners, mentioned in the acknowledgments, as well as the Collaborators, a group of over 40 government, industry and non-governmental organisations that provide expertise and support. The Collaborative Network, the larger group that is informed about meetings, publications and outreach, has almost 300 participants.

If you are interested in participating in the Collaborative or want more information, please visit www.iea.org/G8/CHP/chp.asp.

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