**BEFORE THE**

**COUNCIL OF THE CITY OF NEW ORLEANS**

**APPLICATION OF ENTERGY NEW ORLEANS, LLC FOR A CHANGE IN ELECTRIC AND GAS RATES PURSUANT TO COUNCIL RESOLUTIONS R-15-194 AND R-17-504 AND FOR RELATED RELIEF**

**)**

**)**

**) DOCKET NO. UD-18-07**

**)**

**FIRST DRAFT REBUTTAL TESTIMONY OF**

**MICHELLE P. BOURG**

**BY**

**MYRON B. KATZ, PhD**

**AND**

**FIRST DRAFT DIRECT TESTIMONY OF**

**MYRON B. KATZ, PhD**

**ON BEHALF OF**

**BUILDING SCIENCE INNOVATORS, LLC**

**NOVEMBER 2018**

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Exhibit MBK VS MPB-1 *The Gaslight Era Is Ending All Over Again*

Exhibit MBK VS MPB-2 Minnesota 1987 Variance Criteria restricting Decorative Gas Lamps

Exhibit MBK VS MPB-3 **Smart & Sustainable Cities Committee Meeting Agenda Oct 30, 2018**

# **Exhibit MBK VS MPB-4 Closed Crawl Spaces**

Exhibit MBK VS MPB-5 Gas Distribution Business Function Descriptions

1. INTRODUCTION

Q1. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Myron B. Katz, PhD. My business address is 302 Walnut, New Orleans, Louisiana 70118.

Q2. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

1. I am currently employed by Building Science Innovators, Inc. (“BSI”) as the Director of Research. In this capacity, I oversee all research, development, advocacy, innovation and policy development in service to the needs of and relevant to New Orleans, its buildings and common architecture, the energy flows through these buildings — in the face of a rapidly changing and threatening climate, the current and long-term welfare of its citizens, infrastructure, environment, as measured via economic costs of living, sustainability, reliability, durability, and health of its citizens and the various utilities that these buildings, structures and people depend. My specific responsibilities include budget constrained promotion and protection of safety, compliance with applicable building codes regulations, repairing those codes, recognizing and repairing broken paradigms in these above fields and as well as construction, maintenance, engineering, planning, and real-time system monitoring and dispatch for the storm-water, potable water, gas and electric distribution systems.

Q3. ON WHOSE BEHALF ARE YOU SUBMITTING THIS REVISED DIRECT TESTIMONY?

1. I am submitting this testimony before the Council of the City of New Orleans (“Council”) on behalf of Building Science Innovators, LLC.

Q4. PLEASE DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND.

A. I earned a doctor of mathematics from University of California, Berkeley in 1976 following a BS in mathematics at Louisiana State University a few years earlier. In the first half of the 1980’s, I co-initiated and led with Gary Groesch, Councilman Joe Giarrusso, and Councilman Jim Singleton, two referenda, GET NOPSI BACK, which eventually succeeded in transferring regulatory control of NOPSI back to the City of New Orleans by May of 1985. At the end of that year, I co-founded with Gary Groesch, Karen Wimpelberg, Thomas Lowenberg, and Betty Wisdom, the inception, naming, set-up and first steps that lead to incorporation of the Alliance for Affordable Energy. During the next two years, 1986-1987, I was the energy consultant to Billie Guste, Louisiana Attorney General in his successful legal action to legally establish that over $2 billion invested in the construction of the River Bend Nuclear Power plant imprudent. In the next few decades, I earned professional credentials as a certified Home Energy Rater, Indoor Environmentalist, Real Estate agent, and a Home Energy Rater Trainer. With Norman Witriol and Jinson Erinjeri, I have published research on innovations in home energy performance testing. Since Hurricane Katrina, I have given numerous talks at Louisiana State Engineering Society’s annual conferences. Those talks followed my critical role as one of the two, principal, behind the scenes co-leaders supporting the development of the *Energy Hawk*, in November 2007, the report of 1.5 years, of thousands of hours of volunteer efforts — called “The New Orleans Energy Policy Taskforce.

Q5. PLEASE DESCRIBE THE PURPOSE OF YOUR TESTIMONY.

A. The purpose of my testimony is to point out numerous problems with Entergy New Orleans’ (ENO) approach to its gas distribution business that in many ways is contributing to higher costs for the energy services natural gas provides and the many problems associated with the way the distribution system is maintained and upgraded.

Finally, my testimony points out ENO’s approach to gas distribution is fundamentally ignorant of the needs of its customers, whether they are economic, environmental, health, durability or sustainability… many of these are fundamentally at odds with the purposes upon which a utility should be focused.

**ASSERTIONS:**

**By a 1979 U.S. Department of Energy rule, Gas Lamps have been “illegal” in the US since 1982.** Although exemptions for historic areas can be applied for (and perhaps should be granted in very limited cases), this process has never happened in New Orleans with the result that gas lamp use has increased in New Orleans in the last 3.5 decades instead of being completely curtailed at that time. See Exhibit MBK VS MPB-1 *The Gaslight Era Is Ending All Over Again* and Exhibit MBK VS MPB-2 Minnesota 1987 Variance Criteria restricting Decorative Gas Lamps.

**Since 2016, DOE’s rules, GENERALLY SPEAKING, prohibit gas lighting IN PRINCIPLE because it rules out “any kind” of “general purpose” lighting that is less efficient than 45 lumens per watt (lm/W). However, gas lamps are less than 1/10 as efficient as the now obsolete and by and large “illegal” incandescent lamps installed many decades ago largely to replace gas lamps**.[[1]](#footnote-1)

**The gas repair maps published by MPB are wrong at least in some places.** My home, at 302 Walnut St, (Corner Coliseum west side of Audubon Park) is listed as within a completed area (ENO Exhibit MPB-3 ENO 2018 Rate Case Page 1 of 1), but 302 Walnut is not completely serviced by plastic or high-pressure pipes and in fact the effort to start that process only started in October 2018, months after MPB submitted her testimony. But that process will fail at my home for some of the following reasons. Moreover, without my (the owner’s) permission or notice, at 3430-3432 Dryades, high pressure plastic pipe was installed but by so doing ENO violated the closed crawlspace walls and thereby both increased energy use and decreased durability of that shotgun double.

**Gas service line installations hamper crime prevention**. Recent crime at 3430 – 3432 Dryades St has “encouraged or required”, me, the owner of that property, to maintain closed locks on all gates that provide access to the front and side yards and thereby its gas and electricity meters. This will, necessarily impede, restrict or make impossible for a gas meter reader to make timely readings. This can be avoided by the installation of remotely readable meters which I know exist and that these are commonly serviced by ENO gas electric meter reader personnel because one of my clients located on Jackson Avenue has such meters. I have requested them for both 3430 Dryades and 302 Walnut Street for the same reasons: to allow me to make those properties more secure against crime and keep my gates locked at all times. However, I have had no success reaching appropriate personnel at ENO to provide that installation service.

**Gas service line installations hamper stormwater management.** As pointed out by more than one of the speakers and leader of a branches of City of New Orleans government agencies as well as private companies interested in stormwater problems at the October 30, 2018, **SMART AND SUBSTAINABLE CITIES COMMITTEE, the city is very low on the use of French Drains: we need more and we need to preserve whatever French Drains we still have. However, the installation of a plastic, high-pressure gas line right in the middle of a French Drain at 3430 Dryades may have compromised it and will probably further compromise it when the pipe and pressure-reducing value is relocated to where it belongs: in the crawlspace. See Picture. I can demonstrate that recently completed shoring work at 3430-3432 Dryades implies (asserts?) that the side of the home that had a well-functioning French Drain, 3432 Dryades, experienced substantially less pier subsidence than the other side, i.e., the side that had concrete covering over its original French Drain at 3430 Dryades. See picture.**

**Gas service line installation hampers Primary Energy Conservation by Environmental Coupling.** Before gas lines were upgraded to high pressure at 3430-3432 Dryades, cementitious, HardiPanel™ wall-boards were attached to fill the area between piers in order to enclose the crawlspace. Show Picture. This a well-established (seeExh**ibit MBK VS MPB-4 Closed Crawl Spaces)** means to lower energy consumption for homes in our and similar climates because the ground under a home in New Orleans is warmer in the winter and cooler in the summer than an occupant would set the thermostat during the heating and cooling seasons, respectively. Thus, a home with an enclosed crawlspace will have dramatically lower energy bills in both situations and far superior comfort for the inhabitants of that structure. When the high-pressure gas line was installed at 3432 Dryades, that installation included demolition/removal of the same HardiPanel wall segment just mentioned proximal to the gas meters and thereby grossly undermined the air-barrier separating the closed crawlspace air-volume and the ambient air and, thereby, raised cooling loads in the summer and heating loads in the winter.

# Gas Service line installation hampers durability of homes. It is well known for those in my industry (Exhibit MBK VS MPB-4 Closed Crawl Spaces) that fiber-batt (and for that matter almost any other kind of) insulation system installed between joists over an open crawlspace creates a range of moisture problems for a home in New Orleans. These homes were built decades before AC technology was commonly employed in New Orleans. Although this may have caused few problems when AC technology was first installed around in 1950, because at that time, 1) the outside dewpoint was much lower at that time than now and 2) cooled temperature of the building provided by such equipment was substantially higher: little to no moisture accumulation will happen at a building shell. However, two things have drastically changed: more effective AC equipment has been installed and homes are becoming progressively tighter and Global Warming has raised the average dew point outside from normally well below 73F to normally above 77F. This new situation inverts the temperature gradient so that the outside, ambient dew point is higher than the inside cooled building temperature. This temperature gradient inversion causes moisture to condense in/at virtually all areas of the outside boundary of the thermal envelope system. However, when THIS PHENOMENON happens in insulation, a feed-back loop ensues wherein as moisture is added, the R-value of the insulation drops and more moisture is accumulated which then speeds up heat flows and moisture accumulation. Consequently, it is extremely problematic for homes with open crawl spaces to be fitted with almost any kind of insulation within a foot of the floor over an open crawl space. When moisture accumulates near wood, all of: fungal rot, mold, and termites are sure to infest the wooden parts of the home and generate gross deleterious effects with economic penalties in health and building repair that dwarf the high energy bills that are also common.

**Natural gas is far poorer than electricity for providing its most important energy services** —confirmed by virtually every normal measure of the ***economic***, ***effective*** or ***safety.***

* Lighting
* Water heating
* Space heating
* Cooking
* Electricity reliability and resilience Backup

Natural gas use in any form accelerates Global Warming and is thereby at odds with New Orleans’ master plan, sustainability goals, 2017 Paris Climate Change Treaty obligations, and thus is fundamentally at odds with New Orleans’ long-term viability.

The 2nd recommendation of the New Orleans Energy Policy Taskforce’s report of 2007, for the creation of a Building Science Center must have been effectively opposed by either the Advisors and / or Entergy because it was not allowed to function. Had it been, all the preceding assertions would have been made and considered in a timely fashion over a decade ago.

But it is not too late to fix all the above and the sooner we do this, the better.

Why has this happened? What are defects in public process that allows for these numerous errors and waste of hundreds of millions of publicly funded dollars since Hurricane Katrina?

EXHIBITS:

<https://www.nytimes.com/1979/03/25/archives/the-gaslight-era-is-ending-all-over-again-gaslight-era-ending-all.html>

# *The Gaslight Era Is Ending All Over Again*

**By** [**JAMES BARRON**](https://www.nytimes.com/by/james-barron)

MARCH 25, 1979

***About the Archive***

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March 25, 1979, Page 1

The New York Times Archives

The crowning touch of Peggy Mann Houlton's brownstone on West 94th Street used to be a gas lamp — a small, colonial‐style fixture that reminded her of an era when the New York skyline was bathed in the soft yellow glow of gas light.

The light given off by the lamp was only as bright as a 50‐watt electric bulb, hardly harsh enough to scare away intruders. Still, it gave a comfortable look to the block, between Central Park West and Columbus Avenue. Several of Mrs. Houlton's neighbors liked her lamp so much that, during the 1960's, they installed gas lamps, too.

That was before the energy crisis, before the Department of Energy announced it was banning outdoor gas lights because they consumed too much of a now‐precious resource and before Mrs. Houlton decided to extinguish her lamp.

“I turned it off about a year ago,” she said recently, “even though it didn't use very much gas.”

But the Energy Department's Economic Regulatory Administration estimated that her lamp, along with the 1.5 million others nationwide, did burn a significant amount of fuel — the equivalent of 13,000 barrels of oil daily. If the gaslights were cut off, the department said, some 36 to 73 billion cubic feet of gas would be saved annually.

For that reason, the administration published five pages of regulations in the Federal Register forbidding the installation of new gaslights and requiring utility companies to cut off the fuel supplies to existing lights. The cutoff dates are this Nov. 5 for industrial lights and Jan. 1, 1982, for residential lights.

Gas was first used for street lighting in 1807, along one side of London's Pall Mall. Ten years later a company formed by Rembrandt Peale, who was an artist and proprietor of a museum, installed the first gas street fixtures in America, in Baltimore.

The popularity of gas lights peaked in the late 1920's, but rose again in the 1960's so that they become a familiar fixture around motels, restaurants and upscale subdivisions. Nearly 600,000 lamps were hooked into gas lines in just three years, from 1958 to 1961 — twice the number that illuminated American cities when outdoor gas lighting was more popular than electricity half a century ago.

Like Mrs. Houlton's, most of the fixtures were brand‐new versions of the old‐style lamps, privately owned and operated. At that time, a small copper gas line was cheaper to bury under the lawn than a lead‐covered electric cable. Now, with gas suppliers worrying that there may be spot shortages and homeowners finding gas too expensive for outdoor lighting, the lights are again being scrapped.

This time, no one expects a renaissance. Charles Curtis, the chairman of the Federal Regulatory Commission, said recently that — despite the contention of some Carter Administration officials, who argued last year for deregulation of prices — homeowners should not expect natural gas supplies to become more plentiful. Prices have increased 40 percent since deregulation was passed and the increased prices mean that natural gas users will pay from $1.7 billion to $2 billion extra this year, Mr. Curtis said.

Mrs. Houlton says she is going to let hers rerna??n dark, but 15 communities in New Jersey whose streets are lit with gas lamps did not take the news so calmly. Arguing that they would face regulations do not require a cutoff of lamps in historic districts, and the de “economic hardship” if they had to convert their lamps to electricity, they appealed to the state's Public Utilities Commission and were granted exemptions.

In Glen Ridge, for example, where there are 666 gas lights, the borough clerk estimated that it would cost at least $8 million to make tile switch, while the cost of gas would rise only about $10,000 a year.

Some gas lights still burn in New York City, particularly in Brooklyn, where the Brooklyn Union Gas Company has been installing them in front ?? brownstones. The Federal regulations allow exemptions for historic areas such as Williamsburg, Va.

In Glen Ridge, as in South Orange, East Orange, and Cape May, the streets are lined with tall, mature trees and beneath them, about 75 feet apart, are the white‐domed gaslights — about 3,000 of them in the three communities.

They are equipped with timers, which still have to be wound each week, that turn the main gas jet on at night and off in the morning. Some of the fixtures found their way to Glen Ridge during World War II, when natural gas was expensive and scarce and New York City replaced many of its gas lamps. This explains why there are 12 different types of lamps, with different mantles, in Glen Ridge.

“We'd have people weeping in the streets if we gave up our gas lamps,” Steve Berry, the Glen Ridge town clerk, said. Gaslights are a local trademark — a gas lamp appears on the town seal — and to force Glen Ridge to give them up, or convert them to electricity, would be unthinkable, he said.

**Minnesota 1987 Variance Criteria restricting Decorative Gas Lamps**

<https://www.revisor.mn.gov/rules/4140/date/1987>

Un-reformatted text starts here. But it is easier to read it at the link above.

DEPARTMENT OF ENERGY AND ECONOMIC DEVELOPMENT DECORATIVE GAS LAMPS 4140.0100 DEFINITIONS. 4140.0200 PU RPOSE OF RU LES. 4140.0300 SCOPE OF RULES. 4140.1100 VARIANCE CRITERIA. APPLICATIONS FOR VARIANCE 4140.2100 APPLICATION PROCEDURES AND TIMING. 4140.2200 FORM OF APPLICATION. 4140.2300 CONVERSION COST. 4140.0100 DEFINITIONS. ECONOMIC BENEFIT OF CONVERSION 4140.3100 CALCULATION PROCEDURE. GAS LAMPS WITH ONE MANTLE. GAS LAMPS WITH TWO INVERTED MANTLES. GAS LAMPS WITH THREE INVERTED MANTLES. GAS LAMPS WITH MORE THAN ONE UPRIGHT MANTLE. GAS LAMPS WITH MORE THAN THREE INVERTED MANTLES. 4140.3200 4140.3300 4140.3400 4140.3500 4140.3600 Subpart 1. Scope. For purposes of this chapter, the following definitions shall apply. Subp. 2. Agency. "Agency" means the Department of Energy and Economic Development. Subp. 3. AMC per GLPG. "AMC per GLPG" means average marginal cost per gallon of LP gas. It is the annual cost to a person purchasing one additional gallon of LP gas per month for one year divided by 12. Subp. 4. AMC per KWH. "AMC per KWH" means average marginal cost per kilowatt hour. It is the annual cost to a person purchasing one additional kilowatt hour of electricity each month for one year divided by 12. Subp. 5. AMC per MCF. "AMC per MCF" means average marginal cost per 1,000 cubic feet of natural or mixed gas. It is the annual cost to a person purchasing one additional MCF of natural or mixed gas each month for one year divided by 12. Subp. 6. Applicant. "Applicant" means the person submitting an application for a variance to the prohibition on use of decorative gas lamps. Subp. 7. Btu. "Btu" means British thermal unit, a common unit of energy measurement, which is used in these rules for comparative purposes. For purposes of this chapter one MCF of natural or mixed gas shall be considered to contain 1,000,000 Btu's and one gallon of LP gas shall be considered to contain 93,000 Btu's. Subp. 8. Complete application. "Complete application" means an application that satisfies all of" the requirements of this chapter. Subp. 9. Conversion cost. "Conversion cost" means the dollar cost of adapting a decorative gas lamp to one producing light by electrical energy, or of replacing a gas lamp with an electrical fixture that will provide an equivalent amount of light for the same location. Subp. 10. Decorative gas lamp. "Decorative gas lamp" means any device installed for the purpose of illumination by burning natural, mixed, or LP gas and utilizing either a mantle or an open flame, but does not include a portable gas camp lantern or lamp. Subp. 11. Director. "Director" means the director of the agency. Subp. 12. Home owner. "Home owner" means one or more persons, jointly or severally, in whom is vested a legal or beneficial interest in a dwelling, no more than one-half the square footage of which is occupied by tenants. Subp. 13. KWH. "KWH" means kilowatt hour, 1,000 watt hours, a common unit of measurement for electrical energy. One kilowatt hour of electricity is equivalent to 3,412 Btu's. MINNESOTA RULES 1987 Copyright © 1987 by the Revisor of Statutes, State of Minnesota. All Rights 3165 DECORATIVE GAS LAMPS 4140.1100 Subp. 14. LP gas. "LP gas" means liquefied petroleum gas or propane. Subp. 15. MCF. "MCF" means 1,000 cubic feet, a common quantity for measurement of natural gas. Subp. 16. Person. "Person" means any individual, partnership, corporation, joint stock company, unincorporated association or society, municipal corporation, or any government or governmental subdivision, unit, or agency, other than a court of law. Subp. 17. Tenant. "Tenant" means any person who is occupying a dwelling under any agreement, lease, or contract, whether oral or written, and for whatever period of time, which requires the payment of moneys as rent for the use of the dwelling unit, and all other regular occupants of such dwelling unit. Subp. 18. Utility. "Utility" means any entity engaged in the generation, transmission, or distribution of electric energy and any entity engaged in the transmission or distribution of natural or synthetic natural gas, including but not limited to a private investor-owned utility or a public or municipally owned utility. Statutory Authority: MS s 116J-.10 History: L 1983 c 289 s 115 subd 1 4140.0200

**PURPOSE OF RULES. The purpose of this chapter is to specify the contents of applications for variances to the statutory prohibition on use of decorative gas lamps and to specify the criteria according to which variances shall be granted pursuant to Laws of Minnesota 1976,**

chapter 333, section 6, codified as Minnesota Statutes, section 116H.12, subdivision 3b. Statutory Authority: MS s 116J.10 4140.0300 SCOPE OF RULES. Subpart 1. Prohibitions.

**Beginning April 21, 1977, no person shall use any device installed for the purpose of producing illumination by burning natural, mixed, or LP gas and utilizing either a mantle or an open flame, unless a variance has been granted pursuant to this chapter.**

Beginning April 21, 1977, no person shall provide replacement parts or service intended to maintain the operation of a decorative gas lamp, unless the owner of such lamp has been granted a variance pursuant to this chapter. Subp. 2. Exception. This chapter shall not apply to portable camp lanterns utilizing fuel oil, white gas, or LP gas. Statutory Authority: MS s 116J.10 4140.1100 VARIANCE CRITERIA. Subpart 1. Open-flame decorative gas lamps. No variance shall be granted for open-flame decorative gas lamps. Subp. 2. Decorative gas lamps with incandescent mantles. The director shall grant a variance to an applicant who owns decorative gas lamps with incandescent mantles if the applicant satisfies either of the following criteria: A. Any home owner who is at least 65 years of age as of the effective date of these rules and who resides at the location listed in response to part 4140.2200, subpart 1, item B, shall receive a variance upon filing a complete application. In the case of joint ownership, the age of only the older owner shall be considered. B. Any person who does not meet the criteria in item A shall receive a variance only if the lamps for which the variance is sought cannot be economically converted to electricity. However, that person shall receive, without application therefor, a construction season variance valid until September 30, 1977. A lamp cannot be economically converted to electricity if the total conversion cost

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| **SMART AND SUSTAINABLE CITIES COMMITTEE****MEETING AGENDA****TUESDAY, OCTOBER 30, 201810:15 A.M.** |  |

**AGENDA**

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| **1.** | **[Presentation by Waggonner & Ball To Present: David Waggoner, Founding Principal John Kleinschmidt, Architecture and Environment](http://cityofno.granicus.com/MediaPlayer.php?view_id=42&clip_id=3125&meta_id=426692)** |

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| **2.** | **[Presentation on NORA Community Adaption Program To Present: Brenda Breaux, Executive Director Seth Knudsen, Director of Real Estate Development and Planning](http://cityofno.granicus.com/MediaPlayer.php?view_id=42&clip_id=3125&meta_id=426693)** |

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| **3.** | **[Presentation by Water Institute To Present: Jeff Hebert, Vice President of Adaptation and Resilience](http://cityofno.granicus.com/MediaPlayer.php?view_id=42&clip_id=3125&meta_id=426694)** |

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| **4.** | **[Presentation by the City of New Orleans Office of Resilience and Sustainability To Present: Tyler Antrup, Urban Water Program Manager](http://cityofno.granicus.com/MediaPlayer.php?view_id=42&clip_id=3125&meta_id=426695)** |

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| **5.** | **[Presentation on SBP Resilience Training Presenter: Zack Rosenberg, Co-Founder & CEO](http://cityofno.granicus.com/MediaPlayer.php?view_id=42&clip_id=3125&meta_id=426696)** |

# Crawl Spaces

<https://www.advancedenergy.org/portal/crawl_spaces/>

Many homes built on crawl space foundations in the Southeastern United States suffer from poor moisture management. Some of the common symptoms of a crawl space moisture problem are:

* Mold or moisture damage in the crawl space or living area
* Musty odors in the living area
* Condensation ("sweating") on air conditioning ductwork or equipment
* Condensation on insulation, water pipes or truss plates in the crawl space
* Buckled hardwood floors
* High humidity in the living area
* Insect infestations
* Rot in wooden framing members

These symptoms are most often noticed in the humid spring and summer seasons but can occur at any time of the year. Often, the heating and air conditioning contractor is the first person the residents call to deal with the problem. Typically though, the problem is not due to a failure of the air conditioning system; it results from poor moisture control in the crawl space.

For many decades, building codes and conventional wisdom have prescribed ventilation with outside air as the primary method of moisture control in crawl spaces. In the humid Southeast, however, ventilation with outside air only makes moisture problems worse. Recent research by Advanced Energy and others indicates that a new type of crawl space system, with NO vents to the outside, can provide greatly improved moisture control and significant energy savings when properly installed.

This page lists materials and information generated by Advanced Energy research projects, diagnostic investigations and collaboration with a variety of professional installers and consultants across the country. We hope this information can help you to improve your existing crawl space or to design and install a properly-closed new crawl space.

**Written Recommendations**
[Closed Crawl Spaces: A Quick Reference for the Southeast](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Closed%20Crawl%20Spaces_Quick%20Reference.pdf)
The quick reference summarizes the design elements and installation steps that are discussed in the full 75-page guide below. The quick reference also includes two example designs from the guide.

[Closed Crawl Spaces: An Introduction for the Southeast](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Closed%20Crawl%20Spaces_An%20Introduction%20for%20the%20Southeast.pdf)
This 75-page guide is an introductory reference to crawl space issues:

* Design and implementation recommendations for closed crawl spaces
* Four sample closed crawl space designs and a sample construction sequence
* An overview of NC residential code requirements and issues
* Recommendations for improving existing wall-vented crawl spaces
* A summary of Advanced Energy's crawl space research results
* Answers to frequently asked questions about mold in crawl spaces

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| https://www.advancedenergy.org/portal/crawl_spaces/images/crawl_spaces_book_small.jpg |   | You may purchase a wire-bound copy of the introductory reference, along with laminated copies of the quick reference sheets, for $45 by [clicking here](https://marketplace.mimeo.com/AdvancedEnergy#name=17). You may also send the pdf versions available here for download to your local printer for duplication, as they are of sufficient resolution for high quality reproduction. |
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**Published Articles**
["Closing the Crawl"](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Builder%20Online%20Article%20-%202005.pdf), Builder Magazine, October 2005
["Closed Crawl Spaces Do Double Duty,"](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Home%20Energy%20January%202005_low%20res2.pdf) Home Energy, January 2005
["Crawl Space Mold Liability or Business Opportunity,"](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Crawl%20Space%20Mold%20Liability%20or%20Business%20Opportunity.pdf) Pest Control Technology, June 2003
["Double Duty,"](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Double%20Duty.pdf) Pest Control Technology, October 2004
["To Vent or Not To Vent,"](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/To%20Vent%20or%20Not%20To%20Vent.pdf) Professional Remodeler, September 2004

**Products and Suppliers**
Links to the [manufacturers of products or providers of services](https://www.advancedenergy.org/portal/crawl_spaces/products_suppliers.php) utilized in Advanced Energy research projects or discussed in the crawl space guide.

**North Carolina Residential Building Code**
The NC Building Code Council adopted new code language in September 2004 for both wall-vented and closed crawl spaces. The new language was approved by the legislative rules review process in November 2004. Click [here](http://ecodes.biz/ecodes_support/free_resources/2012NorthCarolina/Residential/Part_I_Residential/PDFs/04_NC_Res_2012.pdf) and go to sections R408 and R409 for more detail.

**Video Overviews**
These short videos provide a short guided tour of crawl space issues and Advanced Energy's Princeville research project.

* [Crawl Space Water Sources and Solutions](https://player.vimeo.com/external/140308897.mobile.mp4?s=ee4de4e32243b8124c316890c13d5614&profile_id=116)
* [To Vent Or Not To Vent](https://player.vimeo.com/external/140309212.sd.mp4?s=6e8195988d95a5f41ad21c35a06166a2&profile_id=112)
* [Can You Close Your Crawl Space?](https://player.vimeo.com/external/140309465.sd.mp4?s=f7e638e29d139efad328ce471125578b&profile_id=112)
* [Moisture Results](https://player.vimeo.com/external/140309277.sd.mp4?s=305d9a8a331f1ca81c4c95cddac4dc92&profile_id=112)
* [Crawl Space Mold](https://player.vimeo.com/external/140309370.sd.mp4?s=e8b787c1fb0246870b425afb845b5071&profile_id=112)
* [Staking Ground Poly](https://player.vimeo.com/external/140309320.sd.mp4?s=037d344dafa1abb7fe3067eabe0ed031&profile_id=112)

**Technical Reports**
Detailed reports of research goals, methods, results and conclusions that have been created per the contract requirements of Advanced Energy crawl space research sponsors and funders.

* [Vented Crawl Spaces as Mold Amplification and Delivery Systems?](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/ASHRAE%20IAQ%20Paper%20Revised%202008-07-15.pdf), ASHRAE IAQ 2007
* [North Carolina Crawl Spaces--Vented and Closed](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/MADD%20Crawls%20for%20AE%20website.ppt), [ppt] (1.6 MB)
* [Assessing Allergens and Asthma Triggers in the Home Environment: A Study of Southeastern United States. Children's Environmental Health Initative, Duke University–December 29, 2005](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Final%20Report%20HUD%20Duke%20University.pdf) (2.7 MB)
* [Crawl Space Characterization: Characterizing Crawl Spaces as Sources of Mold in the Home Environment--September 30, 2005](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Crawl%20Space%20Characterization%202005.pdf) (0.8 MB)
* [Crawl Space Characterization: Characterizing Crawl Spaces as Sources of Mold in the Home Environment (Appendix)--September 30, 2005](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Crawl%20Space%20Characterization%20Appendix.pdf) (5.8 MB)
* [Long-Term Temperature and Relative Humidity: Characterizing Crawl Spaces as Sources of Mold in the Home Environment--September 30, 2005](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Longterm%20Temperature%20and%20Relative%20Humidity.pdf) (3.5 MB)
* [Princeville Field Study Final Technical Report](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Field%20Study%20-%202005.pdf) (1.4 MB)
* [Princeville Field Study Appendix](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Field%20Study%20Appendix%202005.pdf) (4.8 MB)
* [Technology Assessment Report](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Technology%20Assessment%20-%202005.pdf) (2.0 MB)
* [Characterization Study Final Technical Report](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Characterization%20Study%20-%202005.pdf) (0.7 MB)
* [Characterization Study Appendix](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Characterization%20Study%20Appendix%202005.pdf) (2.2 MB)
* ["Moisture Solution Becomes Efficiency Bonanza in Southeastern United States"](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Moisture%20Solution%20Becomes%20Efficiency%20Bonanza.pdf), ACEEE technical paper, August 2004
* ["Moisture Performance of Closed Crawl Spaces and Their Impact on Home Cooling and Heating Energy in the Southeastern United States"](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Moisture%20Performance%20of%20Closed%20Crawl%20Spaces.pdf), ASHRAE technical paper, December 2004
* [Princeville Hygrothermal Study Final Technical Report](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Hygrothermal%20Study%20-%202005.pdf) (7.7 MB)

[Additional Online References](https://www.advancedenergy.org/portal/crawl_spaces/additional_references.php)

**Archives**
Previously published research documents or other publications that may still be of use.

* [Hygrothermal Performance Study Pilot Report](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/hygrothermal_performance_study_pilot_report.pdf)
* [Eastern NC Research Overview](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/crawl%20space%20marketing%20sheet.pdf)

**Research report available:**
Closed crawl space performance in cold and hot-humid climates

* [Project Summary](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/Closed%20Crawl%20Spaces.pdf)
* [Full Report](https://www.advancedenergy.org/portal/crawl_spaces/pdfs/NCEMBT%20Report.pdf)
1. <https://www.federalregister.gov/documents/2017/01/19/2016-32012/energy-conservation-program-energy-conservation-standards-for-general-service-lamps>,

**Standard Incandescent Lamps’ Efficiency ~= 800 lumens/60 watts ~=13.3 lumens/watt**

See <http://www.candlepowerforums.com/vb/showthread.php?180416-Coleman-propane-lantern-lumens> for the light output of a gas lamp ~= 800 lumens ~= same as a standard 60 Watt incandescent,

Because of their very high power consumption of one kWh/h, **Common Gas Lamps’ Efficiency = (800 lumens/[3500 BTU/h]) ~= (800 lumens/[1 kwh/h]) = (800 lumens/1000 watts) = 0.8 lumens/watt.** <https://www.sapling.com/12049844/much-gas-lamp-post-cost-per-year>. Thus “standard” or “common” gas lamps have an efficiency of about 1 lumen w. [↑](#footnote-ref-1)