Energy Building Regulations: The Effect of the Federal Performance Standards on Building Code Administration and the Conservation of Energy in New Buildings

This comment explores the changes in the administration and enforcement of building regulations which will be engendered by the proposed federal energy building standards. Additionally, it evaluates the effectiveness of the proposed standards in achieving the congressional goal of the greatest practicable energy savings in new construction.

INTRODUCTION

To prevent a severe shortfall in energy supplies, Congress passed the Energy Conservation Standards for New Building Act of 1976[1] (hereafter referred to as the Building Energy Standards Act). This statute requires the development and implementation of energy conservation building standards to improve the thermal efficiency of all new buildings in the nation.[2] On November 14, 1979, the Department of Energy (DOE) released proposed energy conservation standards for new buildings.[3] Application of these standards to the design of new buildings will significantly affect the nation's energy demands, and will provide an opportunity to demonstrate a national commitment to conserving the world's remaining energy resources.

Reduction of energy consumption in buildings has the unique virtue of causing little human discomfort or change in habits, while making a significant contribution to the conservation of energy.[4] Approximately one-third of the energy used in the

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[1] Energy Conservation Standards for New Buildings Act of 1976, Pub. L. No. 94-385, 90 Stat. 1144 (codified at 42 U.S.C. §§ 6831, 6831 to 6840 (1977)).

[2] *Id.* § 6831.

[3] Department of Energy, Energy Performance Standards for New Buildings, Proposed Rule, 44 Fed. Reg. 68,120 (1979) (proposed to be codified in 10 C.F.R. § 435) [hereinafter cited as Proposed Rule].

[4] R. STOBAUGH & D. YERGIN, ENERGY FUTURE 216-27 (1979). The authors conclude that the nation has two choices: to import more oil or to accelerate the development of conservation and solar energy. Based upon extensive economic

United States is consumed in the operation of commercial and residential buildings.[5] Buildings designed to conserve energy may save fifty percent of the energy currently required for heating, cooling and lighting comparable buildings constructed to meet present building codes.[6]

To realize the energy savings possible with energy efficient building design, local and state governments have invoked their police powers to initiate energy conservation building codes.[7] The variations among energy-related building standards and the overlapping of jurisdiction among enforcement agencies have, however, caused confusion among architects, builders and code ad-

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studies, they conclude that "the nation would be better served by concentrating its exploratory and development drilling in the partially proven acreage of conservation, and the promising but still largely untested acreage of solar." Conservation could supply up to 40% of America's current energy use. Id. at 11. *See also* P. O'CALLAGHAN, BUILDING FOR ENERGY CONSERVATION 10 (1978).

[5] *See* FEDERAL ENERGY ADMINISTRATION, PROJECT INDEPENDENCE REPORT 164 (1974) [hereinafter cited as PROJECT INDEPENDENCE REPORT]. About 30% of all the energy consumed in the country is used to heat, cool, light and operate machines inside the buildings and homes of America. This does not include the energy used to manufacture the materials that are used in the construction of the buildings or the energy used in daily maintenance. W. CLARK, ENERGY FOR SURVIVAL, 181-82 (1975). *See also* R. STOBAUGH, & D. YERGIN, *supra* note 4, at 166. The authors provide a slightly higher figure for energy consumption in buildings, estimating that between 36% and 40% of U.S. energy consumption is used to heat, air-condition, light, and provide hot water for homes, commercial structures and factories.

[6] SAVING ENERGY IN THE HOME: PRINCETON'S EXPERIMENTS AT TWIN RIVERS 63-64, 100 (R. Socolow ed. 1978) (finding that a 67% reduction in annual energy consumption for space heating is practical with relatively simple measures); J. HAMMOND, M. HUNT, R. CRAMER, & L. NEUBAUER, A STRATEGY FOR ENERGY CONSERVATION 2 (1974) [hereinafter cited as HAMMOND & HUNT] (reporting that a 50% savings in energy for heating and cooling buildings is readily attainable at no added cost of construction); A. REITZE, ENVIRONMENTAL PLANNING: LAW OF LAND AND RESOURCES 14-2 (1974) (suggesting better building design could result in savings of energy of 35-50%); PROJECT INDEPENDENCE REPORT, *supra* note 5, at 167 (finding that 36% of the energy used in buildings could be saved without significantly changing average new house cost or the lifestyle of residents); and Department of Energy, 44 Fed. Reg. 68,120, 68,161 (1979) (suggesting that a 17% to 52% energy savings will be attainable with the new Building Energy Performance Standards (BEPS)).

[7] *See* Francis, 8 ENVT'L L. 131-71 (1977). The author discusses the use of the police power by local governments to implement energy conservation building ordinances. A set of guidelines are provided to help local governments implement energy conservation programs. *See, e.g.*, CITY OF DAVIS ORDINANCE No. 784, sec. 6-9 (1976). Currently, 34 states have enacted energy conservation codes that cover all or a part of new private construction. 44 Fed. Reg. 68,120, 68,158 (1979).

ministrators.[8] The building energy regulations developed by DOE in accordance with the Building Energy Standards Act bring uniformity to energy efficiency building standards.[9]

Under the federal program, energy budgets are established for residential buildings and sixteen categories of nonresidential buildings in seventy-eight different climate zones.[10] The energy budgets are expressed as allowable annual energy consumption in British Thermal Units (BTUs) per square foot of floor area.[11] Aside from variation in building categories and number of climate zones, the federal standards are similar in form to the California nonresidential standards which became effective in July of 1978.[12]

Since the federal and California programs are similar, the California experience in implementing energy conservation regulations is useful in evaluating the effect of the federal program on building code administration throughout the nation. In California, energy conservation building regulations have significantly altered the practices of local building departments. It appears

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[8] In Pellish, *Federal Bureaucracy has No Magic Wands for Energy Savings in Buildings*, 47 PROFESSIONAL ENGINEER 45, 46 (Sept. 1977), two independent surveys are cited which conclude that, despite overt efforts at coordination between state and local agencies, there are areas of confusion and conflict with respect to jurisdiction over and enforcement of building standards. The problem stems from the fact that too many public agencies have asserted their authority in the same field. Dr. Pellish suggests that the federal government should assist state and local governments to establish an orderly and comprehensive administrative system so that the proposed federal energy performance standards will be uniformly applied.

[9] *Id.* at 48. It is noteworthy that the purposes of the Building Energy Standards Act include the development of uniform performance standards for new residential and commercial buildings which are to be adopted by state and local governments throughout the nation. 42 U.S.C. § 6831 (1977).

[10] The proposed rule provides energy budgets for single-family detached and single-family attached residential buildings. Multiple-residential buildings and commercial buildings are divided into 16 categories according to function. *See* 44 Fed. Reg. 68120, 68167 (1979) (proposed to be codified in 10 C.F.R. § 435.04). In addition, the proposed rule outlines a procedure whereby a proposed building design located anywhere in the United States may be related to one or more of the 78 Standard Metropolitan Statistical Areas (SMSAs) for which energy budgets are provided. *See, id.* at 68,169 (proposed to be codified in 10 C.F.R. § 435.05), and *id.* at 68,170 - 68,179. *See also* text accompanying notes 54-61 *infra* for an explanation of the derivation of the energy budgets.

[11] *Id.* at 68167 (proposed to be codified in 10 C.F.R. § 435.01(i)).

[12] *See* CALIFORNIA ENERGY COMMISSION, ENERGY CONSERVATION STANDARDS FOR NEW NONRESIDENTIAL BUILDINGS; CAL. ADMIN. CODE, tit. 24, §§ T20-1451 to T20-1525 (July 26, 1978).

that promulgation of the Federal Building Energy Performance Standards (BEPS) will also have a profound impact on local building code enforcement and the functioning of local building agencies.

This comment explores the changes in the administration and enforcement of building regulations which will be engendered by the proposed BEPS program, and evaluates the effectiveness of the standards in achieving the congressional goal of the greatest practicable energy savings. The first section discusses the general considerations in developing energy conservation building regulations. It distinguishes performance and prescriptive energy conservation building standards, and explains the derivation of energy conservation regulations. The second section focuses upon the effect of the BEPS program on the administration and enforcement of building regulations. Problems with verification and practical application of the federal regulations are considered in light of the California experience in implementing performance standards. The final section compares state and federal regulations and analyzes the energy savings which may be realized from the BEPS program.[13]

I. General Considerations in Developing Building Energy Performance Standards

The impact of the BEPS program on the administration of building regulations is dependent upon the technical and procedural requirements of the performance standards. These requirements are delineated in the BEPS regulations[14] but have little meaning without considering the technical foundation and social factors applied in deriving the standards.

Development of effective standards to regulate energy use in buildings presents complex technical problems. Energy is consumed in a building for heating, lighting, cooling, domestic hot water and operation of equipment.[15] The effect of these variables on energy use will change with the design and function of a given structure.[16] In comparison with other factors, however, climate

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[13] This comment is intended to assist Department of Energy officials in implementing the energy conservation building standards, and to provide guidance to local building officials and the public in understanding the federal building energy regulations.

[14] Proposed Rule, *supra* note 3.

[15] F. Dubin & C. Long, Energy Conservation Standards for Building Design, Construction, and Operation 2 (1978).

[16] *Id.*

will have the most pronounced impact on the energy requirements of any building.[17] An equitable energy conservation building code must therefore divide jurisdictions into climate zones, and provide different standards based on climate zone and building type.

Existing building codes do not take into account climatic variables and energy use, but regulate the design and construction of buildings for the principal purpose of protecting the public health and welfare.[18] Nevertheless, Congress chose to effect conservation in buildings through existing codes.[19] Reliance on traditional building codes is based upon the presumption that it is cheaper and more convenient to use building code officials to enforce energy conservation standards than to develop an alternative enforcement mechanism.[20]

In addition to requiring implementation of federal standards through existing building codes, the Building Energy Standards Act mandates performance standards.[21] This requirement raises two fundamental issues: 1) how are performance standards distinguished from other forms of regulations, and 2) how are per-

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[17] *Id.* In climates with mild winters, the seasonal cooling load may be larger than the seasonal heating load and may consume more energy. In cold climates, heating usually consumes the most energy during the year.

[18] *See, e.g.*, INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS, UNIFORM BUILDING CODE (1979 ed.). This is a model set of regulations for the construction, enlargement, occupancy, alteraton, repair, moving, removal, demolition, conversion, equipment, use, height, area and maintenance of all buildings.

[19] The Energy Conservation Standards for New Building Act of 1976 provides that the performance standards be implemented through state and local building codes. 42 U.S.C. § 6831 (1977). As an alternative to the use of building codes, energy conservation building measures may be implemented through other programs. For example, energy efficient buildings may be encouraged with tax credits in the same way solar systems are encouraged with tax credits. California currently provides a 55% tax credit for the installation of solar systems. CAL. REV. & TAX. CODE § 23601 (West 1979). The federal government allows a 15% tax credit for the addition of insulation and other energy conservation components to existing buildings. I.R.C. § 44C. Several authorities have suggested that the tax incentive or subsidy for conservation should be linked to the cost of oil. The true cost of imported oil is perhaps three times its U.S. market price so that it would be sensible to institute an incentive payment or other form of subsidy of two thirds of the cost of implementing conservation and solar energy. R. STOBAUGH & D. YERGIN, *supra* note 4, at 227. With a two-thirds tax subsidy it is arguable that no builder could afford to forego energy efficient design.

[20] *See* H. DICKENS & A. WILSON, *"Energy Conservation and Building Regulations,"* in FIRST CANADIAN BUILDING CONGRESS, ENERGY AND BUILDINGS 202 (1977).

[21] 42 U.S.C. § 6831 (1977). *See* note 68 *infra*.

formance standards derived? A third issue, of equal concern, is: how were technical and social considerations weighed in the derivation of the proposed BEPS regulations?

A. *Prescriptive and Component Performance Regulations Distinguished*

The Building Energy Standards Act defines performance standards as energy consumption "goals to be met without specification of the methods, materials, and processes to be employed in achieving the goals."[22] Given this definition, it seems evident that Congress intended to promulgate standards which follow the form of existing building codes. Historically, building codes devised to protect the public health and safety have constrained the design of structures, but generally have not preferred particular building materials and construction techniques.[23]

Energy performance standards are usually promulgated according to floor area. Typically, an energy performance standard sets an annual energy budget per square foot of floor area for a particular type of building in a specific climate zone.[24] For example, the General Services Administration has developed performance standards for new federal office buildings which set 55,000 BTUs per square foot of floor area as a goal for maximum annual energy use.[25] A designer of a federal office building must select a desired temperature and humidity, heating system, cooling system, lighting program, occupancy schedule and insulation plan to meet the energy budget.[26] Hence, energy performance stan-

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[22] 42 U.S.C. § 6832(a) (1977).

[23] *See* Welch v. Swasey, 214 U.S. 91 (1909) (permitting the regulation of the height of buildings). *Cf.* Klingler v. Bickel, 117 Pa. 326 (1887); City of Charleston v. Reed, 27 W. Va. 681 (1886); and Baumgartner v. Hasty, 100 Ind. 575 (1884) (all three cases upholding regulations prohibiting wood buildings in fire zones).

[24] R. KNOWLES, *"Solar Energy, Building, and the Law,"* in ENERGY CONSERVATION THROUGH BUILDING DESIGN 231, 240 (D. Watson ed. 1979).

[25] Fifty-five thousand BTUs are roughly equivalent to one-half gallon of oil. Thus, the GSA standards provide for greater energy efficiency than is found in the average New York City office building which uses 3.8 gallons of oil per square foot per year. R. STEIN, *"Observations on Energy Use in Buildings"* in ENERGY CONSERVATION THROUGH BUILDING DESIGN 40-41 (D. Watson ed. 1979). Square foot standard for GSA buildings is quoted in R. STOBAUGH & D. YERGIN, *supra* note 4, at 167; and is also included in DUBIN-MINDEL-BLOOME ASSOCIATES, P.C., ENERGY CONSERVATION DESIGN GUIDELINES FOR OFFICE BUILDINGS (Jan. 1974).

[26] Brief for Petitioner at 1, Building Code Action v. Energy Resources Conservation and Development Commission, No. 9768425 (Super. Ct., Alameda

dards, like other performance standards, inform a designer how the building must function. They do not prescribe design details.

In comparison, prescriptive standards require that buildings include specific systems or design features. A prescriptive energy conservation standard specifies the amount of insulation in the walls, the size and type of windows, the ventilation system, the heating and cooling system and other elements of the building.[27] Prescriptive codes explicitly set design criteria and require specific components to save energy.

Somewhere between the extremes of the spectrum represented by performance and prescriptive standards are component performance standards.[28] A typical component performance standard, and the most widely applied energy standard in the United States, is ASHRAE 90-75, developed by the American Society of Heating, Refrigerating and Air Conditioning Engineers.[29]

ASHRAE 90-75 specifies thermal efficiency requirements for components of the building envelope—walls, roof, and floor—and requires minimum performance levels for lighting and equipment.[30] To illustrate the difference between prescriptive standards and component performance standards, a prescriptive standard might require one 10′ x 10′ window for each 400 square feet of west facing wall section, as well as R-11 insulation[31] between wall studs sixteen inches center-to-center. A component performance standard would simply specify that the west wall

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County, filed July 29, 1978) (discussing the application of the GSA 55,000 BTU annual energy budget).

[27] *Id.*

[28] In contrast to prescriptive standards which establish requirements for each element of a building, component performance standards articulate more general guidelines for each section of the structure. H. Dickens & A. Wilson, *supra* note 20, at 203.

[29] To promote uniform energy conservation codes, the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) drafted a model code known as ASHRAE 90-75. American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc., Energy Conservation in New Building Design (1975). *See* text accompanying note 8 *supra*. ASHRAE 90-75 was the first attempt to bring uniformity to the area of energy conservation building regulations.

[30] *Id.*

[31] Thermal Resistance ("R" value) is the measure of the resistance of a material or building component to the passage of heat in $\frac{°F \cdot \text{SQ. FT.}}{\text{BTU}}$. It is the inverse of the coefficient of the heat transfer, U:R = 1/r. As "R" increases, the resistance of the building component to heat flow also increases. Cal. Admin. Code. tit. 24, § T20-1402 (July 26, 1978).

must meet a thermal resistance standard of R-8, which allows the designer to select the appropriate combination of windows and wall materials.

The nation's architects have opposed both prescriptive standards and component performance standards.[32] They asserted that such criteria would stifle innovation and could be counterproductive.[33] This criticism was influential in persuading Congress to mandate performance standards.[34] Congress recognized that a costly new technology was necessary for the promulgation of performance based regulations, but decided to incur the cost because of the advantages of performance standards.[35]

B. *The Technical and Social Factors Considered in Deriving Building Energy Performance Standards*

The Department of Energy developed and established a comprehensive methodology for deriving the BEPS regulations. Proposed standards were evaluated for their conservation potential, as well as their social and economic impacts. In that federal standards consider social factors, they differ from the prescriptive and component performance standards promulgated by industry trade associations. Trade association regulations, such as ASH-

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[32] *See* R. KNOWLES, *supra* note 23, at 240; and CALIFORNIA COUNCIL OF THE AMERICAN INSTITUTE OF ARCHITECTS, ENERGY CONSERVATION PERFORMANCE STANDARDS FOR NEW NON-RESIDENTIAL BUILDINGS: A COMPREHENSIVE APPROACH 1 (1975).

[33] The American Institute of Architects (AIA) testified before Congress that strict prescriptive criteria would stifle innovation in energy efficient design and could actually be counter-productive, impeding technological change in the building industry. The AIA urged Congress to adopt performance standards. *Conservation and Efficient Use of Energy: Hearings Before a Subcomm. of the House Comm. on Government Operations*, 93d Cong., 1st Sess. 33-35 (1973) (statement of Leo A. Dailey).

[34] Letter from Nicole Gara, past Congressional Liaison for the AIA, to author (Jan. 10, 1979) (on file at U.C. DAVIS L. REV.). Ms. Gara states that the AIA lobbying efforts were instrumental in persuading Congress to adopt performance standards.

[35] The Energy Conservation Standards for New Buildings Act of 1978 directs the Secretary of the Department of Housing and Urban Development (HUD) to utilize the services of the Director of the National Bureau of Standards, the heads of other appropriate federal agencies and the National Institute of Building Services to carry out any activities which the Secretary determines may be necessary for the development of performance standards. 42 U.S.C. § 6839 (1977). *See also* text accompanying notes 103-108 *infra*. Congress authorized grants and technical aid to local jurisdictions to assist in the implementation of the BEPS program.

RAE 90-75, are consensus codes.[36] They are derived from thermal performance calculations and agreement among members of building trade associations that such standards are technically feasible and desirable.[37] While consensus codes and BEPS are based upon the same technical considerations, BEPS are unique because they are partially based upon social considerations.

The technical basis of energy conservation building regulations includes both a thermal model used to compute energy consumption and a cost-benefit analysis. A thermal model simulates the energy performance of a building in a specific climate.[38] As various energy conservation measures are proposed for a building, the thermal model projects how much energy is saved and provides the input for a cost-benefit analysis.[39] Energy thermal models are inherently inaccurate because it is not known how some mechanical systems of a building affect energy use and how the systems interact.[40] In addition, a completely accurate model would require infinite detail and would thus be impossible.[41] There are substantial differences among existing thermal models in their consideration of climatic factors and building systems. The models therefore vary considerably in their accuracy.[42]

Although the thermal model upon which energy conservation standards are based does not necessarily influence the stringency or effectiveness of the standards, it does affect the accuracy of projections of energy savings realizable from conservation measures.[43] The Department of Energy has developed a computer

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[36] H. DICKENS & A. WILSON, *supra* note 20, at 203.

[37] *Id.*

[38] F. ARUMI, *"Computer-Aided Design for Buildings,"* in ENERGY CONSERVATION THROUGH BUILDING DESIGN 142-43 (D. Watson ed. 1979).

[39] *Id.*

[40] The thermal modeling of building performance is an imprecise science because there are many unknown factors. For example, very little information is available on the effect upon a dwelling's energy consumption of variations in the engineering and design of heating systems. V. HANBY, *"Fluidic Diverter Valves Applied to Intermittent Domestic Heating,"* in ENERGY AND HOUSING, SPECIAL SUPP. TO BUILDING SCIENCE 9 (B. Jones ed. 1975). *See also* F. DUBIN & C. LONG, *supra* note 14, at 13-17. The authors provide a discussion of the problems of thermal models and the differences between the models.

[41] DEPARTMENT OF ENERGY, ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS, NOTICE OF PROPOSED RULEMAKING 33 (Draft Oct. 10, 1979) [hereinafter cited as [DRAFT] NOTICE OF PROPOSED RULEMAKING].

[42] F. DUBIN & C. LONG, *supra* note 14, at 13-17.

[43] THE CONSERVATION FOUNDATION, COMMENTS ON ADVANCE NOTICE ON PROPOSED RULEMAKING, ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS 23-25

thermal model called DOE-2 which the Department claims will simulate an actual building's energy use within a fifteen percent range of accuracy.[44] DOE-2 was used in the derivation of the federal energy performance standards, and is the required evaluation technique to verify that the energy use of a building design does not exceed the federal standards.[45]

While energy scientists use a thermal model to predict the energy savings attainable from a specific conservation measure, they use cost-benefit analysis to determine whether the energy savings will pay the cost of the conservation measure.[46] Most calculations of cost effectiveness of energy conservation measures are based upon life cycle cost analysis.[47] Life cycle cost analysis considers all costs occurring during the lifetime of an investment and compares them with the benefits.[48]

Although life cycle cost analysis is a useful tool for evaluating energy conservation measures, the answers it provides depend upon the information chosen for input into the life cycle cost formula. The selection of informational input is a policy decision.

(1979). The authors suggest that the selection of the thermal program will significantly affect the projected conservation potential of different conservation measures. They note that several of the programs considered by the Department of Energy in the development of preliminary thermal standards do not adequately account for solar gain. In addition, they suggest that the climate data fed into the computer in the development of the preliminary standards provided misleading information on the performance of buildings in many regions of the country. *See* text accompanying notes 86-92 *infra.* The initial inaccuracy in the computer model may be compounded when applied in verifying that a building design does not use more energy than allowed by the appropriate energy budget.

[44] 44 Fed. Reg. 68,120, 68,154 (1979).

[45] *Id.* at 68,152. *See* note 85 *infra.*

[46] H. MARSHALL & R. RUEGG, *"Life-cycle Costing Guide for Energy Conservation in Buildings,"* in ENERGY CONSERVATION THROUGH BUILDING DESIGN 162, 178 (D. Watson ed. 1979).

[47] This follows because the total owning and operating costs over the life of a building may greatly exceed its initial costs. *See* F. CALVERT, ENERGY UTILIZATION IN BUILDINGS: UNDERLYING PRINCIPLES FOR ANALYSIS 164-65 (1977).

[48] H. MARSHALL & R. RUEGG, *supra* note 45, at 162. In the case of buildings, a 30-year period is usually selected for the cost-benefit analysis. The life cycle cost of an energy conservation measure is the present value of the sum of the initial, replacement and maintenance costs during the 30-year period of the cost-benefit analysis. To determine the life cycle benefit of an energy conservation measure, the total dollar value of the energy savings over the 30-year period is computed and adjusted for present value. Once the life cycle costs and benefits of an energy conservation measure have been calculated, they are used to determine the cost-benefit ratio, the cost-benefit differential, and the payback period. *Id.* at 162-66.

For instance, the value selected for the cost of energy dramatically affects the results of life cycle cost analysis. Should energy's marginal cost be used rather than its average cost, much more stringent conservation measures become cost effective.[49] In some respects, selection of the marginal cost makes sense since the energy saved in new buildings is newly generated energy which is produced at the marginal cost. Yet from the point of view of the new building owner, who pays only the average cost of energy, the more stringent measures based upon marginal cost are not cost effective.[50]

The Department of Energy has taken into account social considerations as well as technical considerations in the derivation of the BEPS regulations. Social considerations are reflected in the setting of energy budgets and the perspective adopted toward cost effectiveness. Conservation measures which may be extremely cost effective from the viewpoint of the nation, may be burdensome to individuals. For example, reducing America's dependence on unstable supplies of foreign oil holds enormous benefit for society; however, it may price an individual out of a home if it is included as a factor in setting energy conservation building standards.

Initially, the Department of Energy intended to consider noncost factors in the cost-benefit analysis through use of a resource impact factor.[51] The Department subsequently abandoned the resource impact concept in the development of the Building Energy Performance Standards because DOE found it too complicated to be practical.[52] Nevertheless, the Department developed an alternative approach using economically based weights which

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[49] Marginal cost of energy is simply the cost of developing new energy. For example, a new coal-fired power plant may produce electricity which costs eight cents per Kilowatt Hour (KWH), compared to older hydroelectric power which generates electricity at one cent per KWH. The average cost of energy is the mean price of the power produced by all old and new sources within the utility network.

[50] *See* Brief for Respondent at 4, Building Code Action v. Energy Resources Conservation and Development Commission, No. 84-65 (Super. Ct., Marin County, filed Feb. 1978). The California Energy Commission argued that a liberal interpretation of cost effectiveness would permit the Commission to evaluate societal costs of energy procurement and would also allow consideration of the massive investment costs in new generation facilities (marginal cost).

[51] DEPARTMENT OF ENERGY, ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS, ADVANCE NOTICE OF PROPOSED RULEMAKING AND NOTICE OF PUBLIC MEETINGS, 14, 16-18 (Nov. 1978).

[52] 44 Fed. Reg. 68,120, 68,137 (1979).

are intended to take into account the true costs to the nation of using fuels such as oil.[53]

C. Derivation of the Federal Standards and the Requirements of the BEPS Regulations

The Department of Energy performance standards for single family residential dwellings are derived from life cycle cost analysis.[54] The Department selected the minimum point on the life cycle cost curve (the life cycle cost optimum) as the basis for the residential budgets.[55] Although the Department acknowledged that there is evidence that tighter budgets may be economically feasible, it rejected more stringent standards.[56] The reasons included the policy consideration that stricter budgets would create an even greater increase in first building costs, further intensifying the present slowdown in the residential construction market.[57]

In contrast to the residential standards, the nonresidential standards are only indirectly based upon life cycle cost analysis.[58] Instead, the Department used a statistical approach. It conducted a nationwide survey of the design and energy use of different types of commercial buildings.[59] Subsequently, a team of architects redesigned a statistical sample of these buildings to maximize the conservation of energy.[60] The Department of Energy applied life cycle cost analysis to the redesigned buildings, and

[53] *Id.* at 68,137-38.

[54] *Id.* at 68,148-49.

[55] *Id.* Note that DOE acknowledges that there is considerable uncertainty regarding the precise identification of the life cycle cost minimum. The minimum life cycle cost is more a range than a single point on the life cycle cost curve. At the life cycle cost optimum the life cycle curve is flat since there are many different designs which will be optimal in terms of life cycle cost analysis. Some designs will use more energy and some less. To insure the standards are effective, the Consumer Energy Council of America suggests that it may be proper to set the energy budget standards slightly below the life cycle optimum point. *See* CONSUMER ENERGY COUNCIL OF AMERICA, BUILDING ENERGY PERFORMANCE STANDARDS, A PRIMER ON THE DEPARTMENT OF ENERGY'S NEW CONSERVATION INITIATIVE 41-42 (1979). *See also* note 48 *supra*, for a discussion of life cycle cost analysis.

[56] [DRAFT] NOTICE OF PROPOSED RULEMAKING, *supra* note 41, at 63. *See also* 44 Fed. Reg. 68,120, 68,149 (1979).

[57] [DRAFT] NOTICE OF PROPOSED RULEMAKING, *supra* note 41, at 65. *See also* 44 Fed. Reg. 68,120, 68,149 (1979).

[58] 44 Fed. Reg. 68,120, 68,146-47 (1979).

[59] *Id.* at 68,128-29.

[60] *Id.* at 68,129.

set energy performance standards proportionate to the energy use of the redesigned buildings.[61]

The Department of Energy expresses these residential and nonresidential performance standards as "design energy budgets."[62] Such budgets vary according to category of building and climate zone.[63] To enforce the standards, the Department of Energy has established regulations which require that a building's "design energy consumption," which is the estimated annual energy consumption of that building determined from its design, not exceed its "design energy budget."[64] Application of the "design energy budget" to a specific building design requires a method of verifying that the building will not use more energy than prescribed in its "design energy budget."[65] Developing reliable methods of verifying compliance with the federal standards is thus a major impediment to the successful implementation of the BEPS program. The problems of verification and enforcement of the BEPS regulations is the next subject of inquiry. To this end, an examination of California's experience with a similar program is useful in projecting the potential successes and failures of the BEPS program.[66]

II. Administration of Building Energy Performance Standards

California's experience in implementing energy conservation building regulations indicates that such energy standards engender a concentration of building code administration. This concentration of administrative functions runs counter to the policy espoused by Congress in enacting the Building Energy Standards Act. Congress proposed that state and local governments should

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[61] *Id.* at 68,146-48.

[62] Energy budgets are promulgated in terms of allowable annual energy consumption in BTUs per square foot of floor area. *Id.* at 68,167 (proposed to be codified in 10 C.F.R. § 435.02).

[63] Energy budgets are provided for residential buildings, as well as for 16 categories of nonresidential buildings in 78 different climate zones. The climate zones are identical to Standard Metropolitan Statistical Areas (SMSAs). *Id.* at 68,167-68 (proposed to be codified in 10 C.F.R. §§ 435.02, 435.04).

[64] *Id.* (proposed to be codified in 10 C.F.R. §§ 435.02, 435.03).

[65] *Id.* at 68,151.

[66] *See* text accompanying notes 84-110 *infra* for a discussion of the potential for failure in the administration of BEPS. *See also* text accompanying note 129 *infra* for a discussion of the successful development of federal residential energy standards.

adopt and enforce the federal standards through existing building codes.[67] Congress preferred that local government agencies, which issue building permits, implement the energy standards.[68] In view of the complexity of verification and enforcement of the BEPS regulations, it appears that the federal program, like the California program, will cause a concentration of administrative duties and remove code enforcement from the hands of local government.

In addition to the centralization of administrative functions, California found that performance standards are impractical. After almost two years of experience with energy conservation building regulations, the State found prescriptive standards to be a more workable means of conserving energy in new buildings.[69] Although prescriptive standards are more easily understood than performance standards, they still lead to centralization of the administration of energy regulations. The Department of Energy recognizes that there will be enormous problems with local verification and enforcement of the BEPS regulations and is exploring simple prescriptive methods of compliance.[70]

A. *The California Experience: Centralization of the Administration of Energy Conservation Standards.*

On July 1, 1978, California implemented energy conservation regulations for new nonresidential buildings.[71] The California Energy Commission promulgated a prescriptive approach similar to ASHRAE 90-75, as well as performance standards.[72] The per-

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[67] 42 U.S.C. § 6834(b)(3) (1977). *See* text accompanying notes 103-108 *infra.* Congress intends to provide assistance to local governments in implementing the standards.

[68] 42 U.S.C. § 6834(b)(4)(A) (1977). If the department which grants building permits on behalf of a local jurisdiction is unable to enforce the standards, then some other local agency must take responsibility for implementing the standards. Upon the failure of any local agency to implement the program, the state government must take responsibility. *Id.* § 6834(b)(4)(B), (C).

[69] Performance standards are rarely used by the designers of new buildings in California, and then only by the designers of large buildings. CONSUMER ENERGY COUNCIL OF AMERICA, *supra* note 55, at 26. *See also* NATIONAL CONFERENCE OF STATES ON BUILDING CODES AND STANDARDS, INC., SURVEY ON UTILIZATION OF SYSTEMS ANALYSIS DESIGNS IN STATE ENERGY CONSERVATION CODES (1979) (finding that there is little use of performance standards throughout the nation).

[70] [DRAFT] NOTICE OF PROPOSED RULEMAKING, *supra* note 41, at 15. *See also* 44 Fed. Reg. 68,120, 68,148.

[71] CAL. ADMIN. CODE, tit. 24, § T20-1451 (July 26, 1978).

[72] *Id.* §§ T20-1451 to T20-1542. *See* text accompanying note 28 *supra* for an

formance standards provide annual energy budgets for twelve categories of building use in fifteen climate zones.[73] To determine whether building designs meet the required energy budgets, the California Energy Commission developed an energy analysis computer program which is available for public use.[74] Compliance with the performance standards, however, may be verified by any computer program which has been certified by the Commission.[75]

In addition to the prescriptive and performance approaches, a building complies with the California regulations if it derives over forty percent of its annual thermal energy requirement (heating, cooling, and hot water) or more than twenty percent of its annual total energy requirement from nondepletable sources.[76] Buildings which do not qualify for this exemption may still receive credit for use of renewable sources of energy since such sources are not included in the calculation of the total energy consumption of the building.[77]

Although California appears to have developed workable energy conservation performance standards, these standards have not been used by the building community. The cost and complexity of meeting the California nonresidential performance standards have proved prohibitive for small builders, and have discouraged large developers from using the standards. Less than one percent of the nonresidential buildings approved since the effective date of the energy conservation standards have been designed in accordance with the performance approach.[78] Even in the case of buildings larger than 10,000 square feet, fewer than five percent were designed using the performance option.[79]

The prescriptive approach is widely used because it is easier to understand and cheaper to apply than the performance approach. However, it too is complex. The prescriptive standards' technical intricacy requires engineering skills which exceed the capabilities of the average design technician in a municipal building inspec-

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explanation of ASHRAE 90-75.

[73] *Id.* § T20-1470. The CAL/ERDA Public Domain Computer Program is the evaluation tool.

[74] *Id.* § T20-1471.

[75] *Id.* § T20-1472.

[76] *Id.* § T20-1453(b).

[77] *Id.* § T20-1480. *Cf.* text accompanying notes 134-35 *infra* (the BEPS program excludes renewable sources of energy from the standard as an incentive for solar utilization).

[78] CONSUMER ENERGY COUNCIL OF AMERICA, *supra* note 55, at 26.

[79] *Id.*

tion department.[80] As a consequence of the complexity of both prescriptive and performance approaches, many municipalities ship nonresidential plans to the State Housing and Community Development Department to determine whether they comply with the nonresidential energy standards.[81] Thus, despite the Legislature's intent to train building officials and implement the standards through local building departments,[82] the complexity of the standards has forced a centralization of the administration of building regulations.

B. The Problems Involved with Administering the Federal Building Energy Performance Standards: Verification and Enforcement

Nationwide administration of building energy standards presents more complicated problems than developing a program for only one state, even a state as large and diverse as California. The most significant impediments to implementation of the BEPS regulations are verification and enforcement of the standards through thousands of local building departments. These problems are not, however, insurmountable. Development of simple prescriptive standards which are equivalent to the BEPS regulations, and providing training to local building officials, may make enforcement through local agencies possible.

1. The Problem of Verifying Compliance with the Building Energy Performance Standards, and the Need for Prescriptive Regulations

A designer complies with BEPS regulations by demonstrating that the predicted energy use of a building design will not exceed the building's energy budget.[83] Therefore, an accurate calculation

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[80] Letter from Doran Maxwell, President, California Building Officials Association, to author, (Nov. 3, 1979) (on file at offices of the U.C. DAVIS LAW REVIEW) [hereinafter cited as Maxwell letter]. Mr. Maxwell states that the Davis Building Inspection Department, like many other departments in average-sized cities, has neither the expertise nor the financial resources to plan-check nonresidential buildings for compliance with state energy standards. Consequently, the plans are sent to the State Housing and Community Development Department to determine compliance.

[81] *Id.*

[82] CAL. PUB. RES. CODE §§ 25402.1(d), (e) (West Cum. Supp. 1979). *See also* text accompanying note 68 *supra*.

[83] 44 Fed. Reg. 68,120, 68,167 (proposed to be codified in 10 C.F.R. § 435.03).

is necessary to determine the predicted energy use of a building design. To verify that a building design complies with the appropriate energy budget, the local building department is required to use either DOE-2, a Department of Energy computer program, or an alternative evaluation technique approved by the Department.[84] Use of DOE-2 on the local level is precluded by its cost, the technical proficiency necessary to operate the program, and the lack of computer facilities in most building departments.[85] Since it is unrealistic to assume that DOE-2 will be used by any but the largest building inspection departments, most verification will be achieved through alternative procedures.

An alternative verification procedure includes either a computer analysis or manual evaluation technique which produces approximately the same results as DOE-2.[86] The Department of Energy has proposed a procedure by which alternative verification techniques may be submitted for approval.[87] An alternative method which has been approved by DOE may be used by a local building department or by a qualified design professional to certify compliance with the standards.[88]

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[84] The standard method of evaluation includes the use of the DOE-2 program to verify that the design energy consumption of a building does not exceed its design energy budget. *See* text accompanying notes 44-45 *supra.* In special cases where it is necessary to evaluate the contribution of solar energy the TRNSYS and DEROB programs are to be used. 44 Fed. Reg. 68,120, 68,167 (1979) (proposed to be codified in 10 C.F.R. § 435.03). Upon written application and the submission of the required information, DOE will approve alternative evaluation techniques if they produce approximately the same results as the DOE approved computer programs. *Id.* at 68,169 (proposed to be codified in 10 C.F.R. § 435.06).

[85] F. ARUMI, *supra* note 38, at 142. The author notes that, while the cost of computer time has decreased, most design professionals are unfamiliar with the use of computers. Although DOE claims that the DOE-2 is cheap and easy to use, no such claim is made for the TRNSYS and DEROB routines which are necessary for the evaluation of certain types of buildings. [DRAFT] NOTICE OF PROPOSED RULEMAKING, *supra* note 41, at 29-31. DOE acknowledges that there are problems endemic to the use of computer programs, namely: reproducibility of results, limited knowledge, and excessive computation time. *Id.* at 32.

[86] 44 Fed. Reg. 68,120, 68,154 (1979). DOE suggests that it is in the public interest to establish both computer based and manual techniques as alternative evaluation techniques. For residential and small commercial buildings, DOE believes manual techniques should be emphasized.

[87] *Id.* at 68,169 (to be codified in 10 C.F.R. § 435.06). *See* text accompanying notes 75-77 *supra* for a discussion of California's alternative verification procedure.

[88] If a local agency is certified to use an alternative compliance procedure, a qualified design professional may certify that the building design meets its

Although the approval of equivalent verification techniques seems sensible, it simply adds to the inaccuracy of the verification procedure. The Department of Energy admits there is little overall practical experience in establishing test methodology for determining equivalency.[89] Furthermore, DOE suggests that equivalency will probably be demonstrated if the results are within a range of fifteen percent of DOE-2 results.[90] The DOE-2 program itself is expected to predict the actual performance of a building only within a fifteen percent range of accuracy.[91] Hence, the alternative verification technique could project a design energy consumption which would vary up to thirty percent from the actual energy use of the structure. For some categories of buildings, there is only a forty percent variance in the proposed energy budgets for the mildest and most severe climates.[92] In such cases a thirty percent deviation in the accuracy of the verification procedure may be too great for the performance standards to be meaningful.

In light of the problem involved with verification of performance standards, promulgation of prescriptive regulations may be the only practical means of implementing nationwide energy conservation building regulations. Congress tacitly agreed that federally mandated performance standards may not be practical by permitting states to achieve the performance standards through any code approved by the Secretary of Housing and Urban Development.[93] While such language in the enabling legislation might

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proposed energy budget. The proposed regulation requires both certification by a qualified design professional and approval by the local agency. Note that local agencies can use alternative approval techniques without the use of qualified design professionals. *See id.* at 68,159-60.

[89] *Id.* at 68,154.

[90] [DRAFT] NOTICE OF PROPOSED RULEMAKING, *supra* note 41, at 38.

[91] 44 Fed. Reg. 68,120, 68,154 (1979). *See* text accompanying note 44 *supra.*

[92] In the case of small office buildings the lowest energy budget is for the San Francisco SMSA — 87,000 BTUs/(ft2) (yr), and the highest energy budget is for the Miami SMSA — 125,000 BTUs (ft2) (yr). The variance is 43.6%. In the case of large offices the lowest energy budget is again for the San Francisco SMSA — 101,000 BTUs/(ft2) (yr), and the highest budget is for the Miami SMSA — 140,000 BTUs (ft2) (yr). The variance is 38.6% In the case of gymnasiums the lowest energy budget is for the Oakland SMSA — 108,000 BTUs/(ft2) (yr), and the highest energy budget is for the Houston SMSA — 150,000 BTUs/(ft2) (yr). The variance is 38.8%. Several other categories of buildings have the same range of variance between the low and high energy budgets. *Id.* at 68,175-79 (proposed Table I-3).

[93] 42 U.S.C. § 6834(a)(1) (1977). The Department of Energy has assumed

be interpreted as a carte blanche for state governments to develop their own prescriptive standards, the Department of Energy - now responsible for the implementation of standards - will not approve the complete elimination of the performance approach.[94] Under the proposed implementation procedures, a state or local government could substitute its own code for BEPS if the following basic requirements are met:

> 1. The code is equivalent to or exceeds the requirements of the BEPS regulations, and
> 2. The building code jurisdiction has an adequate implementation program.[95]

In addition to approving state and local codes, the Department of Energy intends to develop and approve model prescriptive standards which comply with BEPS.[96] This effort may include modifying the Department of Housing and Urban Development Minimum Property Standards, the Farmers Home Administration Construction Standards, and ASHRAE 90-75 so that a building designed in accordance with these modified codes would comply with the performance standards.[97] Promulgation of prescrip-

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responsibility for certifying local codes pursuant to the Department of Energy Reorganization Act. 42 U.S.C. § 7154 (1978).

[94] *See* 44 Fed. Reg. 68,120, 68,157-58 (1979). The proposed implementation procedures require that each state or local code contain a procedure whereby an applicant, in lieu of meeting the prescriptive or component requirement of the energy part of the code, could qualify his or her building design using a performance standard. *See* text accompanying notes 24-26 *supra,* for a discussion of performance standards.

[95] 44 Fed. Reg. 68,157 (1979). In addition to the basic requirements, DOE has identified other possible features which it may require from state programs before certification is granted. These include:

1. Design of buildings in excess of 50,000 gross square feet be evaluated and certified by a qualified design professional using an approved evaluation technique;
2. The state or local building code include a procedure whereby an applicant could qualify the design of a building using a performance approach;
3. The state certified code guarantee that a building permit would not be issued where a building design does not satisfy the energy section of the code; and
4. Periodic inspections be conducted during construction to assure the building is constructed in conformance with the approved design. *Id.* at 68,158.

[96] [DRAFT] NOTICE OF PROPOSED RULEMAKING, *supra* note 41, at 15. *See also* 44 Fed. Reg. 68,120, 68,158 (1979). For an explanation of prescriptive standards, *see* text accompanying note 27 *supra.*

[97] *See* THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, MINIMUM PROPERTY STANDARDS FOR ONE AND TWO FAMILY DWELLINGS, HANDBOOK 4900.1 (1979 ed.); THE DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, MINIMUM PROPERTY

tive and component performance standards may make possible verification by local building departments.[98]

2. Enforcement of Building Energy Performance Standards

The means of enforcing the BEPS regulations remains uncertain. While Congress determined that local building codes were the appropriate vehicles for implementing performance standards, the House and Senate could not agree on how to make the state and local agencies adopt and enforce the federal regulations. A compromise was reached in conference committee.[99] The resulting Building Energy Standards Act includes the sanction that no federal financial assistance shall be made available for the construction of any building in any state unless the state implements the building performance standards.[100] But, before the final standards become effective, Congress must review the regulations to determine if the sanction is necessary and appropriate.[101]

The cost and complexity associated with the implementation of the performance standards makes it questionable whether states will enforce the standards without the threat of losing all federal construction aid.[102]

Apparently expecting to get congressional approval of the sanctions, the Department of Energy has proposed procedures on how local jurisdictions should enforce the federal standards.[103] These regulations not only require that building designs conform to the

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STANDARDS FOR MULTIFAMILY DWELLINGS, HANDBOOK 4910.1 (1973 ed.); FARMERS HOME ADMINISTRATION CONSTRUCTION STANDARDS, 7 C.F.R. § 1804, App. D (1978); and THE AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR CONDITIONING ENGINEERS, INC., ASHRAE STANDARD 90-75 ENERGY CONSERVATION IN NEW BUILDING DESIGN (1975). *See* note 29 *supra*.

[98] The Department of Energy recognizes that the implementation of state and local building codes equivalent to the federal performance standards is essential to implementation of the BEPS program. DOE indicates that local administration of the regulations is necessary, and has proposed a program of developing and approving prescriptive standards to ease the burden on local government. 44 Fed. Reg. 68,120, 68,158, (1979). *Cf.* Maxwell letter, *supra* note 80 (implying that local building technicians may not be able to apply prescriptive standards).

[99] CONSUMER ENERGY COUNCIL OF AMERICA, *supra* note 55, at 9.

[100] 42 U.S.C. § 6834(a) (1977).

[101] *Id.* § 6834(c) (1977). Even if Congress does not approve the sanctions, all housing subject to the Minimum Property Standards (all subsidized and federally insured housing) must comply with BEPS. [DRAFT] NOTICE OF PROPOSED RULEMAKING, *supra* note 41, at 82.

[102] CONSUMER ENERGY COUNCIL OF AMERICA, *supra* note 55, at 10.

[103] 44 Fed. Reg. 68,120, 68,157-60 (1979).

appropriate design energy budgets or alternative codes, but also direct local building officials to conduct field inspections to ascertain whether the buildings are being constructed according to the approved designs.[104] Although this is normal procedure, inspection of energy conservation systems may in some cases require skills which exceed the expertise of the average building official.

Anticipating that state and local jurisdictions would have difficulty enforcing the performance standards, Congress authorized grants to state and local governments to help meet the costs of adopting and implementing the energy regulations.[105] In addition, Congress required technical assistance be provided to the state and local governments.[106] In response to this legislative mandate, the Department of Energy has proposed two methods of assistance both of which a local jurisdiction may adopt. First, "qualified design professionals" will be allowed to certify that a building complies with BEPS or an alternative code,[107] and, second, states will be permitted to implement their own energy codes equivalent to the federal standards.[108]

Although the Department of Energy's proposals will probably help somewhat in the administration and enforcement of the energy regulations, they are not sufficient. A comprehensive program is needed to improve the technical competence of building code administrators and to develop a model administrative system for the orderly implementation of energy standards.[109] Furthermore, it may be necessary for the federal government to establish regional centers for the purpose of certifying that the building designs comply with BEPS. The effectiveness of a national program to conserve energy in buildings through codes and standards will ultimately be determined by the capabilities of the administrative system responsible for enforcing these codes and standards.[110] With such a caveat in mind, this comment now

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[104] *Id. See* note 95 *supra.*

[105] 42 U.S.C. § 6836 (1977).

[106] *Id.* at § 6877.

[107] Certification by a qualified design professional requires a determination by the professional that the design energy consumption of a building design does not exceed the applicable design energy budget for that building type. The qualified design professional may follow the standard evaluation technique (DOE-2) or any other approved procedure. A design professional may be a licensed architect, engineer, code official, or member of any related professional group. 44 Fed. Reg. 68,120, 68,159 (1979).

[108] *Id.* 68,157-59. Criteria for state rates are included in note 95 *supra.*

[109] D. Pellish, *supra* note 8, at 47.

[110] *Id.* at 46.

turns to a discussion of the effectiveness of the Federal Building Energy Performance Standards in achieving the congressional goal of saving energy in new structures.

III. THE EFFECTIVENESS OF THE FEDERAL BUILDING ENERGY PERFORMANCE STANDARDS

Under the authority granted by Congress in the Building Energy Standards Act, the Department of Energy may expend substantial federal resources in developing and implementing energy conservation building regulations.[111] Whether the outlay is worthwhile depends not only upon the development of workable verification and enforcement procedures, but also upon the promulgation of effective standards which will result in significant energy savings.

The criterion for evaluating the proposed federal Building Energy Performance Standards is the congressional mandate to "achieve the maximum practicable improvements in energy efficiency and increases in the use of nondepletable sources of energy."[112] While there is evidence that the Department of Energy's residential standards meet this mandate, it appears that the commercial standards fail to promote the maximum practicable improvements in energy efficiency.

The shortcomings of the federal nonresidential standards are evident when the BEPS regulations are compared with other energy conservation building standards. Energy budgets for office buildings are an appropriate indicator of the effectiveness of the federal standards in regard to other types of buildings, since in theory the energy budgets for offices are more stringent than for other nonresidential structures.[113] The BEPS regulations provide an energy budget of 101,000 BTUs per square foot per year for large office buildings constructed in the San Francisco and Oakland climate zones.[114] According to the regulations, the San Fran-

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[111] 42 U.S.C. §§ 6836, 6837, 6839 (1977). *See* text accompanying notes 105-106 *supra*.

[112] 42 U.S.C. § 6831(b)(2) (1977).

[113] DOE derived the nonresidential standards by means of a statistical process. Buildings were selected from each of the 16 categories of commercial buildings and redesigned to improve their energy performance. The energy performance standard for office buildings was set equal to the performance level of the top 30% of the redesigned office buildings. For other categories of buildings, the performance standards were set equal to the performance level of the top 50% or 70% of the redesigned buildings. 44 Fed. Reg. 68,120, 68,147-48. (1979).

[114] The 101,000 BTUs/(ft2)(yr) figure is provided in Table I-3 of the proposed

cisco and Oakland areas have the mildest climate in the nation and, therefore, the energy budgets are greater for all other standard Metropolitan Statistical Areas.[115] The 101,000 BTUs per square foot per year standard is not stringent.

Five years ago, the General Services Administration adopted a performance standard of 55,000 BTUs per square foot per year for all new office buildings.[116] The standard was adopted after a federal office building in Manchester, New Hampshire, was designed and finally built to comply with an energy budget of only 55,000 BTUs per square foot per year.[117] It is now practical to design office buildings which use approximately 35,000 to 40,000 BTUs per square foot per year.[118] One recently constructed state office building in Sacramento, California, was designed to meet an energy budget of only 25,000 BTUs per square foot per year.[119] Similarly, it is possible to reduce the energy budgets of other types of buildings substantially below 100,000 BTUs per square foot per year.[120]

Although the Department of Energy should not be compelled to promulgate energy budgets which can be met only by "state of the art" designs, significantly tighter nonresidential standards are warranted. The Department did not set the nonresidential budgets at the life cycle cost minimum—as was done in the case of residential standards—because DOE determined that more stringent commercial energy budget levels exceeded the current knowledge of most designers.[121] In light of the congressional mandate that the energy performance standards should achieve "maximum practicable" energy savings,[122] Congress and various citizen groups may question the Department of Energy's grounds for reducing commercial standards to below the levels known to be cost effective. Office building energy budgets in the range of the General Service Administration standard of 55,000 BTUs per

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BEPS regulations. *Id.* at 68,175.

[115] The Oakland and San Francisco SMSAs have approximately the same climate fewer total heating and cooling degree days than the other 78 SMSAs. *See* Table II-1 of the proposed BEPS regulations, *id.* at 68,180-81. *See* note 63 *supra* for discussion of SMSA.

[116] *See* text accompanying note 25 *supra.*

[117] F. Dubin & C. Long, *supra* note 14, at 11.

[118] *Id.* at 12.

[119] S. Van Der Ryn, *Abstracted in Sacramento,* 22 CoEvolution Q. 20 (1979).

[120] F. Dubin & C. Long, *supra* note 14, at 12.

[121] 44 Fed. Reg. 68,120, 68,161 (1979).

[122] 42 U.S.C. § 6831(b)(2) (1977).

square foot per year have been shown to be practical.

Besides being unnecessarily lax, the commercial standards appear to be partially based on inaccurate delineation of climate zones. One prominent example is the assignment of higher design energy budgets to the San Diego area than to the San Francisco area.[124] San Francisco has 3,060 annual heating degree days while San Diego has only 1,439 heating degree days.[125] San Diego receives substantially more sunshine in winter. In summer, the weather of the two areas is similar.[126] It is thus difficult to imagine why buildings in San Diego are allowed to use more energy.

Incompetent delineation of climate zones can produce practically meaningless building energy performance standards. A

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[123] F. DUBIN AND C. LONG, *supra* note 14, at 12.

[124] Table I-3 of the proposed BEPS regulations provides higher energy budgets in San Diego than in San Francisco for all categories of buildings except elementary schools and warehouses. 44 Fed. Reg. 68,120, 68,170, 68,175 (1979).

[125] A heating degree day is a unit based upon temperature difference and time which is used in estimating fuel consumption and specifying a nominal annual heating load of a building. For any one day, when the mean temperature is less than 65 °F, there exists as many degree days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65 °F. Annual heating degree days are a summation of the daily heating degree days. CAL. ADMIN. CODE, tit. 24, §T20-1402 (July 26, 1978).

The appendix to the CALIFORNIA ENERGY COMMISSION ENERGY CONSERVATION STANDARDS FOR NEW RESIDENTIAL BUILDINGS include the accepted figures of 3,060 annual heating degree days for the San Francisco area and 1,439 annual heating degree days for the San Diego area. *Id.* at App. T20-B.

The heating degree day figures included in the BEPS regulations are different since the computation of heating degree days is founded upon a 60° F base rather than the typical 65° F base. 44 Fed. Reg. 68120, 68,180-81 (1979). While use of the 60° F figure may better represent the true heating loads of modern, well insulated buildings, it presents administrative problems since annual degree day figures founded upon the 60° F base are not readily available for most communities.

DOE has also deviated from standard practice in selecting 50° F as the base for calculation of cooling degree days. *id.* DOE's use of these cooling degree days to compute cooling load is the likely cause of the skewing of the San Diego and San Francisco energy budgets. Cooling degree days are a very poor measure of summer heat load. Window size and orientation are more important factors. Even in a mild climate a building will have an enormous heat load if it has large west facing windows exposed to direct sunlight. *See* HAMMOND & HUNT, *supra* note 6, at 9-16 (1976).

[126] In summer, the design temperature for San Diego is 84 degrees, while the design temperature for San Francisco is 80 degrees. ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION, RESIDENTIAL ENERGY CONSERVATION MANUAL 19, Appendix E (Draft 1977).

striking example is the California nonresidential standards. These standards permit a commercial building in Stockton, a Central Valley city with hot summers and mild winters, to use the same energy per square foot as a similar building in South Lake Tahoe, a mountain city with mild summers and cold winters.[127] Similarly, an office building in San Diego, the state's sun capitol, is allowed as much energy use for heating as an office in Eureka, a cold and rainy northern coastal town.[128]

While it is difficult to evaluate the federal residential standards because of the lack of comparative data, the available information suggests that the BEPS residential standards are both reasonable and effective. Davis, California, is one of the few cities in the nation which has developed residential energy performance standards.[129] Houses built according to the Davis code use approximately one-half of the energy needed to heat and cool a typical modern home.[130] Although federal standards and Davis standards are not expressed in the same terms, the federal regulations appear to be more stringent.[131] In addition, data from Portland, Oregon, suggests the federal standards will save a substantial amount of energy in comparison with existing Oregon standards which already include fairly strict insulation requirements. New homes currently constructed in Portland with R-19 insulation in the ceiling and R-11 insulation in the walls use more than

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[127] Energy Conservation Standards for New Nonresidential Buildings, CAL. ADMIN. CODE, tit. 24, §T20-1475 (July 26, 1978).

[128] *Id.*

[129] CITY OF DAVIS, ORDINANCE No. 784 (1976).

[130] CITY OF DAVIS, DAVIS ENERGY CONSERVATION REPORT 18 (1977).

[131] The Davis standards are expressed in terms of allowable BTUs/(ft2) (day), where the day is the ASHRAE winter design day. ASHRAE HANDBOOK OF FUNDAMENTALS (1972). The ASHRAE winter design day includes 552 degree hours which is equivalent to 22.9 degree days. CITY OF DAVIS CAL. RESOLUTION No. 1883 § 5(A)(4) (1975). The Davis Ordinance provides a varying heat loss standard depending upon the size of the house. A 1,500 square foot dwelling is an average sized house. For such a dwelling, 208 BTUs/(ft2) (day) heat loss is allowed on the design day. *See* CITY OF DAVIS ORDINANCE No. 784, Table 2, (1976).

Upon extrapolation to yearly heat loss based upon 2,819 heating degree days (calculated according to the 65 °F base, *see* note 123 *supra*) allowed 25,584 BTUs/(ft2) (yr) for heating. When 1,837 heating degree days (calculated according to the 60 °F base, *see* note 123 *supra*) are used as a basis of extrapolation, the Davis Code house is allowed 16,685 BTUs/(ft2) (yr) for heating. In comparison, BEPS allows only 22,000 BTUs/(ft2) (yr) for both heating and cooling in the Sacramento SMSA (when gas is used for heating). 44 Fed. Reg. 68,120, 68,170 (1979).

twice the amount of energy for space heating and cooling than would be allowed under the federal standards.[132]

In addition to requiring maximum practicable improvements in energy efficiency, Congress mandated that the performance standards for both residential and commercial buildings are to increase the use of nondepletable sources of energy.[133] The Department of Energy proposes to meet this requirement by providing an exemption from a building's energy budget for all energy derived from nondepletable sources.[134] Hence, the incentive to incorporate a solar system in a building is permission to design a less efficient building. This policy is contrary to the goal of energy waste prevention, which was cited by Congress as one reason for enacting the BEPS legislation.[135] Other methods of encouraging the use of solar systems should be included in the BEPS regulations.[136]

CONCLUSION

There are no easy solutions to the nation's energy problems. Energy conservation design standards present an opportunity to save significant amounts of energy in new buildings. The preparation of adequate standards, however, presents complex technical problems with social, economic and legal ramifications. In this respect, these problems are similar to those encountered in preparing standards for regulating building design for safety and health. But, whereas public health and safety regulations have evolved over a period of a century, energy conservation regula-

[132] UNITED STATES DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, 3A ENERGY CONSERVATION CHOICES FOR THE CITY OF PORTLAND 11 (1977). The average annual energy to heat a 1,700 square foot house in Portland is 101.5 million BTUs or 59,700 BTU (ft^2) (yr). In contrast, the federal standards allow only 25,300 BTUs/(ft2) (yr) for heating and cooling a Portland home (when gas is used for heating). 44 Fed. Reg. 68,120, 68,173 (1979).

[133] 42 U.S.C. § 6831 (b) (2) (1977).

[134] 44 Fed. Reg. 68,120, 68,142 (1979).

[135] Congress states: "Federal performance standards for newly constructed buildings can prevent such waste of energy, which the nation can no longer afford in view of its current and anticipated energy shortage." 42 U.S.C. § 6831 (b)(2) (1977).

[136] Methods of encouraging the use of solar technology include more directly requiring passive solar design for new dwellings. Also, a total exemption from the BEPS regulations could be provided if a building derives a specified percentage of its energy use from non-depletable sources. This policy was adopted by the California Energy Commission. *See* CAL. ADMIN. CODE, tit. 24, § T20-1453 (b) (July 26, 1978); text accompanying note 76 *supra*.

tions must be developed immediately.[137]

Regulations that are not practicable or are difficult to verify and enforce are of questionable value to society. If the BEPS program is to be workable, the Department of Energy must develop easily understandable prescriptive codes and educate state and local building officials. Even with such an effort, there is likely to be a concentration of building code administration. The Department of Energy should make plans to handle this structural change in the building industry.

The federal regulation of residential and commercial construction entails enormous costs and disruption. It is apparent that the BEPS program will only be worthwhile if the standards are effective. The congressional mandate of "maximum practicable energy savings and increases in the use of nondepletable sources of energy" may be achieved by substantially reducing the energy design budgets for commercial buildings, improving the incentives for use of solar energy and refining the delineation of climate zones.

William D. Kopper

[137] *See* H. DICKENS & A. WILSON, *supra* note 20, at 206.