FISCAL STRATEGY FOR AFFORDABLE HOUSING

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Centre for Science and Environment

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1. WHY THIS STUDY?

COVID-19 pandemic and the overall economic slowdown have affected the construction sector, especially the affordable housing segment, adversely. Developers as well as buyers have been hit hard. Households have lesser money to spare to buy a house following job losses and pay-cuts. This is widening the already existing affordability gap, that is worst for the lower income groups (LIG). The pandemic has also resulted in a negative curve for developers in the affordable housing segment. Increased cost of materials, reduced liquidity and scarcity of labour pose a challenge for developers to keep up the supply stream of houses while meeting the combined benchmarks of thermal comfort and liveability.

Will the affordable housing sector be able to balance the requirements of environmental and energy performance of the housing stock with increased cost of construction and new materials for LIG in a slowing economy? This conversation has become particularly important in the context of availability of new materials and walling technologies. Although expensive, they are preferred because of the ease and speed of construction. But many of them may not provide good thermal resistance and can undermine the thermal comfort of buildings.

COVID-19 HAS HIT THE ALREADY SLOWING AFFORDABLE HOUSING SECTOR HARD

Under current affordable housing schemes like the Pradhan Mantri Awas Yojana-Urban (PMAY-U), government of India has already set targets for affordable housing and is financially supporting the segment to give a push to the private sector under the affordable housing in partnership (AHP) vertical. New materials and technologies are the main contenders for this financial support. Even with low market penetration, these technologies have disrupted the material supply chain. But this penetration is happening without much clarity on the performance of the materials. Moreover, self-construction by individual households under PMAY-U also requires informed material choices.

If new materials and technologies are not tested for performance with regard to their thermal properties before their rapid uptake in the construction sector, the housing stock will underperform on environmental, thermal comfort and energy consumption indicators. As a result, the cost of the underperforming houses will fall on low income beneficiaries, resulting in even higher environmental cost and an adverse impact on human health.

It has, therefore, become necessary to assess the economics of meeting the goals of thermal comfort and liveability within the affordability range of targeted income groups. This will help in designing appropriate fiscal strategies to address the additional costs of introducing efficient material and upgraded design for improving the thermal comfort of the housing stock.

The additional cost of making the affordable housing thermally comfortable with innovative architectural design and specific walling assemblies is expected to be resisted by the industry during an economic slump. This is where imaginative fiscal tactics can step in to fill the breach. PMAY-U's fiscal strategy needs to be tweaked to better suit the changing scenario.

Against this backdrop, Centre for Science and Environment (CSE) has planned this study. It aims to assess the economic value chain framework of the housing sector. It will help to understand the flow of the construction process in the conventional sector. It will illuminate changes that can be expected in the penetration of new and alternative materials and construction technologies, and the fiscal strategies needed to address this challenge. It will also help identify the risks in the sector.

CSE has been working with a few state and local governments during the past few years and keeping a track of the progress of affordable housing schemes, especially PMAY-U, from this perspective. Earlier ground assessments, captured in our publications *Beyond the Four Walls of PMAY* and *Optimizing the Third Skin*, have performed deep dives into different aspects of affordable housing, with appropriate and topical case studies. This current assessment, the third in the series, focuses on a fiscal strategy for affordable housing.

CONSTRUCTION INDUSTRY CAN BE EXPECTED TO RESIST BEST PRACTICES FOR AFFORDABLE HOUSING DURING A PANDEMIC

Some of the key highlights of the analysis and the way forward are as follows.

Access to affordable housing: Improvements in performance of the building stock have to be achieved within the limits of affordability in the sector. Affordability of housing for LIG and economically weaker sections (EWS) are assessed on a range of criteria, including household income, housing unit size and price or expenditure towards it, and disposable surplus income. Estimates by the McKinsey Global Institute suggest that the affordability gap stands at 80 per cent for 'deprived' households (the segment with an income below Rs 90,000 per annum) and 50 per cent for the 'aspirer' households (the segment with an income of Rs 90,000—2,00,000 per annum).[1] As per Indian government standards, both 'deprived' and 'aspirer' categories fall under EWS. Evidently, about 96 per cent of India's housing shortage is in the EWS and LIG categories. Moreover, as recently announced by the government of India in the wake of the migrant crisis during the COVID-19 lockdown, rental housing will be developed at par with mainstream affordable housing under national and state schemes for the first time in India. This requires a deeper assessment of the market, and how fiscal strategy can be effectively linked with performance indicators for the housing stock to inform policies.

Cost matters—combine price indicators with performance: For an effective fiscal strategy, it is important to know how housing prices behave across cities. India has an official indicator to track the trends in housing prices at the city and national levels, like the National Housing Bank's RESIDEX, that includes two indices: a housing price index (HPI) at assessment prices, and an HPI at market prices, for under-construction housing units. It captures the rise and fall in housing prices based on the carpet area size. But it does not reflect the

performance of the housing market for lower income households that generally occupy smaller units. India has not carried out proper household income surveys. Price-to-income ratio, which is the median house price divided by the annual median household disposable income in a city, is expected to be a better indicator for affordability than housing price, as it accounts for income disparity among cities. More needs to be done in this regard to create a robust indicator.

Low income groups have poor access to housing finance: While demand for grants in the Union budget 2020–21 by state governments for formal partnership-based affordable housing under PMAY-U shows a reduction, its Credit-Linked Subsidy Scheme (CLSS) has seen a 50 per cent increase. This includes interest rate subsidy credits upfront to the beneficiary's account. This lending-focussed or low cost loans strategy for LIG face a challenge. LIG and EWS households face difficulties in accessing formal housing finance. In fact, data available from the National Housing Bank (NHB) show that disbursement of housing loans by housing finance companies for lower income groups have reduced. The year-on-year growth in disbursement of loans upto Rs 200,000 for this group has dropped to 11.82 per cent in 2017-18 as compared to 48.23 per cent year-on-year increase during 2016-17. Small size loans do not form even 2 per cent of the total loans extended by public sector banks and housing finance companies. As a result, the housing stock in the market remains out of reach of the ones who seek housing the most. Also, gross non-performing assets with public sector banks are highest in the loan slab of upto Rs 2 lakh. Increasingly, lending institutions are shying away from extending loan to LIG. This further compromises accessibility of the poorer sections of the society to housing finance. This can be yet another dampener for uptake of housing stock with improved performance.

PMAY-U'S FISCAL STRATEGY NEEDS TO BE TWEAKED TO BETTER SUIT THE CHANGING SCENARIO

Growth in the sector is not inclusive: The proportion of GDP that goes into financing housing in the country is increasing since 2012 and, according to NHB, recorded a 10.3 per cent increase in 2018. However, the number of EWS and LIG households benefitting from housing finance is still very low. As of June 2018, a mere 1.4 per cent of EWS and LIG households have been supported under the CLSS vertical of PMAY-U. An investigation as to why this class is either not availing or not receiving housing finance benefits needs to be carried out.

The material connect—what is at stake: CSE has investigated use of alternative materials and construction technologies in Gujarat, Karnataka, Maharashtra, Uttar Pradesh and other states. Deep-dive assessments in Telangana and Karnataka, along with local market surveys, and visits to manufacturing units of alternative material and affordable housing sites, have yielded valuable insights. This has helped us to arrive at a ballpark estimate of additional costs involved in the adoption of new and alternative material and technologies for walling. Compared to conventional materials—brickwork in a conventional reinforced concrete cement structure—that are widely used in states, the cost of new technologies is high. Due to data limitations, these cost additionality estimates above conventional walling assembly in government housing projects

in Telangana do not include structural costs, which increase proportionally with the weight of the structure and need to be studied further. The assessment did reveal that the incremental increase in cost of using fly ash and AAC blocks range between Rs 15–20 per square foot and Rs 78–130 square foot respectively. But their replacement with new materials: precast concrete system, monolithic concrete system using aluminium or plastic formwork and monolithic concrete system using modular tunnel formwork, costs Rs 200–400, Rs 200–300 and Rs 200–250 per square foot respectively. This additional cost is expected only with replacement of conventional with new materials that are preferred for speed of construction and the associated cost savings.

These cost estimates can be expected to change if requirements of thermal comfort properties are added to them. The current thickness at which poured concrete technologies (e.g. precast concrete, monolithic concrete system using aluminum or plastic formwork and monolithic concrete system using modular tunnel formwork) are being used without paying attention to their thermal properties, undermines thermal comfort as they allow more heat influx from the concrete walls. To stop this will need regulatory interventions and guidance for walling assemblies. If used appropriately and in the right order, the assemblies will keep up the construction pace while enhancing thermal comfort. Enhanced composition of massing and insulation with right proposition of shading may work at an additional cost of Rs 500–600 per square foot over conventional construction, which could initially be high due to very low market penetration. As there are no thermal performance criteria in our construction protocols, this will result in high operational costs and increased living expenses for the occupant, higher emissions due to increased energy consumption and health disadvantages.

THE NUMBER OF EWS AND LIG HOUSEHOLDS BENEFITTING FROM HOUSING FINANCE IS STILL VERY LOW

Assess economic value chain of the housing sector to address sytemic constraints and to better target policy: To arrive at the way forward on fiscal strategy, this study has tried to understand the economic value chain around housing. This helps to highlight systemic factors that support or constrain specific segments of the housing sector, influencing its targeting and performance. The economic value chain needs to be understood separately for rental housing. Currently hit by the economic slowdown, recalibrating the value chain is crucial to demystify the risks linked with the housing sector.

To understand the economic value chain of the housing sector, linkages in terms of raw material flow, jobs, services and skills—both direct and indirect—become important. After occupation, households consume resources that incur costs and generate demand for resources and allied services. This is denoted as intermediate demand. The entire construction process yields gross fixed capital in the form of dwelling units for the economy. Housing sector accounts for 1.24 per cent of the total economic output and 6.8 per cent of the employment in the country, according to a study by National Council of Applied Economic Research. The share of informal employment to total employment in residential construction is the second highest among all sectors after agriculture. The specific nature and magnitude of these linkages need further assessment, with a focus on skill upgradation and job creation.

New materials and technologies to have a bearing on housing construction economics: In a regular commercial construction, the developer's revenue stream is set for the longer term and is based on sales or lease of the newly constructed space. Economic viability in construction of affordable housing needs to be understood from this perspective. In the affordable housing sector, the cash flow comes from the government and is limited to the construction phase. Affordable housing projects in most states are being developed on public private partnership (PPP) models, in which the developer's role is to design, build and transfer the units to the government. Overall, developers see a smaller window of opportunity to generate profits only during the construction phase.

New technologies like monolithic concrete structures cast in-situ, precast concrete structures and extruded polystyrene-based (EPS) wall panels shift the market towards processed materials that incur higher costs. This will have additional bearing on intermediate inputs related to primary materials. For instance, more use of cement will require additional mining of lime and iron for increased use of steel. This will also increase costs that has been analysed in detail in this study. But the price of processed materials varies widely across different parts of India. As seen in Greater Hyderabad, the Municipal Corporation using tunnel formwork to create monolithic structures at Rampally under the state affordable housing scheme has increased the need for intermediate inputs related to the secondary sector (e.g., renting of heavy cranes) and tertiary sector (e.g., transportation and warehousing of imported equipment) and this will reflect in the housing construction cost. Tracking this is important to develop an informed fiscal strategy. Can long-term revenue models such as rental housing be possible, where developers are involved in operation and maintenance?

LINKAGES OF RAW MATERIAL FLOW, JOBS, SERVICES AND SKILLS ARE IMPORTANT TO UNDERSTAND THE ECONOMIC VALUE CHAIN OF HOUSING

Evaluate new materials—prioritize thermal comfort and resource efficiency: Currently, developers are using expensive technologies to save time and it is said that with time saved they are able to make low-cost construction feasible. Savings in time translate into savings in interest on the capital invested by developers. Providers of precast concrete system technology suggest that new technologies can save upto 50 per cent of the time compared to conventional buildings. For example, a project with about 40,000 square feet of built-up area may not take more than four months from conception to completion using this technology. But a conventional construction would take 12 to 14 months.

However, according to developers, it is also not easy to benchmark and ascribe time related savings to this technology that comprise of design, fabrication and erection of the buildings on-site—fabrication being the most critical stage, as assembling of buildings does not take much time. Fabrication is faster if the plant is owned by the vendor; with a third party fabricator, the turn-around time is longer. Since a major part of this technology is automated, there is much subjectivity around the actual time taken.

Alternative materials and technologies require more skills for engineering, fabrication, management and construction; therefore, they involve higher value addition than conventional structures due to engagement of more skilled workers. This adds to the stock of housing at a faster pace than conventional

housing technology, resulting in increase in the aggregate capital stock of the country. But it will have to account for requirements of thermal comfort. For instance, autoclaved aerated concrete (AAC) blocks, as an alternative material to burnt clay bricks, are able to provide better thermal comfort but are more expensive. Other alternative technologies will also need assessment. For instance, substantial monolithic concrete housing structures have been created in Andhra Pradesh, Gujarat, Karnataka, Tamil Nadu, Telangana and other states. But the thermal transmittance value of a 100 mm wall built using this technology is 3.59 W/m^{2}K, about 60 per cent higher than that of a regular burnt clay brick wall (2.13 W/m^{2}K). This means that houses for the poor will heat up nearly twice as fast as conventional houses. To mitigate this heat gain, correct orientation, enhanced natural ventilation, improved shading, enhanced thermal resistivity, and reduced surface exposure to ambient heat will have to be adopted.

IN COMMERCIAL CONSTRUCTION, DEVELOPERS' REVENUE STREAM IS SET FOR A LONGER TERM. STATE-BACKED AFFORDABLE HOUSING LIMITS PROFITS TO THE STAGE OF CONSTRUCTION

This is an area where the government must intervene and not just back these technologies only for speed of construction. Adoption of new and expensive materials needs to be informed or the operational expenditure will increase for beneficiaries. More the value added or invested into housing construction in terms of good designs, well-researched materials, etc., lesser will be the incremental increase in demand for household consumption. Uninformed selection of affordable housing sites, and weak or poor accessibility to basic services and amenities will add substantially to household consumption and intermediate demand in the housing economic value chain. Thus, material selection must be linked with performance criteria for design and construction to improve operational efficiency and annual thermally comfortable hours, and reduce the per capita energy footprints.

Need regulatory interventions to balance cost and performance: Currently, there are fears that developers may want to save on construction costs at the cost of quality and performance of houses. The government needs to support construction of affordable housing with incentives, but only if it ensures good designs and quality of materials and performs well based on predefined criteria for thermal comfort and liveability.

Currently, variations in the cost of provisioning affordable housing across states is determined by varying regulatory approaches. State governments have procured construction of affordable housing at capped rates, predominantly for conventional construction. These rates are significantly lower than prevailing market rates. Small-scale contractors and developers often try to save money by cutting down design cost and quality of materials. CSE's compilation of construction cost benchmarks for EWS units in government affordable housing projects in select states shows a wide variation. Telangana has the cheapest cost at an average of Rs 1,175 per square foot, followed by Rajasthan at Rs 1,200 per square foot and Karnataka at Rs 1,700 per square foot. Andhra Pradesh and Uttar Pradesh have expensive construction costs at nearly Rs 2,400 per square foot. Nearly all states have a fixed building design template.

To compensate for the low profit margins, governments have brought down taxes and duties. Since April 2019, the GST on affordable housing has been lowered, from 8 per cent to 1 per cent. PMAY-U has asked for mandatory exemption from stamp duty and other levies and also allows additional floor area ratio (FAR) or floor space index (FSI) or transferable development rights (TDR). While these measures can compensate for lower profit margins, they cannot ensure good designs or quality of materials. Currently, TDR allow developers to relocate the affordable housing component of a project to peripheral and unfavourable locations. These mechanisms need to be ring-fenced in favour of beneficiaries.

Time has come to ensure that the fiscal strategy for the affordable housing sector combines these goals. A pushback from the industry can be expected as the economic slowdown and COVID-19 pandemic continues to bear down on the construction sector. Complications in loan repayment; increasing non-performing assets ratios; rising costs of cement, fine and coarse aggregate, river sand, and burnt clay brick; and other factors are not going to help get the sector out of a rut either. COVID-19 guidelines for construction require stringent hygiene measures—use of masks, gloves, and regular sanitization of construction equipment, offices and labour camps—all of which add to costs.

TO IMPROVE OPERATIONAL EFFICIENCY, MATERIAL SELECTION MUST BE LINKED WITH PERFORMANCE CRITERIA FOR DESIGN AND CONSTRUCTION

Therefore, a stimulus package, while supporting construction of houses, needs to be linked with strategies to reduce operational expenditure for the beneficiaries who are also facing enormous economic hardship.

Converge with environmental goals: The bottom line is that the sector as a whole will have to reduce its environmental footprints. Doing so will require an environmental and carbon impact framework for housing construction, material transition and supply chain. For example, a shift from regular burnt clay bricks to AAC blocks can save top soil. A framework that includes environmental and carbon footprints, and serviceability and accessibility of new development, needs to be adapted for the sector.

NEXT STEPS

Affordable housing sector has always faced liveability and, ironically, affordability challenges. COVID-19 pandemic has further exposed gaps in the current strategies in mitigating these challenges. The fiscal strategy for the sector needs ample rethinking. The disruption due to the pandemic can be turned into an opportunity to reboot the sector.

Need improved criteria for assessing affordability and establishing affordable housing price-to-income ratios in cities in the post COVID-19 scenario: Establish clear criteria for assessing affordability. The recent migrant labour crisis due to the pandemic-induced lockdown was more evident in the national capital and big metropolitan cities. Interestingly, the same cities have the widest housing affordability gaps. For instance, Mumbai has the highest price-to-income ratio among cities globally. The government needs to build data repositories to understand the nature and limits of housing affordability of the economically vulnerable population. At present, the vulnerable are hardly

represented in databanks. Proper documentation of household incomes and expenditures, and market prices at the city level (across classes) is necessary.

Need strategies to minimize cost of improving thermal comfort and new construction technologies to the beneficiaries: This will require collating data and conducting research on how past affordable housing schemes performed with regard to inclusivity, accessibility, thermal comfort (energy prudence), resource efficiency and environmental sustainability. The learning curve from this gap analysis must be internalized in the larger housing strategy, while focusing on performance and economic incentives. Our analysis shows that despite the availability of low-interest loans, the share of non-performing assets is high in the lower lending bracket. A fiscal strategy is needed to mitigate the incremental costs of new technologies and materials, and adoption of the thermal comfort approach for beneficiaries. Three parties are involved in the final sale and purchase of affordable housing: developers, beneficiary and lenders or banks. The developers bear the enhanced cost of construction due to new material and thermal comfort requirements. For the banks, there is a cost of funds and intermediation charges that are normally passed on to the borrowers. Developers and lenders need to recover costs. These lending costs are built into the construction cost of the developers, whether they have raised funds independently or from bank. Ultimately, the price charged to the beneficiaries includes all costs.

It has been observed that under CLSS, the percentage of non-performing assets is high for loans upto Rs 2 lakh. This implies that lending to this segment is not profitable for the banks. State intervention can compensate the losses that banks incur in lending to low-income groups. A suitable fiscal policy is needed to absorb the extra cost of housing either through an interest subvention scheme or direct cash assistance to absorb the losses arising from non-performing assets in the affordable housing sector. It is important that the beneficiaries, whose housing needs are urgent, are not denied access to housing due to the extra costs of providing thermal comfort.

Shift policy focus from only constructing the housing stock to green performance and lowering of operational cost burden for beneficiaries: This sector is vulnerable to low demand and liquidity, stuck capital, and uncertainties around the availability and costs of material and labour during this period. The government is promoting alternative materials and construction technologies, but without adequate research into their suitability from a thermal comfort standpoint. Several incentives such as extra FAR, FSI and TDR and tax holidays are being provided to the sector but in an uninformed manner. Built structures without regulations on performance can add to the operational cost burden for the beneficiaries in terms of increased requirement of annual operational hours of cooling and increased costs due to poor liveability and serviceability. Performance safeguards are needed in affordable housing planning and construction.

A number of incentives are already available to developers. Linking these with performance regulations is necessary. Information on performance of materials,

and operational performance for thermal comfort and energy efficiency need to be prioritized, with stringent specifications to avail economic incentives. Existing regulatory frameworks such as Environmental Impact Assessment (EIA), building bye-laws and PPP models or procurement guidelines for affordable housing need to incorporate these performance indicators and instill healthy competition among developers based on green performance of affordable housing.

Guide the housing sector on alternative material and construction technologies: PMAY–U aims to achieve the affordable housing target to provide housing for all by 2022. Detailed evaluation of new material and walling assembly techniques from the standpoint of thermal comfort by Building Material and Technology Promotion Council (BMTPC) is urgently needed. This needs to be linked with fiscal incentives.With a handful of players, there is ample scope to understand the economics and impact of these technologies. Benchmarking of cost of primary and processed materials, transportation, warehousing, design and engineering, and tax exemptions are some of the steps that can help. Deep-dive investigations at the state level can reveal critical areas that need redress to arrest cost escalation.

Need instruments of accountability and a disclosure system for availing incentives: Green housing incentives are needed for performance and accountability. Developers need to be assigned resource efficiency and sufficiency targets for every affordable housing project when seeking building permission from the government. Third party assessment and verifiable annual disclosure of energy and other resource use during the operation of buildings needs to be made mandatory. This will ensure that targets are met during the operational phase. A certification tool may be developed for developers to track their performance, and it may be linked to future incentives like extra FAR or FSI or TDR. It is too early to say whether such a system can be used to offset additional costs. But it is not early at all to underline the importance of regulating the construction sector based on performance.

2. REINVENTING FISCAL SUPPORT FOR AFFORDABLE HOUSING

THE CHALLENGE

Affordable housing programmes are aimed at meeting the shortfall in housing demand fulfilment. PMAY has also been designed to address this issue. A large part of the housing demand is determined by poverty and low income profiles of substantial sections living in cities. It is also linked to obsolescence of dwelling units. A 2012 report of the Ministry of Housing and Urban Affairs's (MoHUA) technical group on urban housing shortage found that 'obsolescence'—dwelling units aged above 80 and those above 40 years old and reported to be in a 'bad' condition—accounted for 12 per cent of the total housing shortage, second only to 'congestion', which can be attributed to rapid growth in urban population.

WHO RECOGNIZES THE DISEASE BURDEN OF HEAT STRESS IN STRUCTURES AND RECOMMENDS THAT NATIONS INTERNALIZE IT IN HOUSING POLICY AND DESIGN

New constructions to meet the gap in supply will make an enormous demand on materials—the use of old materials will rise and the utilization of alternative materials will pick up. There are concerns that this may lead to widespread use of alternative materials that have not yet been evaluated from the standpoint of performance and this uninformed action may lead to the construction of less durable and less sustainable structures in the country. Introduction of alternative materials and their promotion with limited knowledge about their thermal resistance and use can create additional risks of increasing energy intensity and have unintended consequences for public health.

Selection of materials for housing construction has a multifaceted impact. It has an impact on embodied energies and associated environmental impact related to the production and transportation of materials. Choice of materials has implications for resource sufficiency when we factor in recyclability or reusability based on the principles of a circular economy. The economic impact of the materials utilized is also high as they form the bulk of the construction cost.

Moreover, the use of materials in structures, especially in wallling assembly and roofing within the overall design framework, has significant bearing on the thermal comfort of the structure. This is a very important aspect that needs to be looked into as India has more than 3,000 cooling degree days (CDD)—among the highest in the world. Due to a warming environment and rising frequency and intensity of heat waves in India every year, CDDs are going to increase correspondingly. WHO has recognized the disease burden related to heat stress in structures and recommends that nations internalize this in housing policies and design. If health becomes one of the criteria for determining housing shortage, the numbers of obsolescent and non-performing structures

in India is going to swell manifold. Typically, build stock lasts for around 50 years. As average ambient temperatures rise, it will not be possible to retract materials that are not performing from the build stock as per requirements of the changing climate. This underlines the need to act now.

India's Cooling Action Plan (ICAP) states that a significant percentage of Indian households will be living in houses that would not be able to keep them thermally comfortable. Heat loading in the group housing typology—which makes up nearly all formal housing being constructed—will be more due to the large area of exposed and poorly insulated walls. In such cases, thermally efficient walling assemblies, i.e., materials and building elements like orientation, envelope design, shading devices, layout, ventilation and daylighting strategies become crucial. Otherwise, households will be forced to switch to mechanical means of cooling, increasing energy costs. Since these projects are being built for households with meagre incomes, it will also breach the financial sustainability of the endeavour. Heat stress will also increase public health risks. Currently, the policy landscape in India does not recognize this escalated cost accruing to households on occupying newly built housing structures.

At this stage, when India is aggressively building affordable housing and promoting new materials and technologies, it is imperative to ensure that the right materials and designs, that are responsive to the native climate, are used and promoted. The current practice of using materials and technologies that fast-track construction is emissions-intensive and relies heavily on cement and steel. The emerging construction sector has the potential to alter the materials supply chains and resource consumption trajectories. However, comprehensive and cross-cutting studies are needed against the backdrop of reducing overall emissions under India's Nationally Determined Contributions.

BUILT STOCK LASTS FOR AROUND 50 YEARS. WEEDING OUT NON-PERFORMING MATERIALS NOW WILL ENSURE VIABLE AFFORDABLE HOUSING STOCK IN THE WARMING FUTURE

This material flow will also alter and create direct and indirect linkages in the construction economy that need to be understood for their implications on the cost of transition and environmental performance, and their management.

ACCESS TO AFFORDABLE HOUSING

Broadly speaking, a dwelling unit in India is defined to be affordable when a household spends less than 30 per cent of its income on housing-related expenses (see *Table 1: Evolving definition of housing affordability*). To be precise, a house is affordable when its cost does not exceed four times the annual gross household income of EWS and LIG households. For the middle income group (MIG), this threshold is five times the annual gross household income.

This criterion was laid down by the Deepak Parekh Committee on affordable housing. Established in 2008, the committee defines affordability based on the cost of the house or equated monthly instalment (EMI) as a proportion of income. It lays down that for EWS, the EMI or rent should not exceed 30 per cent and for LIG it should not exceed 40 per cent of the gross monthly income. The dwelling size and annual income definitions have changed over the years. In 2012, a task force on affordable housing under MoHUA stated that borrowing capacity must not exceed five times the annual income. (Borrowing capacity is

the sum of money someone is able to borrow from a lender. This amount varies for each individual according to their unique circumstances.) In 2015, however, PMAY guidelines provided annual income classification of the EWS, LIG and MIG but did not specify borrowing capacity of the beneficiaries. Further, they stated that 35 per cent of all dwelling units should be less than 30 square metre in size for the EWS category. Thus, this definition needs to reflect 'housing affordability' from the beneficiary's perspective.

Currently, there are three indicators of housing affordability: household income, housing unit size and price or expenditure towards it. However, global definitions suggest that these indicators are not adequate, mainly because income and affordability do not always follow a linear trend (see *Graph 1: Income disposability is income group-sensitive).* According to Jones Lange LaSalle Research, the portion of income spent on food and other consumables and rent is higher for lower income groups.[2] As a result, disposable surplus income is higher at high income levels and drops steeply at lower income levels.

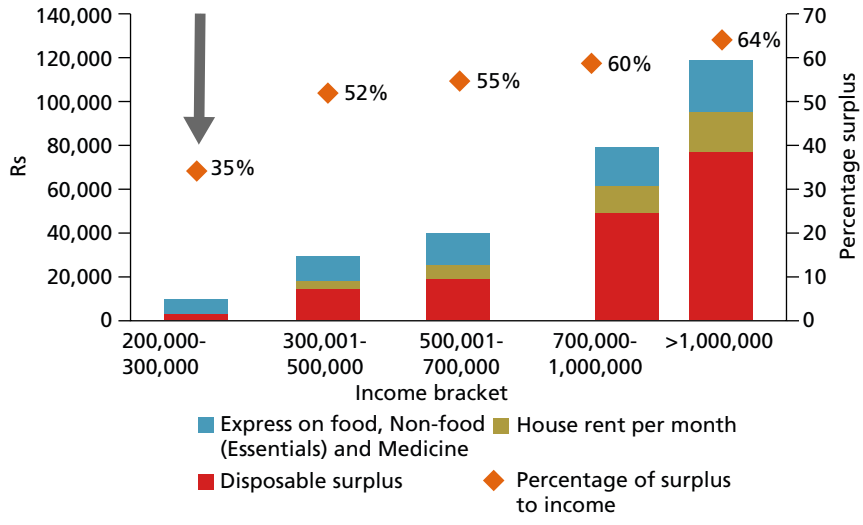
Table 1: Evolving definition of housing affordability

		Dwelling unit size	Income criteria	Monthly installment	Cost	Borrowing capacity
Deepak Parekh Committee 2008	EWS	Upto 30 sq m of carpet area	Upto Rs 3 lakh per annum	EMIs should not exceed 30 per cent of the gross household monthly income	Not exceeding four times the annual gross household income	NA
	LIG	30–60 sq m of carpet area	Rs 3–6 lakh per annum			
	MIG	Above 60 sq m of carpet area (MIG I: upto 120 sq m) MIG II: upto 150 sq m)	Above Rs 6–18 lakh per annum	EMIs should not exceed 40 per cent of the gross household monthly income	Not exceeding five times the annual gross household income	NA
MoHUA Task Force on Affordable Housing 2012*	EWS	21–27 sq m of carpet area	Upto Rs 1 lakh per annum	NA	NA	Five times the annual income
	LIG	28–60 sq m of carpet area (LIG A: 21-40 sq m; LIG-B: 41–60 sq m	Rs 1–2 lakh per annum	NA	NA	Five times the annual income
Pradhan Mantri Awas Yojana 2015*	EWS	30 sq m carpet area	Upto Rs 3 lakh per annum	NA	NA	NA
	LIG	60 sq m carpet area	Rs 3–6 lakh per annum	NA	NA	NA
	MIG-I	160 sq m carpet area	Rs 6–12 lakh per annum	NA	NA	NA
	MIG-II	200 sq m carpet area	Rs 12–18 lakh per annum	NA	NA	NA

Note: *A project qualifies as an affordable housing project when 35 per cent of the units are made for the EWS category.

Source: CSE compilation from multiple sources

Graph 1: Income disposability is income group-sensitive



Source: Jones Lang LaSalle Research, 2016

Real estate market understands this relationship very well. This is why most of the formal housing supply is inclined towards upper income segments to maximize profitability, even when the actual demand is huge in the lower income segment. According to McKinsey Global Institute, affordability gap stands at 80 per cent for the deprived (income segment of below Rs 90,000 per annum) and 50 per cent for the aspirers (income segment of Rs 90,000 to Rs 200,000 per annum).[3] This is further evidenced by our national statistics stating that about 96 per cent of India's housing shortage is made up of EWS and LIG, whereas 11.09 million houses are lying vacant as per Census 2011. To reduce this affordability gap, there is a need to build a realistic picture of the market and access to affordable housing in order to inform policies. For this, effective performance indicators are needed.

ABOUT 96 PER CENT OF INDIA'S HOUSING SHORTAGE IS MADE UP OF EWS AND LIG HOUSEHOLDS; THIS WHILE 11.09 MILLION HOUSES ARE LYING VACANT

NATIONAL HOUSING BANK RESIDEX

India has an official indicator to track the trends in housing prices at city and national levels. National Housing Bank (NHB) RESIDEX is based on information collected from 50 cities in 21 Indian states. It comprises of two indices—housing price index (HPI) at assessment prices and HPI at market prices for under-construction housing units. While the former is computed using lenders' valuation data received from banks or housing finance companies (HFCs), the latter is based on primary market data for under-construction properties, collected from developers, builders and brokers.

This indicator is limited to capturing the rise and fall in housing prices. Moreover, housing prices are classified on the basis of carpet area size at the city level for units under three size categories: lesser than 60 square metres, 60–110 square metres, and more than 110 square metres. These categories are unable to demonstrate performance of the housing market for lower income segment that generally occupy units with smaller than 40 square metres carpet area.

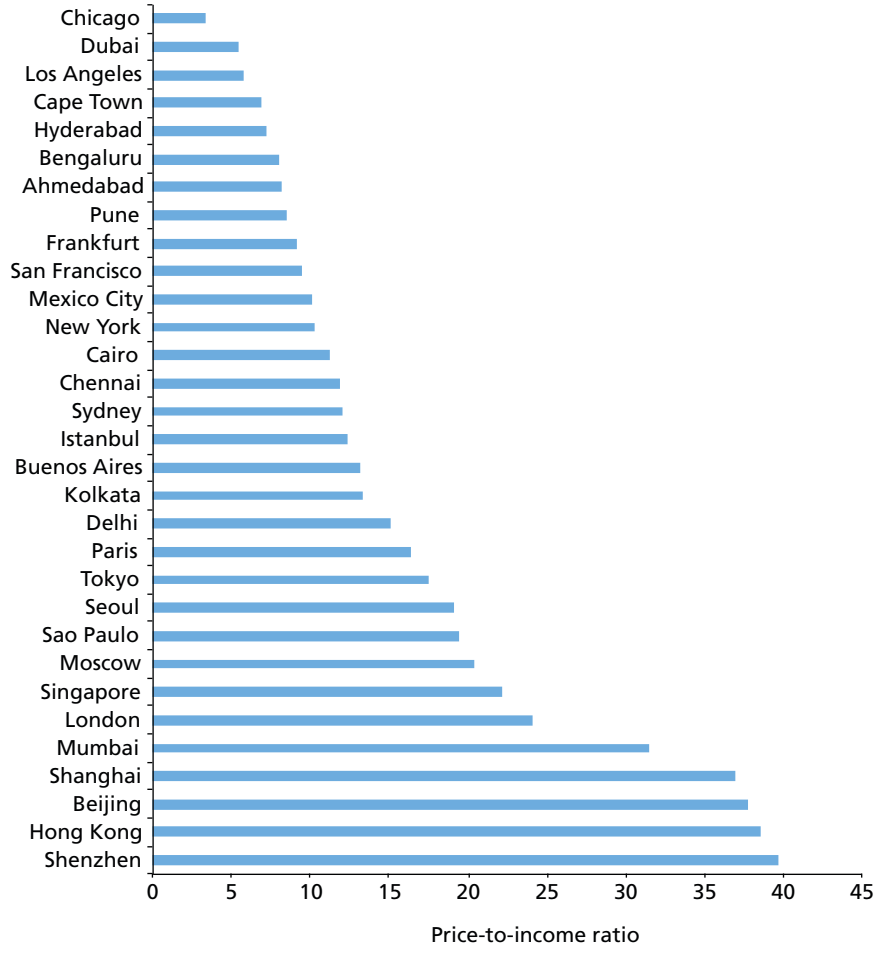
PRICE-TO-INCOME RATIO

MUMBAI HAS ONE OF THE HIGHEST PRICE-TO-INCOME RATIO AMONG GLOBAL CITIES

Price-to-income ratio (PIR) is the median house price divided by the annual median household disposable income in a city. It is a better indicator for housing affordability than housing price as it takes into account the income disparity among cities. A study by Asian Development Bank (ADB) found PIR to be higher in countries with a population of more than five million. This was affirmed for India by a study based on crowdsourced data. The study reveals PIRs of Indian metropolitan cities are higher than those of developed cities like Chicago and Los Angeles (see *Graph 2: Price-to-income ratio of global* cities).[4] Mumbai has one of the highest PIR among cities globally.

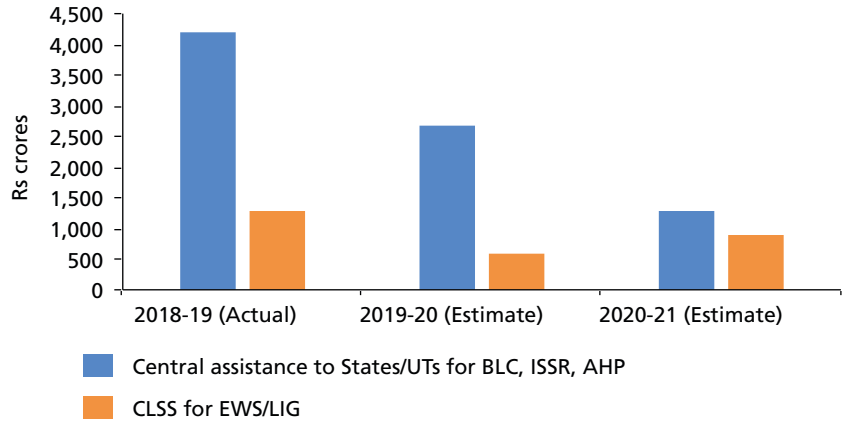
However, the ADB study stated that an upward bias occurs in PIR analysis due to the use of household expenditure data in countries without household income surveys. India is among these countries. In India, household expenditure data is based on Census 2011 and results of the 72nd round of National Sample Survey (NSS). There is paucity of official data on household income. Considering the wide income disparity between states (and cities), there is a need to strengthen metrics at the city level for better analysis.

Graph 2: Price-to-income ratio of global cities



Source: IDFC Institute, 2018

Graph 3: Budget outlay for PMAY-U



Source: Union Budget 2020–21

ACCESS TO HOUSING FINANCE

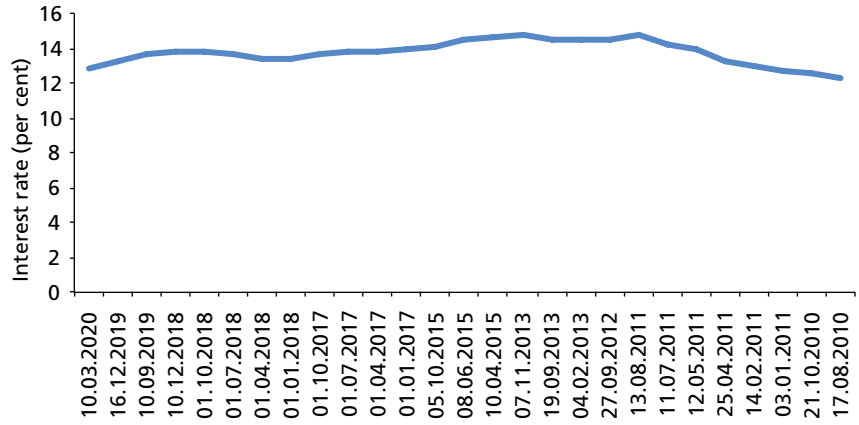
According to the Union budget for 2020–21, state grant demands under PMAY-U show a reduction compared to the previous year. Only the Centrally sponsored CLSS, that deals with self-construction by individual households under PMAY-U, has seen a 50 per cent increase in the estimate (see *Graph 3: Budget outlay for PMAY-U*). This indicates a shifting priority of the national scheme towards lending-focused demand-side interventions.

LENDING INTEREST RATE AND TERM

A trend analysis of benchmark prime lending rate (BPLR) suggests that interest rates for housing have witnessed a reduction since September 2019, according to State Bank of India data (see *Graph 4: Benchmark prime lending rate*). The CLSS component of the PMAY-U provides a housing loan of upto a maximum value of Rs 6,00,000 per dwelling unit. The schemes provides EWS households an interest subsidy at a rate of 6.5 per cent for a tenure of 20 years or loan tenure, whichever is less. The interest rate subsidy credits upfront to the beneficiary's account and is calculated on net present value (NPV) at a discounted rate of 9 per cent. This benefits EWS households with a maximum saving of Rs 2,20,000 per dwelling unit. However, EWS households are mostly involved in the informal sector and face difficulties in accessing formal housing finance. A ground investigation of micro-finance interest rates and terms across cities will paint a better picture of access to housing finance for the lower income population. Key indicators will be micro-finance interest rates and term benchmarking at the city level.

EWS HOUSEHOLDS ARE MOSTLY INVOLVED IN THE INFORMAL SECTOR AND FACE DIFFICULTIES IN ACCESSING FORMAL HOUSING FINANCE

Graph 4: Benchmark prime lending rate



Source: State Bank of India

DISBURSEMENT OF HOUSING LOANS

According to NHB, the rate of growth of disbursement of housing loans to lower income groups by HFCs has decreased in the past couple of years. Disbursement of loans of upto Rs 200,000 witnessed a year-on-year growth of 48.23 per cent in 2016–17, which dropped to 11.82 per cent in 2017–18 (see *Table 2: Disbursement of housing loans by HFCs*).

Housing loans to beneficiaries with income below Rs 10,000 per month made up a small portion (2.24 per cent) of the total loan disbursements by HFCs (see *Table 3: Loan disbursement as per income category* .

Table 2: Disbursement of housing loans by HFCs

Particulars	2015–16 (Rs crore)	2016–17 (Rs crore)	Year-on-year growth	2017–18 (Rs crore)	Year-on-year growth
Upto Rs 2,00,000	1,324	1,963	48.23 %	2,195	11.82 %
Above Rs 2,00,00 upto Rs 5,00,00	1,549	1,942	25.43 %	1,933	-0.46 %
Above Rs 5,00,000 upto Rs 10,00,000	8,166	9,662	18.32 %	12,600	30.40 %
Upto Rs 10,00,000	11,039	13,568	22.91 %	16,728	23.29 %
Above 10,00,000 upto 15,00,000	12,623	13,912	10.21 %	17,750	27.59 %
Above 15,00,000 upto 25,00,000	24,954	24,325	-2.52 %	34,223	40.69 %
Above 25,00,000	53,750	60,541	12.64 %	80,802	33.47 %
Total	1,02,366	1,12,346	9.75 %	1,49,503	33.07 %

Source: National Housing Bank, 2018

Table 3: Loan disbursement as per income category

Particulars	Monthly income > Rs 5,000		Monthly income Rs 5,001 to Rs 10,000		Monthly income > Rs 10,000		Total	
	Number of loans	Amount (Rs crore)	Number of loans	Amount (Rs crore)	Number of loans	Amount (Rs crore)	Number of loans	Amount (Rs crore)
Upto Rs 3,00,000	1,508	12	43,974	362	1,95,431	2,523	2,40,913	2,897
Above Rs 3,00,00 upto Rs 5,00,00	850	28	1,547	51	63,538	2,542	65,935	2,621
Total	2,358	40	45,421	413	2,58,969	5,065	3,06,848	5,518

Source: National Housing Bank, 2018

Table 4: Performance of public sector banks on individual housing loans

Housing loan slab	Disbursement	Outstanding	GNPA (%)	Disbursement	Year-on-year growth	Outstanding	Year-on-year growth	GNPA (%)
Upto Rs 2,00,000	1,224	5,940	11.55	995	-18.71 %	6619	11.43 %	11.33
Above Rs 2,00,00 upto Rs 5,00,00	4,868	25,768	3.22	3,206	-34.14 %	24,407	-5.28 %	3.51
Above Rs 5,00,000 upto Rs 10,00,000	17,173	83,160	1.82	14,740	14.17 %	86,289	3.76 %	1.99
Above 10,00,000 upto 25,00,000	52,149	225,984	1.14	59,193	13.51 %	258,619	14.44 %	1.34
Above 25,00,000	67,926	245,992	1.21	104,965	54.53 %	316,320	28.59 %	1.44
Total	143,340	586,844	1.46	183,098	27.74 %	6,922,254	17.96%	1.64

Source: National Housing Bank, 2018

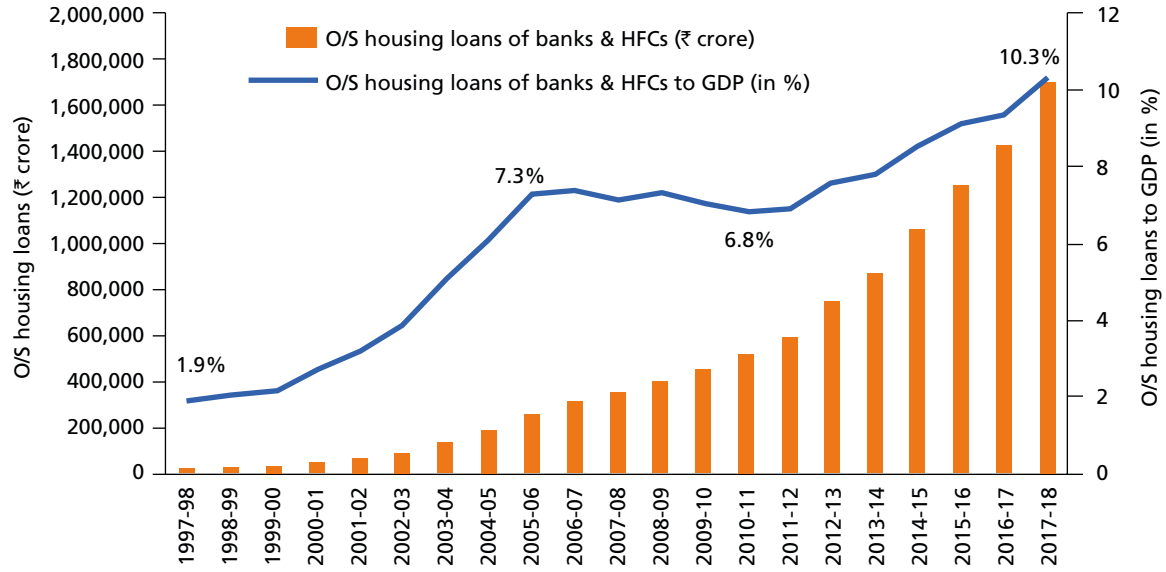
SHARE OF NON-PERFORMING ASSETS

The effectiveness of the government's move to focus on affordable housing finance is questionable. Currently, housing stock supplied by the market remains out of reach of the ones who seek housing the most. Small-sized loans do not form even 2 per cent of the total loans extended by public sector banks and HFCs, according to NHB data (see *Table 4: Performance of public sector banks on individual housing loans*).[5] The data highlights that, at 11.33 per cent, the gross non-performing assets (NPA) with public sector banks are the highest in the loan slab of upto Rs 2 lakh. This makes lending institutions wary of loaning to lower income groups and affects the accessibility of the destitute to housing finance.

OUTSTANDING HOUSING LOANS AND GDP

A good indicator of availability of housing finance in an economy is the percentage of outstanding housing loans in gross domestic product (GDP). This shows what proportion of the GDP has gone into financing housing in the country. According to NHB, this percentage has been increasing in India since 2012 and was recorded at 10.3 per cent in 2018 (see *Graph 5: Outstanding housing loans as percentage of GDP*). While this percentage has increased, the number of EWS and LIG households benefitting from housing finance is still very low in India. As of June 2018, 156,242 EWS and LIG dwelling units have been supported under the CLSS vertical of PMAY-U. This number is merely 1.4 per cent of the national validated housing demand of 11.2 million. (However, its share is increasing.) This underlines the irony of the situation—the primary target group of affordable housing schemes may either not be availing or not receiving housing finance benefits. This needs to be investigated.

Graph 5: Outstanding housing loans as percentage of GDP



Source: National Housing Bank, 2018

3. THE MATERIAL CONNECTION

MATERIALS: WHAT IS AT STAKE?

CSE is investigating the material connection and has engaged with the providers of alternative materials and technologies promoted by BMTPC in its third compendium of emerging technologies across India, especially in the states of Gujarat, Karnataka, Maharashtra and Uttar Pradesh. Deep-dive engagements have been performed in Karnataka and Telangana and include local market surveys, and visits to manufacturing units of alternative materials and affordable housing sites where they were being utilized.

It is necessary to assess the implication of alternative materials and technologies for walling and how the costs compare with conventional materials like brickwork in a conventional reinforced concrete cement structure, widely used in India. Based on inputs from the ground—including discussions with developers implementing affordable housing projects, CREDAI representatives and material suppliers—CSE has estimated a range of cost additionalities of new and alternative materials. Due to data limitations, structural costs have not been considered for this analysis. Structural costs increase proportionally with the weight of the structure and need to be studied in detail separately.

ALTERNATIVE MATERIALS AND TECHNOLOGIES MUST BE COMPARED WITH CONVENTIONAL MATERIALS LIKE BRICKWORK ON ECONOMIC, COMFORT AND ENVIRONMENTAL PARAMETERS

To understand the difference between different building typologies, samples from many blocks have been considered; these include Kollur, YSR Nagar and Gajwel affordable housing projects in Telangana. The study reveals that the incremental increase in cost of using fly ash and AAC blocks ranges between Rs 15–20 per square foot and Rs 78–130 square foot respectively. But their replacement with new materials, including precast concrete system, monolithic concrete system using aluminium or plastic formwork, and monolithic concrete system using modular tunnel formwork, cost Rs 200–400, Rs 200–300 and Rs 200–250 per square foot respectively. This additional cost is expected only with replacement of conventional materials with new materials that are preferred for speed of construction and the associated cost savings.

But the larger purpose is not just material replacement for speed but to ensure the selection of material and walling assembly with thermal comfort properties. For instance, at present the industry is largely using concrete, be it in the form of blocks of 150 mm thickness or in the form of poured concrete technologies, e.g., precast concrete, monolithic concrete system using aluminum or plastic formwork, or monolithic concrete system using modular tunnel formwork. Even for poured concrete in a frame, the industry adheres to 150–160 mm thickness specifications as going beyond this leads to increase in the dead load, making the structure heavy and unviable.

Concrete is similar to red bricks in terms of massing properties and how much heat it allows in. But a brick wall is 230 mm thick (compared to 150

mm thickness of a concrete wall) and the two materials vary in density. This compromises the thermal comfort experience due to more heat influx from concrete walls. But due to speed of construction, concrete is still the most popular and preferred application. It is also a heat trapper.

This means there is a need for regulatory requirements and guidance for walling assemblies that will promote proportionate use of insulation and massing properties of materials. If used appropriately and in right order, this composition will keep up the construction pace while ensuring the enhancement of thermal comfort. SP-41, an old building code of India, also highlights this in relevant chapters.

But use of appropriate walling assembly comes with an additional or incremental cost compared to conventional concrete. Fast-paced technologies like precast and monolithic concrete systems work at a supplementary margin that is around Rs 200–400 per square foot. Enhanced composition of massing and insulation with the right shading may lead to an additional cost of Rs 500–600 per square foot over conventional construction. This could be even higher initially due to low market penetration as there are no thermal performance criteria in our construction protocols.

FOR EVERY ADDITIONAL RUPEE INVESTED IN THE RESIDENTIAL CONSTRUCTION SECTOR, RS 2.84 ARE ADDED TO GDP AND RS 0.12 GETS COLLECTED AS INDIRECT TAX

In a business-as-usual scenario, current housing schemes will create fixed assets in the form of housing stock for the government but with lower economic value, and without regulations for green performance, this will lead to high operational costs and increased living expenses for the occupant, and higher emissions due to increased energy consumption and health disadvantages at the societal level.

HOUSING SUPPLY AND ECONOMIC VALUE CHAIN

Construction is the second largest economic activity in India.[6] The housing sector accounts for 1.24 per cent of the total economic output and 6.8 per cent of the employment in the country, according to a study by National Council of Applied Economic Research. The share of informal employment to total employment in residential construction is second highest among all sectors, next only to agriculture.[7] Moreover, for every Rs 1 lakh investment in the residential construction sector, 4.06 new jobs are created and for every additional rupee invested, Rs 2.84 are added to GDP and Rs 0.12 gets collected as indirect tax. These relationships may vary following the outbreak of COVID-19. For instance, the cost of materials has increased by about 25 per cent in the Delhi region. Given the low availability of labour, construction costs may have increased substantially.

While these numbers establish that housing has strong linkages with the economy, what is not known yet is the specific nature and magnitude of these linkages in a complex and evolving housing sector. Government of India declared April 2019 to March 2020 as the 'Construction Technology Year' in a bid to welcome innovative and alternative materials and construction technologies from around the world.[8] In order to understand the impact of these technologies on the economy and environmental sustainability, and

implications of recent pandemic-induced slowdown, the linkages need to be understood holistically.

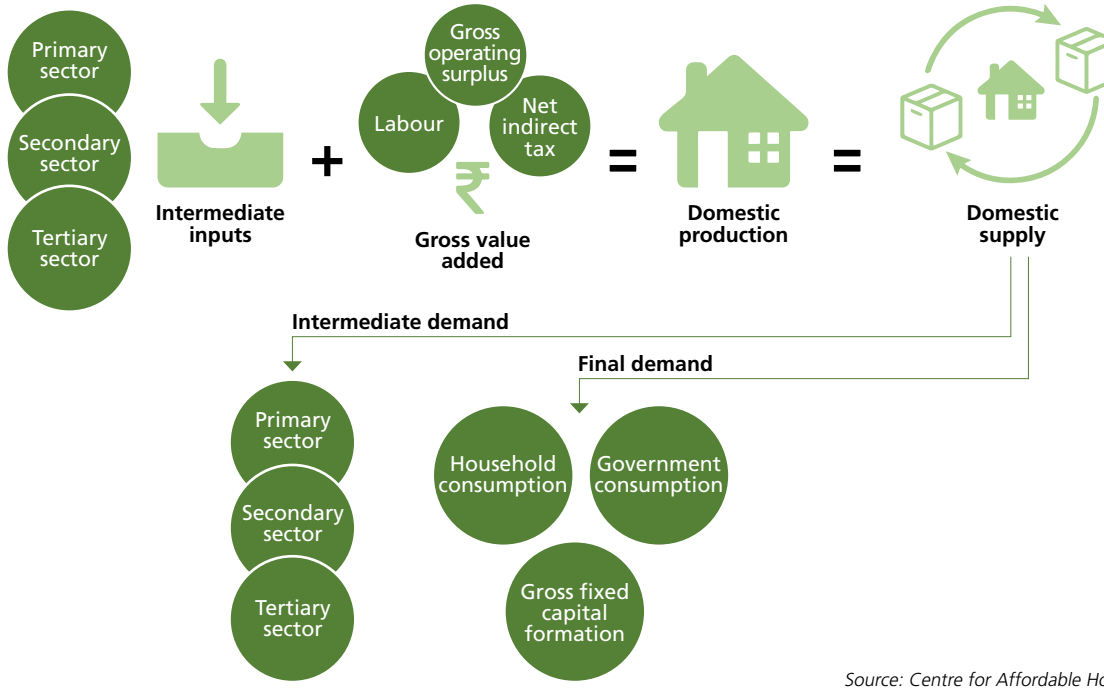
The economic system of the housing sector is vast and complex. Centre for Affordable Housing Finance describes a housing economic value chain framework.[9] In this framework, the economic value of housing is understood along with the construction process. The chain begins with the identification of raw materials (sand, stone, lime, wood, etc. from the primary sector), manufactured goods (processed timber, cement, steel, paints, equipment, etc. from the secondary sector) and services (financial, legal, social, transportation, warehouse, etc. from the tertiary sector). Moreover, domestic housing supply generates intermediate demand for furniture, appliances and household services. This is an indirect impact of the housing sector. The final demand in the housing value chain comprises the total demand for final goods and services in a sector or economy at a given time.

FOR EVERY RS 1 LAKH INVESTMENT IN THE RESIDENTIAL CONSTRUCTION SECTOR, 4.06 NEW JOBS ARE CREATED

Understanding the economic value chain highlights the structural factors that support or constrain specific segments of the housing sector and influence its targeting and performance. Over time, policymakers can use this analysis to design specific interventions.

In the wake the COVID-19 lockdown, and the enormous numbers of displaced migrant workers in cities, government of India has decided to develop rental housing at par with mainstream affordable housing under national and state schemes for the first time. For these reasons, housing economic value chain could undergo a change from the perspective of its economic potential.

Figure 1: Housing economic value chain framework



Source: Centre for Affordable Housing Financ

ALTERNATIVE MATERIALS, THERMAL COMFORT AND THE ECONOMIC VALUE CHAIN

We can understand the effects of a transforming construction sector using the housing value chain framework. This section illustrates the value chain framework for India based on the conventional construction sector (see *Figure 2: Housing in a conventional construction sector*).

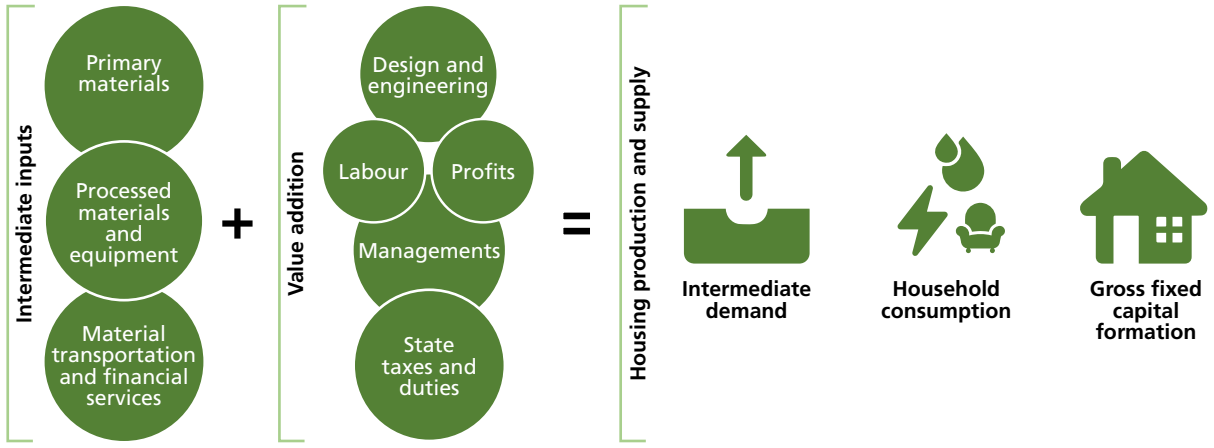
Conventional construction technology largely relies on reinforced concrete cement (RCC) frame structures with brickwork, mostly using burnt-clay bricks. Intermediate inputs that go into the making of bricks include primary materials such as clay, sand, timber and lime. This technology also uses processed material and equipment like cement, steel, window and door frames, plastic, paints, nails and hinges. There are also support services that include material transportation, finance and warehousing.

COVID-19'S MIGRANT WORKFORCE CRISIS HAS GOADED INDIAN GOVERNMENT INTO DEVELOPING RENTAL HOUSING AT PAR WITH MAINSTREAM AFFORDABLE HOUSING

Bricks and processed material inputs then undergo value addition by labour of varying skills. In a construction process, the skilled labour component includes architects, engineers, and managerial and financial professionals. Semi-skilled and unskilled component includes masons and handymen.

Developers organize housing activities and bear the cost of construction. Costs of new materials and new construction technologies add to the overall costs of housing activities and result in a reduction in the gross operating surplus available to the developers. In order to continue to keep this sector financially viable even after the introduction of new materials and technologies, and after taking into consideration the requirement of thermal comfort, it may be necessary to design a fiscal strategy that attracts new investment.

Figure 2: Housing in a conventional construction sector



Source: CSE research

ASSESSING INTERMEDIATE INPUTS

In the emerging construction sector, the conventional RCC frame and brickwork construction will be replaced with construction technologies that enable a speedy delivery. These technologies include monolithic concrete structures cast in-situ, precast concrete structures and extruded polystyrene-based (EPS) wall panels. In this scenario, the requirement will shift towards processed materials that incur higher costs. Consequently, intermediate inputs related to primary materials will also increase. For instance, increased use of cement will require more mining of lime and iron (for steel).

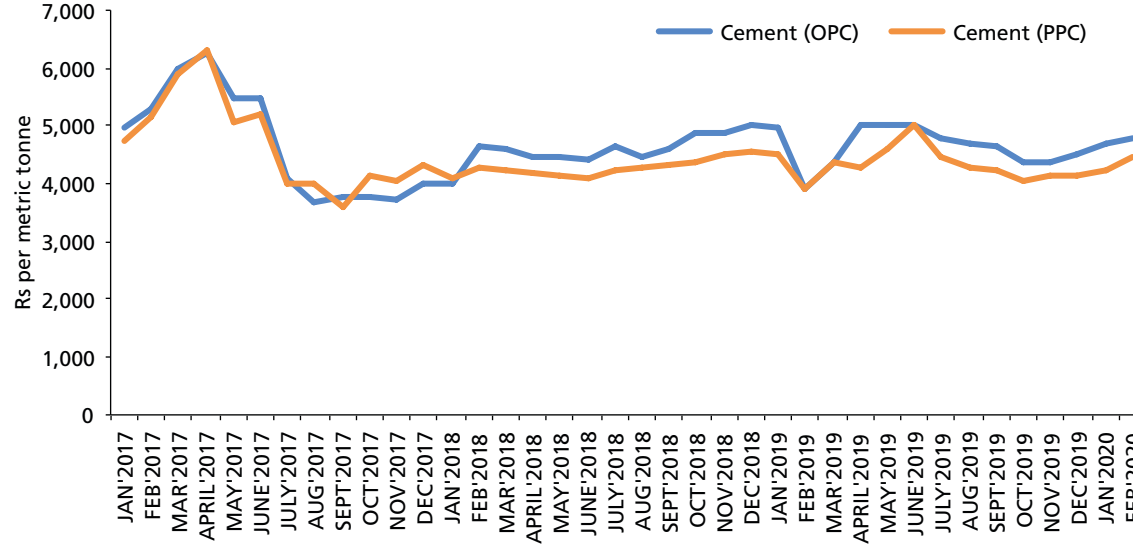
FAST-PACED AFFORDABLE HOUSING CONSTRUCTION SHIFTS THE DEMAND TOWARDS PROCESSED MATERIALS THAT INCUR HIGHER COSTS

Key indicator: Base price of processed materials

Cement and steel are the main processed materials required in construction. Emerging technologies, such as the ones with precast concrete structures or monolithic concrete structures, use these two materials liberally.

The rates for ordinary portland cement (OPC) and Pozzolana Portland cement (PPC) spiked in April 2017 to Rs 6,320 per MT and then fell back to Rs 3,600 and Rs 4,000 respectively by August 2017. As the rates of this commodity are influenced by demand and supply, this depression could be related to low demand following the announcement of goods and services tax (GST) that strongly affected the construction sector. Base price of commonly used OPC has stabilized at Rs 4,000–5,000 per metric tonne (MT) (without taxes) for most months since January 2017, according to the base prices notified by Central Public Works Department(CPWD) headquarters. However, the base price of cement have seen an upward trend since October 2019, denoting a gradually increasing demand. In February 2020, the base price of OPC reached Rs 4,453 per MT (see *Graph 6: Base prices of cement*)

Graph 6: Base prices of cement

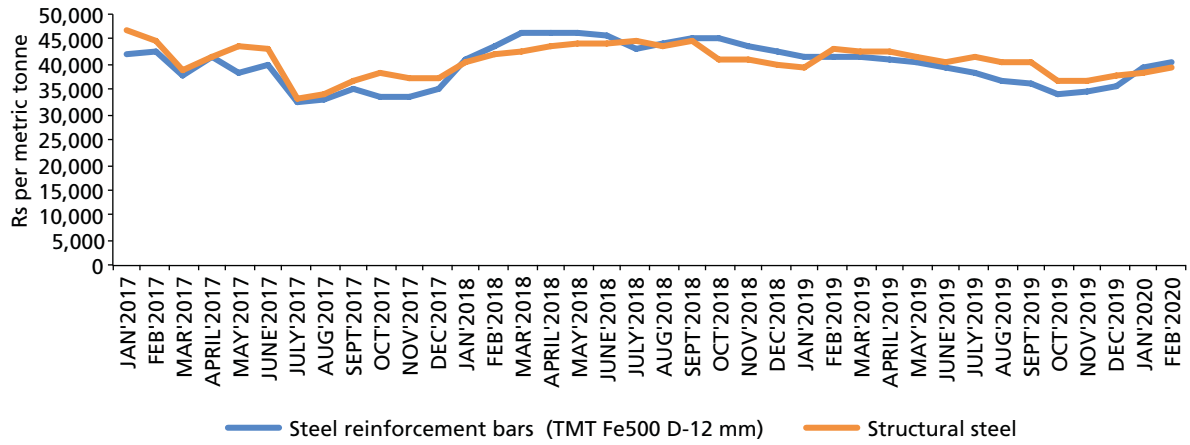


Source: CPWD 10 CA indices

Similarly, the base price of steel has also been rising since October 2019. In that month, the prices stood at Rs 34,200 per MT for steel reinforcement bars and Rs 36,589 per MT for structural steel (see *Graph 7: Base prices of steel*).

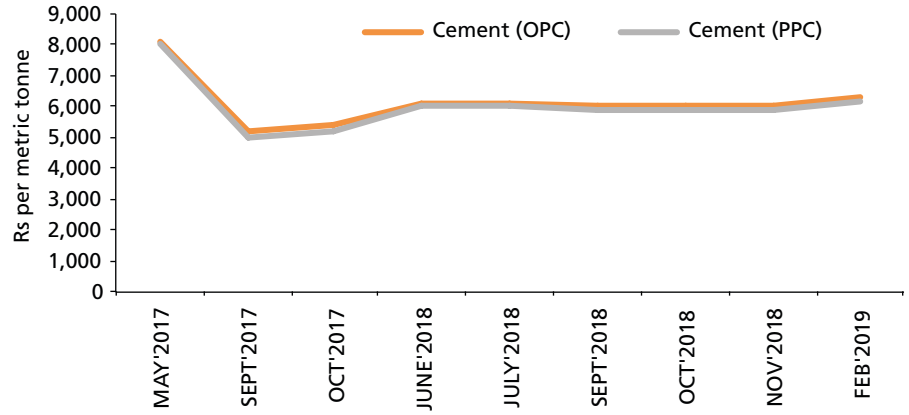
However, the price of processed materials varies widely across different parts of India. CPWD 10 CA Indices, available for a few months (until February 2019) for the South Zone, show the base prices of cement and steel are quite higher in the zone than the Central rates. This variance applies to local markets as well, that are incident to further deviations from government base prices. For instance, in Warangal the government price of cement is Rs 4,600 per MT, whereas market price is Rs 5,500 per MT. Government of Telangana recognizes these local market variations due to which it is controlling the prices of cement, steel and river sand and making them available to the developers at cheaper rates. This signals the need for cost benchmarking of key materials for major cities at the state level (see *Graph 8: Base prices of cement in CPWD South Zone* and *Graph 9: Base prices of steel in CPWD South Zone*).

Graph 7: Base prices of steel



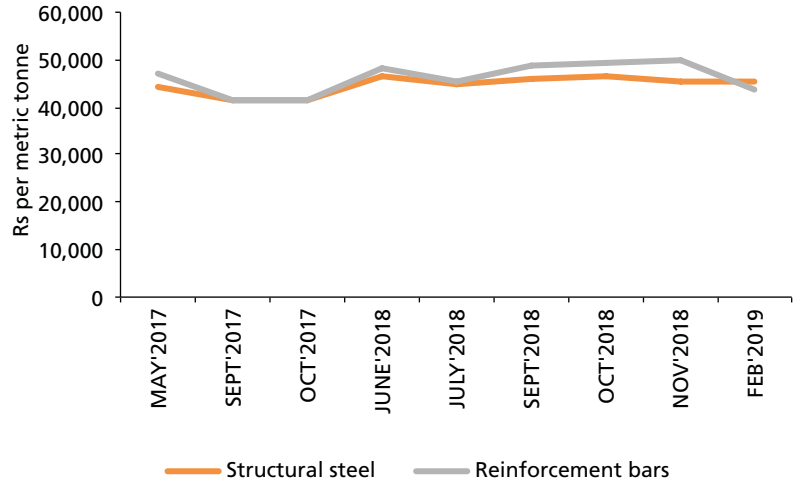
Source: CPWD 10 CA indices

Graph 8: Base prices of cement in CPWD South Zone



Source: CPWD 10 CA indices

Graph 9: Base prices of steel in CPWD South Zone



Source: CPWD 10 CA indices

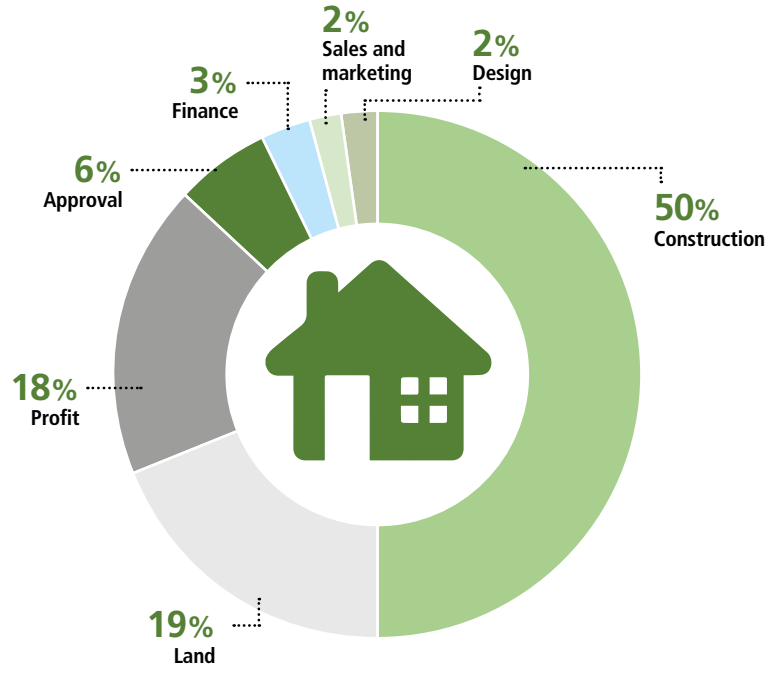
Apart from cement and steel, a few processed materials and equipment are being imported and more will continue to be imported due to the impetus given by Global Housing Technology Challenge (GHTC) launched in 2019. GHTC is a programme led by Ministry of Housing and Urban Affairs for stimulating material and construction technology transition in India, especially in the affordable housing sector. For instance, Greater Hyderabad Municipal Corporation is using tunnel formwork to create monolithic structures at Rampally under the state affordable housing scheme. The formwork equipment has been transported from Turkey as it uses a patent technology that is not yet manufactured in India. As seen in Greater Hyderabad, the Municipal Corporation using tunnel formwork to create monolithic structures at Rampally under the state affordable housing scheme has increased the need for intermediate inputs related to the secondary sector (e.g., renting of heavy cranes) and tertiary sector (e.g., transportation and warehousing of imported equipment) and this will reflect in the housing construction cost. This calls for a thorough investigation.

MATERIALS LIKE CEMENT AND STEEL ARE NOT THE ONLY IMPORTS IN THE CONSTRUCTION VALUE CHAIN, PATENTED TECHNOLOGIES LIKE TUNNEL FORMWORK MAY ALSO BE IMPORTED

Key indicator: Construction cost benchmarking for alternative technologies

According to the Centre for Affordable Housing Finance's (CAHF) housing economic value chain framework, construction cost is the key indicator to understand value addition and the impact of an emerging construction sector. A study by Knight Frank suggests construction cost accounts for at least 50 per cent of the affordable housing cost. In government projects, this proportion increases substantially to 75 per cent, wherein the projects are procured at a capped amount and do not involve the cost of land. This leaves the construction cost comprising mainly of material and labour cost.

Figure 3: Affordable housing project cost break-up



Source: Knight Frank research, 2019

CONSTRUCTION (LABOUR AND MATERIALS) ACCOUNTS FOR 50-75 PER CENT OF THE AFFORDABLE HOUSING COSTS

Investigation into alternative construction technologies

Construction costs depend on typology, design and materials. These factors, in turn, affect the need for labour, infrastructure and consultancy (design and approval fees), among others. Cost of alternative technologies related to only materials is guided by CPWD in its Schedule of Rates (SoR) for new and innovative technologies, released in 2018. The rates for construction and fabrication of wall panels is available (see *Table 5: Government rates of alternative construction technologies*). Pertinently, the rates for construction of superstructure and other building elements are not included. The cost of constructing a wall panel using an alternative technology is much higher than the conventional burnt clay brickwork, which remains Rs 86.43 per cubic foot.

Table 5: Government rates of alternative construction technologies

Technology	Rate
Expanded polystyrene core panel system (200 mm wall panels, upto G+3 level)	Rs 301.69 per sq ft
Glass fibre reinforced gypsum panel building system (124 mm wall panels)	Rs 119.89 per sq ft
Precast concrete (150 mm hollow core slab)	Rs 117.42 per sq ft
Precast concrete (wall panels)	Rs 389.55 per cu ft
Factory made fast-track modular building system (130 mm EPS core wall panels)	Rs 201.79 per sq ft

Source: CPWD, 2018

The SoR suggests the use of a specific technology for a minimum volume of construction in order for it to be feasible. For instance, precast concrete system is suggested for a project with at least 5,000 dwelling units. Monolithic construction system using plastic or aluminium formwork is suggested for at least 100 repetitions. Ground experience in states has revealed that there is much variation in the application as well as the cost of alternative technologies in local markets.

A monolithically constructed affordable housing project (using plastic or aluminium formwork) costs between Rs 2,000 and Rs 2,500 per square foot in Hyderabad and requires at least 250,000 square feet of construction volume to be economically feasible, according to a CREDAI Hyderabad representative. However, the technology is being implemented in Hyderabad's Dundigal project at a construction cost of Rs 1,410 per square foot. This includes cost of all the material, equipment, transportation, labour and other sundries. The same project is using precast concrete technology at the same cost, which is the most expensive of alternative technologies given in CPWD's SoR. The catch here is that the developers are able to strike feasibility even at low construction cost. They use these expensive technologies in order to build their experience portfolio and save time. Savings in time translates into savings in interest on the capital invested by the developers. Providers of precast concrete system technology suggest that it can save upto 50 per cent of time compared to conventional building technology. To exemplify, a project with about 40,000 square feet of built-up area took not more than four months from conception to final finishing using this technology, whereas conventional construction would have taken 12–14 months.

DEVELOPERS SOMETIMES USE EXPENSIVE TECHNOLOGIES TO SAVE TIME AND BUILD THEIR EXPERIENECE PORTFOLIO

However, it is not easy to benchmark time related to this technology; comprising of three major components—design, fabrication and erection of the buildings on-site. Fabrication is the most critical stage, assembling buildings does not take as much time. Fabrication is faster if the plant is owned by the vendor; with a third party fabricator, turn-around time increases. Since a major part of this technology is automated, there is much subjectivity around the time taken. A similar perspective was shared by the vendors of EPS core panel technology.

However, market penetration of alternative construction technologies is low, with only a handful of providers in play. While technologies may offer flexibility with time, projects may still not be feasible for the developer, especially in areas where skilled manpower is scarce or the technologies are relatively inaccessible. In order to kick-start these technologies, the financial models adopted in government and private projects need to be investigated in depth.

Economic viability of commercial construction is better than that of affordable housing. In commercial construction models, the developer's revenue stream is set for the longer term and is based on sales or lease of the newly constructed space. In the affordable housing sector, cash flows from the government and is limited to within the construction phase. Affordable housing projects in most states are being developed on PPP models in which the developer's role is to design, build and transfer the units to the government. Overall, developers see a

smaller window of opportunity to generate profits during only the construction phase. For a larger window, long-term revenue models such as rental housing need to be explored, wherein the developer can be engaged in operation and maintenance as well.

Prioritizing thermal comfort and resource efficiency in housing

As compared to conventional construction, use of alternative materials and technologies requires more skills to be engineered, fabricated, managed and constructed; therefore, it involves higher value addition than a conventional sector. But the economic value addition is not limited to this. For instance, AAC blocks perform better on thermal comfort than burnt clay bricks, according to a CSE study *Optimizing the Third Skin*. As per results of a sample housing project in Warangal, Telangana, the cost of AAC blocks is higher than that of burnt clay bricks (see *Table 6: AAC vs burnt clay brick*). The cost of masonry and labour is also slightly higher. The reason, as explained by the contractor, is the skill needed for wet plaster. If not plastered appropriately, walls made of AAC blocks may develop cracks. At the same time, AAC blocks reduce structural load by upto 30 per cent, which cuts down the requirement of steel in the superstructure by 5–10 per cent. Overall, at this higher cost, AAC blocks as an alternative material are able to provide better thermal comfort to the beneficiary and facilitate resource savings. But what about other alternative technologies?

RENTAL HOUSING CAN EXTEND THE PROFIT WINDOW FOR DEVELOPERS, WHO CAN BE ENGAGED IN OPERATION AND MAINTENANCE

This discussion raises a key question: What is the value addition from alternative technologies that the construction sector is banking on? The answer is higher profits; while the government is favouring these technologies and materials due to their speedy delivery of houses. For instance, substantial monolithic concrete housing structures have been created in Andhra Pradesh, Gujarat, Karnataka, Tamil Nadu and Telangana and other states. But the thermal transmittance value of a 100 mm wall built using this technology is 3.59 W/m^2K, about 60 per cent higher than that of a regular burnt clay brick wall (2.13 W/m^2K). This means that houses for the poor will heat up nearly twice as fast as conventional houses. To mitigate this heat gain, measures like correct orientation, enhanced natural ventilation, improved shading, and reduced surface exposure to ambient heat are critically important. This is an area where government intervention is a must.

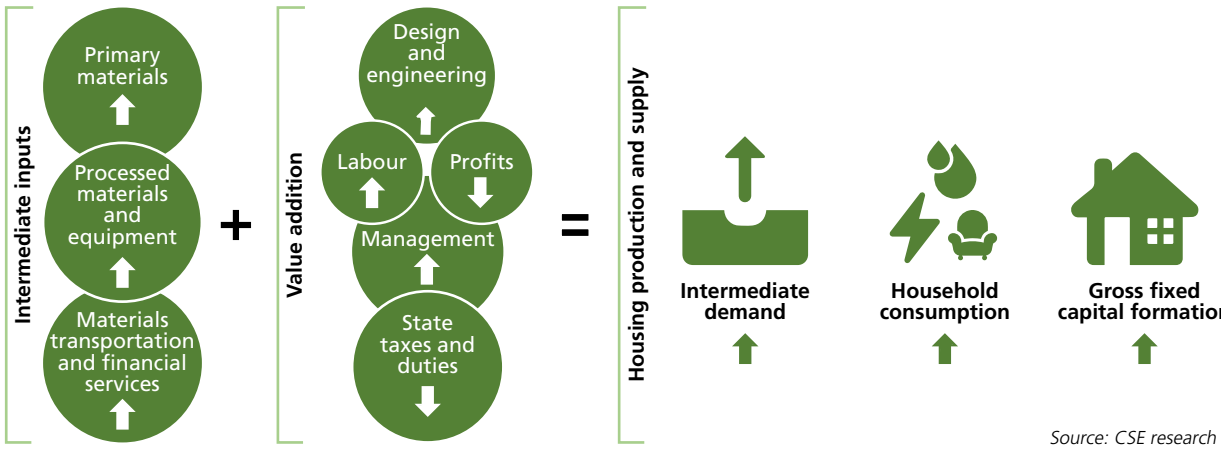
In a warming climate, houses with faster heat loading will have higher thermal stress in a country where 70 per cent of the geographic area faces hot summers.

Table 6: AAC vs burnt clay brick costs

	Cost of constructing one cubic metre of panel walls in the superstructure in a sample project in Telangana			
	Number of bricks	Cost of bricks (Rs)	Cost of masonry and labour (Rs)	Total cost (Rs)
Autoclaved aerated concrete blocks	52	4,264	1,499.32	5,763.32
Burnt clay bricks	512	2,734.4	1,434.52	4,168.92

Source: CSE investigation

Figure 4: Housing in the emerging construction sector



Source: CSE research

This will either affect the health and well-being of beneficiaries or increase electricity bills by forcing them to invest in mechanical means of cooling. In its Housing and Health Guidelines, the World Health Organization (WHO) recognizes that high indoor temperatures can result in heat-related illnesses and pose a bigger health risk to those with cardiovascular and pulmonary issues.[10] WHO has highlighted the need for countries to prepare strategies to safeguard populations from excess heat in housing. In tropical regions, indoor maximum acceptable temperature is 32^{0}C, as per WHO. However, this research is currently being expanded.

THE EMERGING CONSTRUCTION SECTOR MUST DELIVER THERMAL COMFORT AND RESOURCE EFFICIENCY

Housing produced using alternative construction technologies will have more gross fixed capital formation due to fast-paced construction than conventional housing. In this scenario, household consumption and intermediate demand for services are going to increase (see *Figure 4: Housing in the emerging construction sector*). This is primarily due to the push towards fast-paced housing construction in a frenetic and uninformed manner. Uninformed selection of affordable housing sites, and weak or poor accessibility to basic services and amenities will substantially add to household consumption and intermediate demand in the housing economic value chain.

It is clear that the use of alternative materials and construction technologies will have a higher cost than conventional construction. But if this higher cost does not include informed designs and choice of materials, it will increase the expenditure to be borne by beneficiaries. The more the value added or invested in housing construction in terms of good designs, well-researched materials, etc., the lesser will be the intermediate demand and household consumption. In a rapidly transforming construction sector, it is essential to guide this value addition.

The next question is: How do we ensure that the emerging construction sector delivers on the requirements of thermal comfort and resource efficiency? The answer lies in determining the benefits and costs. Much more information needs to be obtained around alternative materials and construction technologies. Since the costs are a function of demand and supply, investigation at a local level (formal and informal markets) is also necessary. This knowledge on alternative materials and construction technologies will have to feed into performance

criteria for design and construction, which have become necessary in the wake of a warming and resource-burdened environment. These criteria must be able to guide construction efficiencies in structures not only in terms of operational efficiency such as percentage of annual thermally comfortable hours, per capita energy footprints, etc., but also regarding how much cement or steel loading per square foot is acceptable and beyond what point is material overrun or abused.

STATE GOVERNMENTS PROCURE AFFORDABLE HOUSING AT CAPPED RATES. THIS PUTS PRESSURE ON DEVELOPERS TO SEEK OTHER AVENUES OF PROFIT

Regulation for incentives

Traditionally, state governments have procured affordable housing at capped rates (predominantly of conventional construction). These rates are fairly lower than existing market rates. As a result, affordable housing construction lands with small-scale contractors or developers, who try to hedge their dwindling profits by cutting down design costs and quality of materials. CSE has compiled construction cost benchmarks for EWS units in government affordable housing projects in different states and found that they vary widely. Of the states reviewed, Telangana has the cheapest cost at an average of Rs 1,175 per square foot, followed by Rajasthan at Rs 1,200 per square foot and Karnataka at Rs 1,700 per square foot. Andhra Pradesh and Uttar Pradesh have the highest construction costs at nearly Rs 2,400 per square foot. Nearly all states have a fixed building design template.

To compensate for the low profit margins, governments have brought down taxes and duties. For instance, since April 2019, GST on affordable housing has been lowered from 8 per cent to 1 per cent. PMAY-U asks states to mandatorily exempt developers of affordable housing from paying stamp duty and other levies and to provide them additional FAR, FSI or TDR. While these measures may be able to make up for dwindling profits, they cannot ensure good design or quality of materials. CSE studies *Beyond the Four Walls of PMAY* and *Optimizing the Third Skin* assessed the designs of a few affordable housing projects in states like Gujarat, Rajasthan and Telangana and found there is much scope for improvement. Issues included poor daylight ingress, ventilation and higher exposed surface area. Further, according to a CREDAI Hyderabad representative, stone dust is commonly used as a replacement for fine aggregate or sand for its cheaper prices. It goes into cement mortar mix, plaster and even fly ash concrete blocks. Below a certain percentage in a mix, it may not make a difference, but if added in higher quantities, it affects durability because it does not bond well with cement. Such issues create a policy intervention area.

Table 7: Construction cost benchmarks across states

State	Construction cost (Rs per sq ft)
Telangana	950–1,410
Rajasthan	1,200
Karnataka	1,700
Madhya Pradesh	2,164
Gujarat	2,222
Andhra Pradesh	2,384
Uttar Pradesh	2,450

Source: CSE compilation

Currently, due to the government's indifference, developers are striving to save on construction costs and sacrificing the quality and performance of houses. These savings later incident on beneficiaries in terms of making up for comfort and well-being in ill-designed houses. The government must support construction of affordable housing with incentives, but only those which ensure good design and quality of materials and perform based on predefined criteria. For this, specifications needs to be created and embedded in the construction process as part of a larger regulatory framework to ensure thermal comfort, resource efficiency and environmental sustainability in housing.

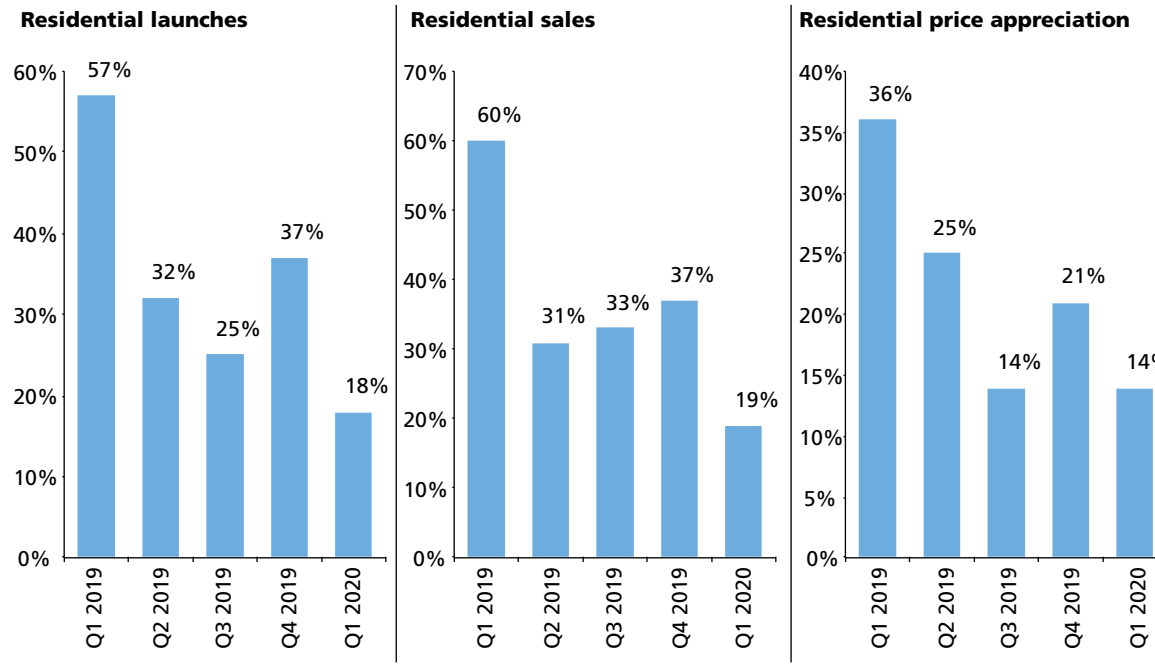
GOVERNMENT MUST ONLY PROVIDE INCENTIVES TO AFFORDABLE HOUSING THAT PERFORMS WELL ON PREDEFINED CRITERIA OF DESIGN AND MATERIALS

IMPACT OF COVID-19 ON THE CONSTRUCTION MARKET

Key indicator: Material and construction cost benchmarks at the city level

The economic slowdown due to COVID-19 pandemic has hit the construction sector hard. Reserve Bank of India (RBI) has cut the repo rate by 40 basis points to adjust liquidity and injected about Rs 3.74 trillion by cutting cash reserve ratio (CRR) by 100 basis points.[11] It has also announced a moratorium of six months on all term-loans. Nevertheless, stakeholder sentiments in the housing sector have turned decidedly pessimistic, as assessed by Knight Frank-FICCI-NAREDCO research in their quarterly Real Estate Sentiment Index.[12] The residential real estate market saw a steep decline in new launches, sales and price appreciation in Q1 2020 (see *Graph 10: Performance of residential real estate market in Q1 2020*).

Graph 10: Performance of residential real estate market in Q1 2020



Source: Knight Research Frank

Other impacts of COVID-19 on the housing sector include difficulty in loan repayments (due to job losses and pay-cuts), reduction in housing demand, delayed project deliveries (due to capital stuck in unfinished projects, low liquidity and reduced sale prices), and increase in non-performing asset (NPA) ratios.

The ground impact of COVID-19 on the housing construction sector can be demonstrated by a case study in Delhi (*see Table 8: Material cost benchmarks for Delhi region before and during COVID-19*). The study compares costs for basic construction materials such as cement, fine aggregate, coarse aggregate, river sand and burnt clay brick. The increase from a before COVID-19 scenario ranges between 11.11 per cent and 35.71 per cent. The impact is heavier in materials that are part of informal markets. Further, interaction with construction industry experts has revealed that compliance with COVID-19 guidelines for construction will influence statements of purchase (SoP) and project costing even further. For instance, CREDAI's COVID-19 guidelines ask for stringent hygiene measures such as use of masks, gloves, and regular sanitization of construction equipment, offices and labour camps. All these measures will add to the construction cost. This impact of the pandemic now needs to be determined in other cities to ascertain the nature and level of support required from the government.

PRICES OF BASIC CONSTRUCTION MATERIALS LIKE CEMENT, SAND AND BURNT CLAY BRICKS HAVE RISEN BY 11-36 PER CENT IN DELHI DURING COVID-19

Table 8: Material cost benchmarks for the Delhi region before and during COVID-19

Material	Before COVID-19	During COVID-19	Per cent increase
Regular burnt clay brick (Rs per 1,000)	4,500	5,000	11.11
Cement 43 grade OPC (Rs per bag of 50 kg)	325	420	29.23
Cement 53 grade PPC (Rs per bag of 50 kg)	290	380	31.03
Coarse aggregate 12.5 mm (Rs per cu ft)	40	50	25.00
Stone dust as an alternative to fine aggregate (Rs per cu ft)	38	48	26.32
Yamuna river sand (Rs per cu ft)	28	38	35.71

Source: CSE research

Key Indicator: Labour unemployment rate at state level

Apart from this, availability of labour (especially unskilled and semi-skilled labour) will be an issue in a post-COVID-19 scenario. According to Centre for Monitoring Indian Economy, the labour unemployment rate shot up to 23.48 per cent nationally in the month of May 2020, from 8.75 per cent in the month of March 2020.[13] At 25.79 per cent, it is even higher for urban areas. As of 24 May 2020, daily numbers suggest only an increase, which will pose a major challenge for the construction sector in the foreseeable future.

The unemployment rate for May 2020 is higher at the state level, especially in states like Tamil Nadu (33.0 per cent), Jharkhand (59.2 per cent), Bihar (46.2 per cent) and Haryana (35.7 per cent). Several state governments have tried to change labour laws to mitigate the impact of COVID-19 on the labour-force and construction sector. However, the efforts may not be adequate.

Table 9: Monthly unemployment rates in India

Month	India	Urban	Rural
	Unemployment rate (per cent)		
May 2020	23.48	25.79	22.48
April 2020	23.52	24.95	22.89
March 2020	8.75	9.41	8.44
February 2020	7.76	8.65	7.34
January 2020	7.22	9.70	6.06
December 2019	7.60	9.02	6.93
November 2019	7.23	8.88	6.45
October 2019	8.10	8.27	8.02
September 2019	7.16	9.62	6.00
August 2019	8.19	9.71	7.48
July 2019	7.34	8.30	6.90
June 2019	7.87	8.26	7.69

Source: Centre for Monitoring Indian Economy, 2020

On the one hand, liquidity in the market has reduced; on the other hand, purchasing power of the consumer has taken a heavy blow. In this scenario, the government needs to intervene in order to stimulate the construction sector. Further, it will be a good strategy to promote construction of houses that reduce operational expenditure for the beneficiaries who are already facing a heavy monetary crunch.

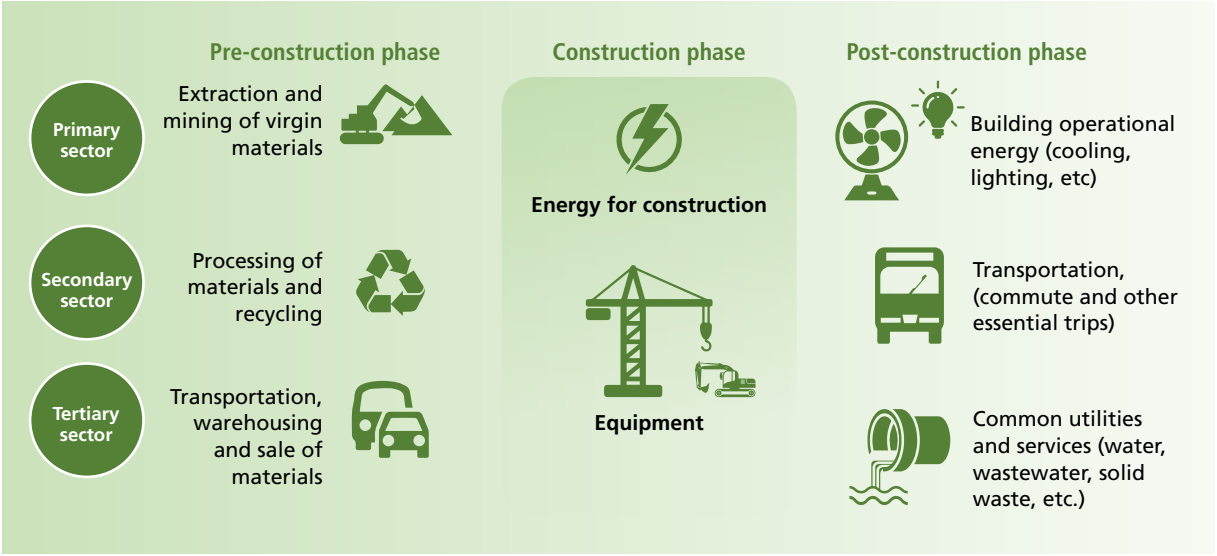
AVAILABILITY OF LABOUR WILL BE AN ISSUE IN A POST-COVID-19 SCENARIO. NATIONAL LABOUR UNEMPLOYMENT RATE SHOT UP TO 23.48 PER CENT IN MAY 2020, FROM 8.75 PER CENT IN MARCH 2020

ASSESSING CARBON IMPACTS OF THE HOUSING CONSTRUCTION PROCESS

The previous discussion has highlighted areas with regards to the quantum (increase and decrease) and economic value of materials and activities in the housing construction process. For a circular and resource-efficient economy, establishing the carbon impacts of an emerging housing construction and supply chain is equally important, considering a lot of material transition. For instance, the shift from regular burnt clay bricks to AAC blocks would mean a transition from the use of top soil to use of cement that is an important ingredient to produce AAC blocks. A substantial volume of affordable housing will be constructed in the near future given the severe housing shortages in most states. Therefore, the impact of this transition needs to be gauged with a view to reduce the resource footprints and clean the housing sector. To understand this, CSE has prepared a carbon impact framework for the housing sector (see *Figure 5: Carbon impact framework for the housing sector*).

Under the framework, the three stages of pre-construction, construction and post-construction have been considered to assess building emissions in the current and future—when the transition to alternative materials and construction technologies would have taken place—affordable housing sector. In the pre-construction stage, embodied energy related to materials, their mining, processing, transportation, etc., must be calculated. During the construction stage, transition to alternative technologies translates to use of machinery and equipment such as fixed or moveable cranes, aluminium or

Figure 5: Carbon impact framework for the housing sector



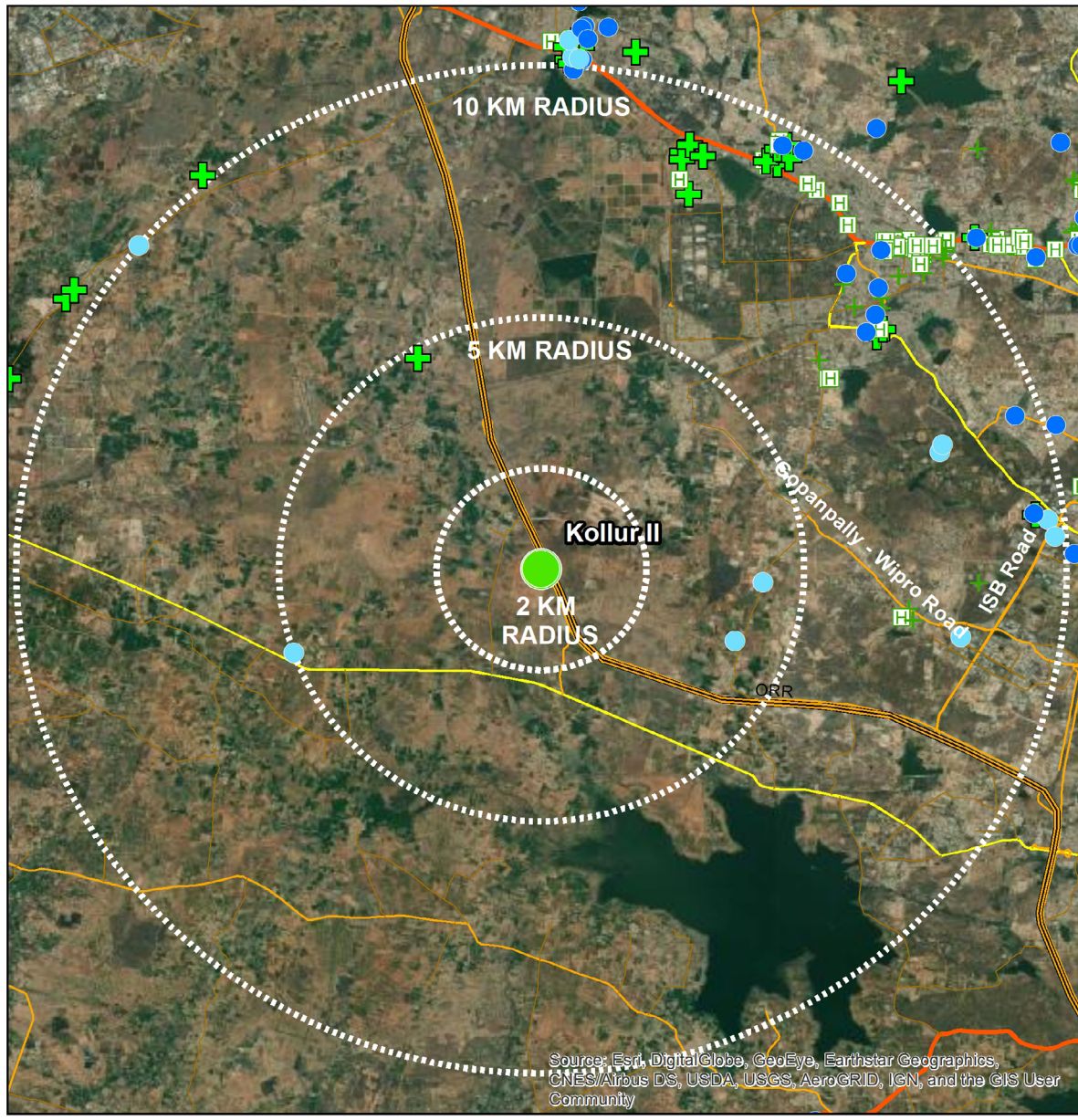
Source: CSE research

plastic formwork; reduced project period due to fast-paced construction; and consequent changes in emissions as compared to the conventional construction sector. The third stage is the occupancy stage and involves the operational energy demand in buildings due to cooling, lighting and other appliances and related emissions. CSE is investigating this in Telangana, based on the affordable housing shortage placed by the state, and preparing building energy roadmaps. Three scenarios have been assumed to determine their sources and emissions footprints in the sector—per capita floor area of 8 sq m, 10 sq m and 12 sq m. The three scenarios translate into a need to construct around 133 million sq m, 167 million sq m and 200 million sq m respectively by 2034. Similarly, area footprints need to be determined for different states to determine the energy footprints and related emissions in the affordable housing sector.

Apart from building energy emissions, the framework also includes assessment and comparison of emissions from common services such as water and wastewater management when they are centralized vs when they are decentralized. The impact of location of affordable housing translates to transportation needs and affects emissions as well.

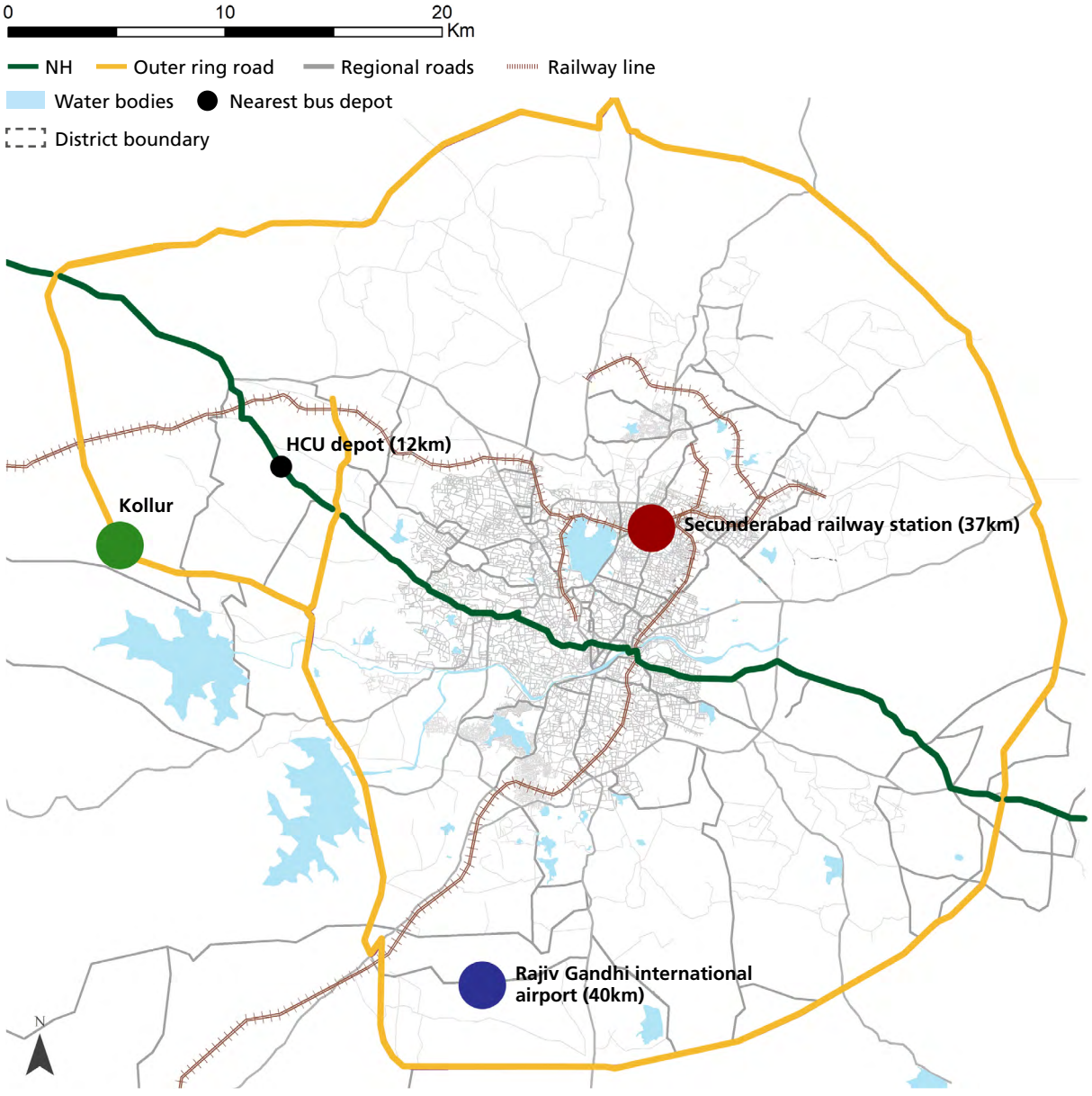
CSE is investigating access to basic services and infrastructure, including other location-related attributes of affordable housing in states (see *Map 1: Proximity analysis of essential services for the affordable housing project at Kollur, Hyderabad* and *Map 2: Connectivity analysis of the affordable housing project at Kollur, Hyderabad*). These analyses will ascertain the efficiency and the cost implication to beneficiaries associated with service distribution at new affordable housing sites. The analyses and results will be a part of affordable housing guidelines that will be published soon.

Map 1: Proximity analysis of essential services at the affordable housing project at Kollur, Hyderabad



Source: CSE research

Map 2: Connectivity analysis of the affordable housing project at Kollur, Hyderabad



Source: CSE researcl

Comprehensive carbon impacts of new affordable housing need to be evaluated in detail. Here these issues have been highlighted in context to indicate that support for the sector will have to include a much wider set of indicators to reduce footprints of development and improve usability at affordable costs. Fiscal strategies will have to account for this.

4. NEXT STEPS

History has evidence that crisis brings reason and opportunity to change. The disruption due to the current pandemic is an opportunity to reinvent. The affordable housing sector has always faced affordability and liveability challenges and the COVID-19 pandemic has further exposed the gaps in the current strategies in mitigating these challenges. Fiscal strategy for the sector needs rebooting and ample rethinking. The current disruption due to the pandemic is an opportunity that that must not be lost.

Need improved criteria for assessing affordability and establishing affordable housing price-to-income ratios in cities in the post COVID-19 scenario: Establish clear criteria for assessing affordability. The recent migrant labour crisis due to the pandemic-induced lockdown was more evident in the national capital and big metropolitan cities. Interestingly, the same cities have the widest housing affordability gaps. For instance, Mumbai has the highest price-to-income ratio among cities globally. The government needs to build data repositories to understand the nature and limits of housing affordability of the economically vulnerable population. At present, the vulnerable are hardly represented in databanks. Proper documentation of household incomes and expenditures, and market prices at the city level (across classes) is necessary.

Need strategies to minimize cost of improving thermal comfort and new construction technologies to the beneficiaries: This will require collating data and conducting research on how past affordable housing schemes performed with regard to inclusivity, accessibility, thermal comfort (energy prudence), resource efficiency and environmental sustainability. The learning curve from this gap analysis must be internalized in the larger housing strategy, while focusing on performance and economic incentives. Our analysis shows that despite the availability of low-interest loans, the share of non-performing assets is high in the lower lending bracket. A fiscal strategy is needed to mitigate the incremental costs of new technologies and materials, and adoption of the thermal comfort approach for beneficiaries. Three parties are involved in the final sale and purchase of affordable housing: developers, beneficiary and lenders or banks. The developers bear the enhanced cost of construction due to new material and thermal comfort requirements. For the banks, there is a cost of funds and intermediation charges that are normally passed on to the borrowers. Developers and lenders need to recover costs. These lending costs are built into the construction cost of the developers, whether they have raised funds independently or from bank. Ultimately, the price charged to the beneficiaries includes all costs.

It has been observed that under CLSS, the percentage of non-performing assets is high for loans upto Rs 2 lakh. This implies that lending to this segment is

not profitable for the banks. State intervention can compensate the losses that banks incur in lending to low-income groups. A suitable fiscal policy is needed to absorb the extra cost of housing either through an interest subvention scheme or direct cash assistance to absorb the losses arising from non-performing assets in the affordable housing sector. It is important that the beneficiaries, whose housing needs are urgent, are not denied access to housing due to the extra costs of providing thermal comfort.

Shift policy focus from only constructing the housing stock to green performance and lowering of operational cost burden for beneficiaries: This sector is vulnerable to low demand and liquidity, stuck capital, and uncertainties around the availability and costs of material and labour during this period. The government is promoting alternative materials and construction technologies, but without adequate research into their suitability from a thermal comfort standpoint. Several incentives such as extra FAR, FSI and TDR and tax holidays are being provided to the sector but in an uninformed manner. Built structures without regulations on performance can add to the operational cost burden for the beneficiaries in terms of increased requirement of annual operational hours of cooling and increased costs due to poor liveability and serviceability. Performance safeguards are needed in affordable housing planning and construction.

A number of incentives are already available to developers. Linking these with performance regulations is necessary. Information on performance of materials, and operational performance for thermal comfort and energy efficiency need to be prioritized, with stringent specifications to avail economic incentives. Existing regulatory frameworks such as Environmental Impact Assessment (EIA), building bye-laws and PPP models or procurement guidelines for affordable housing need to incorporate these performance indicators and instill healthy competition among developers based on green performance of affordable housing.

Guide the housing sector on alternative material and construction technologies: PMAY–U aims to achieve the affordable housing target to provide housing for all by 2022. Detailed evaluation of new material and walling assembly techniques from the standpoint of thermal comfort by Building Material and Technology Promotion Council (BMTPC) is urgently needed. This needs to be linked with fiscal incentives.With a handful of players, there is ample scope to understand the economics and impact of these technologies. Benchmarking of cost of primary and processed materials, transportation, warehousing, design and engineering, and tax exemptions are some of the steps that can help. Deep-dive investigations at the state level can reveal critical areas that need redress to arrest cost escalation.

Need instruments of accountability and a disclosure system for availing incentives: Green housing incentives are needed for performance and accountability. Developers need to be assigned resource efficiency and sufficiency targets for every affordable housing project when seeking building permission from the government. Third party assessment and verifiable annual

disclosure of energy and other resource use during the operation of buildings needs to be made mandatory. This will ensure that targets are met during the operational phase. A certification tool may be developed for developers to track their performance, and it may be linked to future incentives like extra FAR or FSI or TDR. It is too early to say whether such a system can be used to offset additional costs. But it is not early at all to underline the importance of regulating the construction sector based on performance.

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The affordable housing sector in India has been transforming with the use of alternative materials and construction technologies. It is yet to inculcate the values of environmental and energy performance and thermal comfort for all, bogged down by a widening affordability gap, increased cost of construction and a slowing economy. COVID-19 and the resultant lockdown has added to these challenges.

But this time of adversity is also a time of opportunity—to revamp the sector substantially so that we can bring it towards 'green' performance. A robust fiscal strategy can be the game changer.

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