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***OUTCOME-BASED CODES* SUMMARY**

The building sector represents one of the largest consumers of energy in the US, accounting for over 40% of annual US energy consumption. Recent policy directives have targeted aggressive building energy performance improvements over the next 20 years. Energy codes represent a tool to significantly reduce building-sector energy use, and this has led to a much accelerated pace of code stringency increases. However, it is becoming clear that current energy codes include a number of structural and enforcement characteristics that may significantly limit the ability to continue to develop significantly more stringent code strategies without major shifts in the structure of energy codes.

Current energy code strategies primarily address only the physical characteristics of buildings; they do not address how the buildings use energy once they are completed. But the way the building is operated and occupied has a major impact on annual energy use, and this is an area that current codes are unable to address. And the variability of energy performance outcome once the building is completed leads to significant confusion in the market as to what exactly the code is delivering on building energy performance.

To better align building sector performance improvement over time with widely accepted policy goals and public expectations, it is necessary to move to an ***outcome-based code*** strategy, where the metric by which building performance is judged is the actual energy use of the building This approach represents a focus on real and measurable energy performance improvement., rather than on the relationship of the building energy characteristics to a theoretical code baseline building (as expressed by "percent better than code" performance claims).

Building energy use is driven by three key aspects of the building: 1) The physical characteristics of the building, including layout, materials insulation and glazing, lighting and HVAC system characteristics and efficiencies; 2) Operational characteristics of the building, including control system function, maintenance practices, system operation, and local environmental conditions; and 3) Tenant behavior including use type, schedule, occupant density and habits, and tenant-provided equipment density and use. Of these three aspects, energy codes regulate only a subset of the physical characteristics of the building. Neither operational or tenant aspects are currently within the scope of energy codes.

However, many studies have shown that operational practices and tenant behavior can have huge impacts on building energy use. Plug loads alone can impact total building energy use by 40% or more even within an office environment, depending on equipment density and use habits. As energy codes become more stringent on building physical characteristics, operational and occupant loads will become an ever-larger part of the remaining energy use in buildings. In order to achieve the levels of aggressive building performance being targeted by codes, it will be critical to address these aspects of building energy use. At the same time, as public perception of building performance issues becomes more widespread, the fact that a building can 'exceed code requirements' and still perform poorly has become a significant liability for some buildings and programs. Increasingly, market attention will be focused on measured energy use, not theoretical feature improvement.

By adopting an *outcome-based* approach to energy code regulation, operational and tenant energy use characteristics become part of the opportunity for reduced building energy use. In fact, improvements in operational practices and tenant behavior can be highly cost effective even in the absence of specific code targets.

In order to move toward *outcome-based* codes, a number of policy, data, and administration pieces must be put in place. Key steps in this process include:

Better data about actual building performance is needed
Information about how the building stock is currently performing is sparse. National data from CBECS and Portfolio Manager gives a general sense of building performance, but does not address regional and local variation well, and is limited to certain project types. A number of jurisdictions have adopted d*isclosure ordinances* which require buildings to provide current building energy performance information to interested parties in a leasing or sale transaction. In some jurisdictions, this information also becomes available to the jurisdiction itself to support informed decisions about what kind of performance local codes and design/construction/operation practices are currently delivering. More and better information about building performance must be made available to policy makers, code jurisdictions, and the market so that realistic building performance targets can be set.

Adjustable tracking/reporting tools are needed
Tools and methodologies are needed for consistent reporting of building performance information. Although better disclosure information may allow jurisdictions to set building performance targets, these targets must account for typical variation in schedule, use, occupant density, and other factors associated with individual building use patterns. Just as EPA Portfolio Manager accounts for plug loads, climate, and schedule by building, any effort to adopt *outcome-based codes* must be able to adapt to individual variation in how a building is used while still reporting a common metric that can be compared among buildings.

Commitment and enforcement mechanisms
Current code enforcement strategies generally end at the time of building completion (certificate of occupancy). In order to extend code scope into the operational life of the building, new incentives and enforcement mechanisms must be developed. These may take the form of performance bonds, annual inspections, utility rate accelerators, or other strategies. Unlike current code strategies, the application of these enforcement mechanisms would need to occur after the building has been occupied and operational for at least a year or more.

Metering capabilities
To manage operational energy use effectively, building operators and tenants must have access to good information about how the building is performing on an on-going basis. This implies that various feedback and submetering capabilities must be integrated into the building design to enable real-time performance monitoring and response. Although many detailed monitoring systems are available, even simple performance feedback tools are adequate for most building monitoring.

Summary
Long-term building performance improvement goals cannot be met without directly addressing building operational energy use. *Outcome-based codes* represent a policy tool to generate long term improvement in building energy use. Properly developed, outcome-based codes can lead to significantly better building performance, increased flexibility for existing building upgrades, better market perception of building performance, and more innovative new building design strategies. The industry and policy must move toward measuring actual outcomes on building energy performance.

GUIDING PRINCIPLES FOR CODE IMPROVEMENT

A series of guiding principles have been identified that help define the context of how the evolution of energy codes might be considered. These principles come up repeatedly in discussions about code upgrade opportunities and barriers:

- The scope of energy codes (regulated aspects of buildings) needs to expand to account for energy-consuming aspects of buildings that are not currently regulated.

- Buildings need to be both built and operated well for maximum performance. Energy codes need to expand to address operational capabilities of buildings, as well as the component efficiencies currently regulated by codes.

- From a policy standpoint, the goals of energy code improvements need to be calibrated to actual performance outcome. This requires better data on how well current codes are performing across the building stock and a process in place to collect building performance information on an ongoing basis as part of each code upgrade. This will allow energy code upgrades to align better with policy goals.

- Codes need to become outcome-based to achieve the long term policy goals now in place for the building stock. Outcome-based codes will continue to include prescriptive components but will be structured to provide more flexibility for design innovation to meet performance targets.

- Codes must require feedback and performance monitoring capabilities in buildings that allow operators and occupants to effectively understand and manage their role in building energy use. Metering and real-time data collection capabilities can provide this kind of information.

- The transition to outcome-based codes will occur along a continuum, not all at once. Several interim steps have been identified to move code language and enforcement processes toward an outcome basis. As a starting point, codes should immediately begin to require the capability of projects to collect actual energy performance data. Projects submitted using a performance path should be required to calibrate actual performance to predicted performance during the operational phase.

- Current enforcement structures will need to be modified to incorporate a focus on longer-term building performance. The code enforcement process cannot end at the time of initial building completion. New enforcement mechanisms may take the form of annual inspection policies, varying utility rate structures or other financial incentives/penalties, rather than/in addition to the permit-based enforcement currently practiced. Incentive policies should dovetail with code enforcement processes to leverage market forces to encourage projects to meet or exceed code requirements.

- There is still room to improve the performance of energy codes within current code structure, and these opportunities should continue to be pursued.

- There is a recognition that upgrades to existing buildings need to be effectively addressed by code improvement goals, but that they need to be treated differently than new construction. A performance-based outcome may serve this need well.

- Reach codes should be adopted to provide predictability to the market on where energy codes are headed in the next cycle.