THE CHANDIGARH SOLAR CITY PROJECT: IDENTIFYING SYNERGIES AND MAXIMIZING THE CO-BENEFITS OF NDC-SDG LINKAGES IN CLIMATE POLICY

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ACTION AREA: Mitigation

FOCUS AREA: Aligning

COUNTRY: India

SECTORS INVOLVED: Energy

TIMEFRAME: 2009-2022

CASE SUMMARY: As part of the Government of India's (GOI) solar city initiative, "Development of Solar Cities", the Chandigarh Solar City Project achieved the targeted 10% reduction of conventional energy demand in its first 5 years of operation through various innovative measures that started a holistic and sustainable transition of the electricity sector in the city. These measures include initiatives and interventions aimed at installing rooftop solar photovoltaics (PV), increasing forest cover, and awareness campaigns on the benefits of solar energy. The project also set its own objective of installing 40 MW solar capacity between 2009 and 2018 (the summation of the rooftop solar PV (10 MW) and large-scale solar (5MW & 25 MW) targets in the long term, based on energy audits and renewable energy potential assessment), delineated in Chandigarh's Solar City Master Plan. In June 2018, the target was revised to follow national Renewable Purchase Obligations (RPOs), with an RPO target of 10.5% for the period 2019-2022 for Chandigarh. This target translates to 69 MW of installed solar capacity by 2022, a jump of 29 MW from the 2018 target.

The project is being implemented by the Department of Science and Technology's (Chandigarh Administration) organisation, the Chandigarh Renewal Energy and Science & Technology Promotion Society (CREST), after a thorough and robustly consulted design process conducted by The Energy and Resources Institute (TERI). The model targets the residential as well as non-residential sector to promote solar energy. It creates an enabling environment for the sectors to produce green power using grid connected solar PV systems, install solar water heaters (SWH) and use energy efficient appliances for lighting and cooking. Further initiatives are currently being taken up to solarise government buildings and public facilities.

Moreover, the programme has successfully generated socio-economic co-benefits which can be used to leverage the sustainable development goals (SDGs) as well as the country's nationally determined contribution (NDC) targets as part of the Paris Agreement. For example, the model enables access to affordable and clean energy, which meets both India's emission reduction NDC target and SDG 7. This case study identifies these potential co-benefits of the model along with their potential entry points to meet said national climate and development targets.

Chandigarh´s Solar City Project qualifies as a good practice because it is innovative in terms of its approach, technically feasible, it aligns well with the SDGs and it engages with key stakeholders.

BACKGROUND:

The rapid industrialisation and urbanisation in India has led to a significant increase in the country's energy consumption (Figure 1). This is reflected in India's contribution to the global energy demand, which has increased from 4.4% at the beginning of the century to 5.7% in 2013 (Ministry of Power, 2018) and is expected to rise further to 25% by 2040 (Government of India, 2017). Almost 75% of the rise in current demand is met by fossil fuels which are non-renewable, environmentally polluting as well as fiscally unsustainable due to India´s resulting dependency on imports (India Energy Outlook, 2015). Therefore, it is essential to increase the deployment of renewable energy (RE) in the country which can help to address concerns regarding energy poverty, climate change and energy security.

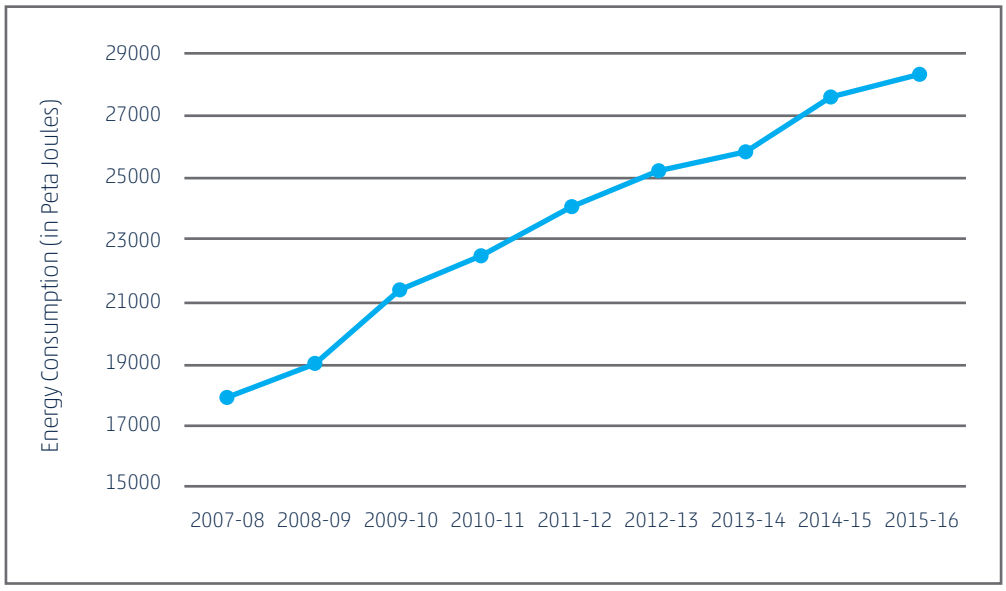

Figure 1: Energy consumption trend of India
(Ministry of Statistics and Programme Implementation, 2018, p. 44)

To increase the momentum of renewable energy integration in the national electricity grid, India has set an ambitious target of 175 GW installed RE capacity by 2022 (Government of India, 2018). The abundance of solar energy has and will continue to be one of the major opportunities to meet this target in the future. In order to effectively harness solar energy for the country's energy needs, one of the eight national missions under the National Action Plan on Climate Change (NAPCC) is dedicated to solar – the Jawaharlal Nehru National Solar Mission (JNNSM). Against this background, in May 2011, the Ministry of New and Renewable Energy (MNRE) launched a programme on the "Development of Solar Cities". The initial objective set by the Joint Electricity Regulatory Commission (JERC) was to bring down the projected demand of conventional energy in selected cities by 10% after five years of the introduction of the programme, mainly through renewable energy projects and energy efficiency measures. As part of the programme, 60 solar cities have been developed as of 2017. The project then followed the provisions of the Renewable Purchase Obligations (RPO), a national intervention that sets state-wise targets on the proportion of renewable energy to be integrated into energy generation. For Chandigarh, the RPOs set by the JERC were 2.5%, 3.6% and 8% for 2018, 2019 and 2022, respectively. The target was revised by GOI's Ministry of Power (MOP) in June 2018 to 10.5% for 2022. Chandigarh is one of the four best performing cities, i.e. 'model cities'.

Due to its increasing population, Chandigarh has witnessed a surge in the trend of per capita consumption of electricity. The electricity sector of the city is further worsened since it does not generate electricity on its own and relies entirely on the central grid. Therefore, it becomes imperative for the city to reduce this dependency by generating power from renewable energy sources.

ACTIVITIES: A range of activities has been conducted to turn Chandigarh into a model solar city, ranging from strategic planning and identification of suitable sites for solar projects to awareness raising and MRV.

1. PREPARATION OF A 'MASTER PLAN': A robust and comprehensive design plan for implementing a model solar city project in Chandigarh (called the Master Plan) was prepared by TERI and approved by MNRE in 2012. It lays out a roadmap which guides the executing agencies towards effective implementation of the model.

2. ESTABLISHMENT OF SOLAR CITY CELL: The Chandigarh Solar City cell has been established in Chandigarh Renewable Energy and Science & Technology (CREST). It holds the responsibility of identifying sites and guiding the implementation of solar projects.

3. AWARENESS RAISING FOR SOLAR ENERGY, PROMOTIONAL AND CAPACITY BUILDING INITIATIVES: CREST has been aggressively promoting solar energy by creating awareness campaigns through e-media, newspapers, solar camps and door to door campaigning. The executing agencies have also built their capacity through interactions, seminars and visits to solar plants throughout the country. Initiatives have also been taken up to promote solar energy both in public and private buildings in cities, as well as villages. These initiatives advocate the installation of solar photovoltaics (SPVs) in government buildings and replacement of conventional street lights with solar lighting. Further, lucrative subsidies are offered to private buildings to promote rooftop SPV's and solar water heaters.

4. TRACKING THROUGH MRV SYSTEM: The project developers hold the responsibility of monitoring, reporting and verifying power generation from each installed plant through either an online or offline portal. This data is used by CREST to keep a check on the efficiency of the plant and also prepare monitoring reports.

INSTITUTIONS INVOLVED:

- **IMPLEMENTING AGENCY:** Chandigarh Renewable Energy and Science & Technology (CREST);
- **FUNDING AGENCY:** Ministry of New and Renewable Energy (MNRE) and Department of Science and Technology (DST), Chandigarh;
- **DISTRIBUTION COMPANY:** Chandigarh Electricity Department (CED) is the electricity distribution company (DISCOM) involved which is responsible for monitoring grid-based evacuation for consumers, i.e. the sale of surplus electricity back to the grid.

COOPERATION WITH: The Master Plan was prepared by The Energy and Resources Institute (TERI). TERI also developed a high-performing and flexible Web GIS tool to estimate the rooftop solar power potential for the Chandigarh area. The design process involved the inputs and participation from the Shakti Sustainable Energy Foundation (SSEF) and the MNRE as support partners and the Solar Energy Corporation of India (SECI) and the Confederation of Indian Industry (CII) as strategic partners.

FINANCE: The project is mainly financed by the MNRE, with a budget of approximately USD 2.4 billion (~INR 174.43 billion reported in Chandigarh's Solar City Master Plan; Conversion Rate: 1 USD= 73 INR) for the period between 2009 and 2018. Chandigarh's Solar City Master Plan document disaggregates this budget for the short term, medium term, and long term, respectively amounting to USD 2.35 billion, USD 23.24 million, and USD 13.79 million, and further, within the several activities implemented under the project. The budget thereon was determined annually, and is currently approximately USD 3.42 million (INR 250 million for 5 MW solar installed capacity addition. CREST interview in November 2018; Conversion Rate: 1 USD= 73 INR) for the financial year ending 31 March 2019.

IMPACT OF ACTIVITIES:

- **REDUCTION IN CO_2 EMISSIONS:** The activities under the Solar City Project have significantly contributed to the emission reductions in Chandigarh, eliminating over 31,000 metric tons of CO_2 emissions (equivalent to carbon sequestered by 3.4 million trees) as of 1 October 2018 (Figures provided by CREST on 1 October 2018. Calculated by CREST based on the installed power capacity.) These figures will substantially rise as the coverage of the solar projects in the city increases.

- **SAVINGS ON ELECTRICITY BILLS:** According to recent estimates, Chandigarh has successfully installed a solar capacity of 23.5 MW (Figures provided by CREST as of October, 2018.) in about 793 sites. This has led to a considerable reduction in electricity bills through a three-pronged approach of replacing conventional energy with freely available solar energy, using energy efficient measures that reduce the quantity of energy used, and enabling the sale of excess power from consumers back to the grid. Savings of USD 3.426 million (converted from the figures provided by CREST as of 1 October 2018 (INR 25 crores). Calculated by CREST based on the installed power capacity. Conversion Rate: 1 USD= 73 INR.) have been made by consumers on electricity bills until this date.

- **CONSISTENT AND RELIABLE POWER SUPPLY:** Chandigarh is prone to experience frequent power shortages which is met through short term power purchases and power exchange platforms. The introduction of solar energy to the power mix has considerably alleviated the burden on the grid via a reduction in peak demand. This has enabled the grid to provide a consistent and reliable supply of clean energy.

- **CONTRIBUTING TO NATIONAL RENEWABLE ENERGY TARGETS:** This project has also enabled Chandigarh to meet its national renewable energy targets. One notable example in that regard is the Renewable Purchase Obligation (RPO), a key policy instrument that obligates entities to include a proportion of renewable energy into their energy use (Table 1). Further, it also contributes to India's Smart Cities Project, which targets for at least 10% of electricity to be generated from solar power.

POWER	ENERGY SALE IN MU	RPO TARGET IN MU (SOLAR + NON-SOLAR)	RPO TARGET IN % (SOLAR + NON-SOLAR)	RPO COMPLIANCE IN MU			
				SOLAR PHYSICAL CAPACITY	SOLAR REC PURCHASE	NON-SOLAR PHYSICAL CAPACITY	NON-SOLAR REC PURCHASE
FY 2011	1,285.33	12.85	1	0	0	0	0
FY 2012	1,301.48	26.03	2	0	2.36	0	10.75
FY 2013	1,376.43	41.3	3	0	2.36	0	52.7
FY 2014	1,423.04	42.79	3	0	15.89	0	42.48
FY 2015	1,512.54	49.92	3.3	0	8.54	0	36.6
FY 2016	1,491.32	52.95	3.55	0.41	9.60	0	43.8
FY 2017	446.26	21.64	4.85	22.99	4.3	0	24

Table 1: Status of Solar Renewable Purchase Obligation compliance of Chandigarh (Joint Electricity Regulatory Commission Tariff Order, 2018)

- **ACHIEVED MILESTONES:** The project has gained considerable recognition and has been one of the most successful amongst the range of cities selected for MNRE's umbrella solar initiative. It has received numerous awards, including the National Excellence Award for solar rooftop projects in 2016, the National Excellence Award 2016 (awarded to CREST for being the top performing state nodal agency for renewable energy), and the second position in the country to achieve the highest capacity addition in grid connected solar rooftop power generation in 2014-15. It was also selected to represent India's solar theme in COP 21.

- **THE CO-BENEFITS OF ACTIVITIES:** Although the Master Plan was not prepared with the intention to contribute to the SDGs, the (development) co-benefits the programme presents become apparent once they are examined more carefully. The model is highly promising in the long term, considering the numerous benefits and co-benefits that can be identified. Furthermore, it could potentially contribute to meeting directly and indirectly both the NDC and SDG targets. Through this case study, those NDC targets and SDGs that could be positively aligned with the activities of the programme were identified. It was observed that SDG 11a, SDG 11b, SDG 7 and NDC target 2 are crosscutting in all activities, while some activities impact particular NDC targets and SDGs (Table 2).

WHY IS IT GOOD PRACTICE:

The Chandigarh Solar City Project constitutes a good practice because of its participatory approach, the innovative technology applied, as well as its exemplary procurement and installation method, i.e. its technical feasibility. Its goals also well align with the SDGs in many regards.

- **STAKEHOLDER ENGAGEMENT:** The Master Plan for the design and implementation of the project was designed through a participatory approach that involved key stakeholders, such as MNRE and JERC, and urban local bodies like the CREST, Public Works Department, Municipal Corporation of Chandigarh, Chandigarh Administration, Municipal Water Supply Department, Forest Department, Chandigarh Electricity Department, and power utilities (DISCOMs). This ensured deliberation of all stakeholder concerns followed by a consensus-based decision making. The collaboration amongst stakeholders for the design and implementation process of the programme exhibits the ideas in SDG 17 (Partnerships for the Goals).

- **INNOVATION:** CREST had set up a 10KWp floating SPV at Dhanas lake which is providing power for aeration of the lake. The developer of the plant made technological improvements to the SPV to produce 30% more power in comparison to conventional SPVs. This innovation is highly replicable in small ponds since it is cost effective, land-neutral and highly efficient. Another innovation came through the development of a Solar rooftop Web-GIS based tool which serves as a decision support system to check for the feasibility of rooftop SPVs based on their location. This also enables meeting SDG 9 (Industry, Innovation and Infrastructure).

Figure 2: Floating SPV in Dhanas Lake, Chandigarh (picture provided by case study authors)

- **TECHNICAL FEASIBILITY:** A minimum electricity generation is guaranteed for all solar PVs installed under this plan. The technical quality and standards are maintained through regular third-party inspections of the installed PVs. The quality of solar panels installed by the developer is also ensured through the provision of a 10-year operation and maintenance by the engineering, protection and procurement and construction contractor. Further, this innovative approach embraces the goals laid out by SDG 9 (Industry, Innovation and Infrastructure) and SDG 11 (Sustainable Cities and Communities).

- **ALIGNMENT WITH SUSTAINABLE DEVELOPMENT GOALS (SDGS):** In addition to the climate change benefits, the programme has several socio-economic co-benefits which can contribute to both global and national climate and developmental targets, i.e. NDCs and SDGs. Table 2 in this case study illustrates how the projects supports reaching the SDGs in the case of Chandigarh. The 'co-benefits' approach is integral when considering links between climate related policies sustainable development, as they are closely aligned concepts that cannot be treated in silos. Climate policies often have sustainable development co-benefits, and vis-à-vis, developmental policies can be designed to create climate co-benefits. It is therefore imperative that policy makers consider those links carefully when designing their climate and development policies.

SUCCESS FACTORS: A number of factors has enabled the successful realisation of the Chandigarh Solar City Project. Support in installing solar plants was offered to consumers to increase take-up. With the Master Plan, a clear pathway for implementation has been established. Additionally, through its long-term planning and budgetary requirements, the plan manages to create long-term impact. Also, the programme has created tangible co-benefits

- **PROFESSIONAL AND TECHNICAL SUPPORT:** The Government of Chandigarh initiated an online portal (https://www.solarchandigarh.com/) to speed up and simplify the regulatory mechanisms for applying and obtaining subsidies aimed at installing solar plants, as well as to increase the convenience of consumers. The portal not only ensures transparency but also builds confidence of residential consumers with clearances being obtained in a fixed time period.

- **FINANCIAL OR IMPLEMENTATION PLAN:** The Master Plan is a robust document which puts forth actions based on an extensive scientific and case study analyses. Initially, various scenarios were prepared through the use of energy planning tools, such as RETScreen Clean Energy Management Software and LEAP (Long-range Energy Alternatives Planning system), which helped explore opportunities to meet the current energy demand with renewables and reduce future demand. This was followed by a techno-economic feasibility analysis of the available renewable energy options which helped to propose actions. An analysis of the impact of these actions through a comparison of business as usual and solar city scenario re-established the impending impact of the interventions. Further, several case studies were analysed to incorporate replicable practices into the programme.

- **LONG-TERM IMPACT:** The Master Plan delineates and sets clear targets for the city to meet in the short-, medium- and long-term for all proposed measures (Table 3). Given the dynamic nature of the document, the targets have been routinely revised by the implementing agency to speed up the transformation. The Master Plan also specifies the long-term budgetary requirements, which increases the preparedness of the implementing agency to speed up its actions in line with the targets.

DESCRIPTION	TARGET		
	SHORT TERM (TILL 2012)	MEDIUM TERM (TILL 2015)	LONG TERM (TILL 2018)
1. Energy Conservation*	Reduction in present energy consumption		
1.1 Residential Sector	10%	15%	20%
1.2 Commercial Sector	10%	15%	20%
1.3 a Municipal Sector (Water pumping)	1.50%	3.00%	4.00%
1.4 a Municipal Sector (street lighting)	1.50%	3.00%	4.00%
2. Coverage of Solar Water Heating systems (As a proportion of total heating demand in residential and commercial sector)	10%	25%	45%
3. Rooftop solar energy based electricity generation	2.5 MW	5.0 MW	10.0 MW
4. Large solar energy based electricity generation at Landfill site	3.0 MW	5.0 MW	5.0 MW
5. Large solar energy based electricity generation at Patiyala ki Rao site	5.0 MW	15.0 MW	25 MW
GHG emission reduction (tCO_2/annum)	90973	214051	404969

* As a percentage of reduction in energy consumption over projected consumption in BAU scenario

Table 3: Targets for Solar city Chandigarh (ENVIS Centre of Chandigarh´s State of Environment, 2016)

- **IDENTIFIABLE CO-BENEFITS IN THE PROGRAMME:** As stated above, explicitly identifying the socio-economic co-benefits in an intervention is integral to help meeting national and global targets. Such co-benefits could be clearly identified in a manifold way through an analysis (see Table 2) of the programme's activities. Further, scaling up through replication, as is already being done with other solar cities, presents opportunities for identifying other such co-benefits that enable meeting future demands of both urban and rural populations.

OVERCOMING BARRIERS / CHALLENGES:

WHAT WERE THE MAIN BARRIERS / CHALLENGES TO DELIVERY?	HOW WERE THESE BARRIERS / CHALLENGES OVERCOME?
FINANCIAL: There are no loan products or easy financing options in place for residential consumers to address the high upfront cost of solar rooftop installation. The national government does provide a subsidy under the model but applying for and obtaining this subsidy is a complicated and time-consuming process, making it unattractive for the consumers.	To reduce the burden on residential consumers, CREST has empanelled vendors to install rooftop SPVs, shifting the responsibility of procuring subsidies from the consumers to the vendor. CREST also launched an online portal that regulates and eases the process of obtaining regulatory clearances and subsidies for consumers.
ECONOMIC: A low residential grid electricity tariff in Chandigarh, and further, an extremely low payback on sale of surplus power in the presence of rooftop SPVs, has exacerbated residential unwillingness for rooftop PV installation.	The JERC revised the solar tariff in 2015 in line with the average power purchase cost of Chandigarh to increase the willingness of residential consumers to install rooftop SPVs. CREST has also taken up various promotional activities for the same, such as door to door campaigning. Further, empowering the DISCOMs through schemes such as the newly launched central government scheme, Sustainable Rooftop Implementation for Solar Transfiguration of India (SRISTI) could address the challenge of high upfront cost for installation for residential consumers, allowing them to pay only for the electricity used.
INFRASTRUCTURAL: Project developers have little incentive for installing rooftop SPVs in small residential spaces considering the high risks associated with payment from the beneficiaries.	The government is developing and initiating new policies and schemes that empower DISCOMs in the rooftop PV uptake process. Through schemes such as SRISTI, DISCOMs can serve as demand aggregators, considering the direct distribution of power to residential consumers, and also reduce the risks and burden borne by developers. SRISTI in particular aims to address the long standing issues with installation of solar rooftops in residential buildings in India. The scheme has been drafted and is still in the process of review and revision in order to robustly address the issues. An effort to devise a utility-based model completely driven by DISCOMs is also being prepared in Chandigarh and other cities.

LESSONS LEARNED:

- **LEVERAGE THE CO-BENEFITS APPROACH:** From the design of the project, it can be seen that emission reduction efforts have been effectively integrated with developmental imperatives, contributing to India's transition to a low-carbon urban economy.

- **UNDERSTAND INFRASTRUCTURAL BARRIERS:** Challenges posed by installing rooftop SPVs in small residential spaces were comprehensively understood. Through an information feedback mechanism with the nodal ministry, DISCOM driven robust policy interventions addressing these challenges (such as the SRISTI scheme and the utility driven model) are soon to be incorporated into the project. These interventions also provide co-benefits, such as reduction in peak load and losses, an opportunity for utilities to claim RPOs, etc.

- **MAINTAIN CREDIBILITY:** Through a robust system of checks and balances leveraged from the MRV framework and transparency of pertinent information through online portals and promotional activities, the project maintains credibility, consistency and trust.

HOW TO REPLICATE THIS PRACTICE:

The Solar City initiative by MNRE is a country wide initiative, currently limited to few cities, with potential cities to be included in the future. As one of the most successful cities under the mission, the Chandigarh model provides a comprehensive knowledge base on the challenges and best practices for other such cities to incorporate into their implementation plan. These best practices can also be emulated in potential frameworks aimed at moving to a low-carbon economy in regions that can harness solar potential.

- **CONDUCT A DEEP ASSESSMENT OF NEEDS:** The programme highlights the necessity to assess the disaggregated infrastructural, informational or financial needs in implementing such a programme. Cities must set targets only after understanding the future energy demand, geographical build-up and potential location for SPV installations in the city.

- **ADOPT A DYNAMIC AND FLEXIBLE FRAMEWORK:** The programme also emphasises the need to have a flexible framework that evolves to address barriers, issues and risks as they are identified. For Chandigarh, it was integral to develop schemes such as SRISTI that have addressed issues of solar PV uptake and helped speed up the process.

- **CONSIDER PUBLIC-PRIVATE PARTNERSHIP OPPORTUNITIES:** With the promotion of solar energy in the country attracting enormous attention, there is also an opportunity for public entities to involve and engage with the private sector to form public-private-partnerships. Such PPP models should be devised while keeping in mind the technical and financial barriers learnt through cases like Chandigarh and others.

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FURTHER KEY RESOURCES:

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· ENVIS Centre of Chandigarh´s State of Environment (2016). Chandigarh: A Model Solar City. Available at: http://chenvis.nic.in/index3.aspx?sslid=1341&subsublinkid=357&langid=1&mid=1

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· Ministry of Statistics and Programme Implementation (2018). Energy Statistics (Twenty-Fifth Issue). Available at: http://mospi.nic.in/sites/default/files/publication_reports/Energy_Statistics_2018.pdf

WEBSITES:

· Online portal for clearance and subsidies on solar plants: https://www.solarchandigarh.com/

· CREST website: http://crestchd.org.in/aboutus.asp

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ANNEX

Table 2: Co-benefits of Solar city Chandigarh and its alignment with India's NDC and global SDGs (table created by case study authors)
(Note: Only quantifiable NDC targets have been captured in this table)

Direct Impact Indirect Impact

ACTIVITY	LINKAGE WITH INDIA'S NDC TARGETS	BENEFITS AND CO-BENEFITS	SDGs IMPACTED	
Residential Sector				Cross cutting
Rooftop SPVs	**NDC Target 3:** Reduction in emission intensity of GDP **NDC Target 4:** Nonfossil fuel installed capacity	Reduction in electricity bills	**SDG 7.1:** Affordable, reliable & modern energy	**DIRECT** **SDG 13:** Climate Action **SDG 11a:** Strengthening national and regional development planning **SDG 11b:** Increase in no. of cities adopting integrated policies and plans **INDIRECT** **SDG 8.3:** Policies supporting employment, innovation, entrepreneurship and formalization of medium and small enterprises. **SDG 12a:** Strengthen technological capacities for sustainable consumption & production
		Improved Health due to decrease in pollution levels	**SDG 3.9:** Reduce illnesses and deaths from hazardous chemicals and pollution **SDG 11.6:** Reduce adverse per capita environmental impact of cities.	
		Sustainable infrastructure	**SDG 11.3:** Enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management	
			SDG 12a: Strengthen technological capacities for sustainable consumption & production	
Use of Energy efficient appliances	**NDC Target 3:** Reduction in emission intensity of GDP	Reduction in electricity bills	**SDG 7.1:** Affordable, reliable & modern energy	
		Efficient utilisation of energy resources	**SDG 8.4:** Improve resource efficiency in consumption and production	
			SDG 12.2: Sustainable & efficient use of natural resources	
Efficient devices in villages (Cooking and lighting	**NDC Target 3:** Reduction in emission intensity of GDP	Improved health due to reduction in Indoor air pollution	**SDG 3.9:** Reduce illnesses and deaths from hazardous chemicals and pollution	
			SDG 11.6: Reduce adverse per capita environmental impact of cities.	
		Efficient utilisation of energy resources	**SDG 8.4:** Improve resource efficiency in consumption and production	
			SDG 12.2: Sustainable & efficient use of natural resources	
		Reduction in Energy poverty	**SDG 7.1:** Affordable, reliable & modern energy	

ACTIVITY	LINKAGE WITH INDIA'S NDC TARGETS	BENEFITS AND CO-BENEFITS	SDGS IMPACTED	
Commercial Sector				Cross cutting
Replacement of conventional technology with energy efficient technology (Street lighting and water pumping)	**NDC Target 3:** Reduction in emission intensity of GDP **NDC Target 4:** Nonfossil fuel installed capacity	Reduction in electricity bills	**SDG 7.1:** Affordable, reliable & modern energy	**DIRECT** **SDG 13:** Climate Action **SDG 11a:** Strengthening national and regional development planning **SDG 11b:** Increase in no. of cities adopting integrated policies and plans **INDIRECT** **SDG 8.3:** Policies supporting employment, innovation, entrepreneurship and formalization of medium and small enterprises. **SDG 12a:** Strengthen technological capacities for sustainable consumption & production
		Reduction in emissions from energy		
		Efficient utilisation of resources	**SDG 8.4:** Improve resource efficiency in consumption and production	
			SDG 12.2: Sustainable & efficient use of natural resources	
Promotion of Green buildings and installation of rooftop SPVs	**NDC Target 3:** Reduction in emission intensity of GDP **NDC Target 4:** Reduction in Non-fossil fuel installed capacity	Improved health due to decrease in emission and pollution levels	**SDG 3.9:** Reduce illnesses and deaths from hazardous chemicals and pollution	
			SDG 11.6: Reduce adverse per capita environmental impact of cities.	
		Renewable and cleaner energy use	**SDG 7.1 :** Affordable, reliable & modern energy **SDG 7.2:** Renewable energy in energy mix **SDG 7.3:** Energy efficiency **SDG 7.5:** Infrastructure and technology	
		Efficient use of energy resources	**SDG 12.2:** Sustainable & efficient use of natural resources	
Power Generation				
Solar PV power plants (also includes solar landfills)	**NDC Target 3:** Reduction in emission intensity of GDP **NDC Target 4:** Reduction in Non-fossil fuel installed capacity	Use of clean energy	**SDG 7.1:** Affordable, reliable & modern energy **SDG 7.2:** Renewable energy in energy mix	
		Reduction in emissions	**SDG 7.1:** Affordable, reliable & modern energy **SDG 7.3:** Energy efficiency	
		Improved health due to decrease in emission and pollution levels	**SDG 3.9:** Reduce illnesses and deaths from hazardous chemicals and pollution **SDG 11.6:** Reduce adverse per capita environmental impact of cities.	
		Efficient use of resources	**SDG 12.2:** Sustainable & efficient use of natural resources	

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ACTIVITY	LINKAGE WITH INDIA'S NDC TARGETS	BENEFITS AND CO-BENEFITS	SDGS IMPACTED	
Commercial Sector				Cross cutting
Awareness generation and Training	**NDC Target 4:** Reduction in Non-fossil fuel installed capacity	Promotion of sustainable activities (Clean energy, energy efficiency, green buildings)	**SDG 11.3:** Enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management **SDG 7.1 :** Affordable, reliable & modern energy **SDG 7.2:** Renewable energy in energy mix **SDG 7.3:** Energy efficiency **SDG 7.5:** Infrastructure and technology **SDG 12.8:** Awareness for sustainable development.	**DIRECT** **SDG 13:** Climate Action **SDG 11a:** Strengthening national and regional development planning **SDG 11b:** Increase in no. of cities adopting integrated policies and plans **INDIRECT** **SDG 8.3:** Policies supporting employment, innovation, entrepreneurship and formalization of medium and small enterprises. **SDG 12a:** Strengthen technological capacities for sustainable consumption & production

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