Barriers to Non-Compressor Cooling: Air Conditioners in Social Context

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As part of a study sponsored by The California Institute for Energy Efficiency (CIEE), we report the results of 82 interviews regarding the experience and the possibility of selling homes without compressor air conditioning (AC) in "transitional" (between cool and hot) climates. The interviews with residents indicate that non-AC construction is a viable option from a comfort perspective, and reveal several strategies for staying cool without AC, including altering the "meaning" of the heat. The interviews with industry representatives reveal several barriers to the acceptance of alternative cooling strategies. Implications for "degrading" the AC are discussed.

Introduction

In 1993 the California Institute for Energy Efficiency (CIEE) initiated an ambitious project aimed at encouraging the substitution of non-compressor cooling for conventional AC in new construction in California's "transition" climates—those areas situated between the relatively cool coast and the relatively hot (in the summer) central valley. The project involves a group of building scientists whose task is to research technologies that separately or in combination might substitute for AC and to suggest actual designs that would incorporate these technologies. It also includes a sociologist charged to research the real or imagined barriers to the widespread public acceptance of these and similar designs. In this paper we report the first results of the sociological portion of this inquiry. As "first results" the findings are inconclusive but plainly sufficient to shift the burden of proof to those who take the need for compressor air conditioning for granted.

The impetus for the study derives from the fact that compressor air conditioners create an enormous summer afternoon peak electrical load, combined with the emergence of approaches to building that promise greater comfort with less energy: thermal mass, new approaches to evaporative cooling, efficient night venting with or without whole house fans, phase-change sheetrock, and so on (Feustel et al. 1992). Joe Huang has estimated the potential savings from substituting non-compressive for compressive cooling to be 32 GWh annual per year and 86 MW peak per year in new construction and 1360 GWh annual and 2 GW peak from retrofits (Huang 1994), so the battle seems worth engaging. Thoughts of substitution are further encouraged, however, by the apparent fact that much current AC installation is not precisely climate-driven—that, as one of our informants, a Realtor, suggested, the air conditioner has achieved the status of a "standard" feature of a modem home, so that it now appears in new construction in climate zones where it was rare until recently and is not really "needed."[1]

We went "into the field," then, to see how much resistance to the attempted displacement of the AC could be anticipated, and to try to formulate procedures for neutralizing this resistance.

"Comfort" Without Air Conditioning

We conceived of our first task as that of examining the actual experience of persons living in non-AC new housing through the valley's summer heat; to do this we first conducted two interviews with each of the two adults in twenty households in a "cohousing" project in Davis, one interview in the Spring, before the heat, and a second toward the end of the Summer. This is a population of relatively well-educated, relatively young first-time homeowners living in a community where energy conservation is not a deviant commitment; thus it constitutes a "weak" test of the hypothesis that the air conditioner is not essential to well-being, but the test is also "strong" insofar as this is, by conventional appraisal, not a "transitional" climate zone—it is a hot setting in the summer. The residents had a major role in designing the housing, and although the houses were pre-plumbed to receive AC units none were installed.

The central finding of this inquiry was that none of our interviewees expressed a desire to install AC as a result of their summer experience. There were, however,

demurrers; especially in two-story homes, the "upstairs problem" was frequently noted, and there were several residents who expressed a desire for additional coolth—the value of a whole house fan, for example, being noted in several cases. But there were a number of interviewees who indicated their surprise that the homes had "performed" as well as they had.[2] There were also several testimonies to the effect that the "temporary" nature of the heat—there is a strong diurnal swing in the temperature in this setting, with rapid evening cooling characteristic of arid climates—made it seem more tolerable.

In a second set of interviews we talked to twenty-two residents of a long-standing subdivision of detached single-family homes in Davis that had been built with energy conservation (and in several homes 'alternative' energy, especially solar panels for heating water) as one of its features. Here again the population is distinctive in its apparently "green" orientation, but nonetheless the findings are very suggestive: several of our interviewees denied being, in effect, "religious" about conservation but it was clear in almost every case that the character, siting, landscaping and "management" of these homes had vitiated the need for conventional AC.

A second and earlier study of "cooling behavior" in Davis (Hackett and Lutzenhiser 1991) offers additional support to the idea that the AC may be dispensable in this setting. This research tracked the process of converting a "student family" housing complex from "master" metering of energy consumption (the total energy bill for the complex is divided equally among the tenants and included in the rent payment) to separate meters and accounts for each apartment, and examined the consequences of this change for energy consumption. In a virtually collective response that surprised housing officials and even several of the tenants, the tenants with few exceptions dealt with this new requirement that they "pay for their own energy" by simply turning off their air conditioners. This was true even of those residents who stood to pay less for their energy under the individual account system than when they paid the average for the complex. But it may be even more significant that this change did not appear to be simply reactive and temporary; tenants interviewed in the summer a year after the conversion were still very restrained in their AC use, and very few of them were of the view that this change had compromised their comfort.

Is the Demand for Air Conditioning "Inflated?"

The dominant "conventional wisdom," in our experience of it, is that in this setting the air conditioner needs no special explanation. But its widespread recent appearance in "transitional" settings, combined with the kinds of conduct and experience revealed in these interviews, raises the question of whether the need or even the desire for AC has come to be taken for granted to a degree that is not clearly warranted by experience itself. If this is so it may owe much to changes in the organization of the housing industry-the emergence of large national development firms that may achieve significant economies by "standardizing" features of homes that were once optional or, as in the case of AC, appropriate only to particular settings.

Other forms of standardization may have similarly questionable consequences, as in the domination of what might be termed "central tendency" thinking in research on thermal comfort and its reflection in current HVAC systems design. Fanger's classic thermal comfort research, for example-in which room temperatures are adjusted until experimental subjects report having neither warm nor cool sensations—has been the basis for the sizing and design of heating and cooling systems, that these might be adequate to keeping persons within the measured "comfort zone" (Fanger 1972). But the emphasis on "thermal neutrality" directs attention neither to what is thermally desirable nor, more importantly, to what is acceptable to subjects, and it is important to note that these data are, as are all data, the product of the method used to produce them and the situation of their production, such that "real world" variation and diversity is muffled.[3]

By contrast, the importance of variation in energy consumption patterns, and the concomitant growth of "disaggregated" models of energy use, has been a rapidly growing theme in behavioral energy research (Schipper et al. 1985; Stern 1992; Lutzenhiser 1993). The relevant preferences and conduct (not always the same thing) vary by culture, gender, age, ethnicity and other bases of social differentiation, suggesting that standards of comfort and discomfort are social and learned, that standards attach themselves to persons and not simply to bodies.[4]

Our interviews produced a fund of material on the variable and situational meaning of comfort, warmth and coolth. For example, it seems plain that there is a distinction to be made between "private" and "public" comfort standards: my heat, for example, is a good deal more tolerable than the same heat when experienced by my guests.[5] A related consideration has to do with the question of whether the heat is "temporary," one informant telling us that "I know the late afternoon heat will soon be gone, but when my family visited [from Chicago] they didn't, so for them the heat was a lot less tolerable. " Yet another variation on this theme supports the notion that control is an important variable-a "political" consideration, perhaps—in determining heat-tolerance: the fact that the cohousing residents had participated in the decision not to install AC, coupled with the fact that the houses were

pre-plumbed for the discretionary addition of AC if that seemed necessary, seems from the results of several interviews to have implied that the heat was, at least in part, their own decision, and hence more manageable.[6] Another commentary suggests a different way in which the meaning of the heat can be decisive in determining the experience of it, and in doing so strongly challenges a purely "physical" interpretation of warmth: one gardener-interviewee told us that "I sun-dry a lot of tomatoes in the hot summer heat here, so I think of the heat as useful, and welcome it."

Living without AC in a warm climate involves the use of "coping strategies" —paying attention, for example, to late-afternoon swimming possibilities or naps, or arranging to have time for reading in front of a fan during that period. We also found it provocative that some of our informants, a few of whom were opposed "in principle" to the use of AC, nevertheless were inclined to time their visits to air-conditioned supermarkets during the hottest part of the day, and to embrace AC in their cars if not in their homes; the suggestion here seems to be that "artificial" coolth is legitimate if it can be experienced as "incidental" to activities that are understood to be something other than "cooling." There are, of course, other considerations that can legitimate AC without impugning one's reputation as a person who doesn't need it: dealing with health issues, for example, especially with the problem of allergies, or with issues of security, which may make the opening of one's home to nocturnal venting seem imprudent.[7] Our overall impression, however, was that most of those we interviewed did, in fact, "cope" reasonably well with the heat, employing sometimes arcane skills that at least one "progressive" builder we talked to—the builder of the cohousing project—thought were in short supply, both in the building and in the thermal management of homes, due to the air conditioner itself: "The air conditioner," she said, "has made us very stupid."

And another possibility, one that is not directly supported by these data but is consistent with them, is that the presence of the AC has in itself influenced what people mean when they imagine a "comfortable" setting. It is a summer commonplace in this setting that persons leaving an air-conditioned market on a hot afternoon will experience the climate as much warmer than it was before they entered, and this may serve as an abbreviated confirmation of the idea that the use of the air conditioner may create a dependency, a quite physical conception of the heat "problem" that conforms to and makes appropriate the AC as a "solution." It may be an overstatement to imagine the AC as "addictive," but reasonable to think that the air-conditioner-in-use serves not only to manage the heat but to indicate the magnitude of the user's discomfort. An important hypothesis to consider, then, is that the AC is essentially self-justifying, making our experience of the climate seem hot enough to warrant its use. If this is so it would, for example, be worthwhile to inquire as to whether the thermal "reputation" of communities is historically altered, with the increased saturation of AC in the housing stock, so that they are experienced as warmer than in the pre-AC era.

The View from the Industry

If compressor cooling is now conventional in settings that are conventionally understood to be hot, these interviews add up to a "deviant case" analysis; they raise the possibility that the convention itself, although widespread, has shallow roots, and they offer a precedent that might be useful in changing it. To make this kind of change, however, requires cooperation from the various components of the housing industry. To gain an initial sense of the likelihood of such cooperation we interviewed twenty-one industry representatives—divided about equally between architects, builder/developers, Realtors and HVAC installers-working in or near one of California's "transition" climate zones.[8]

As we expected, if this group were voting today non-compressive cooling would not be a strong candidate, but there was also a provocative degree of variety in their views. Sixteen of the 21 agreed that the AC was "important for comfort" in that region, although nearly half of the sixteen qualified this by noting that this was especially true in the eastern, more inland sector of the region. At the same time, 15 of the 21 said that it was possible to sell a home that was not equipped with an AC; but the qualifications to this possibility were legion: such a sale would be likely to take place only at the coolest edge of the region, or only in a "custom" home, or only if the AC were sacrificed to affordability (as in a "starter" home, or low-income housing). We had a somewhat surprising response to the question of whether a non-air conditioned home could sell if it were pre-plumbed for AC but the AC not installed: over half the interviewees professed to not having heard of this arrangement and offered some version of a positive response—the idea was "interesting" or "worth a try" or, in two cases, "great." Two builders said that they had built a number of pre-plumbed ("air prepped," we learned) houses and had not had negative results, but one Realtor commented that she thought this "a ploy on the part of the builder, to get more money for doing what ought to be standard [installing the AC]."

As we also suspected would be the case, there seemed evidence from these few interviews of real diversity within this group, much of it related to occupation; the architects were clearly the most inclined to be comfortable with non-compressive sources of comfort and the Realtors

the least, with HVAC installers and builders in between—although, again, the qualification of responses with respect to micro-climates and the limited number of interviews makes these distinctions unstable. When we asked where in the industry the strongest barriers to non-compressive cooling would be found, however, there was widespread mention of Realtors, appraisers and lenders—those most immediately involved in establishing value and in completing sales. Our sense is that the builders themselves tend to be perceived within the other sectors of the industry as essentially opportunistic, willing to build whatever can gain a good appraisal and sell.[9]

We did have one, potentially very significant, observation that was repeated in some form by six of those interviewed, four of them Realtors: that there is a significant market for "older" homes in the area and that older homes, regardless of the climate, are not "obligated" to have AC. If people will buy an old, but not a new, home without AC, then the presumption of near universal consumer demand for thermal comfort requiring air conditioning is called into question. Our data suggest that when AC is not part of the social context that people relax their demand for thermally neutral surroundings. Applying this observation to the new home market suggests that people expect standard central air conditioning not only because of what it does, but because a new home without AC is substandard, or deviant.

"Degrading" the Air Conditioner

We take it to be the case that the compressor air conditioner is "expendable," especially but by no means exclusively in "transition" climates, if that expendability depends only on climate, building technologies and the experiences of consumers. If this is so then what needs attention, in our view, is the social *meaning* of the AC, its "semiotic" significance. As things stand, the central AC as a standard feature of new construction is not only an ingredient in the dwelling but an indicator of its quality. To building scientists and to "progressive" actors in the housing industry, however, the AC is an indicator of something quite different: it is an indicator of a *poorly* constructed dwelling because it is that device that is required to remove heat that should not be present at all. The builder who constructed the cohousing project stigmatized the air conditioner telling us that "The air conditioned house is a *handicapped* house." What this reasoning does is to open the door to the eventual inclusion of the AC in the same category as certain other relatively dormant technologies, some of which may be scheduled for revival (one conventional builder said to us "The evaporative cooler? Absolutely obsolete. I can hardly bring myself to even think about it").[10]

While it is no doubt crucial to gain an audience and a hearing for this line of reasoning, the important place given to convention and to normality in building and to precedent in appraising means that, as a practical matter, alternative cooling technologies will be widely "adopted" only *after* they are actually utilized and experienced in existing dwellings. As with any "emergent" technology, alternative cooling technologies are subject to a classic chicken and egg dilemma. Few people have experience with state of the art alternative cooling, instead they may remember a poorly maintained swamp cooler in an old rental house or, worse, a sweltering August weekend in a modern ("handicapped") home waiting for a Monday visit by the HVAC repairman. Until non-cooling houses begin to be seen in light of their design and construction *quality* and are common enough that they are not seen as "deviant," the potential market for such homes will not be tapped by a cautious and conservative building industry. This gives an important place to the reporting of experiences such as those reported here, but it probably also means that care should be taken not to "undercapitalize" early construction of alternative dwellings. A "non-cooling" or non-air conditioned home in the midst of conventional dwellings is an instance of deviation, not variation; a non-air conditioned home in a subdivision of similar dwellings is an instance of normality, to say nothing of intelligence.

Endnotes

1. We should note that it can be persuasively argued that air conditioning is not "appropriate" anywhere in California, since the AC removes heat by removing moisture. California is either cool in the coastal regions or relatively hot and arid in the valley during the summer; in the latter setting, then, the AC is an inappropriate dryer in an already-dry climate.

2. These houses are well-insulated and both constructed and sited to maximize their thermal integrity, but in two other respects they offer the "strong" test of the notion that the AC is not a necessity: the many small children in a community of young parents make it difficult to keep the homes closed to the loss of coolth, and the new landscaping means that there is virtually no help offered from evapotranspiration from shrubbery and trees.

3. de Dear (1992) defends research in the Fanger tradition by noting that "thermoneutrality" research yields the same results in a variety of cultures, but he fails to note that as long as the measurement procedures and the settings are the same these "cultural" variations have no way to manifest themselves. Thermal preferences are situational.

4. Our preliminary assessment of air conditioning load-shape data for several individually monitored houses in the California central valley, provided by Joe Eto at LBL, suggested highly variable AC-use "profiles" or "signatures;" some homes appear to be oriented to "seasonal" use, others to "daily peak" use, still others to "situational" use and some to relatively idiosyncratic "personal" use, for example, but we have as yet no way to attach these variations to other social markers (e.g. occupation, gender).

5. One of our interviewees made a suggestive analogy here to the idea of a "messy" room: "*my* mess is not the same as, and it's certainly more tolerable, than *a* mess. "

6. This supports the general argument that when people control their own thermal environment, whether in homes or workstations, their "comfort zone" is much broader than when they do not (Givoni, 1992; Ed Arens, personal communication, 1993).

7. One surprising finding of this research was that intelligence about proper procedures for night venting seemed in short supply, even among many of those who relied on it for cooling their residences. Houses would routinely be closed, for example, at 9 a.m., when residents would begin to experience the day's warmth, but nearly two hours after coolth was maximum and heat gain had begun.

8. The region is located at the northeastern edge of the San Francisco bay area; the respondents were drawn primarily from the communities of Concord, Benecia, Antioch, Pleasanton and Walnut Creek.

9. The next phase of this study includes several interviews with lenders, appraisers and building inspectors, and a second round of interviews with the same kinds of actors interviewed thus far. In the next phase our informants will be asked to assess actual building plans and elevations.

10. We note, incidentally, that in several of our interviews on both the consumer and the industry sides there were expressions of warmth toward the evaporative cooler, in every case by persons who had "grown up" with or otherwise utilized this device—further evidence, we think, that technologies tend to be self-justifying, that comfort "standards" are adjusted to the capacities and the qualities of the devices that "meet" them.

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