



International Climate Initiative (IKI)



Projects in India

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

On behalf of:



Federal Ministry for the
Environment, Nature Conservation,
Building and Nuclear Safety

of the Federal Republic of Germany



Unique facts and figures

The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) has been supporting 43 climate and biodiversity protection projects in India with their International Climate Initiative (IKI) since 2008.

Of these, 25 projects are being carried out by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ GmbH).

The focus of the GIZ's engagement in India in terms of the International Climate Initiative is on climate policy, energy and biodiversity.

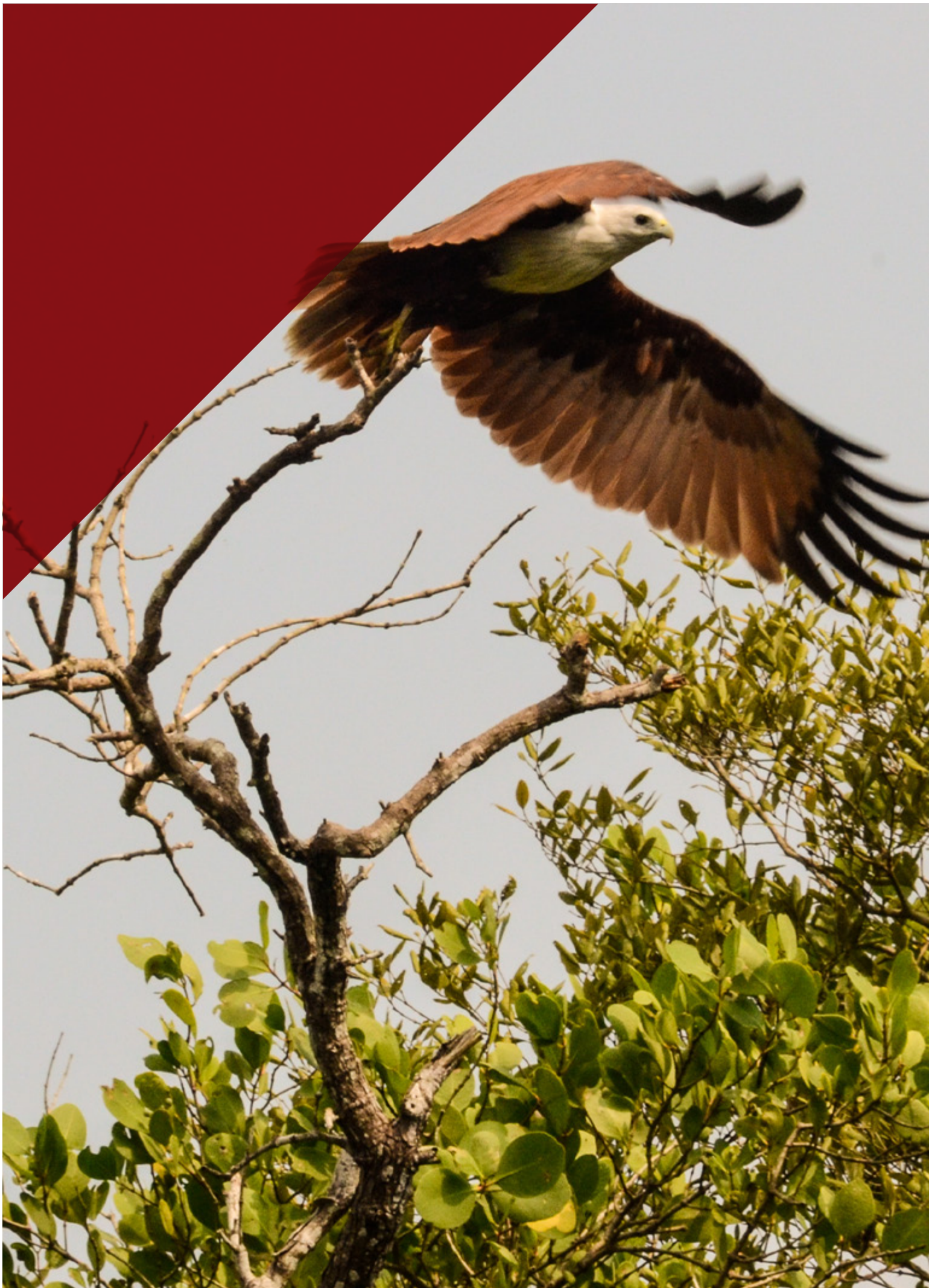
The Comsolar project promotes the commercialisation of solar energy in India.

The Solmap India project measures solar radiation country-wide and sends investors the solid data they need to invest in solar power stations.

In Mumbai and five other places in India, the BMUB is supporting India in setting up coastal and marine protected areas together with the local public. One of their focuses is on the preservation of mangroves.

The BMUB is also promoting projects to support the Indian government's National Action Plan on Climate Change, for example in sewage disposal. In Nashik, there is currently a pilot scheme, which enables communities in urban regions to see their sewage as raw material and so to dispose of sewage in a cost effective way.

In the resource efficiency programme together with its partners, the GIZ is finding approaches to enable India organise its construction industry and automobile sector in a more resource-efficient way, which can protect the climate.



Foreword

India is a vast nation with a population that is particularly affected by climate change. Although the country has comparatively low emissions per capita, it is, in absolute terms, the fourth highest emitter of greenhouse gases globally, after the China, the USA and the EU. The growing economy and the aspirations of a rapidly urbanising population with a growing middle class are putting tremendous pressure on the environment and natural resources. Yet, along with India's economy, awareness of the necessity to protect the environment is steadily increasing. Just recently, the Indian government published its "Intended Nationally Determined Contribution (INDC)", which lay down India's ambition to reduce carbon emissions relative to its GDP by 33% to 35% from 2005 levels by 2030. Furthermore, India has ambitious plans to adapt to the changing climate, thus making India a strategic partner for Germany for climate change mitigation and adaptation. Given the tremendous opportunities for collaboration and mutual learning in the areas of climate change and energy technology, Prime Minister Narendra Modi and Federal Chancellor Merkel took the occasion of the third Intergovernmental Consultations held in New Delhi on 5th October 2015 to forge an Indo-German Climate and Renewables Alliance, a comprehensive partnership to harness technology, innovation and finance in order to make affordable, clean and renewable energy accessible, and to foster climate change mitigation efforts.



This new Alliance is another important building block in the strong bilateral cooperation between India and Germany in these areas. The International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) has been financing climate and biodiversity projects in developing and newly industrialising countries since 2008. In this framework, on behalf of the BMUB, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is supporting the Indian government through a number of projects on climate change adaptation and mitigation, biodiversity protection, resource conservation and renewable energy. While India has been a partner country of the IKI since its beginnings in 2008, the project portfolio in India is now among the largest within the IKI. To date, BMUB has supported 21 bilateral projects with funding of over EUR 60 million, which have facilitated substantial progress and innovative development in their specific areas. 14 of these projects have been or currently still are implemented by GIZ with funding of over EUR 50 million. In addition, BMUB is funding a further 22 global and regional projects with India as one of several partner countries.

IKI is offering India support on its way towards more sustainable, climate-friendly development by introducing innovative approaches and technologies. GIZ is very happy to be able to contribute to this process today and in the future.

Dr. Wolfgang Hannig
Country Director
GIZ India

Table of Contents

Foreword	3
Good for India, good for the climate	6
Climate change affects India's agricultural population directly	7
The benefits and co-benefits of Indian energy policy	7
Co-benefits as a basis for collaboration	8
Biodiversity	14
Engaging with the local population	14
Mumbai's last mangrove forests should become local recreation areas	15
A festival for turtles	16
Khazan: centuries-old tradition to cultivate rice and fish	17
Getting involved	18
The beauty of the mangroves	18
Impact	19
The contribution of the GIZ	19
NAMA	20
Developing nation-specific measures for limiting emissions in India	20
NAMAs: voluntary involvement in climate protection	21
India: well-prepared for NAMAs	21
Impact	21
The contribution of the GIZ	21
Resource efficiency	22
Resource efficiency also protects the environment	22
Raw material cycles secure valuable resources and save energy	23
Using German expertise	24
Impact	24
The contribution of the GIZ	24
Waste to energy	26
The raw material sources of toilet sewage and kitchen waste	26
Sustainable business model for sewage disposal	27
Impact	28
The contribution of the GIZ	28

IGEF	30
Connecting energy policy, climate protection and economics successfully	30
Collaboration with the economy	31
Annual high-level meetings	31
Impact	32
The contribution of the GIZ	32
Comsolar	34
The sun is rising on India's rooftops	34
More than 100 gigawatts of solar energy by 2022	35
Comsolar: Solar energy for cities and industry	35
Impact	36
The contribution of the GIZ	36
Comsolar DMRC	37
Future RESCO model for underground train services in India	37
RESCO model protects the environment and saves energy costs	38
Impact	38
The contribution of the GIZ	38
Comsolar India One	40
Solar energy for 25,000 people	40
A solar system for day and night	41
CSP technology that is replicable in India	41
Impact	42
The contribution of the GIZ	42
SolMap	44
Globally unique	44
Scientific pioneer project with great potential	45
Indian equatorial sunbelts: perfect for photovoltaics	46
Impact	46
The contribution of the GIZ	46
RESRA, Trigen	48
Rural energy supply	48
Trigeneration: New energy technology for combined electricity, heating and cooling	49
Twenty-one bilateral IKI projects in India until now	50



Good for India, good for the climate

Due to its dense population, strong economic dependency on weather conditions and the importance of agriculture, India is one of the countries that is especially threatened by climate change. At the same time, India contributes to a growing extent to global emissions of gases which are damaging to the environment, even though their per head emissions are still very low in comparison to industrial countries. With this in mind, the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) has been cooperating with India within the German International Climate Initiative (IKI) since 2008. The central goal of the projects promoted by the IKI is to initiate reform and transformation processes and biodiversity protection in the partner countries, and through this, to bring an impulse for negotiations to the fore at conventions for climate change and biodiversity. This is why the project activities often place an emphasis on political structures, decision and implementation processes and the partners' skills in relation to these. The IKI supports the partner countries in developing and implementing goals and action plans tailored to the relevant country.

This publication presents the projects that the GIZ is carrying out as part of the International Climate Initiative in India.

CLIMATE CHANGE AFFECTS INDIA'S AGRICULTURAL POPULATION DIRECTLY

In October 2014, Cyclone Hudhud sweeps across the east coast of India at 200 kilometres an hour, uproots trees, tears roofs from houses, hurls cars through the air. Two days later, the inhabitants of Visakhapatnam, a city with a population of over a million, are still sitting in the dark with no electricity. Is Hudhud a result of climate change?

Many experts see climate change as the reason for the increased strength and number of extreme weather events.

Fortunately, the Indian authorities were able to draw up a positive balance after the cyclone. The meteorological early warning systems had worked, several hundreds of thousands of people were brought to safety in good time. Catastrophe was kept at bay because India was well prepared.

Working out reliable scientific prognoses, developing best practice models, organising finance models, forming strategic alliances: The list of things India needs to do to prepare for climate change is long. 70 percent of the Indian population - around 850 million people - are dependent on agriculture. Every change in the climate, every change in the timing of monsoons, affects India's agricultural population directly.

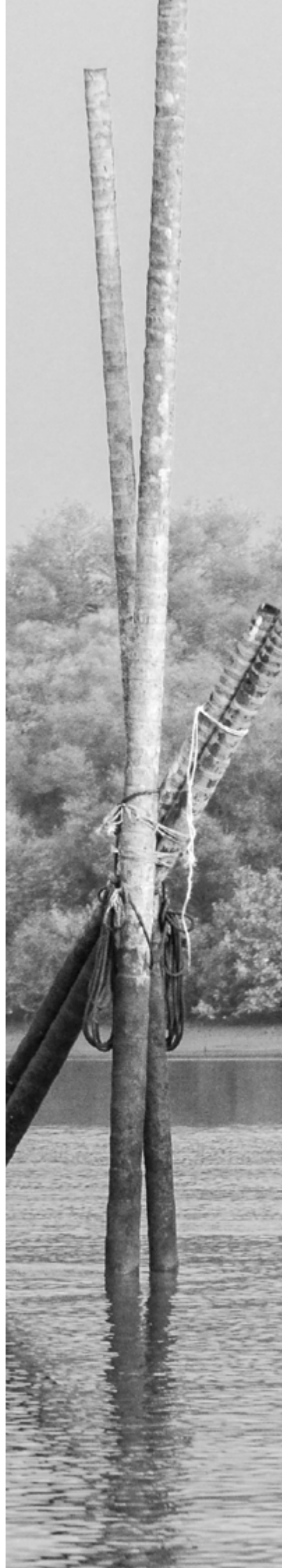
To be able to feed its population of over 1.2 billion people tomorrow and the day after tomorrow reliably and self-sufficiently, India must prepare itself for weather changes today. The three climate scenarios the Indian Institute of Tropical Meteorology (IITM) has calculated with the PRECIS model at the British Hadley Centre have a clear message. Based on a climate scenario involving a future balanced mix of fossil and non-fossil energy sources, the IITM predicts an average temperature increase in India of two degrees or more before 2050. The worst-case scenario would see temperatures in India rise by as much as 3.5 to 4.3 degrees Celsius before the end of the century¹.

"There is no doubt that climate change and the problems of climate change are very important for India," says Ajay Mathur, Director General of the Bureau of Energy Efficiency at the Ministry of Power. "This is becoming clear very quickly if you look at the facts. For example water: The changes to the hydrological systems and their consequences for water supply and agriculture will affect more people in this country than anywhere else."

THE BENEFITS AND CO-BENEFITS OF INDIAN ENERGY POLICY

Ajay Mathur is one of the most renowned Indian experts on climate change. He has appeared at several Conferences of the Parties (COPs) and is one of the authors of the Indian government's Low Carbon Strategy. "India's energy intensity decreases by 2.5 percent every year," he says. Thus India's economic energy intensity will be reduced by 25 percent from 2005 to 2020. This is one of the goals of the National Action Plan on Climate

¹ Ministry of Environment & Forests 2012: India - Second National Communication to the United Nations Framework Convention on Climate Change



Change that India formulated in the national goals for 8 sectors in 2008.

Twenty five percent energy efficiency means a lot for India: It increases the economy in the field of international competition, secures India's energy provision and helps to reduce dependence on fossil-based raw materials. The higher the energy efficiency, the more growth and prosperity India creates. This is one of the most important governmental goals in a country in which 900 million people must survive on less than two US dollars a day.



“We see the positive consequences for the climate as very important additional benefits that we are achieving with the projects we are carrying out to promote energy efficiency and renewable energies,” says Mathur. If India needs proportionally less energy for a GDP unit, this has a positive effect on the climate. It is also because of this that the government wants to transform the energy industry to significantly increase efficiency and the proportion of renewable energies.

Contributing almost 70 percent, the energy industry is one of the largest emitters of greenhouse gases. The restructuring of the energy industry thus decides whether India's per head use can be limited - as presented in the best case scenario of the government's low carbon strategy study - to 2.6 tonnes per head by the year 2030, or if it will have significantly increased.

This is also very important for the global climate. With 1.5 tonnes of CO₂² per head, India is one of the countries with the lowest emissions. Due to the size of its population, however, India is one of the biggest emitters of greenhouse gases worldwide, after China, the USA and Europe. So India is a deciding player in the community of nations for international climate negotiations.

CO-BENEFITS AS A BASIS FOR COLLABORATION

Renowned Indian scientists propose that India should strive for positive side effects as a guideline for Indian climate policy in the study published in 2013 “Indian Climate Change Policy - Exploring a Co-Benefits Based Approach”. This study argued that besides the three determinants of growth, inclusion of people from lower social classes and local environmental influences, a fourth determinant should be introduced: CO₂ reduction. According to this study, India should orientate fundamental political decisions in future around the requirement that a significant reduction in CO₂ emissions needs to be included.

Striving for positive side effects is also a goal of the Indo-German collaboration for climate and biodiversity protection. Since 2008, the International Climate Initiative (IKI) of the BMUB has been supporting its Indian partners with numerous projects. Besides the reduction in greenhouse gases and the protection of biodiversity, most IKI projects also aim for growth, social inclusion and resource protection. Thus, the projects protect German and Indian interests in equal measure. On the one hand, India is able to significantly reduce its greenhouse gas emissions in future, building on the pilot projects promoted by the IKI. At the same time, however, India also profits from the economic, social and ecological side effects that are achieved with the project.

2 International Energy Agency, numbers for 2012

21 bilateral IKI projects have been set in motion by India and Germany since 2008 in the field of environmental and climate protection, in the energy industry, in sewage disposal and in resource efficiency. Of them, 14 projects are being carried out by the GIZ. These projects being implemented by the GIZ and its partners in India are presented in this publication. They are pilot schemes with technologically, ecologically, methodologically and institutionally ambitious approaches to solutions. Because they are introduced in a replicable way, Germany and India are developing approaches to solutions that can produce a significant leverage factor.

This collaboration is particularly significant in the energy industry. The IKI projects have been able to profit significantly from Germany's leading expertise in energy change. "You in Germany have made it possible, you have shown us that energy change is possible," says Varsha Joshi the Joint Secretary at the Ministry for New and Renewable Energy (MNRE). She is feeling a wind of change in Indian energy policy. "Until now we who campaigned for renewable energies were always junior partners in the energy industry in India. That is changing now."

And Tarun Kapoor, Joint Secretary for the National Solar Mission in the MNRE said at an event on solarthermics in the industry: "We know that renewable energies are the only chance that we have in India."

For India, the continued expansion of renewable energies in the energy mix is creating a significant increase in energy security and less dependence on fossil fuels, including expensive energy imports. At the same time, the decentralised possibilities of use for renewable energies enable an environmentally-friendly and equally cost effective energy supply and access to energy in off-grid areas and communities in India. The expansion of renewable energies in India is also a big step forward for the global climate. This is good for India as well.

Interview Sanjay Vashist



Sanjay Vashist is Regional Director of Climate Action Network South Asia. He has been actively working towards mobilised civil society action on climate policies in South Asian Countries and Region. Previously, he has worked as Fellow with The Energy and Resource Institute in New Delhi; International Coordinator for Climate Action Network International (CANI) in Bonn and Natural Resource Scientist with Development Alternatives in New Delhi – coordinating the activities of ENGOs network, also acting as focal point for ENGOs constituency of observers under UNFCCC.

In this interview, he shares his assessment of India's INDC.

Q India presented its INDC on 2 October 2015, Mahatma Gandhi's birthday. Some analysts have concluded that if India manages to increase the share of non-fossil power generation as outlined in its INDC, it will actually surpass its aim of reducing its emission intensity by 30% to 35% compared to 2005 levels by 2030. What is your assessment of India's INDC?

SV India's INDC is on the lower side of its 47% reduction of emission intensity for GDP fair share, but compared to the majority of rich countries, it has put forward numbers that are ambitious, especially in the present context of vague means of implementation. Looking at India's domestic target to achieve 175 GW of electricity from renewable energy by 2022, this is very ambitious and one of the key efforts to move away from a fossil fuel economy in the long term. Although this target is considered by some to be unrealistic, if serious efforts are made and adequate support is made available through bi-lateral / multi-lateral partnerships, India could achieve at least 36% of electric power installed capacity from non-fossil fuel by 2022, and possibly more than 40% by 2030. Joint efforts to achieve the target of 175 GW from renewable energy in coming 7 years could unlock a true 'renewable energy revolution'.

India's INDC, however, also pitches for adding 'Clean Coal' technology, leaving fossil fuel to be the major source of energy in the next 30 years or more. The continuance of coal in India is due to the present bottle neck of alternative sources of energy that can drive economic growth. With a per capita net income of approx. 1400 USD in 2014-15, energy from alternative sources needs to be affordable.

Q Energy is key to India's development, but also crucial for a low-carbon growth strategy. Is there a way to reach both targets: a better energy supply for India's population through climate-friendly energy generation?

SV It is not enough to look only at energy supply to address the issue of growth with low carbon impact. Energy efficiency is crucial to transitioning to 100% renewable energy. Access to technologies and investments are key to enable the switch, especially in the building sector.

On the demand side, the direct energy demand by households is only a small fraction compared to the indirect demand for the production and transportation of goods and materials. The challenge is not only meeting the electricity demand of citizens, but also the electricity demand of industry and agriculture. And more importantly, meeting the non-electricity energy demand, which is larger still.

While traditionally there was a high dependence on coal, efforts are being made to diversify to other energy sources. Technology access, costs to consumers and favourable policy frameworks will be decisive factors in achieving low-carbon growth. Energy security remains the primary goal, followed by the goal of environmental integrity, and thus policies recently have been focussing on enhancing energy efficiency and adding energy from clean sources like renewables and nuclear. Given India's huge coal reserves, the only way to reduce its use in future is by making renewable technologies affordable and promoting local innovation. India's push for 'Make in India' provides an opportunity to scale up climate-friendly energy generation.

Q Energy generation from renewable sources is one of several key factors to achieve low-carbon development. Energy and resource efficiency are others. In your view, which sectors offer the greatest potential for greenhouse gas mitigation in India? What is required to realize this potential?

SV India's aspiration to achieve steady rates of high and inclusive growth will increase greenhouse gas emissions if it follows the business as usual path of development, especially if the past dependence on fossil fuel continues. Thus it is crucial to identify sectors that provide low carbon development potential.

One of the areas with great potential for greenhouse gas mitigation is increasing the efficient usage of existing power generation and transmission systems, as India's technical and distribution losses are currently very high.

There is also much potential in the residential sector, which contributed to 25% of total electricity consumption in 2011. A huge stock of new building will be constructed from now on to 2030 and reports suggest potential of about 50% reduction from current consumption levels.

Transport is another key sector. Efficiency norms in public and private passenger transport, freight transport and increased public transport in urban areas have high potential for low carbon growth.

Industry consumes around 50% of the total final energy demand. Thus improving energy efficiency in SMEs, which have high employment and inclusive growth potential, and introducing efficiency standards that make industries competitive as well as address energy security concerns, is important. Existing policies have indeed introduced such measures, but in absence of efficient technologies, the policies may fall short of their goals.

Q India and Germany have cooperated in the field of renewable energy for many years. Which areas should bilateral cooperation on energy focus on in the years to come, and in which areas can India provide leadership (e.g. through south-south-cooperation)?

SV In India, the promotion of renewable energy needs to be carried out on two fronts: First, on softer issues, like building support in favor of renewable energy, mobilizing stakeholders, making policy frameworks friendly for renewable energy promotion, etc.. And secondly on the infrastructure-related challenges that India faces, like storage of generated energy, smart grids to access energy from diverse sources, upgrades of distribution lines, etc.. Cooperation with Germany could address the challenges India faces with respect to infrastructure while also sharing the approaches followed to overcome policy and political challenges. The idea of creating a 'Grand Solar Alliance' in COP 21 by India and Africa is a good example of South-South Cooperation.



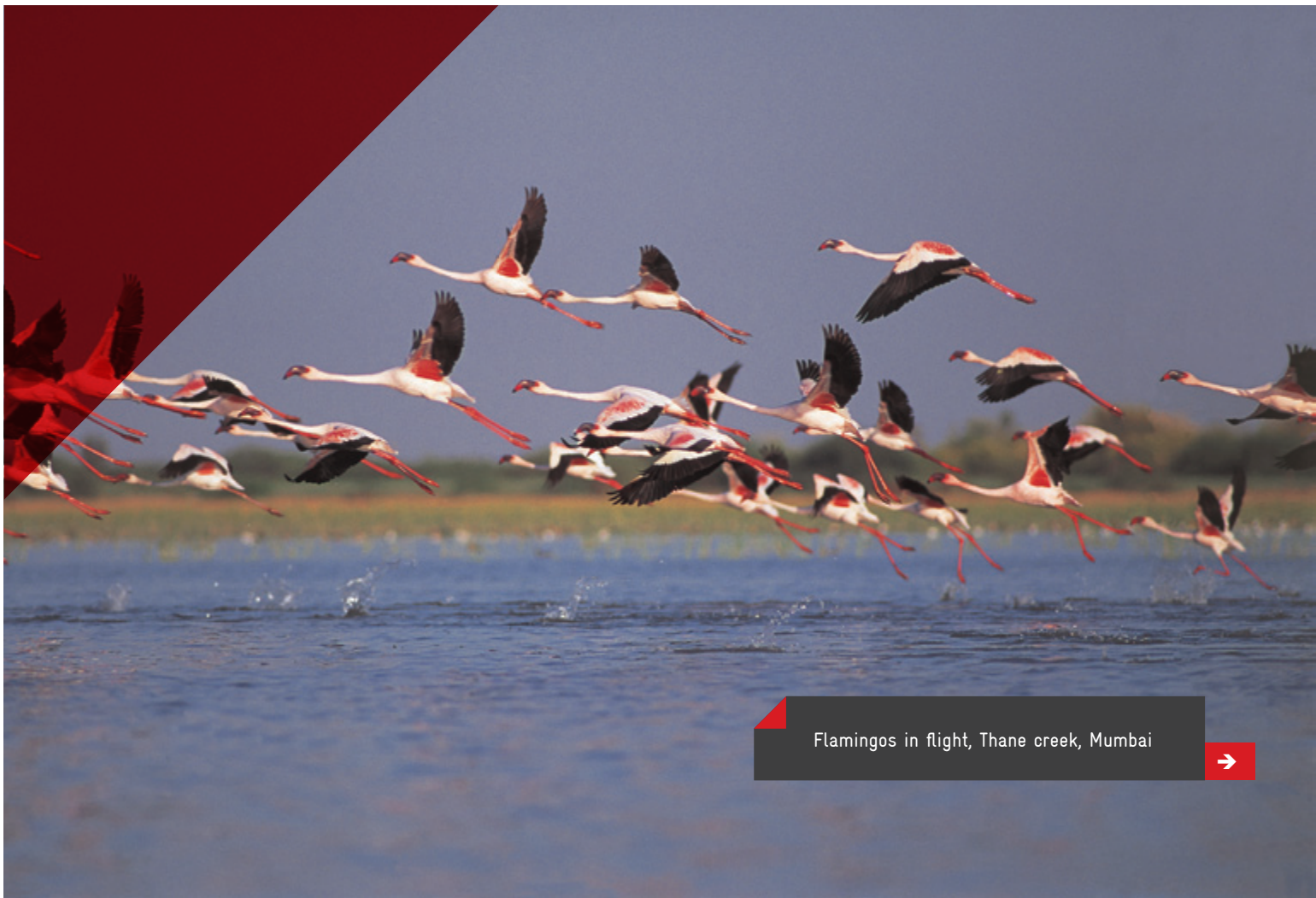


A key element of Germany's climate financing

Since 2008, the International Climate Initiative (IKI) of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) has launched more than 470 climate and biodiversity projects. The total project volume since 2008 amounts to €1.4 billion according to Doha-counting. In the early years of the programme, its financial resources came from the proceeds of auctioning allowances under the emissions trading scheme. To ensure financial continuity, further funds were made available through the Special Energy and Climate Fund. Both funding mechanisms are now part of the Federal Environment Ministry's regular budget.

IKI focuses on four funding areas: climate change mitigation through greenhouse gas emission reductions, adaptation to the consequences of climate change, conservation of natural carbon sinks, and protection of biodiversity. One important focus is supporting the partner countries in meeting their obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). The projects look for innovative solutions to the challenges and develop new political, economic and regulatory approaches, as well as technological options and cooperation models.

Project application is open to applicants worldwide through an annual call for proposals. This two-stage procedure is designed to ensure that funding is awarded to ambitious projects with the most suitable implementing organisations. As a result, the programme is characterised by a wide variety of national and international implementing organisations. The IKI deals with this great variety of issues in the partner countries and funding areas by using a range of methodological approaches adapted to the individual situation. For example, projects focus on or combine funding mechanisms, technological cooperation, policy advice or capacity building, and also the preparation of studies and concepts or support for the implementation of specific climate change mitigation and biodiversity conservation measures.



Flamingos in flight, Thane creek, Mumbai



Biodiversity

ENGAGING WITH THE LOCAL POPULATION

Marine coastal areas are some of the most productive ecosystems in the world with a fascinating variety of species. They are the principle source of nourishment for millions of people, offer protection against extreme weather events, absorb CO₂ and enable varied sources of income, some in tourism. The dramatically increasing economic use of these areas makes it even more important to consider their ecological role. With its Indian partners, the GIZ is developing participative concepts for an improved management of existing protected areas and the designation and cultivation of new protected areas in six coastal locations in the states of Gujarat, Goa, Maharashtra and Tamil Nadu. The goal is to win the population over for the protection of nature. Only in this way can the ecologically important functions of this area be secured in the long term.

Mumbai of all places. Each year in December, over 20,000 flamingos fly into the Thane Creek to put on weight for three months. It is one of the most fascinating spectacles that the world of birds has to offer and one of the largest collections of flamingos anywhere on the planet. When the proud, up to 1.5 metres tall birds of passage glide over the Thane Creek, they look straight at the skyscrapers of the largest city in India. Among the assembly, there are also small flocks of the rarer lesser flamingo, which is on the red list of endangered animals.

Mumbai is the pulsating economic centre of India and a juggernaut of modern times. The megacity, with 20 million inhabitants, produces more waste, sewage and car emissions each day than almost any other city in the world. But the flamingos roost here anyway - because the Thane Creek provides them with abundant plankton, mosquito larvae, small crustaceans, mussels and lugworms due to the ebb and flow of the tide. However, it is a ticking time bomb. The Thane Creek is transforming into a cocktail of chemicals due to the insufficiently cleaned sewage water from the city and its industry. It's not just scientists who are asking how this is affecting the health and life expectancy of the flamingos.

MUMBAI'S LAST MANGROVE FORESTS SHOULD BECOME LOCAL RECREATION AREAS

Polluted, but still the green lung of the city: the last connected mangrove forests in Mumbai can be found along the 26 kilometre long, narrowing Thane Creek. To preserve them in the long term, the Chief Conservator of Forests, N. Vasudevan, wants to turn the mangrove belt into a protected nature park and local recreation area for the city. Currently, only very few people in Mumbai are familiar with the difficult-to-access mangrove forest at the edge of the city. Vasudevan wants to change this: "The mangroves belong to all of the residents of Mumbai. We want to open this area for local recreation so that the people of Mumbai learn to appreciate its value. Only in this way can we preserve the mangroves in the long term."

Mumbai is growing every day. Everywhere, new houses are being built - the city needs space. That's why even the last mangroves at the Thane Creek are threatened from the point of view of investors: they quite simply have the best real estate potential.

To protect them, the Forest Authorities in Mumbai are working with the GIZ programme for sustainable management of marine and coastal areas. The GIZ is supporting India as part of the International Climate Initiative to gain protected status for ten percent of its coasts by 2020. 192 contracting member states at the convention on biodiversity agreed to this goal. "Here in India, we are implementing a large biodiversity programme," says Edgar Endrukaitis, Head of the GIZ programme. "In Mumbai, we have been advising the forest authorities for two years to develop and implement modern concepts for the protection of nature."

Besides giving political advice, the project will help to lay out walking paths through the mangrove forest, organise experience areas and boat tours, and construct a nature information centre to show visitors the uniqueness of the ecosystem, aimed in particular at the urban population. "In lots of respects, mangrove forests are very valuable. The thick roots provide fish, crabs and mussels with the best conditions for life, the wood gives oysters, snails and algae a home and on the treetops, water birds nest. At the same time, mangroves protect coasts and the people who live there from floods. They absorb CO₂ and are thus important for protecting the climate," says Edgar Endrukaitis.



Mangroves at Velas, Maharashtra

A FESTIVAL FOR TURTLES

Whenever the sun comes up over the small settlement of Velas on the coast of Maharashtra, it shines on a rural life no different from the many other villages along India's coast. But, in fact, this is a rather special place. Every year, lots of turtles appear on the beach upstream to take a long walk through the Indian Ocean to deposit their eggs in the nests they have buried in the sand. An ancient instinct helps them find the same beach where they themselves hatched over and over again. Industrial development and the urbanisation of the coastal region means that this coast, which is incredibly important as a nesting site for turtle procreation, is increasingly less suitable. The consequence: the eggs are laid on beaches that are not promising for the tiny turtles' chances of survival.

The residents of Velas want to stop this development. Supported by engaged employees of a local NGO, they have successfully fought against the influx of non-local investors into their community. But they have gone one step further. Each year, when the season of the turtles' arrival approaches, a previously set number of households in the village open up rooms in their houses for ecologically interested tourists. Eating with the host families gives the tourists a look at village life and nostalgic memories of old India. The morning walks to the beach with a demonstration of the measures taken by the local public to ensure the turtles are better protected are designed to sensitise the visitors to the necessity of better protecting this region, which is so important for the survival of the sea turtles. Supriya Jhunjhunwala, Technical Expert at the GIZ, advises the village council and the NGO on the planning of the visitor accommodations, the setting of the minimum standard for hospitality, the improvement of the protective measures and the development of an information concept coordinated with the visitor needs, all of which should help this 'soft' eco-tourism to be a success. A success that doesn't just promote eco-sensitivity, but also shows that village communities can secure their livelihood by protecting the environment. The highlight of the annual season is the turtle festival, which is also supported by the project, with many visitors, some even making the five hour drive from Mumbai.

KHAZAN: CENTURIES-OLD TRADITION TO CULTIVATE RICE AND FISH

A few hundred kilometres south of Mumbai is the island Chorao, which is between the two rivers Mandovi and Mapusa, from where you can see Panaji, the capital of Goa. There, GIZ employee Aaron Lobo is developing a concept with the inhabitants of Chorao for the protection of the coastal catchment area with its mangrove forests and high biodiversity.

Aaron Lobo is also capitalising on the centuries old culture of the Khazans. With the help of a sophisticated irrigation technique, the fishermen and farmers of Goa are combining rice and fish cultivation in the brackish coastal water. “They use the salt water from the sea to clean fields of weeds, use the monsoon to clean the salt from the fields and then close the gates for three months to cultivate the fish, who swim into the Khazans during the flood, in the rice fields,” says Aaron Lobo, a marine and fisheries biologist. This system is not practised anywhere else in the world.

In times of climate change and increasing water levels on the Goan coast, it is important to fall back on traditional coastal protection measures like mangrove forests and Khazans. “We will revive the Khazans and show how important mangroves and Khazans are for the future of Goa. Mangroves are fish nurseries. They protect cities and villages against storms and floods because they break the force of the flood waves,” says Aaron Lobo. “They have a very important function, not just for the ecosystem, but also for the people.”

Together with the island residents, Aaron Lobo is developing ideas for how they can align the protection of biodiversity with their own interests. For example, with Premanand Mahambre, the chairman of the farmers’ association in Chorao. The 63 year old wants to revive the tradition of the Khazans. Because catching fish brings in more income, many residents don’t grow rice any more. They also no longer maintain the sod and soil protective dams. These were looked after and maintained by their fathers and grandfathers for several hundred years to protect their land from flooding. According to Mahambre, Goa may lose a large part of its cultivatable space this way: “Our ancestors were able to fight the sea and the rivers off of around 18,000 hectares of cultivatable land in the Khazans. Goa needs this land to feed its people.”



Khazan system, Goa



GETTING INVOLVED

Another focus of the collaboration between the GIZ and the Indian Ministry of Environment, Forests and Climate Change is to provide further training for the employees of the state forestry departments. It was only a few years ago that the forestry departments in India assumed responsibility for the mangrove forests. Now the forestry workers should learn as much about mangroves and marine biology as possible. Together with the leading national educational establishments for forest officers, the GIZ is developing a biodiversity programme as curriculum for their training. The programme also focuses on the involvement of the most important participants in the protection of nature and communication with the public. "It doesn't make sense to establish nature reserves without including the people living there in the concept. That's not sustainable," says the GIZ programme leader, Endrukaitis.

THE BEAUTY OF THE MANGROVES

Interview with N. Vasudevan,
the Chief Conservator of Forests in Mumbai

What is the importance of the mangrove forests at the Thane Creek for Mumbai?

Mumbai is a very urban region, we have hardly any green areas left. If we manage to protect the mangrove forests, we will get to keep one of the last continuous green areas in the city. Mangroves are also important for coastal protection in Mumbai. They shield the city from floods.

You will have to convince lots of major players of this first. How will you do that?

There has been a change of opinion in Mumbai since the tsunami did a lot of damage in India. Many feel that nature has an important function for people. But it is going to be difficult. We can do it if we forge a strong alliance for environmental protection with environmental groups, scientists, politicians and the local economy.

Currently only very few people in Mumbai know about the mangrove forests on their doorstep. How do you want to change that?

By bringing in light tourism, laying footpaths, offering boat tours and building a modern information centre. The Mumbaikars will then very quickly see the beauty of nature on their doorstep.



IMPACT

- In Goa, Gujarat, Maharashtra and Tamil Nadu, the management of existing nature reserves has improved. There are new reserves, which are being implemented and cooperatively planned with the people living there and the social actors.
- The reserves are to be opened for light tourism to inform visitors of the significance of the marine coastal regions for climate protection and biodiversity.
- The joint plan supports India to achieve the goal set out in the convention on biodiversity to turn ten percent of the marine and coastal regions into nature reserves.

THE CONTRIBUTION OF THE GIZ

- The GIZ advises the forest authorities on how to improve the management of existing nature reserves in coastal regions and how to plan and implement new reserves. For this, the partners are inviting international experts, organising discussions with managers of nature reserves and developing topical studies.
- The GIZ is developing a curriculum to provide further training to the employees of the Indian forest management, who run the nature reserves, on coastal protection.
- The GIZ is initiating a dialogue with environmental associations, private companies and the fisheries sector. They are developing communication strategies to enlighten the local population and to protect the environment.





NAMA

DEVELOPING NATION-SPECIFIC MEASURES FOR LIMITING EMISSIONS IN INDIA

The GIZ has begun to support the Indian government with feasibility studies, technical expertise and training for the development of two nationally appropriate measures for limiting emissions (Nationally Appropriate Mitigation Actions - NAMAs).

In October 2014, at a workshop of the Indian civil society in Mumbai, Enrico Rubertus spoke on the topic of the Nationally Appropriate Mitigation Actions (NAMAs). “The NAMAs are voluntary measures by countries for climate protection. The countries have a lot of room for maneuver when selecting their NAMAs,” he said. “India is already running some programmes that contribute to global climate protection. These could also be declared to be NAMAs.”

The climate specialist and GIZ employee, Enrico Rubertus, has been working in the field of climate change in India for many years. Now he advises his Indian counterparts at the Ministry of Environment, Forests and Climate Change (MoEFCC) on how to prepare for the first two NAMAs in India. His tasks include involving private organisations in the discussion. He travelled to Mumbai to make Indian civil society more familiar with the ideas of the NAMAs.

NAMAs: VOLUNTARY INVOLVEMENT IN CLIMATE PROTECTION

The term NAMA was outlined and described in the context of international climate negotiations at the world climate conference in Bali in 2007 as referring to voluntary measures for the protection of the climates of developing countries. These are to contribute to both global climate protection and economic development. Many developing countries are already implementing ambitious measures for the protection of the climate. However, these are only partially declared as 'NAMAs', which means people often falsely think that only very few NAMAs have been implemented until now. For the implementation of mitigation measures in general but also of NAMAs in particular, international climate financing is available - for example from the NAMA Facility or the Green Climate Fund.

INDIA: WELL-PREPARED FOR NAMAs

The low carbon strategy of the Indian government provides a good basis for the development of an eco-friendly economy and thus for Indian NAMAs. In a low carbon scenario, the participating authors have calculated that the low, but rising per-head emissions in India would be reduced by one tonne of CO₂ to 2.6 tonnes per head in 2030 compared to the Business as Usual scenario. For this, 0.15 percentage points per year would have to be invested in the Indian economic output in low carbon measures.

India already has a lot of measures on the way to combat climate change. Besides the effect on the climate, these often have additional positive side effects, says Rubertus. "If a government wants to organise a whole sector in a low carbon way, this can also create new jobs at the same time, which increase competition and thus create more economic output."

Together with his Indian partners, Rubertus is now developing framework conditions and criteria for the selection of NAMAs. For this, the partners are also using the expertise of the GIZ to create synergies, for example with the REDD+ mechanism for avoiding deforestation. "India is expected to then get two NAMAs going in forestry and waste management," says Rubertus. Using feasibility studies, the partners are now checking which subsectors are to be dealt with, whether they support socioeconomic development and the transfer of technology, and how the private sector can be brought in.

IMPACT

- NAMAs support low carbon development for whole sectors and thus make a highly positive contribution to the climate.
- NAMAs can have positive side effects like creating new jobs, better infrastructure and higher competition. So they are an attractive instrument for developing and emerging countries to voluntarily contribute to the protection of the environment and at the same time to financially support this protection.

THE CONTRIBUTION OF THE GIZ

- The GIZ advises the Indian actors as part of the International Climate Initiative for the development of two NAMAs in forestry and waste management. This includes the construction of a Measuring, Reporting and Verification system (MRV) for the two sectors.



Construction site, New Delhi



Resource efficiency

RESOURCE EFFICIENCY ALSO PROTECTS THE ENVIRONMENT

Together with their Indian partners, the GIZ is examining how India can organise their construction sector and mobility sector in a more resource efficient way.

Indian households still need less than a third of the material resources that Europeans need. But India's middle class and its needs are sharply on the rise - and so too is its demand for steel, concrete, rare earth elements or copper to build cars and apartments and construct fridges, smart phones and air conditioners. But where should these resources come from if more than 1.2 billion Indians catch up to this level of development and consumption? And how can material cycles be created so that they consume as little raw material and energy as possible, protect the environment and are also cost effective and socially sustainable?

RAW MATERIAL CYCLES SECURE VALUABLE RESOURCES AND SAVE ENERGY

The resource efficiency program at the GIZ is looking for answers to these questions with its partners in ministries, the economy, science and civil society. "Indian society is spending a lot of time discussing how water, energy and land are becoming ever more limited. But it is not talking about the daily rising demand for metals, construction materials and raw materials," says Frank Samol from the GIZ. Resources concern many economic activities. Steel, for example, needs a lot of energy before it can be processed. Where iron, copper or even bauxite are used for aluminium production, this often ecologically destroys complete mining regions or turns out the people living there. And many resources are already limited where they are needed. "Sand for example," says Samol. But without sand, no houses and bridges can be built and no glass can be made.

Many resources are available as secondary raw materials so they can be recycled and injected back into the economic cycle instead of being stored unsorted and uselessly as waste. Here is an example for construction material: "The construction sector is the biggest industry in India. Every day in India, thousands of tonnes of rubble are created. This rubble contains lots of valuable raw material, but it is currently not being recycled. We want to develop material cycles with the GIZ to effectively use our resources in a way that protects the climate and is socially sustainable," says K Vijaya Lakshmi, Vice President of Development Alternatives.

The development organisation has been working on the issue of resources for 30 years and has already developed energy and resource protecting markets for construction materials like bricks made from fly ash, a waste product of pit coal combustion, in cooperation with science and government. "Our fly ash bricks save 80 percent of the energy consumption and thus 80 percent of the CO₂ emissions," says Lakshmi.



USING GERMAN EXPERTISE

The Indo-German resource efficiency project is concentrated on two sectors: on the construction industry and the mobility sector, with a focus on the automobile industry. International and national experts have begun to examine how these markets have been organised so far, where resources can be saved and how material cycles can be efficiently created on behalf of the GIZ. Thus the project relies on German expertise, says Samol. “German industry and scientific equipment are very innovatively established for resource efficiency. We will initiate a partnership between India and Germany involving companies, organisations, business representatives and research institutions.”

IMPACT

- Efficient resource cycles save energy and material, increase competition and protect the climate. Recycled aluminium reduces CO₂ use by 70 percent compared to primary manufactured aluminium. If bricks are produced from fly ash - a waste product of pit coal combustion -, 80 percent less greenhouse gas is emitted when compared to standard construction bricks.
- The project is developing recommendations for political and scientific action using market analysis and innovative pilot projects in the mobility and construction industries.
- The results and experiences have a positive effect on social and economic political discussion in India on the wide ranging themes of climate change, sustainable production and consumption.

THE CONTRIBUTION OF THE GIZ

- Involving international experts, organising training and transfer of expertise to the Indian partners.
- Germany is advising those who are implementing pilot projects which illustrate the high potential of resource efficiency in India.
- Assistance in the formulation of a resource strategy for India.





Waste to energy

THE RAW MATERIAL SOURCES OF TOILET SEWAGE AND KITCHEN WASTE

The city of Nashik will soon create electricity and organic fertilisers from restaurant waste and toilet sewage. This way it can dispose of sewage and create electricity at the same time.

Black water from toilets and food scraps are not waste. Used correctly, they are important raw material and energy sources. Biogas, electricity and organic fertilisers can be created from them. Using the right mixture, co-fermentation plants create more biogas than conventional biogas plants. The more concentrated the so called black water - i.e. toilet water, urine and excrement - is, the more methane gas is released during fermentation and the more electricity can be produced from it. As black water is mostly collected in cesspits in India and is not washed through drainage in sewage treatment plants and thus diluted by other household waste water, the energy yielded is already high and it can be increased even further with the addition of food scraps. Compost can be created from the fermentation process - as a soil improver. The German water supply and removal company Hamburg Wasser developed the system.

In Nashik, the city and the GIZ have constructed a pilot plant for the co-fermentation of food scraps from restaurants with black water from the city cesspits in Nashik. With food scraps from 1,300 restaurants and black water from 400 public toilets, the city of Nashik is already producing electricity and organic fertilisers.

SUSTAINABLE BUSINESS MODEL FOR SEWAGE DISPOSAL

The biggest use lies in developing a suitable operation and business model, with which sewage in India can be processed in the most cost effective way. This is based on a partner approach, which allows the public and private sectors to share responsibility. The city of Nashik, as the public bearer and owner of the project, is using the prices for the energy supplied in the state of Maharashtra and has brought in a tax liability for organic waste from hotels and restaurants. These businesses send their raw material and are able to dispose of their waste cleanly.

India's communities, which only in the rarest cases have functioning sewage disposal systems, can kill two birds with one stone using this business model. They would finally have a system for cheaply disposing of their toilet sewage and at the same time they would be creating electricity with biogas. "The idea to create energy for Nashik from food scraps and black water is very pleasing to me," says R.K. Pawar, head engineer of the city water and sewage supply in Nashik. This idea should get around in India. "A particular focus of the project is to show the potential of such a method of disposal and to make it well known," says Dirk Walther, the project leader of the GIZ on site.

If the Nashik pilot plant becomes part of the general running of things, it wouldn't just be a good idea for India. Around the world, large amounts of sewage end up uncleaned in nature, dirtying water resources and ecosystems, which are important to life, and threatening the health of the people who live nearby. Several thousands of people die each day, especially children, as a consequence of unhygienic contact with black water. Seeing sewage from toilets and food scraps as sources of raw material changes the problem of sewage disposal into a sustainable solution that will protect life, as well as create energy, water and organic fertilisers.

IMPACT

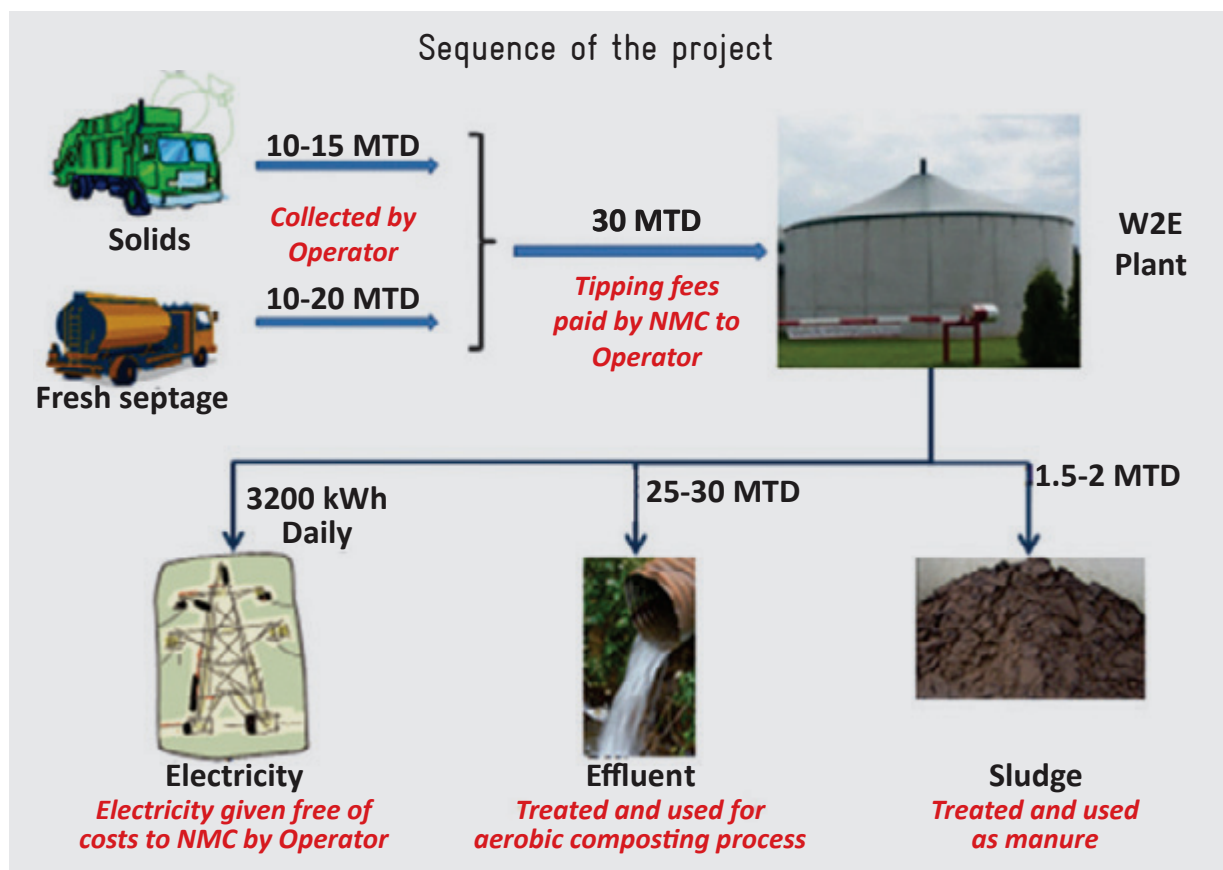
- Pilot plant for sewage disposal - with high potential to treat global sewage in a cost effective way.
- Climate-friendly creation of biogas and electricity

THE CONTRIBUTION OF THE GIZ

- Conception of pilot plant in collaboration with the Indian partners.
- Transferring expertise and specialist knowledge to the Indian partners in city management and ministries

“The idea to create energy for Nashik from waste and black water is very pleasing to me.”

R.K. Pawar, head engineer of the city water and sewage supply in Nashik







IGEF

CONNECTING ENERGY POLICY,
CLIMATE PROTECTION AND ECONOMICS
SUCCESSFULLY

The Indo-German Energy Forum (IGEF) is a high-level forum at which Indian and German decision makers discuss current energy policy developments and initiate new cooperations that are picked up by the International Climate Initiative.

In 2006, the German Chancellor Angela Merkel and then Indian Prime Minister Manmohan Singh brought to life the Indo-German Energy Forum (IGEF). The IGEF is a high-level political dialogue. Here, high ranking representatives of both countries discuss current political approaches and their collaboration in the energy sector. Among them are the leading department of economy and energy, as well as representatives from the ministries for the environment and developmental collaboration. The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) is currently financing the IGEF connection office led by the GIZ by means of the International Climate Initiative (IKI).

COLLABORATION WITH THE ECONOMY

The particular characteristic of the IGEF is that the private sector is also part of the work group. “The IGEF is much more than a collaboration between two governments. The IGEF is the bridge between politics and private economy,” says Ajay Mathur, Managing Director of the Agency for Energy Efficiency in the Indian Ministry of Power. Many new projects are conceived in the IGEF, addressing both the interests of politicians and the concerns of the private sector. “We believe that projects will only work if markets arise and companies make profits,” says Ajay Mathur.

ANNUAL HIGH-LEVEL MEETINGS

Tobias Winter and his five colleagues of IGEF organise high-level forums every year, where the state secretaries of the participating ministries contribute political momentum. The bilateral thematic work groups, workshops and specialist conferences of the IGEF with broad participation from the private sector and research institutes offer opportunities to discuss current questions of the development of the Indian energy system. “IGEF commissions feasibility studies, prepares the work groups and organises topical discussions between all participants,” says Winter.

The forum covers a range of topics, for example, the question of how renewable energies are integrated into the Indian network or how the 400 million Indians without access to electricity can be provided with reliable and environmentally friendly energy. In the area of energy efficiency, it discusses how a climate-friendly environment can be created for the enormous investments into India's economy, for example in the building sector, so that in future less greenhouse gas is emitted. The IGEF has initiated many projects, including several IKI projects, such as the Comsolar project for the market development of solar energy in India.



IMPACT

- The IGEF support office helps to enable a continuous political dialogue between India and Germany on questions of energy and climate.
- Indian and German decision makers from politics and the private sector initiate future projects for low emissions and climate-friendly energy policy in India.

THE CONTRIBUTION OF THE GIZ

- The International Climate Initiative finances the support office with contact structures in Delhi and Berlin to facilitate the work of the IGEF and its working groups.



Participants from the public and private sector at the 5th Indo-German Energy Forum held at Berlin in February 2013







Mirros being aligned and placed on the parabolic reflectors



Comsolar

THE SUN IS RISING ON INDIA'S ROOFTOPS

The around 1.5 million photovoltaic (PV) systems on German roofs produce half of Germany's electricity on sunny days. Comsolar wants to contribute to repeating this success story in India. The project develops demonstration projects and business models so that investors can more easily tap into the amazing potential of solar power in India.

Around the world, prices for solar systems and PV panels are falling. In India too, solar power stations produce energy at production costs that can compete with fossil fuels in many locations. But before solar electricity arrives at the plug sockets of consumers, there are still lots of open questions to be answered, for example, at what conditions can solar electricity be fed into electricity networks and how can the Indian networks provide large, irregularly fluctuating solar electricity quantities reliably?

MORE THAN 100 GIGAWATTS OF SOLAR ENERGY BY 2022

But above all, the market players must be convinced that solar power stations in India are a lucrative investment. “Even I didn’t know three years ago that solar power was a very serious and certainly worthwhile opportunity for India,” says Tarun Kapoor. Today the department leader for India’s solar mission at the Ministry for New and Renewable Energies (MNRE) is convinced of the technology. “Renewable energies are our only chance to free India from its dependence on coal and at the same time to provide all Indians with electricity. Solar power stations will play a decisive role in this.” Solar power stations with a power of 13,000 megawatts are already being built or projected, says Tarun Kapoor. In the meantime, the Indian government has increased their goal to 100 GW for solar plants by 2022.

To convince investors, India and Germany have initiated the joint project Commercialisation of Solar Energy in Urban and Industrial Areas, Comsolar for short, which is financed by the IKI. “The goal of our advice and activities is to support a quick development of the market for solar energy,” says Timon Herzog, project leader of Comsolar at the GIZ. Comsolar develops business models and advises the Indian Ministry for Power and several states on creating guidelines and legal frameworks. It also develops training for the partners, commissions international experts with market studies and implements demonstration projects to show technical and economic feasibility. Among these projects are India One and the collaboration with the Delhi Metro Rail Cooperation (DMRC).

COMSOLAR: SOLAR ENERGY FOR CITIES AND INDUSTRY

Comsolar concentrates on urban and industrial centres of the country, where energy needs will rise dramatically with increasing urbanisation. Its focus is the market for solar thermal process heat and networked PV roof systems. Together with the Ministry for New and Renewable Energies (MNRE), Comsolar is developing market-orientated legal frameworks, initiating pilot projects, commissioning feasibility studies and inviting industry representatives and potential investors to workshops to convince them of the potential of solar energy systems.

Timon Herzog sees the biggest potential for photovoltaic systems on roofs in the Indian cities and manufacturing sites. “Solar systems on roofs save money and space. Lots of small, sparsely installed systems in the cities can also be integrated very well into an electricity network.” This has already worked in Germany with its 1.5 million solar energy systems on roofs. Timon Herzog is convinced that this success story can be repeated in India. “Because there is a lot more solar radiation in India, the energy yield and cost effectiveness is comparatively higher than in Germany.”

IMPACT

- Comsolar has already initiated more than 20 pilot projects for solar applications in the Indian market
- The Delhi Metro Rail Corporation (DMRC) wants to install photovoltaic systems with a power of 20 megawatts on the roofs of their underground stations, operation halls and offices in the next three years
- More than ten states have created rules for networked PV roof systems since the project began
- Solar thermal technologies and solutions for industrial process heat, solar building heating and thermal storage have been developed and implemented and have become well known in the market

THE CONTRIBUTION OF THE GIZ

- The GIZ advises several states and the Ministry for New and Renewable Energies (MNRE) with a team of eight energy experts on the development of the Indian solar market, develops business models for investors and implements pilot and demonstration projects.
- On the website www.solarguidelines.in, potential investors can find a detailed step by step set of instructions for how they can invest in the Indian solar market, at www.soproindia.in, companies can learn about solar thermic systems for process heat



“Renewable energies are our only chance to free India from its dependence on coal and at the same time to provide all Indians with electricity. Solar power stations will play a decisive role in this.”

Tarun Kapoor, State Secretary for India's solar mission at the Ministry for Power



Rooftop photovoltaic system at Dwarka
Sec 21 Metro station, Delhi



Comsolar DMRC

FUTURE RESCO MODEL FOR UNDERGROUND TRAIN SERVICES IN INDIA

The Delhi Metro Rail Corporation (DMRC) wants to install photovoltaic systems with a power of 20 megawatts at its stations and operation and office buildings in the next three years. Investment and operation is being taken on by service providers. The DMRC, in return, gets green electricity, which is cheaper than coal-powered electricity.

Anoop Kumar Gupta, Managing Director of the DMRC, is one of the pioneers for large solar applications in India's large cities. Kumar recently had a pilot project with 500 kilowatts of power installed in the underground station Dwarka Sector 21. He is very happy with the results. "The system creates green electricity, that we use ourselves, and the electricity is also cheaper than it would be if we had to buy it. And we don't have to take care of anything, we just provide the space."



RESCO MODEL PROTECTS THE ENVIRONMENT AND SAVES ENERGY COSTS

This is made possible by a so-called RESCO model. Using this model, a Renewable Energy Service Company (RESCO) invests in and operates the system and delivers the electricity at an agreed set price to the owner of the surface, in this case the DMRC. The underground operator just provides the surface and receives cheap, green energy in return. It's no wonder then that Gupta wants to make more roof spaces available for RESCOs. On their underground stations, operating buildings and office spaces, the DMRC has tens of thousands of square metres of unused roof space. Gupta wants to attach photovoltaic systems to around half of these in the next three years. He has committed to this goal in the DMRC's own Solar Policy, which has been made public. "Then photovoltaic systems will have been installed onto our roofs with a power of 20 megawatts," says Gupta.

The DMRC project is part of Comsolar, which wants to commercialise solar energy in India. "We have financed feasibility studies, advised DMRC on project development from the initial idea to the implementation and provided training to DMRC employees. Originally, DMRC wanted to integrate small PV systems on the domed roofs of individual stations," says Timon Herzog from the GIZ. "We have demonstrated the potential of the large operating buildings which can easily be equipped with PV systems, and developed different business models for the DMRC management to give them several options to choose from."

What works at the DMRC in Delhi will soon be brought to other cities. "We are advising practically all of the underground companies in India," says Anoop Kumar Gupta. "Many of them have announced that they are now having solar energy systems installed on their roofs according to the RESCO model." For this, the DMRC will work with ComSolar and the MNRE workshops for Indian underground train companies to implement PV projects on underground station roofs.

IMPACT

- As a showcase for the RESCO models wanting to operate photovoltaic systems on rooftops in large Indian cities, the PV project at the DMRC is very significant for Delhi and other large Indian cities
- The project proves that climate-friendly electricity from solar power is already able to compete with energy sources which are damaging to the environment

THE CONTRIBUTION OF THE GIZ

- The GIZ has commissioned international consultants with the testing of the technical feasibility and technical project design. It has also developed a competitive RESCO model for photovoltaic systems on roofs in India





Parabolic reflector at the Brahma Kumari
aashram in Mount Abu



Comsolar India One

SOLAR ENERGY FOR 25,000 PEOPLE

In Rajasthan, 770 parabolic reflectors are to provide the 25,000 guests of the Ashram in Mount Abu with electricity, warm water and cooking energy from 2016. Due to its particular storage technique, the solar thermal power station, India One, will produce electricity and heat around the clock.

The sight is spectacular. Like beings from another world, hundreds of silvery shining parabolic reflectors are lined up next to one another, each of them more than four times as tall as a person and framed with a yellow metal rack. It doesn't take a second until the piece of wooden that Jayasimha Rathod is holding in the burning point of the parabolic reflectors sets alight. "Yes, it happens very quickly, the parabolic reflectors create a temperature up to 1,100 degrees celsius in the receiver," says the mechanical engineer and technical leader of India One, as the system here in the Ashram of the Brahma Kumaris in Mount Abu is called.

A total of 770 parabolic reflectors with a surface of 60 square metres each, each made from 800 individual mirrors, are lined up precisely by the millimetre to catch the sun's rays and reflect them to the receiver at the right angle. The centrepiece is a one tonne heavy steel block with a lens, onto which the parabolic reflectors concentrate the sun's rays. Behind the lens, water runs through a heat exchanger, evaporates and turns a centralised turbine, creating up to a megawatt of electricity. "That is enough for the Ashram to provide 25,000 guests with electricity, warm water and steam to cook with," says Aneta Loj, who was born in Poland and has now lived in the spiritual community for a few years.



A SOLAR SYSTEM FOR DAY AND NIGHT

Concentrated Solar Power (CSP) is the name of this technology, which gathers the sun's energy and produces electricity using water vapour or another medium, such as a chemical substance. But for India One, there were other things to consider. "For us it is important to be independent and to produce green energy that does not harm the environment," says Aneta Loj. "We also want to develop a technique that can be replicated everywhere in India.." The transfer medium isn't an efficient but poisonous chemical, instead it is pure water, and the receiver is completely made of steel. This has another advantage, "Because steel stores the heat for a very long time, we can produce electricity round the clock," says Aneta Loj.

Brahma Kumaris is a spiritual association with around one million followers worldwide. At its centrepiece is the idea that man can develop a better self through meditation. Making the world better is also one of their principles - for example by using green electricity, "We have already set up six large solar thermal systems and one hundred photovoltaic systems in our meditation centre," says Golo Pilz, the German Technical Expert who was instrumental in setting up the solar thermal power station at Mount Abu.

CSP TECHNOLOGY THAT IS REPLICABLE IN INDIA

For fifteen years, the Ashram has been boiling water vapour from solar energy, which is created with so-called Scheffler parabolic reflectors. The CSP system for creating electricity also follows the technology of the German engineer, Wolfgang Scheffler. Because the new power station is adapted to the Indian context, Brahma Kumaris can produce a large part of the technology they need for it in their own workshop. Golo Pilz and his colleagues have trained 200 employees for this, who weld the parabolic reflectors together and set them up. With the expertise that India One has acquired over the years, there are plans for further systems to be built in India. "The technology is very well suited to providing cost effective heat for industrial processes or electricity for regional or power networks," says Golo Pilz.

IMPACT

- India One has developed a technology that can be easily replicated in India. The experience that the Brahma Kumaris have accumulated in the last four years will be made available to other projects free of charge to build more CSP systems in India.
- The system produces up to one megawatt of climate-friendly solar electricity and water vapour for showering and cooking.

THE CONTRIBUTION OF THE GIZ

- GIZ provides technological expertise from Germany – for example from the Fraunhofer-Gesellschaft – and necessary material like steel and receivers.







SolMap

GLOBALLY UNIQUE

With the project Solar Mapping and Monitoring (SolMap), the Indian government can measure the solar radiation for the entire Indian land area. The GIZ supported this pioneering work with technical expertise and expert knowledge. The data from SolMap enables investors to have the highest possible level of planning security when developing systems and selecting locations, considering risk factors for climate and weather.

They are just four metres high, thin as a rake and decorated with all sorts of meteorological measuring instruments. At first glance, the measuring stations for the SolMap project from the Indian government don't look like much. But if you listen to Godugunur Giridhar and Indradip Mitra (from GIZ India) for a few minutes, you will know what is hidden inside the 121 measuring stations installed so far. "We have the best measuring instruments that can be found on the global market today with a maximum error tolerance of two percent," says Godugunur Giridhar, the director of the Solar Radiation Resource Assessment (SRRA) in Chennai. This is a decisive step forward, as until now only a few measuring systems of mostly insufficient quality were available.

The weather stations measure 37 kinds of weather data every second and send them by GPRS to the server room, two doors down from the SRRA leader's office. "But only the solar radiation is really important for us," says Indradip Mitra. "There are three values for the solar radiation. For photovoltaics, you have to know the value for global radiation which comes from all directions, for Concentrated Solar Power (CSP) you need the direct solar radiation, i.e. the radiation coming only from the direction of the sun. The diffused sun radiation - the difference between the two - is important for agriculture and the property sector." If you can measure the values for global and direct solar radiation exactly, you know where the best location for a solar power station is - and this gives investors the highest possible level of security for the factor that determines the value of their investment: solar radiation.



SCIENTIFIC PIONEER PROJECT WITH GREAT POTENTIAL

However, what sounds so easy in theory is actually hard to achieve in practice. So far, only a few countries have been able to deliver direct and global sun radiation values through such a comprehensive and high value measuring project as the SRRA in India. Mitra, Giridhar and their fifteen colleagues worked on a project that will be significant for the future of the solar industry not just in India. For this, they have honed the technique for three years with scientific rigour and with the help of satellite data, data quality control, algorithms, special software and discussions with leading research institutes in Europe and the USA, so that they can now say that their data is reliable and of the best possible quality.

A great deal of thought has been put into SolMap. Sometimes, for example, a bird resting on the measuring lens can distort the results. "One particular feature of SolMap is the quality of the data," says Indradip Mitra. "Together with the German company, Suntrace, we have developed a special software over the course of many months to automatically detect and correct errors. This way we can be sure that our data is correct."

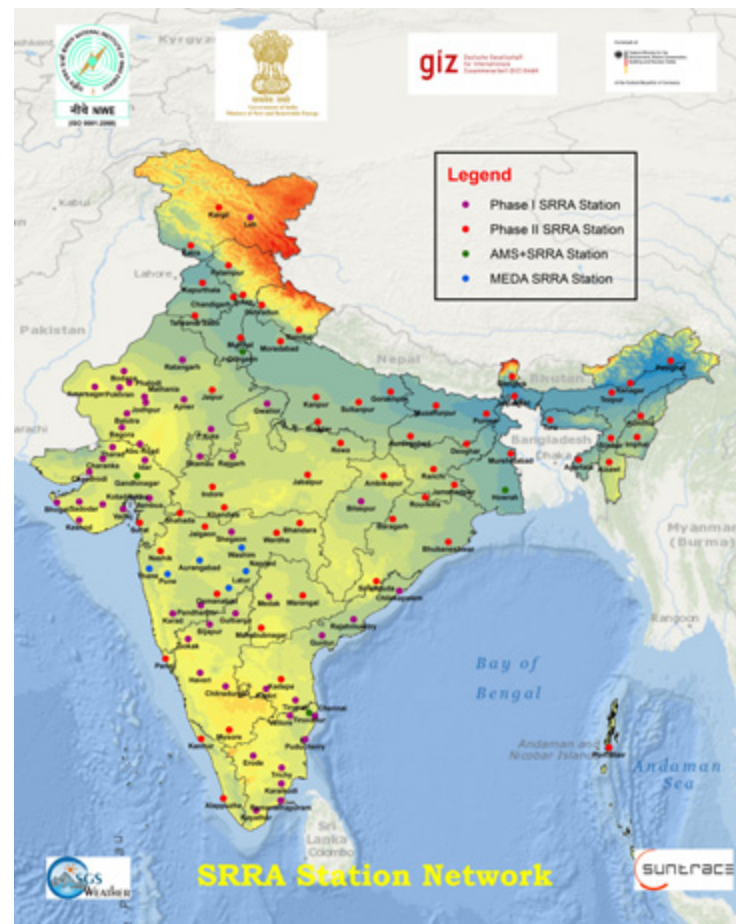
In contrast to satellite data that was the basis for investment decisions for solar power stations in India until now, the measurements from the SRRA stations are significantly more precise. "The satellites give values that are up to 20 percent higher than the values we have measured," says Godugunur Giridhar. This wasn't pleasing news. Not for investors who have already built CSP systems for creating electricity and now have to make due with

as little as one fifth less solar energy than was predicted. And also not for the Indian government, who saw CSP power stations as a functioning solution for wide spread solar electricity provision in India. Only certain regions in India reliably supply the 2,000 kilowatt per hour of direct sun radiation each year (kWh/m² p.a.) that is needed to efficiently operate a CSP power station. That is bad news.

INDIAN EQUATORIAL SUNBELTS: PERFECT FOR PHOTOVOLTAICS

The good news is: The values are sufficient to profitably use CSP power stations for creating heat, for example for application in industry. And even better: All Indian locations are generally suited for photovoltaics to produce cheap, clean and climate-neutral electricity. “For large photovoltaic power stations and CSP systems for creating heat, India thus offers excellent conditions - the sunbelt being an even more excellent region,” says Indradip Mitra.

But SolMap doesn't just supply data for future solar applications. It also helps to record and optimise the level of efficiency of already installed solar power stations. “With our data, we support operators in increasing the level of usefulness,” says GIZ adviser Indradip Mitra. A good quarter of India's solar power stations are already using SolMap to retrieve more electricity from their systems. And with the other 34 items of weather data that SolMap collects besides sun radiation, in future, precise data on climate change and its consequences can be generated. This data can be used in lots of ways, for example in agriculture to counter the consequences of climate change.



IMPACT

- SolMap India supplies very reliable and high quality data on solar radiation on the largest surface used for this purpose so far: the entire land area of India.
- SolMap provides precise data in an India-wide network and can provide the sun radiation for any second of the measurement timeframe that has passed within a total of three years.
- Investors and companies that want to invest in solar power stations in sunny India use this data as a basis for a decision to invest in and operate their systems.
- The planned expansion of the measurements to the whole Indian subcontinent promises a high value database for the whole country.

THE CONTRIBUTION OF THE GIZ

- The GIZ accompanied the Solar Radiation Resource Assessment (SRRA) in Chennai for the full time period of three years to project and implement SolMap. While the Indian partners took on the costs for the measuring stations, the GIZ contributed the experience of world leading experts into the project and financed the special software for data quality assessment.





Trigen

RURAL ENERGY SUPPLY

The farmers near Korba in Chhattisgarh plant grain, maize and rice. Until now, they have sold their products in an unprocessed state at markets, getting very low returns. If these products were to be processed, they would bring in much more money. However, the existing electricity supply wasn't sufficient to do so. The available power line only supplies single-phase electricity, which is too weak to operate agricultural machines. Recently, 24 villagers created a productive network chain with the support of the GIZ and installed generators for creating electricity. The residents collect and buy jatropha seeds, which are then processed into oil and press cake. With the oil, the generators create three-phase power, which is strong enough to run irrigation pumps and flour and oil mills. Now the farmers can process and refine their products and sell them for more money. 4,000 families benefit from the project, which was created with the help of the International Climate Initiative and the technical advice of the GIZ. A newly founded women's cooperative has been particularly successful, manufacturing high quality nutritional supplement mixtures from various grains and other products with a mill. They are an ideal nutritional supplement for infants and pregnant women in a region in which undernourishment is still widespread. The production chain is carbon neutral and has been run by the villagers on their own since the project was completed.

NEW ENERGY TECHNOLOGY FOR COMBINED ELECTRICITY, HEATING AND COOLING

The patients and doctors in the emergency hospital in New Delhi don't notice the new energy technology in the basement. But they benefit from it. This is because energy supply is now much more reliable and efficient than it used to be, thanks to the trigeneration system (combined power-heat-cooling), says Deepak Bhutale, the responsible engineer at the emergency hospital: "Even if the power network in Delhi keeps going down over and over again, we don't just produce electricity and heat with our trigeneration system, but also the cooling for our air conditioners. And we can do all of this more efficiently and in a more environmentally friendly way than with any other technology." Trigeneration is based on the principle of using the waste heat from electricity production partially as direct heat and converting part of it to create air-conditioning. With this technology, the energy yield of 85% is more than twice as high as compared to a standard diesel generator, which would usually be used in India during power outages. The GIZ planned the trigeneration pilot project in the emergency hospital with their Indian partners and implemented it for the International Climate Initiative. Trigeneration pilot projects are particularly suited for hospitals, airports or shopping centres, i.e. anywhere where cooling is needed, as well as electricity and process heat. The GIZ has already identified around one hundred locations in India, in which significantly more safe and efficient energy can be produced with this technology.



Staff of the emergency hospital, New Delhi, at the trigeneration system



Twenty-one bilateral IKI projects in India until now

IKI projects in India	Implementation organisation	BMUB promotional volume	Duration
Eco Industry Parks in Andhra Pradesh	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 720,332.08	2008 – 2012
Climate protection and decentralised energy supply - Indo-German Energy Forum	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 1,253,464.07	2008 – 2011
Demonstration proposal in India for the conversion of a production plant for the manufacture of split and window type air conditioners operated with natural coolants	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 2,175,797.27	2008 – 2014
Trigeneration Trauma Centre All India Institute	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 1,151,292.65	2008 – 2014
Climate-neutral energy supply for rural areas	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 4,720,471.16	2008 – 2014
Commercialisation of solar energy in the urban and industrial sector (ComSolar)	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 13,872,000.00	2009 – 2016
Excellence Enhancement Centre - India	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 1,745,604.31	2009 – 2015
Energy generation from sewage and organic waste	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 2,036,382.00	2009 – 2016
Solar Mapping and Monitoring (SolMap)	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 1,948,300.00	2010 – 2015
Connecting office - Indo-German Energy Forum (2nd phase - Climate protection and decentralised energy supply - Indo-German Energy Forum)	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 3,214,165.00	2012 – 2016
Development and management of NAMAs in India	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 3,000,000.00	2013 – 2017

Integration of renewable energies into the Indian power system, I-RE	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 1,997,467.00	2014 – 2017
Resource efficiency and secondary material management as a contribution to climate protection	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 2,995,132.00	2014 – 2017
Sustainable management of coastal and ocean protection, India	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	€ 9,600,000.00	2012 – 2017
Transfer of the energy campaign catering industry to developing and emerging countries	adelphi consult GmbH	€ 141,563.30	2008 – 2009
Promotion of a low carbon transport sector in India	United Nations Environment Programme (UNEP) -	€ 1,955,857.11	2010 – 2015
Financing programme for research cooperation in the field of innovative climate protection technology	KfW Development bank	€ 5,000,000.00	2013-2018
India Sustainable Mobility Initiative	Institute for Transportation & Development Policy (ITDP)	€ 2,350,000.00	2015 – 2019
Disaster prevention and adaptation to climate change in remote villages in the Himalayas	Diakonie Katastrophenhilfe, Evangelisches Werk für Diakonie und Entwicklung e.V.	€ 13,025.00	2008 – 2009
Improvement of nature reserve management and adaptation to climate change in climatically vulnerable ecosystems in India.	KfW Development bank	€ 200,000.00	2009 – 2010

BMUB is funding a further 22 global and regional projects with India as one of several partner countries under the International Climate Initiative.

Imprint

Published by	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH B-5/2, Safdarjung Enclave New Delhi – 110029 INDIA
Registered offices	Bonn and Eschborn, Germany www.giz.de/india
Responsible	Dr. Wolfgang Hannig, Country Director, GIZ-India
Author	Jörn Breiholz
Photo credits	Jörn Breiholz, Enrico Fabian and Aparna Banerjee
Edited by	Aparna Banerjee
Design and Layout	Aspire Design www.aspiredesign.in
New Delhi, November 2015	

On behalf of the German Federal Ministry for the Environment,
Nature Conservation, Building and Nuclear Safety