RAISING THE ROOF: KEEPING IT GREEN IN THE GARDEN STATE

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INTRODUCTION

Growing concern about greenhouse gas emissions, global warming, and rising energy prices led Chicago and Seattle to enact legislation promoting or requiring newly constructed buildings to be built and run in an environmentally friendly fashion.[1] Requirements were placed on buildings' energy usage, efficiency, emissions, and construction materials, among other metrics.[2] Also included were specifications for the use of "green roof" technology, a building practice shown to reduce buildings' energy usage and enhance stormwater management.[3] In recognition of the importance of environmentally friendly development, New Jersey has several pending pieces of legislation containing provisions requiring or promoting the use of green roofs in both new and existing buildings in the state.[4] These bills promote the use of green roof technology in residential areas through low-interest loans to the State's citizens and mandate the use of green roofs in certain government and commercial buildings.[5] To date, the legislation has languished, arguably due to the difficulty in balancing the costs and benefits of installing green roofs.

This Note addresses the need for green roof legislation in New Jersey through a discussion of the benefits of green roofs and a detailed analysis of the current green roof legislation pending in the New Jersey Assembly. Part I introduces the technological background of green roofs. This Part includes a discussion of the characteristics of and differences between the two categories of green roofs, namely, intensive and extensive. It also explains the benefits of green roofs, ranging from lower energy usage and reduction of air pollution to improved storm

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[1] *See* CHI., ILL., CODE § 18-13-101(2008); Seattle, Wash., Ordinance 123495 (Dec. 20, 2006).

[2] *See generally id.*

[3] *Id.;* J. Cullen Howe, *Green Roofs*, 2008 Emerging Issue (MB) No. 3069 at 1 (Nov. 5, 2008).

[4] Assemb. B. 709, 215th Leg. (N.J. 2012); Assemb. B. 710, 215th Leg. (N.J. 2012); Assemb. B. 711, 215th Leg. (N.J. 2012); Assemb. B. 712, 215th Leg. (N.J. 2012); Assemb. B. 713, 215th Leg. (N.J. 2012).

[5] *Id.*

water management and water quality. Part II summarizes past and current green roof legislation in cities and countries throughout the world. The discussion includes green roof laws in Chicago, Seattle, New York, Germany, and Canada. Part III introduces the bills currently pending in the New Jersey legislature. This section includes a discussion of the potential drawbacks of each bill and speculates as to the reasons behind the legislature's reluctance to enact the legislation. Part IV reviews recent studies of green roof technology, and includes a cost-benefit analysis of green roof implementation. An analysis of the advantages and disadvantages of green roof construction confirms that New Jersey would benefit both economically and environmentally from the passage of the pending green roof legislation. Part V discusses other arguments for and against the passage of green roof legislation in New Jersey.

I. Green Roof Technology

The use of green roofs is anything but new. Studies show that people have utilized green roofs for heat retention in buildings for centuries.[6] Records of the first green roofs date back to 600 B.C.E. in Babylon.[7] Similarly, Vikings and French colonists constructed roofs using sod in Nova Scotia and Newfoundland to increase heat retention inside their homes.[8] While the implementation of and knowledge regarding the benefits of green roofs has expanded since that time, the basic technology behind these roofs has not changed. In its most basic form, a green roof consists of a thick layer of a growing medium or soil mix that is placed on top of a traditional sealed, waterproof roof.[9] Vegetation is then planted on top of this growing medium.[10]

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[6] STEVEN PECK & MONICA KUHN, DESIGN GUIDELINES FOR GREEN ROOFS 2 (2001).

[7] JOHN D. MAGILL ET AL., A HISTORY AND DEFINITION OF GREEN ROOF TECHNOLOGY WITH RECOMMENDATIONS FOR FUTURE RESEARCH, at 2-3 (Southern Illinois Univ. Carbondale, Research Paper No. 91) (2011), *available at* http://opensiuc.lib.siu.edu/gs_rp/91/ (citing IAN SIMPSON, *A Reinterpretation of the Great Pit in Hofstathir Iceland*¸ GEOARCHEOLOGY : AN INT'L J. 511-30 (1999)).

[8] *Id.* at 2.

[9] *Green From the Top Down*, ADVISOR ONE, Sept. 20, 2008, http://www.advisorone.com/2008/09/01/green-from-the-top-down.

[10] *Id.*

Engineers have developed improvements to increase the efficiency of green roofs. Today, the growing medium is made up of a mixture of sand, gravel, organic matter, and soil, among other materials.[11] There is normally a filter cloth installed below the growing medium to contain the roots but allow for water to pass through.[12] Lastly, most modern day green roofs include a drainage layer between the filter cloth and the waterproofing layer of the roof, which enhances stormwater management.[13]

While the basic structure of all green roofs is the same, there are two variations on the basic structure. Those variations are known as extensive and intensive. Depending on factors such as the types of vegetation and the depth of the growing medium contained on the roof, green roofs are either extensive, intensive, or a combination of the two.

A. Extensive vs. Intensive Green Roofs

Extensive green roofs are best described as the simple, yet rugged category of green roofs.[14] Their surfaces are characterized by lower weight, shallower growing medium (two to six inches in depth), lower capital cost, and lower maintenance needs.[15] Conversely, intensive green roofs are more comparable to a conventional garden or park.[16] They are characterized by a heavier and much deeper growing medium (eight to twenty-four inches in depth).[17] Intensive green roofs are more expensive to build and require more maintenance than extensive green roofs.[18]

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[11] PECK & KUHN, *supra* note 6, at 4.

[12] *Id.*

[13] *Id.*

[14] U.S. Envtl. Prot. Agency, *Reducing Urban Heat Islands: Compendium of Strategies, Chapter 3 Green Roofs*, at 4 (Oct. 2008), http://www.epa.gov/heatisld/resources/compendium.htm.

[15] *Green Roof Feasibility Review: King County Office Project*, PALADINO & COMPANY, INC., 1 (2004), http://your.kingcounty.gov/solidwaste/greenbuilding/documents/KCGreenRoofStudy_Final.pdf.

[16] *Reducing Urban Heat Islands*, *supra* note 14, at 4.

[17] *Green Roof Feasibility Review*, *supra* note 15, at 2.

[18] Joshua Wachtel, *Green Roofs: Prove Their Value in Return on Investment*, IN BUSINESS, May-Jun. 2007, at 17.

There are advantages and disadvantages to both types of green roofs. Extensive green roofs are advantageous because they are suitable for large areas and require less technical expertise; however, they are less energy efficient than most intensive green roofs and do not have the same stormwater retention benefits.[19] Extensive green roofs are better suited for retrofitting a green roof to an existing structure because of their lighter weight.[20]

Because of the difference in depth of the growing mediums, intensive green roofs can accommodate a greater range of plant diversity than extensive types, including larger trees and shrubs.[21] This option allows for the design of very attractive green roofs.[22] Because of the larger vegetation potential, intensive green roofs often require irrigation systems, which in turn require energy and water.[23] Therefore, it is possible that very elaborate designs actually work against the ultimate goals of energy efficiency and water management.

While certain buildings may only be able to accommodate an extensive green roof due to load restraints on the roof, most newly constructed roofs will allow for either an intensive or extensive setup.[24] In many instances, the roof is a hybrid and combines characteristics of both.[25] Factors such as "location, structural capacity of the building, budget, client needs, and material and plant availability" determine the characteristics and requirements of each individual green roof.[26] Depending on the features chosen, building owners and surrounding communities will be subject to a wide range of economic and environmental benefits.

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[19] PECK & KUHN, *supra* note 6, at 5.

[20] *Reducing Urban Heat Islands*, *supra* note 14, at 4.

[21] J. Wylie Donald and Jocelyn Gabrynowicz Hill, *McCarter & English LLP on Covering the Green Roof – With Insurance*, 2009 Emerging Issues 4168, at 2 (citing PECK & KUHN, *supra* note 6, at 4-5).

[22] *Green Roof Feasibility Review*, *supra* note 15, at 2.

[23] PECK & KUHN, *supra* note 6, at 5.

[24] *Id.* at 5.

[25] Wachtel, *supra* note 16, at 15.

[26] PECK & KUHN, *supra* note 6, at 5.

B. Benefits of Green Roofs to Building Owners

The construction of a green roof in place of a conventional rooftop creates a number of direct benefits for the building owner, including reducing the building's energy usage, enhancing outside noise protection, and improving quality of life for both humans and wildlife.[27]

Green roofs can help decrease a building's energy usage and therefore reduce utility costs, regardless of the time of year, because the growing medium can store large amounts of water from rain and snow.[28] By storing water, the green roof is able to retain large amounts of heat from the sun, thereby reducing temperature fluctuations on a daily and yearly basis.[29] The growing medium acts as extra insulation and prevents heat loss through the roof, decreasing the energy required to heat the building in the winter.[30] In the summertime, the vegetation's shading and a process called evapotranspiration[31] causes green roof temperatures to be cooler than conventional rooftops, thereby reducing energy needs for cooling and lowering utility costs for the building owner.[32]

Studies have shown that green roof buildings are better protected from outside noise than conventional rooftop buildings due to the insulating character of the roof. When green roofs are designed to insulate for sound, the growing medium is used to block lower frequency sound waves while the plants and vegetation are used to block the higher frequencies.[33] One study showed that installing a growing medium five inches thick can reduce sound inside the building by as much as 40 decibels (dB), the equivalent being a quiet radio inside a home.[34]

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[27] Dusty Gedge & Mathew Frith, *Green Roofs: Benefits and Cost Implications*, LIVINGROOFS.ORG 11 (2004), http://www.sustainable-eastside.net/Green%20Roofs%20Report%202.07.05.pdf.

[28] *Id.* at 11-12.

[29] *Reducing Urban Heat Islands*, *supra* note 14, at 8.

[30] PECK & KUHN, *supra* note 6, at 6.

[31] "Plants absorb water through their roots and emit it through their leaves – this movement of water is called transpiration. Evaporation, the conversion of water from a liquid to a gas, also occurs from the surfaces of vegetation and the surrounding growing medium. Together, the processes of evaporation and transpiration are referred to as evapotranspiration. Evapotranspiration cools the air by using heat from the air to evaporate water." *Reducing Urban Heat Islands*, *supra* note 14, at 3.

[32] Gedge & Frith, *supra* note 27, at 11.

[33] PECK & KUHN, *supra* note 6, at 7.

[34] *Id.* The decibel (dB) is a unit used to measure sound level. The actual loudness will depend on a number of factors including how far away one is from the source of the noise,

Green roofs also improve quality of life for humans and provide a habitat for various plant and animal species. Through green roof implementation, people are able to enjoy gardens and green spaces in urban environments that otherwise lack natural parks and gardens.[35] Moreover, the additional square footage of safe, usable green space in an urban environment could help to increase property value.[36] These roofs provide a habitat for endangered animal or plant species that might otherwise have trouble surviving in certain areas; extensive green roofs require only minimal human interaction for maintenance which allows the vegetation and wildlife to go undisturbed.[37] However, one drawback to this style of green roof is that it is "likely to appear untidy, 'scruffy' and unmaintained . . . and therefore likely to draw criticism from those people . . . who seek the 'neat and tidy' approach to landscape."[38]

C. Benefits of Green Roofs to the Community

While a building owner may directly benefit from a green roof, implementation will also provide indirect yet substantial benefits to the surrounding area.[39] These benefits include reduced air pollution, reduced greenhouse gas emissions, enhanced storm water management, and enhanced water quality for the surrounding area.[40]

Green roofs help to reduce air pollution and greenhouse gas emissions. By reducing the building's temperature in the summer, occupants of buildings with green roofs can maintain a comfortable interior temperature without using air conditioners as often as those in

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whether the source is indoors or outdoors, as well as other conditions. *dB: What is a decibel?*, PHYSCLIPS: UNIV. OF NEW SOUTH WALES, SCH. OF PHYSICS, http://www.animations.physics.unsw.edu.au/jw/dB.htm (last visited Jan. 15, 2013); An approximate comparison of 40 dB would be that of a quiet radio inside the home. *Decibel*, THE INTERNET SOUND INST., http://www.soundinstitute.com/article_detail.cfm/ID/95 (last visited Jan. 15, 2013).

[35] Gedge & Frith, *supra* note 27, at 17-18.

[36] PECK & KUHN, *supra* note 6, at 7.

[37] *Id.*

[38] Urbis Limited, *Study on Green Roof Application in Hong Kong: Final Report* 12 (2007), http://www.devb.gov.hk/filemanager/en/content_29/Green%20roof%20study_final%20report.pdf.

[39] *Reducing Urban Heat Islands*, *supra* note 14, at 11.

[40] Gedge & Frith, *supra* note 27, at 11.

buildings with conventional roofs.[41] The result is less air pollution and fewer greenhouse gas emissions.[42] The vegetation growing on the roof helps to offset pollutants and gases through processes known as dry deposition[43] and carbon capture and storage.[44] It is estimated that for every 1,000 square feet of green roofing, roughly forty pounds of particulate matter can be removed from the air annually.[45] This number is equal to the annual particulate matter emissions of fifteen cars.[46]

One of the most important benefits of green roof technology is the management of storm water runoff. Green roofs prevent water runoff from rainfall, just as natural turf and vegetation help to absorb water that would otherwise become runoff.[47] This is especially true in urban environments that often lack any natural runoff collection.[48] Because of concentrated building, paving, and inadequate sewer systems, urban areas in New Jersey are subject to flooding after heavy rainfall.[49] The construction of more green roofs in areas that flood frequently would help to alleviate and manage the stormwater.[50] Essentially, green roofs "act as a catch basin and the soil and sedem plants act as a sponge and soak up much of that sudden inundation and then slowly release the water."[51] One study, conducted for the City of Portland, Oregon estimated that if half of the buildings in downtown Portland utilized

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[41] *Id.*at 12.

[42] *Id.*

[43] Dry deposition is "the falling of small particles and gases to the Earth without rain or snow." U.S. Envtl. Prot. Agency, *Acid Rain*: *Glossary*, http://www.epa.gov/acidrain/glossary.html#GlossD (last updated Dec. 4, 2012).

[44] *Green Roofs*, *supra* note 3. Carbon sequestration and storage is the process in which atmospheric carbon is captured by vegetation and is stored as biomass. This is done through photosynthesis. *Green Roof Research Program*, MICH. STATE UNIV. DEP'T OF HORTICULTURE, http://www.hrt.msu.edu/greenroof/ (last visited Jan. 15, 2012).

[45] "Particle pollution contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. The size of particles is directly linked to their potential for causing health problems." *Particulate Matter: Basic Information*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/pm/basic.html (last accessed Jan. 15, 2013).

[46] *Reducing Urban Heat Islands*, *supra* note 14, at 7.

[47] *Id.*

[48] Gedge & Frith, *supra* note 27 at 11.

[49] For example, the city of Hoboken's streets are periodically subject to flooding due to heavy rain during the Hudson River's high tide. *See* Ray Smith, *When will the flooding stop?*, HUDSON SEWAGE AUTH., Aug. 21, 2011, http://www.nhudsonsa.com/images_subpages/raydoc.pdf.

[50] *Reducing Urban Heat Islands*, *supra* note 14, at 8.

[51] *Green From the Top Down*, *supra* note 9.

green roofs (roughly 219 acres), 17 million gallons of sewage overflow would be eliminated annually.[52]

Green roofs also improve the overall quality of water in the area. Many older sewage systems in New Jersey combine rainwater runoff with sanitary sewer systems.[53] By reducing the amount of sewage overflow, less rainwater becomes contaminated.[54] Furthermore, green roofs can act as a filter for the rainwater.[55] By soaking up water, the green roof vegetation is able to remove pollutants contained in the rain water that would otherwise run down the side of a conventional roof.[56] After analyzing several green roof studies, a 2005 Canadian report revealed that green roofs are able to "remove up to 95 percent of the cadmium, copper, and lead from stormwater runoff."[57] One of these studies also concluded, however, that the choice of vegetation and materials in the growing medium on a green roof will impact the amount of pollutants that are removed or, conversely, released.[58] In some instances, certain pollutants may be reduced while the amount of other pollutants increases.[59] It has been suggested that the increase in pollutants is only temporary due to the amount of pollutants initially contained in the vegetation or growing medium, especially those that are organic.[60]

Considering the large percentage of roof cover in major cities throughout the United States, the opportunities for green roof construction are immense.[61] A study conducted as part of the Urban Heat Island Pilot Project found that twenty to twenty-five percent of urban land cover comes from roofing.[62] With its high population and

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[52] PECK & KUHN, *supra* note 6, at 9 (citing S. BECKMAN ET AL, GREENING OUR CITIES: AN ANALYSIS OF THE BENEFITS AND BARRIERS ASSOCIATED WITH GREEN ROOFS 26 (Portland State University, 1997)).

[53] U.S. ENVTL. PROT. AGENCY, KEEPING RAW SEWAGE & CONTAMINATED STORMWATER OUT OF THE PUBLIC'S WATER (2011), *available at* http://www.epa.gov/region2/water/sewer-report-3-2011.pdf.

[54] *Id.* at 11.

[55] *Reducing Urban Heat Islands*, *supra* note 14, at 9.

[56] Gedge & Frith, *supra* note 27.

[57] *Reducing Urban Heat Islands*, *supra* note 14, at 9.

[58] *Id.* at 9-10.

[59] *Id*.

[60] *Id.*at 8.

[61] *Id.* at 1.

[62] *Id*.

housing unit density, New Jersey is no exception to this trend.[63] To understand the green roof proposals pending in New Jersey, it is helpful to look to other cities and countries that are already active in green roof policymaking.

II. Green Roof Legislation Outside of New Jersey

A number of cities and countries have already implemented green roof codes and policies to promote energy efficiency, water conservation, and other environmental goals. Some cities require green roofs for certain buildings while others have simply promoted the construction of green roofs through tax incentives and low interest bank loans.

A. Chicago

Chicago has emerged as one of the most green roof friendly cities in the United States.[64] In 2002, the Chicago Energy Conservation Ordinance went into effect. That ordinance requires residential and commercial building owners and developers to install green roofs or reflective roofing on all new and refurbished roofs.[65] Chicago has also increased green roof production in the city through the Green Roof Grants Program.[66] Established in 2005, the program awarded grants of up to $5,000 to residential and small commercial green roof projects.[67] The program was very successful and succeeded in financing over seventy green roof projects throughout Chicago between 2005 and 2007.[68]

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[63] New Jersey had the highest population density (1,195.5 people per square mile) and housing unit density (483.2 housing units per square mile of land area) of all States as of the 2010 Census. SELECTED DATA FROM THE 2010 CENSUS, U.S. CENSUS BUREAU, http://www.census.gov/geo/www/guidestloc/select_data.html (last visited Jan. 15, 2013).

[64] Meredith Laitner, Adam Stella, & Madeline Zamoyski, *Green Building City Survey*, 11 N.Y.U. J. LEGIS. & PUB. POL'Y 81, 81 (2008).

[65] CHI., ILL., CODE § 18-13-101 et. seq. (2008); THE CITY OF L.A. ENVTL. AFFAIRS DEP'T, *Green Roofs – Cooling Los Angeles, A Resource Guide* VII-5 (2006) *available at* http://www.greensulate.com/pdf/LA_GreenRoofsResourceGuide.pdf.

[66] Natural Res. Def. Council, *Rooftop to Rivers II: Chicago, Illinois: A Case Study of How Green Infrastructure is Helping Manage Urban Stormwater Challenges* 2, NATURAL RES. DEF. COUNCIL, http://www.nrdc.org/water/stormwater/files/RooftopstoRivers_Chicago.pdf. *Reducing Urban Heat Islands*, *supra* note 14, at 23.

[67] *Reducing Urban Heat Islands*, *supra* note 14, at 20.

[68] *Rooftops to Rivers*, *supra* note 66, at 2.

In 2000, the city of Chicago constructed its most famous green roof atop City Hall, an eleven-story office building.[69] The 20,000 square foot garden contains 20,000 plants consisting of more than 150 different species.[70] The city of Chicago estimated that the green roof on top of the City Hall saved roughly 9,000 kilowatt hours and 740,000,000 Btus per year.[71] This translates to approximately $3,600 in energy savings per year.[72] The cost to retrofit the green roof was about $75 per planted square foot (about $1.5 million total), whereas a conventional reroofing would have cost an estimated $50 per square foot (about $1 million total).[73] Although this is a substantial price difference, it is important to realize that costs can vary greatly depending on the complexity of the design.[74] The cost-benefit discussion below will show that most green roofs do not cost fifty percent more than conventional rooftops. The main focus of the City Hall project was to increase public awareness of green roofs through research and demonstrations, as well as to provide a green roof with high aesthetic value.[75] Therefore, the cost of its construction was likely higher than that of typical green roofs.

In order to monitor the benefits associated with green roofs, the city recorded surface temperatures on the City Hall roof.[76] The researchers left a portion of the roof as a paved, conventional rooftop.[77] One weather station was placed on the green roof segment and another station was placed on the conventional roof segment.[78] The two rooftop temperatures were compared in August 2001, when the air temperatures ranged between 90 and 100 degrees Fahrenheit.[79] The green roof temperatures were between 91 and 119 degrees Fahrenheit, while the conventional roof temperatures ranged from 126 to 130 degrees

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[69] *City Hall's Rooftop Garden,* CITY OF CHICAGO, http://www.cityofchicago.org/city/en/depts/dgs/supp_info/city_hall_green_roof.html (last visited Jan. 15, 2013).

[70] *Id*.

[71] *Reducing Urban Heat Islands*, *supra* note 14, at 6.

[72] *Id*.

[73] *Green Roofs – Cooling Los Angeles, A Resource Guide*, *supra* note 65, at III-14.

[74] *Id*.

[75] Urbis Limited, *supra* note 38, at 27.

[76] *Monitoring the City Hall Rooftop Garden's Benefit*, CITY OF CHICAGO, http://www.cityofchicago.org/content/city/en/depts/doe/supp_info/monitoring_the_cityhallrooftopgardensbenefit.html (last visited Mar. 9, 2012).

[77] *Id*.

[78] *Id*.

[79] *Id*.

Fahrenheit.[80] Another roof adjacent to City Hall constructed only of black tar was monitored on the same day; the weather station revealed a surface temperature of 169 degrees Fahrenheit, over fifty degrees warmer than the green roof's temperature.[81] The conventional rooftop's higher temperatures inevitably lead to elevated temperatures inside the building. Consequently, in order to maintain a comfortable temperature inside, the building's cooling system must use additional energy during Chicago summer months. To avoid this, local laws such as Chicago's Energy Conservation Ordinance help to decrease energy usage by promoting green roof construction.

B. Seattle

Seattle implemented its Green Factor Ordinance in 2007 to "improve air quality, reduce energy consumption, cool the city in the summer and insulate it in the winter, and reduce storm water runoff."[82] This ordinance applies to most new commercial structures, multi-unit residential structures, and parking lots.[83] It requires that any such building achieve a certain green factor by meeting a landscaping target using various landscaping methods.[84] One of the accepted methods is the construction of a green roof.[85] The construction of green roofs more than doubled in 2008 due to the Green Factor Ordinance.[86] According to Seattle Public Utilities, almost 95,000 square feet of green roofs were built in 2008, compared to about 45,000 square feet in 2007.[87]

The Seattle Green Roof Evaluation Project compared rainfall runoff amounts based on varying thicknesses of green roofs between 2005 and 2007.[88] The study compared the measurable runoff amounts at

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[80] *Id.*

[81] *Monitoring the City Hall Rooftop Garden's Benefit, supra* note 73.

[82] Howe, *supra* note 3, at 3.

[83] Seattle, Wash., Ordinance 123495.

[84] The buildings covered by the ordinance include: "all new commercial structures over 4,000 square feet, all residential structures of more than four units, and all parking lots with more than twenty parking spaces in neighborhood business districts." *Id.*

[85] *Id.*

[86] Annika McIntosh, *Green Roofs in Seattle: A Survey of Vegetated Roofs and Rooftop Gardens* CITY OF SEATTLE PUB. UTIL. 6 (2010), http://www.seattle.gov/DPD/cms/groups/pan/@pan/@sustainableblding/documents/web_informational/dpdp020213.pdf.

[87] *Id.*

[88] Drew A. Gangnes, *Seattle Green Roof Evaluation Project Final Report*, MAGNUSSON KLEMENCIC ASSOC. 1, (March 2007),

five separate green roof plots.[89] According to the final report, between sixty-five and ninety-four percent of the measurable rainfall runoff was mitigated by green roof plots over the two year period.[90] The two- and four-inch thick green roofs reduced runoff by sixty-five percent while the six-inch thick roofs reduced runoff by ninety-four percent.[91] These results confirm that green roofs implemented through the Green Factor Ordinance alleviate substantial stormwater runoff in Seattle's urban landscape.

C. New York

Like Chicago and Seattle, New York has taken steps to promote the implementation of green roofs.[92] In 2008, the New York state legislature passed a green roof tax abatement designed for cities of over one million people.[93] This tax credit (affecting only New York City) enabled a property owner to apply for a one-year property tax credit of up to $100,000 if he or she installed a green roof on at least half of his or her available rooftop space.[94] The tax credit allowed the building owner to recoup part of the cost of installing the green roof.[95] Although the exact price of a green roof will vary, the price per square foot of the initial green roof installation was estimated to range between $10 per square foot for extensive green roofs and $25 per square foot for intensive green roofs.[96] The New York City tax credit equals roughly $4.50 per square foot of green roof implementation, allowing building owners to recover between twenty-two percent and forty-five percent of their initial investment costs.[97]

According to one study, the installation of a forty square foot green roof in New York City results in approximately 800 gallons of rainfall runoff being captured each year.[98] If an intensive forty square foot

http://www.seattle.gov/dpd/cms/groups/pan/@pan/@sustainableblding/documents/web_informational/dpdp_019828.pdf.

[89] *Id.*

[90] *Id.*

[91] *Id.*

[92] *Green Roofs*, *supra* note 3, at 3.

[93] N.Y. REAL PROP. TAX LAW, tit. 4-B (2012).

[94] *Green Roofs*, *supra* note 3, at 3.

[95] *Id.*

[96] *Reducing Urban Heat Islands*, *supra* note 14, at 10.

[97] *Green Roofs*, *supra* note 3, at 3.

[98] *The Value of Green Infrastructure For Urban Climate Adaptation*, THE CENTER FOR

installation costs $1,000, an investment of $100,000 prevents 80,000 gallons of rainfall from ever reaching the sewer system, thus reducing the amount of street flooding and storm water contamination.[99] Due to New York City's lack of permeable ground and natural vegetation, this tax abatement, if utilized, could significantly ease stormwater overflow.

D. Outside of the United States

Green roofs are also being developed internationally. Cities in Germany, Canada, and many other countries have green roof legislation mandating or promoting the construction of these roofs. In Germany, the green roof market expanded by nearly twenty percent annually in the 1980s due to legislation, municipal grants and incentives.[100] Specifically, in Stuttgart, air quality concerns and the urban heat island effect[101] motivated the green roof movement beginning in the 1980s.[102] Not only does the city have an annual budget for green roof construction, but green roofs are often incorporated anytime a public building's roof is due for replacement.[103] For private property owners interested in constructing green roofs, the city of Stuttgart provides free consultations, comprehensive informational brochures, and payment for fifty percent of the costs associated with the construction.[104] Furthermore, city regulations require that new developments meet green building standards, which includes the option of green roof construction.[105] These programs have led to a substantial increase in the number of green roofs throughout the city; by 2007, roughly 105,000 square meters of public roofs had been converted to green roofs, and

CLEAN AIR POLICY (2011) http://ccap.org/assets/THE-VALUE-OF-GREEN-INFRASTRUCTURE-FOR-URBAN-CLIMATE-ADAPTATION_CCAP-February-2011.pdf (citing *A Greener, Greater New York*, CITY OF NEW YORK, (2007), http://www.nyc.gov/html/planyc2030/html/publications/publications.shtml)).

[99] *The Value of Green Infrastructure For Urban Climate Adaptation*, *supra* note 98; *Reducing Urban Heat Islands*, *supra* note 14, at 11.

[100] PECK & KUHN, *supra* note 6, at 3.

[101] "The 'Urban Heat Island Effect' is the well documented phenomenon that urban areas are generally hotter than the surrounding countryside due to a variety of factors including the large number of built structures with heat absorbing properties; the reduction in evaporating surfaces; the lack of vegetation cover and increased surface run-off; an increase in air pollutants; the heat production from buildings; and less cooling wind because of shelter from buildings." Urbis Limited, *supra* note 38, at 15.

[102] *Id.* at 46.

[103] *Id.*

[104] *Id.*

[105] *Id.*

privately owned green roofs totaled 55,000 square meters.[106]

Toronto has also enacted policies and initiatives to promote green roofs. The Toronto City Council adopted the Green Roof Bylaw ("Bylaw") in May 2009.[107] Under the Bylaw, green roofs are required on "new commercial, institutional, and residential developments with a minimum Gross Floor Area of 2,000" square meters.[108] Depending on the size of the building, the green roof must cover between twenty and sixty percent of the available roof space.[109] Starting in April 2012, all new industrial developments meeting the square footage specifications are subject to the Bylaw requirements.[110] Property owners may apply for an exemption or a variance allowing for a smaller percentage of green roof coverage, but the owners granted such exemptions or variances are subject to a fine of $200 per square meter of roofing for not meeting the green roof requirement.[111] The city's stated goals in mandating green roof construction are consistent with all the benefits associated with green roofs, including mitigating stormwater runoff, improving water and air quality, reducing energy use, and increasing green space.[112]

III. New Jersey Legislation

There are currently three bills pending in the New Jersey Legislature that involve implementation of green roofs on governmental, residential, and commercial buildings.[113] The bills' primary sponsors are Assemblymen Ruben J. Ramos, Jr. (District 33 – Hudson), Assemblyman John F. McKeon (District 27 – Essex), Assemblyman Wayne P. DeAngelo (District 14 – Mercer and Middlesex), and Assemblywoman Connie Wagner (District 38 – Bergen

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[106] *Id.*

[107] CITY OF TORONTO MUN. CODE ch. 492-5 (2012); *Green Roofs: Making Policy*, CITY OF TORONTO, http://www.toronto.ca/greenroofs/policy.htm (last visited Jan. 15, 2013).

[108] *Green Roofs*, *supra* note 107.

[109] *Id.* (2,000 – 4,999 square meters – 20%; 5,000 – 9,999 square meters – 30%; 10,000 – 14,999 square meters – 40%; 15,000 – 19,999 square meters – 50%; 20,000 or greater square meters – 60%).

[110] *Id.*

[111] *Id.*

[112] Urbis Limited, *supra* note 38, at 47.

[113] Assemb. B. 709, 215th Leg. (N.J. 2012); Assemb. B. 710, 215th Leg. (N.J. 2012); Assemb. B. 713, 215th Leg. (N.J. 2012). There are actually five companion bills currently pending in the New Jersey General Assembly. However, due to the similar language and application of the bills, this Note will limit the analysis to three of the bills.

and Passaic).[114] Each bill was initially introduced on January 10, 2011 during the term of the 214th Legislature.[115] The Assembly referred the bills to the Assembly Appropriations Committee on February 10, 2011.[116] Once the 214th Legislature adjourned without action on the bills, the sponsors reintroduced the bills to the 215th Legislature.[117] The bills were referred to the Assembly Environment and Solid Waste Committee immediately after reintroduction.[118]

A. Additional DEP Ranking Points for Green Roof Projects

Assembly Bill No. 709 (formerly 3678) is an amendment to the New Jersey Environmental Infrastructure Financing Program ("EIFP") legislation.[119] The purpose of the EIFP is to provide "low-interest loans for the construction of a variety of water quality protection measures."[120] This amendment requires the New Jersey Department of Environmental Protection ("DEP"), specifically the DEP Commissioner, to give projects that involve green roofs extra points in its EIFP ranking system.[121] The ranking system is significant because limited funds are available for project financing.[122] Therefore, under this bill, projects that include a green roof will be ranked higher and would therefore be more likely to receive financing.[123] The ranking system currently gives "additional points to clean water projects whose purpose is to improve energy and water efficiency."[124] The proposed amendment therefore recognizes the value of green roof designs in meeting these goals.[125]

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[114] *Id.*
[115] *Id.*
[116] *Id.*
[117] *Id.*
[118] *Id.*
[119] N.J. ADMIN. CODE § 58:11B-20 (2012).
[120] *Environmental Infrastructure Financing Program*, N.J. DEP'T OF ENVTL. PROT., http://www.nj.gov/dep/grantandloanprograms/er_eifp.htm (last visited Jan. 15, 2013).
[121] Assemb. B. 709, 215th Leg. (N.J. 2012).
[122] *N.J. Envt'l Infrastructure Fin. Program: State Fiscal Year 2013 Project Priority List and Fin. Strategy*, 4 N.J. DEP'T OF ENVTL. PROT. (2012), *available at* http://www.njeit.org/pdf/SFY13_Jan_Report.pdf.
[123] *Id.*
[124] *Id.*
[125] *Id.*

To fully understand the bill's impact, it is necessary to closely examine the proposed language. The bill amends the existing EIFP by adding the following provision:

> In developing the project priority list required . . . the commissioner shall provide additional points, as part of the department's ranking criteria, for projects that include the construction and maintenance of a green roof . . . to reduce stormwater runoff in the project design . . . "Green roof" means a roof that includes, among other things, a growth medium and a vegetation layer of drought resistant and hardy plant species, designed to improve stormwater management.[126]

This language suggests that designs which include simple green roofs consisting of only a drainage layer, basic growing medium, and resilient plant species will receive additional points in the EIFP ranking system. As a result, EIFP applicants may achieve a higher point ranking without substantially increasing the design or maintenance costs of the roof. Furthermore, incorporating an effective green roof may actually save the building owner money over the roof's lifetime.[127] Because financing under the EIFP is limited to local governments, utility companies, and improvement authorities, the advantages associated with green roofs such as improved stormwater management and energy efficiency could directly benefit municipal budgets as well as the surrounding communities.[128]

Due to the nature of EIFP, the funding is limited and the application process is competitive. For example, during the 2012 state fiscal year, the EIFP identified 704 Clean Water Projects, costing over $3.8 billion, that were eligible for funding.[129] Because of the limited amount of funding available, only fifty-seven Clean Water Projects, with an estimated cost of around $350 million, received loans from the EIFP.[130] Therefore, this amendment would greatly incentivize applicants to include a green roof in their design in order to achieve a higher ranking on the points system. Because the language of the bill strictly increases the point allocation for green roof projects, no additional state

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[126] *Id.*

[127] *See infra* Part IV.

[128] *Frequently Asked Questions*, N.J. ENVTL. INFRASTRUCTURE TRUST, http://www.njeit.org/faqs.htm (last visited Jan. 15, 2013).

[129] *N.J. Envt'l Infrastructure Fin. Program: State Fiscal Year 2013 Project Priority List and Fin. Strategy*, 4 N.J. DEP'T OF ENVTL. PROT. (2012), *available at* http://www.njeit.org/pdf/SFY13_Jan_Report.pdf.

[130] *Id.*

funding is being diverted to the EIFP.[131] Legislators and concerned citizens opposing increased state spending will find that this bill does not directly affect the state budget yet will greatly incentivize green roof construction in New Jersey. However, because only local governing bodies and utilities are eligible for the financing from the EIFP, the scope of potential projects financed by this bill is limited; private citizens looking for low interest loans to help fund green roof construction would not be eligible to seek funding under this legislation.[132]

Because Bill No. 709 merely incentivizes EIFP applicants to include green roofs in project proposals, the number of green roofs that would eventually be funded and implemented as a result thereof is difficult to determine. However, even if only a limited number of green roofs are constructed, the potential benefits to the surrounding community are substantial. Furthermore, the bill's passage will represent New Jersey's commitment to reducing carbon emissions and increasing energy efficiency across the state. As long as green roofs are discussed as an option in the EIFP application process, citizens and businesses of New Jersey will become more familiar with green building practices and realize the potential benefits associated with them, thereby increasing implementation in the private sector.

B. Government Building Green Roof Mandate

As originally introduced, the second bill, Assembly Bill No. 710 (formerly 3679), required "any new building, facility, or structure having at least 15,000 square feet in total floor area, which is to be constructed for the sole use of a State governmental entity, to be designed, constructed, and managed to include a functioning green roof . . ."[133]

After a favorable report by the Assembly Environment and Solid Waste Committee in February 2011, the New Jersey Office of Legislative Services ("OLS") and the Executive Branch issued a Fiscal Note regarding this bill in May 2011, stating they were unable to determine the potential fiscal ramifications of the bill's passage.[134]

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[131] Assemb. B. 709, 215th Leg. (N.J. 2012).

[132] *Frequently Asked Questions*, *supra* note 128.

[133] Assemb. B. 710, 215th Leg. (N.J. 2012).

[134] OFFICE OF LEGISL. SERV. & EXEC. BRANCH, 214TH LEG., FISCAL NOTE – ASSEMB. B. 3679 (May 16, 2011) (N.J. 2011).

Regarding the initial costs, the Fiscal Note stated that "[t]he cost could vary significantly depending on the size and type of building, facility, or structure to be constructed, the design and complexity of the roof, the need for specialized elements and materials, the cost of labor, and other factors."[135] While this is certainly a legitimate concern for the State, a number of studies have shown that the savings from having a green roof in place of a conventional roof will outweigh the higher initial costs of construction.[136]

Because there are no direct cost savings for the State with the initial green roof construction, the only way the bill makes fiscal sense is if the long term savings outweighed the increased initial costs.[137] The State would therefore have to realize savings over the life of the green roof.[138] These savings could be calculated in a number of ways. In determining savings, experts consider the lifespan of green roofs to be double that of conventional rooftop materials in some instances.[139] While a conventional roof is expected to last between fifteen and twenty years, a green roof can last between thirty-five and forty years.[140] As discussed in the Fiscal Note, further savings could come from lower energy usage in the building, lower maintenance and operational costs, or through alleviation of the excess stormwater runoff.[141] It is also believed that the cost of green roof construction materials will drop as the implementation of green roofs increases market demand.[142] Furthermore, the Fiscal Note fails to acknowledge other ways in which the green roofs could positively impact the State. While the greatest benefits of green roofs are the energy savings and stormwater management, other important benefits include a reduction in greenhouse gas emissions and an increase in urban green space.[143]

In response to the questions raised by the OLS and Executive Branch in the May 2011 Fiscal Note, the Assembly Environment and Solid Waste ("AEN") Committee and Assembly Appropriations ("AAP") Committee amended the bill in June and December 2012,

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135 *Id.*
136 *See infra* Part IV.
137 FISCAL NOTE – ASSEMB .B. 3679 (May 16, 2011).
138 *Id.*
139 *Reducing Urban Heat Islands*, *supra* note 14, at 10.
140 *Green Roofs – Cooling Los Angeles, A Resource Guide*, *supra* note 65 at II-7.
141 FISCAL NOTE – ASSEMB .B. 3679 (May 16, 2011).
142 *Reducing Urban Heat Islands*, *supra* note 14, at 11.
143 *See generally id.* at 4-12.

respectively.[144] The Committees removed the language mandating green roofs in newly constructed buildings and replaced it with the following:

> Any State department, division, commission, or authority having authority to design, construct, or manage the construction of a State building, facility, or structure shall *identify design standards and maintenance requirements and consider, to the extent feasible, the use of a green roof* . . . for any new building, facility, or structure having at least 15,000 square feet in total floor area that is to be constructed for the sole use of a State governmental entity . . . In this context, *feasibility shall include both physical and fiscal concerns related to the design, installation, and maintenance of a green roof*. . .[145] (emphasis added).

While these amendments substantially alter the original language of the bill as introduced in 2011, the changes provide greater flexibility for the State in choosing whether or not to implement green roofs. This flexibility helps to fill the void left by the original bill in two important ways.

First, the bill's amendments resolve the concerns raised in the May 2011 Fiscal Note. The OLS and Executive Branch presumably had questions about the bill's ramifications on the State budget.[146] As a result of the newly added 'feasibility' language, the OLS has since stated it "does not expect the State to incur additional costs as a result of the bill."[147] This is because the bill no longer *requires* the inclusion of a functional green roof; rather, a green roof will be included in the design only if it is fiscally feasible to construct and maintain.[148] By altering this requirement the bill avoids the fiscal hurdles previously discussed, thereby improving its chances of becoming law.

Second, the amended bill provides the flexibility needed to ensure green roofs are utilized in areas of the state where they will be the most effective. Green roofs are most beneficial in highly-populated urban settings because the impervious surfaces found in these types of cities "greatly reduces the infiltration capacity of the soil and dramatically

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[144] Assemb. B. 710, 215th Leg., 1st Reprint (N.J. 2012); Assemb. B. 710, 215th Leg., 2nd Reprint (N.J. 2012).

[145] Assemb. B. 710, 215th Leg., 2nd Reprint (N.J. 2012).

[146] *See* OFFICE OF LEGISL. SERV. & EXEC. BRANCH, 214TH LEG., FISCAL NOTE – ASSEMB. B. 3679 (May 16, 2011) (N.J. 2011).

[147] N.J. ASSEMB. APPROPRIATIONS COMM., STATEMENT TO ASSEMBLY, ASSEMB. B. 710 (DEC. 13, 2012), 214TH LEG. (N.J. 2012).

[148] Assemb. B. 710, 215th Leg., 1st Reprint (N.J. 2012); Assemb. B. 710, 215th Leg., 2nd Reprint (N.J. 2012).

alters urban hydrology causing increased flooding, aquatic ecosystem degradation, and water quality impairment."[149] Rural areas, however, have sufficient green space to absorb heavy rain or snow and accordingly have less stormwater runoff.[150] Therefore, green roof construction in those areas of the state may be cost prohibitive because no stormwater benefits are realized. And, alternatively, "other [stormwater] management strategies may be more easily implemented" in those rural areas.[151] Therefore, green roofs in rural areas may be considered infeasible for purposes of Bill No. 710. However, the State will likely find that green roofs are much more feasible in densely-populated urban settings due to the benefits they will provide to the surrounding community. This flexibility ensures that every newly constructed State building will be specifically designed in light of the needs of the surrounding community.

In exploring the bill's scope, it is also necessary to outline the categories of buildings covered. The bill requires consideration of green roofs on new buildings constructed "for the sole use of a State governmental entity" and goes on to define such entities as:

> Executive, Legislative and Judicial branches of the State government, any agency or instrumentality of the State, including any board, bureau, commission, corporation, department, or division, any independent State authority, and any State institution of higher education. A county, municipality, or school district, or any agency or instrumentality thereof, shall not be deemed a State governmental entity.[152]

This language makes it clear that the bill applies to newly constructed buildings used exclusively by the *state* government or any of its thirty-one higher education institutions.[153] Local governments,

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[149] Timothy Carter & Laurie Fowler, *Establishing Green Roof Infrastructure Through Environmental Policy Instruments*, 42 ENVIRONMENTAL MANAGEMENT 151 (2008) (citing Michael J. Paul & Judy L. Meyer, *Streams in the Urban Landscape*, 32 ANNUAL REVIEW OF ECOLOGY AND SYSTEMATICS 333 (2001)).

[150] *See* Paul J. Whalen & Michael G. Cullum, *South Florida Water Management District, Technical Publication 88-9: An Assessment of Urban Land Use / Stormwater Runoff Quality Relationships and Treatment Efficiencies of Selected Stormwater Management Systems*, WATER QUALITY DIVISION RESOURCE PLANNING DEPARTMENT SOUTH FLORIDA WATER MANAGEMENT DISTRICT 3 (1988), http://www.sfwmd.gov/portal/page/portal/pg_grp_tech_pubs/portlet_tech_pubs/dre-258.pdf.

[151] Carter & Fowler, *supra* note 149, at 158.

[152] N.J. Pub.L. No. 2007 ch. 269 (2008); *see* Assemb. B. 710, 215th Leg. (N.J. 2012).

[153] *N.J. College & University Directory by Sector*, STATE OF N.J., http://www.state.nj.us/highereducation/colleges/schools_sector.htm#pru (last visited Jan. 15,

private colleges and universities, and school districts are not required to construct green roofs under Bill No. 710.[154] Therefore, opponents of the bill concerned with increasing property taxes and municipal spending will discover that although local communities will directly benefit from green roof implementation, Bill No. 710, if enacted, will not further strain municipal or county budgets.

In contrast, supporters of green building practices may feel the bill's scope is too limited and should include buildings constructed by local governments and school districts.[155] However, these exclusions will not defeat the bill's effectiveness. According to the New Jersey Building Authority ("Authority"), the body in charge of "financing, acquiring, constructing, reconstructing, rehabilitating, or improving office buildings and related facilities to meet the needs of State agencies," projects totaling more than 2 million square feet have been constructed since the Authority's inception in 1981, costing roughly $680 million.[156] While these buildings represent only a fraction of the newly constructed State buildings in New Jersey, considering the bill's effect on these types of projects helps to understand the full scope of benefits associated with it.

Because most of the Authority's projects involve large, box-shaped office buildings, they present ample opportunity for the construction of green roofs.[157] First, office buildings of this size often create large tracts of impervious surfaces, thereby causing stormwater management issues.[158] While retaining ponds, also referred to as detention ponds, are often used to offset the increased runoff in these situations, the ponds

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[154] Assemb. B. 710, 215th Leg. (N.J. 2012).

[155] These supporters will find hope in Assembly Bill No. 712, which is very similar to 711 but mandates that green roofs be installed on buildings funded in whole or in part by the State, the New Jersey Schools Development Authority or the New Jersey Economic Development Authority. Assemb. B. 712, 215th Leg. (N.J. 2012).

[156] N.J. BLDG. AUTH., http://www.state.nj.us/njba/ (last updated July 31, 2012); N.J. BLDG. AUTH., 2006 ANNUAL REPORT (2006), *available at* http://www.nj.gov/njba/AnnRpt.htm.

[157] *See generally* 2006 Annual Report, N.J. BLDG. AUTH. (2006), *available at.* http://www.nj.gov/njba/Report/2006AnnualReport.pdf.

[158] Oregon Environmental Council, http://www.oeconline.org/our-work/rivers/stormwater/stormwater%20report/impacts ("The total impervious surface area of a watershed can be estimated by associating a percentage of imperviousness with different land uses and totaling them up. Typical total imperviousness in medium-density, single-family home residential areas ranges from 25% to nearly 60%. Total imperviousness at strip malls or other commercial and industrial sites can approach 100%.").

have limited application in certain landscapes.[159] Not only are retaining ponds often infeasible in urban environments where space is limited, but the costs of constructing and maintaining the ponds do not provide any of the energy-saving features associated with green roofs.[160] Furthermore, because the large office buildings usually include a flat rooftop, implementing a simple, yet effective green roof on these structures would have little effect on the buildings' overall design.[161]

The Assembly Committees' amendments to Bill No. 710 are crucial to the bill's ultimate passage into law. By adding the feasibility clause, the Committee members acknowledged that green roofs are not always fiscally feasible or physically necessary. However, the mandate requiring building designers to consider green roofs in their proposals will inevitably lead to more green building awareness. Furthermore, in parts of New Jersey where stormwater runoff persistently presents problems for the citizens and local governments, green roofs will prove to be fiscally effective and environmentally sustainable.

C. Low Interest Loans on Green Roof Construction

The third bill, Assembly Bill No. 713 (formerly 3682), authorizes the DEP to grant "low interest loans to qualified applicants towards the construction or acquisition and installation of . . . green roofs to be installed on single family residences or on property of commercial, institutional, and industrial entities, in order to conserve water or improve stormwater management."[162] Furthermore, the bill authorizes the DEP to award grants to local governments to assist in construction, acquisition, or installation of green roofs.[163] Although the bill does require the DEP to establish a loan program, the language of the bill permits the DEP to use its discretion in deciding whether or not to accept applications and enter into loan agreements.[164] Thus, by not

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[159] U.S. ENVIR. PROT. AGENCY, NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) (last updated 2012), *available at* http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=68.

[160] Stacey Eriksen et al., *Low Impact Development and Green Infrastructure in the Semi-Arid West*, U.S. ENVIR. PROT. AGENCY 2012, http://www.epa.gov/region8/greeninfrastructure.html.

[161] *Reducing Urban Heat Islands*, *supra* note 14, at 13.

[162] Assemb. B. 713, 215th Leg. (N.J. 2012).

[163] *Id.*

[164] *Id.* ("*may* accept applications for blue roof or green roof loans . . . and *may* enter into

requiring the DEP to enter into loan agreements with qualified applicants, this portion of the bill gives the DEP the ability to make expert decisions based on the best interests of the State and availability of funding.

Bill No. 713 uses the Global Warming Response Act as its vehicle for promoting green roof construction.[165] Among other things, the Global Warming Response Act establishes the Regional Greenhouse Gas Initiative ("RGGI") and the Global Warming Solutions Fund.[166] The RGGI is a multi-state initiative whose purpose is to limit the amount of carbon dioxide emissions from regulated power plants.[167] Essentially, participating states "sell nearly all emission allowances through auctions and invest proceeds in consumer benefits: energy efficiency, renewable energy, and other clean energy technologies."[168] All proceeds from the RGGI's public auctions are then placed into the Global Warming Solutions Fund.[169] These funds are used "for purposes of energy efficiency, conservation and greenhouse gas reduction" by the New Jersey Economic Development Authority ("EDA") and the DEP.[170] The proposed amendment to the Global Warming Response Act enables these agencies to use the funds in green roof projects in order to promote water conservation and improve stormwater management.[171] Therefore, this bill increases the types of projects that may be sponsored by the Global Warming Solutions Fund to include green roof construction.

The proposed bill also requires the State Treasurer to establish the Blue and Green Roof Revolving Loan Account, which will be contained within the Global Warming Solutions Fund.[172] This account will ensure that a portion of the Global Warming Solutions Fund will be dedicated exclusively to providing grants and low-interest loans for green roof construction, acquisition, and installation.[173] Funding for the account will

loan agreements with qualified owners . . .") (emphasis added).

[165] *Id.*

[166] N.J. Stat. Ann. tit. 26 ch. 2C §§ 47, 50 (West 2007).

[167] REGIONAL GREENHOUSE GAS INITIATIVE, http://www.rggi.org/ (last visited Jan. 15, 2013).

[168] *Id.*

[169] N.J. Stat. Ann. tit. 26 ch. 2C § 50 (West 2007).

[170] ASSEMB. ENV'T & SOLID WASTE COMM., 214TH LEG., STATEMENT - ASSEMB. B. 3682 (N.J. 2011).

[171] Assemb. B. 713, 215th Leg. (N.J. 2012).

[172] *Id.*

[173] *Id.*

come from proceeds from the RGGI's public auctions, as well as "grants, contributions, donations, and reimbursements from federal aid programs."[174]

New Jersey became a member of the RGGI in December 2005.[175] However, in November 2011, New Jersey Governor Chris Christie withdrew the state from the RGGI, stating that the program was "gimmicky" and did not work to help the environment.[176] New Jersey's withdrawal from the RGGI could substantially impair green roof funding available under Bill No. 713.[177] In response to Governor Christie, the New Jersey Senate introduced Bill No. 1322 (formerly 2946) in 2012, which essentially reverses Governor Christie's withdrawal and requires New Jersey to participate in the RGGI.[178] After both the Senate and Assembly passed the bill, Governor Christie issued an Absolute Veto in July 2012, stating the "RGGI did nothing more than impose a tax on electricity to be borne by New Jersey's overburdened taxpayers."[179] Without the funding created by the RGGI, the amount of capital available in the Blue and Green Roof Revolving Loan Account will be limited to federal aid only.[180]

Inadequate funding of the Blue and Green Roof Revolving Loan Account will undoubtedly render this bill ineffective. Without money to provide low interest loans, the State will be unable to properly promote green roofs in the private sector. In doing so, New Jersey is shifting part of the burden of statewide stormwater management, greenhouse gas reduction, and energy efficiency onto its citizens and businesses. While green roofs provide a number of direct benefits to building owners including lower energy costs, usable green space, and noise reduction,

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[174] *Id.*

[175] Letter from Bob Martin, Comm'r, N.J. Dep't of Envtl. Prot., to Signatory States, Reg'l Greenhouse Gas Initiative (Nov. 29, 2011), *available at* http://www.rggi.org/docs/Documents/NJ-Statement_112911.pdf.

[176] Terrence Dopp & Simon Lomax, *Christie to Pull New Jersey Out of 'Gimmicky' U.S. Northeast Carbon Market*, BLOOMBERG (May 26, 2011, 5:00 PM), http://www.bloomberg.com/news/2011-05-26/christie-to-pull-new-jersey-out-of-gimmicky-u-s-northeast-carbon-market.html.

[177] While New Jersey was a member of the RGGI from 2005 to 2011, 14 auctions had generated more than $113 million for use in the Global Warming Solutions Fund. *Auction Results*, REGIONAL GREENHOUSE GAS INITIATIVE, http://www.rggi.org/market/co2_auctions/results (last visited Jan. 15, 2013).

[178] S.B. 1322, 215th Leg. (N.J. 2012).

[179] Letter from Christopher J. Christie, Governor of N.J., to N.J. Senate (July 26, 2012), *available at* http://www.njleg.state.nj.us/2012/Bills/S1500/1322_V1.PDF.

[180] Assemb. B. 713, 215th Leg. (N.J. 2012).

the benefits to the surrounding neighborhoods and municipalities are only obtainable if there is widespread green roof implementation. Opponents of this bill may argue in favor of a strictly open market approach to determine when green roofs are ready for widespread use. While this is a valid argument, in order to help speed up adaptation, the State must be willing to incentivize the construction of green roofs and educate its citizens regarding the importance of green building technology. Otherwise, problems created by greenhouse gas emissions, high energy use, and stormwater flooding may end up costing the State and municipalities substantially more money than it would cost to provide low interest loans to incentivize green roof construction.

IV. Cost-Benefit Analysis of the Proposed Legislation

It is understood that the initial cost of green roofs will normally be higher than that of a conventional roof.[181] However, only a full life-cycle analysis can reveal the true costs and benefits of green roofs in a way that will give the Legislature sufficient information to determine whether or not the green roof bills should take effect based solely on the fiscal perspective.[182] Furthermore, even in situations where the green roof implementation costs more than a conventional roof, the other benefits stemming from green roofs justify the increased cost in densely populated areas.[183] In order to promote widespread acceptance of green roofs, it is useful to quantify the economic savings associated with their construction and implementation.[184]

A. University of Michigan Study

In 2006, the University of Michigan compared the costs and benefits of a conventional rooftop with that of a green roof.[185] In the analysis, researchers took into account three of the primary benefits associated with green roofs: energy savings, stormwater management, and air pollution reduction.[186] Using case studies available at the time, the median cost of a new conventional roof on a 20,000 square foot

[181] *Reducing Urban Heat Islands*, *supra* note 14, at 10.

[182] *Id.* at 11.

[183] *See id.*at 13.

[184] CORRIE CLARK ET AL., *Green Roof Valuation: A Probabilistic Economic Analysis of Environmental Benefits*, 42 ENVIRON. SCI. TECHNOL. 2155, 2155 (2008).

[185] *Id.*

[186] *Id.*

rooftop was found to be $16.75 per square foot ($335,000 in total initial cost).[187] In the same manner, a new extensive green roof with soil depths ranging from two to three inches was found to cost $23.20 per square foot ($464,000 in total initial cost).[188]

The study first calculated the stormwater fees and reductions associated with green roofs. For purposes of the study, it was assumed this municipality had an established stormwater management fee in order to quantify the savings.[189] Based on eleven different municipalities, the study found the mean annual stormwater fee to be roughly $340 for the conventional rooftop and $160 for the green roof. This resulted in an annual savings of $180 for green roof implementation.

Next, researchers computed annual energy costs. The study used historical energy consumption data from 130 university buildings to determine the heating and cooling costs. The energy prices were calculated to be "$3,240 and $1,580 per year for the conventional and green roof, respectively."[190] Therefore, the green roof saved approximately $1,660 in energy costs per building each year.

Finally, the study computed the public health benefits associated with green roof implementation through air pollution mitigation. Using results from greenhouse research, the study calculated the 20,000 square foot green roof to have an annual economic benefit to the public of $890 due to fewer premature deaths and fewer cases of chronic bronchitis

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[187] *Id.* at 2161.

[188] *Id.*

[189] Many New Jersey cities, such as Jersey City, currently fund their stormwater management and sewer systems through a service charge collected from metering the amount of runoff. "The problem with this fee structure is that large generators of stormwater runoff, such as malls and parking garages, contribute very little toward the maintenance of the city's [Combined Sewer System] in proportion to the burdens that they create. Therefore, the Jersey City Environmental Commission recommends that the city adopt a stormwater user fee that would more accurately and effectively direct the costs for stormwater management toward those properties that generate the most runoff. Such a fee, which would be based on a property's amount of impervious cover (i.e., and asphalt parking lot), would give large generators of stormwater an incentive to utilize low impact development techniques and retrofit large impervious areas . . . .On February 9, 2012 Senator Bob Smith introduced a bill in the New Jersey State Legislature that would specifically authorize municipalities and municipal utilities authorities to create a stormwater utility and adopt such a stormwater fee (S1557)." William Schulte, *Green Jersey City: The Importance of Revising the City's Stormwater Fee Structure,* JERSEY CITY INDEPENDENT, Mar. 5, 2012, *available at* http://www.jerseycityindependent.com/2012/03/05/green-jersey-city-the-importance-of-revising-the-citys-stormwater-fee-structure/.

[190] CLARK ET AL., *supra* note 184, at 10.

associated with air pollution.[191]

Once these values were calculated, the study determined the "length of time required for a return on investment on the 20,000 square meter green roof."[192] The study assumed the conventional and green roofs to have lives of twenty-eight and forty years, respectively; the maintenance costs for both types of roofs were assumed to be equal. The cost of the green roof was found to be twenty-five and twenty-nine percent less than the conventional roof ($602,000) over the forty-year lifespan of the green roof.[193] Under this analysis, the green roof's higher initial investment would cancel out after twenty years; roughly $2,700 is saved each year due to the green roof implementation (sixty-one percent due to energy savings; thirty-three percent due to pollution mitigation; and seven percent due to stormwater fee savings).[194]

B. Installation Costs

In its Fiscal Note discussing Bill No. 710, the OLS and Executive Branch acknowledged that it is difficult to quantify the costs and benefits of green roofs.[195] Part of this difficulty is due to the varying views on the costs of green roofs. One study has shown that the installation costs range between $15 and $18 more than a conventional roof per square foot.[196] However, other sources have found that contractors are quoting the price of green roof installations between only $7 and $10 more than conventional roofs per square foot.[197] In Germany, where green roofs are prevalent, the initial cost of green roofs ranges between $8 and $15 per square foot, depending on the type of growing medium, the drainage system, the use of fencing or railings, and the plants used, among other factors.[198] In a conventional roof

[191] *Id.*

[192] The study implemented a six percent interest rate as well as an inflation rate of three percent. *Id.*

[193] *Id.*

[194] *Id.*

[195] OFFICE OF LEGISL.SERV. & EXEC. BRANCH, 214TH LEG., FISCAL NOTE – ASSEMB. B. 3679 (May 16, 2011) (N.J. 2011).

[196] David Sailor et al., *Developing Design Tools for Estimating the Energy and Water Performance of Green Roofs*, PORTLAND STATE UNIVERSITY (2008), http://www.portlandonline.com/bps/index.cfm?c=45076&a=204080.

[197] *Id.*

[198] *Reducing Urban Heat Islands*, *supra* note 14, at 10.

installation, the cost can vary between $0.50 and $6 per square foot.[199] As with both green and conventional roofs, this price will vary greatly depending on the size of the rooftop, ease of access to the roof, the pitch of the roof, and any local market factors.[200]

C. Maintenance Costs

The maintenance costs are also higher for green roofs than conventional roofs.[201] Over the lifetime of a green roof, the cost of maintenance is expected to exceed the traditional rooftop costs by between $10 and $12 per square foot.[202] The maintenance costs will vary depending on the plant selection and whether the building owner chooses to use an extensive or intensive roof.[203] However, this cost can be offset by the extended lifetime of a green roof. The average lifetime of these roofs varies, but it is suggested that green roofs have a lifespan of "approximately fifty years, or about 150 percent that of a standard roof."[204] Therefore, the maintenance costs of a green roof, calculated over the lifetime of the roof, are actually equal to or less than those of a traditional roof.[205] Considering the maintenance cost calculation, in addition to the direct benefits to the building owner such as reduced energy use and reduced stormwater management fees, green roofs are a very attractive alternative to conventional roofs.[206]

One of the main factors affecting the cost of green roof construction is the physical layout of the roof which is due, in part, to the physical barriers created in placing and keeping the growing medium and vegetation on the surface of a high pitched roof. In some instances a high pitched roof makes the implementation of a green roof prohibitively expensive or even impossible. One way the State could reduce both the initial and maintenance costs of the green roofs would be to ensure the new buildings are specifically designed to be able to accommodate green roofs.

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199 *Id.* at 12.
200 *Id.*
201 Sailor, *supra* note 196.
202 *Id.* (citing Kats, THE COSTS AND FINANCIAL BENEFITS OF GREEN BUILDINGS (2003)).
203 *Reducing Urban Heat Islands*, *supra* note 14, at 4.
204 *Sailor*, *supra* note 196, at 13.
205 *Id.*
206 *Id.*

V. Arguments For and Against Green Roof Legislation

Although the benefits associated with green roofs are numerous, a number of factors must be considered by the Legislature before enacting the green roof bills. Some arguments in favor of green roof legislation include potential job creation, green roof building standards implementation, increased public awareness, and reinforcement of the government's position on reducing greenhouse gas emissions and energy efficiency. However, there are a number of arguments opposing the passage of the bills as well, including opposition to increased government regulation, state budget ramifications, and the immaturity of the green roof market.

A. Factors in Favor of Green Roof Legislation

If the New Jersey Legislature enacts the pending legislation related to green roof technology, the green roof market will inevitably expand. This will not only create direct benefits to the building owner and the surrounding environment, but it will also create demand for more roofing projects around the state. This increase in demand will likely create job opportunities for roofing companies, green roof inspectors who will be needed to ensure the building owners are adhering to the green roof specifications, engineers to determine the load that the building's roof can carry, architects who need to design new buildings that cater towards green roof implementation, and landscape architects to conceptualize the layout of the green space.[207] Furthermore, because the proposed legislation requires the state to craft green roof regulations and standards, the market will become much more predictable and building owners will gain confidence that the green roofs are just as functional, if not more functional, than conventional roofs. The widespread use of green roofs will increase the opportunities for technology research and development to perfect drainage systems and materials used in those systems.[208] Similarly, the price of the materials and the labor costs will likely drop due to large scale production efficiencies.[209]

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[207] PECK & KUHN, *supra* note 6, at 10.

[208] *Reducing Urban Heat Islands*, *supra* note 14, at 18.

[209] *Id.* at 10.

Although the bills do not require private citizens to construct green roofs on their rooftops, the bills will inevitably promote private green roof implementation. The green roofs on government buildings will provide public awareness and showcase the benefits associated with their construction. By requiring public higher education institutions to include green roofs on newly constructed buildings, Assembly Bill No. 710 would create opportunities to educate students about energy efficiency, pollution, and protecting the environment. By enacting the self-imposed green roof legislation, the government would be establishing its commitment to energy efficiency and greenhouse gas reduction. Providing low-interest loans for green roof construction through Bill No. 713 is an essential first step towards incentivizing green roof construction in the private sector.

New Jersey's current legislation regarding green living shows that the state is committed to decreasing its carbon emissions and lowering energy use. The current New Jersey Energy Master Plan holds that New Jersey seeks to improve energy conservation through energy-efficient building programs and roof insulation practices.[210] The New Jersey Global Warming Response Act also states that New Jersey needs to stabilize greenhouse gas emissions and actually reduce the emissions to 80 percent below 2006 levels by 2050.[211] It is established that green roofs will help to reduce emissions through decreased energy usage.[212] The pending bills would move New Jersey forward in meeting the commitments established in the Master Plan and Global Warming Response Act.

B. Factors Against Green Roof Legislation

While green roof construction plays a large role in mitigating environmental concerns such as stormwater runoff, energy consumption, and habitat creation, there are legitimate concerns regarding the passage of the bills. These concerns include increased costs to the state, increased government regulation, and safety matters. The higher initial costs of green roofs means the state will incur higher initial costs in constructing government buildings if the legislation

[210] STATE OF NEW JERSEY, 2011 N.J. MASTER PLAN FINAL 110-11 (2011) http://nj.gov/emp/docs/pdf/2011_Final_Energy_Master_Plan.pdf.

[211] *Id.* at 76 (citing N.J. Global Warming Response Act, N.J. STAT. tit. 26 ch. 2C §§ 37-57 (2012)).

[212] *Reducing Urban Heat Islands*, *supra* note 14, at 4-12.

passes. Sources for funding will need to be determined. Citizens and legislators who oppose the green roof legislation may argue that the money being spent on green roof construction would be better spent on other state programs such as education. However, those who oppose the legislation must also realize that while the initial and maintenance costs of a green roof are potentially higher than that of a conventional rooftop, the life of a green roof is much longer and therefore green roof construction may actually save the state money over the life of the roof.[213]

Those citizens who oppose government regulation may also fear that the proposed legislation creates much more government regulation. As with the increased costs associated with green roofs, this is a legitimate concern. But, a reading of the pending legislation reveals that none of the bills regulate or require green roof construction by individual state citizens.[214] Instead, the bills only require green roofs to be constructed on new buildings or facilities being used solely for a governmental purpose.[215]

The city of Chicago held a Green Roof Summit to discuss the operations and maintenance of green roofs in June 2010.[216] During the conference, green roof experts and practitioners created a list of continuing challenges and issues they face with implementing green roof construction.[217] One problem concerned a lack of attention and resources to monitor and maintain green roofs, which often leads to failure of the vegetation and reduced effectiveness.[218] Another challenge was immaturity of the green roof market, resulting in inconsistent quality of craftsmanship.[219] Moreover, the requirements for maintenance are still unclear.[220] While these challenges are obstacles to green roof construction and sustainability, they are not insurmountable, and should

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[213] CLARK ET AL, *supra* note 184.

[214] Assemb. B. 709, 215th Leg. (N.J. 2012); Assemb. B. 710, 215th Leg. (N.J. 2012); Assemb. B. 711, 215th Leg. (N.J. 2012); Assemb. B. 712, 215th Leg. (N.J. 2012); Assemb. B. 713, 215th Leg. (N.J. 2012).

[215] Assemb. B. 710, 215th Leg. (N.J. 2012).

[216] GREEN ROOF SUMMIT: OPERATIONS AND MAINTENANCE SUMMARY 1 (June 16, 2010), *available at* http://www.cityofchicago.org/content/dam/city/depts/doe/general/GreenBldsRoofsHomes/Green_Roof_Summit.pdf.

[217] *Id.*

[218] *Id.*

[219] *Id.*

[220] *Id.*

not discourage the legislature from enacting the green roof legislation. All new technology must evolve and overcome challenges before widespread adoption. Green roof legislation will actually help to overcome these deficiencies by creating uniform green roof safety and construction standards.

Due to a lack of green roof use in the United States, the OLS and Executive branch were right in questioning the costs and benefits of the legislation. Because the majority of current green roof legislation has been passed at the municipal level, it is difficult to project the outcomes of a state-wide requirement. The city-wide ordinances have proven to be very successful. The success of municipal ordinances, coupled with the unproven character of state-wide legislation, raises questions regarding the pending bills. Furthermore, because green roof installation is such a specific endeavor, the installation for each roof requires certain materials and labor that are specific to that roof's setup. Thus the use of a state-wide mandate may have problems that a local, city-wide ordinance would be able to avoid.

However, green roof laws implemented at the state level may have benefits that cannot be accomplished at the city level. Because the state has more funding available than a city, it is in a better position to provide financial incentives to its citizens. The state's greater personnel and administrative resources suggest that it is in a better position than municipalities to ensure the law is proper and effective. Also, the use of uniform, state-wide regulations and standards for the construction and maintenance of green roofs provides some stability to the market as well as increased predictability.

CONCLUSION

As we become more knowledgeable about greenhouse gas emissions and the effect that people and buildings have on the environment, it is important that the government provide some regulation in order to decrease pollution and encourage responsible energy usage. The use of green roofs in place of conventional roofs affords measurable benefits to the building owner, the surrounding neighborhood, the state, and the environment. The experiences gained in places where green roofs are encouraged have shown that the roofs do indeed save energy and money over the lifetime of the roof. The measured and reasonable incentives set out in New Jersey's proposed green roof legislation represent one positive step toward reducing

greenhouse gas emissions as required by the New Jersey Master Plan and Global Warming Response Act.