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**Energy Conservation for Hot Water May
be in Tension with with Public Health
Outcomes**

NOTE TO READERS

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**Hot Water Energy Conservation has
Environmental/Affordability Benefits, but
Care Must be Taken to Avoid Adverse Health
Outcomes**

Controlling the energy consumption associated with hot water usage in the home has important environmental and affordability implications. Hot water energy consumption can be the third largest end-use of energy in the home, behind only electric appliances (including lighting but not refrigeration) and space heating.¹ According to the U.S. Department of Energy (DOE), nationally, the average annual energy expenditure for residential hot water is \$291, compared to an expenditure of \$1,810 on a household's total home energy consumption.²

To a low-income household, the expenditures on energy for hot water can be significant. The DOE's 2005 Residential Energy Consumption Survey (RECS) reports that households with income below Poverty Level using natural gas for water heating spend, on average, from \$335 (East South Central Census Division) to \$242 (East North Central Census Division)³ annually to heat water.⁴ Low-income households using electricity for hot water spend between \$343 (New England Census Division) and \$226 (East South Central Census Division) each year.

¹ 2005 RECS, at Table US14. Total household consumption (million Btu) nationwide reaches 94.9 mmBtu, with 40.5 mmBtu representing space heating, 24.7 mmBtu representing appliances (including lights but not refrigeration), and 19.2 mmBtu representing hot water.

² 2005 RECS, at Table US15. Expenditures on electric appliances nationally reach \$647, while space heating expenditures nationally reach \$534.

³ The RECS divides the country into nine Census Divisions: New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain and Pacific.

⁴ 2005 RECS, Table WH8.

To some low-income households, the expenditures on energy for hot water can be particularly significant. Even aside from the impact on the total energy bill,⁵ tenants of public and assisted housing⁶ are often eligible for a bill subsidy called a “utility allowance.” By providing a financial assistance amount designed to offset utility costs, HUD can maintain the statutorily-mandated limit of total shelter costs⁷ at 30% of income.⁸ Utility allowances are established on an end-use basis; separate allowances are set for space heating, water heating, appliances and refrigeration.⁹ As a result, ac-

⁵ For households with income below Poverty level, hot water expenditures represent \$259 of total energy expenditures of \$1,485. For households with income below \$10,000 per year, without taking into account household size, hot water expenditures represent \$226 of total energy expenditures of \$1,353. 2005 RECS, Table US15.

⁶ Public housing represents housing units owned and operated by local Public Housing Authorities. Most “assisted housing” is comprised of units subsidized through the federal “Section 8” program.

⁷ Total shelter costs include rent plus all utilities (except telephone).

⁸ “In 1969, the Housing Act was amended in a fundamental respect: the Brooke Amendment, Pub. L. 91-152, 213, 83 Stat. 389, imposed a ceiling for rents charged to low-income people living in public housing projects, and, as later amended, Pub. L. 97-35, 322, 95 Stat. 400, provides that a low-income family “shall pay as rent” a specified percentage of its income. HUD has consistently considered “rent” to include a reasonable amount for the use of utilities, which is defined by regulation as that amount equal to or less than an amount determined by the PHA to be a reasonable part of the rent paid by low-income tenants.” *Wright v. Roanoke Redevelopment and Housing Authority*, 479 U.S. 418 (1987) (internal notes omitted).

⁹ See e.g., 24 CFR 982.517(b)(2)(ii) (2012). (“In the utility allowance schedule, the PHA must classify utilities and other housing services according to the following general categories: space heating; air conditioning; cooking; water heating; water; sewer; trash collection (disposal of waste and refuse); other electric; refrigerator (cost of tenant-supplied refrigerator); range (cost of tenant-supplied range); and other specified housing services.” (Section 8). See also, 24 CFR 965.505(b) (2012). “Allowances for both PHA-furnished and resident-purchased utilities shall be designed to include such reasonable consumption for major equipment or for utility functions furnished by the PHA for all residents (e.g., heating furnace, hot water heater), for essential equipment whether or not furnished by the PHA (e.g., range and refrigerator), and for minor items of equipment (such as toasters and radios) furnished by residents.” (public housing).

curately estimating hot water consumption in order to set an accurate hot water utility allowance can be worth hundreds of dollars of subsidy each year to tenants of public and/or assisted housing.

Influencing household behavior to control hot water consumption poses a dilemma for low-income service providers. On the one hand, lowering consumption can reduce bills and improve affordability. Reducing hot water consumption for public and assisted housing tenants can also allow Public Housing Authorities (PHAs) to set lower hot water utility allowances thus promoting more efficient and less expensive operation of housing affordability programs. On the other hand, reducing the energy consumption associated with hot water use in the home can pose substantial health problems if the health risks associated with lower water temperatures are not taken into account.

The tension between energy conservative behavior and health risks presents itself in particular when considering proposals to save energy by reducing the temperature of water maintained in a water heater tank. Reducing water temperature in a hot water tank to 120° is commonly viewed as a desirable energy conservation strategy.¹⁰ Others disagree that significant savings are associated with reducing the water temperature in the tank; this author has previously argued that energy consumption is driven by temperature at the outlet (e.g., faucet, showerhead), not temperature in the tank.¹¹ Nevertheless, in setting hot water utility al-

¹⁰ Contrast the recommendation of the U.S. Department of Housing Development. In its Guidebook on the preparation of utility allowances for public housing agencies, HUD recommended that “the suggested temperature for hot water *at the tap* in public housing is 120° F.” (emphasis added). Hebert and Nolden (1998). *Utility Allowance Guidebook for Optional Use by Public Housing Agencies*, at 51: HUD: Washington D.C. The HUD recommendation, in other words, clearly distinguishes between the water temperature in the tank and the water temperature at the tap.

¹¹ If the temperature in the tank is lower, water at the outlet must include a higher proportion of hot water in the mix in order to deliver desired temperatures at the outlet. Accordingly, what savings might be generated in the tank are offset by the higher consumption at the outlet. See e.g., Colton (2007). *The Law and Economics of Determining Hot Water Energy Use in Calculating Utility Allowances for*

lowances, PHAs often assume that a 120° temperature is an integral component of “energy conservative” behavior.

The discussion below explores the tension between health and energy conservation in setting hot water utility allowances. The consideration is merited by the dual regulatory mandates that utility allowances reflect the behavior of an “energy conservative household” while at the same time utility allowances must also provide for a “safe, sanitary and healthful living environment.”¹²

Asthma, Allergens and Demographics

A hot water tank temperature of 120° does not deliver water that is sufficiently hot to provide a safe and healthy living environment. In particular, hot water washing has been identified as a necessary activity to help control the asthma epidemic that is now facing the United States.

Asthma is a serious public health problem in the United States. According to the U.S. Environmental Protection Agency (EPA), nearly 25 million people have asthma. The EPA reports that “asthma accounts for over 15 million physician office and hospital outpatient department visits and nearly 2 million emergency department visits each year.”¹³

Every day in America:

- 40,000 people miss school or work due to asthma.

Public and Assisted Housing, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont (MA).

¹² 24 CFR 965.505 “The objective of a PHA in designing methods of establishing utility allowances for each dwelling unit category and unit size shall be to approximate a reasonable consumption of utilities by an energy-conservative household of modest circumstances consistent with the requirements of a safe, sanitary, and healthful living environment.” (relating to PHA owned and operated units). See also, 24 CFR 982.517 (Section 8 utility allowances).

¹³ U.S. Environmental Protection Agency (March 2011). *Asthma Facts*, at 1, EPA, Indoor Environments Division, Office of Air and Radiation.

- 30,000 people have an asthma attack.
- 5,000 people visit the emergency room due to asthma.
- 1,000 people are admitted to the hospital due to asthma.
- 11 people die from asthma.¹⁴

Asthma is a particular problem for children. It is one of the most common serious chronic diseases of children, and is the most common cause of missed school days,¹⁵ causing nearly 10.5 million missed school days each year. Asthma is the third-ranking cause of hospitalizations each year among children age 15 and under.¹⁶ Much of this is preventable.¹⁷ According to a report jointly published by the National Pharmaceutical Council and the Asthma and Allergy Foundation of America, as much as 40 percent of the risk of asthma in minority children is attributable to exposure to residential allergens that could be reduced, if not eliminated.¹⁸

Populations other than children also have a heightened risk. According to the U.S. Consumer Product Safety Commission (CPSC), “people who are inside a great deal may be at greater risk of developing health problems, or having problems made worse by indoor air pol-

¹⁴ Asthma and Allergy Foundation of America (2012). *Asthma Facts and Figures*, at 1.

¹⁵ Lowell Weicker, Jr. (2000). *Attacking Asthma: Why America Needs a Public Health Defense System to Battle Environmental Threats*, at 4, Pew Environmental Health Commission: Philadelphia (PA).

¹⁶ *Asthma Facts and Figures*, supra, at 1.

¹⁷ “Interventions to reduce [house dust mites] and food allergen exposure during the first 9 months of life have been reported to result in a decrease in the frequency of asthma. . . at 12 months of age suggesting that early allergen avoidance may indeed prevent the development of allergic diseases and asthma.” Vojta et al (2001). “Effects of Physical Interventions on House Dust Mite Allergen Levels in Carpet, Bed and Upholstery Dust in Low-Income Urban Homes,” *Environmental Health Perspectives*, 109(8): 815.

¹⁸ Mayrides and Levy (2005), *Ethnic Disparities in the Burden and Treatment of Asthma*, “Key Findings”. National Pharmaceutical Council and Asthma and Allergy Foundation of America: Washington D.C.

lution. These people include infants, young children, the elderly and those with chronic illnesses.”¹⁹ Senior citizens in the U.S. account for nearly 60% of the annual deaths due to asthma each year.²⁰

Asthma rates are higher in low-income communities.²¹ Social factors, including nutrition and poverty, are factors that cause both asthma development²² and exacerbation.²³ There is little question but that asthma disproportionately affects low-income persons. The Pew Environmental Health Commission reports:

Our analysis shows that the burden of asthma falls most heavily on those below the Poverty line. Our research and the research of others indicates that the prevalence rates of asthma among people living below the Poverty Level are significantly higher than the rates of Americans who are not poor. Our analysis shows that about 15% of asthma among the poor is attributed to poverty.²⁴

Pew continues:

There are also important integrations between social and environmental factors. The Institute of Medicine report on environmental justice found inequities in health risk based on low income and minority status. These inequities could result in more exposure to substances that cause asthma symptoms. Today, there is a substantial disparity in the impact of asthma that could have a significant social component; many studies have reported especially high rates of asthma hospitalizations and emergency room visits in low income, inner city and minority communities. Our re-

search shows that there is a strong relationship between asthma and poverty.²⁵

Exposure in early life to allergens is one of the primary "inducers of asthma."²⁶

Finally, asthma is not race neutral. Overall, the African-American mortality rate from asthma is 300% that in the white population.²⁷ In addition, the national rates for emergency department visits and hospitalizations are two to three times higher for the black population than for white.²⁸ For kids, nationally, childhood asthma causes absence from school for an average of about four days per year per child with asthma. Between 11% and 12% of Black children missed at least one day per month because of asthma, while only three to five percent of white children did.²⁹

Asthma and Hot Water

A discussion of asthma is significant within the context of considering hot water needs for public and assisted housing. The importance lies in the factors that cause either the development of asthma or the exacerbation of asthma (as these terms are defined above).³⁰ Controlling environmental conditions is an important aspect to controlling asthma. "It is expected that improving environmental conditions that asthmatics face will cut down on the number and severity of their attacks

¹⁹ *Id.*, at 1.

²⁰ *New Asthma Estimates: Tracking Prevalence, Health Care and Mortality*, NCHS, CDC, 2001

²¹ *Attacking Asthma*, *supra*, at 6.

²² *Id.*, at 9. Asthma development is initiation of asthma in persons without the disease. *Id.*

²³ *Id.*, at 9. Asthma exacerbation is the triggering of an asthma attack or worsening of an attack in a person with asthma. *Id.*, at 9.

²⁴ *Id.*, at 10.

²⁵ *Id.*, at A1-6 and A1-12. See generally, Institute of Medicine, Committee on Environmental Justice (1999). *Toward Environmental Justice: Research, Education and Health Policy Issues*, National Academy Press: Washington D.C.; Eggleston, P.A., et al. (1999). *The Environment and Asthma in U.S. Inner Cities. Environmental Health Perspective* 1999; 107 Suppl. 3:439-450; Sarpong, S.B., et al. (1996). "Socioeconomic status and race as risk factors for cockroach allergen exposure and sensitization in children with asthma," *J. Allergy Clinical Immunology*. 97: 1393-401; Claudio, L., et al. (1999). Socioeconomic factors and asthma hospitalization rates in New York City. *J. Asthma* 36:343-50.

²⁶ *Id.*, at 13.

²⁷ *Disparities in the Burden and Treatment of Asthma*, *supra*, at 8.

²⁸ *Id.*, at 9.

²⁹ *Id.*, at 13.

³⁰ See, notes 22 - 23, *supra*, and accompanying text.

and may diminish the number of people sensitized to environmental agents."³¹

The 1999 Institute of Medicine report *Clearing the Air* found a direct causal relationship³² between dust mites and both the development and exacerbation of asthma.³³ Dust mites, in particular, are an "indoor allergen"³⁴ that is subject to control (or mitigation) through appropriate household actions.

The availability of hot water is critical to the control of dust mites as a causal source of both the development and exacerbation of asthma. In addition to the seminal Institute of Medicine study linking dust mites to asthma, institutions ranging from the National Institute of Health (NIH)³⁵ to the American Lung Association³⁶ have reached the same conclusion.

The only way to effectively control dust mites is through hot water clothes washing. According to the American Lung Association, families with persons experiencing asthma should wash bedding and pillows in hot water of at least 130° F on a weekly basis. The American Lung Association says:

Dust mites are tiny, microscopic spiders usually found in house dust. Several thousand mites can be found in a pinch of dust. Mites are one of the major triggers for people with allergies and asthma. They need the most work to remove. . . Following these rules can

also help get rid of dust mites: . . . Wash all bedding every week in water that is at least 130 degrees F. . .³⁷

The American Lung Association recommendation is echoed by most medical opinion. Blue Cross/Blue Shield, for example, states that "families with members who have asthma can do the following to improve the home environment. . . wash sheets and blankets weekly in hot water (= or > 130° F)."³⁸ The Nemours Foundation, sponsors of the national Kids Health campaign, recommends that: "A family needs to take the environmental control measures that reduce exposure to a child's allergy triggers. . . The following are suggested environmental control measures for different allergens and irritants: . . . Wash sheets and blankets a child sleeps on once a week in very hot water (130° F or higher) to kill dust mites."³⁹

There is universal recognition of the fact that clothes-washing at temperatures equal to or greater than 130° is necessary to control the dust mites associated with triggering asthma. A publication jointly published by the U.S. EPA, the Consumer Product Safety Commission, the American Lung Association and the American Medical Association, states quite clearly that to control dust mites as asthma triggers, households should "wash bedding and soft toys frequently in water at a temperature above 130° to kill dust mites."⁴⁰

The Asthma and Allergy Foundation of America states that:

The first and most important step to reduce dust mites is to cover mattresses and pillows in zippered dust-proof covers. . . The next most important step is to wash the

³¹ *Disparities in Burden and Treatment*, supra, at 14.

³² Other categories of possible relationships included sufficient evidence of association; limited/suggestive evidence of association; and inadequate evidence of association.

³³ *Attacking Asthma*, supra, at A1-8, citing Institute of Health (1999). *Clearing the Air: Asthma and Indoor Air Exposures*, National Academy Press: Washington D.C.

³⁴ See, text accompanying note 37 for a description of dust mites.

³⁵ National Institute of Health and National Heart, Lung and Blood Institute (July 1997). *Guidelines for the Diagnosis and Management of Asthma, Clinical Practice Guidelines, Expert Panel Report No. 2*, at 46, National Institute of Health: Washington D.C.

³⁶ American Lung Association (2000). *Home Control of Allergies and Asthma*, at 3, American Lung Association: Washington D.C.

³⁷ *Id.*, at 3.

³⁸ Blue Cross/Blue Shield of Texas (2000). *Staying Healthy: Chronic Diseases: Asthma*, at 7 - 8, Blue Cross/Blue Shield of Texas: Austin (TX).

³⁹ Nemours Foundation (2000). *Kids Health: Asthma: Environmental Control Measures*, at 1, Nemours Foundation: New York.

⁴⁰ Environmental Protection Agency (et al.). *Indoor Air Pollution: An Introduction for Health Professionals*, at 10.

sheets and blankets weekly in hot water. Temperatures of at least 130 degrees F are needed to kill dust mites.⁴¹

The Alliance for Healthy Homes offers identical advice.⁴² The temperature of the water used in the laundry process is critical. According to the U.S. Consumer Product Safety Commission, “always wash bedding in hot water (at least 130° F) to kill dust mites. Cold water won’t do the job.”⁴³

There is an economic component to the use of hot water as well. According to one study of asthma prevention:

Despite the reputed health benefits of indoor allergen avoidance, particularly for asthma patients, inexpensive, practical and effective methods for home allergen control remain illusive. This may be especially true for residents of low-income urban areas, who often have limited resources available to apply toward home allergen mitigation interventions.⁴⁴

Nonetheless, hot water washing, in combination with the use of “allergen-impermeable covers” were then found to reduce dust mite allergen levels.⁴⁵

Summary and Conclusions

Not all energy reduction strategies are wise actions to take. In particular, setting hot water tank temperatures at 120°, even if assumed to be an effective usage reduction measure, which is debatable, can result in substantive adverse health outcomes. One result of lowering hot water temperatures in the tank is to preclude the ability of low-income households, including ten-

ants of public and assisted housing, from achieving the end-use hot water temperatures needed to provide a safe and healthy living environment.

The water temperature achieved “at the outlet” (whether that involves a faucet, a showerhead or a clothes-washer) is a function of the mixture of the hot and cold water delivered to that tap. In turn, the ultimate tap temperature is a function both of the temperature of the hot and cold water inflow and the proportion of hot and cold water which is combined one with the other at the tap.

Mixing water can only *reduce* the temperature of hot water at the outlet. If the water in the tank is 120° without a booster heater on the washing machine, in other words, the temperature of the water in which clothes are washed will, of necessity, be less than 120°. Unless, therefore, Housing Authorities provide clothes washers which heat water to the necessary temperatures through booster heaters, rather than mixing hot water from the tank to achieve the water temperatures in the wash cycles, the provision of 120° temperatures in the hot water tank is at odds with existing medical recommendations on how to control the disease of asthma.

One of the primary ways to reduce home energy bills, and thus improve affordability, for low-income households is through the pursuit of energy conservation measures. One measure commonly recommended is the reduction of hot water temperatures in the home to 120 degrees (F).

Care must be taken in the implementation of this energy conservation recommendation. While reducing hot water temperature to 120 degrees at the tap may be appropriate, reducing temperatures to 120 degrees in the tank may have adverse health consequences.

For more information on the consideration of hot water energy usage in the preparation of utility allowances for public and assisted housing, please write: roger[at]fsconline.com

⁴¹ Asthma and Allergy Foundation of America (2012). *Dust Mites*, at 2

⁴² Alliance for Healthy Homes, *Health Hazards: Prevention and Solutions: Insects*, at 4.

⁴³ U.S. Consumer Product Safety Commission, *Biological Pollutants in Your Home*, at 6, CPSC Document #425.

⁴⁴ *Effect of Physical Interventions*, *supra*, at 815.

⁴⁵ *Id.*, at 818.

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