Study on Using the Climate Auction Model to Catalyse Energy and Resource Efficient Buildings

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PILOT AUCTION FACILITY for Methane and Climate Change Mitigation

ESMAP Energy Sector Management Assistance Program

Excellence In Design For Greater Efficiencies Edge

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www.carbontrust.com
+44 (0)20 7170 7000

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List of Abbreviations

Abbreviation	Meaning
AFD	Agence Française de Développement
BEE	Indian Bureau of Energy Efficiency
BREEAM	Building Research Establishment Environmental Assessment Method
ECBC	Energy Conservation Building Code
EDGE	Excellence in Design for Greater Efficiencies
EE	Energy Efficiency
ESMAP	Energy Sector Management Assistance Programme
GRIHA	Green Rating for Integrated Habitat Assessment
LEED	Leadership in Energy and Environmental Design
IFC	International Finance Corporation
IGBC	Indian Green Building Council
KfW	Kreditanstalt für Wiederaufbau
MRV	Monitoring, Reporting, and Verification
NDC	Nationally Determined Contribution
PAF	Pilot Auction Facility
RISE	Regulatory Indicators for Sustainable Energy
SWH	Solar Water Heater
UNDESA	United Nations Department of Economic and Social Affairs
WRI	World Resources Institute

Executive Summary

Introduction

The Pilot Auction Facility (PAF) is an auction-based pay-for-performance mechanism that was originally developed by the World Bank to attract investment to projects that reduce methane emissions.[1] The purpose of this study was to assess whether the PAF climate auction model could be translated effectively to the residential new building sector.

A qualitative review of six countries[2] was carried out to inform the basic conditions that would need to be met for the climate auction mechanism to be successfully rolled out to the residential building sector. India was then selected as a case study to carry out a quantitative assessment of the potential impact of the mechanism.[3]

Definition of green buildings

Green building definitions were reviewed to establish the metric upon which the auction should rely to assess bids and award the climate auction's incentive. It was concluded that the auction mechanism should use metrics that are relevant, credible, simple, practical, and global: as such, the primary metric should be modelled percentage reduction in energy consumption per unit area versus a local benchmark. This is because the housing sector already uses unit area (usually square meters) as the basic input to assess projects, making an auction mechanism easy to understand and thus more likely to succeed. Energy, consumption is also directly linked to carbon emissions from buildings, providing a direct link to climate change mitigation.

An assessment of three global and five national green building certification schemes[4] was then carried out to identify which would be the most suitable to be used as the benchmark scheme for the purposes of the auction. Each scheme was evaluated across four categories:

1. **Uptake:** What is the scheme's geographical coverage? How many certifications have there been to date?
2. **Relevance:** Is there an energy/emissions focus? Does it apply to new-build construction? Does it apply to residential buildings?
3. **Cost:** What is the certification price? What is the administrative burden?
4. **Metrics:** Does the scheme generate quantitative energy/emissions reduction estimates? Is ongoing monitoring and verification (M&V) required?

1 https://www.pilotauctionfacility.org/

2 Argentina, India, Indonesia, Mexico, South Africa and Vietnam.

3 The choice of India as a case study country is by no means an indication of a preferential positioning of the country vis a vis others for the initial implementation of the auction mechanism. The ultimate decision on when, where, and how to implement the mechanism will depend upon discussions between the World Bank, potential programme funders, and other relevant stakeholders.

4 BREEAM, EDGE, Greenships, Greenstar SA, GRIHA, IGBC, LEED, LOTUS.

Excellence in Design for Greater Efficiencies (EDGE) achieved the best scoring against each criterion. It was therefore recommended that the EDGE scheme could be adopted as the default certification scheme for an auction, but that any schemes able to demonstrate their alignment with EDGE in terms of quantitative estimates of energy savings and third-party auditing of such savings should also be accepted.

Country and sector analysis

This phase of the study sought to answer a number of key questions regarding the translation of the climate auction mechanism to the building sector. These were distributed across three key elements:

1. **Geographical targeting:** Where could an auction be implemented (e.g., single city, whole country, or some other geographical boundary)?
2. **Sectoral targeting:** What factors are likely to be important for an auction (e.g., income level, building type)?
3. **Participant targeting:** Who is likely to be bidding into the auction (e.g., real estate developers, construction companies, project aggregators)?

In terms of **geographical targeting,** UN population data showed that the vast majority of future population growth and thus housing demand will come from large (300k+ inhabitants) cities. Based on this data, the most relevant target for the auction mechanism is large cities in middle-income countries. This produced a list of six target countries.

A policy review of the six target countries also showed that testing the auction mechanism at the level of a single city or state within a single country, or multiple cities within the same country at most, gives the highest chance of success. This is because political responsibility for housing is usually devolved at the state or even municipal level, and also because in larger countries climatic variation would make comparing bids nationwide more complicated[5] (equally costed bids might deliver widely divergent water savings in dry versus wet areas, for example).

In terms of **sectoral targeting,** income level was found to be the most salient dimension, which incorporated other considerations such as building type. Four income segments (low, social housing, middle income, and high income) were assessed against five criteria of relevance to the auction mechanism (potential for poverty reduction, potential for carbon reduction, readiness of the green supply chain, competitiveness and complexity of the housing value chain, and additionality of the auction mechanism). Middle income stood out as a priority, while low income presented the greatest challenges, with social housing and high income in the middle. The middle-income segment has the best balance across all indicators.

Finally, in terms of **participant targeting** real estate developers were identified as the most suitable target bidders for the auction. This is because they will have ownership of the crucial design and engineering segment of the value chain, which is when decisions that will determine the "greenness" of a building are made.

Cost-benefit analysis of the potential auction in India

India was chosen as a case study to carry out a quantitative assessment of the potential impact of the auction mechanism. This assessment was carried out using the EDGE online modelling tool and cash flow analysis.

While the Indian government has commited to reducing emission intensity by up to 35% on 2005 levels by 2030, and buildings are mentioned in the Nationally Determined Contribution (NDC) as one of the key levers to achieve this goal, no explicit mention is made of building specific targets, and no national policies exist that incentivise green new build (UNFCCC, 2015).

It was found that using a combination of low cost, passive measures which meet EDGE's minimum 20/20/20 threshold,[6] the currently unfunded green cost premium of green buildings would vary between 3 and 8% of construction costs, and 17 to 29 USD/m^2, with the lower-middle-income segment having the lowest premium and the high-income segment having the highest.

5 While there is nothing that would prevent an auction being piloted at the national level, state-level deployment would be simpler and as such maximise the chances of success. National level scale-up could follow the initial pilot demonstration.

6 20% energy savings, 20% water savings, 20% embodied energy savings against a local benchmark.

Based on this, a USD 50 million auction could potentially expect to catalyse 1.7 to 2.9 million m^2 of green building space,[7] delivering between 1.4 and 2.3 $MtCO_2$ of carbon savings, 1,400 to 2,100 GWh of energy savings, 56 to 146 bn litres of water savings, while reducing energy bills for 100,000 to 410,000 people. The highest carbon, energy, and water savings would be in the lower-middle-income segment, while the highest number of people supported would be in the low-income segment.

A USD 50 million auction would also create greater or equivalent total savings in the economy of the target country, largely benefitting the poorest citizens in the lower income segments. This would be highly dependent on the discount rate, but at 10%, up to 60 million USD in energy savings could be created, while with no discount rate, the savings would amount to USD 250 million.

The auction could also support an awareness raising effort to increase understanding of the financial benefits associated with green buildings among Indian consumers, particularly in the lower income segments.

The quantitative analysis confirms that the lower income segments are the best target for the auction mechanism. However there is a trade-off between people supported and carbon saved; targeting the low-income segment supports more people but the lower-middle-income segment offers more carbon savings.

Auction proposal

The overarching aim of a potential auction should be to keep the mechanism as simple as possible to maximise chances of success. Based on the analysis described in this study, four main eligibility criteria have been identified. These are mostly focused on ensuring that the process is kept simple for bidders, while guaranteeing a minimum level of energy and carbon savings and poverty reduction.

1. The financial incentive should be awarded to bids putting forward the lowest price per square meter and achieving a minimum performance improvement of 20% in energy use, water use, and embodied energy over the local baseline (as per EDGE criteria). Equivalent local certifications should also remain eligible should they be able to demonstrate to the auction host they are using a comparable process.

2. Bids should only be accepted from developments expecting to sell housing units at or below a given price to ensure that developers targeting the higher income segments of the population are not subsidised—this should be aligned with the considered government definitions of housing affordability.

3. There should be no limitation on which type of entity is allowed to bid; however, proposed developments should have secured land rights before being allowed to bid.

4. Overall, real estate developers and housing associations represent the main target for a potential auction and should be targeted by awareness raising and promotion efforts.

The option to receive the financial incentive should be awarded when the preliminary certification is achieved, after the design phase. In line with the results-based principle of the climate auction model, the actual payment would be disbursed upon confirmation of certified status by a third-party auditor at construction completion.

Eligibility criteria could be extended or altered to meet funder requests or World Bank priorities, but it is recommended that these are only considered after an initial run of the mechanism in the housing sector has proven successful.

Different weightings could be applied to savings, or the focus could be directly on a particular kind of savings, such as carbon or energy. Other criteria which could be considered include poverty reduction criteria, an urban density/proximity to city centre criterion, a vulnerability to extreme weather event, or a waste management criterion.

7 Large developers such as Tata Housing, DLF, or VHBC might have up to 7 million m^2 under construction at any point in time, while medium sized ones such as 3C or VGN could have 2–3 million m^2.

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1 Introduction

1.1 Pilot Auction Facility

The Carbon Trust has been commissioned by the World Bank to carry out a study to understand how a climate auction model based on the Pilot Auction Facility (PAF) could be used to catalyse energy, and resource efficiency in the residential building sector, focusing on new build developments.

The PAF is an auction-based pay-for-performance mechanism that was originally developed by the World Bank to attract investment to projects that reduce methane emissions. According to the World Bank, the auction platform provides a transparent means for allocating and determining the value of a financial incentive that private firms need to make investments in emission reductions. The competitive nature of the auction reveals the minimum price required by the private sector to make emission reduction investments, therefore maximizing the impact of public funds and achieving the highest volume of climate benefits per dollar.

The first phase of this study analysed the potential geographies, markets, and sectors that could benefit from the climate auction model. The second phase developed a proposal to implement the mechanism and explored the financial costs and benefits of the intervention.

1.2 Project overview

The first part of the study looked at a selection of countries which could provide an analytical basis to test how the auction could work in practice. Six markets were selected (Argentina, India, Indonesia, Mexico, South Africa and Vietnam) based on a number of criteria, including residential energy, use, projected building growth, and carbon intensity.

The analysis sought to identify the key dimensions that should be considered when translating the auction mechanism to the building sector. This included defining what a green building is for the purposes of the auction and which metric should be used to award the subsidy; carrying out a prioritisation exercise to assess which dimensions (such as geography, sector, and building type) would have the most impact on the success of the mechanism; and understanding the type of bidders who would likely participate.

In the second phase of the study, India was selected as a case study to carry out a more in-depth analysis of the potential implementation of the potential auction. The Carbon Trust quantitatively analysed the financial implications of the auction mechanism considering different income groups, different climatic zones, and different green building scenarios. The analysis provided data on the incremental construction cost premium for green buildings, the potential emissions reductions associated with the mechanism, and the number of people supported. This analysis was used to derive minimum eligibility criteria and preparatory steps which could be used by the World Bank or another funder as a "blueprint" to introduce the mechanism to the residential building sector in India and other countries.

It is important to note that the selection of the six countries does not represent a commitment by the World Bank to implement the auction mechanism in any of those countries. The ultimate decision of whether, where, and when to implement the mechanism will be taken up by the World Bank or another funder in consultation with all relevant stakeholders and in due course.

2 Definition of Green Buildings

To qualify for the auction mechanism, residential developments will need to be constructed to a verified green buildings standard. This section defines what green buildings are in the context of the potential auction mechanism, identifies the key performance metrics and criteria that need to be assessed, and analyses the main certification schemes that could be used by the mechanism to assess and verify buildings' eligibility.

2.1 Definition of resource efficient buildings

There is no universally agreed definition of green or resource efficient buildings, with different definitions incorporating different green themes (e.g., energy, emissions, water, waste, biodiversity, air quality) and building life cycle stages (e.g., design, construction, operation, demolition, and renovation). Some sample definitions by relevant institutions are provided in Table 1. Agreeing on a precise definition in the context of the climate auction is important because it will form the basis for selecting metrics to evaluate building projects and award financial incentives.

2.2 Metric selection

A wide range of qualitative and quantitative metrics exist for different green themes and building life cycle stages, some examples of which are summarised in Table 2.

The auction mechanism should use metrics that are relevant, credible, simple, practical, and global:

- **Relevant:** Metrics should reflect the goal to reduce CO_2 emissions and reduce poverty, and should therefore primarily focus on emissions or energy.
- **Credible:** Metrics needs to be able to robustly demonstrate the auction's impact. They must therefore be based on sound methodologies and solid evidence, and quantitative if possible.
- **Simple:** For the auction to gain traction, metrics need to be easy to understand by its target audience. They should be familiar to the construction industry, and a single metric is preferable to multiple.
- **Practical:** Metrics need to be straightforward and low cost to measure. Metrics should not require significant post-construction monitoring and verification.
- **Global:** For the auction to be fully scalable, metrics should be applicable globally—but also able to reflect local contexts.

As such, **we recommend that the auction mechanism's primary metric should be modelled percentage reduction in energy, consumption per unit area versus a local benchmark,** i.e., a green building certification.

TABLE 1: Definition of green buildings

Institution	Green building definition
World Green Building Council	A green building is a building that in its design, construction, or operation reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life
US EPA	Green building is the practice of creating structures and using processes that are environmentally responsible and resource efficient throughout a building's life cycle from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building
USGBC	. . . the planning, design, construction, and operations of buildings with several central, foremost considerations: energy use, water use, indoor environmental quality, material section, and the building's effects on its site
Sustainable Build	. . . green buildings are structures that are sited, designed, built, renovated, and operated to energy-efficient guidelines, and that will have a positive environmental, economic, and social impact over their life cycle
EU DG Environment	Resource efficiency in the context of moving toward more sustainable buildings is understood as the broad concept aiming to reduce resource use and limit the environmental impacts from buildings throughout their life cycle—from material extraction for use in the construction phase, through resource use during occupancy and maintenance, to material recovery at demolition

TABLE 2: Example of green building metrics

		Green themes				
		Energy	**Emissions**	**Water**	**Waste**	**Other**
Life cycle stage	**Design**	• Modelled energy, consumption per unit area • Use of energy, efficient equipment or low-carbon generation	• Modelled CO_{2e} emissions per unit area • Use of low-emissions equipment	• Modelled water consumption per unit area • Use of water efficient equipment	• Incorporate waste minimisation strategies for construction and demolition	• Incorporation of biodiversity measures
	Construction	• Energy, intensity of construction processes	• Embedded CO_{2e} in construction materials • Sustainability of construction materials	• Measured water usage per day (directly abstracted and mains)	• % of construction waste to landfill	• Minimization of social impacts (noise, disruption, etc.)
	Operation	• Actual metered energy, consumption per unit area	• Actual CO_2 emissions per unit area	• Actual metered water consumption per unit area	• Actual waste generated per person • Recycling levels	• Evidence of sustainability codes and practices
	Demolition & renovation	• Energy, intensity of demolition processes	• Life cycle assessment of embedded CO_2 in materials (linked to waste)	• Measured water usage per day (directly abstracted and mains)	• % of demolition waste to landfill	• Site remediation and restoration

The following section will provide more detail on global building certification schemes and their applicability to the auction mechanism.

2.3 Assessment of certification schemes

There are a large number of certification schemes around the world that assess the performance of buildings against a given set of green criteria. These schemes use a variety of different approaches to determine the overall green rating of a building. Eight certification schemes were shortlisted and assessed in detail to determine their applicability to the auction mechanism.

Assessments covered four themes, as summarised in Table 4. Certification schemes were rated against each theme on a red/amber/green scale according to their applicability to the mechanism.

TABLE 3: Summary of certification schemes assessed

Scheme	Summary
BREEAM	**BREEAM** is a holistic sustainability assessment method that can be applied to multiple building types. Founded in the UK in 1990, it was the world's first sustainability assessment method for buildings.
Edge	**EDGE** was set up in 2013 by the IFC as an output-based certification tool. EDGE uses an online software platform to estimate the performance of a building against a local baseline. The software calculates the financial viability of a green project.
	Greenship rating system is a holistic sustainability assessment method that can be applied to multiple building types. The scheme was established by the Green Building Council of Indonesia.
greenstar	**Green Star SA** is a scheme used in South Africa, based on the Australian Green Star scheme. The scheme was managed and designed by the South Africa Green Building Council.
	GRIHA is a green building rating scheme used in India for new buildings over 2,500 m^2 focused on the full life cycle of a building. GRIHA was developed by TERI.
	IGBC rating system is a holistic sustainability assessment method that can be applied to multiple building types. IGBC Rating Systems was established by the Indian Green Building Council and has replaced LEED in India.
	LEED is a widely used holistic sustainability assessment method that can be applied to multiple building types. LEED was formed by the US Green Building Council in 1994.
LOTUS	**LOTUS** is a holistic sustainability assessment method that can be applied to multiple building types. LOTUS was formed under the Vietnam Green Building Council.

TABLE 4: Assessment themes and questions

Theme	Questions	Considerations
Uptake	• What is the scheme's geographical coverage? • How many certifications have there been to date?	Global coverage is desirable but not essential. Number of certifications gives a sense of a scheme's traction.
Relevance	• Is there an energy/emissions focus? • Does it apply to new build construction? • Does it apply to residential buildings?	Schemes need to align with all three areas of relevance. Partial alignment may be acceptable (e.g., if schemes apply to residential buildings but only over a minimum size).
Cost	• What is the certification price? • What is the administrative burden?	Ideally schemes will be cheap and require minimal administration. Schemes that are both expensive and time consuming should be avoided if possible.
Metrics	• Does the scheme generate quantitative energy/emissions reduction estimates? • Is ongoing monitoring and verification (M&V) required?	Quantitative reduction estimates are essential. Some degree of ongoing M&V is acceptable, but not if it extends over multiple months or years.

Table 5 provides a summary of the assessments.

The only certification scheme to be rated 'green' for all four themes is the IFC's EDGE scheme. EDGE was launched by the IFC in 2013 to specifically target emerging markets, given the greater focus of existing schemes on developed countries (Kapoor, 2014). EDGE provides a freely available software modelling tool which can be used by developers to estimate the potential savings of their building. Three categories of savings are included: energy, savings, water savings, and embodied energy, in materials savings. Achieving a 20% reduction of all three against a local benchmark means the project achieves the minimum EDGE Certification. At construction completion, a third-party auditor confirms that the building has incorporated the measures listed in the design phase and assigns the certification.

Three other schemes (GRIHA, IGBC and LOTUS) were rated a combination of 'green' and 'amber' across the four themes, which suggests they could be considered for the auction mechanism in certain circumstances. The remaining four schemes (BREEAM, Greenships, GreenStar SA, and LEED) were rated 'red' for one or more theme, which suggests they should not be considered for a climate auction.

We therefore recommend that the EDGE scheme could be adopted as the default certification scheme for the auction, but that any schemes able to demonstrate their alignment with EDGE in the following key areas should also be considered:

- Minimum performance criteria of a 20% reduction across energy, consumption, water consumption, and embodied energy
- Requirement for quantitative estimates to be validated by a third-party auditor

TABLE 5: Certification scheme assessment summary

	Uptake		Relevance			Cost		Metrics		Summary assessment*			
	Geographical coverage	Number of certifications	Energy/ emissions focus?	Applies to new build?	Applies to residential?	Price	Admin burden	Generates quantitative reduction estimates?	Requires ongoing M&V?	Uptake	Relevance	Cost	Metrics
BREEAM	Global	561,270	Y	Y	Y	H	M	N	N	G	G	A	R
EDGE	Global	>100	Y	Y	Y	L	L	Y	N	G	G	G	G
	Indonesia	41	Y	Y	Min. 2,500 m^2	L	H	N	N	A	A	A	R
Greenstar SA	South Africa	304	Y	Y	Multi-unit only	H	H	N	N	A	A	R	R
	India	650	Y	Y	Min. 2,500 m^2	L	H	Y	N	A	A	A	G
IGBC	India	4,077	Y	Y	Y	L	H	Y	N	A	G	A	G
	Global	80,000	Y	Y	Y	H	H	Y	N	G	G	R	G
LOTUS	Vietnam	12	Y	Y	Y	L	H	Y	Y	A	G	A	A

*Explanation of colour coding: Green = scheme is fully applicable to the auction mechanism; Amber = scheme is partially applicable to the mechanism; Red = scheme is not applicable to the mechanism.

3 Country and Sector Analysis

3.1 Introduction

This phase of the study sought to answer a number of key questions regarding the translation of the auction mechanism to the building sector. These were distributed across three key elements:

1. **Geographical targeting**—where should the auction be implemented. A single city, a whole country, or some other geographical boundary

2. **Sectoral targeting**—what factors are likely to be important for the auction, e.g., income level; building type (single family homes, multifamily)

3. **Participant targeting**—who is likely to be bidding into the mechanism. Real estate developers, construction companies, project aggregators.

The analysis also sought to identify additional criteria beyond energy and carbon savings and poverty reduction which might be added as eligibility criteria to the auction mechanism.

To provide a sensible boundary for the research, six countries were selected based on a number of criteria. The research included both literature review and stakeholder consultation in each of the selected countries. Finally, a single country was chosen to act as a more in-depth case study to carry out a cost-benefit analysis of the potential auction mechanism.

As stated before, the selection of a number of countries does not imply a formal endorsement on the part of the World Bank of any of those countries for implementation of the auction mechanism at this stage.

3.2 Geographical targeting

Following an assessment of over 40 countries, the following countries were selected for review: **Argentina, India, Indonesia, Mexico, South Africa** and **Vietnam.** The assessment criteria are summarised in Table 6, below.

TABLE 6: Country selection criteria

Sufficient market size	Population growth projections
	Growth of total building stock and proportion that will be green buildings
Additionality of auction intervention	Presence of green building policies
	Listing of buildings in Nationally Determined Contributions
Existence of green building supply chain	World Bank Regulatory Indicators for Sustainable Energy (RISE)
	Domestic green building certification
Likelihood of success for auction mechanism	Existence of World Bank operations in the country
	Ease of doing business rankings for real estate

A subset of the geographical targeting analysis consisted in identifying which of the six countries presented the best characteristics to act as a case study for a more in-depth analysis of the potential costs and benefits of the proposed auction mechanism. The key criteria used are listed in Table 7.

Each of the six countries was assessed along those dimensions. The process was primarily qualitative, relying on literature review and expert consultation.

Based on our assessment, two countries scored fairly high across most indicators: India and South Africa. **India was picked as the ideal location for the case study analysis given its large and competitive housing market, large variation in economic conditions, and federal structure allowing for political analysis at different levels.**

Drawing from UN population data, we were able to conclude that the vast majority of population growth and thus demand for new residential buildings will take place in rural areas in lower- and upper-middle-income countries (UNDESA, 2015). Across all income segments, the global urban population will grow by more than one billion 2016–2030, while the rural population will remain stable (with increases in lower income countries being offset by declines in upper-middle-income ones).

TABLE 7: Criteria for prioritisation of case study country

Theme	Metrics used	Overview of metric	Rationale for inclusion
Building sector growth	New buildings (2016–2030)	Estimation of new building stocks up to 2030. Data sourced by EDGE from Navigant	Important to define the volume of new buildings required and it can be used to assess the degree to which a country is expected to develop green buildings given current policies.
	New green buildings (2016–2030)		
Population growth	Absolute growth	National population growth from 2017 to 2030	Useful proxy for new build growth to check against other estimates. Faster growth indicates greater strain on the housing stock, while absolute growth indicates the total market opportunity.
	Annual growth	Annual percentage population growth from 2017 to 2030	
Housing deficit	House deficit	Cumulative shortfall in homes. Householders in this category may be living in informal developments	Useful proxy for the level of priority a government will give to increase the new build rate to close the housing deficit
	Homes that require improvement	In this category households have a home that lacks the basic services required, or is in a dilapidated condition so needs to be replaced	
Energy profile	Energy trilemma index	Ranks countries on sustainable energy through 3 dimensions: Energy security, energy equity (accessibility and affordability), environmental sustainability	Illustrates the overall sustainability of the energy supply in that country. A lower trilemma score would be indicative of potential greater additionality.
	Residential energy consumption	% of total energy consumption going to the residential sector	Useful to assess the overall importance of the residential sector
Carbon intensity	Residential energy emission factor	Overall carbon intensity of the residential sector based on the fuel mix from IEA (including direct fuel use for cooking, heat)	Useful benchmark to understand where the auction would have the greatest carbon emission reduction impact

TABLE 8: Ranking of selected countries

Theme	Argentina	India	Indonesia	Mexico	South Africa	Vietnam
Building sector growth	MEDIUM	HIGH	MEDIUM	LOW	LOW	HIGH
Population growth	LOW	HIGH	MEDIUM	MEDIUM	HIGH	LOW
Housing deficit	LOW	HIGH	MEDIUM	MEDIUM	LOW	HIGH
Energy, profile	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	LOW
Carbon intensity	LOW	HIGH	MEDIUM	MEDIUM	HIGH	MEDIUM
Housing policy	MEDIUM	LOW	LOW	HIGH	HIGH	MEDIUM
Overall score	MEDIUM-LOW	MEDIUM-HIGH	MEDIUM	MEDIUM	MEDIUM-HIGH	MEDIUM

Sources: Building growth projections sourced from data obtained by the EDGE team from Navigant, population growth data sourced from UNDESA, housing deficit data sourced from country level reports, energy, profile and carbon intensity data sourced from IEA, housing policy data sourced from RISE Energy Efficiency Building score.

Sixty percent of this population increase will be driven by cities with more than 300,000 inhabitants, of which there will be 1,692 in the world in 2030. Eighty percent of this increase will be driven by middle-income countries. This trend held true for the six countries analysed (Figure 1). **Based on this data, it was concluded that the most relevant target for the auction mechanism would likely be large cities in middle-income countries.**

Having established large cities as the most fruitful potential target for the auction, we sought to identify the geographical level at which the mechanism could be deployed. The overarching driver for the selection was to look at reducing implementation complexity to maximise the chances of success. This recommendation is specifically targeted at the pilot stage, where the main incentive would be to achieve a successful demonstration of the mechanism. More complexity could be introduced in the scale-up phase, rendering some of the considerations below less relevant.

Our conclusion is that testing the auction mechanism at the level of a single city or state within a single country, or multiple cities within the

FIGURE 1: Share of population growth 2015–2030 in cities with 300k+ inhabitants

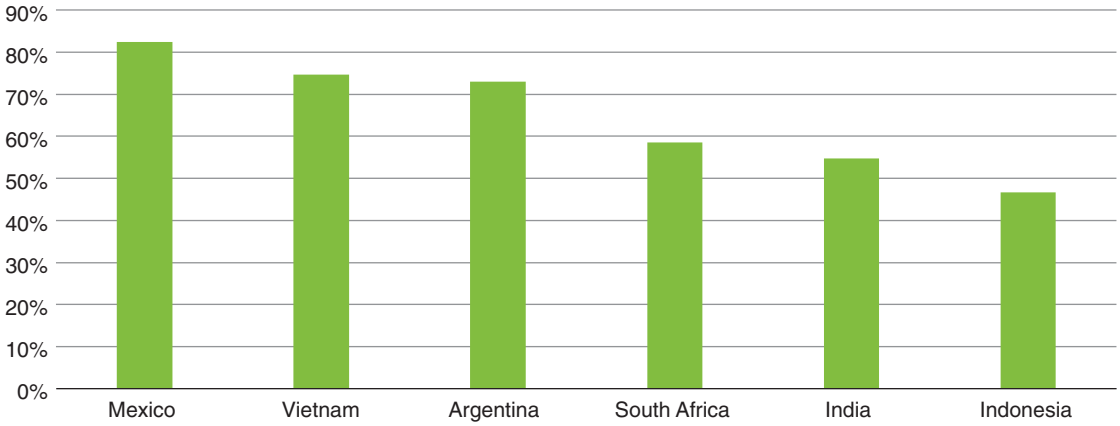


TABLE 9: Geographical target analysis for a proposed auction

Geographic dimension	Advantages	Disadvantages
Single city/single state	• Reduction in administrative complexity and transaction costs • Higher comparability of bids • Easiest to rapidly implement • Lower risk of failure leading to higher chance of scale-up	• Risk of lower competition and less bidders • Specificities of single city environment might make the auction mechanism less replicable elsewhere
Multiple cities/state in one country	• Greater competition among bidders • Greater variation in bidder and building types provides broader testing of the auction mechanism	• Greater administrative complexity • Less comparability between bids due to larger climatic variation which make for example water savings more expensive to achieve in drier areas • More risk of failure
Multiple cities/states in multiple countries	• Provides solid information for future scale-up of the auction mechanism • Ability to compare and adapt success of the mechanism in cities with different policy and regulatory frameworks	• High transaction costs and likely management burdens on World Bank implementation team due to regulatory and market differences between cities and countries • It might not be possible to have standardised eligibility criteria • High risk of failure
Multiple countries	• Tests the pilot already at the scale the auction mechanism is ultimately expected to reach • Bids will likely be submitted by the strongest developers in each country	• Greatest administrative complexity • Will almost certainly require country-specific eligibility criteria • Requires complex evaluation of multiple competing certification schemes • Greatest risk of failure

same country at most, gives the highest chance of success. Table 9 provides a summary of the reasoning behind this recommendation.

3.3 Sectorial targeting

Following an analysis of the residential building market in each of the six selected countries, income segments emerged as the most useful dimension to carry out an effective sectoral breakdown and segmentation. Other relevant dimensions such as building type tend to be dependent upon income, for example with the low-income segment being characterised by single family dwelling, usually informal in less developed markets.

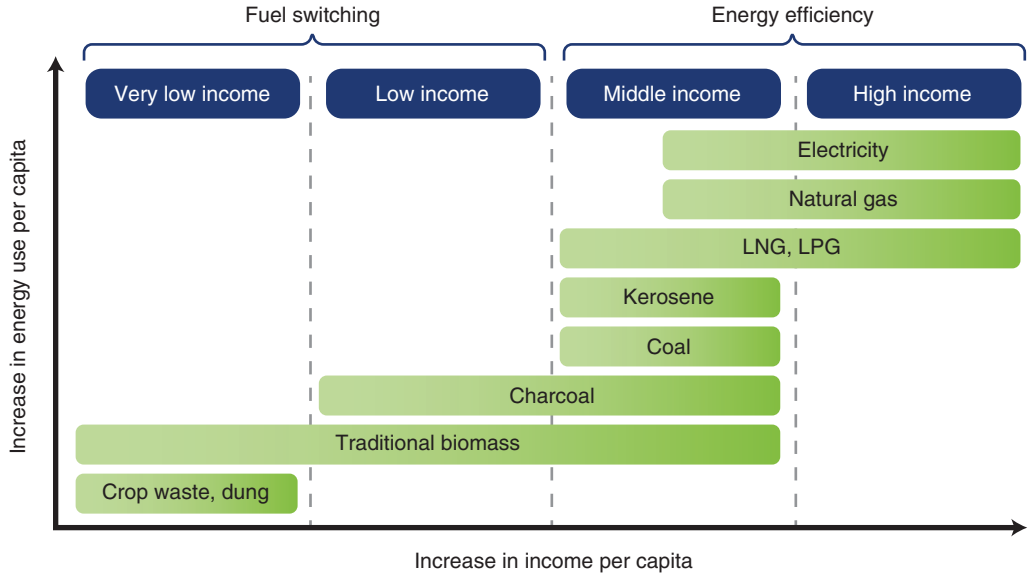
The World Bank Group uses four income definitions: low income, lower middle income, upper middle income and high income (World Bank, 2017). Some adjustments were made to these four categories for the purpose of the study. Social housing was extracted as a subset of low income, while lower and upper middle income were aggregated. The rational and description of each segment is provided in Table 10.

Income is particularly relevant because it is directly correlated with energy use and the potential for efficiency, in a concept known as the energy ladder (Figure 2) (WHO, 2006). As income increases, energy use becomes more modern, more sophisticated, and higher. At lower income levels the main intervention is fuel switching to cleaner, more modern fuels. At higher incomes, efficiency becomes more important. At the same time subsidies provided to the low-income segments in some of the countries, such as Mexico, might also make this segment more interesting for local governments, as more efficient buildings would reduce the burden of subsidies on public finances.

TABLE 10: Description of income segments across the six selected countries

Market segment	Description
Low income	**Average 40–80% of the residential market.** Building type is (typically) single family dwelling or one story multifamily; at the poorer end of the spectrum in poorer countries informal housing (shacks, huts) are an important component
Social housing	A subsegment that deserves separate analysis is social housing, defined as housing provided via government programmes to the poorest income segment. Limitations on government budgets usually confine support to a small portion of the low-income segment
Lower middle and upper middle income	**Average 20–40% of the market.** Greater formality, more middle and high rises in more central urban locations. There is great variation in income levels within this segment, with the lower middle income end comprising a great share of households who would be considered poor by developed country standards
High income	**Average 1–10% of the market.** Approaches developed country standards, with presence of international developers. Largely urban in Tier 1 cities,[8] with luxury high rises and gated developments an important component

FIGURE 2: Energy ladder



The income segments in the six countries were assessed across five core indicators which are likely to be crucial in ensuring the success of the auction mechanism:

- **Poverty reduction:** The potential for the auction to reduce poverty by reducing energy bills for vulnerable households.
- **Carbon reduction:** There is generally a linear connection between energy efficiency and carbon emission reductions, modulated by a country's overall residential energy mix. The characteristics of residential energy supply will be an important driver of carbon emission reductions, with coal-based electricity grids and oil-based heating systems providing greater carbon savings than gas-based systems.
- **Green readiness:** This indicator assesses the degree of availability of a green supply chain, in terms of capacity for certifying buildings, but also to provide the required technologies and construction materials.

8 The Indian government categorizes cities in three tiers, with the eight largest cities belonging to Tier 1. There are 26 cities in Tier 2 and 33 in Tier 3. There are also 5,000 Tier 4 towns and 638,000 villages.

- **Housing value chain:** This indicator assesses the size, complexity and skills of the housing developers who are active in each income segment. The success of the auction mechanism will depend on the presence of housing developers with sufficient scale and skills to successfully bid into the mechanism. Volatility of residential housing markets is also considered as housing crises can lead to developers defaulting.

- **Additionality:** Whether the auction would achieve a transformational impact, or at least impact over and above what existing policies and interventions would realize.

Low-income segment

- **Poverty reduction:** Greatest potential for poverty reduction, as this segment is characterized by slums and informality, with a lack of access to many housing amenities.

- **Carbon reduction:** While there would be a high absolute potential reduction due to the fact that this segment comprises the majority of the population in most countries analysed, per capita reduction would be smaller given lower energy use as per the energy ladder.

- **Green readiness:** Given the high degree of informality and the simple nature of the dwellings, this segment would struggle with sourcing the technologies and materials required to green buildings. There would also be a greater weight of the green cost premium due to low construction costs.

- **Housing value chain:** Informality means developers are often the house owners themselves, or are very small and informal.

- **Additionality:** There are no government policies explicitly supporting or incentivising green buildings in this sector at the moment in the six countries analysed.

Social housing

- **Poverty reduction:** Very high as this segment directly services people in the low-income segment who have difficulty accessing formal housing.

- **Carbon reduction:** This segment is characterised by larger developments and high rises, meaning a higher chance of deeper decarbonisation.

- **Green readiness:** The capability and skills in this sector are low for building green buildings. Experience from programmes such as the UNEP Sustainable Social Housing Initiative shows that considerable technical assistance should be expended to upskill this sector before it is ready for green buildings.

- **Housing value chain:** Large scale formal developments/social housing: greater participation of large developers, particularly in South Africa and Mexico, usually operating on government contracts or with subsidies; greater use of high rises.

- **Additionality:** The involvement of government in this sector broaches the question of whether a more effective approach to making social houses more green would be through government policy and procurement.

Middle income

- **Poverty reduction:** Lower potential; however, in lower income countries the middle-income segment still incorporates a large share of the population which would be considered poor by developed country standards.

- **Carbon reduction:** This is the fastest growing segment in terms of energy consumption and emissions due to rising incomes, and would present a great opportunity for carbon reduction.

- **Green readiness:** Housing units are more advanced, meaning there is greater potential for green solutions, with some potential for transfer from higher income segments.

- **Housing value chain:** Developers serving this segments tend to be medium to large sized and more plugged into the formal economy. There is also considerable competition.

- **Additionality:** Government policies in some countries support green buildings in this segment, and at the higher end of this segment a case could be made for unsubsidised green buildings, particularly with stronger policies in place. However, the vast majority of this segment remains in need of further support.

High income

- **Poverty reduction:** Nonexistent potential.

- **Carbon reduction:** Very high potential, particularly on a per capita basis due to high energy consumption.

TABLE 11: Results of income segmentation analysis

Income level	Poverty reduction	Carbon/ energy	Green readiness	Value chain	Additionality	Overall score
Low income	HIGH	MEDIUM	LOW	LOW	HIGH	MEDIUM-LOW
Social housing	HIGH	MEDIUM	LOW	MEDIUM	MEDIUM	MEDIUM
Lower middle and middle income	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM-HIGH

- **Green readiness:** The new build in this segment is often led by international developers or highly skilled boutique constructors using efficient equipment and materials. The presence of international developers means best practice can be imported from developed countries with green building practices.
- **Housing value chain:** Developers serving this segment tend to be large, often international, and with strong capabilities, and would be very suited to bidding into the auction mechanism.
- **Additionality:** Overall, this segment should not be receiving public subsidies and would not align with the World Bank's goals. A more effective intervention would be to encourage the government to introduce green standards for higher income homes and provide technical assistance to developers.

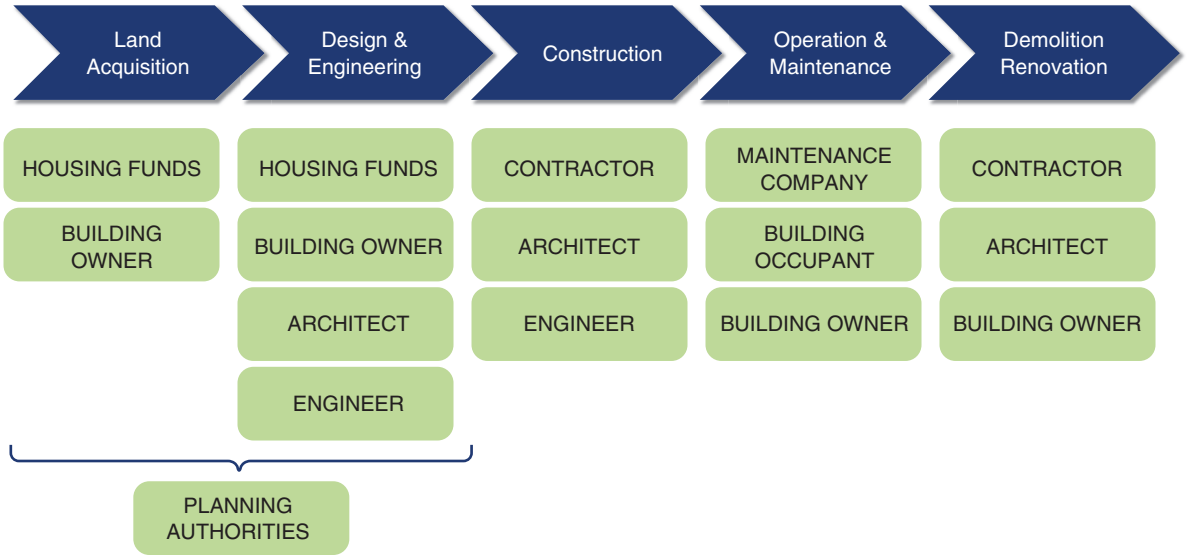
Table 11 provides a qualitative ranking of the four income segments across the five criteria based on the reasoning shown above. **Middle income stands out as a priority, while low income presents the greatest challenges, with social housing and high income in the middle. The middle-income segment has the best balance across all indicators.**

However, the ultimate decision on which segment to proceed with, or whether to include multiple segments, will hinge upon the relative weighting assigned to each indicator.

3.4 Participant targeting

An important aspect of this study is to map out and assess the relevant individuals or institutions in the building value chain that could bid into the auction. The residential construction value chain is very complex and involves a multitude of actors and stakeholders (Figure 3). There is a high degree of between country variation. As such the analysis in this section presents a high-level view of the key

FIGURE 3: Housing value chain



characteristics that would be expected of auction bidders, while more detailed conclusions will be provided in Chapter 4.

For the auction mechanism it will important to ensure that bidders have contractual responsibility over the design and engineering phase of building development, because this is the point at which key decisions are made that will influence how green a building ends up being, particularly for structural decisions such as thickness of walls, reflectivity of roof, window to wall ratio, and other such passive measures.

The most relevant entities for the design and engineering segment are **real estate developers.** This term can include **housing funds, building owners** and **contractors** as shown in Figure 3.

Real estate developer is a broad term which can define different institutions carrying out different activities along the value chain. Real estate developers will more often focus on land acquisition and outsource or subcontract other phases of the value chain. On average, larger companies will tend to directly own more of the supply chain, while smaller ones will outsource or subcontract most of the work. In the low-income segment of most analysed countries, a large part of housing development is carried out directly by future homeowners, who subcontract small-scale builders.

All of the target market analysis countries have sufficiently developed housing markets able to provide a good number of medium to large bidders as long as the geographical boundary is appropriate. While the overall value chain is fairly similar across the six countries analysed, there are important variations between the size and role of the different stakeholders. Overall, all markets have sufficient competition at the developer level, with thousands of companies of different sizes operating across all income segments. Carbon Trust analysis indicates that there is typically 5–10 large developers operating in each market.

4 Cost-Benefit Analysis of Potential Auction in India

4.1 Introduction

As mentioned in Chapter 3, India was picked as a case study country to carry out a more in-depth assessment of the potential impact of the auction mechanism. To this end, quantitative analysis was carried out using the EDGE green building software and cash flow modelling in Excel to quantify the costs and benefits of a USD 50 million financial incentive dispersed via an auction mechanism in several different regions of India.

The results of this analysis were combined with more qualitative research and the outputs of the previous chapter to provide an initial auction proposal structure and eligibility criteria.

4.2 Cost-benefit analysis

Methodology

This study has carried out an economic cost-benefit analysis to assess the potential impact of a USD 50 million auction on the Indian market. A number of different dimensions were modelled across income, climate zones, green scenarios, unit size and building types. The EDGE tool was used to assess energy, water and embodied energy reductions that could be achieved using three different green building scenarios. The EDGE software has been benchmarked against real data from more than 30 Indian cities and is considered a robust tool to assess the theoretical performance of a building. The EDGE outputs were modelled on a cash flow model to estimate the full impact of the auction, using India specific construction cost data. For this analysis EDGE version 2.1.1 was used.

The four main income groups modelled are low income, lower middle, upper middle and high income, and these income groups were redefined to the Indian government definitions. The low-income segment should not be considered to include highly informal developments, as those are unlikely to be able to participate in the auction mechanism and are too basic to feature into the EDGE modelling of housing characteristics. However it would include social housing.

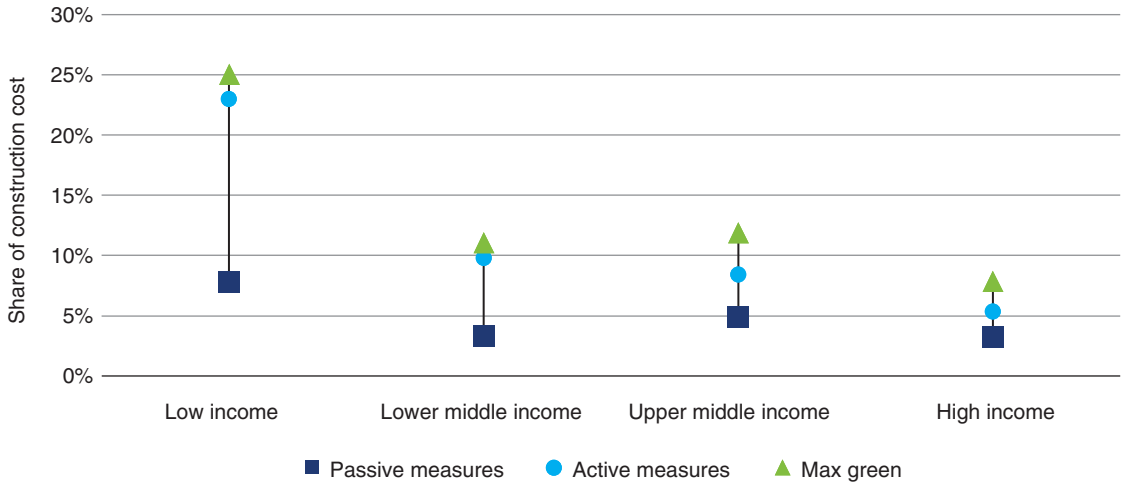
The study varied the building unit size based on the income segment. All six climatic zones in India were modelled (montane, humid subtropical, tropical wet and dry, tropical wet, semiarid, and arid). The analysis accounted for three different building scenarios using a different combination of interventions.

The results were compared against the base case results in the EDGE software tool, with all the parameters left to the default settings.

TABLE 12: Green building scenarios

Passive measures	Active measures	Max green
Design-based measures to improve building performance Focused on: • Building fabric • Insulation • Air tightness • Natural light • Solar gain	More efficient appliances installed to improve building efficiency Focused on: • Efficient lighting, heating and hot water systems • Renewable energy generation • Systems to recycle or harness energy/water	Combination of active and passive measures to improve building performance. This maximises all elements of the passive and the active scenarios to achieve the highest possible savings across all dimensions

FIGURE 4: Green cost premium as a share of construction costs



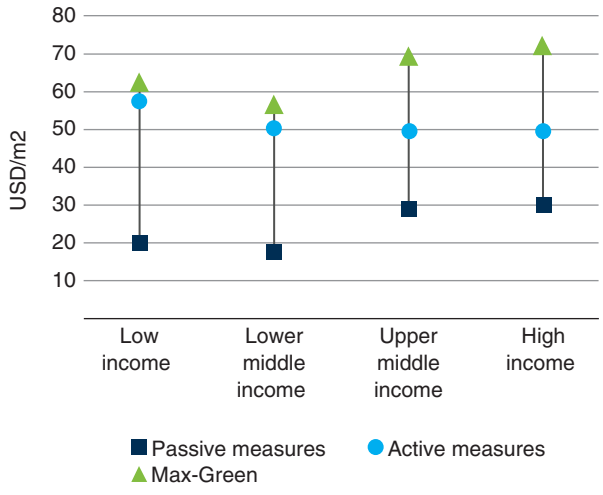
Results

Overall, while single family dwellings are cheaper to build compared to high rises, the relative additional cost of green compared to underlying construction cost is greater, making them a less valuable target for the auction mechanism. As such, the analysis in this chapter focuses on high rises (Langdon & Seah Consulting India, 2016).

Figure 4 displays that the construction cost premium for a green building can vary between 3% and 25% across income segments.[9]

The small difference between active measures and max green is attributed to some passive measures included in max green that reduce the cost of construction (for example by reducing use of expensive materials like glass). In monetary terms, Figure 5 illustrates that the green cost premium varies

FIGURE 5: Green cost premium in US$/m^2



9 It is important to note that the green cost premiums shown below are calculated as a percentage of construction costs excluding land. A more detailed discussion of land rights issues and their impact on the viability of construction projects will be provided in Section 5.4.

TABLE 13: Savings by Indian climate zone

Savings	Montane	Humid subtropical	Tropical wet and dry	Tropical wet	Semiarid	Arid
Carbon savings	2.81	1.00	0.73	0.86	0.77	0.90
Energy savings	1.65	1.00	0.77	0.93	0.83	0.92
Water savings	0.99	1.00	1.00	1.04	1.00	0.99
Share of population	**2.5%**	**35%**	**32.5%**	**9.8%**	**14.5%**	**5.7%**

between ~USD 17 and ~USD 70 per square meter. Again, this is largely driven by the different measures being included in each scenario, and the different unit sizes within each income segment.

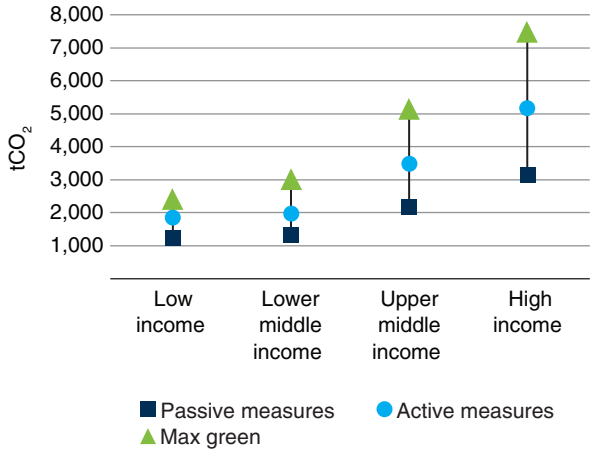
Assuming an auction of USD 50 million, the carbon savings (in million tonnes of CO_2) for the low-income segment would be US$24 compared to US$37 for the high-income segment (based on the passive scenario).

The next variable to consider is whether a potential auction could have more or less impact in a particular climate zone in India. There is a degree of variation in savings across climate zones, which could impact a potential auction's result. In Table 13 the humid subtropical region has been used as a baseline to normalise the data, as it accounts for approximately 35% of the population. Overall the variation in savings across different climate regions indicate that climate could be an important factor to be considered when deciding where to target a potential auction.

The analysis also confirms that carbon and energy, savings on a per capita basis increase by income level. The spread in the total savings per building among different scenarios also increases with income, showing the potential for a greater degree of decarbonisation at higher income levels.

Table 14 illustrates the result of an auction of USD 50 million being implemented in India across a weighted average of climatic zones. Overall, the passive scenario delivers the largest absolute savings across all dimensions, due to its lower green cost premium per square meter. However a slight trade-off emerges between people and carbon, as more carbon is reduced in the lower-middle-income segment (2.3 $MtCO_2$) versus the low-income segment (2 $MtCO_2$), while the reverse is true for people supported by the mechanism (~410k in the low-income segment versus ~390k in the lower middle income).

FIGURE 6: Carbon savings per building



In the active and max green scenarios, a clear inverse relation appears between people and carbon, with more people being supported in the lower income segments but more carbon being saved in the high-income ones.

While greener buildings can reduce a low-income household's energy spending by up to US$200 per year, which is 5% of their total yearly spending on all goods and services, there is no evidence for a willingness by Indian consumers to pay a premium for green buildings. Meanwhile, commercial properties appear to command ~2% higher rents according to a study by Vestian/Assetz, which explains the dominance of the commercial sector in green building developments in India to date (Vestian, 2016). The main reason for this reluctance appears to be lack of trust in the purported bill savings of greener buildings. The proposed auction mechanism could also support an awareness raising

TABLE 14: Potential impact of a USD 50 million auction

Income segment	Scenario	People (000)	Carbon ($MtCO_2$)	Energy (TWh)	Water (bnLT)
Low income	Passive measures	411.3	2.0	1.9	1,161.1
	Active measures	119.9	0.9	1.0	310.0
	Max green	110.6	1.1	1.2	380.9
Lower middle income	Passive measures	392.2	2.3	2.1	1,469.4
	Active measures	107.0	0.9	1.0	368.7
	Max green	95.0	1.2	1.2	436.0
Upper middle income	Passive measures	148.6	1.4	1.3	701.1
	Active measures	81.6	1.2	1.3	359.2
	Max green	57.8	1.2	1.2	334.3
High income	Passive measures	100.7	1.4	1.4	560.9
	Active measures	60.9	1.3	1.5	308.6
	Max green	40.9	1.3	1.4	273.0

effort, coupled with operational monitoring of green buildings, to show that the savings are realized and are sizeable, particularly for lower income households.

Regardless of their recognition in the market, the auction mechanism would create substantial monetary savings. There are two important considerations to highlight, the first on whether these savings would "pay back" the additional cost of green measures, and the second on whether they would pay back the cost of the subsidy.

In the first case, while the cost of the green measures would be borne by housing developers, the savings would accrue to tenants. As such, the payback period itself is not measuring anything that figures in any single private actor's financial calculations. Nonetheless, taking a social perspective at a 10% discount rate,[10] most green measures outside of the most basic passive scenarios were found not to pay back within a 30 year time horizon. At a 0% discount rate, measures usually had average payback periods of 5 to 15 years, as usually measures beyond meeting the bare minimum 20/20/20 criteria were used.

The second case is more relevant for the auction mechanism. While the subsidy itself would not be paid back to funders, it would create greater or equivalent total savings in the economy of the target country, largely benefitting the poorest citizens in the lower income segments. This would be highly dependent on discount rate, but at 10%, up to 60 million USD in energy savings could be created, while with no discount rate savings would amount to USD 250 million.

Conclusions

The quantitative analysis confirms that the lower income segments are the best target for the auction mechanism. However there is a trade-off between people supported and carbon saved, with low income supporting more people but lower middle income saving more carbon. In particular, as the complexity of the green measures implemented increases from passive measures such as greater solar reflectivity of walls to more active measures such as solar water heating, the trade-off becomes more stark and linear, with the high-income segment delivering the greatest energy, consumption, and carbon remission reductions but the smallest number of people being supported.

Ultimately, the choice of which income segment to target, and how this influences the eligibility criteria, will depend upon the priorities of the funders of the auction mechanism and the characteristics of the housing market of the country in which it is implemented.

10 According to World Bank guidance, a discount rate of between 8–12% is appropriate for developing countries with rapidly growing economies (>5%). India's per capita growth rate over the past 20 years has been 5.5% and in the last 10 years has fluctuated between 4–6%.

5 India Residential Housing Sector Review

5.1 Introduction

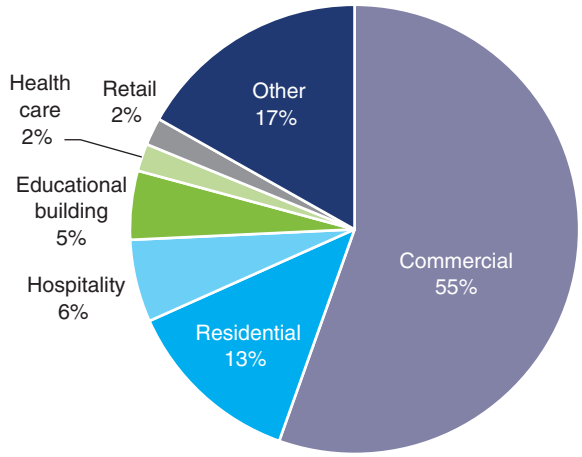
This chapter provides an in-depth assessment of the residential housing sector in India with the purpose of supporting the quantitative analysis of Chapter 4 in providing a set of eligibility criteria that will form the basis of the auction proposal in Chapter 6.

The key elements analysed are the certification infrastructure of the country, looking at the current development of green buildings and the characteristics of the relevant certification schemes; policies, regulations, and incentives schemes at both national and subnational levels; and the composition of the housing value chain.

5.2 India certification summary

India has the second largest building footprint registered for green certification after the U.S. but only 13% of this relates to the residential sector (Vestian, 2016). Green building certification is stronger in the commercial sector due to the presence of multi-national firms who need to meet international corporate social responsibility commitments, and therefore opt to certify their real estate. The Indian government has outlined minimum energy performance standards for commercial buildings through the 'Energy Conservation Building Code' (ECBC) (Chaturvedi, 2015). At the time of writing, there are no plans to extend the ECBC code to the residential sector. Tier 1 cities such as Mumbai, Pune, Bangalore, and Chennai have almost half of the total certified footprint. This is partly attributed to the number of corporates and the availability of state support for green buildings.

FIGURE 8: Distribution of IGBC registered projects



India has two domestic green building certifications, Indian Green Building Council (IGBC) and Green Rating for Integrated Habitat Assessment (GRIHA). According to discussions with green building experts in India, both schemes have been adapted to suit the Indian market and are available for residential and commercial properties (Professor Kini, 2017). Up to 2016 the IGBC scheme accounted for 99% of the green building certification market (Vestian, 2016). EDGE and Leadership in Energy and Environmental Design (LEED) certifications are the two main international certifications in India.[11] A summary of the four certification schemes can be found in Table 15.

11 Based on consultations with Mili Majumdar.

TABLE 15: Review of Indian green building certification schemes

	EDGE	GRIHA	IGBC home	LEED V4
Total certifications (India)*	7	925 (based on all GRIHA schemes)	3,186 (based on all IGBC schemes)	623
Approach	Quantitative	Qualitative	Qualitative	Qualitative
Ratings	Pass, good, very good, excellent, and outstanding	1 star to 5 star	Certified, silver, gold, and platinum	Certified, silver, gold, and platinum
Lifecycle stage	Design and construction	Design, construction, and ongoing operation	Design and construction	Design, construction, and ongoing operation
Fees	Low	Low	Low	High
Time frame	< 1 month–1.5 months	1–3 months	1–3 months	1–3 months
Administrative complexity	Low	High	Medium	Medium

*Covers all certification scheme variants including home, office, retail, interior, etc. Taken from each of the certifications host website on 29/06/2017.

5.3 Building policy review

While the Indian government has commited to reducing emission intensity by up to 35% on 2005 levels by 2030, and buildings are mentioned in the NDC as one of the key levers to achieve this goal, no explicit mention is made of building specific targets, and no national policies exists that incentivise green new build (UNFCCC, 2015).

However, more targeted incentives exist at the state level. Given the federal structure of India, this suggests that states would be a better political unit to engage for the auction mechanism.

Multilateral Development Banks (MDBs) have also targeted green building programmes in India, although support aimed specifically at residential buildings has been more limited. The MDB interventions are summarised in Table 17.

The KfW programme has financed some 2,000 home loans and has saved more than 42,000 MWh of electricity, the equivalent of removing 50,000 Indians from the electricity grid, and the programme has estimated annual CO_2 savings of 37,000 tons (KfW Development Bank, 2016). The AFD programme is expected to be published in August 2017, and potentially there is some risk of providing a double subsidy to those that benefit from the AFD support and later receive an option as part of a potential auction (Severac, 2017). There could be some justification for allowing this, as a potential auction would only provide the finance once all construction activities have been complete, therefore the developer will need to fund the additional construction cost premium in the interim, and potentially they can use the SUNREF programme to obtain a cheaper form of capital. The Sustainable Housing Leadership Consortium (SHLC) has been convened by the IFC in 2016 under European Union funding. The consortium has partnered with India's leading real estate developers and financial institutions to develop innovations to lower the cost of green building, support capacity building, and mainstream green building policy (Narayan, 2017). The SHLC and the auction could be complementary, with the SHLC supporting building developers with knowledge and the auction providing the required financial assistance.

At a national level the Ministry of Housing and the Bureau of Energy Efficiency would need to be consulted and informed, but political support and cooperation on implementation should be sought at the state level, targeting those states which have green building incentives in place, to maximise the chances of a successful rollout of the pilot. State governments could be the primary partners for implementation of a potential auction, targeting those with the most ambitious policies.

TABLE 16: Summary of Indian state green building incentives

Policy	Description	Applicability to the auction	States with mechanism
Additional floor to area ratio (FAR) allowance for meeting a green building standard	Additional allowances on the FAR made to developers for meeting a green building certification. The incentive economically benefits the developer without a financial cost to the local state. There are potential issues with incentivising developers with developing green space without monitoring actual energy savings and environmental improvements.	Provides the developer with an economic incentive to build to a green building certification. Potentially it could lower the green construction cost premium as the cost of the measures could be spread across a greater number of properties or on larger higher value units. This is a particularly relevant issue for India due to the high cost of land.	Maharashtra, Punjab, Rajasthan, Uttar Pradesh, West Bengal
Subsidy on green measures	A subsidy is made available for building to a green standard or utilising a certain proportion of the developments energy needs from a renewable clean power source.	Where such a mechanism is already present for meeting a green building certification, it would not be highly additional to introduce the subsidy mechanism as participants have an existing incentive that combined with the auction mechanism would potentially give them an unfair competitive advantage.	Andhra Pradesh
Street lighting programmes	Requirements to install energy efficient street lighting.	This initiative has developed a local supply chain for energy efficient lighting.	Chandigarh, Himachal Pradesh
Energy, audit programme	Subsidised audits are available for property developers to improve the energy efficiency of the development.	The policy could be additional to the auction if it reduced the cost of obtaining the green building certification.	Maharashtra
Solar water heater (SWH) programmes	Either mandatory or optional requirement to have all hot water installed through a solar water heater. Some states have helped residents or developers purchase a solar water heater through a subsidy scheme.	One such measure for certain climatic regions to increase energy efficiency. This should reduce the cost and in some cases local subsidies are available to cover the SWH. There is a small risk that this subsidy could later be removed for participants in the auction.	Haryana, Rajasthan

TABLE 17: MDB green building related programmes, sourced from Indian Renewable Energy and Energy Efficiency Database, funder websites, and expert consultations

Active?	Name	Funder	Implementer	Overview of support	Targeted at
Yes	**Partial Risk Sharing Facility**	World Bank	Sidbi/YES BANK	The programme supports energy efficiency through providing grants for energy efficiency initiatives. Although the programme has not specifically targeted the building sector, it has benefitted green buildings, and developers are eligible for the funding if they can prove the energy efficiency benefit.	Developer/ ESCo's
Ended 2016	**Indo-Swiss Building Energy, Efficiency Project (BEEP)**	Swiss Aid	BEE	Four components: (i) 3 to 4 day workshops for commercial building developers, (ii) technical assistance in developing building material testing infrastructure, (iii) design of guidelines and tools to design energy efficient residential and public buildings, (iv) dissemination.	Developers
Ended 2014	**Residential energy efficiency programme**	KfW	National Housing Bank	This programme creates a market for green buildings through the provision of: • Concessionary finance to individual borrowers for purchasing an energy efficient house (€50 million credit) • Technical assistance tool developed to calculate the level of energy savings of energy efficiency (EE) houses (€1.5 million grant).	Tenant/ occupier
Starting in 2017 (4 year prog.)	**SUNREF Housing India**	AFD	National Housing Bank	The scheme disperses finance to commercial banks and housing finance corporations to be lent against multi-story residential properties that meet an IGBC (gold or above) or GRIHA (4 star or above) certification. In total €100 million of credit along with a €12 million technical assistance/financial incentive grant will be provided.	Commercial banks and HFCs targeted but finance provided to both developer and occupant

5.4 India building value chain and bidder identification

Informality remains a huge issue in the Indian housing market, which means that a potential auction will be unlikely to be able to target the lowest income segment. It is estimated that up to 47% of urban Indian households live in informal housing with no property rights or land rights (FSG Mumbai, 2016).

However, the social housing segment could be approached, with developers such as Tata Value Housing entering a potential auction with an affordable housing development; this could indirectly impact the poorest segment of the population as they could move into social housing.

In order to prevent subsidies being disbursed to the high-income segment, a "selling price" cap on the proposed projects could be included in the eligibility criteria. It is suggested that this cap be placed at the "Low-Income Group" level according to Indian government definitions. This corresponds to the lower-middle-income group in our analysis and would ensure that the mechanism was targeted at the most vulnerable segment of the population. This is illustrated in Table 18.

TABLE 18: Income segments and house prices in India

Indian census definition	Income level	Size of unit	% of housing need	Number of housing units (millions)	Cost of house ($ million)	Cost of house (USD)	Average cost per m^2
Economically weaker sections (EWS)	Less than $6.37 per day	Up to 30 m^2	40	18.4	0.5	$7,720	$257
Low-income group (LIG)	$6.37 to $12.75 per day	30 to 60 m^2	30	13.8	1.5–2.0	$23,170–$30,890	$600
Middle-income group (MIG)	$12.75 to $42.48 per day	60 m^2 to 111 m^2	20	9.2	4.0–4.5	$61,780 to $69,510	$767
High end and luxury	Above $42.48 per day	N/A	10	4.6	Above 5.0	$77,240 +	N/A

The Indian housing value chain is strongly characterised by geography with most developers operating locally. This reinforces the recommendation of adopting a "State by State approach." Table 19 provides a summary overview of the Indian housing market and provides a brief description for each income segment.

Two further factors reinforce the recommendation of targeting the lower-middle-income segment, where poverty reduction can still be achieved at the same time as developers are likely to be of a sufficient size and complexity to be able to handle the auction mechanism and the complexities of achieving green building certification.

The first one is **finance,** which remains difficult to obtain for developers at the smaller end of the scale. Restrictions on access to credit can impede the growth of the sector. At present no dedicated finance facility exists for real estate developers; this restricts growth within the sector. The sector is further hampered by restrictions on access for formal finance for land acquisition. Options are available to support the affordable credit for social housing, but this support is only available for occupants rather than developers. A common method for developers is to fund properties through incremental construction payments from customers. Finance that is available for affordable credit for social housing is only available for occupants rather than for the developer.

The second and most important one is **land rights.** Land price estimates vary from 45% of the final development cost to 60% (inclusive of profit, administration costs, etc.). Land prices are high due to a shortage of available land to develop, land banking speculation, and complex restrictions on land use. Land prices are particularly high in cities such as Mumbai and New Delhi. Estimates on the time it takes to acquire land and obtain development permits vary from
~2 months to five years. Therefore it is recommended that only bidders with fully secured land rights are accepted into the mechanism. This means that, outside of rare cases, financial institutions would likely be excluded from bidding.

TABLE 19: Evaluation of Indian Housing Value Chain, adapted from (Sarma, 2016)

	Local small	Local medium sized	Established local	National
Examples	Mahabaleshwara, Savvy	Adani, VGN, 3C company	Lodha, Prestige, Sobha	DLF, Tata Housing, VHBC
Number of participants	Concentrated	Concentrated	A couple of these players for each state	Few
Portfolio under construction (m^2)	< 1 million	1–3 million	3–4 million	4–8 million
Focus	Small standalone developments.	Medium sized developments in specific locations within a region.	Medium to large developments, in multiple locations within a region.	Medium and large developments across multiple sectors in multiple states. Greater use of in-house expertise across the value chain.
Customer base	Local customer and investor base. Reputation often developed through word of mouth.	Local brand with strong brand awareness in city or state.	Nationally recognised brands.	
Access to capital	Limited access to capital, projects financed through down payments at points of construction and completion of a development. Commercial finance available, albeit at a high interest rate.		Access to capital reserves or can borrow finance from investors or commercial institutions.	
Green technology expertise	**Low:** Usually does not have the financial resources to invest in green buildings. However, niche developers may specifically build and develop green properties at a premium to sell to climate conscious citizens.	**Medium:** May have in-house green expertise and can afford to consult external advice.	**High:** Motivated by CSR goals and investor guidelines, likely to have in-house experts on green building.	
Applicability to the auction	Potentially more nimble to new requirements and more receptive to consumer demands than larger developers. However, may not have the economies of scale to provide the most financially competitive green buildings and are generally not familiar with green building certification.		Developers in these two groups have showcase developments to show green building capabilities but generally do not apply green building measures universally, unless there is an economic case to do so. These players are likely to be able to provide green buildings at an economic price and have specific divisions for affordable housing. They either have in-house expertise for meeting green building certification or can easily finance advice on this matter.	

6 Auction Proposal

The overarching aim of the design of a potential auction should be to keep the mechanism as simple as possible to maximise chances of success. A positive demonstration at the pilot level would greatly increase the likelihood that the mechanism could secure further funding at both international and national levels to achieve scale-up and rollout to multiple countries.

As such, this section proposes a simple set of eligibility criteria that should be considered for the pilot stage of the auction mechanism. Additional criteria could be added to later bidding rounds, once the auction has demonstrated its credibility and results.

The criteria developed here are derived from research and consultation carried out in six specific countries, with a particular focus on India for the quantitative analysis. However the same reasoning could be applied to any other market. In Section 6.6 of this chapter we present a schematic approach to replicating the auction mechanism in other countries.

6.1 Eligibility criteria

Based on the analysis described in the previous chapters, four main eligibility criteria have been identified. These are mostly focused around ensuring that the process is kept simple for bidders, while guaranteeing a minimum level of energy and carbon savings and poverty reduction.

1. The financial incentive should be awarded to bids putting forward the lowest price per square meter and achieving a minimum performance improvement of 20% in energy, water and embodied energy, over the local baseline (as per EDGE criteria). Equivalent local certifications should also remain eligible should they be able to demonstrate to the auction host that they are using a comparable process.

2. Bids should only be accepted from developments expecting to sell housing units at or below a given price to ensure that developers targeting the higher income segments of the population are not subsidised—this should be aligned with Indian government definitions of housing affordability.

3. There should be no limitation on which type of entity is allowed to bid; however, proposed developments should have secured land rights before being allowed to bid.

4. Overall, real estate developers and housing associations represent the main target for a potential auction and should be targeted by awareness raising and promotion efforts.

6.2 Preparatory steps

The auction host would need to seek the relevant national and state political approvals when implementing an auction in a new country. In India, there is an expectation that the proposed auction should have to secure the political support of the Ministry of Housing and the Bureau of Energy Efficiency.[12] Consultations with these entities could lead to additional technical and financial assistance. Political support is likely to be very important for a successful implementation, and it is recommended

12 Depending on the positioning of the programme, the Ministry of External Affairs could also be important.

that high level conversations would take place in advance of the first round of bidding

The main public sector implementation partners are expected to be state governments. A single state with progressive green building legislation should be targeted for the initial pilot phase, with the pilot targeting one or more Tier 2 cities to sidestep issues with high land prices in Tier 1 cities. A promotion phase of at least six months in duration should follow the political agreements to give developers with eligible projects in the pipeline sufficient time to prepare their bids and make the required design modifications. Overall, timelines in the residential real estate sector are fairly extensive, with up to five years from conceptualisation to construction, and therefore funder's expectations should be aligned with these timelines.

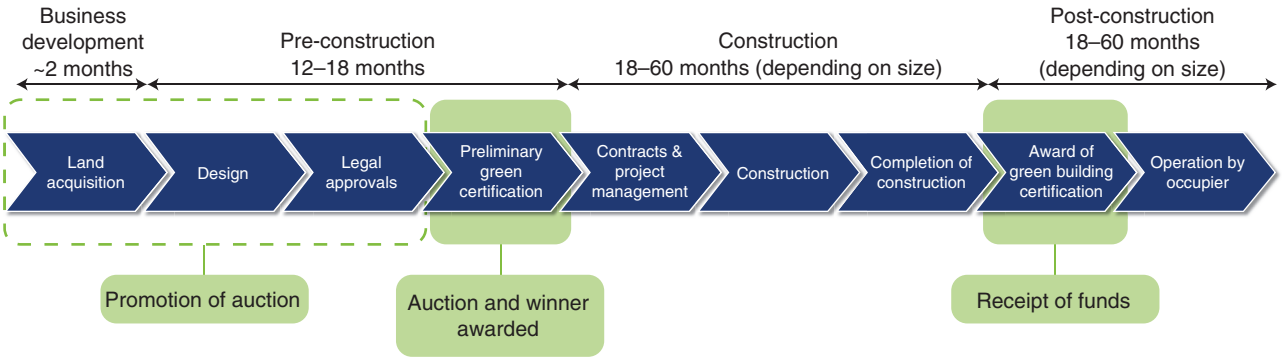
6.3 Eligible participants

A potential auction should not limit eligibility to potential participants, but the expectation is that participation will vary and a real estate developer will have the most straightforward role in the auction. In Table 20 we have outlined the pros and cons of the main potential participants.

TABLE 20: Potential participants that could bid into a potential auction

Organisation	Expected take up	Expected impact	Pros	Cons
Real estate developer	High	Medium to high	• Number of participants • Potential for economies of scale • Adoption of green technologies and practices could be replicated by competitors	• Less concerned with long-term operation costs • More concerned with using green credentials as a sales platform • Potentially the auction will only award funds to the largest companies who can build to the green standards at the lowest costs due to economies of scale • Could target developers who already have a propensity to build green
Housing association	High	High	• Concerned with long-term operation and maintenance costs so will consider actual performance compared to theoretical • Benefits those poorer in needy households	• Scale and number of housing associations
Commercial Bank	Medium	Medium to low	• Could be offered as part of a green lending product, and will reduce the certification costs	• Less clear role in the auction, question over how they will economically benefit from the auction • Funds may not be dispersed if the bank does not capitalise on advertising the auction • Funding could be insignificant compared to commercial banks' lending portfolio • Adds an additional actor into the supply chain and could therefore add funds
State/municipal government/ local authority	Low	High	• Potentially easier to target lower income groups and more ethically conscious • Could be incorporated as part of another green buildings programme • Network with local developers • Could take over the programme management	• Slow to disseminate funds

FIGURE 8: Construction timeline and auction mechanism milestones



At any point onward from the award of the option, the winner of the incentive payment could sell on the contract to another bidder who meets the eligibility requirements of the scheme

6.4 Disbursement of options

There are three distinct phases in the auction: the promotion of the auction, the eligibility to bid, and the final receipt of funds. The timelines of these phases should be synced with the timelines of the residential real estate market. Based on market research and consultation with independent experts, this study has defined the residential timelines for a potential auction in India.

While eligibility to bid should be allowed at any point in time, the option should be awarded only when the preliminary certification is achieved after the design stage. The actual payment would only be disbursed upon construction completion and award of certification.

6.5 Other criteria

Eligibility criteria could be extended or altered to meet funder requests or World Bank priorities. Further analysis should be carried out at the implementation to the design stage to precisely determine how to maximise a potential auctions impact against World Bank and other funder's goals.

Different weightings could be applied to savings, for example, in water stressed geographies such as Bangalore in India, greater weight could be given to water savings (as measured by the World Resources Institute (WRI) water stress index tool) so that equivalently priced bids with greater water than energy savings could be prioritised.

Alternatively, the focus could be directly on **a particular kind of savings,** such as carbon or energy, in which case bidders might be requested to present a USD/tCO_2/m^2 metric. This would be easy to apply using the EDGE platform and comparable across bids, although the disadvantage is it could preclude other certifications.

A poverty reduction criteria could be added prioritising bids from projects with an expected sell price within the affordable housing segment, or with explicit participation from public authorities certifying the social housing character of the development. Bids from areas with higher incidence of poverty could also be prioritised.

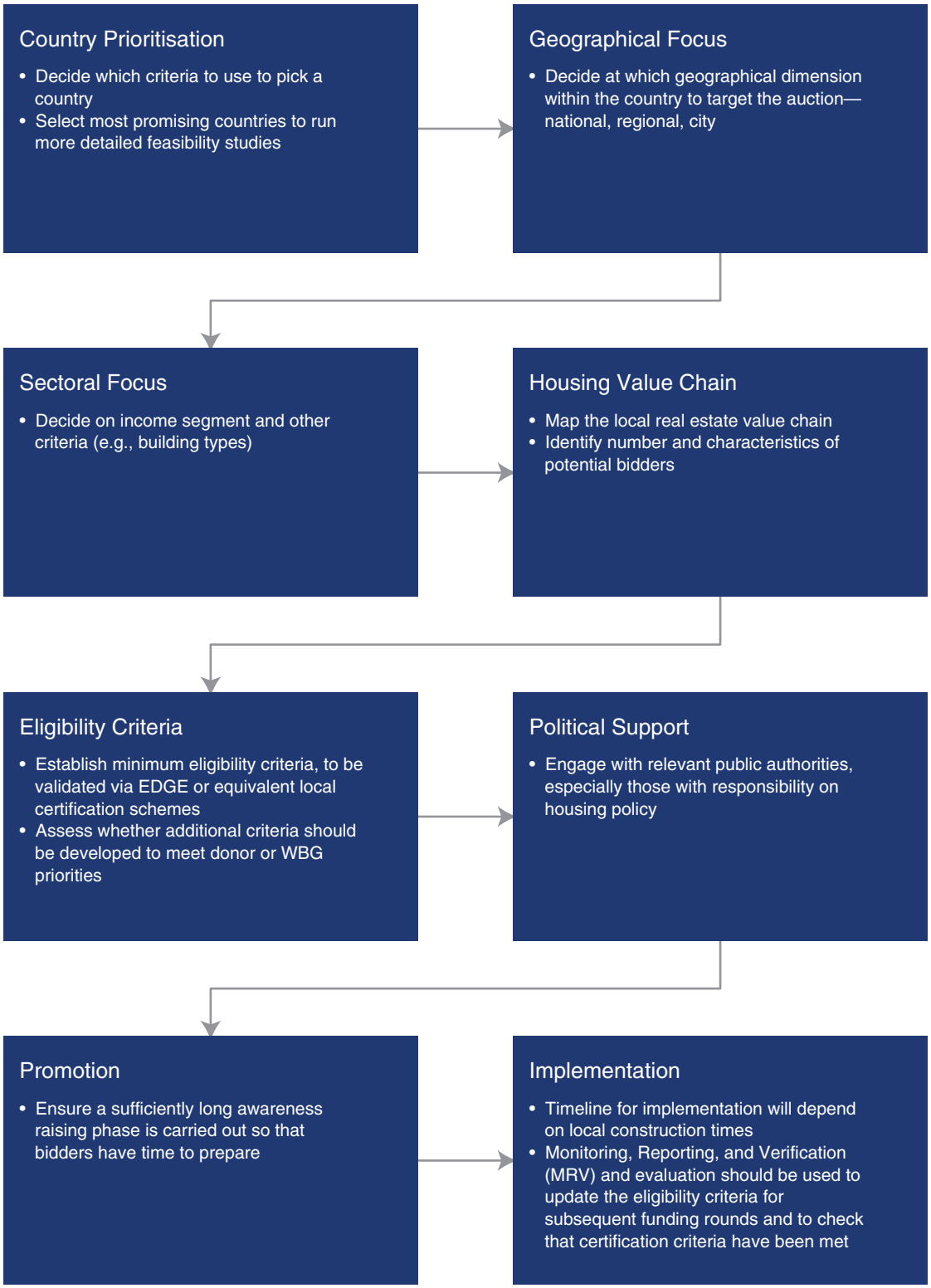
An urban density/proximity to city center criterion could be added to ensure that no developments are supported which strand their tenants far from job opportunities. This would be highly contingent on the geographical origin of the bid and might require detailed heat mapping of target cities to determine which areas should be off limits for the mechanism.

A vulnerability to extreme weather event criterion could be added, excluding developments in high-risk areas from bidding; this would require detailed mapping of high-risk areas, which might not be available for all geographies and all weather risks.

A waste management criterion could be added asking bidders to submit documentation proving they have a strategy in place to reduce or recycle the waste produced during the construction process.

6.6 Process for replication of the auction in other geographies

The Carbon Trust has established an eight-step framework to replicate the auction mechanism in other countries. This includes a listing of all the key analytical steps that should be undertaken to ensure the mechanism has a high likelihood of success in a new geography.


Country Prioritisation
• Decide which criteria to use to pick a country
• Select most promising countries to run more detailed feasibility studies
Geographical Focus
• Decide at which geographical dimension within the country to target the auction—national, regional, city
Sectoral Focus
• Decide on income segment and other criteria (e.g., building types)
Housing Value Chain
• Map the local real estate value chain
• Identify number and characteristics of potential bidders
Eligibility Criteria
• Establish minimum eligibility criteria, to be validated via EDGE or equivalent local certification schemes
• Assess whether additional criteria should be developed to meet donor or WBG priorities
Political Support
• Engage with relevant public authorities, especially those with responsibility on housing policy
Promotion
• Ensure a sufficiently long awareness raising phase is carried out so that bidders have time to prepare
Implementation
• Timeline for implementation will depend on local construction times
• Monitoring, Reporting, and Verification (MRV) and evaluation should be used to update the eligibility criteria for subsequent funding rounds and to check that certification criteria have been met

7 Conclusions

The purpose of this study was to assess whether the climate auction model as piloted by the Pilot Auction Facility (PAF) deployed by the World Bank in support of methane emission reductions could be translated effectively to the residential new build sector.

The study carried out both qualitative and quantitative analysis, including in-depth policy and market reviews of six developing countries. India was selected as a case study based on a number of criteria plus discussions with the World Bank, and a modelling effort was completed to estimate the potential impact that a USD 50 million auction targeting buildings would have in the country in terms of poverty reduction, energy savings, carbon savings, and water savings.

The conclusion is that the mechanism could be replicated in the housing sector, and that it would have a large and positive impact on both poverty reduction and carbon emission reduction. It would also generate considerable financial savings to an amount greater than the initial investment by the auction's funder.

The choice of India as a case study country is by no means an indication a preferential positioning of the country vis a vis others for the initial implementation of the auction mechanism. The ultimate decision on when, where, and how to implement the mechanism will depend upon discussions between potential programme funders and other relevant stakeholders.

In addition to this report, two slide decks presenting the analysis and the emerging conclusions were produced and shared with World Bank, and are available as technical annexes.

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Interviews

Name	Role	Organisation
Abimbola Olukemi Windapo	Quantitative Social Researcher	Cape Town University
Agustina Galli		LEED AP
Alejandra Rueda		Agencia de Protección Ambiental
Andrés Schwarz	Independent LEED Expert	LEED AP
Autif Sayyed	Green Building Specialist	IFC
Chandan Bhavnani	Vice President	YES BANK
Dr. Fatma Mohamed		University of Dar es Salaam
Dr. Gehan Nagy	Assistant Professor of Architecture	The British University of Egypt
Ernesto Infante Barbosa	Deputy Director of Multilateral Affairs and Sustainability	Sociedad Hipotecaria
Fabby Tumiwa	Executive Director	Institute for Essential Reform (IESR)
Felipe Faria	CEO	Green Building Council of Brazil
Grahame Cruickshanks	EDGE Expert	Green Building Council South Africa
Guillermo Simon-Padros	CEO	Argentina Green Building Council
Idris F. Sulaiman	Technical Advisor	Indonesia Green Building Council
Llewellyn Van Wyk	Principal Researcher	Council for Scientific Research
Manfred Braune	Chief Technical Officer	Green Building Council South Africa
Megan Sager	Director	Sustainable Solutions South Africa
Mili Majumdar	Managing Director	GBCI
Odón de Buen	General Director	CONUEE
Pablo Barcos	Real Estate Manager	Compass Group
Pradeep G. Kini	Architect	Faculty of Architecture, Manipal University
Prem Zalzman	Director de Nuevas Tecnologías para el Desarrollo Sustentable	Ministerio de Ambiente y Desarrollo Sustentable
Roberto Malvido Arriaga	CEO	CASAS PAQUIMÉ
Sanjay Seth	Senior Fellow & Senior Director	TERI
Sanjith Naik	Managing Director	Mahabaleswara Builders
Shruti Narayn	Lead—Green Building Program	World Bank India

Name	Role	Organisation
Songo Didiza	Executive Director	Green Building Design Group, South Africa
Sonia Rani	Fellow and Area Covenor	The Energy Resources Institute (TERI)
Srinath Komarina	President, Responsible Banking	YES BANK
Steven Piro	Director	Synergy Efficiency
Totok Sulistiyanto	Energy Consultant	Indonesia Green Building Council
Xavier Leulliette	Technical Manager	Vietnam Green Building Council

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