Formulation of Policy Incentives for Promoting Green Buildings in Tamil Nadu

Final Report

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Abbreviations

AAC: Autoclaved Aerated Concrete

BEE: Bureau of Energy Efficiency

CFL: Compact Fluorescent Lamp

CII: Confederation of Indian Industry

CMDA: Chennai Metropolitan Development Authority

CMWSSB: Chennai Metropolitan Water Supply and Sewerage Board

ECBC: Energy Conservation Building Code

EDGE: Excellence in Design for Greater Efficiencies

ENVIS: Environmental Information System

EPI: Energy Performance Index

FAR: Floor Area Ratio

FSI: Floor Space Index

GHG: Greenhouse Gas

GRIHA: Green Rating for Integrated Habitat Assessment

I&A: Infrastructure and Amenity

IFC: International Finance Corporation

IGBC: Indian Green Building Council

IT: Information Technology

KW: Kilowatts

KWh: Kilowatt hour

LED: Light Emitting Diode

LPD: Light Power Density

MCM: Million Cubic Meters

MLD: Million Litres per Day

MT: Metric Tonnes

MU: Mega Units

MW: Megawatts

PV: (Solar) Photo Voltaic or SPV

SVAGRIHA: Small Versatile Affordable GRIHA

TANGEDCO: Tamil Nadu Generation and Distribution Corporation

TNEB: Tamil Nadu Electricity Board

TNERC: Tamil Nadu Electricity Regulatory Commission

TR: Ton of Refrigeration

uPVC: Unplasticised Polyvinyl Chloride

WWR: Window Wall Ratio

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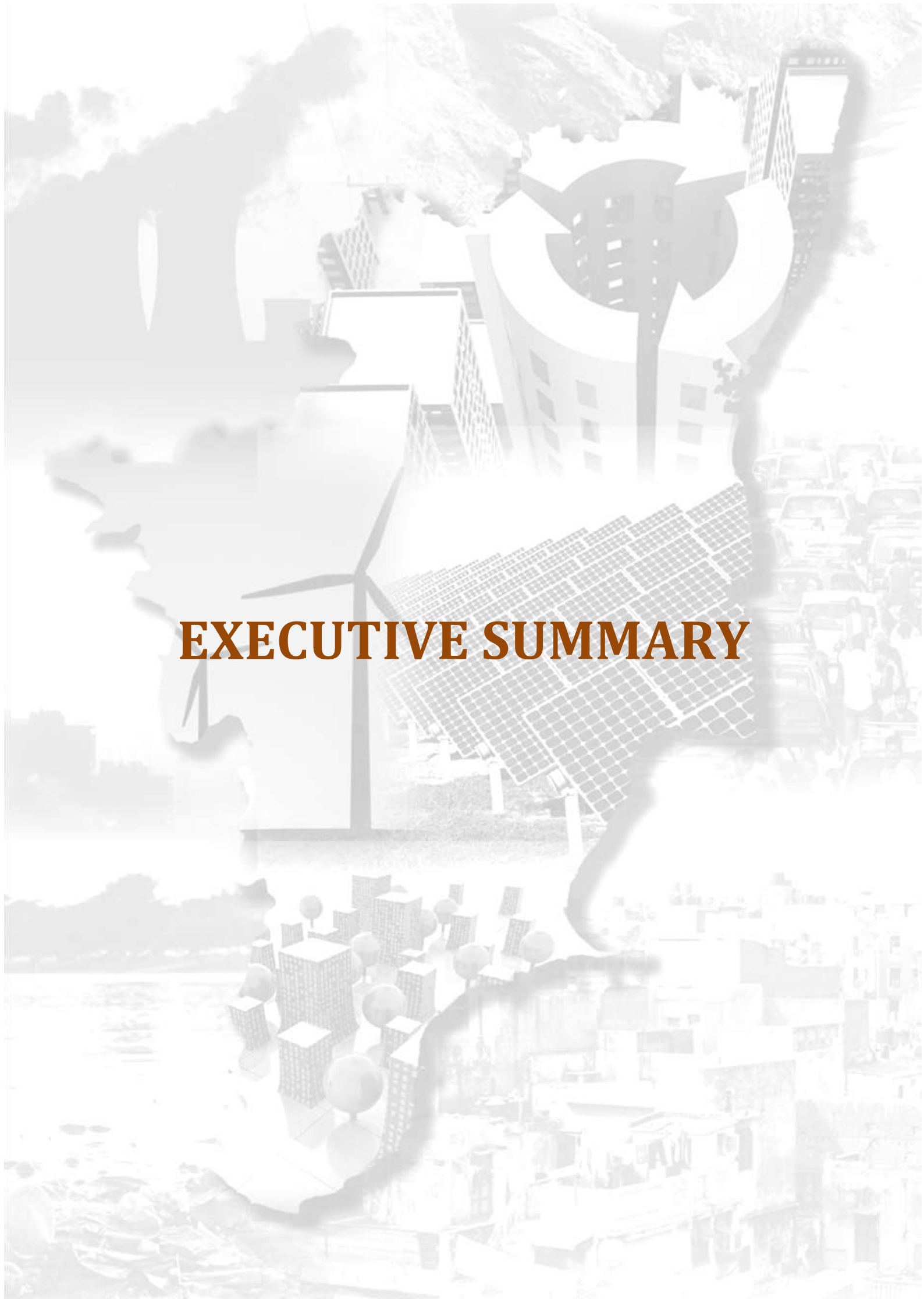


EXECUTIVE SUMMARY

Executive Summary

Brief

The State of Tamil Nadu is experiencing urbanization at a rapid pace. Nearly 48% of population resides in urban areas, posing huge challenges for municipalities. The cities are experiencing huge construction activities, which is resulting into increased demand of resources such as energy, water, material, while at the same time a lot of construction and solid waste is generated after buildings are occupied. The absence of larger policy and incentives to distribute the growth is further creating vulnerability (Source: Tamil Nadu Vision 2023). The intention of the report includes developing policy incentives for Tamil Nadu state to enhance the state as a prime engine of national growth by promoting low carbon urbanization and climate resilient infrastructure and upgrade to an environmentally sustainable state.

The following report recommends policy incentives for green buildings and green certified buildings based upon the level of their performance and certification. During the analysis it has been observed that green certified buildings' energy and water consumption can be reduced by 50% if buildings are minimum GRIHA 3 Star/ IGBC Gold rated. This implies that if green buildings are made a mandate in Tamil Nadu, the State will be able to provide energy and water to 50% more number of new buildings, with a minimum raise in infrastructure costs. For example, by constructing 100 new commercial buildings, 86MWh of electricity required in a conventional case could be reduced to 38MWh if the buildings are GRIHA 3 Star rated. Hence electricity could be supplied to another 100 buildings, without increasing power generation capacity at State level.

In general, developer are inclined for conventional buildings due to the additional capital and construction costs involved in green buildings, as customer/end user do not prefer to pay a premium for these green features despite to the evident payback period. To encourage developer to opt for green buildings, many municipalities are offering additional FSI to benefit the developer. However, this needs to be analysed and benefits have to be quantified to propose sustainable policy incentives. The report therefore identifies and recommends policy incentives by quantifying and balancing benefits for municipalities/government, developer as well as end user simultaneously by adopting green buildings. Recommendations include benefit analysis for developer to build green buildings, for owner to demand green buildings and municipalities to facilitate green buildings.

Summary of Resource Consumption Reduction and Cost Increment in Green Buildings

The comparative analysis between green and conventional buildings showed a substantial benefit for occupant and government with reduction in resource consumption. Table 1 shows the demand reduction potential and cost variation respectively for IGBC and GRIHA rated buildings against conventional buildings.

Table 1: Summary of savings by green buildings in resource consumption and cost increment from conventional building types

Certification Type	Commercial					Residential				
	Energy Savings (%)	Water savings (%)	Solid Waste reduction (%)	Waste Water reduction (%)	Cost Increment (%)	Energy Savings (%)	Water savings (%)	Solid Waste reduction (%)	Waste Water reduction (%)	Cost Increment (%)
Green Case	10	40 - 46	46	28 - 43	0.7 - 2.5	35	36 - 41	46	52 - 67	0.7 - 2.2
GRIHA 1 star	36	69 - 100	51	67 - 76	2.5 - 6.6	43	47 - 72	51	58 - 81	2.6 - 3.8
GRIHA 3 Star	54	69 - 100	55	72 - 86	6.5 - 11.9	57	57 - 83	55	66 - 88	4.8 - 5.2
GRIHA 5 Star	61	75 - 100	60	86 - 92	9.7 - 14.8	64	68 - 90	60	85 - 88	6.5 - 7.7
IGBC Silver	36	43 - 83	46	52 - 66	3.4 - 8.1	39	76 - 97	51	98 - 100	2.3 - 5.8
IGBC Gold	53	76 - 100	46	83 - 91	5.7 - 11.9	54	77 - 97	55	95 - 96	6.6 - 9.9
IGBC Platinum	56	76 - 100	51	83 - 91	9.1 - 15.1	59	77 - 94	60	95 - 97	6.7 - 7.7

Summary of Policy Incentives Recommended for Green Buildings

It is analysed and recommended that in a green certified building (GRIHA/IGBC) resource consumption can be substantially reduced and hence construction of green buildings can be incentivized.

Recommendation 1: Rebate on PFSI charges for green certified buildings located in Chennai Metropolitan area.

Table 2: Recommended Rebate on PFSI for Green Certified Buildings

Rebate on Premium FSI charges (₹/ Sq.ft)			
Builtup area (Sq.m)	**GRIHA 1 Star/ IGBC Silver**	**GRIHA 3 Star/ IGBC Gold**	**GRIHA 5 Star/ IGBC Platinum**
Commercial Buildings			
above 5000	70	131	195
below 5000	170	228	304
Residential Buildings			
above 5000	43	74	101
below 5000	87	100	111

(Or)

Recommendation 2: Rebate on combination of PFSI charges and I&A charges for green certified buildings located in Chennai Metropolitan.

Table 3 Recommended Rebate on PFSI + I&A charges for Green Certified Buildings

Rebate on Premium FSI Charges (₹/ Sq.ft) + I&A Charges (%)			
Builtup area (Sq.m)	**GRIHA 1 Star/ IGBC Silver**	**GRIHA 3 Star/ IGBC Gold**	**GRIHA 5 Star/ IGBC Platinum**
Commercial Buildings			
above 5000	63 + 10% I&A	110 + 30% I&A	174 + 30% I&A
below 5000	63 + 10% I&A	207 + 30% I&A	283 + 30% I&A
Residential Buildings			
above 5000	22 + 60% I&A	64 + 30% I&A	91 + 30% I&A
below 5000	66 + 60% I&A	90 + 30% I&A	100 + 60% I&A

Recommendation 3: Additional FSI for green buildings located in Tier 2 & 3 cities and semi urban areas where Premium FSI charges are not collected.

Recommendation 4: Rebate on property tax for green building owners.

Table 4 Recommended rebate on property tax

Certification Type	Rebate (%)
GRIHA 1 star/IGBC Silver	5
GRIHA 3 Star/IGBC Gold	10
GRIHA 5 Star/IGBC Platinum	15

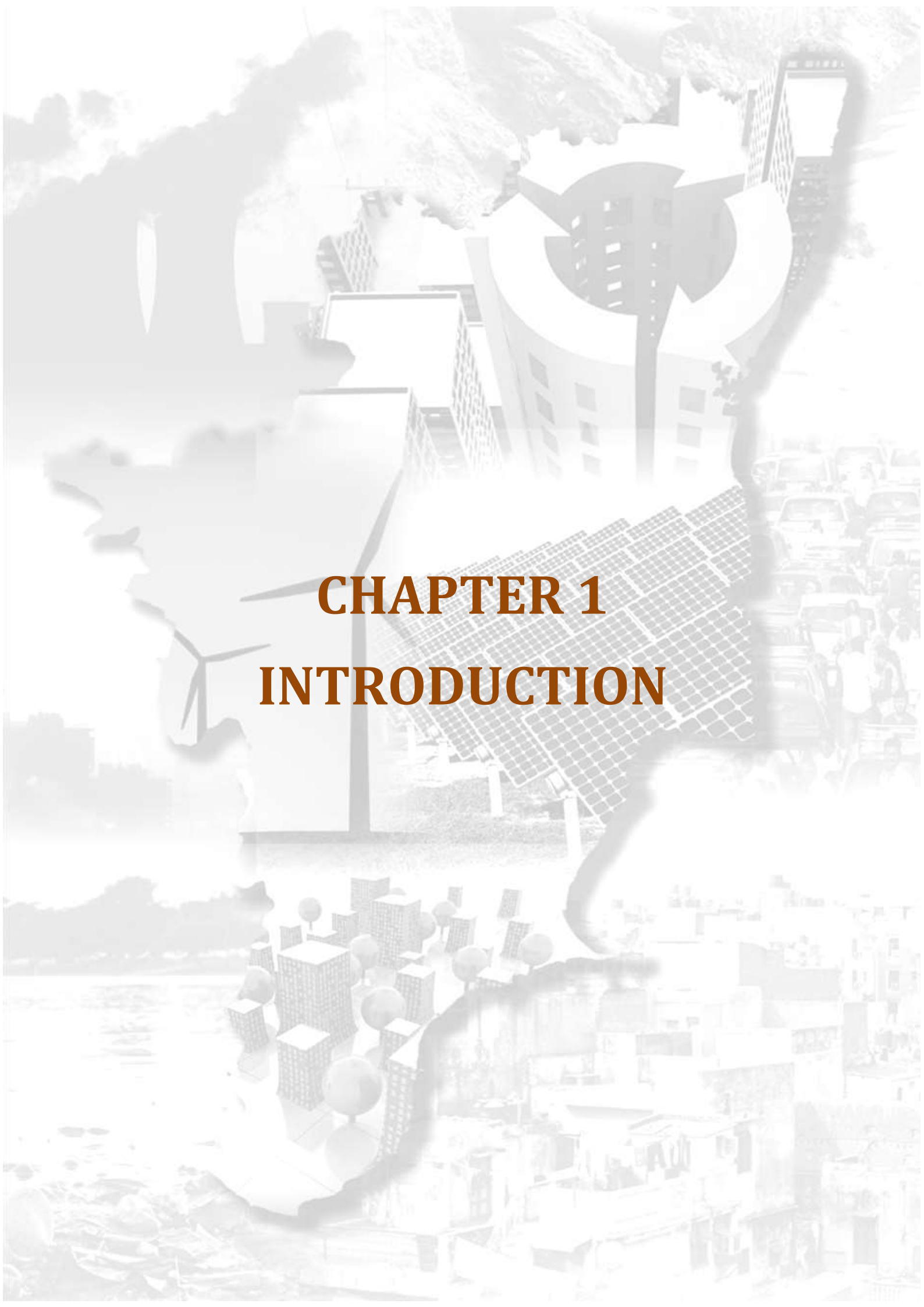
Recommendation 5: Rain water Tax for buildings more than 1000Sq.m built up area, equivalent to water charges, if roof top rain water is discharged in storm drains of the city.

Recommendation 6: Waste water Tax for buildings more than 5000Sq.m built up area, equivalent to water charges, discharged untreated to sewer line.

Recommendation 7: Fast track approvals or sanction on priority basis for projects registered for green certification.

Disclaimer

- *Information and data in the report is based on multiple sources like interviews, official websites and reports etc and national standards such as NBC 2005, SP41, ECBC 2007 etc. Details provided wherever applicable.*
- *Cost of building materials, technology is analysed based on current market rates considered from Chennai region. Values are subject to change based on time and location.*
- *Sample calculations are performed for typical building typologies and cases.*



CHAPTER 1
INTRODUCTION

1. Introduction

Tamil Nadu is one of the South India States, spread across an area of 13,058 Sq.Km. Total population of the State is 721.39 Lakh, out of which rural population accounts to 52%.

Tamil Nadu does not have any perennial river, and hence is heavily dependent upon monsoons to recharge the water resources. Despite to its highest installed renewable energy capacity the state experiences huge deficit in demand-supply gap.

The State of Tamil Nadu recognizes that it needs to meet the aspirational requirements of its people through integrated sustainable development approach. Therefore, the State is in the process of notifying many policies to mainstream green buildings, energy efficiency and renewable energy. According to the Vision 2023 of Tamil Nadu State, The State will provide the best infrastructure facilities in India in terms of Universal access to housing, water & sanitation, Energy, Transportation, Irrigation, Connectivity, Healthcare and Education.

The current project, as part of the above approach, analyses and recommends policy incentives for mainstreaming green buildings in Tamil Nadu.

1.1. Background

Before extracting the policy incentive recommendations for Tamil Nadu state, a thorough background study has been carried on current and future scenario of the state to understand the impact of green buildings.

1.1.1. Energy

Tamil Nadu is the fourth largest state in India in terms of Gross State Domestic Product (GSDP). The energy sector in the industrialized and fast growing state has been the prime mover of the economy over the past decades (Tamil Nadu Vision 2023). To satisfy the energy needs of the State, Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) has installations with a capacity of 11884.44 MW. Besides, it has installations in renewable energy sources like wind mill, solar, biomass and cogeneration up to 8219.67 MW (Source: TNEB). Tamil Nadu is the leading state in generating power from renewable (wind + solar) technologies which sums up to 47%.

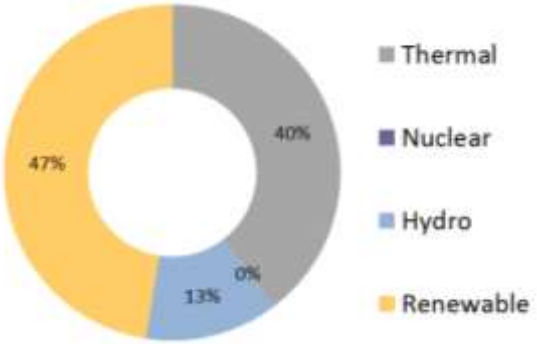


Figure 1: Electricity Generation Installed Capacity for Tamil Nadu (Source: Central Statistics Office National Statistical Organisation Ministry of Statistics and Programme Implementation Government of India).

As of year 2014, the state had 7633 MU of energy demand with only 7319 MU of supply. This means the state has a deficit of 3.5%. The per capita consumption of electricity is high in Tamil Nadu with 1065 kWh, as compared to the average national consumption of 734 kWh and is the highest in South India (Source: Tamil Nadu State Action Plan for Climate Change draft). As per the state government reports, domestic sector have highest energy demand followed by industrial and commercial building typologies.

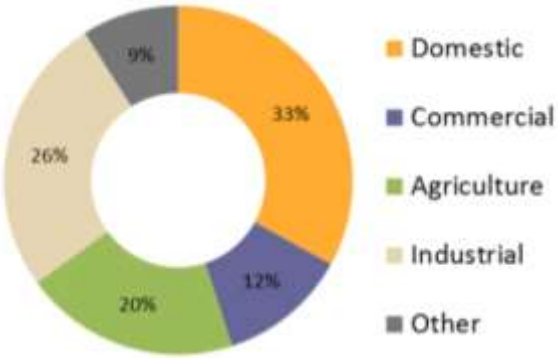


Figure 2: Energy Consumption breakup for Tamil Nadu (Source: Tamil Nadu State Government and National Informatics Centre)

The trend from past few year explains a rise of almost 2000 MU (Million Units) of energy demand each year in the state (Source: Tamil Nadu Statistics). According to the second volume of vision 2023, it is estimated that by 2018-19, the state may experience a deficit of almost 16.2 Billion Units. Therefore by 2023 the state targeted setting up of an additional 10,000 MW of green power, besides 20,000 MW of conventional power generating capacity. A total investment of ₹3,89,335 crores has been proposed on energy sector

alone under the vision (Source: Tamil Nadu Vision).

1.1.2. Water

Water supply is the next biggest challenge in the state. Tamil Nadu does not have any perennial river, and hence is heavily dependent upon monsoons to recharge the water resources. The total water potential of the State including cross border contribution from Andhra Pradesh, Karnataka and Kerala is 1775.60 TMC (47,680 MCM). This also includes ground water potential of about 20,649 MCM. The sectorial demand for water in 2011 was 49,773 MCM, which is about 2000 MCM more than the potential availability. The demand is projected to increase to 48,766 MCM and 55,919 MCM in 2020 and 2045 respectively. The gap between supply and demand by 2020 is expected to be 5,211 MCM (11%) and it is likely to go up to 17% by 2050, if there is no intervention. Nearly 11000 crores are being invested for water supply and sanitation on 12th five year plan.

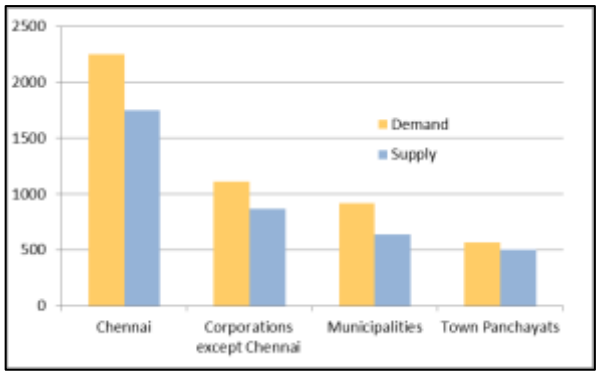


Figure 3: Urban Drinking Water Demand-Supply gap in MLD, for year 2014

The State envisages the supply of 24×7 piped water supply to all households living in both urban and rural areas as outlined in the Vision Tamil Nadu 2023 (Source: State Planning Commission Report, 2014).

1.1.3. Waste Water

A change in water availability and supply also affects sewered sanitation and drainage systems. When water supplies reduce, sewerage systems also become vulnerable. Further, sewage treatment plants are vulnerable to floods or sea level rise, as these are often located near river or seas. Where the sewer outfalls are in the sea, sea-level rise will affect the functioning of such systems. Storm water drainage systems could become frequently overloaded and cause flooding if heavy storms become more frequent due to climate change. (Source: National Mission on Sustainable Habitat).

2023).

Tamil Nadu is one of the few States that has initiated sewerage network provision in all corporations, municipalities and town panchayats through a sustainable financing and user charge framework (Tamil Nadu Vision 2023). In Chennai, currently 99% of the main areas are having sewer facilities and the city has waste water treatment capacity of 558 MLD at present while it is estimated an additional requirement of 1240 MLD capacity by year 2026 (Tamil Nadu Vision 2023).

1.1.4. Solid Waste Management (SWM)

Urbanization has its major challenges with pollution and waste management. In Tamil Nadu while daily generation of solid waste is 14532 TPD (Tonnes Per Day), 14234 TPD is collected and only 1607 TPD is treated (Source: Action Plan for Management of Municipal Solid Waste Management).

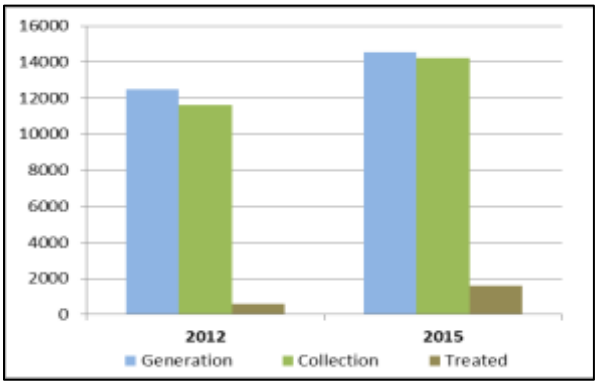


Figure 4: Solid Waste Management Trend

Chennai Corporation alone generates solid waste of approximately 3500 MT per day (Source: Chennai Corporation). The Corporation was the first in the country to implement Solid Waste Management, yet it is experiencing huge challenges due to the steep rise in waste generated and land required for filling from the last few decades. The trend is expected to continue in the future year. For 2023 targets, 500 crores of investments worth projects are proposed to improve the SWM in Chennai city itself (Tamil Nadu Vision 2023).

Out of all building typologies Residential and Commercial buildings generate maximum waste at urban level.

Figure 5: Daily (in tonnes) quantity of Solid Waste generated from Residential and Commercial buildings in Tamil Nadu state (Source: Tamil Nadu Pollution Control Board, 2012)

1.1.5. Emissions

About the state's carbon footprint, as per study carried out by CII, a total GHG Emission of 111.86 million tons is indicated from the state during the year 2009-10 while building sector alone contributed more than 7 million tons of emissions in which energy sector has 75% footprint out of these total emissions in buildings. Also 40% of power is produced by thermal energy which further adds to the GHG emissions. According to the ENVIS Centre on Human Settlements, Chennai is the highest per capita emitter of greenhouse gases among seven major cities in the country.

1.1.6. Urban Heat Island

Urban areas are susceptible to heat island effect and as the temperature increases in the future, the human habitats are likely to consume more electricity to achieve comfort, unless building norms are changed and urban planning brings in more green areas and wind corridor. With more and more population moving to the cities, heavier density of housing would mean enhancement of this problem. Also impact of heavier precipitation, intense cyclones, and stronger storm suggest flash floods in coastal regions will affect livelihoods and increase morbidity. The other likely impacts of climate change on habitat could manifest in terms of higher capacity of the atmosphere to bear pollutant loads leading to more health hazards, and higher capacity of water to absorb pollutants (Final draft report on Tamil Nadu State Action Plan on Climate Change).

1.2. Tamil Nadu Priorities and Proposed Policy Incentives

The State of Tamil Nadu recognizes that it needs to meet the aspirational requirements of its people through integrated sustainable development approach. Therefore, the State is in the process of notifying many policies to mainstream green buildings, energy efficiency and renewable energy. According to the Vision 2023 of Tamil Nadu State, The State will provide the best infrastructure facilities in India in terms of Universal access to Housing, Water & Sanitation, Energy, Transportation, Irrigation, Connectivity, Healthcare and Education.

The current project, as part of the above approach, analyses and recommends policy incentives for mainstreaming green buildings in Tamil Nadu.

The current policies and regulations to mainstream green buildings in Tamil Nadu include:

- Treatment of waste water for buildings above 2500 Sq.m of built up area, which are not connected with the city sewer lines.
- Rain water harvesting
- Roof top solar water heater
- ECBC is notified and in the process of adoption in the building bye laws.

The Government encourages net metering to promote rooftop penetration thereby encouraging households to generate solar power.

In addition to the above existing policies, in the current project following green building policy incentives have been analysed and proposed:

1. Additional FSI to green certified projects.
2. Rebate in I & A charges for green certified projects.
3. Rebate in property tax for green certified projects.
4. Rebate in Premium charges towards additional FAR for green certified projects.
5. Electricity tariff recommendation for roof top renewable energy integration.
6. Rain water tax.
7. Waste water Tax
8. Green channel for Certified Buildings

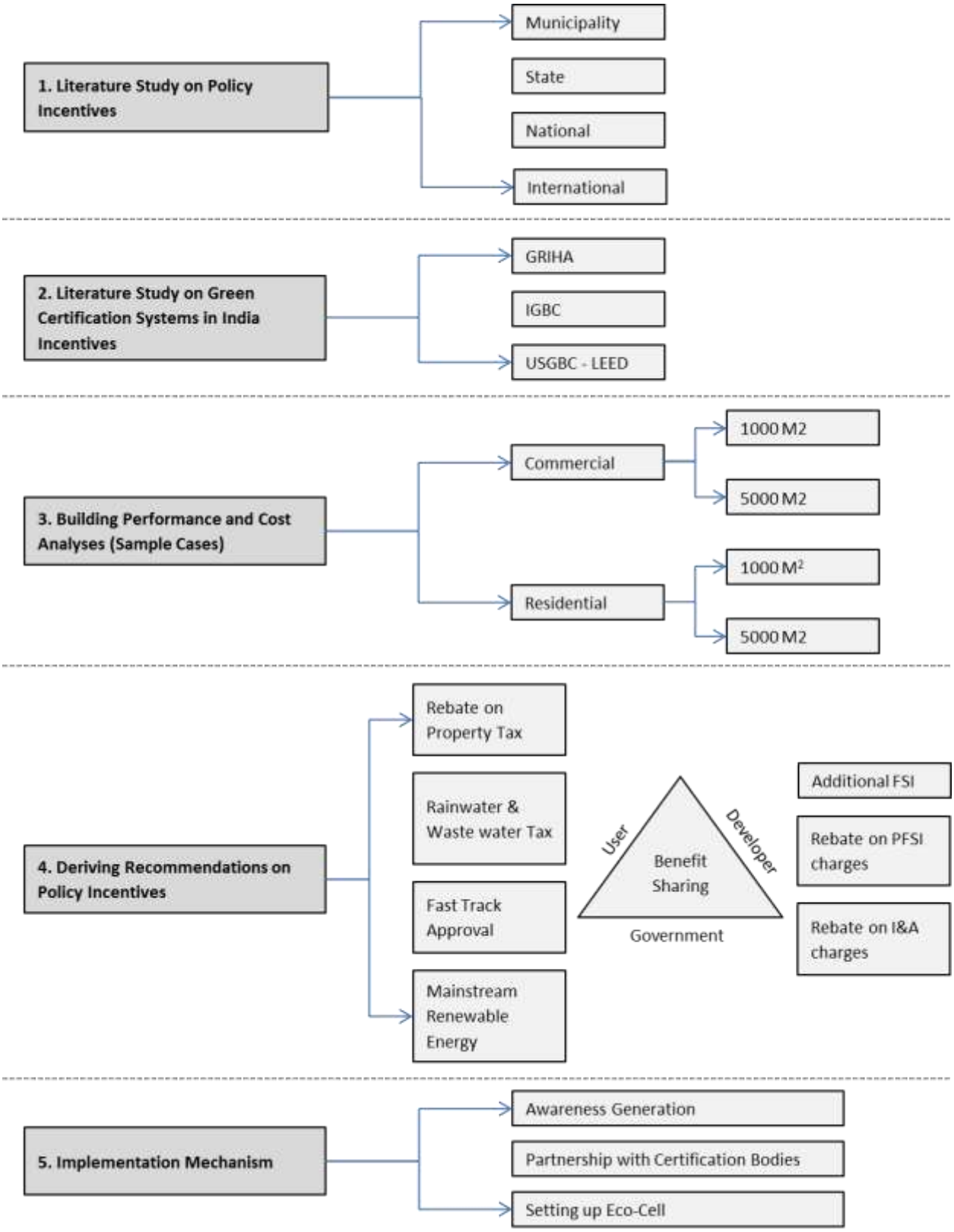
Benefits for green buildings have been quantified for municipality/utility companies on one side as well as benefits for user/owner have been quantified.

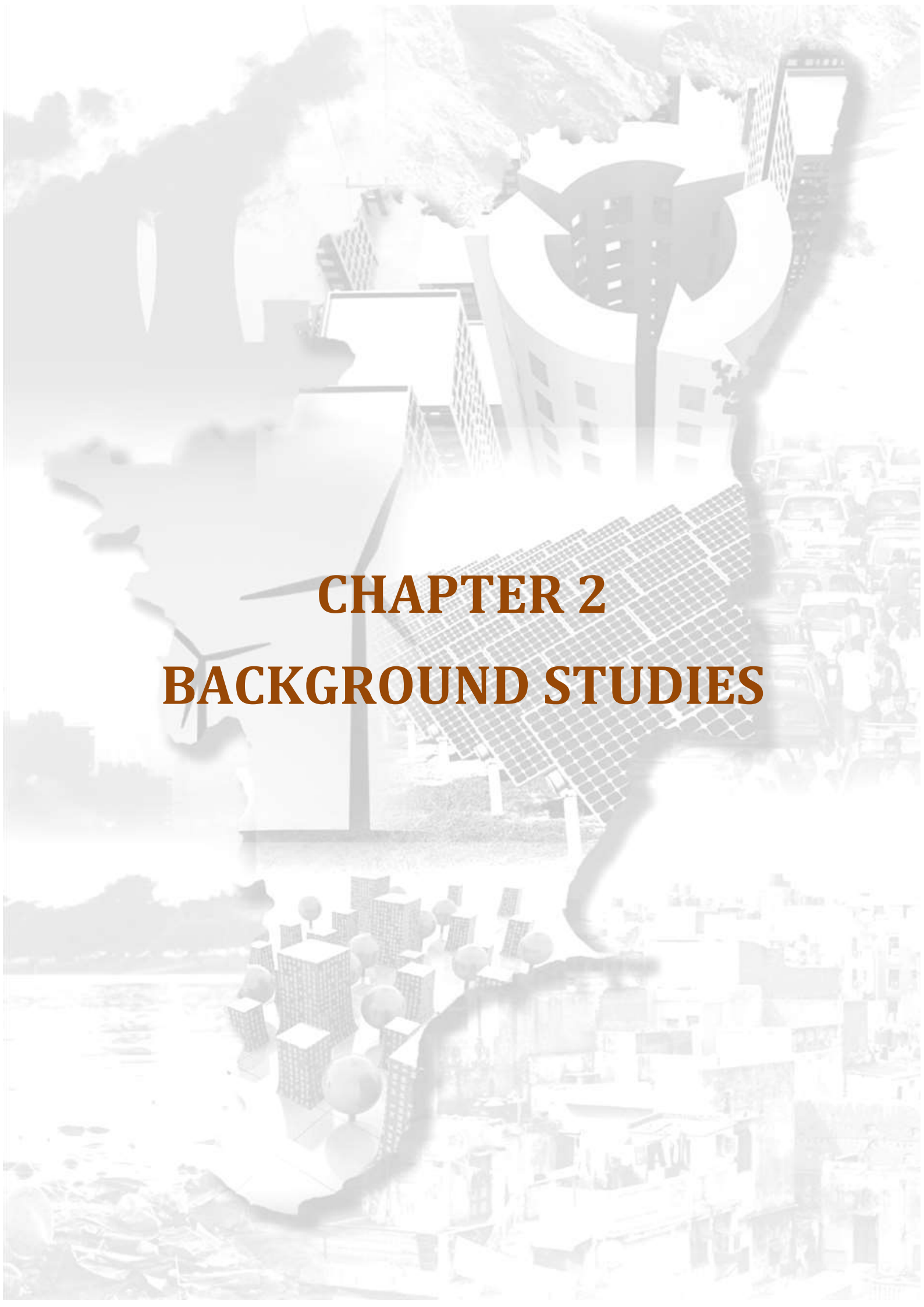
The analysis carried out will support the Government of Tamil Nadu in selecting policy incentives for mainstreaming green buildings. In the next chapter, a summary of policy incentives in India followed by other

States, municipalities and also by other countries is given. Also, a summary of rating systems studied, which could act as implementing agencies for green building policies have been briefed in the next chapter.

1.3. Methodology

The following flowchart explains the methodology used in developing the policy recommendations which shall be beneficial for the government, users and developers at the same time.





CHAPTER 2
BACKGROUND STUDIES

2. Background Studies

During the project, policy incentives implemented by different States for green buildings were studied. Policy incentives implemented by Centre and also by different municipalities, were studied. A summary of policy incentives being implemented in India at various levels is given in Table 5.The policy incentives are shown through various colour codes. The same has been explained in Legend of the table.

S.No	Incentive Type	Legend
1	Additional FAR/FSI	
2	Fees Reimbursement	
3	Rebate on Property Tax	
4	Reduction in Electricity tariff/Sell extra generated power to Govt	
5	Financial Support/Subsidy on Investment cost	
6	Financial Support by Granting Loans	
7	Cash/Appreciation Awards	
8	Not Specified/Unclear	
9	Mandatory	
10	Penalty	

2.1. Summary of Policies Incentives in India at State level and Municipality Level

Table 5 Summary of Policies Incentives in India

S. No.	Policy Incentive		AP+ Telangana	Delhi	Haryana	Karnataka	Kerala	Rajasthan	Sikkim	Uttaranchal	West Bengal	Punjab		Amravati	Bhubaneswar	Durgapur	Nagpur	Noida	Pimpri Chinchwad	Pune	Thane	Kolkata
1	**Green Certification**	State		✓									City/ municipality									
	ECBC				✓		✓															
	GRIHA						✓ ✓	✓	✓			✓			✓			✓	✓ ✓			✓
	IGBC																					✓
	LEED						✓											✓				
2	**Energy Efficiency**																					
	ECBC																					
	Energy Efficient Lighting		✓				✓															
	BEE Certified														✓							

S. No.	Policy Incentive	AP+ Telangana	Delhi	Haryana	Karnataka	Kerala	Rajasthan	Sikkim	Uttaranchal	West Bengal	Punjab	Amravati	Bhubaneswar	Durgapur	Nagpur	Noida	Pimpri Chinchwad	Pune	Thane	Kolkata
	Appliances																			
	Energy Audits																			
3	**Renewable Energy**				✓	✓	✓											✓	✓	
	Solar Water Heater	✓		✓ ✓	✓	✓	✓	✓ ✓ ✓		✓	✓	✓		✓	✓					
	Roof top PV			✓ ✓	✓															
	Wind Energy																			
	Solar Lights (outdoor)	✓																		
4	**Water Efficiency**																			
	Rain Water Harvesting/Recharge	✓	✓															✓		
	Efficient Fixture																			
	Recycling		✓																	
	Dual Plumbing		✓																	
5	**Waste Management**																			
	Waste segregation																			
	Water Waste Treatment		✓																	
	Solid Waste Treatment																			
6	**Materials Sustainability**					✓														
	Green Roof																			
	ECBC Envelope																			
	Reusage					✓														
7	**Promotional Activities**					✓														
8	**Passive/Energy Efficient Design**		✓			✓														
	Other/Comments	**Delhi:** 10% rebate in Property tax for 3 years if provision for extra FAR is not available **Kerala:** SWH and Energy efficient devices mandatory with tax exemption incentive for hotels, hospitals										**Pune:** Vermi composting considered								

2.2. Summary of International Policy Incentives

Policy incentives being implemented by other countries to mainstream green buildings have been summarized in table below:

Table 6: Summary of Policies Incentives around the world

S. No.	Scheme/Incentive	Singapore	USA	UK	Germany	Australia
1	**Energy**					
	• Funding (Partial) to carry out Energy Audits	✓				
	• Co-funding for Retrofits	✓			✓	
	• Grants for Training/Capacity Building	✓				
	• Grants/Schemes for Renewable Energy system Installations			✓		✓
	• Grants for Green Rated Buildings/Buildings meeting efficiency standards		✓			
	• Feed-in Tariffs/ Net-Metering		✓	✓		
2.	**Grants for Water Audits/ Recycling**	✓				
3.	**Benefits of Waste Management**					
	• Waste Minimization/ recycling (Post Occupancy)	✓ (Funding)		✓(Social Benefits)		
	• Sustainable Construction methods (recycling and utilizing demolished waste)	✓ (Funding)				
4.	**Green Roofs**	✓ (Funding 50% of installation cost)			✓ (subsidies on installation cost)	
5.	**Bonus Density**	✓	✓			
6.	**Energy Assessments/ technical Assistance- free of cost**		✓	✓	✓	✓ (through toolkit by government)
7.	**Loans (at low or no interests) for new construction/retrofits/ green technology installations**		✓	✓	✓	✓
8.	**Tax Incentives**		✓		✓	✓
9.	**Expedited Permitting**		✓			
10.	**Permit/Zone Fee Reduction**		✓			
11.	**Rebates on Environmental products**		✓			
12.	**Funding for carrying out Awareness Programs**	✓				

2.3. Brief about Green Rating Systems in India

2.3.1. GRIHA - Green Rated Integrated Habitat Assessment (Version 3.1)

GRIHA rating system applies to new building stock – commercial, institutional and residential – of varied functions. Endorsed by the Ministry of New and Renewable Energy (MNRE), Government of India as of November1, 2007, GRIHA is a five Star rating system, which is developed by TERI (The Energy and Resources Institute) and MNRE as an indigenous building rating system, particularly to address and assess non-air conditioned or partially air conditioned buildings. GRIHA has been developed to rate buildings in India emphasizing national environmental concerns, regional climatic conditions and indigenous solutions. GRIHA certification system can be applied for built up area between 2500Sq.m and 1,50,000 Sq.m, SVAGRIHA is applicable for built up area below 2500 Sq.m and GRIHA for Large Developments is applicable for built up area above 1,50,000 Sq.m.

GRIHA integrates all relevant Indian codes and Standards for buildings and acts as a tool to facilitate implementation of the same

2.3.2. Scoring System

GRIHA is a guiding and performance oriented system where points are earned for meeting the design and performance intent of the criteria. GRIHA emphasizes on "cost effective" strategies for making green buildings and emphasizes on integrated design approach. It is popularly known as a tool to facilitate design, construction, operation of a green building and in turn measure "greenness" of a building in India. There are a set of 34 criteria of GRIHA, which are categorized into mandatory and optional. There is an option of non-applicability clause, for certain criterias, where site might not be suitable to apply for conditions laid in the criteria.

It is a 100 point system, different levels of certification are awarded based on percentage of points earned. The minimum percentage required for certification is 50. Below table provides details of rating awarded for points earned.

Table 7: Summary of GRIHA rating system

Points scored (%)	Rating
50-60	One Star
61-70	Two Star
71-80	Three Star
81-90	Four Star
91-100	Five Star

Criterions in GRIHA are categorized under following segments. Break up of points under each segment are given in table below:

Table 8: Summary of Criterions in GRIHA 3.1

Category	Points
Sustainable Site planning	16
Water Management	13
Energy Optimization	36
Sustainable Building Materials	14
Waste Management	5
Health & Wellbeing	14
Building Operation and Maintenance	6
Innovation	4

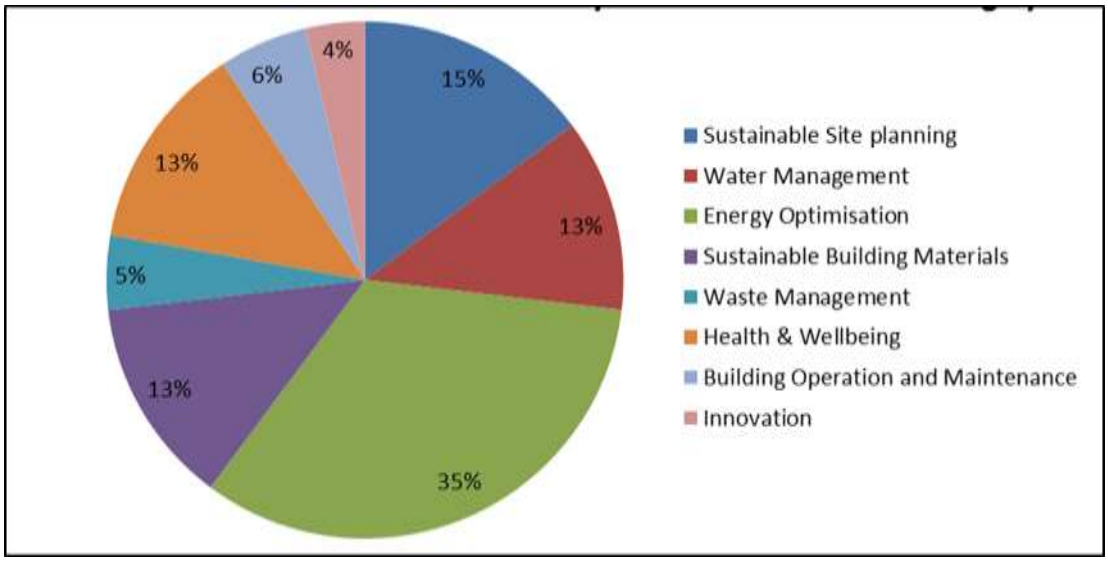


Figure 6 Summary of weightage of GRIHA criterions

2.3.3. IGBC - Green New Buildings Rating System®

IGBC Green New Buildings Rating System® is a voluntary and consensus based rating system, for new buildings, which is based on availability of existing materials and technologies. The objective of IGBC Green New Buildings rating system is to help in designing environment friendly buildings, through architectural program, water efficiency, effective handling of waste, energy efficiency, sustainable buildings, and focus on occupant comfort & well-being.

The rating system is designed primarily for new buildings, both for air-conditioned and non-air-conditioned buildings which are either occupied by owner or Tenant such as IT parks, banks, shopping malls, hotels, hospitals, airports, stadiums, convention centres, educational institutions (colleges, universities), libraries, museums, etc.

The rating system addresses green features such as sustainable architecture and design, site selection and planning, water conservation, energy efficiency, building materials and resources, indoor environmental quality, innovation and development. IGBC Green New Buildings Rating System ratings are awarded according to the following certification levels with minimum required points with threshold criteria for certification levels are as under:

Table 9 Summary of IGBC rating system

Certification level	Points scored
Certified	40-49
Silver	50-59
Gold	60-74
Platinum	75-89
Super Platinum	90-100

Criterions in IGBC Green New Buildings Rating System are categorized under following segments. Break up of points under each segment are given in table 10

Table 10: Summary of criterions - IGBC

Category	Points
Site Selection and Planning	14
Water Conservation	19
Energy Efficiency	28
Sustainable Architecture	5
Building Materials and Resources	16
Indoor Environment Quality	11
Innovation and Development	7

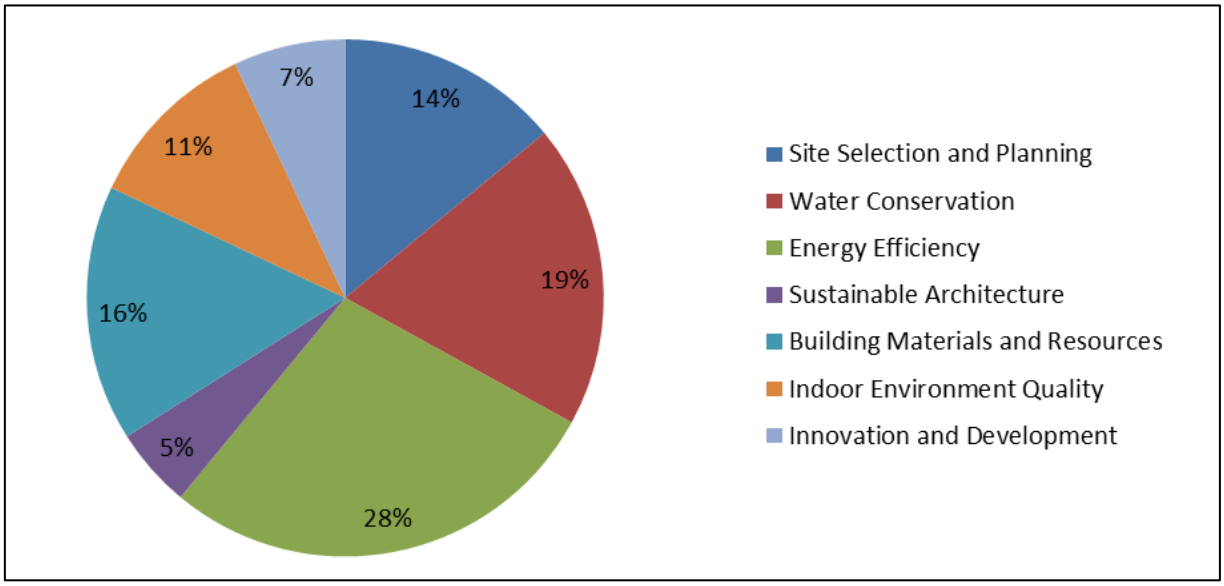


Figure 7 Summary of weightage of IGBC criterions

2.3.4. LEED– Leadership in Energy and Environmental Design (Version V4)

LEED rating system has been developed by USGBC (United States Green Building Council), United States, initially piloted in US and later expanded to many countries across world. The rating system addresses green features such as sustainable architecture and design, site selection and planning, water conservation, energy efficiency, building materials and resources, indoor environmental quality, innovation and development. LEED V4 is the latest version released is currently in practice.

The rating system is applicable for both air-conditioned and non-air-conditioned spaces of many building typologies like residences offices, hospitals, institutes, retail, hotels etc. Similar to IGBC, LEED too has rating hierarchy as Certified, Silver, Gold, and Platinum.

LEED Rating System ratings are awarded according to the following certification levels with minimum required points with threshold criteria for certification levels are as under:

Table 11: Summary of LEED rating system

Certification level	Points scored
Certified	40-49
Silver	40-49
Gold	50-59
Platinum	60-74

Criterions in LEED are categorized under following segments. Break up of points under each segment are given in table 12:

Table 12: Summary of criterions – LEED

Category	Points
Site Selection and Planning	14
Water Conservation	19
Energy Efficiency	28
Sustainable Architecture	5
Building Materials and Resources	16
Indoor Environment Quality	11
Innovation and Development	7

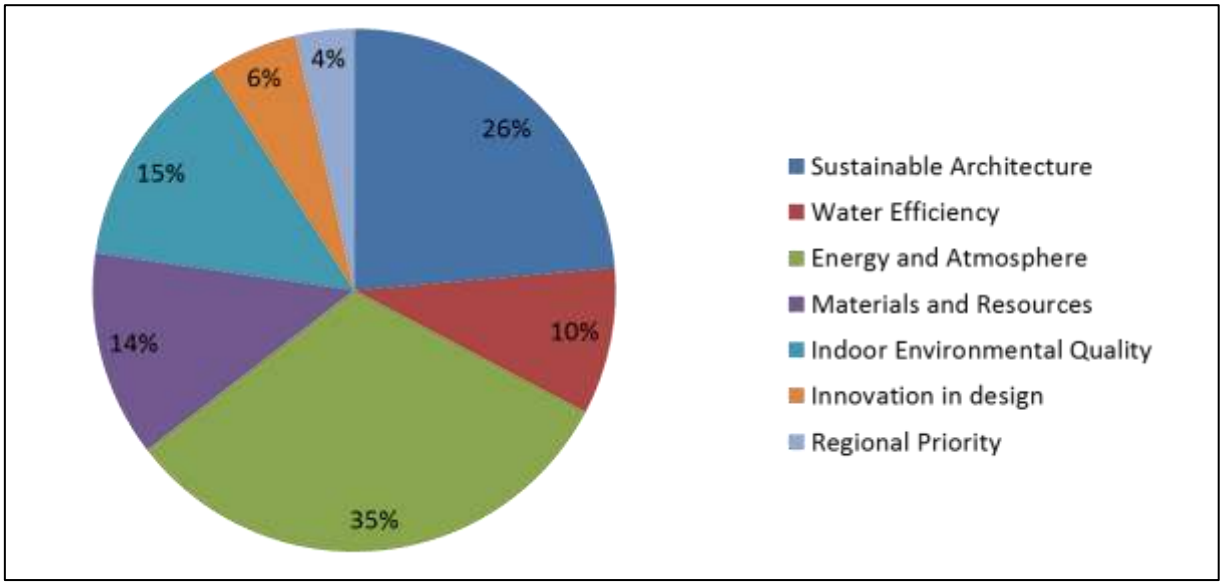
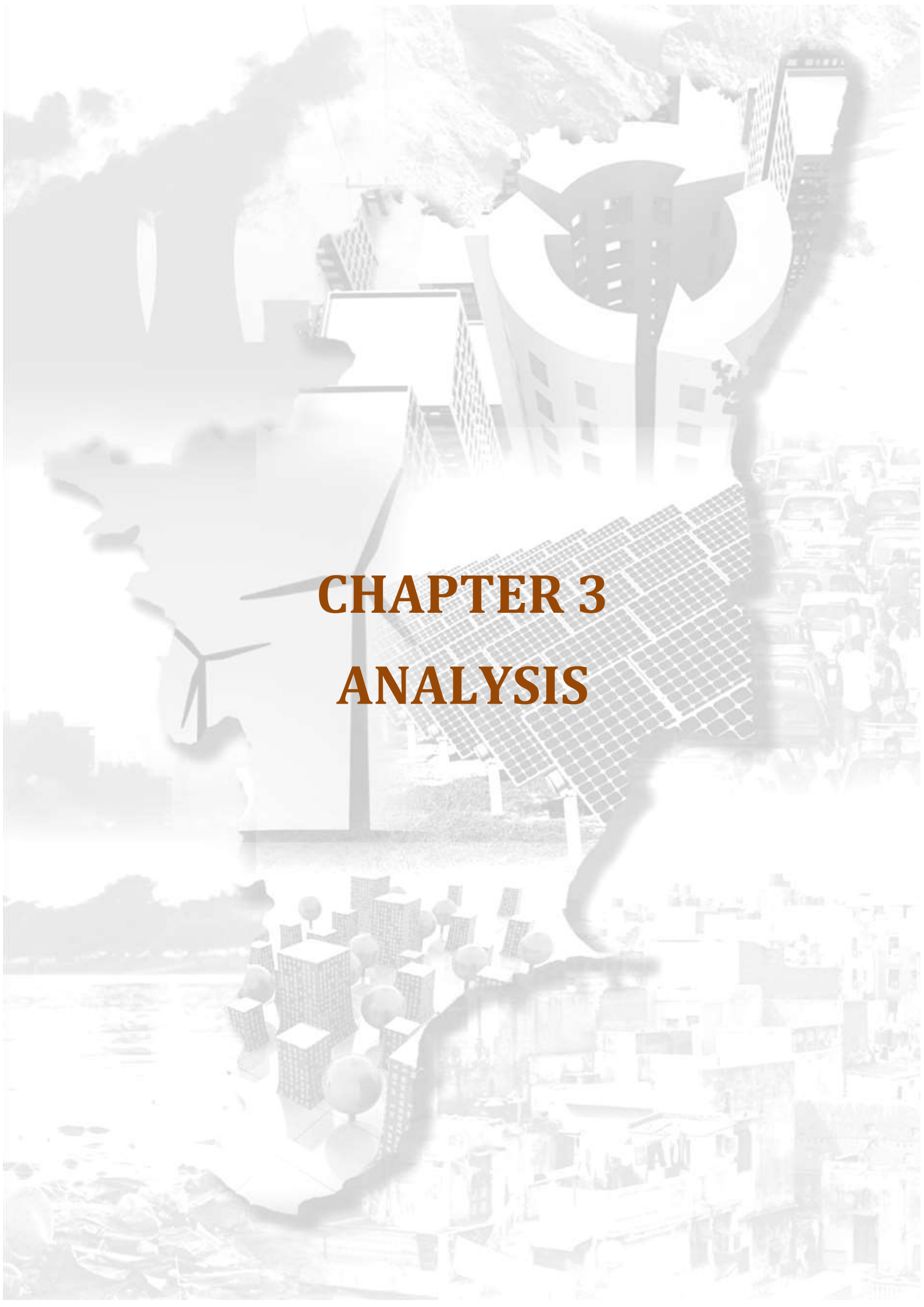


Figure 8: Summary of weightage of LEED criterions

2.4. Summary

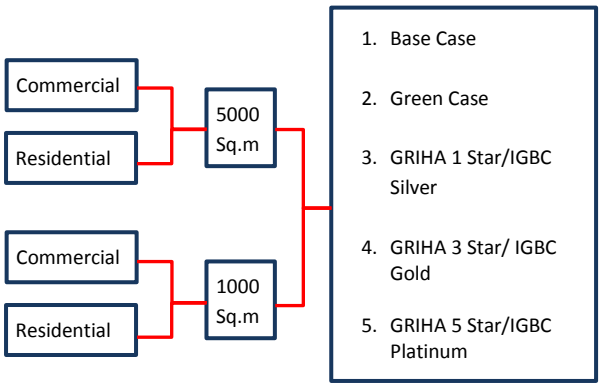
Thus, the above Chapter summarises the green building policy incentives existing internationally as well as in different parts of India. Currently LEED V4 does not have appropriate weightage on waste management which is a priority for Tamil Nadu. Henceforth this report continuous the analysis based on IGBC and GRIHA rating systems which are tailored developed for India.



CHAPTER 3
ANALYSIS

3. Green Building Performance and Cost Analysis

Green buildings are cost efficient on their complete life cycle. The environmental benefits and reduced operational costs directly benefit both the user and government, whereas most construction activities are initiated by developer. Hence it is important to frame the policy aiming benefits to developer as well, by going towards green buildings. To derive the right incentive values for green buildings that benefits government and developer simultaneously, the first most important step was to quantify and establish the capital cost required and thereby savings and benefits from green buildings. This was carried out for both commercial buildings and residential buildings. In order to understand the difference between scale of projects, two types of built up area, 1000 and 5000 Sq.m, were considered, for both residential as well as commercial typology. There were 5 cases created under each typology, with different building features. These are Base case (Conventional typology/business as usual scenario), Green case (building that meets all environmental priorities of Tamil Nadu), GRIHA 1 Star/ IGBC Silver case, GRIHA 3 Star/ IGBC Gold, GRIHA 5 Star/IGBC Platinum.



Base case or conventional case:

Conventional case represents typical commercial/residential buildings in Tamil Nadu. Assumptions and features considered for base case are mentioned below. It has all current mandatory regulations existing in Tamil Nadu with respect to byelaws and environment, integrated.

Green case:

Green case represents a building which shall comply with all the environmental priorities of Tamil Nadu. These include compliance with Energy Conservation Building Code (ECBC), conservation of water, waste water treatment plan above 2500 Sq.m built up area (as per current regulations), recycle, rain water harvesting and integration of renewable energy.

Certified cases:

Certification systems aid in implementation of green policies and regulations. If State Governments partner with certification bodies, implementation of green policies in design, construction and operation becomes easy to achieve. There are three levels of certification systems analysed in this project, these are GRIHA 1 Star, GRIHA 3 Star and GRIHA 5 Star. Under IGBC certification system, IGBC Silver, IGBC Gold and IGBC Platinum has been analysed and quantified for benefits. Features for these cases are also described in section below.

3.1. Analysis for GRIHA Certified Commercial Buildings

Analysis for GRIHA cases is carried out comparing Base case/ Conventional case, Green case against GRIHA 1 star, 3 star and 5 star cases for commercial building typology (Table 13).

*Table 13 Assumptions for Base case, Green case and **GRIHA** certified cases for **Commercial** Building Type*

Base case		Green Case		GRIHA 1 Star		GRIHA 3 Star		GRIHA 5 Star	
1000 Sq.m	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**
Building Envelope									
Brick wall, un-insulated concrete roof, Single glazed units, Aluminium frame, WWR 50%		AAC Blocks for walls, ECBC compliant insulated roof, Double glazed unit meeting ECBC requirement, Aluminium frame, WWR 50%		AAC Blocks, ECBC compliant insulated roof, Double glazed units meeting ECBC requirement, Aluminium frame, WWR 40%		AAC Blocks, ECBC compliant insulated roof, Double glazed units meeting ECBC requirement, UPVC frame, WWR 40%			
Outdoor Lighting									
28W CFL, Electronic Ballast, no controls		50% of 28W CFL, 50% of 25 W LED, Electronic Ballast, timer based controls, for turning off lights when daylight is available.		25W LED, Electronic Ballast, timer based controls, for turning off lights when daylight is available.					
Indoor lighting									
TL5 28 W lamps, electronic ballast, LPD achieved: 10.4W/Sq.m, Illuminance achieved: 500 Lux				TL5 28 W lamps, electronic ballast, daylight controls. LPD achieved: 10.4W/Sq.m, Illuminance achieved: 500 Lux		LED 40 W lamps, electronic ballast, daylight controls. LPD achieved: 7W/Sq.m. Illuminance achieved: 500 Lux			
HVAC / Mechanical systems									
Packaged constant air volume systems, Sq.m/TR achieved: 14		Packaged constant air volume systems, Sq.m/TR achieved: 15.8		Packaged constant air volume systems, minimum BEE 3 Star labelled AC units, Sq.m/TR achieved: 19		Packaged constant air volume systems, BEE 5 Star labelled AC units, Sq.m/TR achieved: 24		VRV (Variable Refrigerant Volume) based systems. Sq.m/TR achieved: 24	
Electrical systems									
Oil filled Transformer, PF maintained 0.90				Dry type transformer, PF maintained 0.95					
EPI (kWh/Sq.m/annum)									
172		**155**		**112**		**80**		**68**	
Percentage of electricity consumption reduction from the grid (%) in comparison to base case									
-		10%		34%		53%		60%	
Renewable Energy Installed (KW)									
0	0	0	0	1.5	5	1	4	1	3.5
Net Percentage of electricity consumption reduction from the grid (%) in comparison to base case									
-		**10%**		**36%**		**54%**		**61%**	

Base case		Green Case		GRIHA 1 Star		GRIHA 3 Star		GRIHA 5 Star	
1000 Sq.m	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**
Landscape Design									
Top soil not preserved, fertile soil purchased post occupancy for landscape design.		Top soil not preserved, fertile soil purchased post occupancy for landscape		Top soil preserved for post occupancy landscape					
Open area with 50% lawn and 50% impervious pavements, Sprinkler large guns for irrigation.		Open area with 37% pervious pavement, 25% impervious pavement, 18.7 % lawn, 10% shrubs & ground cover, 10% trees, Sprinkler large guns for irrigation.		Open area with 20% pervious pavement, 20% impervious pavement, 15% lawn, 25% shrubs and ground cover, 20% trees, multiple sprinklers for irrigation.		Open area with 12% pervious pavement, 12% impervious pavement, 10% lawn, 33% shrubs & ground cover, 33% trees, drip irrigation.		Open area with 12% pervious pavement, 12% impervious pavement, 10% lawn, 33% shrubs & ground cover, 33% trees, drip irrigation.	
Savings in Consumption of Landscape water (%)									
-		55%		53%		62%		62%	
Building water demand (KL/day)									
Conventional plumbing fixtures, waste water treatment system for buildings only above 2500 sq.m built up area.		Efficient plumbing fixtures, waste water treatment in all buildings above 2500 Sq.m, reuse for irrigation.		More efficient plumbing fixtures, waste water treatment in all buildings above 1000 Sq.m, reuse for irrigation and for bigger buildings above 5000 Sq.m, reuse for flushing.				More efficient plumbing fixtures, waste water treatment in all buildings above 1000 m2, reuse for irrigation and inside the building for flushing.	
Rain water recharge and harvesting for reuse (KL/day)									
Rain water harvesting is mandatory, hence ground water recharged through recharging pits				Roof top rain water harvested for reuse for portable purpose. Rain water from landscape used for recharging ground water table.					
Water Demand from outside (KL/day) & Percentage reduction in water demand from outside sources like municipality etc.									
4.6	**15.8**	**2.4**	**9.4**	**0.6** Wet Season	**0** Wet Season	**0.6** Wet Season	**0** Wet Season	**0** Wet Season	**0** Wet Season
				1.4 Dry Season	**3.9** Dry Season	**1.4** Dry Season	**3.9** Dry Season	**0.79** Dry Season	**3.9** Dry Season
-	-	**46%**	**40%**	**87%** Wet Season	**100%** Wet Season	**87%** Wet Season	**100%** Wet Season	**100%** Wet Season	**100%** Wet Season
				69% Dry Season	**75%** Dry Season	**69%** Dry Season	**75%** Dry Season	**82%** Dry Season	**75%** Dry Season

Base case		Green Case		GRIHA 1 Star		GRIHA 3 Star		GRIHA 5 Star	
1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m
Percentage reduction of waste water in sewer lines									
-	-	43%	28%	76%	67%	72%	86%	92%	86%
Waste generated for landfill (Kg/day)									
38	**190**	**20**	**102**	**19**	**93**	**17**	**85**	**15**	**76**
Percentage waste reduction (%) from going to landfill									
-		**46%**		**51%**		**55%**		**60%**	
Cost of building per Sq.ft.(including RE installation)									
2000	2000	2050	2013	2124	2045	2213	2124	2288	2188
Percentage increment in building cost (%)									
		2.5%	0.7%	5.6%	1.8%	10.3%	5.9%	14.1%	9.1%
Cost of building (including certification & registration cost)									
2000	**2000**	**2050**	**2013**	**2132**	**2051**	**2221**	**2131**	**2297**	**2195**
Net percentage increment in building cost (%)									
-	-	**2.5%**	**0.7%**	**6.6%**	**2.5%**	**11.9%**	**6.5%**	**14.8%**	**9.7%**

3.1.1. Summary of Analysis for GRIHA Commercial Buildings

- Net Percentage of electricity consumption reduction from the grid in GRIHA certified commercial buildings in comparison to conventional case ranges from 36% to 61%.
- Percentage reduction in water demand from outside sources like municipality etc., in GRIHA certified buildings in comparison to conventional case range from 100% (wet season) to 69% (dry season). Thus, it is observed that implementation of rain water harvesting for portable re use purpose, is crucial in achieving water security in the State, and hence it is recommended to implement easy and achievable policies to encourage owner in harvesting rain water for reuse potable purpose.
- Percentage of waste reduced from going to landfill in GRIHA certified buildings in comparison to conventional buildings range from 51%-60%.
- Percentage increment in cost in GRIHA certified buildings, due to the above discussed features range from 2.5% to maximum 14.8%, depending upon the size of project and number of features integrated.

3.2. Analysis for IGBC Certified Commercial Buildings

Analysis for IGBC cases is also carried out by comparing Base case/ Conventional case, Green case against IGBC Silver, Gold and Platinum cases for commercial building typology (Table 14).

*Table 14 Assumptions for Base case, Green case and **IGBC** certified cases for **Commercial** Building Type*

Base case		Green Case		IGBC Silver		IGBC Gold		IGBC Platinum	
1000 Sq.m	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**
Building Envelope									
Brick wall, un-insulated concrete roof, Single glazed units, Aluminium frame, WWR 50%		AAC Blocks for walls, insulated roof, Double glazed unit meeting ECBC requirement, Aluminium frame, WWR 50%		AAC Blocks, insulated roof, Double glazed units meeting ECBC requirement, Aluminium frame, WWR 40%		AAC Blocks, insulated roof, Double glazed units meeting ECBC requirement, UPVC frame, WWR 40%			
Outdoor Lighting									
28W CFL, Electronic Ballast, no controls		28W CFL, Electronic Ballast, timer based controls, for turning off lights when daylight is available.							
Indoor lighting									
TL5 28 W lamps, electronic ballast, LPD achieved: 10.4W/Sq.m, Illuminance achieved: 500 Lux				TL5 28 W lamps, electronic ballast, daylight controls. LPD achieved: 10.4W/Sq.m, Illuminance achieved: 500 Lux		LED 40 W lamps, electronic ballast, daylight controls. LPD achieved: 7W/Sq.m. Illuminance achieved: 500 Lux			
HVAC / Mechanical systems									
Packaged constant air volume systems, Sq.m/TR achieved: 14		Packaged constant air volume systems, Sq.m/TR achieved: 15.8		Packaged constant air volume systems, minimum BEE 3 Star labelled AC units, Sq.m/TR achieved: 19		Packaged constant air volume systems, minimum BEE 4 Star labelled AC units, Sq.m/TR achieved: 24		Packaged constant air volume systems, minimum BEE 5 Star labelled AC units, Sq.m/TR achieved: 24	
Electrical systems									
Oil filled Transformer, PF maintained 0.90				Dry type transformer, PF maintained 0.95					
EPI (kWh/Sq.m/annum)									
172		**155**		**112.6**		**83.1**		**77.8**	
Percentage of electricity consumption reduction from the grid (%) in comparison to base case									
-		10%		34%		52%		55%	
Renewable Energy Installed (KW)									
0	0	0	0	1.5	5	1	4	1	4
Net Percentage of electricity consumption reduction from the grid (%) in comparison to base case									
-		**10%**		**36%**		**53%**		**56%**	
Landscape Design									
Top soil not preserved, fertile soil purchased post				Top soil preserved for post occupancy landscape					

Base case		Green Case		IGBC Silver		IGBC Gold		IGBC Platinum	
1000 Sq.m	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**
occupancy for landscape design.									
Open area with 50% lawn and 50% impervious pavements, Sprinkler large guns for irrigation.		Open area with 37% pervious pavement, 25% impervious pavement, 18.7 % lawn, 10% shrubs & ground cover, 10% trees, Sprinkler large guns for irrigation.		Open area with 30% pervious pavement, 30% impervious pavement, 12% lawn, 14% shrubs and ground cover, 14% trees, multiple sprinklers for irrigation.		Open area with 30% pervious pavement, 30% impervious pavement, 12% lawn, 14% shrubs and ground cover, 14% trees, drip irrigation.		Open area with 45% pervious pavement, 15% impervious pavement, 12% lawn, 14% shrubs and ground cover, 14% trees, drip irrigation.	
Savings in Consumption of Landscape water (%)									
-		55%		60%		68%		68%	
Building water demand (KL/day)									
Conventional plumbing fixtures, waste water treatment system for buildings only above 2500 Sq.m built up area.		Efficient plumbing fixtures, waste water treatment in all buildings above 2500 Sq.m, reuse for irrigation.		More efficient plumbing fixtures, waste water treatment in all buildings above 1000 Sq.m, reuse for irrigation and for bigger buildings above 5000 Sq.m, Similar, Not reused for flushing.		More efficient plumbing fixtures, waste water treatment in all buildings above 1000 Sq.m and for bigger buildings above 5000 Sq.m, reuse for irrigation and flushing.			
Rain water recharge and harvesting for reuse (KL/day)									
Rain water harvesting is mandatory, hence ground water recharged through recharging pits				Roof top rain water harvested for reuse for portable purpose. Rain water from landscape used for recharging ground water table. Storage Water Tank sizing based on percentage of Monthly peak rainfall.					
Water Demand from outside (KL/day) & Percentage reduction in water demand from outside sources like municipality etc.									
4.6	**15.8**	**2.4**	**9.4**	**0.8** Wet Season	**4.1** Wet Season	**0** Wet Season	**0** Wet Season	**0** Wet Season	**0** Wet Season
				1.7 Dry Season	**8.3** Dry Season	**0.8** Dry Season	**3.8** Dry Season	**0.8** Dry Season	**3.8** Dry Season
-	-	**46%**	**40%**	**83%** Wet Season	**74%** Wet Season	**100%** Wet Season	**100%** Wet Season	**100%** Wet Season	**100%** Wet Season
				64% Dry Season	**43%** Dry Season	**83%** Dry Season	**76%** Dry Season	**83%** Dry Season	**76%** Dry Season
Percentage reduction of waste water in sewer lines									
-	-	43%	28%	66%	52%	91%	83%	91%	83%
Waste generated for landfill (Kg/day)									

Base case		Green Case		IGBC Silver		IGBC Gold		IGBC Platinum	
1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m
38	190	20	102	20	102	20	102	19	93
Percentage waste reduction (%) from going to landfill									
-		46.5%		46.5%		46.5%		51%	
Cost of building per Sq.ft.(including RE installation)									
2000	2000	2050	2013	2149	2065	2215	2111	2291	2180
Percentage increment in building cost (%)									
		2.5%	0.7%	6.7%	2.8%	10.3%	5.2%	14.6%	9.0%
Cost of building (including certification & registration cost)									
2000	2000	2050	2013	2170	2070	2228	2114	2304	2183
Net percentage increment in building cost (%)									
-	-	2.5%	0.68%	8.1%	3.4%	11.9%	5.7%	15.1%	9.1%

3.2.1. Summary of Analysis for IGBC Commercial Buildings

- Net Percentage of electricity consumption reduction from the grid in IGBC certified commercial buildings in comparison to conventional case ranges from 35% to 55%.
- Percentage reduction in water demand from outside sources like municipality etc., in IGBC certified buildings in comparison to conventional case range from 100% (wet season) to 43% (dry season). Thus, it is observed that implementation of rain water harvesting for portable re use purpose, is crucial in achieving water security in the State, and hence it is recommended to implement easy and achievable policies to encourage owner in harvesting rain water for reuse purpose.
- Percentage of waste reduced from going to landfill in IGBC Certified buildings in comparison to conventional buildings range from 46%to 51%.
- Percentage increment in cost in IGBC certified buildings, due to the above discussed features range from 3.4% to maximum 15%, depending upon the size of project and number of features integrated

3.3. Analysis for GRIHA Certified Residential Buildings

Analysis for GRIHA cases is also carried out by comparing Base case/ Conventional case, Green case against GRIHA 1 star, 3 star and 5 star cases for residential building typology (Table 15).

*Table 15 Assumptions for Base case, Green case and **GRIHA** certified cases for **Residential** Building Type*

Base case		Green Case		GRIHA 1 Star		GRIHA 3 Star		GRIHA 5 Star	
1000 Sq.m	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**
Building Envelope									
Concrete masonry unit for walls, un-insulated concrete roof, Single glazed units, Aluminium frame, WWR 30%		Concrete masonry unit for walls, insulated roof, Single glazed unit, uPVC frame, WWR 30%				Concrete masonry unit for walls, insulated roof, Double glazed unit, uPVC frame, WWR 20%			
Outdoor Lighting									
28W CFL, Electronic Ballast, manual switch controls.				28W CFL & T5, Electronic Ballast, timer based controls, for turning off lights when daylight is available.		28 W LED, Electronic Ballast, timer based controls, for turning off lights when daylight is available.			
Indoor lighting									
CFL 28 W lamps, electronic ballast, LPD achieved: 4.08W/Sq.m, Illuminance achieved: 120 Lux				TL5 & CFL 28 W lamps, electronic ballast, LPD achieved: 3.0 W/Sq.m, Illuminance achieved: 120 Lux		TL5 & LED lamps, electronic ballast, LPD achieved: 2.7W/Sq.m. Illuminance achieved: 120 Lux		LED lamps 28W, electronic ballast, LPD achieved: 1.3 W/Sq.m. Illuminance achieved: 120 Lux	
HVAC / Mechanical systems									
Standard Spilt AC with mixed more operation(AC & natural ventilation), TR/flat achieved: 4.5,		Efficient Spilt AC with only AC operation, TR/flat achieved: 3.75		minimum BEE 3 Star labelled Spilt AC with only AC operation, TR/flat achieved: 3.75		minimum BEE 5 Star labelled Spilt AC with only AC operation, TR/flat achieved: 3.0			
Electrical systems									
Oil filled Transformer, PF maintained 0.90				Dry type transformer, PF maintained 0.95					
EPI (kWh/Sq.m/annum)									
141		**90**		**80**		**60**		**50**	
Percentage of electricity consumption reduction from the grid (%) in comparison to base case									
-		**35.5%**		**43%**		**57.2%**		**64.2%**	
Landscape Design									
Top soil not preserved, fertile soil purchased post occupancy for landscape design.		Top soil not preserved, fertile soil purchased post occupancy for landscape		Top soil preserved for post occupancy landscape					
Open area with 50% lawn and 50% impervious pavements, Sprinkler large guns for irrigation.		Open area with 37% pervious pavement, 25% impervious pavement, 18.7 % lawn, 10% shrubs & ground cover, 10% trees, Sprinkler large guns for irrigation.		Open area with 20% pervious pavement, 20% impervious pavement, 15% lawn, 20% shrubs and ground cover, 25% trees, multiple sprinklers for irrigation.		Open area with 12.5% pervious pavement, 12.5 % impervious pavement, 10% lawn, 32.5% shrubs & ground cover, 32.5% trees, drip irrigation.			

Base case		Green Case		GRIHA 1 Star		GRIHA 3 Star		GRIHA 5 Star	
1000 Sq.m	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**
Savings in Consumption of Landscape water (%)									
-		55%		58%		63%		63%	
Building water demand (KL/day)									
Conventional plumbing fixtures, waste water treatment system for buildings only above 2500 Sq.m built up area.		Efficient plumbing fixtures, waste water treatment in all buildings above 5000 Sq.m, reuse for irrigation and for bigger buildings above 5000 Sq.m.		More efficient plumbing fixtures, waste water treatment in all buildings above 5000 Sq.m, reuse for irrigation and for bigger buildings above 5000 Sq.m, reuse for flushing.		More efficient plumbing fixtures, waste water treatment in all buildings above 5000 Sq.m, reuse for irrigation and for bigger buildings above 5000 Sq.m, reuse for flushing.		More efficient plumbing fixtures, waste water treatment in all buildings above 1000 Sq.m, reuse for irrigation and inside the building for flushing.	
Rain water recharge and harvesting for reuse (KL/day)									
Rain water harvesting is mandatory, hence ground water recharged through recharging pits		Rain water harvesting is mandatory, hence ground water recharged through recharging pits		Roof top rain water harvested for reuse for portable purpose. Rain water from landscape used for recharging ground water table.					
Water Demand from outside (KL/day) & Percentage reduction in water demand from outside sources like municipality etc.									
5.5	**20.3**	**3.2**	**12.9**	**2.1** Wet Season	**5.6** Wet Season	**1.6** Wet Season	**3.3** Wet Season	**0.5** Wet Season	**3.3** Wet Season
				2.9 Dry Season	**8.8** Dry Season	**2.4** Dry Season	**6.5** Dry Season	**1.3** Dry Season	**6.5** Dry Season
-	-	**41.3%** Wet Season	**36.5%** Wet Season	**61.5%** Wet Season	**72.3%** Wet Season	**71.3%** Wet Season	**83.5%** Wet Season	**90.1%** Wet Season	**83.5%** Wet Season
-	-	-	-	**47.2%** Dry Season	**56.8%** Dry Season	**56.9%** Dry Season	**68.1%** Dry Season	**75.7%** Dry Season	**68.1%** Dry Season
Percentage reduction of waste water in sewer lines									
-	-	52.7%	67.2%	58.0%	81.3%	66.4%	87.9%	85.2%	87.9%
Waste generated for landfill (Kg/day)									
13.2	**66**	**7**	**35.3**	**6.5**	**32.3**	**5.9**	**29.3**	**5.28**	**26.4**
Percentage waste reduction (%) from going to landfill									
-		**46.5%**		**51%**		**55%**		**60%**	

Base case		Green Case		GRIHA 1 Star		GRIHA 3 Star		GRIHA 5 Star	
1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m
Cost of building (including certification & registration cost)									
1500	1500	1533.2	1509.8	1548.3	1532.9	1564.2	1571.9	1606.5	1591.3
Net percentage increment in building cost (%)									
-	-	2.2%	0.7%	3.8%	2.6%	4.8%	5.2%	7.7%	6.5%

3.3.1. Summary of Analysis for GRIHA Residential Buildings

- Net Percentage of electricity consumption reduction from the grid in GRIHA certified residential buildings in comparison to conventional case ranges from 43% to 64%.
- Percentage reduction in water demand from outside sources like municipality etc., in GRIHA certified buildings in comparison to conventional case range from 90% (wet season) to 47% (dry season). Thus, it is observed that implementation of rain water harvesting for portable re use purpose, is crucial in achieving water security in the State, and hence it is recommended to implement easy and achievable policies to encourage owner in harvesting rain water for reuse purpose.
- Percentage of waste reduced from going to landfill in GRIHA certified buildings in comparison to conventional buildings range from 46%-60%.
- Percentage increment in cost in GRIHA residential buildings, due to the above discussed features range from 2.6% to maximum 7.7%, depending upon the size of project and number of features integrated.

3.4. Analysis for IGBC Certified Residential Buildings

Analysis for IGBC cases is also carried out by comparing Base case/ Conventional case against Green case against IGBC Silver, Gold and Platinum cases for residential building typology (Table 16).

*Table 16 Assumptions for Base case, Green case and **IGBC** certified cases for **Residential** Building Type*

Base case		Green Case		IGBC Silver		IGBC Gold		IGBC Platinum	
1000 Sq.m	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**
Building Envelope									
Concrete masonry unit for walls, un-insulated concrete roof, Single glazed units, Aluminium frame, WWR 30%		Concrete masonry unit for walls, insulated roof, Single glazed unit, uPVC frame, WWR 25%		Concrete masonry unit for walls, insulated roof, Single glazed unit, uPVC frame, WWR 20%		Concrete masonry unit for walls, insulated roof, Double glazed unit, uPVC frame, WWR 20%			
Outdoor Lighting									
28W CFL, Electronic Ballast, manual switch controls.						28 W LED, Electronic Ballast, timer based controls, for turning off lights when daylight is available.			
Indoor lighting									
CFL 28 W lamps, electronic ballast, LPD achieved: 4.08W/Sq.m, Illuminance achieved: 120 Lux				TL5 & CFL 28 W lamps, electronic ballast, LPD achieved: 3.0 W/Sq.m, Illuminance achieved: 120 Lux		TL5 & LED lamps, electronic ballast, LPD achieved: 2.7W/Sq.m. Illuminance achieved: 120 Lux		LED lamps 28W, electronic ballast, LPD achieved: 1.3 W/Sq.m. Illuminance achieved: 120 Lux	
HVAC / Mechanical systems									
Standard Spilt AC with mixed more operation(AC & natural ventilation), TR/flat achieved: 4.5,		Efficient Spilt AC with only AC operation, TR/flat achieved: 3.75		minimum BEE 2 Star labelled Spilt AC with only AC operation, TR/flat achieved: 3.75		minimum BEE 3 Star labelled Spilt AC with only AC operation, TR/flat achieved: 3.00		minimum BEE 4 Star labelled Spilt AC with only AC operation, TR/flat achieved: 3.00	
Electrical systems									
Oil filled Transformer, PF maintained 0.90				Dry type transformer, PF maintained 0.95					
EPI (kWh/Sq.m/annum)									
140.3		**90.6**		**85.8**		**64.7**		**57.1**	
Renewable Energy Installed (KW)									
0	0	0	0	0	0	0	0	0	0
Net Percentage of electricity consumption reduction from the grid (%) in comparison to base case (Excluding Equipment)									
-		**35%**		**39%**		**54%**		**59.3%**	
Landscape Design									
Top soil not preserved, fertile soil purchased post occupancy for landscape design.		Top soil not preserved, fertile soil purchased post occupancy for landscape		Top soil preserved for post occupancy landscape					

Base case		Green Case		IGBC Silver		IGBC Gold		IGBC Platinum	
1000 Sq.m	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**	**1000 Sq.m**	**5000 Sq.m**
Open area with 50% lawn and 50% impervious pavements, Sprinkler large guns for irrigation.		Open area with 37% pervious pavement, 25% impervious pavement, 18.7 % lawn, 10% shrubs & ground cover, 10% trees, Sprinkler large guns for irrigation.		Open area with 17.5% pervious pavement, 17.5% impervious pavement, 13% lawn, 52% shrubs and trees ground cover, multiple sprinklers for irrigation.		Open area with 26.3% pervious pavement, 8.8% impervious pavement, 13% lawn, 52% shrubs and trees ground cover, drip irrigation.		Open area with 26.3% pervious pavement, 8.8% impervious pavement, 13% lawn, 52% shrubs and trees ground cover, drip irrigation.	
Savings in Consumption of Landscape water (%)									
-		55%		37.6%	39.6%	53.2%	54.7%	53.2%	54.7%
Building water demand (KL/day)									
Conventional plumbing fixtures, waste water treatment system for buildings only above 2500 Sq.m built up area.		Efficient plumbing fixtures, waste water treatment in all buildings above 1000 Sq.m, reuse for irrigation and for bigger buildings above 5000 Sq.m, reuse for flushing.		More efficient plumbing fixtures, waste water treatment in all buildings above 1000 Sq.m and buildings above 5000 Sq.m, reuse for flushing and irrigation.		More efficient plumbing fixtures, waste water treatment in all buildings above 1000 Sq.m and buildings above 5000 Sq.m, reuse for flushing and irrigation.		More efficient plumbing fixtures, waste water treatment in all buildings above 1000 Sq.m, reuse for irrigation and inside the building for flushing.	
Rain water recharge and harvesting for reuse (KL/day)									
Rain water harvesting is mandatory, hence ground water recharged through recharging pits		Rain water harvesting is mandatory, hence ground water recharged through recharging pits		Roof top rain water harvested for reuse for portable purpose. Rain water from landscape used for recharging ground water table.					
Water Demand from outside (KL/day) & Percentage reduction in water demand from outside sources like municipality etc.									
5.5	**20.3**	**3.2**	**12.9**	**0.2** Wet Season	**1.6** Wet Season	**0.1** Wet Season	**1.4** Wet Season	**0.1** Wet Season	**1.4** Wet Season
				0.9 Dry Season	**4.7** Dry Season	**0.9** Dry Season	**4.5** Dry Season	**0.9** Dry Season	**4.5** Dry Season
-	-	**41.3%**	**36.5%**	**97%** Wet Season	**92.2%** Wet Season	**97.7%** Wet Season	**85.7%** Wet Season	**94.1%** Wet Season	**88.3%** Wet Season
-	-	-	-	**82.7%** Dry Season	**76.7%** Dry Season	**83.4%** Dry Season	**77.7%** Dry Season	**83.4%** Dry Season	**77.7%** Dry Season
Percentage reduction of waste water in sewer lines									
-	**-**	**52.7**	**67.2**	**98.6**	**100.5**	**95.3**	**96.8**	**95.3**	**96.8**
Waste generated for landfill (Kg/day)									
13.2	**66**	**7**	**35.3**	**6.5**	**32.3**	**5.9**	**29.3**	**5.3**	**26.4**

Base case		Green Case		IGBC Silver		IGBC Gold		IGBC Platinum	
1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m	1000 Sq.m	5000 Sq.m
Percentage waste reduction (%) from going to landfill									
-		46.5%		46.5%		46.5%		51%	
Cost of building (including certification & registration cost)									
1500	1500	1597.5	1518.5	1587.3	1534.5	1599.5	1573.9	1610.9	1600.9
Net percentage increment in building cost (%)									
-	-	3.17%	1.23%	5.8%	2.3%	6.6%	9.9%	7.4%	6.7%

3.4.1. Summary of Analysis for IGBC Residential Buildings

- Net Percentage of electricity consumption reduction from the grid in IGBC certified residential buildings in comparison to conventional case ranges from 39% to 60%.
- Percentage reduction in water demand from outside sources like municipality etc., in GRIHA certified buildings in comparison to conventional case range from 97% (wet season) to 76% (dry season). Thus, it is observed that implementation of rain water harvesting for portable re use purpose, is crucial in achieving water security in the State, and hence it is recommended to implement easy and achievable policies to encourage owner in harvesting rain water for reuse purpose.
- Percentage of waste reduced from going to landfill in IGBC certified buildings in comparison to conventional buildings range from 46%-51%.
- Percentage increment in cost in IGBC residential buildings, due to the above discussed features range from 2.3% to maximum 9.9%, depending upon the size of project and number of features integrated.

3.5. Summary

From the above analysis it is observed that the cost of a green rated building could range from 2.5% to as much as 15% in comparison to a conventional building. However the saving potential is as much as 64% in energy, 100% in water, 60% of waste reduction to go to landfill and 100% of waste water reduction to go to central sewer lines. Figures 9 and 10 and Table 17 summarize the consumption details. Figure 11 summarizes the cost increment details and Table 18 summarizes the resource consumption reduction potential for green buildings against conventional buildings.

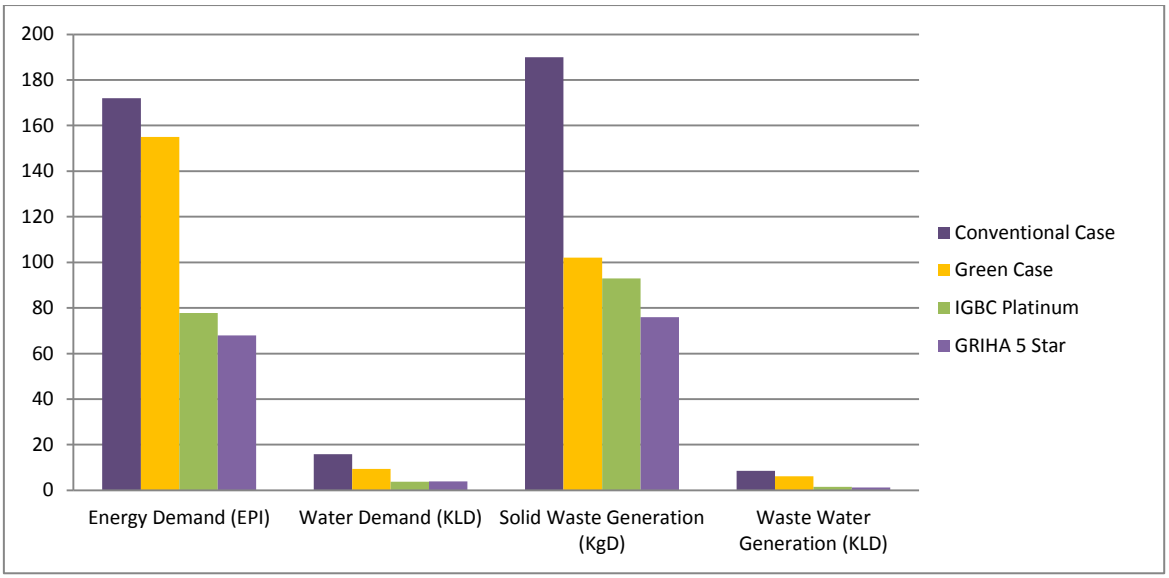


*Figure 9: Summary of Resource Consumption Potential for **Commercial** Buildings in Tamil Nadu*

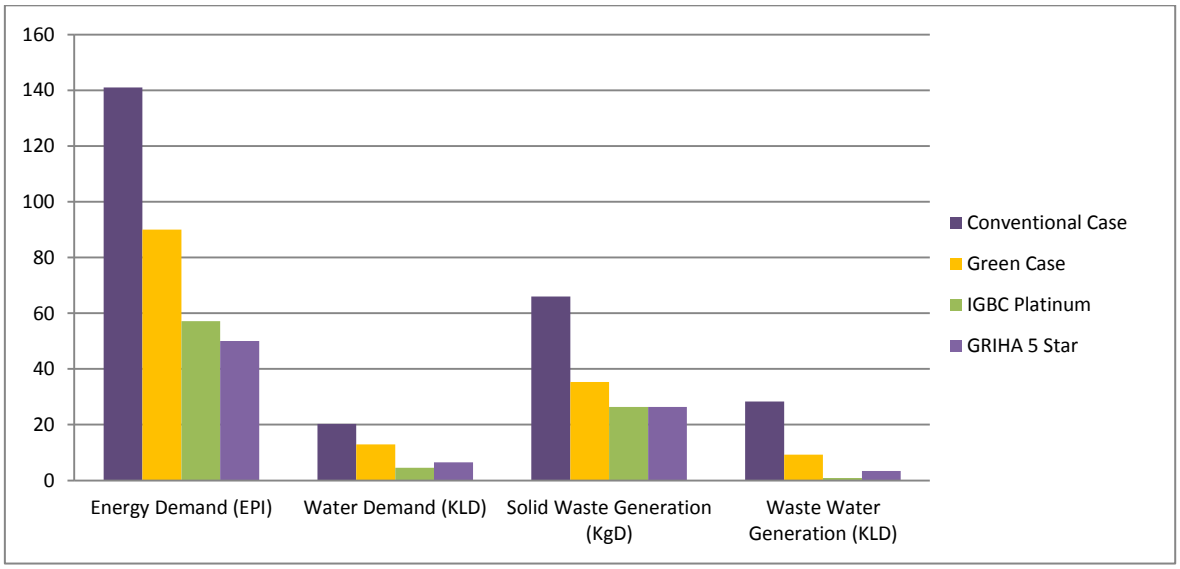


*Figure 10: Summary of Resource Consumption Potential for **Residential** Buildings in Tamil Nadu*

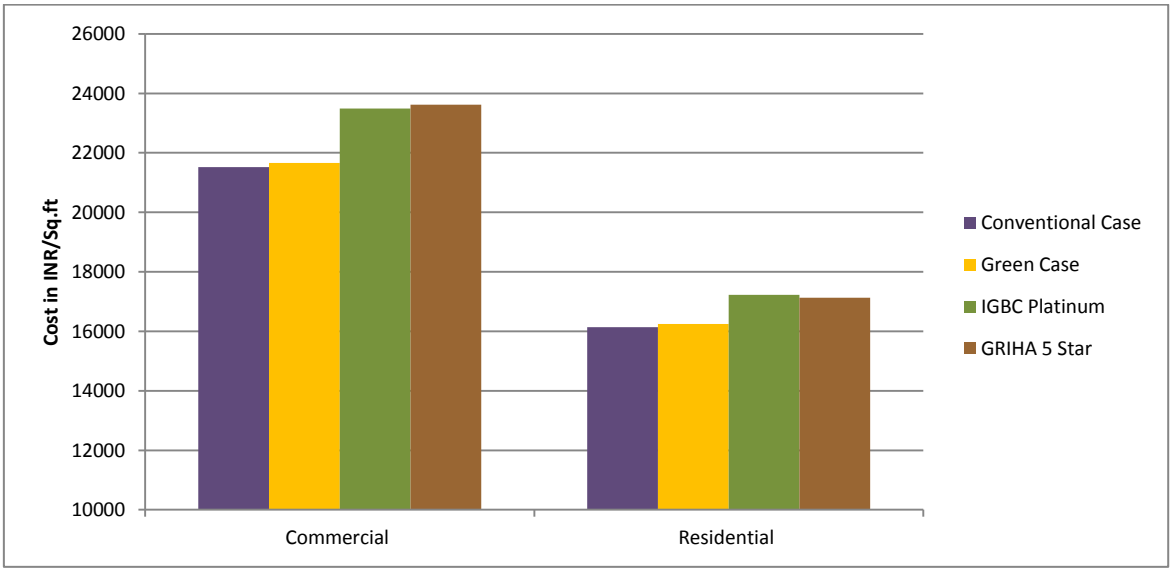


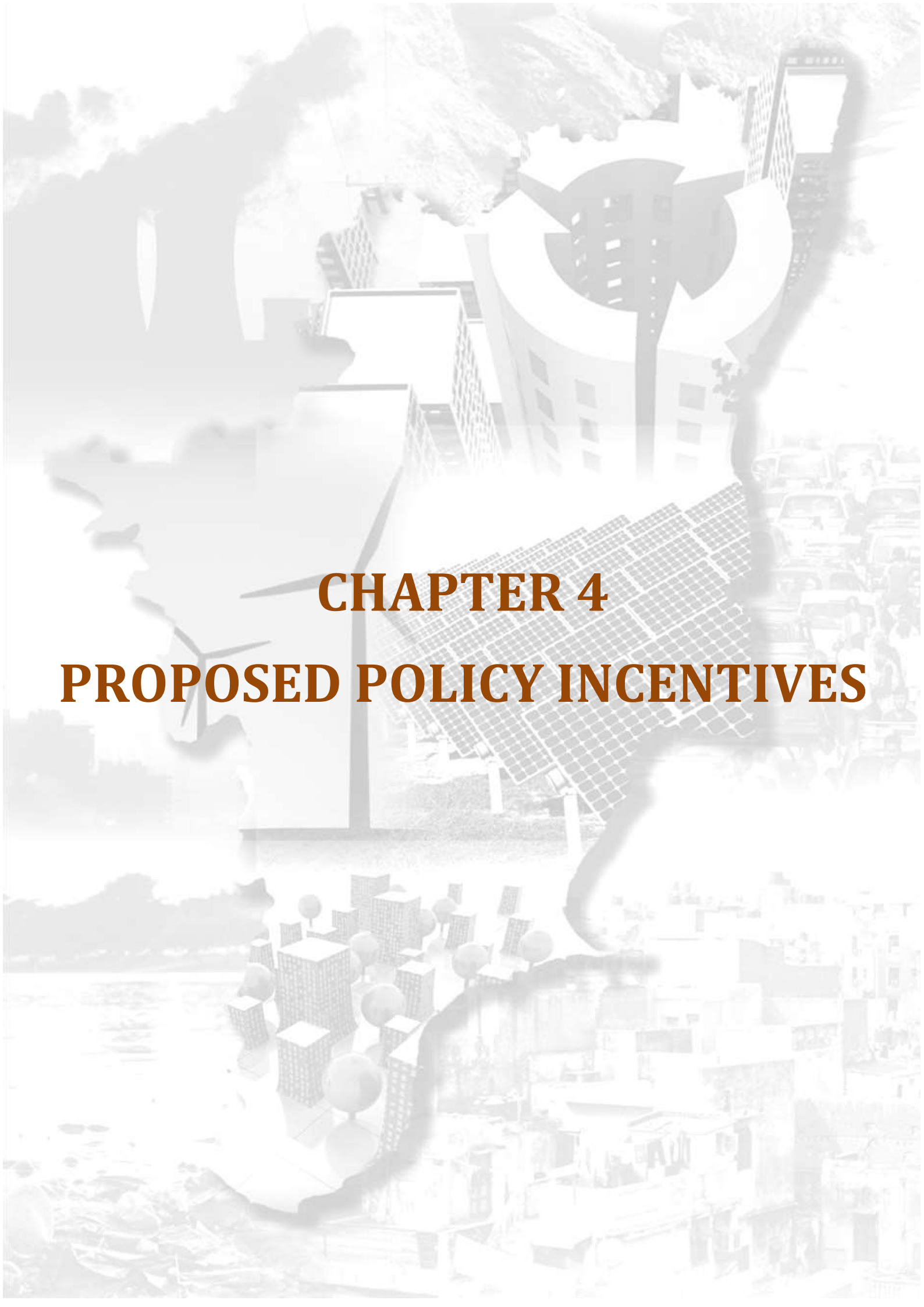
Figure 11: Summary of Cost Variation between Conventional, Green and Green Rated Buildings of Commercial and Residential Typologies in Tamil Nadu

Table 17 Summary of Resource consumption and cost variation for all building types.

Certification Type	Commercial					Residential				
	EPI (kWh/Sq. m/yr)	Water Demand (KLD)	Solid Waste generated (KgD)	Water Water generated (KLD)	Cost ₹/Sq.m	EPI (kWh/Sq. m/yr)	Water Demand (KLD)	Solid Waste generated (KgD)	Water Water generated (KLD)	Cost ₹/Sq.m
Green Case	172	15.8	190	6.2	21,520	141	20	35.3	9.3	16,247
GRIHA 1 star	112	3.9	93	0.6	21,659	80	8.8	32.3	5.3	16,495
GRIHA 3 Star	80	3.9	85	1.2	22,068	60	6.5	29.3	3.4	16,914
GRIHA 5 Star	68	3.9	76	1.2	22,929	50	6.5	26.4	3.4	17,130
IGBC Silver	112.6	8.3	102	5.4	23,618	85.8	4.7	35.3	0	16,602
IGBC Gold	83.1	3.8	102	1.5	22,273	64.7	4.5	29.3	0.9	16,936
IGBC Platinum	77.8	3.8	93	1.5	23,489	57.1	4.5	26.4	0.9	17,226

Table 18 Summary of savings by green buildings in resource consumption and cost increment from conventional building types

Certification Type	Commercial					Residential				
	Energy Savings (%)	Water savings (%)	Solid Waste reduction (%)	Waste Water reduction (%)	Cost Increment (%)	Energy Savings (%)	Water savings (%)	Solid Waste reduction (%)	Waste Water reduction (%)	Cost Increment (%)
Green Case	10	40 - 46	46	28 - 43	0.7 - 2.5	35	36 - 41	46	52 - 67	0.7 - 2.2
GRIHA 1 star	36	69 - 100	51	67 - 76	2.5 - 6.6	43	47 - 72	51	58 - 81	2.6 - 3.8
GRIHA 3 Star	54	69 - 100	55	72 - 86	6.5 - 11.9	57	57 - 83	55	66 - 88	4.8 - 5.2
GRIHA 5 Star	61	75 - 100	60	86 - 92	9.7 - 14.8	64	68 - 90	60	85 - 88	6.5 - 7.7
IGBC Silver	36	43 - 83	46	52 - 66	3.4 - 8.1	39	76 - 97	51	98 - 100	2.3 - 5.8
IGBC Gold	53	76 - 100	46	83 - 91	5.7 - 11.9	54	77 - 97	55	95 - 96	6.6 - 9.9
IGBC Platinum	56	76 - 100	51	83 - 91	9.1 - 15.1	59	77 - 94	60	95 - 97	6.7 - 7.7



CHAPTER 4
PROPOSED POLICY INCENTIVES

4. Proposed Policy Incentives

Based upon benefits quantified in Chapter 3 due to adoption of green building measures, at user level, developer level and state/municipality level, policy incentives are framed and recommended in this chapter. Following are the policy incentives recommended for certified green buildings:

1. **Incentivise rebate on PFSI charges for buildings located in Chennai Metropolitan area.**

(Or)

2. **Rebate on combination of PFSI charges and I&A charges for buildings located in Chennai Metropolitan area.**
3. **Additional FSI for buildings located in Tier 2 & Tier 3 cities and semi urban areas where PFSI charges are not collected.**
4. **Rebate in property tax.**
5. **Rain water tax.**
6. **Waste water tax.**
7. **Fast track approval system for registered green certified buildings.**

4.1. Background Study for Incentive Recommendations on FSI

4.1.1. Current Practice on PFSI in Tamil Nadu

Chennai metropolitan area has maximum allowable FSI upto 1.5. For Multi Storied Buildings it is upto 2.5. Besides, extra FSI is given for a premium charge. Value of this Premium FSI (PFSI) charge is calculated as equivalent to land cost. Additional FSI area allowed for premium charges is: 20%, 30% and 40% of normally allowable FSI. Analysis in this report is carried out for a sample building, assuming the applicable FSI is 1.5, the same analysis holds good for higher FSI, as all numbers will proportionately vary.

Table 19: Additional FSI allowed for Premium Charge

Serial Number	Road Width	Premium FSI (% of normally allowable FSI)
(i)	18 metres and above	40%
(ii)	12 metres – below 18 metres	30%
(iii)	9 metres – below 12 metres	20%

Thus, the the net allowed FSI after adding the premium FSI to the regular FSI of 1.5 is for example, shall be as given in table below:

Table 20: Net FSI including Premium FSI on normally allowed FSI

Current FSI	Additional % allowed	Net FSI allowed
1.5	20%	1.8
1.5	30%	1.95
1.5	40%	2.1

In the current example of a building with Site Area of 3333.33 Sq.m and Built up area of 5000 Sq.m, following the additional FSI, the built up will be:

Table 21: Effective builtup area after availing PFSI on normally allowed FSI

FSI	Built up (Sq.m)
1.5	5000
1.8	6000
1.95	6500
2.1	7000

4.1.2. Summary of Performance Analysis for Green, GRIHA and IGBC Cases

Analysis was carried out to understand the consumption of resources with additional premium FSI, if the buildings undergo for green certification.

The highest allowable % on current FSI is 40%, which is equivalent to FSI 2.1, thus in the current analysis example of Site Ares 3333.33 Sq.m and built up 5000 Sq.m, with the additional FSI, total allowed built up become 7000 Sq.m.

Tables below show analysis of resource consumption of a conventional building with normally allowed FSI of 1.5 (5000 Sq.m builtup area) is same or higher than a green certified building with additional premium FSI of total 2.1(7000 Sq.m builtup area). In other words resources consumption of a green certified building with additional builtup area (7000 Sq.m) is less than conventional building (5000 Sq.m).

*Table 22: Summary of resource consumption for a conventional **commercial** 5000 Sq.m vs. **GRIHA** certified 7000 Sq.m due to additional PFSI*

Resources	Conventional Case (Built up area 5000 Sq.m)	Green case (Not certified) (Builtup area - 7000 Sq.m)	GRIHA 1 Star Certified (Builtup area - 7000 Sq.m)	GRIHA 3 Star Certified (Builtup area - 7000 Sq.m)	GRIHA 5 Star Certified (Builtup area - 7000 Sq.m)
EPI (kWh/Sq.m/yr)	172	155	112	80	68
Electricity Consumption (kWh)	8,60,000	10,85,000	7,84,000	5,60,000	4,76,000
Water Demand (KL/day)	15.8	13.6	5.46	5.46	5.46
Waste water generated (KL/day)	8.6	8.68	0.84	1.68	1.68
Waste generated (Kg/day)	190	142.3	130	118	106

*Table 23: Summary of resource consumption for a conventional **commercial** 5000 Sq.m vs. **IGBC** certified 7000 Sq.m due to additional PFSI*

Resources	Conventional Case (Built up area 5000 Sq.m)	Green case (Not certified) (Builtup area - 7000 Sq.m)	IGBC Silver Certified (Builtup area - 7000 Sq.m)	IGBC Gold Certified (Builtup area - 7000 Sq.m)	IGBC Platinum Certified (Builtup area - 7000 Sq.m)
EPI (kWh/Sq.m/yr)	172	155	112.6	83.1	77.8
Electricity Consumption (kWh)	8,60,000	10,85,000	7,88,200	5,81,700	5,44,600
Water Demand (KL/day)	15.8	13.6	11.62	5.32	5.32
Waste water generated (KL/day)	8.6	8.68	7.56	2.1	2.1
Waste generated (Kg/day)	190	142.3	142.3	142.3	130.3

*Table 24 Summary of resource consumption for a conventional **residential** 5000 Sq.m vs. **GRIHA** certified 7000 Sq.m due to additional Premium PFSI*

Resources	Conventional Case (Built up area 5000 Sq.m)	Green case (Not certified) (Builtup area - 7000 Sq.m)	GRIHA 1 Star Certified (Builtup area - 7000 Sq.m)	GRIHA 3 Star Certified (Builtup area - 7000 Sq.m)	GRIHA 5 Star Certified (Builtup area - 7000 Sq.m)
EPI (kWh/Sq.m/yr)	141	90	80	60	50
Electricity Consumption (kWh)	7,05,000	6,30,000	5,60,000	4,20,000	3,50,000
Water Demand (KL/day)	20.3	18.06	12.32	9.1	9.1
Waste water generated (KL/day)	28.3	13.02	7.42	4.76	4.76
Waste generated (Kg/day)	66	49.42	45.22	41.02	36.96

*Table 25 Summary of resource consumption for a conventional **residential** 5000 Sq.m vs. **IGBC** certified 7000 Sq.m due to additional Premium FSI*

Resources	Conventional Case (Built up area 5000 Sq.m)	Green case (Not certified) (Builtup area - 7000 Sq.m)	IGBC Silver Certified (Builtup area - 7000 Sq.m)	IGBC Gold Certified (Builtup area - 7000 Sq.m)	IGBC Platinum Certified (Builtup area - 7000 Sq.m)
EPI (kWh/Sq.m/yr)	141	90	86	65	57
Electricity Consumption (kWh)	7,05,000	6,30,000	7,84,700	6,37,000	5,83,800
Water Demand (KL/day)	20.3	18.06	6.58	6..3	6.3
Waste water generated (KL/day)	28.3	13.02	0	1.26	1.26
Waste generated (Kg/day)	66	49.42	49.42	49.42	45.28

Green certifications play a role of implementing green measures on site. From the above tables it is evident that in any GRIHA certified building, there will be a minimum reduction of 36% of energy demand, 69% of water demand and 51% of waste generation from a conventional building. Similarly, in any IGBC certified building, there will be a minimum reduction of 36% of energy demand, 43% of water demand and 46% of waste generation from current conventional building.

Hence, a green certified building with higher builtup area which includes maximum PFSI area still has lower demand of resources than a conventional building with no additional PFSI. Therefore, it is recommended that the buildings which get certified could be incentivised with additional FAR, as it is calculated, that the certified buildings, due to reduced consumption of resources, will not bring additional resource demand for the municipality and utility bodies.

4.1.3. Benefits by Green Buildings to the Municipality

Water:

Financial Benefits to the municipality due to reduced water consumption are quantified for Chennai city as a sample study (tables 26 and 27).

*Assumptions and considerations: Cost incurred in water supply for the municipality (or water department) is considered to be approximately ₹ 38/KL (**Source:** CMWSSB).*

Loss for CMWSSB from one building is calculated by subtracting Monthly bill paid from the Actual cost to CMWSSB.

In the analysis it is observed that the GRIHA/IGBC certified commercial buildings when compared with conventional buildings, due to reduced water consumption, can result in no loss for CMWSSB. In the case of residential buildings the annual loss occurring for the water department has drastically come down.

*Table 26: Reduced water consumption, water tariff and water bill (**Commercial case**- 5000 Sq.m)*

	Conventional Case	Green case	GRIHA 1 Star/3Star/5Star	IGBC Silver	IGBC Gold/ Platinum
Demand (KL/day)	15.8	9.4	3.9	8.3	3.8
Demand (KL/month)	410.8	244.4	101.4	216	99
Water Tariff(₹)/ month	35/KL + 400	35/KL + 400	35/KL + 400	35/KL + 400	35/KL + 400
Total water bill paid (₹)/ month	14,778	8,954	3,949	7,953	3,858
Cost to CMWSSB for supply of water ₹ / month	15,610.4	9,287.2	3,853.2	8,200	3,754
Loss to CMWSSB (₹/month)	832.4	333.2	-95.8	247	-103

*Table 27 Reduced water consumption, water tariff and water bill (**Residential case** - 5000 Sq.m)*

	Conventional Case	Green case	GRIHA 1 Star	GRIHA 3/5 Star	IGBC Silver	IGBC Gold/ Platinum
Demand (KL/day)	20.3	12.9	8.8	6.5	4.7	4.5
Demand (KL/month)	609	387	264	195	141	135
Water Tariff(₹)/ month	25/KL + 50	25/KL + 50	25/KL + 50	25/KL + 50	25/KL + 50	25/KL + 50
Total water bill paid (₹)/ month	15,275	9,725	6,625	4,925	3,575	3,425
Cost to CMWSSB for supply of water ₹ / month	23,142	14,706	10,032	7,410	5,358	5,130
Loss to CMWSSB (₹/month)	7,867	4,981	3,382	2,485	1,783	1,705

Energy:

Similar to the above analysis, a sample calculation has been performed for Chennai corporation area, estimating the potential energy savings with green certified buildings by 2023 (Table 28). The table below also shows the benefit quantified by adopting green building practices such as adoption of ECBC and also by adopting green certification systems.

Assumptions and considerations: Savings till 2023 have been projected due to consumption reduction possible from certified buildings, assuming all new buildings will be mandated to be green certified.

Future built up area projection values are estimated based on the information provided by Chennai Corporation.

Table 28 Economical benefit analysis for state government - Energy consumption of GRIHA/IGBC certified buildings & Savings to Utility estimated for future

	Conventional Building	Green case (ECBC compliant)	GRIHA 1 Star	IGBC Silver	GRIHA 3 Star	IGBC Gold	GRIHA 5 Star	IGBC Platinum
Commercial								
EPI (Energy Performance Index) kWh/Sq.m/yr	172	155	112	112.6	80	83.1	68	77.8
Annual Consumption from 1 building (kWh)	8,60,000	7,75,000	5,60,000	5,63,000	4,00,000	4,15,500	3,40,000	3,89,000
Demand reduction to TANGEDCO from 1 Building (kWh)	-	85,000	3,00,000	2,97,000	4,60,000	4,44,500	5,20,000	4,71,000
It is observed that GRIHA 3 Star/IGBC Gold onwards, savings to the utility is more than consumption								
Estimated future Built up area trend in Chennai corporation area every year (Sq.m.)	Approximately 30,00,000 (30 Lakhs Sq.m)							
Estimated future builtup area for commercial is considered as 20% of total builtup area (Sq.m)	6,00,000							
Expected future construction with same trend in commercial sector by 2023 (Sq.m)	48,00,000							
Electricity Consumption Projected for above builtup area in commercial sector (MWh)	8,25,600	7,44,000	5,37,600	5,40,480	3,84,000	3,98,880	3,26,400	3,73,440
Savings projected (MWh)		81,600	2,88,000	2,85,120	4,41,600	4,26,720	4,99,200	4,52,160
Residential								
EPI (Energy Performance Index) kWh/Sq.m/yr	141	90	80	85.8	60	64.7	50	57.1
Annual Consumption from 1 building (kWh)	7,05,000	4,50,000	4,00,000	4,29,000	3,00,000	3,23,500	2,50,000	2,85,500
Demand reduction to TANGEDCO from 1 Building (kWh)	-	2,55,000	3,05,000	2,76,000	4,05,000	3,81,500	4,55,000	4,19,500
It is observed that GRIHA 3 Star/IGBC Gold onwards, savings to the utility is more than consumption								

	Conventional Building	Green case (ECBC compliant)	GRIHA 1 Star	IGBC Silver	GRIHA 3 Star	IGBC Gold	GRIHA 5 Star	IGBC Platinum
Estimated future Built up area trend in Chennai corporation area every year (Sq.m.)	Approximately 30,00,000 (30 Lakhs Sq.m)							
Estimated future builtup area for residential is considered as 20% of total builtup area (Sq.m)	24,00,000							
Expected future construction with same trend in residential sector by 2023 (Sq.m)	1,92,00,000							
Electricity Consumption Projected for above builtup area in residential sector (MWh)	27,07,200	17,28,000	15,36,000	16,47,360	11,52,000	12,42,240	9,60,000	10,96,320
Savings projected (MWh)		9,79,200	11,71,200	10,59,840	15,55,200	14,64,960	17,47,200	16,10,880
Total								
Total Savings projected (Residential + Commercial) (MWh)		**10,60,800**	**14,59,200**	**13,44,960**	**19,96,800**	**18,91,680**	**22,46,400**	**20,63,040**
Savings MW (Source: LBNL 2014)		**539**	**742**	**684**	**1015**	**962**	**1142**	**1049**

Source for future builtup area estimations: Chennai Corporation

According to the Tamil Nadu Vision 2023 report, the state has proposed setting up additional power generating capacity power plants in order to meet the raising energy demand. The investment proposed for one of the projects, the North Chennai Thermal power project (3rd Phase) with 800MW capacity, is ₹4,800 crores (Source: Tamil Nadu Vision 2023). The expenditure required for each additional MW generating capacity plant is calculated to be approximately 5 to 6 crores.

From the above table it can be summarized that by 2023 if all new buildings in Chennai Corporation region are minimum GRIHA 3 star or/and IGBC gold certified, approximately 962MW to 1015MW of energy demand can be reduced. This may save ₹4,800 crores of funds from setting up the thermal power plant. Likewise if green buildings are developed across the state, significant savings in energy and funds can be witnessed.

Summary:

From the above both analyses on water and energy demand reduction, it can be concluded that green buildings can substantially reduce the resource demand on government. Also, as the greenness or efficiency increases, the loss to utility decreases. This means incentivizing on FSI and/or I&A charges for green certified buildings may not affect the financial or public service capabilities of government.

The following rebate values as incentives are thereby developed on FSI charges, I&A charges, property tax where the rebate value balance the benefit between a developer, owner and government at the same time.

4.2. Incentive Recommendation 1: Rebate on Premium FSI Charges. (Or) Recommendation 2: Rebate on Combination of Premium FSI Charges and I&A Charges. (Chennai Metropolitan Area)

4.2.1. Background

Incentivizing additional FSI is the most common practice in many municipalities across India and globe. It is the developer who benefits from this incentive, on investing additional cost for constructing a green certified building. Since, it is proven in the analysis above that the municipalities will not be at a loss from FSI related incentives, same has been proposed in this section. The first incentive recommended is rebate on Premium FSI charges or rebate on combination of Premium FSI charges with I&A charges for Green Certified buildings in Chennai metropolitan area where land cost is usually high.

The recommendation is developed for commercial and residential typologies for buildings above and below 5000 Sq.m of builtup area. The rebate value is derived based on increment cost for construction of a green building.

From the performance analysis chapter, it is understood that cost of smaller footprint building is higher than larger foot print buildings. Hence, to simplify the recommendation, higher rebate value is proposed for buildings with built up area below 5000 Sq.m and vis-a-vis. The tables below provide the recommended rebate values and its equivalent amount for a sample case where the land value is ₹25000/Sq.m.

4.2.2. Recommendations

Following rebate values are recommended for incentive on PFSI charges or PFSI charges + I&A charges. A sample case has been worked for each recommendation value.

*Table 29: Recommended Rebate for **commercial** buildings **above 5000 Sq.m***

		Conventional Building	Green Case	GRIHA 1 Star	IGBC Silver	GRIHA 3 Star	IGBC Gold	GRIHA 5 Star	IGBC Platinum
Cost of Building (₹/Sq.ft)		2,000	2,013	2,051	2,070	2,131	2,114	2,195	2,183
Increment	**₹/Sq.ft**	-	13	70	51	114	131	195	183
	₹/Sq.m	-	140	753	549	1,227	1,410	2,098	1,969
Recommendations									
1. Rebate on PFSI charges	**₹/Sq.ft**	-	-	**70**		**131**		**195**	
	₹/Sq.m	-	-	**755**		**1,410**		**2,098**	
2. Rebate on PFSI charges + I&A charges	**₹/Sq.ft**	-	-	**63 + 10% I&A (7)**		**110 + 30% I&A (21)**		**174 + 30% I&A (21)**	
	₹/Sq.m	-	-	**680 + 10% I&A (75)**		**1185 + 30% I&A (225)**		**1873 + 30% I&A (225)**	
Sample Case of Land Value ₹ 25,000/Sq.m									
Recommended Rebate% in PFSI and its equivalent rebate amount (₹ / Sq.m)		-	-	**3.5% = 875**		**6% = 1,500**		**8.5% = 2,125**	
Recommended Rebate in PFSI+ I&A charges and its equivalent rebate amount (₹ / Sq.m)		-	-	**3% PFSI + 10% I&A = 825**		**5% PFSI + 30% I&A = 1,475**		**8% PFSI + 30% I&A = 2,225**	

From the above table it can be summarised that:

- Rebate on PFSI charges, minimum ₹ 70/Sq.ft. or rebate on PFSI charges ₹ 63/Sq.ft + 10% rebate on I&A charges is recommended for buildings with GRIHA 1 Star / IGBC Silver rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 112 kWh/Sq.m/annum, water demand reduction from non-renewable resources such as municipality/tanker/borewells more than 43% from conventional case and minimum 46% reduction in waste to landfill from conventional case.

- Rebate on PFSI charges, minimum ₹ 131/Sq.ft. or rebate on PFSI charges ₹ 110/Sq.ft + 30% rebate on I&A charges is recommended for buildings with GRIHA 3 Star / IGBC Gold rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 83kWh/Sq.m/annum, water demand reduction from non-renewable resources such as municipality /tanker/borewells more than 75% from conventional case and minimum 46% reduction in waste to landfill from conventional case.

- Rebate on PFSI charges, minimum ₹ 195/Sq.ft. or rebate on PFSI charges ₹ 174/Sq.ft + 30% rebate on I&A charges is recommended for buildings with GRIHA 5 Star / IGBC Platinum rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 78kWh/Sq.m/annum, water demand reduction from non -renewable resources such as municipality/tanker/borewells more than 75% from conventional case and minimum 51% reduction in waste to landfill from conventional case.

Thus, depending upon the Level of rating, the rebate in Premium charge for additional FSI or rebate on combination of premium FSI and I&A charges together can vary from ₹63/Sq.ft to ₹ 195/Sq.ft.

*Table 30: Recommended Rebate for **commercial** buildings **below 5000 Sq.m***

		Conventional Building	Green Case	GRIHA 1 Star	IGBC Silver	GRIHA 3 Star	IGBC Gold	GRIHA 5 Star	IGBC Platinum
Cost of Building (₹/Sq.ft)		2,000	2,050	2,132	2,170	2,221	2,228	2,297	2,304
Increment	**₹/Sq.ft**	-	50	132	170	221	228	297	304
	₹/Sq.m	-	543	1,420	1,829	2,378	2,453	3,196	3,271
Recommendations									
1. Rebate on PFSI charges	**₹/Sq.ft**	**-**	**-**	**170**		**228**		**304**	
	₹/Sq.m	-	-	**1,829**		**2,453**		**3,271**	
2. Rebate on PFSI charges + I&A charges	**₹/Sq.ft**	**-**	**-**	**156 + 20% I&A (14)**		**207 + 30% I&A (21)**		**283+ 30% I&A (21)**	
	₹/Sq.m	**-**	**-**	**1,679 + 20% I&A (150)**		**2,228 + 30% I&A (225)**		**3,046 + 30% I&A (225)**	
Sample Case of Land Value ₹ 25,000/Sq.m									
Recommended Rebate% in PFSI and its equivalent rebate amount (₹ / Sq.m)		-	-	**8% = 2,000**		**10% = 2,500**		**13.5% = 3,375**	
Recommended Rebate in PFSI+ I&A charges and its equivalent rebate amount (₹ / Sq.m)		**-**	**-**	**7% PFSI + 20% I&A = 1,900**		**9% PFSI + 30% I&A = 2,475**		**12.5% PFSI + 30% I&A = 3,350**	

From the above table it can be summarised that:

- Rebate on PFSI charges, minimum ₹ 170/Sq.ft. or rebate on PFSI charges ₹ 156/Sq.ft + 20% rebate on I&A charges is recommended for buildings with GRIHA 1 Star / IGBC Silver rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 112 kWh/Sq.m/annum, water demand reduction from non-renewable resources such as municipality/tanker/borewells more than 64% from conventional case and minimum 46% reduction in waste to landfill from conventional case.
- Rebate on PFSI charges, minimum ₹ 2281/Sq.ft. or rebate on PFSI charges ₹ 207/Sq.ft + 30% rebate on I&A charges is recommended for buildings with GRIHA 3 Star / IGBC Gold rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 83kWh/Sq.m/annum, water demand reduction from non-renewable resources such as municipality /tanker/borewells more than 69% from conventional case and minimum 46% reduction in waste to landfill from conventional case.
- Rebate on PFSI charges, minimum ₹ 304/Sq.ft. or rebate on PFSI charges ₹ 283/Sq.ft + 30% rebate on I&A charges is recommended for buildings with GRIHA 5 Star / IGBC Platinum rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 78kWh/Sq.m/annum, water demand reduction from non -renewable resources such as municipality/tanker/borewells more than 82% from conventional case and minimum 51% reduction in waste to landfill from conventional case.

Thus, depending upon the Level of rating, the rebate in Premium charge for additional FSI or rebate on combination of premium FSI and I&A charges together can vary from ₹170/Sq.ft to ₹ 304/Sq.ft.

*Table 31: Recommended Rebate for **residential** buildings **above 5000 Sq.m***

		Conventional Building	Green Case	GRIHA 1 Star	IGBC Silver	GRIHA 3 Star	IGBC Gold	GRIHA 5 Star	IGBC Platinum
Cost of Building (₹/Sq.ft)		1,500	1,510	1,533	1,543	1,572	1,574	1,592	1,601
Increment	**₹/Sq.ft**	-	10	33	43	72	74	92	101
	₹/Sq.m	-	108	355	463	775	796	990	1,087
Recommendations									
1. Rebate on PFSI charges	**₹/Sq.ft**	-	-	**43**		**74**		**101**	
	₹/Sq.m	-	-	**463**		**796**		**1,087**	
2. Rebate on PFSI charges + I&A charges	**₹/Sq.ft**	-	-	**22 + 60% I&A (21)**		**64 + 30% I&A (10.5)**		**91 + 30% I&A (10.5)**	
	₹/Sq.m	-	-	**238 + 60% I&A (225)**		**683 + 30% I&A (112.5)**		**974 + 30% I&A (112.5)**	
Sample Case of Land Value ₹ 25,000/Sq.m									
Recommended Rebate% in PFSI and its equivalent rebate amount (₹ / Sq.m)		-	-	**2% = 500**		**3.5% = 875**		**4.5% = 1,125**	
Recommended Rebate in PFSI+ I&A charges and its equivalent rebate amount (₹ / Sq.m)		-	-	**1% PFSI + 60% I&A = 475**		**3% PFSI + 30% I&A = 862**		**4% PFSI + 30% I&A = 1,112**	

From the above table it can be summarised that:

- Rebate on PFSI charges, minimum ₹ 43/Sq.ft. or rebate on PFSI charges ₹ 22/Sq.ft + 60% rebate on I&A charges is recommended for buildings with GRIHA 1 Star / IGBC Silver rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 85 kWh/Sq.m/annum, water demand reduction from non-renewable resources such as municipality/tanker/borewells more than 55% from conventional case and minimum 46% reduction in waste to landfill from conventional case.
- Rebate on PFSI charges, minimum ₹ 74/Sq.ft. or rebate on PFSI charges ₹ 64/Sq.ft + 30% rebate on I&A charges is recommended for buildings with GRIHA 3 Star / IGBC Gold rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 65kWh/Sq.m/annum, water demand reduction from non-renewable resources such as municipality /tanker/borewells more than 68% from conventional case and minimum 46% reduction in waste to landfill from conventional case.
- Rebate on PFSI charges, minimum ₹ 101/Sq.ft. or rebate on PFSI charges ₹ 91/Sq.ft + 30% rebate on I&A charges is recommended for buildings with GRIHA 5 Star / IGBC Platinum rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 57kWh/Sq.m/annum, water demand reduction from non -renewable resources such as municipality/tanker/borewells more than 68% from conventional case and minimum 50% reduction in waste to landfill from conventional case.

Thus, depending upon the Level of rating, the rebate in Premium charge for additional FSI or rebate on combination of premium FSI and I&A charges together can vary from ₹43/Sq.ft to ₹ 101/Sq.ft.

*Table 32: Recommended Rebate for **residential** buildings **below 5000** Sq.m*

		Conventional Building	Green Case	GRIHA 1 Star	IGBC Silver	GRIHA 3 Star	IGBC Gold	GRIHA 5 Star	IGBC Platinum
Cost of Building (₹/Sq.ft)		1,500	1,534	1,548	1,587	1,564	1,600	1,606	1,611
Increment	**₹/Sq.ft**	-	34	48	87	64	100	106	111
	₹/Sq.m	-	365	516	936	688	1,076	1,140	1,194
Recommendations									
1. Rebate on PFSI charges	**₹/Sq.ft**	-	-	**87**		**100**		**111**	
	₹/Sq.m	-	-	**936**		**1,076**		**1,194**	
2. Rebate on PFSI charges + I&A charges	**₹/Sq.ft**	-	-	**66 + 60% I&A (21)**		**90 + 30% I&A (10.5)**		**100 + 60% I&A (21)**	
	₹/Sq.m	-	-	**711 + 60% I&A (225)**		**963 + 30% I&A (112.5)**		**1,081 + 60% I&A (225)**	
Sample Case of Land Value ₹ 25,000/Sq.m									
Recommended Rebate% in PFSI and its equivalent rebate amount (₹ / Sq.m)		-	-	**4% = 1,000**		**4.5% = 1,125**		**5% = 1,250**	
Recommended Rebate in PFSI+ I&A charges and its equivalent rebate amount (₹ / Sq.m)		-	-	**2% PFSI + 60% I&A = 975**		**4% PFSI + 30% I&A = 1,112**		**4% PFSI + 60% I&A = 1,225**	

From the above table it can be summarised that:

- Rebate on PFSI charges, minimum ₹ 87/Sq.ft. or rebate on PFSI charges ₹ 66/Sq.ft + 60% rebate on I&A charges is recommended for buildings with GRIHA 1 Star / IGBC Silver rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 85 kWh/Sq.m/annum, water demand reduction from non-renewable resources such as municipality/tanker/borewells more than 45% from conventional case and minimum 46% reduction in waste to landfill from conventional case.
- Rebate on PFSI charges, minimum ₹ 100/Sq.ft. or rebate on PFSI charges ₹ 90/Sq.ft + 30% rebate on I&A charges is recommended for buildings with GRIHA 3 Star / IGBC Gold rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 65kWh/Sq.m/annum, water demand reduction from non-renewable resources such as municipality /tanker/borewells more than 57% from conventional case and minimum 46% reduction in waste to landfill from conventional case.
- Rebate on PFSI charges, minimum ₹ 111/Sq.ft. or rebate on PFSI charges ₹ 100/Sq.ft + 60% rebate on I&A charges is recommended for buildings with GRIHA 5 Star / IGBC Platinum rating. Rebate can be provided for buildings certified under other rating systems such as USGBC / IFC Edge with EPI (Energy Performance Index) lower than 57kWh/Sq.m/annum, water demand reduction from non -renewable resources such as municipality/ tanker/ borewells more than 75% from conventional case and minimum 50% reduction in waste to landfill from conventional case.

Thus, depending upon the Level of rating, the rebate in Premium charge for additional FSI or rebate on combination of premium FSI and I&A charges together can vary from ₹87/Sq.ft to ₹ 111/Sq.ft.

4.2.3. Summary

The above recommendations are provided in terms of ₹/unit area, and not as percentage of Premium Charges since the Premium Charge amount for additional FSI depends upon the land value which varies with location. With higher land value a lower percentage will be applicable, however, with lower land value the percentage of rebate in Premium Charge will become higher, hence generic guideline in terms of ₹/unit area rebate in Premium Charge or combination of premium charge with I&A charges equivalent to increment cost due to additional measures of green building design is proposed.

4.3. Incentive Recommendation 3: Additional FSI for Green Buildings in Tier 2 & 3 Cities and Semi-Urban/Rural Areas.

For green certified buildings in tier 2 and 3 cities like Coimbatore and Tirichy where land value is relatively high but no PFSI charges are collected, it is recommended to incentivize additional FSI upto 5%. Similarly, for green certified buildings in semi-urban and rural areas where land value is usually low (less than ₹2000/Sq.m), it is recommended to incentivize additional FSI upto 10%.

The additional FSI of 5% or 10% can be given as an incentive for certified commercial buildings above GRIHA 3 Star/IGBC Gold or its equivalent in USGBC/ IFC Edge etc, with EPI below 85kWh/Sq.m/annum, water consumption reduction more than 70% from conventional building case and solid waste going to landfill to be reduced more than 45% from conventional building case. In case of certified residential buildings, the above incentive will be applicable for GRIHA 3 Star/IGBC Gold or other green certifications such as USGBC/ IFC etc. with EPI below 65kWh/Sq.m/annum, water consumption reduction more than 50% from conventional building case and solid waste going to landfill to be reduced more than 50% from conventional building case.

4.4. Incentive Recommendation 4: Property Tax Rebate for Green Building Owner

The above recommendations benefit users of green properties as well as developers by directly giving provision to market green buildings. To accelerate the demand from users, besides the known benefits like energy savings, payback and occupancy comfort, rebate on property tax is recommended. Many municipalities across India and abroad have already initiated offering rebate on property tax for green building as an incentive (Table33).

Table 33: Summary of literature study examples showing municipalities offering Incentives on property tax

Sl No	Location	Incentive Value	Incentive for	Description
			State Level	
1	Andhra Pradesh	10%	Solar Lighting/Rain water and Waste segregation	
2	Delhi	10%	On obtaining green rating	Provided upto 3 year. Penalty upto 30% for not complying after availing incentive.
3	Kerala	Not Specified	Using Renewable Energy sources	
4	Maharashtra	Refund	by initiating green building	
5	Rajasthan	5% to 10%	Use of Solar water heater	Penalty if not complying
			Municipal Level	
1	Amaravathi	6% to 10%	Use of Solar water heater	
2	Durgapur	6% to 10%	Use of Solar water heater	
3	Nagpur	6% to 10%	Use of Solar water heater	
4	Pimpri Chinchiwad	Rebate (not specified)	GRIHA certified	
5	Pune	10%	Adoption of Solar system, Rainwater Harvesting system or Vermiculture	
6	Thane	10%	Use of Solar water heater	
			International Level	
1	Cincinnati	Rebate (not specified)	LEED certified	
2	Honolulu		LEED certified	Exempted for 1 year
3	Australia	Concession (Not Specified)	Green Certified or NABER certified	

Based on the above table the following rebate values (Table 34) are determined as incentive on property tax for green buildings in Tamil Nadu which is justified by the overall savings/consumption reductions achievable with building's efficiency and performance, as summarized in table 35.

Table 34: Recommended rebate value on property tax based on certification level

Certification Type	Rebate (%)
GRIHA 1 star/IGBC Silver	5
GRIHA 3 Star/IGBC Gold	10
GRIHA 5 Star/IGBC Platinum	15

Table 35: Benefits for State Government Summary of savings in resource consumption

Certification Type	Commercial				Residential			
	Energy Savings (%)	Water savings (%)	Waste reduction (%)	Cost Increment (%)	Energy Savings (%)	Water savings (%)	Waste reduction (%)	Cost Increment (%)
Green Case	10	40 - 46	46	0.7 - 2.5	35	36 - 41	46	0.7 - 2.2
GRIHA 1 star	36	69 - 100	51	2.5 - 6.6	43	47 - 72	51	2.6 - 3.8
GRIHA 3 Star	54	69 - 100	55	6.5 - 11.9	57	57 - 83	55	4.8 - 5.2
GRIHA 5 Star	61	75 - 100	60	9.7 - 14.8	64	68 - 90	60	6.5 - 7.7
IGBC Silver	36	43 - 83	46	3.4 - 8.1	39	76 - 97	51	2.3 - 5.8
IGBC Gold	53	76 - 100	46	5.7 - 11.9	54	77 - 97	55	6.6 - 9.9
IGBC Platinum	56	76 - 100	51	9.1 - 15.1	59	77 - 94	60	6.7 - 7.7

4.4.1. Benefits for User/Owners

The above recommendation is analysed to understand the overall financial benefit for a user that includes reduced energy, water supply costs and rebate property tax are summarized in the table below.

*Table 36: Benefits for user- **Commercial** building (5000 Sq.m Sample)*

Annual Savings during operation of building	GRIHA 1 Star/IGBC Silver	GRIHA 3 Star/ IGBC Gold	GRIHA 5 Star/IGBC Platinum
Savings on electricity bill (₹/Sq.m/year)	417	624 – 645	639 - 725
Savings on water bill (₹/Sq.m/year)	19 – 30	30	30
Property tax (%)	5%	10%	15%

*Table 37: Benefits for user- **Residential** building (5000 Sq.m Sample)*

Savings during operation of building	GRIHA 1 Star/IGBC Silver	GRIHA 3 Star/ IGBC Gold	GRIHA 5 Star/IGBC Platinum
Savings on electricity bill (₹/Sq.m/year)	348 – 350	382 – 423	529 – 563
Savings on water bill (₹/Sq.m/year)	29 – 39	34 – 39	34 – 39
Property tax (%)	5%	10%	15%

Based on the current property tax system sample calculations have been worked out for a commercial building and a residential building to represent the savings after availing rebate on property tax;

Assumptions and Considerations: Location assume considered as labour colony 1st street, Guindy Area, Chennai.

*Table 38: Sample calculation for a **commercial** building*

	Owner Case	Tenant Case
Total permanent Value :	5000 sq.m = 53820 sqft	5000 sq.m = 53820 sqft
Total Rental Value:	₹. 1,33,205	₹. 1,77,606
Annual Rental Value	(Rental Value x 10.92)	(Rental Value x 10.92)
Annual Rental Value :	₹. 14,54,594	₹. 19,39,458
Half Year Tax To Pay	(Annual Rental Value x Respective Percentage)	(Annual Rental Value x Respective Percentage)
Half Year Tax:	₹. 1,80,370	₹. 2,40,495
Tax Payable after Rebate		
Green Case (5%)	1,71,352	2,28,470
GRIHA 1 star/IGBC Silver (10%)	1,62,333	2,16,446
GRIHA 3 Star/ IGBC Gold (15%)	1,53,315	2,04,421
GRIHA 5 Star/IGBC Platinum (20%)	1,44,296	1,92,396

*Table 39: Sample calculation for a **residential** building*

	Owner Case	Tenant Case
Total permanent Value :	5000 sq.m = 53820 sqft	5000 sq.m = 53820 sqft
Total Rental Value:	₹. 30,274	₹. 40,365
Annual Rental Value	(Rental Value x 10.92)	(Rental Value x 10.92)
Annual Rental Value :	₹. 3,30,590	₹. 4,40,786
Half Year Tax To Pay	(Annual Rental Value x Respective Percentage)	(Annual Rental Value x Respective Percentage)
Half Year Tax:	₹. 40,995	₹. 54,655
Tax Payable after Rebate		
Green Case (5%)	38,945	51,922
GRIHA 1 star/IGBC Silver (10%)	36,896	49,190
GRIHA 3 Star/ IGBC Gold (15%)	34,846	46,457
GRIHA 5 Star/IGBC Platinum (20%)	32,796	43,724

4.5. Recommendation 5: Rain Water Tax

From performance analysis chapter it is observed that harvesting rain water in Tamil Nadu for portable use can make projects water self-sufficient in the monsoon months.

Gaining from the International experience, as given below:

GERMANY: Rain tax exemption

- Rain water tax in Germany is calculated based on the area of impervious surface on site as this impervious surface generates runoff to collect which storm sewer need to be constructed (constructed using tax amount).
- Thus, the government provides for rain-tax reductions or exemptions for sites with reduced footprint of on-site impervious pavement. Various practices followed to achieve the same are replacement of impervious pavement with porous pavement, and/or installing green roofs (turning impervious roofs into porous, prairie-like surfaces).

It is proposed that in Tamil Nadu, in order to successfully implement rain water harvesting for potable use, rain water tax (@ water charges) should be applicable if roof top water goes to the city storm drains. Also it is proposed, that initially this could be proposed for buildings with built up area more than 1000Sq.m.

4.6. Recommendation 6: Waste Water Tax

It is recommended that buildings above 5000Sq.m built up area, should pay waste water tax per KL of waste water discharged in to the city sewer lines without treating. The charges may be determined by Tamil Nadu Water Supply and Drainage Board and Chennai Metro Water Supply and Sewerage Board.

4.7. Benefit analysis to Support Current Solar Policy

The current policy of mandating solar PV system for buildings is examined to support the analysis along with the other green incentives suggested in the policy. Benefits were estimated for the projected stock both at micro level (individual building) as well as the macro level in terms of pay back and energy cost saved by offsetting grid power.

4.7.1. Benefit to Occupant/User

It was observed that once the suggested green measures are implemented, the benefits to consumer are substantial. In residential category, it is possible to make the building a net zero in case of GRIHA 5 star category and when minimum 60% of roof space is used for installing solar photo voltaic. It is also possible to offset almost 2/3rd of energy from the grid if the building is GRIHA 1 star/IGBC Silver certified level building.

In commercial category, it is possible to offset the energy by almost 1/3rd and 1/2nd for GRIHA 1star/ IGBC Silver and GRIHA 5 star/IGBC Platinum equivalent performing building.

Simple payback was calculated for Solar PV (including installation cost) when the solar power tariff is Rs. 9/- per unit and it was observed that payback time would be 11 years in all the cases discussed above. There is no recurring maintenance cost considered in this calculation (Table40).

Table 40: Benefit analysis for user with payback period Calculation

	Residential		Commercial	
Built up Area (Sq.m)	165	165	5000	5000
FSI	1.5	1.5	1.5	1.5
Available roof area for SPV in Sq.m (60% of total area)	45	45	780	780
Capacity of SPV installed (kWp) assuming 8 Sq.m area required for every 1kWp	5	5	95	95
Total Cost of SPV (including installation) with no subsidy from Government	6,25,000	6,25,000	1,18,75,000	1,18,75,000
Total Annual Energy generated considering 19% Capacity Utilisation Factor (CUF)(kWh)	8,322	8,322	1,58,118	1,58,118

	Residential		Commercial	
Green Certified Cases (GRIHA)				
	1 Star	**5 Star**	**1 Star**	**5 Star**
EPI (Energy Performance Index) Ref: Chapter 2	80	50	112	68
Total Annual Energy Consumption (kWh)	13,200	8,250	5,60,000	3,40,000
Total RE used in the building (%)	63	101	28	50
Electricity Tariff (₹. / unit)	7	7	7	7
Solar Power Tariff (₹. / unit)	9	9	9	9
Payback period (years)	11	11	11	11
Green Certified Cases (IGBC)				
	IGBC Silver	**IGBC Platinum**	**IGBC Silver**	**IGBC Platinum**
EPI (Energy Performance Index) Ref: Chapter 2	86	65	112	77
Total Annual Energy Consumption (kWh)	14,190	10,725	5,60,000	3,85,000
Total RE used in the building (%)	59	78	28	41
Electricity Tariff (₹. / unit)	7	7	7	7
Solar Power Tariff (₹. / unit)	9	9	9	9
Payback period (years)	11	11	11	11

4.7.2. Benefits to Government

Assuming 10% growth of building land use/ plot area in coming 5 years where it would be mandated to have the roof top PV (min 60% of the roof area), the benefits to the Govt/ESCOM were estimated in terms of cost saved by offsetting grid power in 11 years (payback time for consumer's investment) and 25 years (expected system life). Building land use area/ builtup roof area have been considered from the already available GIS date for Chennai city and the state of Tamil Nadu.

Table 41: Benefit analysis for Government

	Residential/ Commercial/ Industrial	
	In CMDA Region	**In Tamil Nadu State**
Total Roof Area (Sq.Km)	241 (Source: ARPN 2015)	977 (Source: WISE, 2012)
Total Capacity of Roof top SPV possible (MW)(Assuming 9% of the total landuse/ plot area) (Source: TERI, 2013)	250	1110
Total Annual Energy Generation (MWh) considering 19% CUF (Source: TNERC, 2014)	416100	1830840
Energy Cost Saved (in years) by offsetting grid power (₹ 9 per unit @ 8% annual growth)		
In 5 years	3806550153 (₹ ~380 Crores)	16748820671 (₹~1674Crores)
In 11 years	5687026562 (₹ ~568 Crores)	25022916871(₹ ~2502 Crores)
In 25 years	14511441581 (₹ ~1451 Crores)	63850342958 (₹ ~6385 Crores)

4.7.3. Summary

Based on the analysis it is recommended to:

- Integrate roof top Solar PV for all new residential and commercial buildings, analysis above show benefits at all levels, if 60% of roof top area is used for Solar PV.
- Continue having a differential tariff for solar power and conventional grid power to encourage users to go for roof top solar PV.

4.8. Recommendation 7: Fast Track Approval System for Green Certified Buildings

Fast track approvals or sanction on priority basis for projects registered for green certification is proposed as an incentive to encourage more green buildings. In addition, it is also proposed that Government should consider developing a tool/software for on-line submission of projects for sanctions, with minimum one time meeting requirement (For Eg: A tool that can register all new green buildings and keep track of all department's approvals in one window. This includes green certification bodies and hence govt/local authority can verify the certification system status before releasing final approvals. Owner/developer can also verify online on approval status). This will enhance transparency and improve implementation of green buildings with improved governance.

4.9. Summary of Incentives for Various Green Building Levels

It is analysed and recommended that in a green certified building (GRIHA/IGBC) resource consumption can be substantially reduced and hence can be incentivized.

Recommendation 1: Rebate on PFSI charges for green certified buildings located in urban areas where land value is usually high.

Table 42: Recommended Rebate on Premium FSI for Green Certified Buildings

Rebate on Premium FSI Charges (₹/ Sq.ft)			
Builtup area (Sq.m)	**GRIHA 1 Star/ IGBC Silver**	**GRIHA 3 Star/ IGBC Gold**	**GRIHA 5 Star/ IGBC Platinum**
Commercial Buildings			
above 5000	70	131	195
below 5000	170	228	304
Residential Buildings			
above 5000	43	74	101
below 5000	87	100	111

(Or)

Recommendation 2: Rebate on combination of PFSI charges with I&A charges for green certified buildings located in urban areas where land value is usually high.

Table 43: Recommended Rebate on Premium FSI + I&A charges for Green Certified Buildings

Rebate on Premium FSI Charges (₹/ Sq.ft) + I&A Charges (%)			
Builtup area (Sq.m)	**GRIHA 1 Star/ IGBC Silver**	**GRIHA 3 Star/ IGBC Gold**	**GRIHA 5 Star/ IGBC Platinum**
Commercial Buildings			
above 5000	63 + 10% I&A	110 + 30% I&A	174 + 30% I&A
below 5000	63 + 10% I&A	207 + 30% I&A	283 + 30% I&A
Residential Buildings			
above 5000	22 + 60% I&A	64 + 30% I&A	91 + 30% I&A
below 5000	66 + 60% I&A	90 + 30% I&A	100 + 60% I&A

Recommendation 3: Additional FSI of 10% or more for green certified buildings located in semi-urban and rural areas where land value is low.

Recommendation 4: Rebate on property tax for green building owners.

Table 44: Recommended rebate on property tax

Certification Type	Rebate (%)
GRIHA 1 star/IGBC Silver	5
GRIHA 3 Star/IGBC Gold	10
GRIHA 5 Star/IGBC Platinum	15

Recommendation 5: Rain water Tax for buildings more than 1000Sq.m built up area, equivalent to water charges, if roof top rain water is discharged in storm drains of the city.

Recommendation 6: Waste water Tax for buildings more than 5000Sq.m built up area, equivalent to water charges, discharged untreated to sewer line.

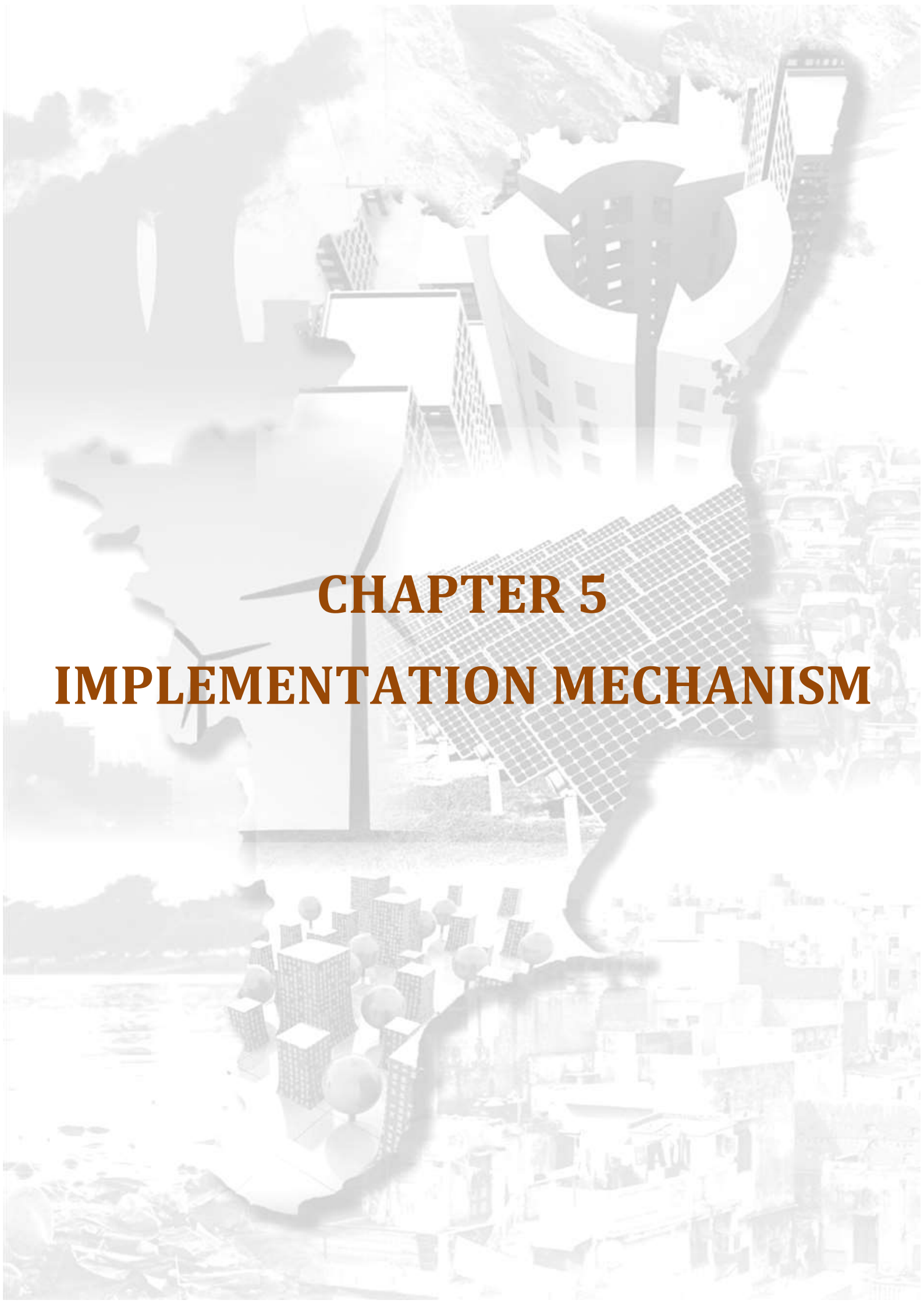
Recommendation 7: Fast track approvals or sanction on priority basis for projects registered for green certification.

4.10. Penalty Clauses for Projects Benefited from Incentives, But Non-compliant to Green Building Requirements

Financial incentives proposed in the section above are related to rebates in Premium FSI charges, rebate in I& A charges, addition FSI for certified buildings for developers and rebate in property tax for owners.

In order to achieve compliance of committed resource consumption reductions, it is recommended to provide completion certificate to the building for occupancy only after the building has received Green Building Certification from Certification Bodies.

It is also recommended that, in order to achieve the same resource consumption during operation phase of the building, property tax rebate should be seized if the building is consuming more than committed. In order to maintain the electricity consumption within specified EPI, it is important to sanction the building/ apartment with the connected load approved during sanction time with the certification.

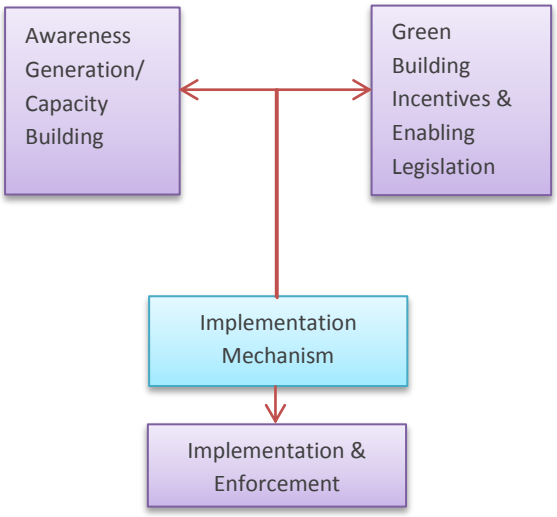


CHAPTER 5
IMPLEMENTATION MECHANISM

5. Implementation Mechanism

A Three Pronged Strategy is recommended to take the green building initiative forward in Tamil Nadu for its successful implementation at all levels.

These are Awareness generation/Training and capacity building, Policy incentives & Implementation mechanism.



5.1. Awareness Generation and Capacity Building

The first and foremost step, which Government needs to take for successful implementation of green building policy incentives is to generate awareness for benefits of green buildings. Awareness needs to be generated at various levels within the government, key stakeholders and civil society.

- Awareness programs and capacity building training programs are required within Government departments in order to understand the benefits of green buildings as well as in the implementation of green building policy incentives.
- Awareness amongst key stakeholders is required, such that they can design green buildings in compliance with the regulations and policy incentives.
- Awareness amongst civil society is required, such that they understand the benefits of green buildings and demand for the same.
- Signage/Hoardings and billboards in various locations to improve awareness and inform public of Government initiatives for promoting green buildings.
- Create a separate website under various Government Departments including CMDA, to make developers/stakeholders aware of green building policies and incentives.
- Annual meets and Professional Awards to buildings with highest rating or most sustainable building.
- Detailed Training programs to improve skills of professionals such that the requirements of green building norms could be met and integrated in building designs.

A plan can be charted out along with the Tamil Nadu Government in order to decide the road map of training programs.

5.2. Implementation Through Setting Up of Eco Cell Within Each Municipality

In order to implement green building features and successful implementation of policy incentives, the Government should join hands with Green certification Agencies, who could be made responsible to set up an Eco cell within each municipality that will check the compliance of projects with green certifications, and accordingly will sanction the applicable incentives. This will enable/facilitate fast track sanction of green certified projects.

This process could eventually be made on line, such that it becomes user friendly with least amount of complications.

5.3. Partnership With Certification Bodies

Certification bodies which are private organizations can be made responsible for implementation and monitoring of green measures based upon the level of certification applied, by signing Public Private Partnerships with certification organizations such as GRIHA & IGBC.

5.4. Monitoring Green Certified Buildings Benefited from Incentives

It is important to have a monitoring mechanism through simple softwares in place to monitor the energy, water and waste consumption of buildings benefited from incentives. It is also important that all concerned Departments/ utilities are aware of consumption levels of incentivised buildings. Success of the project will only be achieved if resources are consumed as committed during sanction time with applied certification. It is also recommended that the utilities should mention the committed resource consumption of the building per month in the bill and the actual consumed. If the actual consumed is more, there should be rules in place to charge higher rate form occupants of the building.

5.5. Converting Policy Incentives into Mandatory Regulations

Policy incentives will give a boost to the green building movement in Tamil Nadu, however, it is important to note that incentives from State Government can only be provided in the initial stages, say, for example for 5 years, post incentives stage, it is recommended to convert policy incentives into mandatory regulations. The following policy incentives are recommended to be a mandate after 5 years of providing incentives. These are:

1. All residential/commercial projects to be green certified with certification bodies existing in India, which include GRIHA, IGBC, USGBC and IFC (Edge rating system).
2. All buildings to install renewable energy for outdoor lighting and common area indoor lighting.
3. All buildings above 1000Sq.m to harvest rain water to use for potable purpose.
4. All buildings above 5000 Sq.m to treat organic wet waste on site. All buildings above 5000Sq.m, only non-reusable, non-recyclable waste to be given to municipality.

The above are in addition to existing mandatory regulations, which are:

5. Mandatory waste water treatment for buildings above 2500 Sq.m which are not connected to city sewer lines.
6. Buildings above 1000Sq.m to comply with ECBC (Energy Conservation Building Code).

5.6. Summary of Implementation Mechanism

1. Awareness generation and capacity building through training programs to all concerned govt. departments and private stakeholders.
2. Set up an Eco-Cell for sanction of certified projects. Future development on-line sanction process.
3. Partner with certification bodies for on ground implementation of green building policies and their incentives.
4. Monitoring mechanism in place through on line simple software designed for implementation of green buildings in Tamil Nadu.

Policy incentives are proposed for 5 years, after which certified green buildings should be mandated.

The Energy and Research Institute (TERI)

Sustainable Building Science: Overview

One of the prime areas of activity within the Energy Environment Technology division is adoption of efficient and environment-friendly technologies in new and existing buildings. The activities of this area focus primarily on energy and resource use optimization in existing buildings and design of energy efficient sustainable habitats.

The Centre for Research on Sustainable Building Science (CRSBS) comprising architects, planners, engineers, environmental specialists , specialised in urban and rural planning, low energy architecture and electro-mechanical systems, water and waste management and renewable energy systems has been offering environmental design solutions for habitat and buildings of various complexities and functions for nearly two decades. The group also undertakes LEED facilitation for buildings.

The Green Rating for Integrated Habitat Assessment (GRIHA) cell, also comprising professionals from the above-mentioned fields is actively involved in facilitation of green rating for buildings under the GRIHA framework. Inputs from CRSBS feed into the processes undertaken at GRIHA cell. The different services offered by the Sustainable Building Science (CRSBS and GRIHA) are as follows:

Environmental design consultancy

Specialised environmental design consultancy and building performance analysis are conducted. A wide range of computations and simulation tools including DOE2, TRNSYS, ECOTECT, RADIANCE, FLOVENT, AGI32, LUMEN DESIGNER, BLAST, Phoenics, RETScreen are used to assess the environmental and cost impact of the design decisions.

LEED and GRIHA facilitation

The team has experience in technically facilitating LEED accreditation [LEED India for New Construction (LEED India NC) and LEED India for Core and Shell (LEED India CS)] for buildings. The group also assists and administers GRIHA, an indigenous green building rating system for buildings, developed at TERI. GRIHA has now been now endorsed by the Ministry of New and Renewable Energy, Government of India, as the national building rating system for India.

Energy audits and energy management programs

Energy conservation studies for a large number of buildings are conducted. There exists a vast experience in conducting energy audits and evaluating a whole range of building upgrade options including envelope retrofit and system retrofit or changes in operational patterns. In addition to establishing operating efficiency of electrical, HVAC, lighting and thermal systems, recommendations to improve upon the same by suitable retrofit measures or by refinement of operational practices are also offered. The group also has expertise in development of energy management programs for service industries like hotels and the corporate sector.

Capacity building

Capacity building for architects, building developers and service engineers on issues such as energy efficiency in building envelopes and systems has been undertaken. Over 1000 architects, developers and engineers in the area of green buildings, energy efficiency and sustainability aspects of built environment have been trained through training programmes, refresher courses, seminars and workshops.

Policy inputs

Several policy initiatives at central and state governments' level towards mainstreaming high performance buildings in India have been successfully completed. Senior members of the group are members of the Committee of experts for development of the Energy Conservation Building Code (ECBC) of India (2007). The manual for environmental clearance of large construction for the Ministry of Environment and Forests, Government of India has also been developed at CRSBS.

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The Energy and Resources Institute
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