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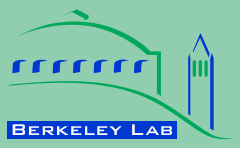

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Gauging Improvements in Urban Building Energy Policy in India

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ABSTRACT

On par with other developing countries, energy use per square meter in India's older existing commercial buildings is quite low compared to even new buildings in developed countries. This is due to low penetration rates of building equipment and appliances, as well as India's predominantly tropical climate and consequent low heating loads. However, recent growth in market demand for better thermal comfort and international-style commercial buildings and large scale residential buildings is leading to significant increases in building energy demand that will likely continue in the medium-term future. The Indian central government has made strong efforts to improve building energy efficiency in the new construction sector through several national level policies. Despite these efforts, building energy codes have only recently started becoming mandatory in eight states and implementation is going to be difficult due to a complex regulatory development structure, an historical low-priority given to building regulation, and unavailability of data. Labeling and incentive schemes for energy efficient features and products are similarly nascent due in large part to a lack of market awareness and lack of government standardization. Through a literature review and interviews, this paper gives an update regarding the expansion of India's capacity to implement building energy codes, especially as experienced in recent development efforts in Hyderabad and Gujarat states, as well as remaining implementation barriers.

Introduction

India's residential and commercial sectors consume about 45% of both total national primary and national final energy (de la Rue du Can, McNeil, & Sathaye, 2009). The residential sector accounts for more than 80% of this demand (de la Rue du Can, McNeil, & Sathaye, 2009). However, much of this energy is in the form of biomass used in residential houses for cooking and water heating; excluding biomass, buildings consume only about 15% of primary energy. Of this non-biomass primary energy, about 75% is used in the residential sector, and 25% is used in the commercial sector (de la Rue du Can, McNeil, & Sathaye, 2009). India's buildings also account for considerable proportion of grid-delivered electricity; residential and commercial buildings together account for about 35% of grid-delivered electricity consumption, with commercial buildings accounting for 8% (CEA 2009). Electricity demand growth is occurring faster than overall energy demand growth, especially in commercial buildings where electricity demand is growing at 11-12% (Kumar et al. 2010). India's total national primary energy demand is expected to grow 2.2 times over the next 15 years due in large part to sustained economic growth in urban areas and the industrial sector (de la Rue du Can, McNeil & Sathaye 2009). Others estimate primary energy demand to expand by 3 or 4 times, and electricity generation capacity by 5 or 6 times (to ~800 GW, from a current 160 GW) compared to 2003-04 (Kumar 2010). Slowing India's future energy demand growth can be achieved by constructing more efficient buildings, managing them carefully, and undertaking retrofits in existing buildings. The former of these policies is much more important than the latter; it is estimated that approximately 70% of India's building stock in 2030 will be built between now and 2030 (Kumar et al. 2010).

Three policies will be critical to mitigating building sector energy demand growth: mandatory building energy codes; consumer information about green strategies and energy efficient building labeling schemes; and economic incentives that push developers to construct more efficient new buildings and building owners and occupiers to save energy in building operations. Building energy efficiency policies and programs in India are in an active design stage with limited implementation to date. Decision-making authority at the national level is spread between several agencies and program design and implementation responsibilities are spread across a large number of state and municipal agencies, resulting in a diversity of implementation regimes and little coordination. Indeed, this diversity of regimes may be a positive development as it is increasingly apparent that local-contextualized building regulatory strategies will need development and testing before large-scale changes are realized in building energy use. The most critical step in improving the speed and scale of building energy efficiency efforts is the promulgation of national standards for building energy efficiency and the implementation of these standards through local level regulations. India's first national building energy code, the Energy Conservation in Buildings Code (ECBC), remains voluntary throughout

most of India while local-level agencies work towards implementation capacity development. This paper builds upon previous work regarding these developments by summarizing key points and providing new information gathered through literature review and interviews.

The ECBC and Local Level Implementation and Enforcement

India's Bureau of Energy Efficiency, an agency within the national-level Ministry of Power, was created by the Energy Conservation Act of 2001 (Law No. 52 of 2001), with the mandate to develop a national energy efficiency code for commercial buildings. In 2007, the BEE released the first version of the ECBC and amended it slightly in 2010 to expand its scope to include more buildings. The code now applies to buildings with connected loads over 100 kW or 120 kVA, and does not apply to multi-family buildings of three stories or fewer above grade or single family buildings (BEE 2009). The ECBC applies to both new construction as well as large-scale commercial building retrofits in which the final air-conditioned space of the building is greater than 1,000 m^2. The National Building Code, most recently revised in 2005, also contains non-mandatory guidance on energy appropriate design, usage, and practices with regards to building materials, construction technologies, and building and plumbing services.

The Energy Conservation Act states that the ECBC is mandatory nationwide, but the BEE initially did not require full implementation while staff conducts trainings and workshops and builds public support. However, in March 2011, BEE called for the mandatory implementation of the code at the local level in in eight states starting in 2012: Delhi, Maharashtra, Uttar Pradesh, Haryana, Tamil Nadu, Andhra Pradesh, Karnataka, and West Bengal (PTI, 2011). Furthermore, three other states (Rajastan, Orissa, and Gujarat) are working on drafting ECBC regulations. Indeed, many of these jurisdictions are reported to have developed draft amended codes, but these efforts may be further delayed while capacity is strengthened and stakeholders come to agreement on best implementation strategies.

ECBC code provisions apply to building envelopes; HVAC mechanical systems; hot water heating and pumping; interior and exterior lighting; and electrical power and motors. Code compliance is based both on expected energy intensity (kWh/m^2) of the building design and final construction and is not evaluated over the lifetime of the building. Compliance requires either meeting minimum thermal characteristics (u-values, r-values, etc.) for building's envelope, fenestration, HVAC and other energy-related design features, or modeling whole building performance to demonstrate the building will use less energy than a standard design for the same type of building in the same climate zone. Under the prescriptive standards approach, the builder has the option of "trade-offs" for envelope features, which allow for lower thermal efficiency in part of the envelope for better efficiency elsewhere. The whole building performance-based compliance option closely mimics Appendix G of ASHRAE 90.1-2004. In

either the prescriptive or performance methods, the building must first meet mandatory measures as well.

Implementation Process. Due to the nature of India's constitution, except in regards to national government-owned buildings, only local level governments have jurisdiction over building energy codes. Local level building regulations, called "bye laws," are the means by which private sector buildings are regulated. A multi-step process to translate the ECBC into enforceable codes is therefore a necessary prerequisite for local level enforcement.

As described in detail in Kumar, et al. (2010) the ECBC local level regulation development process begins with a national level directive calling for ECBC code implementation (Kumar et al. 2010). The Ministry of Urban Development issues a directive to lower-level bodies to begin integrating the code at the state and local level. Local-level implementation of the ECBC will occur in two phases: the writing of ECBC-compliant building codes at the local level and the enforcement of these codes. The role of central level government bodies will be limited to coordinating and monitoring these activities and supporting capacity development through pilot activities (Kumar et al. 2010).

The ECBC dictates that local-level governments have flexibility in how they implement the code (BEE 2009; Rawal 2012). Although variation exists, two bodies are primarily responsible for the local-level ECBC integration effort: state-level Urban Development Departments (UDDs) and the municipal-level Urban Local Bodies (ULBs). UDDs oversee and coordinate the activities of the many ULBs within each state (Kumar, et al. 2010). ULBs are responsible for the regulation of buildings at the town and city level through the writing and enforcement of local bye laws. A primary responsibility of the UDDs is to develop model General Development Control Regulations (GDCR), which broadly cover all aspects of building construction and require passage by the state's legislature. Once the GDCR has been passed by the state legislature, the ULBs will direct their sub-department Town Development Offices (TDOs) to incorporate the provisions of the code into the existing building bye laws. Local-level bye laws and the GDCR can have more exacting standards than national regulations, but BEE must be duly informed and accept any such changes (Evans, Shui, & Somasundaram, 2009a). Once ULB bye laws are accepted by a state ratification process, they are legally enforceable.

Enforcement. Responsibility for code enforcement falls upon the staff of TDOs, who will be responsible for "specifying permit requirements, code interpretations, approved calculated methods, worksheets, compliance forms, manufacturing literature, rights of appeal and other data to demonstrate compliance" (Kumar et al. 2010; BEE 2009). TDO staff will also have the final word on code interpretations, claims of exemption, and rights to appeal.

The project design team is responsible for submitting all construction permit application documents (BEE 2009). The code inspector is responsible for verifying that the work satisfies the code requirements both in the permit for construction and post-construction occupancy permits. Field inspectors are required to visit all building sites during construction to ensure compliance with approved designs (BEE 2009). If non-compliance or an omission is discovered during project plan review, the official may issue a corrective list and require plans and applications be revised to bring them into compliance before issuing a building permit, or stop work altogether (BEE 2009).

Ongoing Efforts to Overcome Barriers to ECBC Implementation

Several barriers to the implementation of the ECBC were outlined in Kumar et al. (2010). This section provides an update to how governments, NGOs and other parties are working to overcome some of these barriers.

Integration of ECBC into Bye Laws

As mentioned, the current major implementation challenge for the ECBC is the integration of its mandates into local building codes. As of yet, no state has promulgated ECBC compliant bye laws for private commercial buildings. However, some states have moved ahead of others on the local bye-law development trajectory: efforts to perfect drafts of ECBC compliant bye-laws are reportedly underway in the states of Rajastan and Orissa as well as the cities of Ahmedabad and Surat, Gujarat State; Bangalore, Karnataka state; and Chennai, Tamil Nadu (Das 2010; Vedala et al. 2011). Haryana state and the capital region of New Delhi have made ECBC compliance mandatory for all government buildings (Das, 2010). Due to a variety of factors, consultants and stakeholders are finding that gaining support at the local level for ECBC bye law development is more difficult process than efforts to develop the original ECBC at the national level. As will be discussed in the findings from recent efforts in Gujarat and Andhra Pradesh states below, the efforts of state level governments attest to the need to dedicate considerable resources to ensuring that new bye-laws match local workforce, administrative capacity, and market contexts.

Building Enforcement and Compliance Capacity

Enforcement of all buildings codes is difficult in India, and inspectors often lack energy code-specific skills. (Evans, Shui, & Somasundaram, 2009a; ASCI, n.d.). A World Bank study found that there is considerable staffing development work to be done as India begins to roll out the ECBC as mandatory (Liu, Meyer & Hogan 2010). Two efforts are needed to build this capacity: the development of training for local level administrators, especially inspectors, and the development of curriculum to train construction professionals in building energy issues.

***Building Enforcement Capacity*.** The Energy Conservation Act requires the BEE to arrange and organize training of personnel and specialists to comply with the Act. This has resulted in regular efforts to inform both local government officials and building sector professionals about the ECBC and its requirements. Efforts to increase awareness of the ECBC and its basic features primarily occur through the presentation of ECBC details at seminars for building professionals and local government officials (BEE 2011). The effort to develop local level enforcement capacity will likely require significant and concerted action by the national government into the medium term future. India is home to over 3,000 ULBs across its 27 states and 1 territory. Until 1992, states were the only sub-national political units recognized by India's national parliament. Significant regulatory responsibility was newly invested in these bodies in the 1992 74th Amendment to India's constitution, which invested ULBs with many new regulatory responsibilities, including the regulation of buildings. For the next decade the development of local level governments and regulatory regimes was significantly hindered by a lack of clarity regarding the distribution of tax revenues from the state to the ULBs, the organization of ULB committees and the slow pace in the adoption of new regulations and policies (NIUA 2005).

Although these challenges persist today, under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), launched in 2005, the national government and its ministries have dedicated substantial resources to improving the economic and social infrastructure of cities. These efforts are expected to be continued and strengthened in the coming period under the 12th Five Year Plan, especially through the construction of new government training centers and programs focused on training ULB staff on urban management, project development implementation and management, and regulatory operations (Planning Commission 2011). However, training is expected to occur in regional centers away from home municipalities and whether ECBC training will be incorporated into these efforts is still uncertain. Furthermore, if local level bye-laws differ substantially from ECBC strictures, it may be difficult to efficiently incorporate meaningful ECBC enforcement training into this program.

As discussed below, a national level effort is underway to develop building sciences curriculum in key universities. This effort is, however, unlikely to assist with the development of local level enforcement capacity. A newly graduated engineer's will likely look for higher-paying private sector opportunities in India's high-speed growth economy than lower-paying jobs in the public sector, and it is still uncertain as to whether programs targeted at higher education will influence the skills capacity of lower-paid local level public sector building inspectors and clerks. Another route, increasingly used in the United States and Europe and under research in India, is to outsource code compliance verification work to third parties (Vaidya 2012). To a certain extent, the third party inspection model is already in operation in India, as both LEED and the

Green Rating for Integrated Habitat Assessment (a domestically-developed building labeling program) essentially require compliance with BEE and both programs have established protocols for certifying inspection parties.

A good model for inspector training and certification already exists in BEE's industrial efficiency programs. BEE has established a national energy efficiency auditor and manager training, examination, and certification system for designated large-scale energy efficiency consumers. This system complies with Energy Conservation Act mandates that large energy users employ energy audit and manager professions within their organizations. A regularly scheduled national examination has been held for several years and continues to improve. Over 3000 professionals have been made certified energy managers and auditors under this program.

***Developing Compliance Capacity Though Building Professional Training*.** Similar to the lack of inspector officials, India lacks a sufficiently large cohort of building professionals trained in energy use issues and building energy simulation (Manu et al. 2010). Indeed, 82% of the construction trades workforce has no formal skills at all (Manu et al. 2010). BEE and international partners from U.S. AID have developed two tools to help both builders and officials more easily determine ECBC compliance. U.S. AID developed a web-based compliance check software called the ECOnirman Tool to clarify the requirements of the prescriptive compliance methodology (U.S. AID India 2011). In addition, the U.S. AID team also developed and released a web-based whole building performance simulation tool in 2011 (Kumar 2011). The tool generates a report on the expected energy use of the designed building, which may be used to document compliance with the whole building method. Mid-career professional training programs and specialized courses in academic institutions will need to expand in the future to ameliorate these inadequacies. The development of these programs is already underway: the National Institute for Advanced Studies in Architecture had been created to strategize the development of a new advanced curriculum for India's 140 architectural schools (Manu, et al., 2010). Education curriculum enhancement began in 2007 within 18 institutions after a survey of architectural schools. The curriculum development program is currently being expanded to include 40 architectural and engineering colleges and curriculum development efforts have first concentrated on the development of building energy sciences courses focussed on energy modeling, with the goal being the eventual development of course in integrated design.

***Enhancing Construction Materials Certification Capacity*.** Neither government nor third-party testing laboratories are currently capable of certifying all the products and equipment necessary to comply with the ECBC's prescriptive compliance methodology (Kumar, et al., 2010). BEE's energy efficiency appliances program certification system is likely to be used as a

template for moving forward in certifying construction products (Kumar, Kapoor, Rawal, Seth, & Walia, 2010). In partnership with the Glazing Society of India and with funding from the national and state government, the Center for Environmental Planning and Technology (CEPT, a university) has recently acquired capabilities to characterize almost all building materials for their energy performance at the newly established Centre for Sustainable Environment and Energy, a national Regional Energy Efficiency Center (REEC) for Buildings and currently applying to the National Accreditation Board for Laboratories for its accreditation (Rawal 2012).

Providing Better Incentives for Enforcement

Full enforcement of building codes in India is "almost non-existent" and "in practice, many builders end up not obtaining the occupancy permit" (Vaidya et al. 2010; Liu, Meyer, & Hogan, 2010). Rather, when local officials review construction plans, they are often checked for compliance with only a few local bye laws, such as set-backs and permissible build-up heights (Vaidya et al. 2010). Buildings in the center of political power, the National Capital Territory of New Delhi, comply with building codes less than 35% of the time (WB & IFC, 2009).

This may not be only due to the need for regulator skill development. One reason for low code compliance rates may be the long wait times and multiple permitting processes for construction projects. These can differ substantially between jurisdictions and can take as long as 224 days (WB & IFC, 2009). The lack of code enforcement also appears to be at least partially due to the multiple public and private side opportunities for corruption (KPMG 2011).

This problem of aligning enforcement incentives may be partially cured by efforts to increase transparency and reduce the complications of permit application and review. Several jurisdictions have implemented electronic filing for building permit applications and many allow online tracking of permits (D'Souza 2011). Construction permit review and issuance has been consolidated into a singular agency in several major cities to reduce permit wait times (D'Souza 2011). Some jurisdictions are also instituting time limits on construction permit review. The concentration of building permit authority into a single agency may increase the efficiency of training activities and the ability to track permits online and time-limit regulations may reduce the incentives to skip critical permit reviews. A critical issue may be increasing the penalties for non-compliant official and permit applicants. Efforts at the national level to develop such penalties are ongoing but may not fully align incentives (Raja & Datta 2011).

Further Developing the National Building Database

The lack of coordination of building energy use data collection efforts is a large obstacle in developing best-fit policies and implementation strategies. To ameliorate this problem and

assist in the development of benchmark building energy use standards, an in-depth national survey of 760 commercial buildings was undertaken between 2008 and 2010, measuring 5 types of commercial buildings in major and medium sized cities in India's five major climate zones (Kumar et al. 2010). The data set has been used to establish benchmarks for building energy use given use type, physical, operational and locational characteristics and these are being integrated into a government-supported national building energy rating scheme (Vaidya et al. 2010). Eefforts are ongoing to develop a new survey to improve the database in the near term future. In addition, the database has been used to develop a web-based building energy performance benchmarking tool called EcoBench. EcoBench uses an online interface to benchmark the expected performance of a user-defined commercial building project against buildings in the database (U.S. AID India 2011). The user can compare their own building parameters (including operation schedule, occupancy, area, percentage air conditioning, etc.) against the average and gain insight into how to improve the building's performance.

Keeping Momentum Going

The energy efficiency policy space in India will have to adjust to the recent exit of a critical information resource and driver of collective action. Since 2000, the cooperative efforts of India's central ministries with the U.S.AID's Energy Conservation and Commercialization (ECO) projects have been an important source of building energy efficiency program funds, strategy development assistance, and information to governments and private buildings sector professionals in India. The work of the ECO-III project came to a close in September 2011. Of course, the Indian government has for many years concentrated considerable energy into developing its many energy efficiency policies and the ECO efforts should be understood as one piece of this effort (Balanchandra et al. 2010). Furthermore, a multitude of other critical players exist: including the Energy and Resources Institute, Shakti Foundation, the India Green Building Council, and many others. The activities of the ECO program and these others helped formed a connective tissue between India's building efficiency communities which cannot be easily quantified but nevertheless deserves to be appreciated and strengthened. Such connective tissue will be vital to sustaining the ECBC rollout effort and sharing best practices amongst states.

Two Cities Moving Forward with ECBC Implementation

The effort to develop building energy codes at the local level is the most important obstacle facing building energy efficiency efforts in India. Although several states are purported to be developing ECBC compliant bye-laws, there is little public documentation of these accomplishments. The bye-law development trajectories of two cities, Hyderabad, Andhra

Pradesh state, and Ahmedabad, Gujarat state, are instructive as to the considerable needs and lead times of even advanced cities in developing local bye-laws.

Hyderabad, Andhra Pradesh: The Importance of Partnerships

Hyderabad is India's fourth largest city by population and a center of the domestic IT industry, the outsourcing of IT services by multi-national corporations, and the domestic pharmaceuticals industry (Vedala et al. 2011). The rapidly developing economy has induced high speed growth in the real estate market, which grew by more than 250% between 2005 and 2010 (Vedala et al. 2011). This real estate expansion is driving energy consumption in the city beyond levels that are considered sustainable over the long term. The construction sector in the city, especially in the new high-tech industries districts, is relatively concentrated and the existence of many energy-conscious private corporations and local and international NGOs working in the city has helped to push the local government towards energy efficiency in buildings through concerted efforts to gather these stakeholders together and discuss implementation possibilities.

Andhra Pradesh state has issued a notification that ULBs will have to incorporate the ECBC into local bye-laws. Hyderabad has formed a steering committee to construct draft bye-laws, develop software which incorporates other local codes, and to undertake administrative capacity development. In particular, in comparison to the efforts in Gujarat, the Hyderabad steering committee is aiming at integrating the entire ECBC into the city's bye-laws.

Hyderabad's efforts to reduce building energy intensity are note-worthy because they appear to be in part driven by Hyderabad's real estate market conditions and the past efforts of progressive city leaders. In particular, the city is home to the India Green Building Council, the developers of India's local LEED-based building labeling program and other energy efficiency labeling programs. Hyderabad is also home to the IGBC's Godrej Business Center, India's first LEED Platinum certified building and an important and high-visibility pilot study on the potential for high-efficiency buildings. Recent conferences on building energy efficiency and ECBC bye-law development efforts have been greatly support by the local chapter of the national Confederation of Real Estate Developers' Associations of India (CREDAI) (Khosla 2011). The effort is also benefiting from the involvement of other important stakeholders, such as the Administrative Staff College of India (ASCI), a policy and program delivery training institute for national, state and ULB-level officials in India. Another local university partner is the nationally-acclaimed engineering university, the International Institute of Information Technology, Hyderabad (IIT), which is helping with the technical details of code development.

The history of code development efforts in Hyderabad also appear to be important to the current ECBC bye-law development effort. These efforts come after a process undertaken in the

10th Five Year Plan period to consolidate and rationalize the many different bye-laws developed under different authorities by several different town planning agencies in Hyderabad (ASCI n.d.). The result of this effort, the promulgation of a more universally applicable set of bye-laws for the Municipal Corporation of Hyderabad, has been acclaimed as a significant step in reducing private-side uncertainty and confusion and minimizing opportunities for corruption "likely to arise due to the multiplicity of permissions required from different authorities" (ASCI n.d.) In addition, these efforts build on top of high level efforts regarding green buildings in Hyderabad. Between 2007 and 2009 the city and the Indian think tank, The Energy and Resources Institute, developed a city-based Environmental Building Regulations and Guidelines (EBRG) (TERI 2009). Released in 2009, these voluntary advisory guidelines give information on how to integrate energy efficiency, ecologically integrated site planning, water management and resource conservation, and waste management into new residential and commercial construction.

Ahmedabad, Gujarat: An Incrementalist Approach

Ahmedabad, Gujarat, is India's fifth largest city and one of its fastest growing. The city is also the home of the Center for Environmental Planning and Technology (CEPT), which is the location of the BEE-sponsored Centre for Sustainable Environment and Energy (CSEE) (U.S. AID, n.d.). Academics at the CEPT and domestic and international consultants are working on designing and constructing a net zero-energy building to house the REEC and several research activities have already taken place, including energy simulation training, building energy performance studies, and thermal comfort studies. Of particular note, the real estate market is not as concentrated in Gujarat as it is in Hyderabad and efforts to development partnerships with local industry have not progressed as far as here as they have in have in Hyderabad. Advocates feel that attempting the integrate the ECBC fully into local bye-laws from the beginning will encounter a certain degree of resistance from local developers and in any case may be overly ambitious considering the city's regulatory capacity. Unlike the efforts of Hyderabad which are pushing for the full integration of the ECBC in the city's bye-laws, CEPT researchers are pursuing partial implementation of ECBC in local bye-laws (Rawal 2011). This draft policy, currently under review at the state level, targets the immediate mandatory integration only of building efficiency measures which can be evaluated by typical visual inspections, such as shell and fenestration measures. If passed, these bye-laws will allow cities in Gujarat to experiment with this partial implementation scheme while capacity for whole-building compliance testing can be perfected and training can be undertaken for local building administrators. The effort to first integrate the more easily implemented portions of the ECBC in Ahmedabad represent the important development of a strategy more in line with local capacity.

Conclusions

Local ECBC-compliant regulatory development efforts are starting in force and the efforts of early developers of ECBC compliant bye laws should be tracked by future research. The early experiences of places like Hyderabad and Gujarat states will be essential in crafting new building energy efficiency policies and programs. Although neither of these efforts can yet be labeled as successes, the development of these two very different ECBC compliance strategies is likely to be instructive of the variant needs and limitations of local governments in India. Several states are purported to have already developed ECBC compliant bye-law drafts, but there is little public documentation of these accomplishments and these local regulatory development efforts are undoubtedly struggling against the many obstacles indicated here. Overcoming these barriers will rely upon incrementally developing enforcement and compliance capacity while increasing market demand drives costs down. The JNURRM in the 12th Five Year Plan presents a significant opportunity to concentrate resources on local official training.

Acknowledgements

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