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Publication Date
2010-10-31

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BERKELEY NATIONAL LABORATORY

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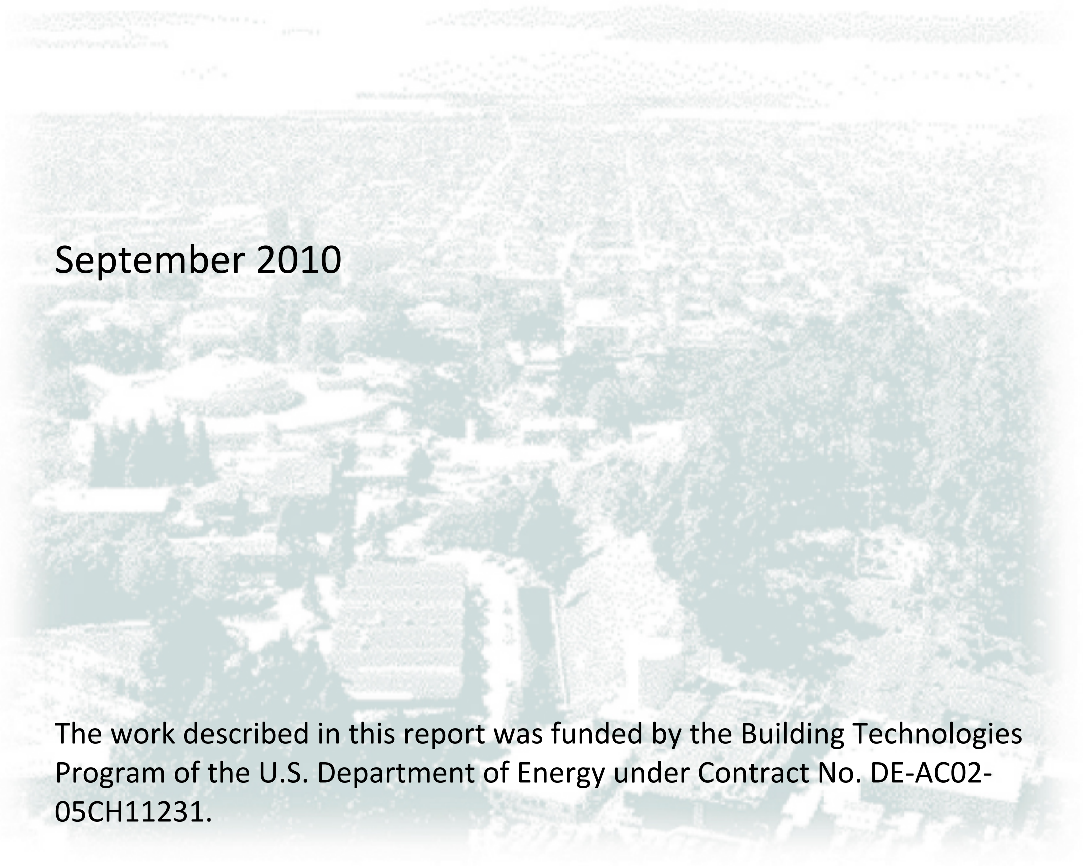

September 2010

The work described in this report was funded by the Building Technologies Program of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Zero Net Energy Myths and Modes of Thought

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ABSTRACT

The U.S. Department of Energy (DOE), the California Public Utilities Commission (CPUC), and a number of professional organizations have established a target of zero net energy (ZNE) in buildings by 2030. One definition of ZNE is a building with greatly reduced needs for energy through efficiency gains with the balance of energy needs supplied by renewable technologies. The push to ZNE is a response to research indicating that atmospheric concentrations of greenhouse gases have increased sharply since the eighteenth century, resulting in a gradual warming of the Earth's climate.

A review of ZNE policies reveals that the organizations involved frame the ZNE issue in diverse ways, resulting in a wide variety of myths and a divergent set of epistemologies. With federal and state money poised to promote ZNE, it is timely to investigate how epistemologies, meaning a belief system by which we take facts and convert them into knowledge upon which to take action, and the propagation of myths might affect the outcome of a ZNE program.

This paper outlines myths commonly discussed in the energy efficiency[2] and renewable energy communities related to ZNE and describes how each myth is a different way of expressing "the truth." The paper continues by reviewing a number of epistemologies common to energy planning, and concludes that the organizations involved in ZNE should work together to create a "collaborative rationality" for ZNE. Through this collaborative framework it is argued that we may be able to achieve the ZNE and greenhouse gas mitigation targets.

Introduction

A national effort is underway to achieve ZNE in buildings by the year 2030. One definition of ZNE is a building with "greatly reduced needs for energy through efficiency gains with the balance of energy needs supplied by renewable technologies" (DOE, 2008, page 1-8). Federal legislation such as the Energy Policy Act of 2005 (EPAct 2005, Public Law No. 109-58) and the Energy Independence and Security Act of 2007 (EISAct 2007, Public Law No. 110-140) have authorized national initiatives that will develop and disseminate technologies, practices, and policies to move the U.S. market toward ZNE buildings. In a parallel effort, several state public utility commissions (such as in California, Oregon, and Washington) and energy offices (such as the New York State Energy Research and Development Authority) have initiated efforts to put the building sector on a path to ZNE.

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[1] The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the official policy or position of the University of Michigan or Lawrence Berkeley National Laboratory.

[2] For an earlier discussion of the myths of energy efficiency in buildings that served as a model for this paper, see Diamond, R., & Moezzi, M. (2000).

Through participation in a multi-year strategic planning process led by the California Public Utilities Commission (CPUC) and the California investor owned utilities (IOUs) that focused on setting ZNE goals, it has become apparent to the authors that the organizations with a stake in ZNE tend to frame the issue in diverse ways, resulting in a wide variety of myths and a divergent set of epistemologies. With significant funding poised in California to promote ZNE, it is timely to investigate how these frames, manifested as myths and epistemologies, might affect the outcome of a ZNE program. Once we understand the divergent points of view it might be possible to engage in a collaborative process that would allow us to resolve conflicts in a mutually beneficial manner to achieve the necessary greenhouse gas reduction goals.

Myths Surrounding Zero Net Energy

The term "myth" in popular usage is defined as "a popular belief or tradition that has grown up around something or someone." (Merriam Webster Online). Folklorists reserve the term "myth" to refer to narratives about origins, usually sacred and often metaphorical. For this paper we are generally referring to the popular definition of myth, but we draw on two concepts from folklore theory.

1. Myths, whether true or not, are a way of structuring understanding of how the world works.
2. These myths are shared by a specific group, which could be any collection of people—for example the professional community of architects—who hold and seek to communicate some common belief.

Thus, the myths we present in this paper are mini-narratives that are reflections of "mental models" (Senge 1990) and "folk models" (Kempton 1986). These myths are used to describe how groups and individuals view the world, and in this case, describe and understand ZNE. By understanding the "how" and "what" of these myths we can begin to understand the practice of energy efficiency planning, and we can begin to determine how these myths push us toward a path of action. Through this process we also reveal and deconstruct the complex host of goals, values, commitments, obligations, sense of self and other issues that surround ZNE.

1. All new (and existing) buildings can be ZNE. When discussing moving the entire market toward ZNE, it is important to differentiate between the technical feasibility, the economic rationale, and the policy implications of such actions. The existence today of a half dozen ZNE buildings—mostly residential, low-rise commercial, or school buildings—demonstrates that under certain conditions it is possible to deliver a ZNE building.[3] But it does not necessarily follow that all buildings and building types can be ZNE.

For instance, the first ZNE buildings tend to be single story, have a low energy use intensity (EUI) and large exposed surface areas for on-site energy generation, usually building integrated photovoltaics. While single-story buildings represent 69% of the number of commercial buildings, and 46% of the sector floor area, (US DOE-EIA 2003) it does not mean that *all* building types can be ZNE—at least not initially under the current technology and economic conditions. Building types such as hospitals and restaurants (high energy use intensity) or high-rise apartments or office buildings (low-surface area for PV) will be much more difficult

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[3] For examples of ZNE commercial buildings, see the Zero Energy Buildings Database at http://zeb.buildinggreen.com/.

and expensive to make ZNE. As evidence, one study that looked at the potential for ZNE for the existing U.S. building stock concluded that 62% of existing buildings and 47% of commercial floor area had the technical potential to be ZNE, without considering any economic criteria for the work (Griffith et al. 2007).

2. New technologies will help us to produce ZNE buildings. The belief that new technologies, or systems of technologies, will produce ZNE buildings—both new construction and retrofit—is debatable. While technology is an important element of ZNE buildings, it is not the only driver, and ZNE buildings must look at a variety of factors, including land use planning, zoning, solar rights, financing, utility tariffs, design practices, commissioning, consumer preferences, occupant behavior, etc. Previous technology demonstration projects such as Bonneville's Energy Edge, showed how new technologies often failed to deliver the expected savings, and, other factors such as commissioning were important to deliver savings (Piette, 1994).

If we only pursue technology options, we are not likely to succeed in achieving ZNE on a wide scale. Buildings are complex systems that incorporate numerous human decision processes, for which technology is but a tool to help achieve a result. For any technology to work as the designer intended, there is a long list of conditions that must be met in the design, installation, commissioning, and operation phases.

3. Smart controls are a key element of ZNE buildings. There is considerable debate over the question of smart buildings vs. smart people. Do we want to have buildings that run themselves in an optimal fashion, or have human oversight of building operation? What do we know about smart buildings? How well do these systems perform? Are they subject to even more intensive commissioning and retro-commissioning than "dumb" buildings? What do we know about building operators? Can a ZNE building rely on smart controls, or does it need to rely on building operators and occupants to perform as intended?

Looking at the early ZNE buildings, we see several instances of where the occupants and operators have compromised the energy performance of the building through their actions. This has been both intentional and inadvertent, e.g., leaving computers and lights on at night, adding additional building equipment and loads that weren't originally considered, and other actions.[4] Perhaps the best solutions are ones that combine elements of both strategies—smart building controls that show when systems are performing poorly, and can correct themselves, but have feedback and override functions to allow the operators to run the buildings as well. An interesting question for research is how operators can/will override the smart controls to deliver increased comfort and other functions in response to user demands.

4. Building integrated photovoltaics (BIPV) are the most cost-effective way to reduce carbon dioxide emissions. Building integrated photovoltaics are an essential component of any ZNE building, as they provide all of the necessary electricity at the building site. Many building owners—and designers—prefer investing in BIPV over energy-efficient strategies, possibly for the public relations value of their visible commitment to the environment. But they are rarely cost effective by traditional economic criteria, and as such, are frequently questioned as rational

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[4] As an example, see the "Case Studies of Carbon Neutrality" produced by the University of Oregon and the American Institute of Architects: http://www.aia.org/practicing/research/AIAS077476

policy for either incentives or building codes. BIPV are also challenged as being less economic relative to larger PV arrays located in areas with high solar gain, and that the advantages in local generation, i.e., lower transmission losses, are small compared to the loss in efficiency of central systems in optimal solar locations.

5. Once people know how much energy they use, they will reduce their consumption. There is a great deal of literature—and hype—on the impact of energy feedback on building energy consumption. While this situation is not unique to ZNE buildings, most ZNE buildings do have dashboards that provide building occupants and operators information on their solar and conventional energy consumption. Just providing information about energy use, however, does not guarantee that individuals or organizations will take action. Other necessary steps include the frequency and format of the information provided, comparisons or benchmarks to past history or peers, as well as several of factors that will vary by building type and user. Energy feedback needs to be in forms that people understand, at intervals they can process, with media they can incorporate into other decisions that all fit into the context of their work requirements.

6. The operation of the ZNE building is the key element in low energy use. Just as myth #2 discussed how technology is not the only element in ZNE performance, building operation is but one element of the ZNE building. Building operations are a key determinant of energy use, but true ZNE must reflect the total energy use of the building, including the transportation needs of building users, "location, location, location" as well as the embodied energy in building construction, renovation and demolition. While this larger life cycle analysis is not traditionally part of the ZNE definition we feel that a true societal test requires that a comprehensive analysis be undertaken to understand the real carbon impact of the building.

7. ZNE will be the rallying cry for a new, environmentally-sensitive architecture. Do architects respond to rallying cries? Some do, but many do not. For instance, in the mid-1970s, following the energy shocks of the first half of the decade, interest in passive solar design rose. And while research and practice focused on resource-efficient design has continued since that time, by the early 1980s, most mainstream architects were more concerned with the pros and cons of postmodernism rather than the need for energy efficient buildings.

Related to ZNE, the organization Architecture 2030, founded by architect Ed Mazria, has had a huge impact in shaping discussions of building energy use. However, one could make an argument that the 2030 Challenge has affected public policy debate more than the activities of individual architects. While Ed Mazria is an enlightened architect influencing policy, it doesn't necessarily follow that all architects are enlightened, nor does it follow that this focus on energy efficiency and renewable energy will be embraced by all of the profession. While many architects see good energy performance as integral to good design, many do not. Expecting the architecture profession, or any other profession, to lead an environmental movement that achieves one hundred percent penetration into the market is unreasonable and unlikely to occur.

8. Vernacular design provides an environmental model for ZNE buildings. Vernacular design, also known as design strategies that are native to a region or country, *can* provide a model for *some* ZNE buildings. Thoughtful, knowledgeable response to climate and the specifics of a particular place will always benefit a building design. Proper orientation will improve the performance of residential buildings and small commercial buildings. However, the specific uses of materials and construction techniques found in vernacular architecture may not be appropriate for contemporary building types.

For example, the high mass vernacular building techniques found in hot-dry climates don’t precisely translate to current methods of construction. Vernacular high mass buildings use thick, massive walls as a way to create a thermal time lag. The thickness of the wall is sized so that daytime heat conducts through the wall and radiantly warms the interior in the evening. Rather than using thick walls, we tend to insulate our buildings and may add thermal mass inside the insulation. The concept of using mass to dampen thermal loads translates from the vernacular to the contemporary. The particular technique of thick, massive walls frequently does not.

9. The push to ZNE will restrict the creative genius of architects. Most parts of Europe have mandatory building energy standards for both residential and nonresidential buildings. In contrast, across much of the USA energy codes are voluntary.[5] Few would argue that the freedom of American architects to disregard the energy performance of their buildings has led them to be recognized for their artistic leadership. If past experience with rigorous energy efficiency standards is an indicator, the artistic freedom of architects will not be compromised by even more stringent requirements. Many architects define themselves as “problem solvers” working in three dimensions. Designing to a standard of ZNE should be considered one additional part of the problem set.

The culture of the architectural profession reinforces the fear that energy standards will limit artistic freedom. There are many roles in the profession. Single practitioners must integrate all of these roles. However, even single practitioners spend only about 15% of their time in schematic design. In larger offices individuals can work to their particular strengths. Some architects have excellent sketching skills, a developed esthetic sensibility, and excel at schematic design. Within larger offices, these individuals are often seen as leaders of the firm both internally and by the public. Others architects may have skills that lead them to excel in understanding building assemblies, construction detailing, specifications, or project management. However, these non-schematic aspects of architecture are treated as peripheral to the profession in most architecture degree programs.

Understandably, educators seek to train individuals to be leaders of the profession, and believe students will learn the technical aspects of design and building in an office while they may never again have time to focus on schematic design upon graduation. This is half correct in that many architects do spend little time working as designers upon graduation. The problem is they *don’t* necessarily learn the technical aspects of design and building simply by working in an office. Architects may have a breadth of knowledge, but the majority of them don’t understand the fundamentals of heat transfer nor the principles that determine how moisture moves through a building assembly. Thus they can’t train young architects on these basic architectural issues essential to good energy performance.

The problems architecture students are trained to solve are limited ones. We need to improve our training of students in basic physical principles and how they apply to buildings. To be effective this means more than requiring one or two survey courses, which are rarely applied to design projects. It means better balance in architectural education with more technical training

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[5] For the current status of each state’s residential and commercial building energy code, see the U.S. Department of Energy website http://www.energycodes.gov/states/.

that integrates design problem solving. Creative genius should be applied to all phases and aspects of architectural design![6]

Myths in Practice

The myths presented above are narratives that are reflections of "mental models," the frame through which an actor views the ZNE landscape and describes the issue of ZNE. While each of these myths are "true" to their author, they would be "false" to someone who does not share the same worldview because they are only a portion of the whole story. By beginning to reveal the frames and understanding the "how" and "what" of these myths we can begin to understand how these myths push us toward a path of action. We can also use the myths to unpack their underlying epistemology, the way one "knows" or justifies belief. By taking on this task we can reveal and deconstruct the complex host of goals, values, commitments, obligations, and other issues that surround ZNE, and hopefully reconstruct the issues in a way that engenders a deeper level of support from all actors.

Energy Efficiency Epistemologies

If myths are an unscientific account of how the world works, then their scientific cousin is epistemology, or the study of knowledge and justified belief. Epistemology is generally concerned with the following questions:

1. What are the necessary and sufficient conditions of knowledge?
2. What are its sources?
3. What is its structure?
4. What are its limits?

Understood more broadly, epistemology is about the creation and dissemination of knowledge in a particular area of inquiry, such as energy efficiency and ZNE. (Stanford, 2005)

This section of the paper outlines four common epistemologies—logical positivism, interpretive inquiry, pragmatism, and collaborative rationality—and describes how each epistemology has a different way of "knowing" which results in different goals, methodologies, measures of success related to ZNE.

This section of the paper concludes by arguing that collaborative rationality, with a focus on three cognitive interests—the technical, practical, and emancipatory—provides the "best fit" for a per capita reduction of greenhouse gases from the built environment. A collaborative rationality accomplishes this through a *reflective* approach that allows participants to learn from a diverse and interdependent set of actors and deconstructing the myths and frames that outline

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[6] Originally published in 1996, *Building Community: A New Future for Architecture Education and Practice* by Ernest Boyer and Lee Mitgang called for recent graduates to be "prepared for the broader professional mission of promoting the value of beauty in society, for connecting buildings to human needs and happiness, and for creating healthier, more environmentally sustainable architecture that respects precious resources." Several architectural education reform projects such as Vital Signs (http://arch.ced.berkeley.edu/vitalsigns/) and the Agents of Change Project (http://aoc.uoregon.edu/) have risen to that challenge and created model curriculum materials to help balance design, technical training, and an understanding of building performance in the accredited schools of architecture in the United States.

their ZNE worldview. This process has been widely recognized as the first step toward true collaborative planning, a process that has been used with great success in California to resolve "wicked problems" such as those related to water rights. (Rittel and Webber, 1973; Innes and Booher, 2010)

Logical Positivism

Programs promoting energy efficiency have historically taken a positivist approach to transform patterns of energy use. The goal of most energy efficiency programs is to *effect* a change in energy consumption by *causing* an end user to purchase a piece of equipment with a higher level of efficiency. This is typically done by providing the end user with information on the cost of the energy efficient equipment and providing a financial incentive to make the investment in the equipment economically attractive. This policy paradigm is widely called the Physical Technical Economic Model (PTEM).

The PTEM relies heavily on engineering and neoclassical economics, and PTEM-based energy planners approach most energy efficiency problems through a methodology called "DMAIC" (Huesing, 2008):

- *Defining* energy savings goals and current processes in use,
- *Measuring* key aspects of current processes and collecting energy and economic data related to the process,
- *Analyzing* the data to determine cause-and-effect relationships and hypothesizing what economic incentive levels are necessary to effect change in the market,
- *Improving* or optimizing an end user process based upon the data provided,
- *Controlling* to ensure that any deviations from the original program goals are corrected as the program scales up to the entire market.

Using methods such as DMAIC, the PTEM has been effective in causing an increase in investment in specific energy efficient technologies such as fluorescent lighting and high efficiency motors. PTEM has been favored over other approaches primarily because energy savings achieved through these programs are easy to verify. But, PTEM-type programs have not been totally effective. Despite substantial efforts (and incentives) to cause investment in energy efficient technologies, a significant gap exists between the potential for energy efficiency and the level of investment actually occurring in the market. (Granade et al., 2009)

Because of its positivist temperament, PTEM-based planners rely on engineering or economics to explain away the gap. The first part to their argument is that there are significant institutional and other barriers in the market that prevent consumers from behaving rationally and therefore prevent the market from performing to its full potential. They state that these barriers include limited availability of capital, predatory pricing, regulatory distortions, transaction costs, and inseparability of energy efficiency from other product attributes. (Sullivan, 2009, pg. iv) Their second argument is that the gap is more apparent than is actually real. Under this explanation they argue that the gap is actually a consequence of the normal operation of an efficient market, and that adoption rates for any new technology should lag behind the level of economic potential at any point in time. (Sullivan, 2009, pg. iii) Neither of these explanations is totally satisfying, and recent research has shown that PTEM-based programs tend to oversimplify consumer and business decision-making, leading to on overemphasis on cost-benefit tests and ineffective marketing. (Sullivan, 2009, pg. iv)

In addition, because energy efficiency as defined under PTEM uses strict neoclassical engineering and economic models, energy savings is defined as the total reduction in energy usage from a baseline condition to a “better” condition after a measure is installed. By doing this, PTEM-based programs inadvertently reward buildings that have a higher initial energy use intensity (single family housing, multi-story office buildings) with greater levels of financial incentives. This is because the baseline energy use intensity for these building types is higher, and therefore the potential for total energy savings (measured in kilowatts (kW), kilowatt-hours (kWh), or therms (thm) of natural gas) is also higher. Because of some of these issues, and a feeling that engineering and economics could not explain away all of the problems, a number of researchers began to push for a theory of energy efficiency grounded in social theory.

Interpretive Inquiry

Beginning in the early 1990s, researchers such as Loren Lutzenhiser showed that the role of human social behavior has been largely overlooked in energy policy, despite the fact that social impacts of energy use have a significant effect on the results of any energy program. He argued that although a social theory of energy was scattered across a number of social science disciplines, a body of research concerned with human factors in energy use did exist and that we should apply these techniques to achieve deeper results. (Lutzenhiser, 1993)

One method advocated by Lutzenhiser was segmentation, or “identifying homogenous sub-populations within larger heterogeneous populations.” (Moss, 2008, pg. 3) This technique, used widely in the field of marketing, is an effort to effectively communicate with, and motivate to action, an increasingly diverse population of individuals, families and businesses by understanding their needs and patterns of energy use. (Ibid., pg. 3) Methodologies advocated by this newly minted “social approach” included ethnographic studies to characterize patterns of energy use in specific demographic groups, focus groups, and longitudinal studies of energy usage. The primary focus of the social approach was reducing energy usage in the residential sector where the PTEM model had failed to achieve penetration and results. Under the social approach, the PTEM failure to penetrate into a market is defined as a failure to understand the needs (especially the non-economic needs) of a market.

While perhaps better equipped to understand the needs of the greater population by determining attitudes on type of development, interpretive inquiry also lacks an ability to make a value judgment favoring one type of development over another. For instance, if a portions of a surveyed sub-population preferred single-family residential over multi-family housing, the social model would not have the grounds to reject the single-family housing even if it was more energy intensive. Because of this, we see socially based energy planners following the same path as their PTEM brethren, driving “whatever the market wants” to a higher level of efficiency.

Pragmatism

Recently, PTEM has been revised by the social approach, resulting in the current “socio-technical” model used by many energy efficiency programs. (Janda, 2002) The current energy efficiency planning process is a collage of PTEM and interpretive methodologies. Under this socio-technical model, the authority to operate programs that are “socially good” but produce little energy or economic savings is granted by lumping all of the programs together into one large program, called a portfolio. In this portfolio, planners are able to shift cost effectiveness from high-producing programs that have a benefit-cost ratio much greater than one to other programs that produce social good but would otherwise not pass a cost effectiveness test.

While this new perspective constructs validity by keeping some of the economic tools from the PTEM, and offers possibilities for reshaping programs to make them more effective in addressing the "gap" between efficiency potential and level of efficiency achieved in the market, this model was not incorporated into the design of energy efficiency programs until very recently and results from this shift have yet to be analyzed. (Sullivan, 2009, pg. vi) Unfortunately, it is unlikely that this socio-technical approach will succeed in promoting ZNE alone.

Recognizing these issues, and in an attempt to allow ZNE to align with traditional focus of energy efficiency programs, the California Public Utilities Commission (CPUC) uses cost-effectiveness calculations procedures from four major perspectives: Participant, Ratepayer Impact Measure (RIM), Program Administrator Cost (PAC), and Total Resource Cost (TRC). A fifth perspective, the Societal test, is treated by the CPUC as a variation on the Total Resource Cost test. The results of each perspective can be expressed in a variety of ways, but in all cases it is required to calculate the net present value of program impacts over the lifecycle of the impacts. (CPUC, 2001)

Under this economic evaluation apparatus, it is assumed that if enough externalities are incorporated into one of the tests, any rational approach to reducing energy usage in the built environment would be permissible and could pass one of these tests. However, studies by consultants to the California Energy Commission (CEC) have shown that this is not the case; commonly used externalities such as costs of carbon have little effect on improving the benefit-cost ratio of any of the tests when applied to ZNE development. (Goetzler, 2008) Unfortunately, it appears that promoting ZNE will never have a benefit-cost ratio much higher than one when only looking at the energy issues in isolation, limiting the ability of energy efficiency programs to promote ZNE unless methodologies and epistemology are adopted to balance social good against economic utility.

Under a pragmatic approach, energy efficiency programs are free to promote any approach to ZNE that is seen to be appropriate. ZNE building incentives survive the five cost-effectiveness tests by being judged as part of a portfolio of programs. But this does not allow ZNE development to stand on its own as an issue, and when the cost effectiveness of other parts of the program falter, funding will be stripped from the ZNE programs to support the overall portfolio. Therefore, the pragmatist approach will not be a sustainable approach to sustainable development; programs promoting low energy buildings must offer consistent incentives to gain traction in the market and must remain available for long periods of time to effect real change in patterns of settlement. To move forward we must combine the frames, myths and epistemologies of the actors to create a new approach, a new collaborative rationality. (Habermas, 1981)

Collaborative Rationality

One of the greatest flaws of energy efficiency planning is a lack of reflection and open dialogue that allows parties to speak honestly and discuss the "warts" inherent to the process. To give an example, in the development of a utility rate case process, in order to move from the current pragmatist approach utilized by many energy efficiency programs to a truly collaborative approach we might begin by analyzing the volumes of communication and transcripts from past energy efficiency rate cases to understand who are the key actors, what are their positions, how these positions are interdependent, and to bring to light how their filings reflect a complex host of goals, values, commitments, obligations, senses of self and others. By conducting this analysis, we would begin to deconstruct the “technical-instrumental” and “moral-practical” dimensions of energy efficiency practice. (Forester, 1993, pg. 5) This reflection is necessary for eventual “authentic dialogue” to occur because it gives the facilitator of a collaborative process a method to bring divergent organizations together in a way that preserves their diversity but promotes interdependence, giving legitimacy to the process and outcomes. (Innes and Booher 2003)

Authentic dialogue[7] is critical to true collaborative planning because it allows a “collaborative rationality” to emerge. This new rationality, defined by the actors in the process, would be the basis for a ZNE policy, and would represent the collective meanings, identities, and heuristics of the team that participated in the process. Collaborative planning is therefore a process that empowers stakeholders by elevating them to the level of decision-makers through authentic dialogue, dependent on a diverse and interdependent set of interests.

Collaborative planning has been effective in solving other “wicked” problems, most notably in Sacramento where the Sacramento Water Forum spent five years in an intensive consensus building process to manage their limited water supply (Innes and Booher 2000; Innes and Booher, 2003; Innes and Booher, 2010). For the first time in California history, a collaborative group was convened that included eighteen state and federal agencies that had jurisdiction over California’s water supply. The collaborative planning process allowed the wide variety of stakeholders to create a collective set of decisions which they were willing to defend to the larger public, and new relationships between former adversaries allowed for creative problem solving that went beyond what would have happened if each organization had entered into a traditional litigation process. While water policymaking is an arena where the most sophisticated collaborative dialogues are occuring, experiments in collaborative thinking are going on in many other arenas, including fiscal reform, school reform, habitat conservation, transportation planning and planning for sustainable development (Innes and Booher 2004, pg. 4)

To our knowledge, true collaborative planning has not been attempted in the past related to energy efficiency and renewable energy, but engaging in such an effort would be timely because many state public utility commissions are planning to leverage billions of dollars in public goods charge funding to support ZNE development. (CPUC, 2009) By engaging in collaborative planning we might allow energy efficiency programs to truly support ZNE that could not have occurred in the past. The result might be communities that are socially inclusive, sustainable, and climate neutral. (Blanco et al., 2009; Blanco et al., 2009a)

Conclusion

Human behavior, including worldviews, myth making, and ways of knowing, have been largely overlooked in energy policy despite the fact that social impacts of energy use have a significant effect on the results of any energy program. Any frame, myth or epistemology is an incomplete truth, and therefore lacks the complete ability to serve the diverse set of needs in our communities. To create whole truths we need to engage in authentic dialogue on the way to

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[7] The concept of authentic dialogue is borrowed from the Frankfurt School of critical theorists, especially Jurgen Habermas (Habermas, 1981). His theories are widely considered to be the foundation of collaborative planning that was later described by Forester, Healy, Dryzek, and Innes/ Booher (Forester 1980; Healy 1992; Dryzek 1990; Innes and Booher 2010).

creating a collaborative rationality that is a reflection of all of the actors in the ZNE process. Only then will we begin to achieve the deep reductions in greenhouse gas emissions necessary to stabilize the global climate system.

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